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Terrestrial and Amphibious Monitoring Plan for the CALFED Bay-Delta Program

Prepared for:

CALFED Bay-Delta Program

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
WESTERN ECOLOGICAL RESEARCH CENTER

Terrestrial and Amphibious Monitoring Plan for the CALFED Bay-Delta Program

By Andrea Atkinson[1], Carolyn Marn[2], and Bellory Fong[3]

U.S. GEOLOGICAL SURVEY
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1.0 EXECUTIVE SUMMARY

Purpose of Terrestrial and Amphibious Monitoring Plan

The Terrestrial and Amphibious Monitoring Plan (TAMP) identifies monitoring recommendations for terrestrial and wetland habitats, the geomorphic and hydrologic processes that support them, and the plants, mammals, birds, reptiles, amphibians, and terrestrial invertebrates that reside within those habitats. This report addresses the fundamental biological and physical elements of the CALFED terrestrial environment that should be monitored in order to judge progress towards the goals of the Ecosystem Restoration Program (ERP).

The TAMP objectives are:

1) Assess status and trends in the valued terrestrial and amphibious resources of the ecosystem as defined by the goals and objectives of the ERP, and
2) Assess the cumulative effects of ERP actions against the background of anthropogenic pressures and natural variation

Development process & history

The Terrestrial and Amphibious Monitoring Plan continues the efforts to develop an implementable status and trends monitoring plan for the CALFED Bay-Delta Program initiated by the former CALFED Comprehensive Monitoring Assessment and Research Program (CMARP). Development of TAMP started in November, 1999. A separate effort developed recommendations for an aquatic monitoring plan. Initial input and review for the TAMP report was obtained from an internal review team composed of members of federal and state agencies and a few stakeholder groups. A preliminary draft report was completed on May 5, 2000.

Three technical workshops were organized to further evaluate and refine elements of the Terrestrial and Amphibious Monitoring Plan (TAMP). The workshop summary report *Terrestrial and Amphibious Monitoring Plan for the CALFED Bay-Delta Program: Workshop Summaries for Summer, 2000* [2] is available on the CALFED web page. http://calfed.ca.gov/adobe_pdf/terrestrial.pdf

The recommendations from the workshops and from the internal review team are incorporated into the present report.

Building on previous work

The TAMP report builds strongly on the foundation of work by previous groups (see Figure 4F). Information was incorporated from the following sources:

- CALFED Ecosystem Restoration Program Plan (July 2000)[8]
- CALFED Strategic Plan for Ecosystem Restoration (July 2000)[9]
- CALFED Indicators Workgroup Final Report (August 1998)[13]
- CALFED Multi-Species Conservation Strategy (July 2000)[11]
- CALFED Technical Reports for the Multi-Species Conservation Strategy (June 1999)[12]

- CALFED Non-native Invasive Species Agency team report (January 1999)[10]
- CALFED Ecosystem Restoration White Papers Efforts (Riparian vegetation[7], Tidal Wetlands[4], Contaminants[5,6])
- CMARP Summary Report, Appendix to EIS/EIR (March 10, 1999)[22]
- CMARP Shallow Water Habitats- Geomorphology emphasis Appendix (Mar 10, 1999)[21]
- CMARP Fluvial Geomorphology Appendices (March 10, 1999)[15,16,17,18,19]
- Army Corps of Engineers Comprehensive Review Study (March 1999)[1]
- Baylands Ecosystem Habitat Goals (1999)[25]
- Baylands Ecosystem Species and Community Profiles (2000)[26]
- Riparian Habitat Joint Venture – riparian bird conservation plan (2000)[33]
- Suisun Ecological Workgroup Final Report (1999)[34]

Many of these documents were in draft stage at the writing of this report and some authors requested we not cite a report until it is finalized (e.g., the CALFED white paper effort[4,5,6, 7], the Suisun Ecological Workgroup report[34]). Thus, some reports listed in the references in Section 18 are not specifically cited under monitoring elements in the TAMP report.

Status of TAMP Report

Currently TAMP provides a skeleton monitoring plan with monitoring recommendations largely addressing **"what"** should be monitored and **"why".** Review and refinement of the plan is needed. The recommendations may also need to be adjusted in the light of recent actions and developments in the ERP. Additionally, the specifics of **"how"** to monitor each element must be detailed –i.e. where, when, how, how often. Much work remains to implement an effective monitoring program.

Although further work is needed, this plan provides an organizing framework that 1) links management objectives and actions to the ecosystem components in simplistic conceptual models, 2) identifies initial monitoring recommendations based on the conceptual models and multiple CALFED and scientific documents, and 3) organizes them into a flexible framework that facilitates review and continued development of the program. The report also identifies the highest priority items that could proceed (or continue) while the plan is further refined.

Steps in Monitoring Plan Design

The TAMP design process is outlined in Figure 4A. This basic sequence, in one form or other, has been used in ecosystem management programs elsewhere in the United States. The first 6 steps used in the development of this report include:

- Step 1. Define Monitoring Program Objectives *(see sections 4, 5-11*)
- Step 2. Compile information on existing monitoring programs *(see appendix E, F)*
- Step 3. Identify relevant time-scales and geographic organization *(see sect. 4)*
- Step 4. Develop management-oriented organizing framework *(see sect. 4)*
- Step 5. Develop/refine simple conceptual models *(see sections 5-11)*
- Step 6. Identify candidate monitoring elements based on conceptual models and existing documents *(see sections 5-11)*

Subsequent needed steps that are not included in the TAMP report are

- Step 7. Develop efficient sampling designs and coordinate with existing monitoring programs
- Step 8. Determine data management, analysis, and reporting mechanisms
- Step 9. Ensure link to ERP management needs and apply to management zones and units within program

These tasks are not necessarily sequential and can involve iterative cycles of review and refinement but ultimately they lead towards on-the-ground implementation of data collection and analysis.

Organizing Framework

The TAMP report organizes discussions of simplistic conceptual models and monitoring elements under the following categories.

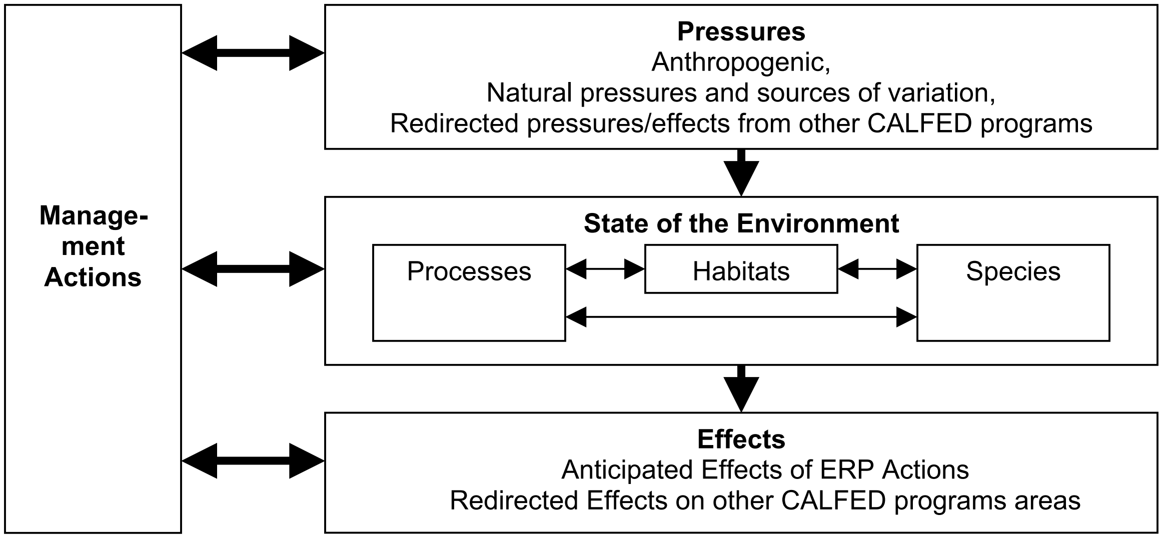
- Large scale habitat and processes issues
- Habitat quality
    - Tidal wetlands
    - Floodplain and riparian wetlands
    - Other habitats
- ERP Biological Communities and other landscape-level communities
- ERP At-risk species
- Landscape-scale pressures
    - Non-indigenous plants & wildlife
    - Contaminants

Within each section the relevant ERP Strategic Plan[9] objectives and ERP Milestones[8a] are included and the at-risk species identified in the Multi-Species Conservation Strategy (MSCS)[11] are listed. The issues and pressures are briefly discussed and a simplistic conceptual model diagram is included in most sections. Basic monitoring questions are articulated and linked to system attributes and the relevant monitoring elements. Existing monitoring programs that may be relevant are included as well as identification of higher priority monitoring elements.

Pressure-State-Management Actions-Effects (PSAE) framework

The report organizes conceptual models and monitoring attributes and elements into a Pressure – State of the Environment – Management Actions – Effects framework. This framework focuses attention on the pressures and management actions that affect the state of the environment (i.e., valued components as identified by the ERP). This helps to focus design of the monitoring program to management goals, objectives, and actions. While some linkages are identified between generalized CALFED program actions and possible redirected effects on other CALFED problem areas (within the ERP as well as between the ERP and other CALFED programs), redirected effects will require a thorough and comprehensive treatment that is beyond the scope of this report.

Figure 1-1. Pressure – State of Environment – Management Action – Effects (PSAE) model



Definition of habitat quality

Tidal wetland habitat quality and freshwater and riparian habitat quality are discussed in sections 6 and 7 respectively. The TAMP report incorporates the concept of monitoring habitat quality which is defined as:

1) habitat extent and connectivity
2) the maintenance and sustainability of natural habitats and vegetation relative to ecological processes
3) functionality in support of biodiversity and at-risk species

The concept of habitat quality links ERP objectives addressing the extent and distribution of habitats, the level of pressures and the status of biodiversity and at-risk species in those habitats. By including enhancement of habitat quality as well as quantity, monitoring can track CALFED actions to improve the utility of habitats specifically for MSCS species as well as for biological communities in general. The pressures on MSCS species were used to create the initial recommendations for attributes of tidal wetland habitat quality (Box 6a) and freshwater & riparian habitat quality (Box 7a).

Types of monitoring expected

Monitoring elements are categorized according to the general method that will be used to acquire the information although specific methods are not included. These include:

1) spatial analysis through <u>remote sensing / GIS mapping</u> of habitat extent & distribution, vegetation, tidal channel networks, length of Delta sloughs, extent of available floodplain, etc.
2) a <u>sampling sites network</u> of extensive and intensive sampling sites to assess habitat quality and biodiversity in 1) tidal wetlands and 2) freshwater and riparian wetlands

throughout a region [extensive sites include sampling of a few variables at many sites like bird abundance point counts; intensive sites include sampling more variables at a few sites to help explain trends seen at the extensive sites such as monitoring nesting success]
3) targeted species-specific surveys of some MSCS species that are not covered adequately by the network of sampling sites.
4) regional surveys of ERP Biological Communities
5) using information gained by the aquatic monitoring plan and existing information sources to assess large-scale changes in flows, sediment, salinity gradient, sea level rise, etc.
6) programmatic monitoring of the location, extent, implementation status and effectiveness of management actions, plus other issues such as tracking protection status of habitats and providing an information clearinghouse of non-indigenous species information.
7) targeted studies to resolve specific questions related to the monitoring program that may not involve long-term monitoring

Summary of highest priority monitoring needs

Of the various monitoring needs identified in this plan, the ones that appear to be of most immediate priority include:

- Map natural vegetation cover and type in Delta and Central Valley floodplain, riparian, and tidal wetland habitats and obtain aerial photographs.
- Coordinate with existing programs to gain GIS layers for land use in and around ERP habitats
- Monitor and map physical landscape changes such as canals, set-back levees, etc.
- Ensure the programmatic tracking of the location, extent, implementation status and results of CALFED projects so that information is available for decision-making
- Implement surveys for species with MSCS goals of “Recover (R)” and “Contribute to Recovery (r)” where needed, implement coordination with other groups where possible. Research to develop monitoring protocols may be necessary.
- Implement surveys for targeted non-indigenous plants in Delta and preferably valley floodplain, riparian and tidal wetland habitats, implement coordination with other groups where possible
- Coordinate with aquatic monitoring plan and other programs to meet needs for contaminant monitoring and water flow, and groundwater monitoring.
- Initiate pilot project / targeted research and build on existing efforts to develop sampling sites monitoring networks and appropriate indicators to monitor in a) tidal wetlands, and b) freshwater and riparian wetlands.

Next Steps
Further work is needed subsequent to this document to create an implementable monitoring program for the CALFED Bay-Delta Program. These steps include:

1) <u>Review and Refine</u>: Technical and programmatic review of the framework, management questions, and individual monitoring recommendations. Also reach consensus on highest priority items and continue identification of monitoring programs and information sources, including other CALFED programs and non-CALFED activities. Review and improvement of the monitoring recommendations for the MSCS "R" and "r" species are a priority.
2) <u>Coordinate with aquatic monitoring plan and integrate with CALFED project monitoring</u>: Coordinate framework and integrate recommendations with aquatic monitoring plan. Also integrate monitoring and information acquired from CALFED projects.
3) <u>Identify monitoring at smaller scales</u>: Apply framework to smaller scales within ERP focus area, i.e. Regions, Ecological Management Zones, and Ecological Management Units.
4) <u>Implement high priority recommendations</u>: Move forward on implementation and/or coordination regarding highest priority monitoring recommendations that have some degree of consensus, i.e. a) developing or identifying existing GIS data layers for vegetation in Delta and Central Valley floodplain, land use in and around ERP habitats, physical landscape changes, b) ensuring programmatic tracking of CALFED project location, extent, implementation status and results, c) implementing baseline surveys and coordinating with other groups for "R" and "r" species and targeted non-indigenous plants
5) <u>Develop/refine sampling sites network concept for tidal wetland and floodplain and riparian habitats</u>: Move forward with research and/or pilot projects to refine monitoring design
6) <u>Develop Information feedback system:</u> Develop a data management, assessment and reporting process that will provide an effective information feedback system to aid management decision-making.

The Terrestrial and Amphibious Monitoring Plan is a living document that will be updated and refined as the specifics of monitoring needs and protocols are identified and clarified and as program needs and priorities evolve. CALFED has already progressed beyond some of the recommendations in this report and the TAMP habitat workshops. For example CALFED has provided funding to the Wetlands Regional Monitoring Program (WRMP) to do a pilot study to develop specific protocols and refined monitoring recommendations for tidal wetlands. CALFED has also developed a high priority list of study needs for at-risk species listed in the Multi-Species Conservation Strategy (http://calfed.water.ca.gov/adobe_pdf/ecosystem_docs/Attachment_3.pdf) and has funded specific research and monitoring efforts through its Proposal Solicitation Process (http://calfed.water.ca.gov/stage1_2002_psp.htm). CALFED currently tracks the implementation status of all actions and the locations of all restoration projects.

2.0 INTRODUCTION

Introduction to TAMP

The Terrestrial and Amphibious Monitoring Plan (TAMP) report identifies biological and physical elements of the terrestrial environment that should be included as part of a baseline monitoring program for CALFED's Ecosystem Restoration Program (ERP) and provides information in an adaptive management context. TAMP addresses monitoring recommendations for terrestrial and wetland habitats, the geomorphic and hydrologic processes that support them, and the plants, mammals, birds, reptiles, amphibians, and terrestrial invertebrates that reside within those habitats.

The TAMP objectives are:

1) assess status and trends in the valued terrestrial and amphibious resources of the ecosystem as defined by the goals and objectives of the ERP, and
2) assess the cumulative effects of ERP actions against the background of anthropogenic pressures and natural variation

A separate effort is identifying monitoring needed for the aquatic environment (fish, deep water processes, benthic invertebrates).

Purpose of this report

This report documents the work accomplished to date in outlining a Terrestrial and Amphibious Monitoring Plan. It provides guidance on further development as considerable work remains. TAMP provides a skeleton monitoring plan with monitoring recommendations largely in the form of **"what"** should be monitored and **"why".** Agreement on the highest priorities for development is needed. Also, the specifics of **"how"** to monitor each element must be detailed –i.e. where, when, how, how often.

Structure of this report

The basic organization of this report is as follows:

- Report summary
- Introduction & Background
- Development of TAMP Monitoring Recommendations
- Monitoring recommendations
  - Large scale habitat and processes issues
  - Habitat quality
    - Tidal wetlands
    - Floodplain and riparian wetlands
    - Other habitats
  - ERP Biological Communities and other landscape-level communities
  - ERP At-risk species
  - Landscape-scale pressures- Non-indigenous plants & wildlife, contaminants
- Relationship to Watershed Program and Aquatic Monitoring Plan
- Next Steps
- Glossary, Bibliography and Appendices

Simplistic conceptual models and the rationales supporting the monitoring recommendations make up the bulk of the report. The models and recommendations for the ERP at-risk species are included as Appendix G.

3.0 RELATIONSHIP OF TAMP TO THE CALFED BAY-DELTA PROGRAM

What is CALFED?
The CALFED San Francisco Bay-Delta Program is a cooperative effort of federal and state agencies and stakeholder groups in California initiated in 1994 "*to develop a long-term comprehensive plan that will restore ecosystem health and improve water management for beneficial uses of the Bay-Delta System.*" The CALFED Bay-Delta Program has four inter-related critical resource problem areas -- ecosystem health, water supply reliability, drinking water quality, and levee system integrity – and is one of the largest and most complex multiple-objective environmental management programs in the world. Figure 3A shows the four CALFED problem areas and the relationship of the various CALFED programs to these problem areas. Progress in any one problem area must be made without significant redirected effects on another problem area.

The driving factor behind CALFED is improving water management for beneficial uses. Past water management strategies have had unintended consequences on the ecosystem: dams on nearly every tributary separate rivers from their headwaters, levees restrict natural river meander processes and cut off habitats, changes in the amount, timing, and temperatures of river flows affect both habitats and species, and water diversions both large and small change flow patterns and cause direct mortality to aquatic species (see Figure 3B). These changes have strongly impacted the aquatic environment but have also severely disrupted the natural hydrologic and geomorphic processes that support terrestrial environments as well. With a rapidly growing human population in California, there is enormous pressure to find a better balance between preserving and restoring the environment and reliably supplying and managing water to support the people of California.

Figure 3A. Four CALFED Critical Resource Problem Areas and the CALFED Programs that address them

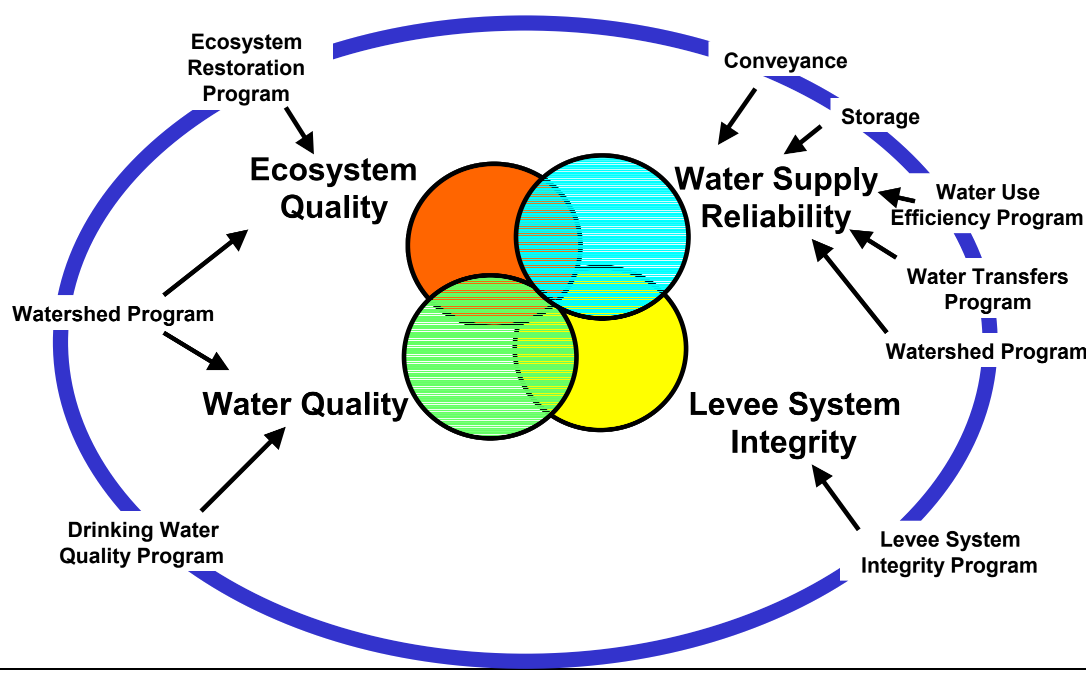


Figure 3B. 'Simple' Model of Water Flow in Northern California

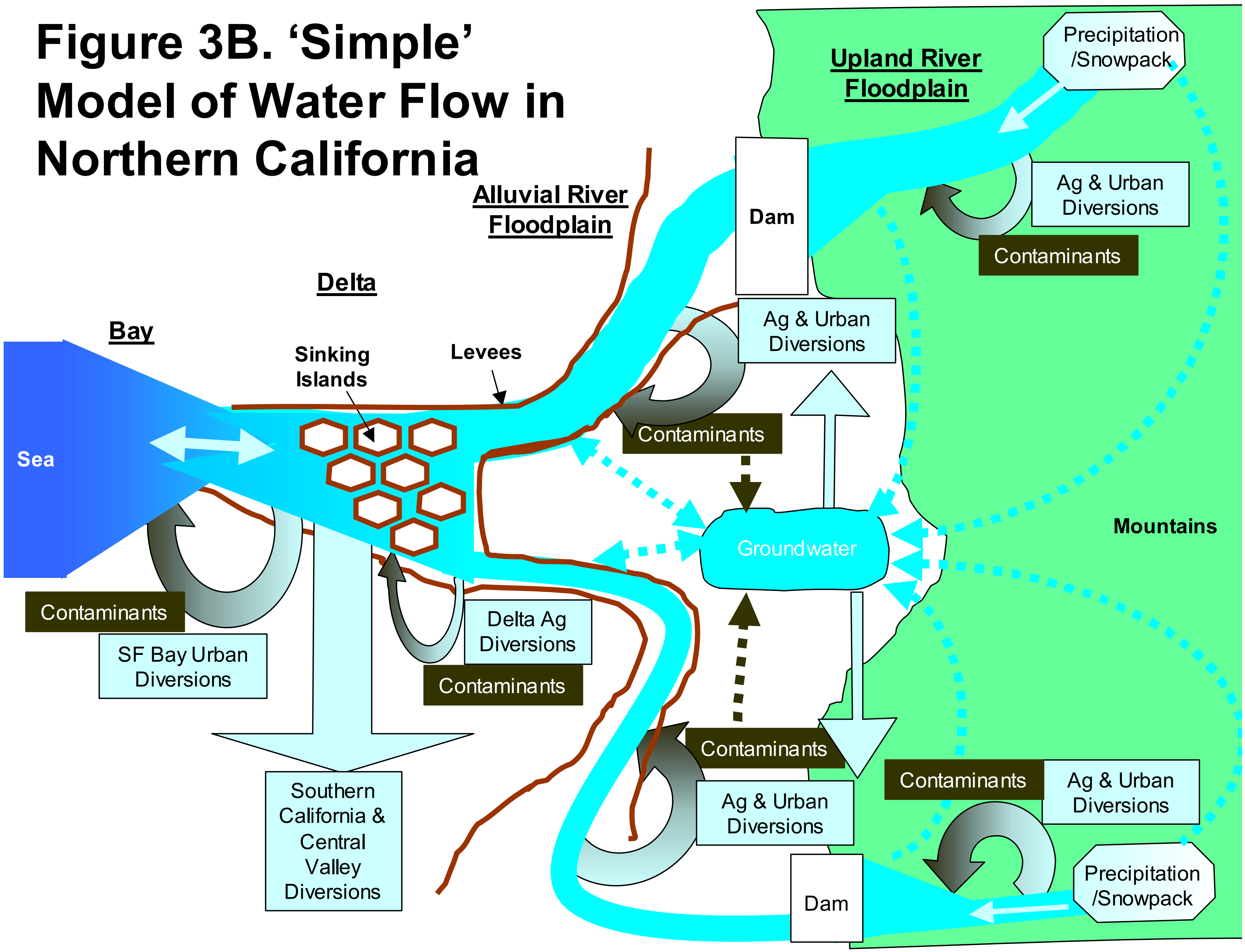


Figure 3C. Relationship of Terrestrial & Amphibious Monitoring to Science Needs for Entire CALFED Bay-Delta Program

(Unshaded areas are addressed by TAMP;
Lightly shaded areas are partially addressed in TAMP)

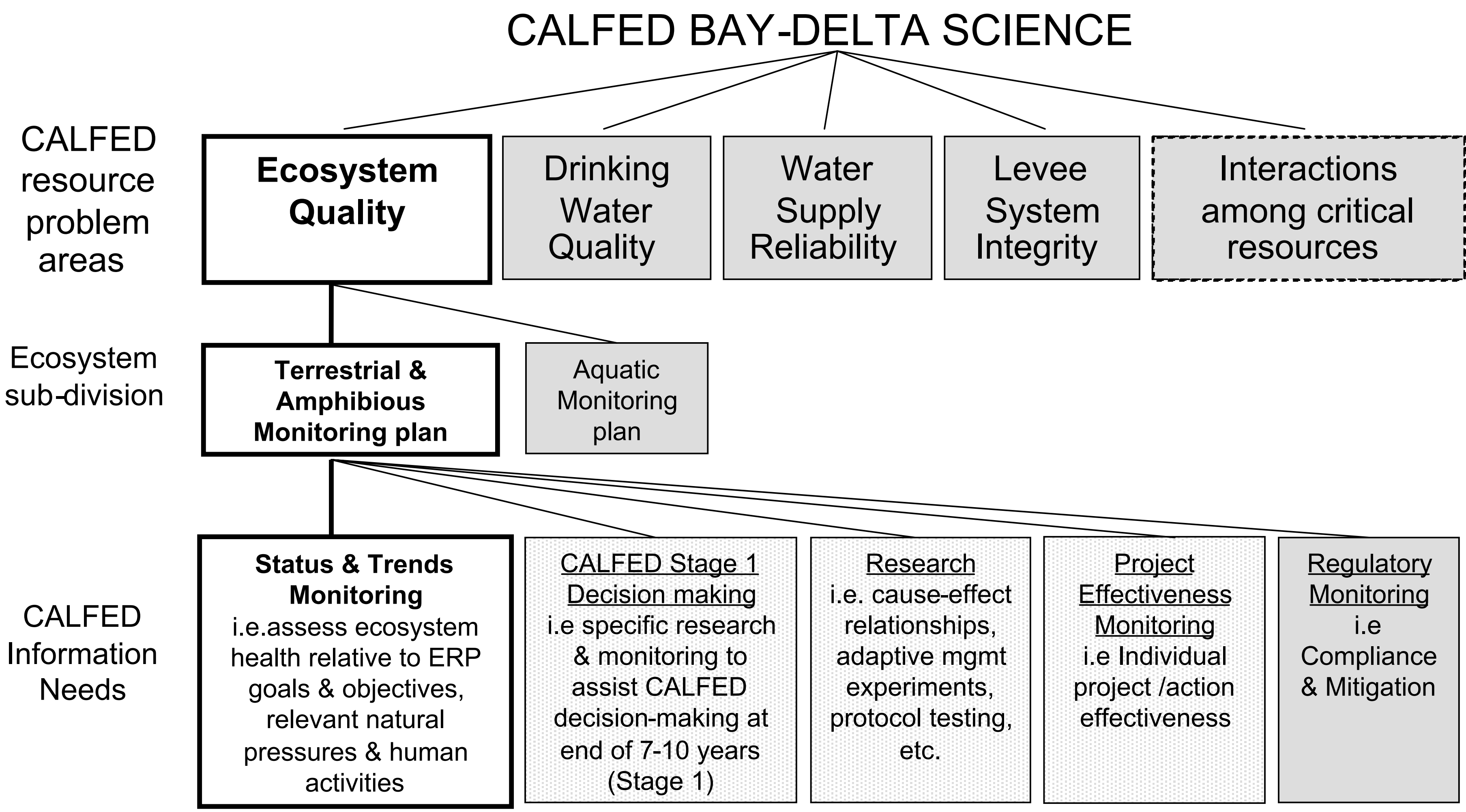
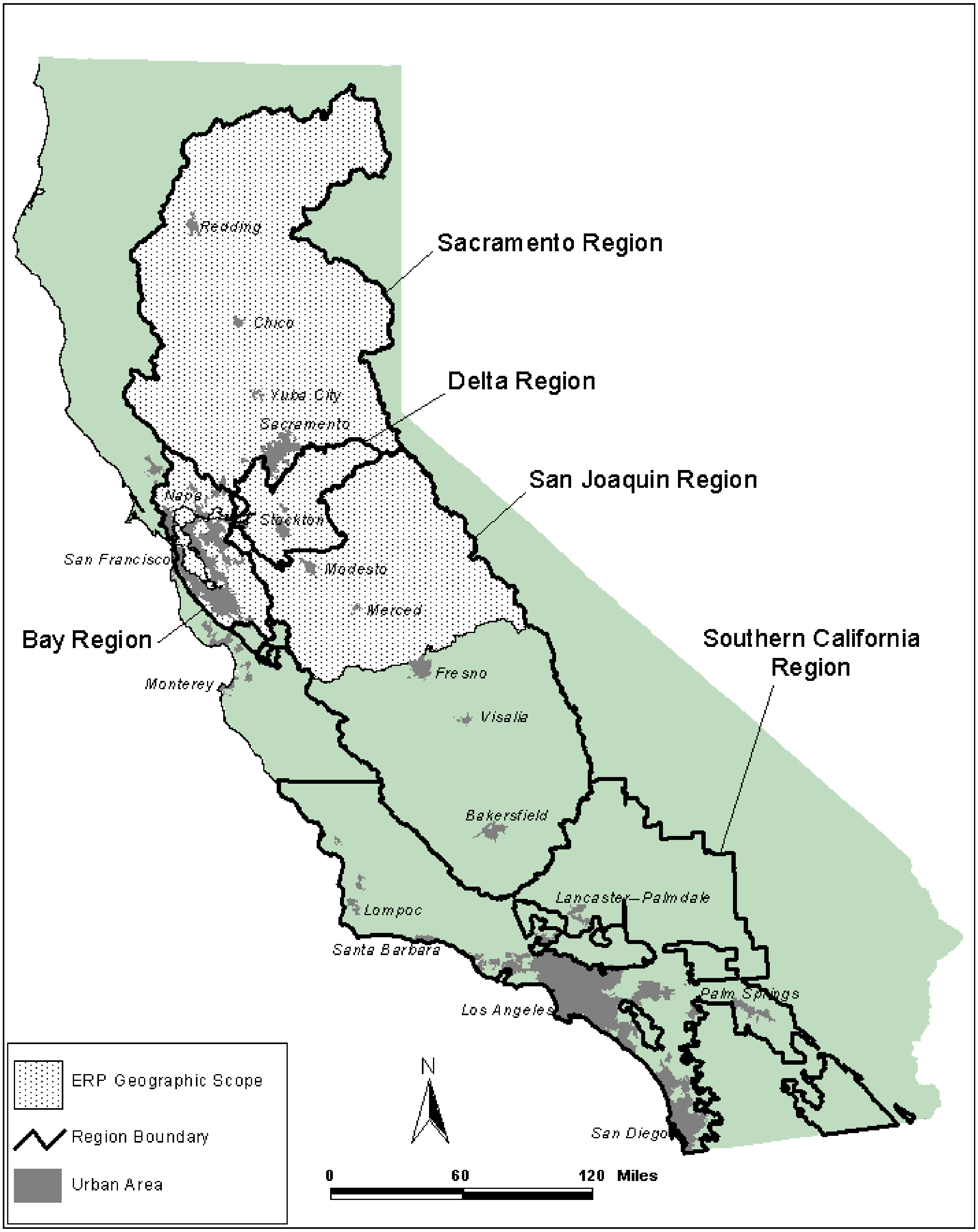


Figure 3D. CALFED Regions and ERP Geographic Scope



Additional information on CALFED can be found on the web at:
http://www.calfed.water.ca.gov/

What is the ERP?
CALFED's Ecosystem Restoration Program (ERP) addresses the problem of declines in ecosystem health through six goals (summarized in the box below; described in detail in Appendix A).

CALFED's ERP goals can be briefly summarized as follows: (For the full text of the CALFED Goals see Appendix A)

1) Achieve recovery of at-risk native species...
2) Rehabilitate natural processes...
3) Maintain and/or enhance… selected species for... harvest...
4) Protect and/or restore functional habitat types...
5) Prevent establishment of...and reduce...impacts of…non-native species...
6) Improve and/or maintain water and sediment quality...

Means and actions to achieve these goals include increasing the amount of available habitat, improving the quality of existing habitats, improving ecological processes, minimizing identified stressors, protecting species' habitats, and establishing populations in new locations.

CALFED Ecosystem Restoration Program goals and objectives[9] coupled with goal prescriptions and recommendations in the Multi-Species Conservation Strategy (MSCS)[11] were driving factors in the development of the TAMP monitoring recommendations.

What is the MSCS?
CALFED's Multi-Species Conservation Strategy (MSCS)[11] is a programmatic document to provide the foundation for compliance with the Endangered Species Act (ESA), California Endangered Species Act (CESA), and Natural Community Conservation Planning Act (NCCPA). The MSCS addresses 244 taxa and 20 communities that currently, or within the foreseeable future, have some level of special protective status and either could be affected by CALFED program actions or are listed under ESA or CESA. Included are those species that must be adequately conserved (State requirement) and for which CALFED Program actions must not cause jeopardy or adversely affect critical habitat (federal requirement). The MSCS provides conservation measures which provide additional detail to ERP programmatic actions and, as necessary for ESA, CESA, and NCCPA compliance, identifies additional mitigation measures for CALFED actions. The ERP Strategic Objectives have incorporated the MSCS designations of "Recover" (R), "Contribute to Recovery" (r), and "Maintain" (m).

The TAMP report identifies general monitoring recommendations for MSCS species and incorporates specific MSCS monitoring recommendations when given in the MSCS document. MSCS species monitoring recommendations must be further refined by species experts in a subsequent step to this report.

CALFED monitoring needs and TAMP

TAMP addresses only part of the overall monitoring needs of CALFED and of the ERP (see Figure 3C). The purpose of TAMP is to define the fundamental biological and physical elements of the terrestrial environment within CALFED's geographical area, (see Figure 3D map) that should be monitored as part of a baseline program. These elements will provide information necessary to evaluate progress towards the goals of the ERP, evaluate status and trends in the ecosystem, and evaluate status and trends of species identified by the Multi-Species Conservation Strategy. Although TAMP incorporates the CALFED ERP Stage 1 milestones, it has very little identified that will directly impact end of Stage 1 decision-making since this mostly involves the aquatic program (CALFED Stage 1 is approximately the first 7 years of the program). TAMP in some cases recommends targeted research instead of long-term monitoring and occasionally includes elements that should be part of project-specific monitoring, but does not provide details. TAMP does not include compliance or mitigation monitoring.

History of TAMP

The development of a Terrestrial and Amphibious Monitoring Plan (TAMP) results from a decision by the former CALFED Comprehensive Monitoring Assessment and Research Program (CMARP) executive committee to continue development of an implementable status and trends monitoring plan for the CALFED Bay-Delta Program. The initial CMARP effort assembled some 30+ workteams which articulated conceptual models and monitoring and research recommendations for the entire CALFED Bay-Delta program. These recommendations are available on the web at

http://calfed.ca.gov/programs/cmarp/contents.html
http://calfed.ca.gov/programs/cmarp/appendices.html

This initial effort required further refinement to create a comprehensive and implementable monitoring program. The CMARP executive committee divided development of a monitoring program into two efforts: an Aquatic Monitoring Plan and a Terrestrial and Amphibious Monitoring Plan. CMARP has since been replaced by the CALFED Science Program but the development of the monitoring program continues.

Development of TAMP started in November, 1999. An organizing framework was selected, information from existing documents was assembled into a draft document, and initial input and review was obtained from an internal review team composed of members of federal and state agencies and a few stakeholder groups. A preliminary draft report was completed on May 5, 2000. Three technical workshops were organized to further evaluate and refine elements of CALFED's Terrestrial and Amphibious Monitoring Plan (TAMP).

1) “Tidal Wetlands Workshop”: Habitats of estuarine tidal and diked wetlands of the Delta, Suisun Marsh and North San Francisco Bay……….………......Aug. 30, 2000
2) “Freshwater & Riparian Wetlands Workshop”: Habitats of freshwater and riparian wetlands of the Central Valley………………………………………...…..Sept. 7, 2000
3) “Landscape Workshop”: Ecological processes and biological communities across the CALFED landscape……...……………………………...…Sept. 14, 2000

Forty-five people participated in one or more of the workshops. The workshop summary document is available on the CALFED web page: *Terrestrial and Amphibious Monitoring Plan for the CALFED Bay-Delta Program: Workshop Summaries for Summer, 2000* [2].

Why have the terrestrial and aquatic monitoring plans been separated?

TAMP addresses monitoring recommendations for terrestrial and wetland habitats, the geomorphic and hydrologic processes that support them, and the plants, mammals, birds, reptiles, amphibians, and terrestrial invertebrates that reside within those habitats. A separate effort is developing the baseline aquatic monitoring plan for fish, aquatic invertebrates, shallow water habitats and the processes that support them. Although dividing the ecosystem into “terrestrial” and “aquatic” components may seem awkward, separate but complementary efforts were believed more effective given the differences in the dominant pressures (habitat loss for terrestrial, water management and diversions for aquatic) and the differences in the level of existing monitoring efforts between the aquatic and terrestrial components. Further discussion of the relationship between the aquatic monitoring plan and the TAMP occurs in section 13.

4.0 DEVELOPMENT OF TAMP MONITORING RECOMMENDATIONS

Design Process for Monitoring Recommendations
The TAMP design process is outlined in Figure 4A. This basic sequence, in one form or other, has been used in ecosystem management programs elsewhere in the United States. The first 6 steps were used in the development of this report include:

- Step 1. Define Monitoring Program Objectives
- Step 2. Compile information on existing monitoring programs
- Step 3. Identify relevant time-scales and geographic organization
- Step 4. Develop management oriented organizing framework
- Step 5. Develop/refine simple conceptual models
- Step 6. Identify candidate monitoring elements based on conceptual models and existing documents

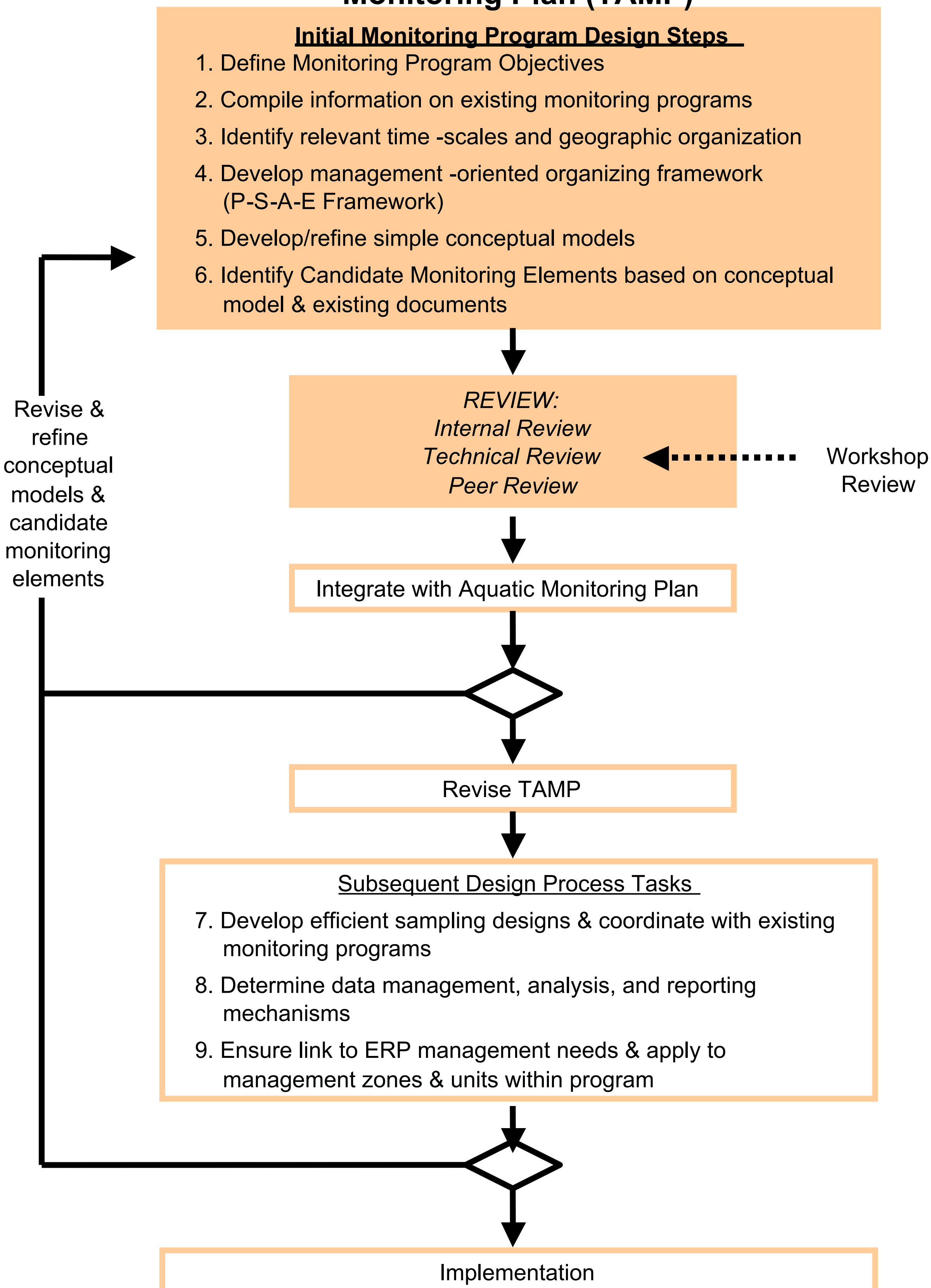
Each step is discussed further below. These tasks are not necessarily sequential and can involve iterative cycles of review and refinement but ultimately they lead towards on-the-ground implementation of data collection and analysis. The design of a status and trends monitoring program for CALFED also will attempt to build upon the large number of existing monitoring and research activities.

Steps 7-10 are not included in this document and will need to be detailed subsequent to this report (see Figure 4A).

Some guiding principles used to develop this monitoring program include

1) Monitoring recommendations should have <u>clearly articulated rationales</u> linked to questions that the information will be used to address. Questions should tie clearly back to CALFED goals and objectives and actions, preferably as part of articulated conceptual models.
2) <u>Resulting information should be interpretable, scientifically defensible, and timely</u> so that it will provide information on both geographic and temporal scales appropriate to management. For example, if management needs to assess changes after 6-10 years, is the chosen indicator expected to show discernable changes within that timeframe or is there a more responsive indicator that should be measured?
3) Program should be as <u>cost effective</u> as possible.

Figure 4A Design Process for Terrestrial and Amphibious Monitoring Plan (TAMP)



Step 1. Define Monitoring Program Objectives

Three concurrent efforts developed goals and objectives for the ERPP: ERP Strategic Plan, Multi-Species Conservation Strategy, and earlier drafts of the Ecosystem Restoration Program Plan. The various goals, objectives, visions, and targets diagrammed below reflect the complexity and large geographic scope of the ERPP. Additionally, the different visions, targets, etc. address different levels of detail and specificity.

The ERPP has a number of different types of goals and objectives
- ERP Strategic Goal
  - ERP Strategic Objectives
    - ERPP Vision statement
      - (ERPP Species Target and MSCS Goal Prescription)
        - ERPP Long-term Objective
          - ERPP Short Term Objective
            - ERPP Stage 1 Expectations
              - ERPP Restoration Actions

In addition, the recommendations in the ERPP Vol. 2 for individual ecological management zones (EMZ) contain:
- ERPP visions for each EMZ
  - ERPP targets for each EMZ
    - ERPP programmatic action for each EMZ

Within the MSCS, species goals include:
- MSCS Goal for each species (i.e. Recover (R), Contribute to Recover (r), or maintain (m))
  - MSCS Goal prescription
    - MSCS Conservation Measures

The ERP Strategic Plan contains
- ERP Strategic goals (See Appendix A)
  - ERP Strategic objectives (See Appendix A)
    - Draft Stage 1 actions

And more recently, the CALFED Programmatic Record of Decision (2000)[8a] identifies ERP Milestones which are descriptions of early targets for actions during CALFED's "Stage 1" or approximately the first seven years.

The TAMP report focuses broadly at the level of the entire ERPP and the four regions. Further development is needed for individual ecological management zones (see section 15). Rather than repeating all the relevant goals, objectives, targets, and actions, <u>this report focuses on the ERP Strategic Goals and Objectives (Appendix A) and ERP milestones (Appendix D), with a few exceptions</u>. For example, with the ERP/MSCS species, the MSCS Goal prescription was listed in addition to the ERP

Strategic objective / MSCS designation of “R”, “r” or “m” because they gave the clearest and most measurable objectives.

ERP Milestones (see Appendix D) are considered as early “actions” and used to provide focus to the conceptual models.

Monitoring Questions

The ERP Strategic Goals and Objectives[9] and ERP milestones[8a] are used to identify basic management questions that the monitoring program should endeavor to answer and helped frame the development of more detailed questions:

Habitat Quality

CALFED has targeted a few high priority habitats including tidal wetlands and freshwater and riparian wetlands. These habitats must be “functional” in support of native species and supported by processes that maintain them.

- What are the status and trends in the extent and distribution of high priority CALFED habitats?
- What are the status and trends in the quality of high priority CALFED habitats relative to supporting native biodiversity and at-risk species?
- What are the status and trends in the sustainability of those habitats by physical and ecological processes?
- What are the status and trends of important pressures that reduce habitat quality?
- What is the implementation status of ERP relevant actions? (see list of ERP milestones)
- What effects have ERP actions had?
- What redirected effects have occurred from other CALFED programs? (e.g., what effect has upstream changes in flows, conveyance, and sediment supplies and upstream habitat restoration had upon habitats and species in Suisun marsh and San Pablo bay?)
- What redirected effects have occurred due to ERP actions on other CALFED programs? [Not currently addressed in TAMP]

Species & Biological Communities

The ERP has specific objectives to “Recover (R)”, “Contribute to the Recovery (r)” or “maintain (m)” specific at-risk species (see Appendix B). The ERP also has targeted specific biotic communities that should be enhanced or at least conserved such as waterfowl, shorebirds, and native resident fish.

- What are the status and trends in abundance, distribution, and long-term sustainability of at-risk species? What are the status and trends in the extent, distribution, and quality of habitat for each at-risk species?
- What are the status and trends in ERP biological communities and their respective habitats?
- What are the status and trends in important pressures that affect these species and biological communities? (i.e. non-indigenous plants and animals, disturbance, habitat loss, etc.)
- What is the implementation status of ERP relevant actions?

- What effect have ERP actions had?
- What redirected effects have occurred from other CALFED programs?
- What redirected effects have occurred due to ERP actions on other CALFED programs?

Ecological Processes and mosaic of habitats across the landscape

Many problems identified by the ERP stem from large-scale changes in hydrologic and geomorphic processes as well as large-scale habitat loss and fragmentation. However, from a terrestrial viewpoint, directly measuring large-scale processes appears to be of lower priority than measuring their effect on the extent, distribution, and quality of habitats.

- What are the status and trends in the extent and distribution of ERP/NCCP habitats?
- What are the status and trends in connectivity among ERP/NCCP habitats?
- What changes in ERP/NCCP habitats are due to land use changes?
- What changes in ERP/NCCP habitats are attributable to changes in water availability and water management practices?
- What changes in ERP/NCCP habitats are attributable to changes in flood management and land/levee erosion control activities?
- What changes in ERP/NCCP habitats are attributable to changes in sediment supply?

Step 2. Compile information on existing monitoring programs

Appendix E contains a list of monitoring programs relevant to TAMP followed by brief descriptions of each of those programs. Appendix F contains a list of sources of spatial analysis information.

Although monitoring programs and information sources are listed next to monitoring elements or are summarized at the end of each section, no attempt was made to ascertain whether the purpose, scope, and methods of monitoring or spatial analysis are compatible with CALFED's information needs.

Step 3. Identify relevant time-scales and geographic organization

Timescales

Information must be timely as well as scientifically defensible. CALFED has several important timeframes that must be considered:

Quarterly - Quarterly reports from funded CALFED projects

Annual - Annual reports & conferences. The CALFED science conference and the State of the Estuary conference are expected to alternate years.

Approx. 7 years – CALFED's "Stage 1" is expected to end in approximately 7 years at which time it is expected to assess progress in each of the four problem areas, the work done, research findings, etc. and use that information to make decisions about Stage 2 actions.

? - Future CALFED Stages

30 years – the CALFED program is currently expected to end in 30 years.

Geographic Organization

CALFED actions will likely have effects at multiple spatial scales, for example, restoring wetlands can have local effects on species but could also change the connectivity of habitats for those and other species across the landscape. Consequently, any evaluation of progress toward meeting ERP goals and objectives requires the assessment of information gathered across multiple spatial and temporal scales. This includes monitoring pressures, ecological processes, habitats, and species.

The geographical organization for TAMP can generally be summarized as follows:

Landscape wide
- **4 Regions**
  - **14 ERP Ecological Management Zones**
    - **52 ERP Ecological Management Units**
      - **Local site/ patch/habitat block**

See Table 4-1 and Figure 3D.

Step 4. Develop management-oriented organizing framework

TAMP adopted a general organizing framework to

- provide a consistent framework to organize the large amount of information involved in developing the terrestrial and amphibious monitoring plan,
- clarify relationships between management actions, anthropogenic pressures, and state of valued ecosystem components identified by the ERP;
- facilitate identification of important elements of a status and trends monitoring plan

This organizing framework consists of identifying the key management issues, creating general categories of monitoring, identifying a geographic framework, and adoption of the Pressure-State-Management Actions-Effects conceptual framework.

General Categories of Monitoring

TAMP identifies five general categories for the baseline monitoring.

1. Large-scale habitat and processes issues
2. Habitat quality
   - Tidal wetlands
   - Floodplain and riparian wetlands
   - Other habitats
3. ERP Biological Communities and other landscape-level communities
4. ERP At-risk species
5. Large-scale pressures requiring additional focus
   - Non-indigenous plants & wildlife
   - Contaminants

Figure 4-1. Geographic Breakdown of ERP Solution Area.

Landscape	Region	Ecological Management Zone	Ecological Management Units
Landscape	1. Delta & Eastside Delta Tributaries (DEDT)	Delta	North Delta South Delta East Delta Central & West Delta
		Eastside Delta Tributaries	Cosumnes River Mokelumne River Calaveras River
	2. Suisun Marsh & North San Francisco Bay (SMB)	Suisun Marsh & North San Francisco Bay	Suisun Bay & Marsh San Pablo Bay Sonoma Creek Napa River Petaluma River
	3. Sacramento River Basin (SACR)	Sacramento River	Keswick to Red Bluff Red Bluff to Chico Landing Chico Landing to Colusa Colusa to Verona Verona to Sacramento
		North Sacramento Valley	Clear Creek Cow Creek Bear Creek Battle Creek
		Cottonwood Creek	Upper Cottonwood Creek Lower Cottonwood Creek
		Colusa Basin	Stony Creek Elder Creek Thomes Creek Colusa Basin
		Butte Basin	Paynes Creek Antelope Creek Mill Creek Deer Creek Big Chico Creek Butte Creek Butte Sink
		Feather River/Sutter Basin	Feather River Yuba River Bear River Honcut Creek Sutter Bypass
		American River Basin	American River Basin Lower American River
		Yolo Basin	Cache Creek Putah Creek Solano Willow slough
	4. San Joaquin River Basin (SJR)	San Joaquin River	Vernalis to Merced Merced to Mendota Pool Mendota Pool to Gravelly Ford Gravelly Ford to Friant
		East San Joaquin Basin	Stanislaus River Tuolumne River Merced River
		West San Joaquin Basin	West San Joaquin Basin

TAMP addresses monitoring from all five perspectives, since no one perspective meets all of CALFED's monitoring needs. ***Large-scale habitat and processes issues*** address the extent and distribution of habitats across the landscape and large-scale processes and pressures that affect them. Monitoring for ***Habitat Quality*** assesses the state of specific habitat types relative to their sustainability and ability to support native species and communities. Monitoring ***ERP Biological communities and other landscape-oriented communities*** addresses the status and trends in targeted ERP Communities such as shorebirds and waterfowl which often utilize more than one habitat type. Monitoring ***Targeted At-risk Species*** focuses on the status of species of concern identified by the ERP and MSCS. ***Large-scale pressures*** such as contaminants and non-indigenous species require a large-scale management and monitoring focus that goes beyond simply monitoring localized effects on specific species, communities, and habitats.

- Large-scale habitat and processes issues

As habitat loss is the fundamental pressure affecting ERP/MSCS at-risk species and biological communities, information on the extent and distribution of habitats across the landscape is a fundamental necessity. Habitat restoration is a major component of the ERP. CALFED will also be affecting water management and sediment management throughout the Central Valley and Bay-Delta with potential effects on terrestrial habitats and biota. Monitoring for large-scale habitat and processes issues is detailed in section 5.0.

- Habitat Quality

This report introduces a concept called habitat "quality" .The ERP has the following strategic goals

> *"Goal 1: Achieve recovery of at-risk native species dependent on the Delta and Suisun Bay as the first step toward establishing large, self-sustaining populations of these species; support similar recovery of at-risk native species in San Francisco Bay and the watershed above the estuary; and minimize the need for future endangered species listings by reversing downward population trends of native species that are not listed."*[9]

> *"Goal 2: Ecological Processes: Rehabilitate natural processes in the Bay-Delta estuary to fully support, with minimal ongoing human intervention, natural aquatic and associated terrestrial biotic communities and habitats, in ways that favor native members of those communities."*[9]

> *"Goal 4 Habitats: Protect and/or restore functional habitat types in the Bay-Delta estuary and its watershed for ecological and public values such as supporting species and biotic communities, ecological processes, recreation, scientific research, and aesthetics."*[9]

Since habitats must be sustained by natural processes and be "functional" in supporting native biotic communities and at-risk species (i.e. appropriate structural and compositional elements and natural levels of pressures), we have broadly defined components of habitat quality as

1) habitat extent & connectivity
2) maintenance and sustainability of natural habitats relative to ecological processes
3) support of native biodiversity and at-risk species.

A fundamental assumption of this report is that a habitat-oriented approach which monitors habitat extent, distribution and quality rather than focusing exclusively on monitoring of at-risk species will be a more effective approach to *"minimize the need for future endangered species listings"* than a species-by-species oriented approach. Monitoring and management for individual species is expensive as at-risk species generally are rare, difficult to detect, and in decline. However, it still may be necessary to monitor at-risk species and biological communities because they represent valued endpoints which are linked to ERP strategic goals and objectives. As understanding of habitat-species relationships improves, habitat quality indicators can be identified, and if overall habitat quality improves, monitoring of habitat extent and quality may eventually replace monitoring for some at-risk species.

The CALFED Bay-Delta Program covers a wide range of habitat types (See table 4-2). For the purposes of identifying monitoring in this report, we reduced the 18 NCCP habitat types[11] and 13 ERP habitat types[8] to 6 habitat groups.

Table 4-2. Habitat Groupings Crosswalk with NCCP and ERP Habitat Categories

TAMP GROUPING	NCCP HABITAT TYPE	ERP HABITAT TYPE
Tidal Wetlands	Tidal perennial aquatic Saline emergent Tidal freshwater emergent	Tidal perennial aquatic Saline emergent wetland Delta sloughs Mid-channel islands & shoals Freshwater emergent wetland
Floodplain and Riparian Wetlands	Valley foothill riparian Valley riverine aquatic Natural seasonal wetlands Managed seasonal wetlands (some) Non-tidal freshwater permanent emergent Lacustrine	Riparian and riverine aquatic Seasonal wetlands
Non-tidal wetlands (outside of floodplain and/or separated from floodplain by levees)	Non-tidal freshwater permanent emergent Natural seasonal wetlands Managed seasonal wetlands Lacustrine	Seasonal wetlands Non-tidal perennial aquatic habitat Freshwater fish habitat
Uplands	Valley foothill woodlands Grassland Upland scrub	Perennial grassland
Inland dune scrub	Inland dune scrub	Inland dune scrub
Wildlife friendly agriculture	Seasonally flooded agriculture Upland cropland	Agricultural lands
Not addressed directly in TAMP	Montane riverine aquatic, Montane riparian, Montane woodland and forest	

Tidal wetlands and *floodplain and riparian wetlands* receive the greatest emphasis since restoration and protection of these habitats is expected to benefit both aquatic and terrestrial ERP/MSCS at-risk species, especially those that CALFED has committed to recovering (R) or contributing to the recovery of (r). For the remaining habitat groups, i.e. inland dune scrub, non-tidal wetlands outside of the floodplain, uplands, and wildlife friendly agriculture, monitoring is focused on the extent and distribution of these habitats and the results of individual projects and activities.

In TAMP the attributes of habitat quality in support of biodiversity are largely defined by the pressures described for MSCS species. Thus, the definition of habitat quality, in practice, focuses largely on the needs for MSCS species. This may not apply in all cases, but it provided a good start for defining habitat quality. This approach was used because

1) CALFED needs to see improvement in habitats for MSCS species to meet the requirements of the Multi-Species Conservation Strategy and
2) MSCS at-risk species are assumed to be sensitive "indicators" of habitat quality, i.e. that the reasons they are declining is because they are the most sensitive species to degradations in habitat quality.

Monitoring recommended for ERP at-risk species and biological communities may overlap with monitoring elements identified for habitat quality; however, the questions that the monitoring data answer may be different.

- <u>ERP targeted Biological Communities and other landscape biological communities</u>

The ERP Biological Communities (waterfowl, shorebirds, wading birds, neotropical migratory birds, native anuran amphibians) are expected to respond to improvements in the extent and distribution of habitats across the landscape, improvements in habitat quality, and reductions in pressures. Each community may serve as 1) indicators of habitat quality when present; 2) indicators of large-scale habitat restoration across the landscape and landscape-level pressures and 3) individual endpoints for ERP specific goals.

Additional biological communities may be recommended for monitoring as restoration of ecosystem processes and across multiple habitats is accomplished. For example, restoration of connectivity among habitats may increase access to native top-down predators such as coyotes, which can help control non-indigenous wildlife such as feral cats and introduced foxes.

- <u>ERP/MSCS At-risk species</u>

Monitoring for species with the CALFED goal of "Recover (R)" and "Contribute to recovery (r)" is described in Section 10 with details in Appendix G. CALFED at-risk species with the CALFED goal of "Maintain (m)" are expected to be monitored through a combination monitoring of extent of habitats, habitat quality monitoring, and specific restoration and mitigation project monitoring. More specific monitoring elements for at-risk species will need to be identified in conjunction with the development of more technical conceptual models, especially for the “R” and “r” species.

Although specific monitoring for “R” and “r” at-risk species is necessary initially, CALFED should consider an eventual goal of working towards substituting species monitoring with monitoring extent and quality of relevant habitats coupled with validation monitoring.

- Large-scale pressures requiring additional focus – non-indigenous plants and wildlife and contaminants

Both non-indigenous species and contaminants move across the landscape and consequently the approach to solving such problems requires a large-scale perspective. Additionally, these pressures may affect individual at-risk species and the quality of specific habitats. CALFED has specific goals that relate directly to each of these pressures.

> *“Goal 5: Prevent the establishment of additional non-native invasive species and reduce the negative ecological and economic impacts of established non-native species in the Bay-Delta estuary and its watershed.”*[9]

> *“Goal 6: Improve and/or maintain water and sediment quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed; and eliminate, to the extent possible, toxic impacts to aquatic organisms, wildlife, and people.”*[9]

Monitoring for these goals is dealt with in section 11, and also is addressed in Habitat Quality (Sections 6 & 7), ERP At-Risk Species (Section 10), and ERP Biological Communities (Section 9).

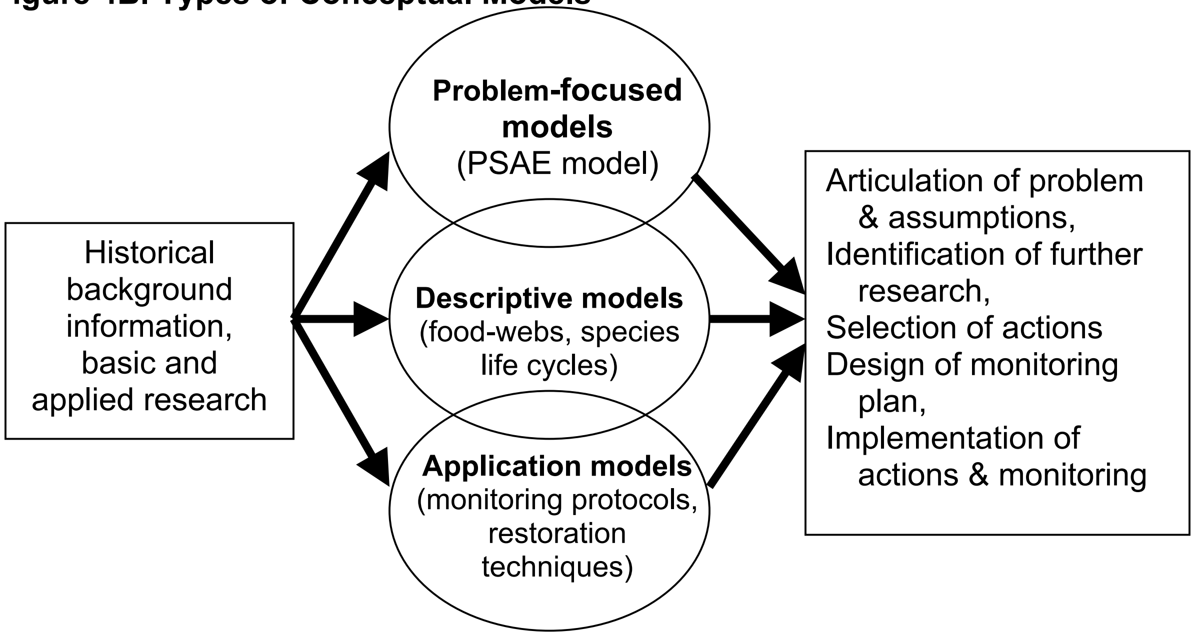
Types of conceptual models

Conceptual models are non-empirical models used to clearly articulate a given system, issue or problem and the factors and relationships involved. Conceptual models are used to increase understanding, communicate assumptions, clarify where research is needed to resolve uncertainties, select actions, facilitate review by outside experts, and/or assist with monitoring design. Sometimes confusion results because the term “conceptual model” means something different to different people. There are many different types of conceptual models being used in CALFED by various people for different purposes and with different scales of focus and complexity.

For the sake of discussion, one can divide conceptual models into

1) problem-focused models which identify the key factors affecting a problem and how human interventions will affect the system,
2) descriptive models such as food-web models or species life-cycle model which show relationships among different components of an ecosystem. These are often more detailed than problem-focused models.
3) application models such as how a given restoration technique is hypothesized to result in habitat suitable for a given species or how a set of monitoring protocols relates to the population status and trends of the species being monitored.

Figure 4B. Types of Conceptual Models



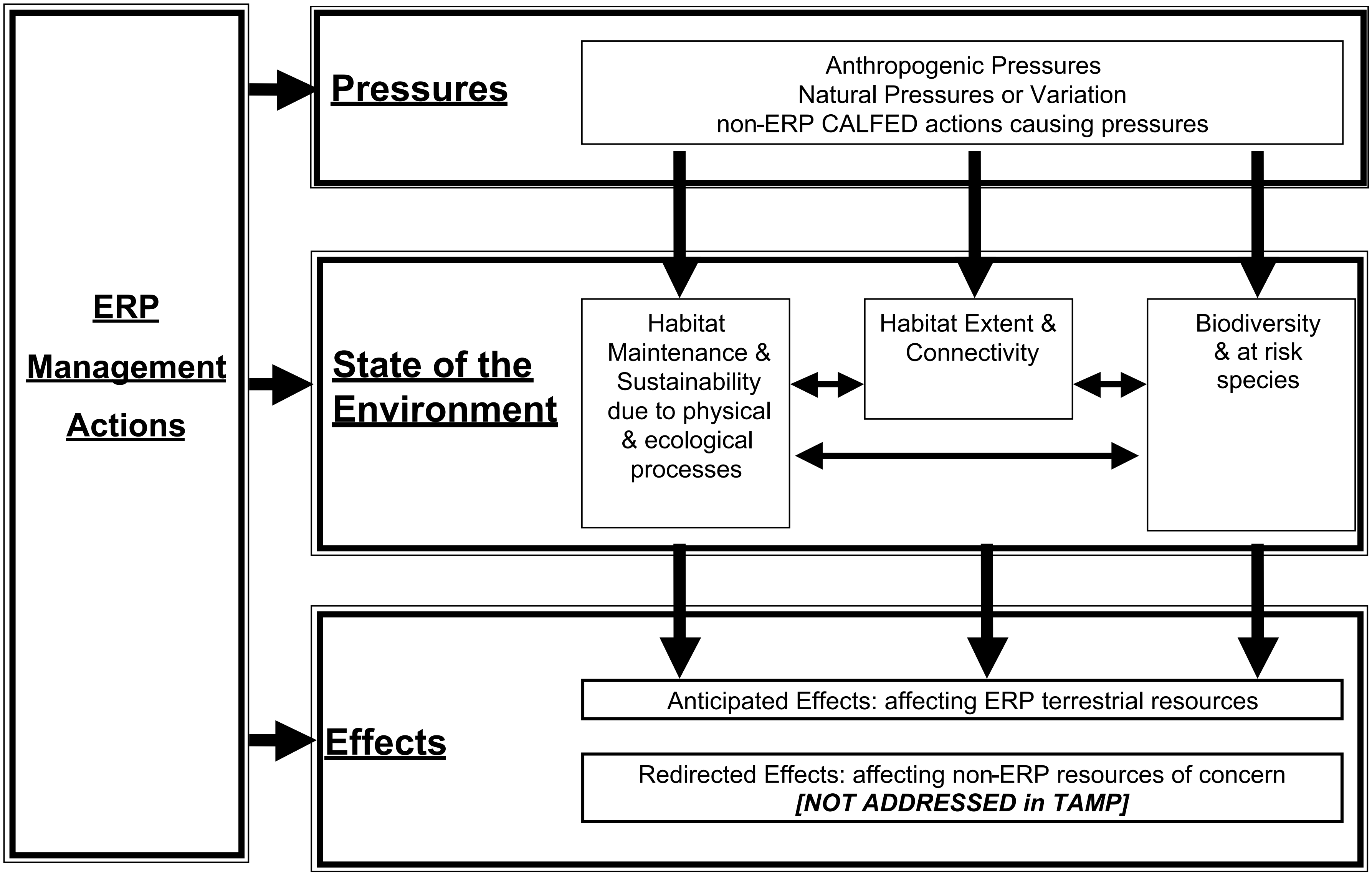
The lines between these different types of models are artificial but ***the important point is that a conceptual model is usually designed for a specific purpose.*** *All* of these types of conceptual models are needed at different points in the program.

P-S-A-E Conceptual framework

In order to select monitoring elements that would be useful in an adaptive management context, TAMP uses the *"**P**ressure-**S**tate-management **A**ctions-**E**ffects"* (PSAE) conceptual framework depicted in Figure 4C. This is a problem-focused model derived from the more traditional pressure-state-response" framework applied in other ecosystem management programs. This framework helps to clarify the relationship between management actions and the state of valued components in the system (that managers are trying to affect) and thus helps to identify the important elements of a baseline monitoring program. Identification and refinement of monitoring elements for the PSAE model depends heavily on technical input from other conceptual models such as habitat-species relationship models, food-web models, species life-cycle models as well as considerable background information and research.

State of the Environment refers to important *ecological processes, habitats,* and *species*, as identified by the ERP. *Pressures* include anthropogenic stressors identified by the ERP (e.g., levees, dredging, invasive riparian and salt marsh plants, contaminants, non-native wildlife), factors which are identified indirectly in the ERP (e.g., urbanization, habitat loss, alterations to managed salinity) and natural disturbances or variability (e.g., climate, diseases). *Management actions* are those taken by the ERP, which are expected to impact the *State of the Environment* and/or *Pressures*.

Figure 4C Selection of Attributes and Monitoring Elements is based on Pressure-State-Action-Effects (P-S-A-E) conceptual model

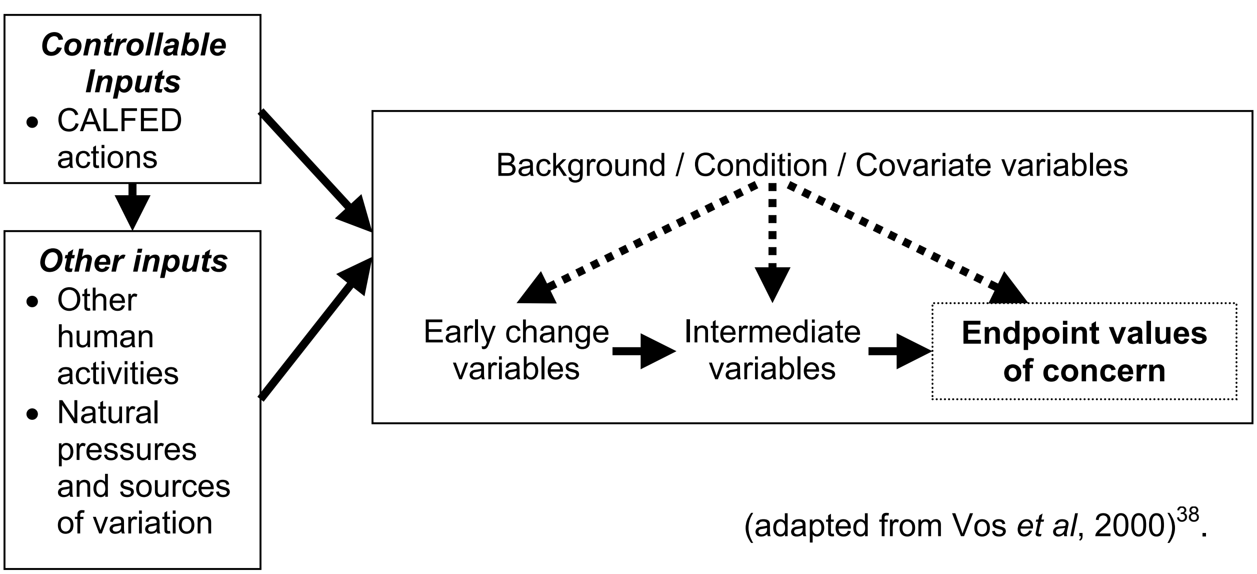


CALFED has four problem areas with the potential to impact one another (See section 3.0 “What is CALFED?”). Therefore, *Effects* in the framework includes both the expected *Effects* of ERP actions on ecosystem components as well as *Redirected effects* on other problem areas addressed by CALFED’s other programs. *Effects* of ERP actions could include monitoring the benefits of large-scale restoration of wetland habitat in the Delta as well as potential negative effects on erosion rates and sustainability of existing marshes supporting ERP species of concern. Although not directly addressed in TAMP, *Redirected effects* may include uncertainties relative to the effects of large-scale wetland construction in the Delta on levels of organic carbon in drinking water or water loss through transpiration—both important concerns to other CALFED programs. Although *Management Actions* of other CALFED programs, such as levee system integrity, can affect Ecosystem quality, these recommendations are addressed generally in TAMP and will need to be refined as more specific actions are identified. ***Recommendations in TAMP address anticipated cumulative effects of actions not project-specific monitoring.***

As specific CALFED actions are identified, monitoring also will need to be identified to address *Redirected effects* for both ERP actions on other CALFED programs as well as other CALFED program actions on ERP resources.

<u>Types of monitoring elements (endpoints, early warning, covariates, etc.)</u>
Different monitoring elements are selected for different purposes. Some elements measure the endpoint itself while others may be covariates or background variables. Some may be intermediate variables that are expected to show earlier responses to actions. And some monitoring elements may be early indicators of change such as an increase in water turbidity can be an indicator of the start of juvenile salmon outward migration to the sea. Other monitoring elements can be early warnings of problems such as changes in the benthic invertebrate community may signal contaminants problems before toxicity effects are discernable in bird populations.

Figure 4D. Types of Monitoring Elements



(adapted from Vos *et al*, 2000)[38].

While monitoring an endpoint like the number of San Pablo California Voles or number of returning adult salmon may seem obvious, costs might be prohibitive, legal problems might exist with monitoring an endangered species, or the expected time to see a response in a long-lived organism might be years or decades. Inclusion or substitution of early and intermediate change variables often can provide useful information for managers, sometimes at lower costs. For example, monitoring the linear extent of available salmon spawning habitat, and estimates of juvenile salmon out-migration would show earlier responses to CALFED actions than monitoring adult salmon alone. Monitoring the extent of suitable San Pablo California Vole habitat with occasional validation monitoring of vole presence might be a substitute for direct monitoring of status and trends in vole populations.

The drawback with selection of indirect indicators is that more assumptions are built into the program. For example, monitoring only the extent of vole habitat assumes that habitat is the primary limiting factor, whereas predation, contaminants, or another factor may be limiting at some point in the future. Additionally, if the relationship between the indirect indicator and the endpoint changes, the condition of the endpoint of concern (vole populations) might deteriorate before managers are aware of a problem. An effective monitoring plan must strike a balance between timeliness of information for managers, costs effectiveness, and effectiveness in monitoring the endpoint value of concern.

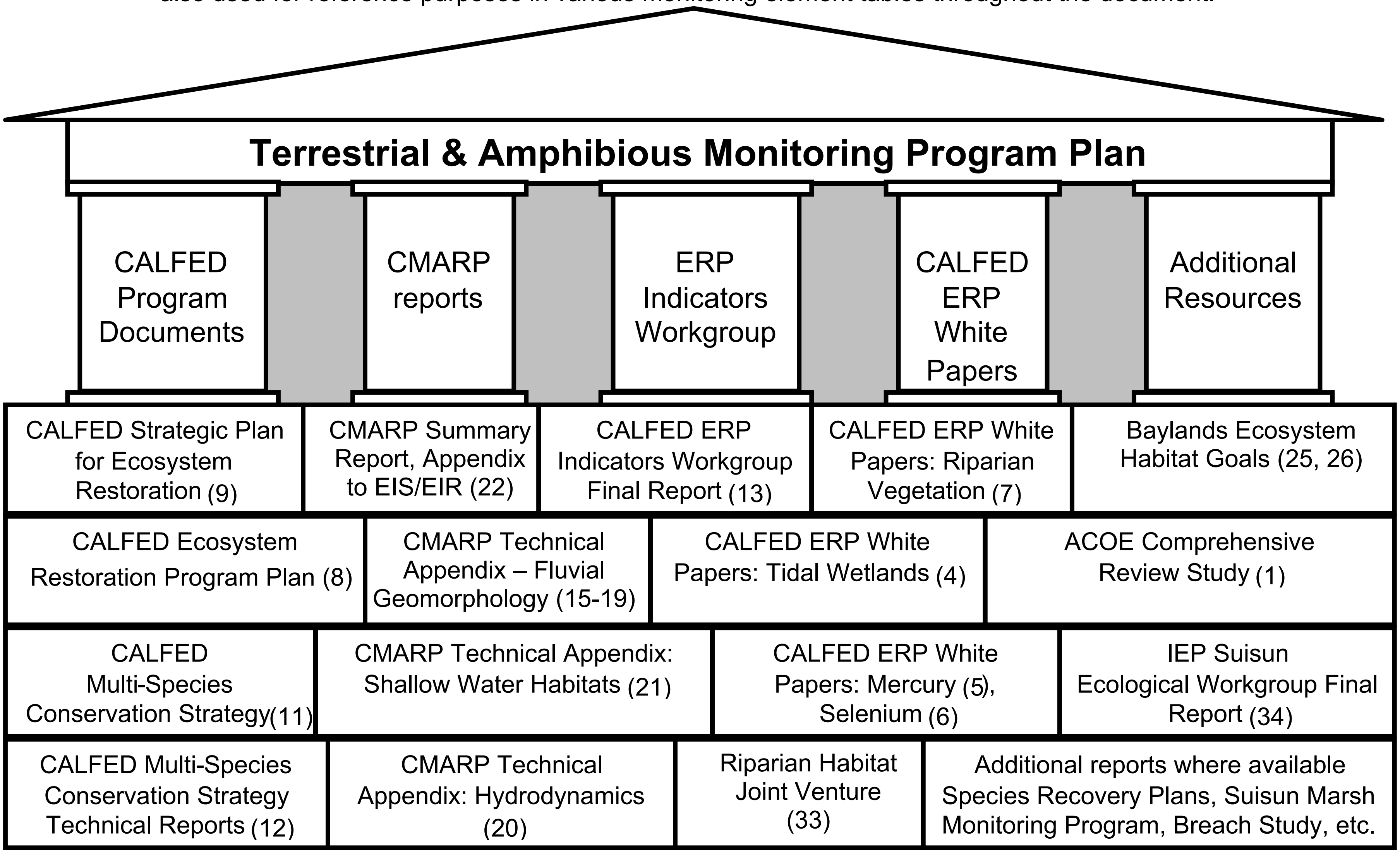
Step 5. Develop/refine simple conceptual models

This report includes simplistic Pressure-State-Management Action-Effects models and monitoring elements that are built upon the foundation of work and recommendations of previous documents (See Figure 4F). Its purpose is to extract the relevant information in these documents, emphasize the relationships between processes, habitats, species and CALFED actions, and assist in identifying monitoring to assess progress towards objectives and cumulative effects of CALFED actions. Thus, important issues/problems identified in the ERP are highlighted and the monitoring attributes are accompanied by rationales, relevant Strategic goals and objectives, and ERP milestones.

Simple conceptual models for at-risk species, largely derived from combining information given in the MSCS Technical Reports, MSCS conservation measures and ERP milestones, are included in Appendix G. As stated previously, further development and refinement of conceptual models for at-risk species is needed to increase the specificity of the monitoring recommendations.

Figure 4E. Terrestrial & Amphibious Monitoring Program Plan is Built on the Strong Foundation of Previous Efforts

Numbers in parentheses () are the reference numbers for these documents. These numbers are also used for reference purposes in various monitoring element tables throughout the document.



Step 6. Identify candidate monitoring elements based on conceptual model and existing documents

Monitoring elements were identified primarily from existing documents and from suggestions from the TAMP workshops. Monitoring elements typically are presented in table form, except for those topics where only a few monitoring elements were identified. In general monitoring *attributes* are identified such as “Natural channel morphology” and then *monitoring elements* associated with this attribute are identified such as channel morphology, sinuosity, width of meander belt, branching, cross-section change, change in floodplain habitats, etc. Often more than one monitoring element is associated with each monitoring attribute.

Monitoring elements are categorized according to the general method that will be used to acquire the information although the details are not included. The main methods by which this monitoring plan will likely be implemented include:

1) spatial analysis through <u>remote sensing / GIS mapping</u> of habitat extent & distribution, vegetation, tidal channel networks, length of Delta sloughs, extent of available floodplain, etc.
2) a <u>sampling sites network</u> of extensive and intensive sampling sites to assess habitat quality and biodiversity in 1) tidal wetlands and 2) freshwater and riparian wetlands throughout a region [extensive sites include sampling of a few variables at many sites like bird abundance point counts; intensive sites include sampling more variables at a few sites to help explain trends seen at the extensive sites such as monitoring nesting success]
3) <u>regional surveys</u> of ERP Biological Communities
4) targeted <u>species-specific surveys</u> of some at-risk species that are not covered adequately by the network of sampling sites.
5) using information gained by the <u>aquatic monitoring plan</u> and existing information sources to assess large-scale changes in flows, sediment, salinity gradient, sea level rise, etc.
6) <u>programmatic</u> monitoring of the location, extent, implementation status and effectiveness of management actions, plus other issues such as tracking protection status of habitats and providing a information clearinghouse of non-indigenous species information.
7) <u>targeted studies</u> to resolve specific questions related to the monitoring program that may not involve long-term monitoring

Monitoring programs or information sources are identified if related to the monitoring element. Monitoring elements that are considered high priority also are identified. Typically these are elements critical for measuring progress towards CALFED goals and objectives and appear to have a high degree of consensus based on the TAMP workshops.

Strengths and Drawbacks of this framework

This framework has the benefit of linking recommended monitoring to CALFED ERP goals and objectives and identifying the questions that the monitoring will be used to answer. This should facilitate the selection and refinement of appropriate monitoring elements, sampling design, and protocols. Clarifying the purpose of monitoring recommended for the program increases the likelihood that information gathered is useful and interpretable to CALFED. Vague objectives motivated by the argument of "knowing-what-is going-on" can often lead programs toward "datakleptomania", the uncontrolled desire to collect more data (Vos et al. 2000)[38]. Given the vast monitoring and research needs of the CALFED program and the limited resources available, datakleptomania is a condition that CALFED cannot afford.

The principle drawbacks of TAMP adopting the pressure-state-management action-effects framework include

1) Redundancy – this method of identifying monitoring elements produces a lot of redundancy because often the same monitoring element is identified for multiple purposes. This can be confusing for the reader when the same monitoring element appears repeatedly. To reduce this confusion, monitoring elements that have appeared previously are italicized.

2) Complexity – Rather than a simple listing of the monitoring elements required, this process attempts to define the questions that generate the monitoring recommendations. This has created a very long, complex document.

3) Practicality – This process starts with the information needs of CALFED rather than existing monitoring programs or existing monitoring protocols. Not all the monitoring elements identified are covered by existing programs or even have existing monitoring protocols.

4) Too large – This plan identifies nearly all possible monitoring elements that could be considered. Not all of these monitoring elements will be needed by CALFED. Refining the monitoring plan to a financially practical level will be an important next step.

5.0 LARGE-SCALE HABITAT AND PROCESSES MONITORING RECOMMENDATIONS

ERP Strategic Goals and Objectives
This section addresses the objectives listed under Goals 2 and Goals 4 (see Appendix A).

> Goal 2: Ecological Processes -- *Rehabilitate natural processes in the Bay-Delta estuary and its watershed to fully support, with minimal ongoing human intervention, natural aquatic and associated terrestrial biotic communities and habitats, in ways that favor native members of those communities.*
>
> Goal 4: Habitats -- *Protect and/or restore functional habitat types in the Bay-Delta estuary and its watershed for ecological and public values such as supporting species and biotic communities, ecological processes, recreation, scientific research, and aesthetics.*

CALFED's goals for rehabilitation of natural processes are closely linked to aquatic resources and thus, the aquatic monitoring program contains more detailed recommendations. Recommendations for monitoring related to terrestrial communities and habitats primarily address multi-habitat sustainability and quality issues. Although affected by changes in ecological processes, individual habitats, habitat quality, biological communities, ERP/MSCS species, non-indigenous species and contaminants are treated in separate sections. Table 5-1 provides an overview of the linkage between MSCS NCCP habitat types and ERP habitat types and the ERP biological communities, ERP/MSCS species, and ERP targeted non-indigenous plants that are found in each habitat type.

Management Questions
Relevant monitoring questions identified for management include:

- What are the status and trends in the extent and distribution of ERP/NCCP habitats?
- What are the status and trends in connectivity among ERP/NCCP habitats?
- What changes in ERP/NCCP habitats are due to land use changes?
- What changes in ERP/NCCP habitats are attributable to changes in water availability and water management practices?
- What changes in ERP/NCCP habitats are attributable to changes in flood management and land/levee erosion control activities?
- What changes in ERP/NCCP habitats are attributable to changes in sediment supply?

Issues
A simplistic diagrammatic conceptual model is presented in Figure 5A. More detailed information is presented in the ERPP (2000)[8].

Habitat loss and fragmentation

One of the primary concerns affecting the terrestrial ecosystem in the CALFED Bay-Delta Program is habitat loss and fragmentation. Approximately 95% of tidal wetlands in the Delta have been lost and 95% of riparian habitat throughout California has been lost. With human population continuing to rise, habitat loss and fragmentation remains an ongoing pressure for terrestrial ecosystems. Terrestrial species that have limited dispersal capabilities are susceptible to effects from habitat fragmentation. The Missing Linkages effort (2000)[32a] identifies critical habitat linkages throughout California including the Bay area and Central Valley.

Water management

CALFED will be changing how water is managed in California: creating more naturalistic flow patterns for fish in rivers and streams, increasing water use efficiency, increasing water transfers, and increasing exports from the Delta. By altering ecological processes or pressures, management actions may directly or indirectly affect terrestrial habitats and species. Both positive and negative effects may occur as a result of ERP actions, as well as other CALFED program actions. For example, management may improve hydrological-geomorphic processes that support terrestrial habitats. Conversely, improvements in water use efficiency, such as decreases in canal leakages that support wetlands, decreases in return flows and in water quality of return flows, as well as changes in cropping patterns, could affect the extent or quality of terrestrial habitats (CMARP Water Use Efficiency appendix report, 1999)[23]. Water transfers could result in lower groundwater levels, which may affect vegetation in riparian and seasonal wetlands (CMARP Water Transfers appendix report, 1999)[24].

However, the most immediate impacts will likely be felt in the aquatic monitoring program.

Salinity in the Delta and Suisun Marsh

Although salinity is a regional issue, salinity levels in the Delta and Suisun marsh are addressed briefly here because they are affected by river flows into the Delta, water exports from the Delta, Delta outflow to Suisun Marsh, tides, sea level rise, and tidal prism in the Delta and Suisun Marsh. Increases in salinity levels in Suisun Marsh could be associated with long-term changes in vegetation; short-term effects are unclear. If vegetation and habitats do begin to change, connectivity among tidal habitats becomes increasingly important since this facilitates population responses of plants and fauna with changing salinity gradients.

Declining Sediment Loading

Since the damming of most major rivers in the Central Valley, sediment supplies that normally would flush from upper watersheds to the alluvial river floodplain to the delta and finally out to the bay and sea have declined. Diminishing sediment supplies could lead to a gradual loss of tidal flats in the Delta, Suisun Marsh and North San Francisco Bay. The Delta also is experiencing gradual erosion of its mid-channel island and shoals (although it should be noted that some of these mid-channel islands were artificially created by remnants of old levees and other structures).

Since salmonid habitats will likely show the earliest effects and response to changes in sediment supplies, TAMP assumes that monitoring of sediment will be recommended in the aquatic monitoring plan's salmonid habitat monitoring. However, additional monitoring for effects on terrestrial habitats could include monitoring channel gravel bars, extent of tidal flats and vegetated marsh plains.

Effects of global warming and climate change

The possible impacts of global warming were raised during the TAMP workshops[2] and consequently are addressed briefly here. Global warming is actually expected to have several different effects on the environment.

- Increasing temperatures and UV radiation may cause the snowpack to melt earlier in the season causing earlier runoff and possibly water shortage problems later in the season.
- Frequency of large storms may increase as the global temperature balance readjusts
- Rising sea levels may cause changes in tidal wetlands as wetlands retreat inland and salinity levels change. If wetland retreat is blocked by levees, sea level rise could result in a gradual decrease in wetland acreage. Connectivity of habitats along salinity gradients may also become important in allowing migration of species as salinity levels change.
- Rising CO2 levels as well as rising temperature may affect competition dynamics and cause changes in the relative abundance of non-indigenous plants and in the plant community composition of various habitats.

The effects of climate change will likely be felt most immediately and strongly in the aquatic environment, e.g. snowmelt timing, streamflow amount & timing, storm frequency and weather, which falls under the either the aquatic monitoring plan or the Water Supply Reliability problem area. However, sea level rise is discussed briefly above in greater detail in the chapter on tidal wetland habitat quality (chapter 6.0). Over the next century or two other terrestrial vegetation may be affected, but its unclear whether there will be a meaningful impact during the 30 years of CALFED on the terrestrial ecosystem.

ERP Milestones and other ERP actions

CALFED's ERP will be protecting, restoring, and enhancing a variety of habitats to benefit both terrestrial and aquatic species in the ERP focus area. The acreages given in the ERP milestones[8a] are summarized in Table 5-2. CALFED also may affect habitats by altering sediment supplies and hydrology. The relevant ERP milestones and additional ERP actions are listed below.

Sediment supplies

- ERP Milestone (DEDT-P4, SACR-P5, SJR-P3): Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources .... Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ of Eastside Delta Tributaries, Sacramento River Basin, San Joaquin River Basin

Hydrology

- ERP Milestone (DEDT-P1): Develop a methodology for evaluating delta flow and hydrodynamic patterns and begin implementation of an ecologically based plan to restore conditions in the rivers and sloughs of the Delta sufficient to support targets for the restoration of aquatic resources.
- ERP Milestone (DEDT-P3): Provide for a fall or early winter outflow that emulates the first “winter” rain through the Delta
- ERP Milestone (SACR-P4): Design and begin implementation of an ecologically based streamflow regulation plan for Yuba River, Butte Creek, Big Chico Creek, Deer Creek, Mill Creek, Antelope Creek, Battle Creek, Cottonwood Creek, and Clear Creek

Monitoring recommendations
See Table 5-3.

Existing Monitoring Programs
Mapping
Appendix F provides a list of existing sources of spatial data and analysis.

Hydrology & Sediment
California Department of Water Resources (DWR)
- Water & Environmental Monitoring Program
- California Data Exchange Center
- California Cooperative Snow Surveys
- California Water Plan Update bulletins
- Delta Environmental Compliance Section
- Groundwater monitoring

United States Bureau of Reclamation (USBR)
- Central Valley Operations
- Stream gaging stations
- Groundwater monitoring

United States Geological Survey (USGS)
- stream gage network
- National Water Information System- groundwater monitoring

Army Corps of Engineers (ACOE)
- Water Control Data System

National Oceanic and Atmospheric Administration (NOAA)
- tidal stage, velocity, and sea level in Bay

National Weather Service- rain gage stations

Table 5-1. Summary of Habitats and Species Across All Regions

This table lists the NCCP habitats, their corresponding ERPP Habitat types, the regions they are found within, and the ERP/MSCS "R", "r", and "m" species, biological communities and non-indigenous species in each habitat.

Regions: SMB = Suisun Marsh, North San Francisco Bay and associated watershed, DEDT=Delta and Eastside Delta Tributaries; SACR = Sacramento River and Basins; SJR = San Joaquin River and Basins

Table 5-1. Summary of Habitats and Species Across All Regions

MSCS NCCP Habitat Type	**ERP Habitat type**	**SMB**	**DEDT**	**SACR**	**SJR**	**ERP/MSCS Species & Biological Communities "R" species: Bold ALL CAPS; "r": Bold;** "m": Plain Text**)**	**Specific Non-indigenous species targeted in ERPP**
Tidal perennial aquatic	Tidal perennial aquatic (includes estuary edge waters; tidal mudflats; transitions between open water & emergent wetlands) Delta sloughs Mid-channel islands & shoals	X	X			Birds: Aleutian Canada goose, American peregrine falcon, bald eagle, California brown pelican, California gull, California least tern, long-billed curlew, osprey, western snowy plover, Alameda song sparrow ERP Biological Communities:Waterfowl, Shorebird and Wading bird guild, Neotropical Migratory birds, Aquatic habitat plant community	Egeria Water hyacinth Water Pennywort Eurasian Watermilfoil Parrotfeather Hydrilla Purple loosestrife
Saline emergent	Saline Emergent Wetland (includes salt & brackish low, middle, and high tidal marsh) Delta sloughs Midchannel islands & shoals	X				Birds: **SAN PABLO SONG SPARROW, SUISUN SONG SPARROW, California black rail, California clapper rail, saltmarsh common yellowthroat,** Aleutian Canada goose, American peregrine falcon, black tern, California gull, long-billed curlew, northern harrier, short-eared owl, white-tailed kite, Alameda song sparrow Mammals: **SUISUN ORNATE SHREW, salt marsh harvest mouse, San Pablo California vole** Plants: **SOFT BIRD'S-BEAK, SUISUN THISTLE, Delta tule pea, Point Reyes bird's beak,** California seablite, Marin knotweed ERP Biological Communities: Waterfowl, Shorebird and Wading bird guild, Neotropical migratory birds, Tidal brackish and freshwater marsh habitat plant community	Perennial pepperweed Cordgrass (introduced)
Tidal freshwater emergent	Fresh emergent wetland Delta sloughs Midchannel islands & shoals	x	X			Birds: **SUISUN SONG SPARROW, California black rail,** Aleutian Canada goose, American peregrine falcon, California gull, long-billed curlew, northern harrier, short-eared owl, western burrowing owl, white-faced ibis, white-tailed kite Mammals: **SUISUN ORNATE SHREW**, Plants: **MASON'S LILAEOPSIS, SUISUN MARSH ASTER, Delta mudwort, Delta tule pea,** Clara Hunt's milk-vetch, Rose mallow Reptiles: **Giant garter snake** ERP Biological Communities: Waterfowl, Shorebird and Wading bird guild, Neotropical migratory birds, Tidal brackish and freshwater marsh habitat plant community	Perennial pepperweed Purple loosestrife Arundo

Table 5-1. Summary of Habitats and Species Across All Regions							
MSCS NCCP Habitat Type	**ERP Habitat type**	**SMB**	**DEDT**	**SACR**	**SJR**	**ERP/MSCS Species & Biological Communities "R" species: Bold ALL CAPS; "r": Bold;** "m": Plain Text**)**	**Specific Non-indigenous species targeted in ERPP**
Non-tidal Freshwater Perennial Emergent	Fresh emergent wetland	x	**X**	**X**	**X**	Amphibians: California red legged frog, Birds: **California black rail, greater sandhill crane,** Aleutian Canada goose, American peregrine falcon, black-crowned night heron, California gull, long-billed curlew, northern harrier, short-eared owl, snowy egret rookeries, tricolored blackbird, western burrowing owl, western least bittern, white-faced ibis, white-tailed kite, Mammals: California wolverine, Plants: **Bristly sedge, Delta coyote-thistle,** Bellinger's meadowfoam, California beaked-rush, Calistoga popcornflower, English peak greenbriar, Ferris's milk-vetch, Four-angled spikerush, Hispid bird's-beak, Kenwood Marsh checkerbloom, Mad-dog skullcap, Marsh checkerbloom, Marsh skullcap, Napa blue grass, North Coast semaphore grass, Pitkin Marsh lily, Rose mallow, Sanford's arrowhead, Slough thistle, Sonoma alopecurus, White sedge Reptiles: g**iant garter snake, w**estern pond turtle ERP Biological Communities: Native anuran amphibians, Waterfowl, Shorebird and Wading bird guild, Neotropical Migratory birds	Perennial pepperweed Purple loosestrife Arundo
Natural seasonal wetland (vernal pools)	Seasonal wetlands	x	**X**	**X**	**X**	Amphibians: California red legged frog, California tiger salamander, western spadefoot toad Birds: g**reater sandhill crane, Swainson's hawk,** Aleutian Canada goose, American peregrine falcon, California gull, long-billed curlew, northern harrier, short-eared owl, tricolored blackbird, white-tailed kite, Invertebrates: **Delta green ground beetle,** Conservancy fairy shrimp, longhorn fairy shrimp, mid-valley fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp, Plants: **Alkali milkvetch, Crampton's tuctoria,** Ahart's dwarf rush, Ahart's paronychia, Boggs Lake hedge-hyssop, Brittlescale, Butte County meadowfoam, Colusa grass, Contra Costa goldfields, Ferris's milk-vetch, Few-flowered navarretia, Greene's tuctoria, Hairy orcutt grass, Hall's tarplant, Heartscale, Heckard's peppergrass, Henderson's bent grass, Hispid bird's-beak, Hoover's spurge, Legenere, Lesser saltscale, Loch Lomond button-celery, Lost Hills crownscale, Mad-dog skullcap, Many-flowered navarretia, North Coast semaphore grass, Palmate-bracted bird's-beak, Pincushion navarretia, Recurved larkspur, Red Hills ragwort, Sacramento orcutt grass, San Joaquin spearscale, San Joaquin Valley orcutt grass, San Joaquin woolythreads, Sebastopol meadowfoam, Slender orcutt grass, Slough thistle, Sonoma alopecurus, Sonoma sunshine, Spiny-sepaled button-celery, Succulent owl's-clover, Vernal Pool smallscale, Dwarf downingia ERP Biological Communities: Waterfowl, Shorebird and Wading bird guild, Neotropical Migratory birds, Seasonal Wetland habitat plant community, Native anuran amphibians	Parrotfeather Perennial pepperweed Purple loosestrife Salt cedar (Tamarisk) Arundo

Table 5-1. Summary of Habitats and Species Across All Regions							
MSCS NCCP Habitat Type	**ERP Habitat type**	**SMB**	**DEDT**	**SACR**	**SJR**	**ERP/MSCS Species & Biological Communities** **"R" species: Bold ALL CAPS; "r": Bold;** "m": Plain Text**)**	**Specific Non-indigenous species targeted in ERPP**
Lacustrine	Non-tidal perennial aquatic	x	x	x	x	Amphibians: California red legged frog Birds: Aleutian Canada goose, American peregrine falcon, bald eagle, California gull, osprey Plants: Eel-grass pondweed Reptiles: Western pond turtle ERP Biological Communities: Native anuran amphibians, waterfowl, neotropical migratory birds	Egeria Hydrilla Water hyacinth Water pennywort Eurasian watermilfoil Parrotfeather
Valley Riverine Aquatic	Riparian & Riverine Aquatic	x	**X**	**X**	**X**	Amphibians: California red legged frog, foothill yellow-legged frog, Birds: **Bank swallow,** bald eagle, black tern, osprey Plants: Eel-grass pondweed Reptiles: Western pond turtle ERP Biological Communities: Waterfowl, Shorebird and Wading bird guild, Neotropical Migratory birds	Egeria Hydrilla Water hyacinth Water pennywort Eurasian watermilfoil Parrotfeather Purple loosestrife
Valley Foothill Riparian	Riparian & Riverine Aquatic	x	**X**	**X**	**X**	Amphibians: Limestone salamander, Birds: **Bank swallow, California yellow warbler, Least Bell's vireo, Little willow flycatcher, Swainson's hawk, Western yellow-billed cuckoo,** California condor, golden eagle Invertebrates: **VALLEY ELDERBERRY LONGHORN BEETLE,** Mammals: **San Joaquin Valley woodrat, riparian brush rabbit,** greater western mastiff-bat, ringtail, Plants: **Delta coyote-thistle, Northern California Black walnut,** Adobe-lily, Arburua Ranch jewelflower, Baker's larkspur, Baker's manzanita, Ben Lomond buckwheat, Brandegee's eriastrum, Brewer's western flax, Carquinez goldenbush, Congdon's lomatium, Contra Costa manzanita, Dimorphic snapdragon, Drymaria-like western flax, Dwarf soaproot, El Dorado bedstraw, Hall's bush mallow, Indian Valley brodiaea, Ione buckwheat, Ione manzanita, Irish Hill buckwheat, Klamath manzanita, Layne's ragwort, Marin checkerbloom, Marin western flax, Mariposa clarkia, Mason's ceanothus, Most beautiful jewel-flower, Mt. Diablo bird's-beak, Mt. Diablo fairy-lantern, Mt. Diablo jewelflower, Mt. Diablo manzanita, Mt. Diablo phacelia, Mt. Hamilton coreopsis, Mt. Hamilton jewelflower, Napa western flax, Pallid	Arundo Tarmarisk Ailanthus Edible fig Northern California Black Walnut Eucalyptus, Black locust Russian olive Perennial pepperweed German Ivy Purple loosestrife

Table 5-1. Summary of Habitats and Species Across All Regions							
MSCS NCCP Habitat Type	**ERP Habitat type**	**SMB**	**DEDT**	**SACR**	**SJR**	**ERP/MSCS Species & Biological Communities "R" species: Bold ALL CAPS; "r": Bold;** "m": Plain Text**)**	**Specific Non-indigenous species targeted in ERPP**
Valley Foothill Riparian (cont.)						manzanita, Parry's horkelia, Pine Hill ceanothus, Pine Hill flannelbush, Red Hills ragwort, Rock sanicle, San Antonio Hills monardella, San Benito evening-primrose, Saw-toothed lewisia, Shaggyhair lupine, Sharsmith's harebell, Stebbins' morning-glory, Tehama County western flax, Tree-anemone, Yellow larkspur, Reptiles: Giant Garter Snake, Alameda Whip Snake, San Joaquin Whipsnake ERP Biological Communities: Waterfowl, Shorebird and Wading bird guild, Neotropical Migratory birds, Upland game, Tidal riparian habitat plant community group, Native anuran amphibians,	
Valley/ Foothill Woodland		x	X	X	X	Amphibians: Limestone salamander, Shasta salamander, Birds: **Swainson's hawk,** California condor, Cooper's hawk, golden eagle, long-eared owl, osprey Invertebrates: Monarch butterfly (roost) Mammal: Greater western mastiff-bat, ringtail, Plants: Adobe-lily, Ahart's paronychia, Baker's manzanita, Beaked clarkia, Bellinger's meadowfoam, Ben Lomond buckwheat, Big Bear Valley woollypod, Brandegee's eriastrum, Brewer's western flax, California vervain, Congdon's lomatium, Dimorphic snapdragon, Drymaria-like western flax, El Dorado bedstraw, English peak greenbriar, Hall's tarplant, Hartweg's golden sunburst, Hospital Canyon larkspur, Ione manzanita, Jepson's milk-vetch, Layne's ragwort, Madera linanthus, Mariposa clarkia, Mt. Diablo manzanita, Mt. Diablo phacelia, Mt. Hamilton coreopsis, Mt. Hamilton jewelflower, Mt. Tedoc linanthus, Napa western flax, Pale-yellow layia, Pallid manzanita, Parry's horkelia, Pine Hill ceanothus, Pine Hill flannelbush, Rawhide Hill onion, Recurved larkspur, Red-flowered lotus, Rock sanicle, San Antonio Hills monardella, San Benito evening-primrose, Shaggyhair lupine, Sharsmith's c Showy madia, Silky cryptantha, Stebbins' morning-glory, Tehama County western flax, Thread-leaved beardtongue, Tree-anemone, Reptiles: Alameda whip snake ERP Biological Communities: Neotropical Migratory birds, Upland game, Native anuran amphibians	Northern California Black Walnut Eucalyptus Russian Olive Black Locust Ailanthus

Table 5-1. Summary of Habitats and Species Across All Regions							
MSCS NCCP Habitat Type	**ERP Habitat type**	**SMB**	**DEDT**	**SACR**	**SJR**	**ERP/MSCS Species & Biological Communities "R" species: Bold ALL CAPS; "r": Bold;** "m": Plain Text**)**	**Specific Non-indigenous species targeted in ERPP**
Grassland	Perennial grassland		**X**		?	Amphibians: California red legged frog, California tiger salamander Birds: **Greater sandhill crane, Swainson's hawk,** California condor, golden eagle, grasshopper sparrow, long-billed curlew, mountain plover, northern harrier, short-eared owl, tricolored blackbird, white-tailed kite Invertebrates: Callippe silverspot butterfly Mammals: Giant kangaroo rat, greater western mastiff-bat, Merced kangaroo rat, Nelson's antelope ground squirrel, San Joaquin kit fox Reptiles: Alameda whip snake, Blunt-nosed leopard lizard, San Joaquin whipsnake Plants: Henderson's bent grass, Large-flowered fiddleneck, Clara Hunt's milk-vetch, Jepson's milk-vetch, Ferris's milk-vetch, Heartscale, Brittlescale, San Joaquin spearscale, Lesser saltscale, Lost Hills crownscale, Big tarplant, Indian Valley brodiaea, Chinese Camp brodiaea, Mt. Diablo fairy-lantern, Tiburon Mariposa lily, Tiburon Indian paintbrush, Sonoma spineflower, Beaked clarkia, Silky cryptantha, Yellow larkspur, Recurved larkspur, Hoover's eriastrum, Spiny-sepaled button-celery, Diamond-petaled California poppy, Adobe-lily, Diablo helianthella, Hall's tarplant, Congdon's tarplant, Brewer's western flax, Marin western flax, Drymaria-like western flax, Santa Cruz tarplant, Pale-yellow layia, San Joaquin woolythreads, Panoche peppergrass, Red-flowered lotus, Showy madia, Ahart's paronychia, White-rayed pentachaeta, Merced phacelia, Calistoga popcornflower, Hartweg's golden sunburst, Rock sanicle, Most beautiful jewel-flower, Mt. Diablo jewelflower, Tiburon jewelflower, Showy Indian clover, California vervain, Fragrant fritillary ERP Biological Communities: Native anuran amphibians, Waterfowl, Shorebird and Wading bird guild, Neotropical migratory birds, upland game	?
Inland Dune Scrub	Inland Dune Scrub		**X**			Invertebrate: **LANGE'S METALMARK** Plants: **ANTIOCH DUNES EVENING PRIMROSE, CONTRA COSTA WALLFLOWER** Reptile: San Joaquin whipsnake ERP Biological Communities: Inland dune habitat plant community	?

Table 5-1. Summary of Habitats and Species Across All Regions							
MSCS NCCP Habitat Type	**ERP Habitat type**	**SMB**	**DEDT**	**SACR**	**SJR**	**ERP/MSCS Species & Biological Communities "R" species: Bold ALL CAPS; "r": Bold;** "m": Plain Text**)**	**Specific Non-indigenous species targeted in ERPP**
Upland Scrub		**X**	**X**	**X**	**X**	Amphibians: Limestone salamander Birds: **Swainson's hawk,** California condor, golden eagle Mammals: greater western mastiff-bat, ringtail Plants: Adobe-lily, Arburua Ranch jewelflower, Baker's larkspur, Baker's manzanita, Ben Lomond buckwheat, Brandegee's eriastrum, Brewer's western flax, Carquinez goldenbush, Congdon's lomatium, Contra Costa manzanita, Dimorphic snapdragon, Drymaria-like western flax, Dwarf soaproot, El Dorado bedstraw, Hall's bush mallow, Indian Valley brodiaea, Ione buckwheat, Ione manzanita, Irish Hill buckwheat, Klamath manzanita, Layne's ragwort, Marin checkerbloom, Marin western flax, Mariposa clarkia, Mason's ceanothus, Most beautiful jewel flower, Mt. Diablo bird's-beak, Mt. Diablo fairy-lantern, Mt. Diablo jewelflower, Mt. Diablo manzanita, Mt. Diablo phacelia, Mt. Hamilton coreopsis, Mt. Hamilton jewelflower, Napa western flax, Pallid manzanita, Parry's horkelia, Pine Hill ceanothus, Pine Hill flannelbush, Red Hills ragwort, Rock sanicle, San Antonio Hills monardella, San Benito evening-primrose, Saw-toothed lewisia, Shaggyhair lupine, Sharsmith's harebell, Stebbins' morning-glory, Tehama County western flax, Tree-anemone, Yellow larkspur Reptiles: Alameda whipsnake, San Joaquin whipsnake ERP Biological Communities: Native anuran amphibians, Neotropical Migratory birds, Upland game	?
Montane Riverine Aquatic	Upper Watersheds	**X**	**X**	**X**	**X**	Amphibians: California red legged frog, foothill yellow-legged frog Birds: Bald eagle, black tern, osprey Plants: Eel-grass pondweed Reptiles: Western pond turtle ERP Biological Communities: Native anuran amphibians, Neotropical Migratory birds, Waterfowl	?
Montane Riparian	Upper Watersheds	**X**	**X**	**X**	**X**	Amphibians: California red legged frog, foothill yellow-legged frog Birds: **California yellow warbler, Least Bell's vireo, little willow flycatcher, b**ald eagle, black-crowned night heron, Cooper's hawk, double-crested cormorant, great blue heron, great egret, long-eared owl, osprey, snowy egret rookeries, yellow-breasted chat Invertebrates: **VALLEY ELDERBERRY LONGHORN BEETLE,** Mammals: California wolverine, greater western mastiff-bat, ringtail Plants: Saw-toothed lewisia, Silky cryptantha ERP Biological Communities: native anuran amphibians, waterfowl, neotropical migratory birds, upland game	?

Table 5-1. Summary of Habitats and Species Across All Regions								
MSCS NCCP Habitat Type	**ERP Habitat type**	**SMB**	**DEDT**	**SACR**	**SJR**	**ERP/MSCS Species & Biological Communities** **"R" species: Bold ALL CAPS; "r": Bold;** "m": Plain Text**)**	**Specific Non-indigenous species targeted in ERPP**
Montane Woodland/ Forest	Upper Watersheds	**X**	**X**	**X**	**X**	Amphibians: Shasta salamander Birds: Bald eagle, Cooper's hawk, northern spotted owl, osprey Invertebrate: Shasta sideband (terrestrial mollusc) Mammal: California wolverine, greater western mastiff-bat, ringtail Plants: Big Bear Valley woollypod, California beaked-rush, Dimorphic snapdragon, Drymaria-like western flax, English peak greenbriar, Indian Valley brodiaea, Klamath manzanita, Madera linanthus, Marsh skullcap, Mt. Diablo fairy-lantern, Mt. Tedoc linanthus, North Coast semaphore grass, Pallid manzanita, Red Hills ragwort, Rock sanicle, Saw-toothed lewisia, Shasta snow-wreath, Silky cryptantha, Thread-leaved beardtongue, Tree-anemone ERP Biological Communities: Native anuran amphibians, Neotropical Migratory birds, Upland Game	?
Managed Seasonal Wetlands	Seasonal wetlands	**X**	**X**	**X**	**X**	Amphibians: California red legged frog, California tiger salamander Birds: **Greater sandhill crane, Swainson's hawk,** Aleutian Canada goose, American peregrine falcon, bald eagle, California gull, long-billed curlew, northern harrier, short-eared owl, tricolored blackbird, western burrowing owl, western snowy plover, white-faced ibis, white-tailed kite Invertebrates: Vernal pool tadpole shrimp Reptiles: **Giant garter snake,** western pond turtle ERP Biological Communities: Native anuran amphibians, Waterfowl, Shorebird and Wading bird guild, Neotropical Migratory birds	?
Seasonally Flooded Agriculture	Agricultural lands	**X**	**X**	**X**	**X**	Birds: **Greater sandhill crane, Swainson's hawk,** Aleutian Canada goose, bald eagle, California gull, long-billed curlew, northern harrier, short-eared owl, tricolored blackbird, white-faced ibis, white-tailed kite Reptiles: Giant garter snake ERP Biological Communities: Waterfowl, Shorebird and Wading bird guild, Neotropical Migratory birds	?
Upland Cropland	Agricultural lands	**X**	**X**	**X**	**X**	Birds: **Greater sandhill crane, Swainson's hawk,** Aleutian Canada goose, California gull, long-billed curlew, mountain plover, northern harrier, white-faced ibis, white-tailed kite Mammal: San Joaquin kit fox ERP Biological Communities: Waterfowl, Shorebird and Wading bird guild, Neotropical Migratory birds, Upland game	?

Table 5-2. Habitat targets based upon ERP Milestones[8a] for stage 1(see Appendix D)

Habitat	Milestone	Location	Acreage	Action
Delta Sloughs	DEDT-H2	Delta-all EMU's	15 miles each	Restore
Tidal Wetlands-tidal freshwater emergent	DEDT-H4	Delta-all EMU's	North- 500 acres East- 500 acres South-4000 acres Cent & west-5000	Restore
Tidal wetl.-channel islands & shoals	DEDT-H6	Delta	Channel isl.-125 ac Shoals-125 acres	Restore
Tidal wetlands- tidal perennial aquatic	DEDT-H11	Delta-all EMU's	North- 500 acres East- 250 acres South-500 acres Cent & west-750	Restore
Tidal wetland – saline emergent	SMB-H2	SMB-all EMU's	Suisun Bay & marsh-7000 acres Other EMUs–1000 ac	Restore
Tidal wetland- tidal sloughs	SMB-H2 SMB-H3	SMB	Suisun Marsh- 30 mi Napa Riv-10 miles	Restore/enhance?
Tidal wetland-tidal perennial aquatic	SMB-H5	SMB	400 acres	Restore
Riparian/floodplain	DEDT-H7	1 trib in EDT	?	Create/restore/enhance
	DEDT-H8	Each EMU in Delta	North-5 miles East-6 Miles South-2 miles	Restore
	DEDT-H9	DEDT-Moklumne, Cosumnes,Calaveras	300 acres	Restore + protect existing habitat
	SMB-H1	SMB – all EMU's	3 linear miles each	Restore and maintain
	SACR-H2	SacR – all EMZ's	?	Restore
	SACR-H3	Cottonwood Cr. EMZ	25% upper & lower	Create/restore/ maintain
	SACR-H4	Battle,Clear,Deer,Mill, Butte,Big Chico, Yuba, Antelope, Feather, Bear Rivers	2 miles each	Restore
	SJR-H4	ESJB & SJRz EMZ's	?	Restore
	SJR-H5	SJR-All EMZ's	ESJB-12.5 mi. WSJB- 1 mi	Restore
Seasonal Wetlands	DEDT-H10	East Delta EMU	1000-1500 acres	Enhance/protect/restore
	SMB-H4	SMB	500 ac / 7000 ac	Restore/Enhance
	SMB-H6	SMB	100 ac vernal pools 500-1000 ac buffer	Restore/Protect/ maintain
	SACR-H5	ARB	1288 ac	Protect & enhance
	SACR-H5	BB	9038 ac	Protect & enhance
	SACR-H5	CB	7109 ac	Protect & enhance
	SACR-H5	FRSB	1398 ac	Protect & enhance
Fresh emergent wetl.	SJR-H2	WSJB	100 acres	Restore/Create
Inland dune scrub	DEDT-H5	Delta	50 acres	Enhance
Non-tidal emergent Wetland	DEDT-H3	Delta	North-500 ac East-250 ac South-1,000 ac Cent & west -2,500	Restore
Perennial Grassland	SJR-H3	WSJB	1000 acres	Restore/ enhance
Wildlife friendly agriculture	DEDT-H1 SACR-H1 SJR-H1	DEDT, SACR, SJR	Delta-10,000+ acres SACR- 44800+ ac SJR- 2294+ ac,	Wildlife friendly agriculture practices; Restore wildlife corridors

Codes for Table 5-2:
EMZ = ERP Ecological Management Zone
EMU = Ecological Management Unit

Region

DEDT:	Delta & Eastside Delta Tributaries
SMB:	Suisun Marsh & North San Francisco Bay
SACR:	Sacramento River Basin
SJR:	San Joaquin River Basin

Ecological Management Zone

ARB	American River Basin
BB	Butte Basin
CB	Colusa Basin
EDT	Eastside Delta Tributaries
FRSB	Feather River/Sutter Basin
ESJB	East San Joaquin Basin
WSJB	West San Joaquin Basin
SJRz	San Joaquin River

Figure 5A. CALFED Large-scale Habitat & Processes Simple Conceptual Model

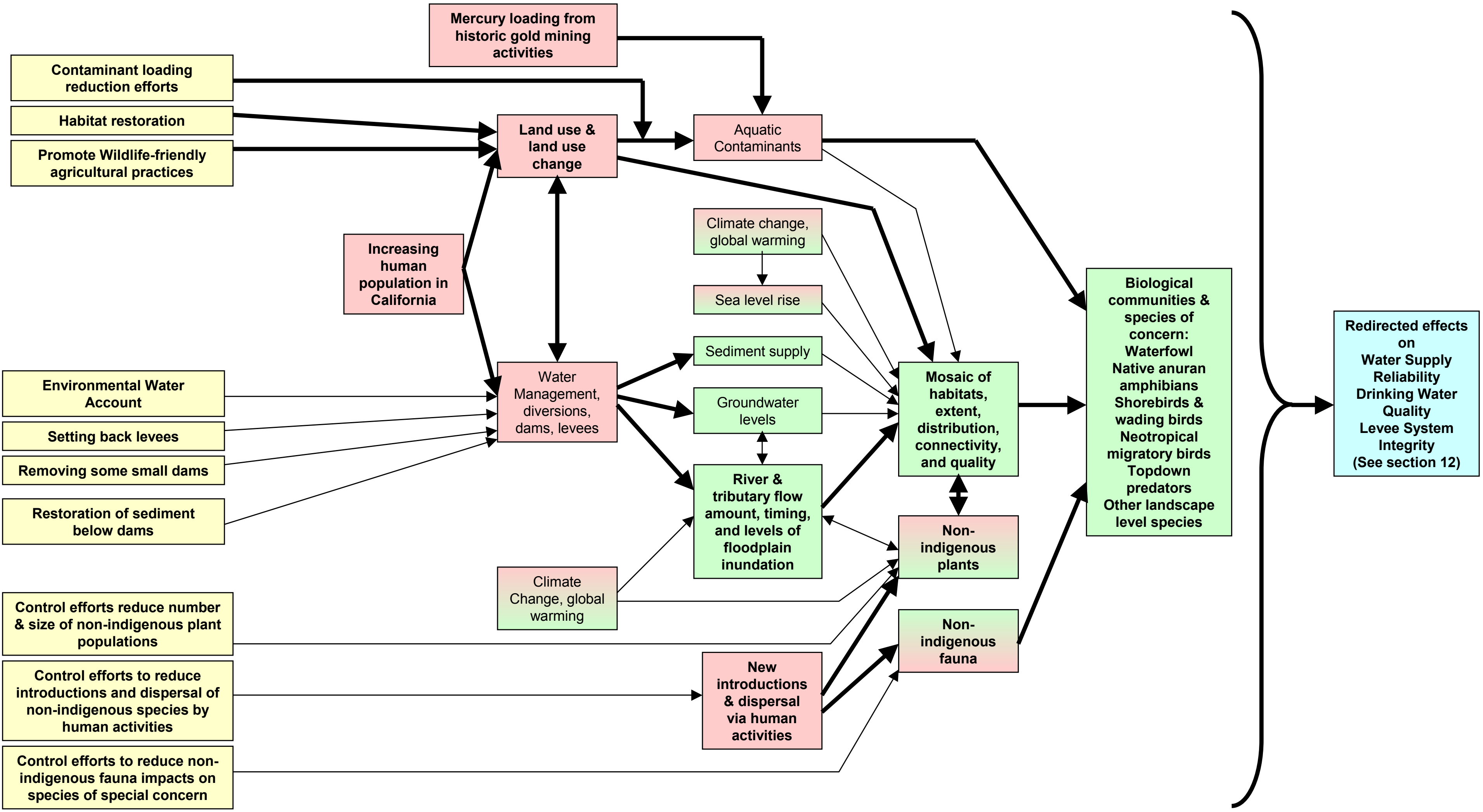


Table 5-3 Large-scale habitat and processes issues monitoring recommendations

Further work is needed in refining this list, prioritizing it, and identifying existing programs. Only the highest priority items are flagged. References are given in parentheses (). P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program
What are the status and trends in the extent and distribution of ERP/NCCP habitats? (ERP Strategic Obj. 4.1 - 4.5)						
5-3.1	**Habitat extent & spatial distribution** What are the status & trends in extent and spatial distribution of ERP and NCCP habitats? There are currently two different classification systems in CALFED, both of which currently require monitoring. (13, 16)	S	Acreage and location of ERP Habitat Types: Tidal Perennial Aquatic Habitat, Nontidal perennial aquatic habitat, Saline emergent wetlands, Fresh emergent wetland, Seasonal wetlands, Riparian and Riverine aquatic habitats, Inland dune scrub habitat, Perennial grassland	Remote sensing / mapping	High	ACOE - Habitat Restoration Feasibility Studies; ACOE - Comprehensive Review Study; Biodiversity Council-land use theme group CALTRANS CMCC within California Department of Information Technology CSU-Chico; Cosumnes River Preserve & restoration studies; CDWR-Sacramento River Riparian Habitat Program; CDWR-Reservoir sites + 1 mile buffer; CDWR-AB360 Delta Levee Maintenance subventions program; CDWR-North Delta Program; CDWR-Statewide Planning (Crop types) Habitat Conservation Plans; SFEI-EcoAtlas; CDFG-Suisun Marsh Vegetation Survey-mapping; CDFG-Central Valley Wetland Mapping Project; Mosquito Abatement Districts; California Legacy Project; USFS w/CDF above 300' contour; USFWS National Wildlife Refuges; Dept. of Conservation - Famland Mapping & Monitoring Program; Dept. of Pesticide Regulation w/USBR - Field Borders mapping; UC Berkeley, CEDR - SF Bay Delta Geodatabasee (Wetlands in Bay/Delta); USBR-Stone Lakes Wildlife Refuge Feasibility Study
			Acreage and location of MSCS- NCCP habitat types: Tidal Perennial Aquatic, Valley Riverine Aquatic, Montane Riverine Aquatic, Lacustrine, Saline Emergent, Tidal Freshwater Emergent, Non-tidal Freshwater Permanent Emergent, Natural Seasonal Wetland, Managed Seasonal Wetland, Valley/Foothill Riparian, Montane Riparian, Grassland, Inland Dune Scrub, Upland Scrub, Valley/Foothill Woodland and Forest, Montane Woodland and Forest, Upland Cropland, Seasonally Flooded Agricultural Land	Remote sensing / mapping	High	
5-3.2	**Dendritic Network of streams** This issue was identified in the TAMP workshops and may be more of a watershed program issue than an ERPP issue. However, across the landscape many smal creeks and tributaries are lost due to land conversion or consolidated into fewer but larger streams and creeks. This can be useful for identifying areas to target restoration efforts (2)	S/P	landscape-level survey of feeder creeks and tributaries to identify whether or not they reach the river or are truncated and combined.(2)	Remote sensing / mapping		Phillip Williams & Associates

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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program
What are the status and trends in connectivity among ERP/NCCP habitats? (ERP Strategic Obj. 4.1 -4.5)						
5-3.3	**Connectivity between patches & groups of patches** To what degree are habitat blocks connected relative to isolation of species or populations?	S	Spatial distribution of patches	Remote sensing / mapping	High	See 5-3.1 above Coordinate with Missing Linkages efforts
			Habitat pattern indices (patch contagion & interspersion, patch cohesion, inter-patch distance, distribution, etc.)	Remote sensing / mapping	High	
			Location of habitat corridors and acreage of contiguous habitat	Remote sensing / mapping; Targeted Studies	High	
5-3.4	**Barriers to species movement / Corridor permeability to species movement** Where do roads, ditches, and canals, and similar barriers restrict movement between habitat blocks? What is the degree of permeability between habitat blocks? What represents a barrier differs by species. Some species that come to mind are the Salt Marsh harvest mouse and riparian brush rabbit. In the case of the Salt Marsh Harvest Mouse, bare patches (such as roads) and open water (ditches) of ten feet present a barrier to movement. In the case of the riparian brush rabbit, they tend to stay within the dense canopies of riparian systems. Various densities of housing can represent barriers to some species and not to others.	P	Presence, type, and distribution of roads and large canals and other barriers (also locations of animal underpasses if relevant)	Remote sensing / mapping; Targeted Studies	High	Coordinate with Missing Linkages efforts
			Simple index of degree of urbanization, habitat quality, and difficulty level of barriers in movement corridors	Remote sensing / mapping; Targeted Studies		Coordinate with Missing Linkages efforts
			Targeted studies to verify movement through corridors of targeted ERP species and other species important for ecosystem processes such as top-down predators	Targeted studies?		
What changes in ERP/NCCP habitats are due to land use changes? (ERP Strategic Obj. 4.1 -4.5)						
5-3.5	**Land use change** How much ERP habitat acreage was converted to other land uses since baseline? Where is it located? Urbanization, changes in agricultural land use, or even changes in land use due to privatization of PG&E lands all can impact natural habitats directly or impact habitat quality by affecting lands adjacent to natural habitat. Changes in the type of cropping system (i.e. from grain crops to vineyards) can affect the utility of that land for wildlife habitat or migration corridors. Permeability of watershed is another way of looking at changes in land use from a water perspective. How much of land is still permeable vs. converted to less permeable land uses? Note: Permeability of watershed is more of a watershed program monitoring element.	P	Acreage and location of habitat types converted to other land uses since CALFED baseline year, urbanization, agricultural land use change (grazing to tree crops to other uses) (16)	Remote sensing / mapping; County records	High	See 5-3.1 above
			Permeability of watershed	Remote sensing / mapping; County records		
5-3.6	**Acreage restored** Where are restoration actions occurring and what is their status?	A	Extent, location, implementation status of restoration projects	Programmatic	High	

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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program
5-3.7	**Acreage under protected status** How much acreage has been protected due to CALFED actions?	A	Acreage of land purchased or otherwise protected through CALFED actions	Programmatic	High	
		E	Change in habitat acreage under protection status	Programmatic	High	
5-3.8	**Habitat Conservation Plans, local watershed planning efforts, and other planning efforts that affect habitat conservation & restoration** Habitat conservation plans are an attempt to take a regional approach to development and environmental protection by protecting critical habitat and connectivity for covered species across the geographic scope of the plan in exchange for allowing limited take of covered species through development of less sensitive areas.	A	Extent, location, and protection status of land designated for protection under Habitat Conservation Plans or other watershed planning efforts	Programmatic	High	
5-3.9	**Habitat Corridors restored** Where has habitat restoration, habitat enhancement, barrier removal or barrier mitigation re-established connectivity between habitats? Are corridors being used by target species?	A	Extent, location, and status of habitat corridors restored	Programmatic	High	Coordinate with Missing Linkages efforts
		E	Use of corridors by target species	Targeted studies?	High	

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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program
What changes in ERP/NCCP habitats are attributable to changes in water availability and water management practices? ((ERP Strategic Obj. 4.1 - 4.5, 2.4, 2.5)						
5-3.10	**Variable river flows** How do current Sacramento River, San Joaquin River,and tributaries hydrographs compare with the natural hydrographs? Are large flow events occurring frequently enough to cause large changes in channel migration and the associated diverse array of habitats associated with those changes? Deviations from the natural hydrograph affect vegetation establishment and maintenance and groundwater levels. It is also an important covariate for understanding floodplain inundation and channel migration processes. Large flow events cause major changes in channel migration (bend cut-throughs, oxbow lakes, etc.) which are associated with a diverse array of habitats years later. (Covariate)	S	Magnitude, timing, and variability of flow in rivers at tributary mouths compared with historic natural hydrograph (1, 13, 16, 21)	Water management - Stream gage network		CDWR USBR USGS
			Delta Inflow (20)	Water Management- Stream gage network		USBR
			Outflow through Golden Gate	Water Management - Stream gage network		
			Water year, including drought & wet years	Water Management - programmatic		CDWR
			Occurrence of extreme flood events, capable of major changes in channel and river course (overlaps with monitoring above) (18)	Water Management - Stream gage network		CDWR USBR USGS
5-3.11	**Variable Tributary Flows** Are tributary flows magnitude, timing, and variability contributing to sustainability and natural succession of NCCP habitats? What changes in NCCP habitats were caused by extreme flood events and/or droughts? (Covariate to interpret other habitat changes)	S	Magnitude, timing, and variability of flow in tributaries at tributary mouths compared with historic natural hydrograph (1, 13, 16, 20, 21)	Water management- Stream gage network		Incomplete-- CDWR, USBR, USGS
			Occurrence of extreme flood events, capable of major changes in channel and river course (overlaps with monitoring above) (18)	Water Management- Stream gage network		Incomplete-- CDWR, USBR, USGS
			Changes in extent and distribution of NCCP habitats attributed to changes in tributary flow	Remote sensing / mapping; targeted studies		
5-3.12	**Salinity gradient in estuary** What are the status and trends in the salinity gradient in the estuary relative to changes in vegetation community composition? Water management has greatly changed the salinity gradient length and variability over the historical record. In addition sea level is rising which will also affect the salinity gradient which in turn affects the composition of vegetation communities throughout the region. (13)	S	salinity measured along longitudinal axis in estuary - range, variability, seasonality (13, 20)	Water Management - Water quality monitoring stations		CDWR?
			Changes in vegetation communities reflecting changes in salinity gradient (I.e. conversion of brackish to saline vegetation communities)	Remote sensing / mapping; Targeted studies?		
			<see 5-3.10: River flows, Delta inflow & outflow (covariates)>			
			<see 5-3.10: Water year, including drought & wet years (as covariate)>			

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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program
5-3.13	**Groundwater table (13,1)** What is the groundwater depth relative to the habitat type? Groundwater depth and variability is an important determining factor in vegetation communities structure and composition in a given patch.	S	depth to groundwater table (13, 16)	Sampling sites network		
			Changes in distribution and extent of floodplain habitats due to changes in groundwater table	Remote sensing / mapping; Targeted studies?		
			Groundwater levels in established wells throughout state	Water management - Well monitoring		
5-3.14	**Water management** Water management changes including reservoir releases, water diversions and return flows, water transfers and groundwater pumping affect the amount timing and variability of flows throughout the season from the historical hydrograph. Flows and groundwater pumping can also affects the depth to the groundwater table which in turn affect riparian vegetation.	P	releases from dams effects on river and tributary flows	Water management		USBR, USACE
			water diversions effects on tributaries and in Delta & return flows	Water management		USBR, CDWR
			water transfers effects on river and tributary flows	Water management		
			<see 5-3.10: Magnitude, timing, and variability of flow in rivers at tributary mouths compared with historic natural hydrograph (12, 13, 16, 21) (covariate)>			
			<see 5-3.13: depth to groundwater table (13,16)>			
			<See 5-3.10: Delta inflow, Delta outflow (covariates)>			
			<See 5-3.10: Outflow through Golden Gate (covariate)>			
5-3.15	**Water Use Efficiency improvement and water transfers impacts on habitat** What changes in distribution and extent of ERP/NCCP habitats are attributable to water use efficiency and water transfer actions? Improvements in water use efficiency and water transfers could have unintended impacts on habitat by decreasing leaks in canals, reducing runoff, and transferring water to other areas that might otherwise have contributed to local habitats (23, 24)	P-R	changes in distribution and extent of habitats due to changes in water use and water transfers	Remote sensing / mapping; Targeted studies?		
			Project impacts on vegetation	Project Monitoring		

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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program
5-3.16	**Relative Sea level Rise** **Is sea level rise changing the extent and distribution of vegetated marsh plain?** Sea level rise is expected to have several effects on the estuary-- * possible changes in the extent of vegetated marsh plain if marsh plain elevation rise cannot keep pace with changes in sea level * possible changes in the salinity gradient in the estuary as sea water encroaches further into the estuary.	P-N	Sea level at fixed point in estuary (Golden Gate Bridge ?)	Water management - gaging stations		NOAA has 4 stations
			<See 5-3.12: salinity measured along longitudinal axis in estuary - range, variability, seasonality>			
			<See 5-3.12: Changes in vegetation communities reflecting changes in salinity gradient (I.e. conversion of brackish to saline vegetation communities)>			
			Extent of vegetated marsh plain (4)	remote sensing / mapping		
5-3.17	**Temperature, climate, floods & droughts, global warming** Is the frequency of extreme weather events increasing? What impact is global warming having on snowmelt, runoff, temperatures, and vegetation in California? What background variability in precipitation and weather must be accounted for when interpreting monitoring results? Temperature, climate, floods, and droughts all have effects on vegetation and consequently are important covariates to monitor to interpret other changes on the landscape. Droughts can allow the spread of non-indigenous plant species. Global warming is expected to impact weather, the frequency of extreme weather events, rising air temperatures, and increasing CO2 levels. These effects will likely be felt most quickly in the aquatic ecosystem. The effects on the terrestrial ecosystem are less clear. Rising temperatures and increases in UV radiation can lead to earlier snowmelt and consequently affect water management in California. (2)	P-N	Occurrence of El nino effects, droughts, floods	weather stations	High-Aq.; Low-Terr.	CDWR, USBR, USGS
			Effects of extreme weather conditions (droughts, floods, El Nino rainfall) on vegetation	remote sensing / mapping	High-Aq.; Low-Terr.	
			Spring and summer temperatures, snowpack melt, and seasonal runoff amount and timing	Weather stations, Water management	High-Aq.; Low-Terr.	CDWR, USBR, USGS
			Yearly precipitation and snowpack status	Weather stations, Water management	High-Aq.; Low-Terr.	CDWR
			Weather, climate (covariate for interpreting other variables)	weather stations	High-Aq.; Low-Terr.	
			Targeted studies of effect of global warming on temperature trends, timing of winter storms, snowpack status, amount & timing of runoff and water supplies in California	Targeted studies?	High-Aq.; Low-Terr.	Universities; DWR, USBR, Aquatic monitoring plan
5-3.18	**Balance seasonal flows from reservoirs for fisheries, water conveyance, flood control, and the needs of other habitats (8)**	A	*<See 5-3.10 Delta inflow & outflow>*	*Aquatic Monitoring*		
			<See 5-3.11: Magnitude, timing, and variability of flow in rivers at tributary mouths compared with historic natural hydrograph (1,13,16,20,21)>	*Aquatic Monitoring*		
5-3.19	**Establish desirable salinity gradients** MSCS recommendation -- establish desirable estuarine salinity gradients by managing water diversions and water releases from upstream reservoirs to control seasonal freshwater inflows to the Delta (11)	A	*<See 5-3.12: salinity measured along longitudinal axis in estuary - range, variability, seasonality>*	*Aquatic Monitoring*		

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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program
What changes in ERP/NCCP habitats are attributable to changes in sediment supply? (ERP Strategic Obj. 2.7, 4.1)						
5-3.20	**Salmonid spawning habitat** Are changes in sediment supply affecting the location and quality of salmonid spawning habitat?Changes in sediment supply will become apparent most quickly in the extent and quality of salmonid spawning habitat before they become apparent in the terrestrial ecosystem.	S	Location salmonid spawning habitat	Salmonid redd surveys	High	<See Aquatic Monitoring Program>
			Quality of gravel for salmonid spawning habitat	Targeted studies?	High	<See Aquatic Monitoring Program>
5-3.21	**Horizontal & Vertical Tidal Marsh Erosion & Deposition processes** Is the sediment supply sufficient to maintain the natural establishment and succession of habitats in tidal wetlands? Is marsh plain elevation being maintained relative to sea level? Maintenance of marsh plain elevation is a combination of sediment accumulation & erosion, biomass accumulation & oxidation, and sea leve rise. The extent and location of mudflats reflect the amount of sediment coming into the estuary. Shoreline change shows where marsh is being lost and gained. Concerns have been raised that the sediment supply tha helps sustain tidal wetlands will diminish and marsh plain rise will not keep pace with the rise in sea level	S	Status & trends in extent and location of tidal mud flats	remote sensing / mapping		SFEI-EcoAtlas; CDFG-Suisun Marsh Vegetation Survey-mapping;
			Extent of vegetated marsh plain	remote sensing / mapping		
			Area of mid-channel islands and shoals	remote sensing / mapping		
			<See 5-3.16: Sea level at fixed point in estuary (Golden Gate Bridge ?) (Covariate)>			
5-3.22	**Sediment erosion and deposition in freshwater & riparian habitats**. Is the sediment supply sufficient to maintain the natural establishment and succession of habitats in tidal, freshwater, and riparian wetlands? Sediment supply from upper watersheds has been greatly diminished in many tributaries due to dams and gravel mining. In addition much of the current sediment from gold mining is being gradually washed out of the system.	S	areas of new sediment deposits and erosion in rivers and tributaries	Sampling sites network		
			<See 5-3.1: distribution and extent of floodplain habitats (13, 16, 18)>	*remote sensing / mapping*		
5-3.23	**Location of dams** Where are dams located in relation to their effect on sediment supplies? Dams block sediment supplies from upper watersheds as well as altering river flows. Dams also block aquatic species from accessing upper watersheds. This is a negative for salmonids, but can be a positive in some cases for native anurans if introduced predacious fish are blocked from reaching upper watersheds.	P	Location & type of dams- large and small	Programmatic		

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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program
5-3.24	**Gravel Mining activities** Gravel mining activities affect the environment both through disturbance and through removal of gravel supplies. Also unfilled gravel pits can provide refugia for introduced bass which prey on native fish and amphibians. The effects of gravel mining differ depending on whether it is conducted within the active stream channel or outside of it.	P	Location & size of gravel mining activities	Programmatic		
5-3.25	**Fine sediment loading** Is fine sediment loading outside of natural variation and toleration of the stream and/or river and causing degradation of habitat quality?	P	Location and degree of sediment loading due to human activities (timber harvest, grazing management along rivers, agricultural runoff, etc.)	Programmatic		
			Water turbidity	Aquatic Monitoring		
5-3.26	**Dam removal** Where are dams being removed and what is the effect on sediment supplies and the movement of species?	A	Location of dams removed to improve streamflow and sediment supply (mostly small, little-used dams)	Programmatic		
		E	Effect of dam removal on sediment supply downstream	Project Monitoring		
		E	Effect of dam removal on movement of species, especially salmonids, but possibly predacious introduced fish if not previously present in upper watershed.	Project Monitoring		
What changes in ERP/NCCP habitats are attributable to changes flood management and land/levee erosion control activities (ERP Strategic Obj. 4.1, 4.2, 2.6, 2.8)						
5-3.27	**Floodplain extent and distribution** What is the extent and distribution of floodplain habitats?	S	distribution and extent of floodplain habitats (13, 16, 18)	remote sensing / mapping	high	DWR Northern District - SB 1086; DWR Delta Planning Branch - North Delta Program
5-3.28	**Levees** Where do levees restrict river meander and extent of the floodplain?	P	Mapping of rivers by type of control, I.e. levees, rip-rap, no levees, etc.	remote sensing / mapping		CDWR, ACOE
5-3.29	**Flood management and erosion control activities** Where have bank stabilization measures been applied that cause loss of habitat and restrict river meander processes?	P	Amount and location of rip-rap and other non-vegetated bank stabilization measures	remote sensing / mapping		CDWR, ACOE
5-3.30	**Set-back levees & restoration activities** Where and to what extent have levee set-back and restoration activities increased the effective extent of the floodplain?	A	Increase in effective floodplain due to set-back levee activities	Project Monitoring		
5-3.31	**Vegetated bank-stabilization measures** Can alternate bank stabilization measures successfully control bank location in critical area without losing habitat?	A/E	Locations and Effectiveness of bank-stabilization measures that do not require loss of habitat	Targeted studies		Existing study

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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program
What changes in ERP/NCCP habitats are attributable to changing weather patterns, rising temperatures and CO2 levels due to global warming? Global warming is expected to impact weather, the frequency of extreme weather events, rising air temperatures, and increasing CO2 levels. These effects will likely be felt most quickly in the aquatic ecosystem. However, the effects on the terrestrial ecosystem over the next 30 years are less clear. Rising temperatures and increases in UV radiation can lead to earlier snowmelt and consequently affect water management in California. Rising CO2 levels and increasing temperatures may affect vegetation over the next 100 years, but it may be difficult to distinguish early effects. There are also few actions that could be taken in response short of increased emphasis on control of non-indigenous plants.						
	<u>Variable river flows (see above)</u>		<See 5-3.11: Magnitude, timing, and variability of flow in rivers at tributary mouths compared with historic natural hydrograph (1, 13, 16, 21)>			
5-3.32	**<u>Consequences of rising temperatures and climate change on vegetation</u>** What are the effects of global climate change within vegetation communities? Changes in temperatures, CO2 levels, and weather extremes are hypothesized to affect the competitive relationships between plant species, sometimes in favor of non-indigenous species, and affect the composition of plant communities. The exact effects are largely speculative at this point. (2)	P	Targeted studies of effect of climate change on vegetation in California	Targeted studies?		university research efforts

6.0 TIDAL WETLAND HABITAT QUALITY

This section on Tidal Wetland Habitat Quality outlines "*what*" needs to be monitored and "*why*" to assess status and trends in the extent and distribution, sustainability, and functioning of tidal wetlands in support of biodiversity and at-risk species and to assess the effects of CALFED actions on tidal wetlands. For the purpose of this report tidal wetlands are defined as the NCCP habitats: *tidal perennial aquatic, saline emergent, and tidal freshwater emergent* and include at least part of the following ERPP habitats: *tidal perennial aquatic habitat, Delta sloughs, mid-channel islands and shoals, saline emergent wetland, fresh emergent wetlands, seasonal wetlands*. The ERP strategic objectives[8] management questions, ERP milestones[8a], and ERP/MSCS at-risk species[8,11] are identified. Issues relating to habitat quality are discussed. Box 6a gives a general description of tidal wetland habitat quality. Figures 6A-6D relate ERP Milestones to pressures and effects on the extent and distribution of tidal wetlands, effects on processes and vegetation within tidal wetlands, and effects on biodiversity and at-risk species within tidal wetlands. Each of these three figures then relates to Tables 6-2, 6-3, 6-4, listing the monitoring attributes and monitoring elements. The re-directed effects of tidal wetland restoration on other parts of CALFED are outlined and an incomplete list of identified monitoring programs and information sources is included.

Many of the aspects of habitat quality are derived from the recommendations in the MSCS conservation measures[11] for ERP/MSCS at-risk species. At-risk species are assumed the most sensitive species to degrading habitat quality. Thus, those aspects that were limiting to these species are included as important components of tidal wetland habitat quality.

Although issues regarding tidal wetland habitat quality are discussed briefly below, more in depth discussions can be found in the Baylands Ecosystem Habitat Goals Project (1999)[25], CALFED whitepaper on tidal wetlands (draft)[4], CMARP Shallow Water habitat appendix report (1998, draft)[21], and Suisun Ecological Workgroup Final Report (1999, draft)[34].

ERP Strategic Objective

> Restore large expanses of all major habitat types, and sufficient connectivity among habitats, in the Delta, Suisun Bay, Suisun Marsh, and San Francisco Bay to support recovery and restoration of native species and biotic communities and rehabilitation of ecological processes. These habitat types include tidal marsh (fresh, brackish, and saline), tidal perennial aquatic (including shallow water and tide flats), nontidal perennial aquatic, tidal sloughs, midchannel island and shoal, seasonal wetlands, riparian and shaded riverine aquatic, inland dune scrub, upland scrub, and perennial grasslands.[9]

Management Questions

What are the status and trends in the extent and distribution of habitats?

- What are the status and trends in the extent and distribution of tidal wetlands and associated upland habitats?
- What is the extent and distribution of good quality habitat that is functional in the support of biodiversity and at-risk species?

- What changes in the extent and distribution of tidal wetlands and associated upland habitats are due to land use changes?

How sustainable are tidal wetlands due to hydrologic and geomorphic processes?
- What changes in the extent and distribution of tidal wetlands are due to hydrologic and geomorphic processes?
- What changes are occurring in the distribution of saline, brackish, and freshwater tidal wetlands due to changes in the salinity gradient in the estuary?
- Do tidal wetlands have topographic complexity, tidal channel networks, low-to high marsh transitions, ponds and pannes to provide a mosaic of habitat types? Will hydrologic and geomorphic processes continue to provide a range of habitat types?

How functional are tidal wetlands in the support of biodiversity and at-risk species?
- What are the status and trends in the extent and distribution of vegetation communities and sub-habitats of tidal wetlands and associated upland habitats? What changes are occurring in vegetation structure, composition, and function?
- What effects are non-indigenous plants having on the structure, composition and function of tidal wetland vegetation?
- What are the status and trends in small mammals, reptiles, amphibians, waterfowl and shorebirds, passerines, rails, and invertebrates in tidal wetlands?
- What is the proportion and/or extent of tidal wetlands that have adequate connectivity with uplands to support a diverse array of fauna including small mammals, rails, passerines, breeding waterfowl, etc.?
- What is the degree of connectedness of tidal wetland habitats relative to the movements of rails, passerines, small mammals, etc?
- What is the level of wildlife health and effect of contaminants in tidal wetlands? Is it outside of acceptable limits?
- What is the level of predation/competition pressure from non-indigenous fauna? Is it outside of acceptable limits?

What restoration actions have occurred and what were their effect?
- What changes in the extent and distribution and protection status of tidal wetlands and associated upland habitats are due to habitat protection and restoration activities?
- What is the effect of habitat restoration and/or habitat enhancement on increasing the availability of habitat with appropriate vegetation structure, composition and function to support biodiversity and at-risk species?
- What is the effect of habitat restoration on biodiversity, at-risk species, and improving the connectivity among habitats?

What re-directed effects has habitat restoration had within the ERPP?
- What re-directed effects has habitat restoration had on the distribution and habitat use of waterfowl and shorebirds?
- Has wetland restoration affected sediment deposition and erosion in other wetlands?
- Has wetland restoration affected mercury bioavailability?

- Has wetland restoration resulted in native or non-native plant species dominated wetlands and increased the rate of spread of non-native plant species?

ERP/MSCS At-risk Species and Biological Communities in Tidal Wetlands[8,11]
(Fish and aquatic invertebrate species are listed for the sake of completeness)

Recover:
BIRDS: San Pablo song sparrow, Suisun song sparrow,
FISH: Central Valley fall-run chinook salmon, Central valley spring-run chinook salmon, Central Valley steelhead, delta smelt, green sturgeon, longfin smelt, Sacramento River winter-run chinook salmon, Sacramento splittail,
MAMMALS: Suisun Ornate Shrew,
PLANTS: Mason's lilaeopsis, Soft bird's-beak, Suisun marsh aster, Suisun thistle,

Contribute to Recovery:
BIRDS: California black rail, California clapper rail, Saltmarsh common yellowthroat,
FISH: Sacramento Perch,
MAMMALS: Salt Marsh Harvest Mouse, San Pablo California Vole,
PLANTS: Delta mudwort, delta tule pea, Point Reyes bird's beak,
REPTILES: Giant Garter Snake,

Maintain:
BIRDS: Aleutian Canada goose, American peregrine falcon, Bald eagle, Black tern, California brown pelican, California gull, California least tern, Long-billed curlew, Northern harrier, Osprey, Short-eared owl, Western burrowing owl, Western snowy plover, White-faced ibis, White-tailed kite,
FISH & INVERTEBRATE: Tidewater goby, California Freshwater Shrimp,
PLANTS: California seablite, Clara Hunt's milk-vetch, Marin knotweed, Rose mallow,

Biological Communities:
Neotropical Migratory birds, Shorebird and Wading bird guild, Waterfowl, anadromous lamprey, Native Resident Fish, Bay-Delta Foodweb Organisms, Aquatic habitat plant community, Tidal brackish and freshwater marsh habitat plant community,

Issues

The general attributes of quality tidal wetland habitat are given in Box 6a. The general issues include:

Habitat loss and fragmentation
The large-scale loss of tidal wetland habitat is one of the most visible effects of human alterations on the Bay-Delta estuary. Tidal wetlands in all areas were composed of a complex mosaic of marsh, stands of more complex vegetation, open-water pools

Box 6a. Elements of Tidal Wetland Habitat Quality for ERP Birds, Reptiles, Mammals, and Plants (combined from MSCS (2000)[11]; Goals Project (1999)[25])
[Note: habitat quality for managing waterfowl may be different]

- **Large patch size:** Marsh is of sufficient size and configuration that it is large enough to develop fourth order tidal channels (marshes would likely need to be at least 1000 acres in size)
- **Transition zones to upland:** Marsh has low-angle upland slopes at upper edge of marshes to provide for establishment of suitable and sufficient wetland to upland transition habitat. To the extent feasible, transition habitat zones should be at least 0.25 mile in width and have low pressure from non-indigenous predators.
- **Buffer Zones:** Marsh has buffer zones from nearby land uses composed of perennial grassland, wetlands or riparian habitat
- **Connectivity:** Marsh has sufficient connectivity with other existing and restored tidal marshes relative to dispersal distances of sensitive ERP/MSCS species to allow safe movement of the species between patches
- **Full tidal action:** Restoration of full tidal action is recommended for areas intended to benefit ERP/MSCS species, although there is considerable controversy that restoration of managed wetlands to full tidal action may cause a decline in habitat for waterfowl.
- **Tidal networks:** Marsh tidal channel network should preferably contain 3rd and 4th order channels.
- **Geomorphic process sustainability:** Sediment erosion and accretion rates should support marsh development, sustainability and a mosaic of different habitat types. Geomorphic processes should support the formation and sustainability of tidal channel networks, pans, etc.
- **Low abundance of non-indigenous marsh plants:** Marsh has low relative abundance of invasive non-native marsh plants
- **Low presence of non-indigenous predators:** Marsh has low presence of non-indigenous predators such as introduced red foxes, Norway rats, feral cats and dogs
- **Low disturbance:** Marsh has low levels of disturbance from human activities including recreational activities, erosion effects due to boat wakes, grazing, etc.
- **Low contaminants**: Marsh has low contaminants problems due to mercury, selenium, urban water runoff, industrial discharge, sewage effluent, etc.
- **Mosaic of different habitat types:** The marsh should have a mosaic of different habitat types due in part to having sufficient patch size to develop a network of tidal channels, have low marsh grading into high marsh and upland areas, natural pans, and have different soils and landscape configuration supporting the different types of vegetation, natural pans, lagoons, channels, etc.
- **Specific vegetation structure, composition, and function** required by sensitive ERP/MSCS species
- **Appropriate animal community groups:** waterfowl, shorebirds, wading birds, passerines, rails, raptors, native anuran amphibians, small mammals, terrestrial invertebrates, aquatic invertebrates, reptiles, top-down predators
- **Presence of "indicator" species:** Presence of sensitive ERP/MSCS species, species requiring a mosaic of habitats, or key indicator species such as top-down predators that are associated with "quality" habitat. The Goals Project (1999) made some initial recommendations for saline tidal wetlands.

and lakes of various sizes, mud flats and small distributary water channels that delivered water to and from the tidal marsh in response to tidal flows. (Brown et al, CALFED Tidal wetlands white paper, draft, 2000) In addition the complex network of tidal channels and sloughs have been substantially reduced. Recent estimates indicate about 95% of Delta tidal wetlands have been lost, along with a significant proportion of the associated tidal sloughs.

Even in Suisun Marsh, which is often perceived as relatively unaltered, most of the tidal wetlands have been diked and are now managed to support waterfowl. Much of the remaining tidal wetland is comprised of edge habitats between channels and the levees protecting managed wetlands. These edge tidal wetlands lack the marsh plains, tidal channel networks, and transition zones to uplands associated with natural tidal wetlands and cannot support all of the plants, animals, and ecological processes expected of natural habitats (CALFED Tidal wetlands white paper, draft, 2000)[4].

Small wetland habitat patch sizes are associated with increased levels of disturbance and increased impact by non-indigenous predators such as cats, dogs, and introduced foxes.

Fragmentation of the remaining habitat has unknown effects on biological populations in tidal wetlands at this time. However, small fragments have an increased likelihood of local extinctions and if located far from other tidal wetlands, re-colonization may be slow. In addition, one possible effect of altered flows and sea level rise may be a gradual change in the salinity gradient in the estuary. Sufficient connectivity among habitats is needed to allow migration of vegetation and fauna with the changing salinity gradient if such changes occur.

Lack of quality transition habitat to uplands

Connectivity with upland habitats and high marsh to upland transition zones provide important habitat for at-risk plant species and for refugia from floodwaters for wetland fauna (MSCS, 2000)[11]. Tidal wetlands without access to high water refugia provide little benefit to terrestrial species. Tidal wetlands adjacent to bare levees are also of diminished quality because they lack quality transition zones to uplands. For example, lack of sufficient cover on levees exposes rails and small mammals fleeing rising floodwaters to predators.

Topographic Complexity

The loss of tidal marsh acreage and large tidal marsh patches also has resulted in the loss of the dendritic pattern of tidal channels, pans, ponds, and the gradient from low to middle to high marsh and upland habitats along with the associated processes, vegetation and fauna they support. These dynamic processes of tidal channel formation and movement are important in creating the subtle topographic variation and mosaic of habitat types needed by various ERP/MSCS species. For example Mason's lilaeopsis grows on eroding banks and levees and depends on the habitat created by the geomorphic processes found in tidal channels (MSCS Technical Reports, June 1999[12]; Goals Project, 1999[25]). Suisun thistle is found in the high marsh area that receives less frequent tidal inundations while Suisun marsh aster is found "along sloughs and riverbanks affected by tidal fluctuations, usually around the mid- to high-tide mark" (MSCS Technical Reports, June 1999)[12]. Loss of pans and ponds have also decreased habitat diversity and affected shorebirds and waterfowl which are now concentrated in diked wetlands and salt ponds (Goals Project, 1999)[25]. The small patch size and resulting loss of topographic complexity in many tidal wetlands has diminished habitat quality for many species.

Diminishing sediment supply

Most rivers in the Central Valley are now dammed thereby cutting off the sediment that normally would flush through the system. Historically large amounts of sediment were added into the system during the gold-mining of the 1800's, but gradually this sediment will be washed through the system and out the Golden Gate. When combined with the slow rise in sea levels, this could cause a gradual erosion in tidal wetlands over the next 100 years or so, but the effect during the next 30 years of CALFED is unclear. (CALFED Tidal Wetlands white paper, draft)[4]

Altered salinity gradient in Suisun Marsh and Delta

The combination of increased exports of water from the Delta, alterations in the amount, timing, and variability of flows, and a slow but gradual rise in sea level may affect the spatial and temporal variability of the latitudinal and longitudinal salinity gradients in the estuary. While variability in salinity is a normal feature of estuaries, a gradual long-term increase in salinity levels is a concern if connectivity of habitats along the estuary is not maintained to allow species to move with the changing gradient. However, variability in salinity levels is normal in the system. The Suisun Ecological Workgroup Final report (draft, 1999)[34] raised the issue that perhaps too little variability in the salinity levels was being created by the Suisun Marsh Salinity Control Gate to maintain a variety of vegetation types. Other than monitoring connectivity among habitat blocks, salinity levels in tidal wetland habitats and sea level rise, all of which should be included for other reasons, it is unclear what should be included in the monitoring plan. If export levels are expected to increase to the point of strongly affecting salinity levels, then targeted research on the relationship between anticipated changes in salinity levels and vegetation may be advisable. What may be of more local concern is if levee failures result in catastrophic flooding of critical islands in the Central and West Delta, this could result in a rapid increases in salinity levels in nearby wetlands.

Non-indigenous plants

The ERPP targeted the following introduced plants as problems in tidal wetlands:

Arundo	Parrotfeather
Cordgrass –introduced	Perennial pepperweed
Egeria	Purple loosestrife
Eurasian Watermilfoil	Water hyacinth
Hydrilla	Water Pennywort

Introduced Tidal Marsh Plants in the San Francisco Estuary (Grossinger *et al*, 1998)[27] provides descriptions and locations for introduced cordgrass (Spartina spp), perennial pepperweed, and purple loosestrife in the Suisun Marsh and San Francisco Bay and for Arundo in the Delta. The Nature Conservancy web page (http://tncweeds.ucdavis.edu/esadocs.html) also provides information. Non-indigenous plants can seriously alter vegetation structure, composition, and function thereby degrading the quality of habitats for native plants and fauna. Delta mudwort, Point Reyes Bird's Beak, Soft Bird's Beak, Suisun Marsh aster, Suisun thistle are all ERP/MSCS plants that are specifically threatened by invasive plant species (MSCS Technical Reports, 1999)[12]. In addition non-indigenous plants such as water hyacinth provide habitat for non-indigenous fish and invertebrate species. Thus monitoring the relative abundance of non-indigenous plants and the abundance and spread of key non-indigenous plant species is important for monitoring habitat quality.

A possible redirected effect of tidal wetland restoration and other CALFED actions that has been raised is that such actions could result in an increased rate of spread of non-indigenous plant species across the landscape.

<u>Non-indigenous fauna</u>
Non-indigenous fauna have serious impacts on tidal wetland species. Predation by introduced red foxes, Norway rats, feral cats and dogs are specific pressures that affect species that live or nest on the ground or in low vegetation such as Suisun ornate shrew, salt marsh harvest mouse, and San Pablo California vole, California black rail, California clapper rail, and Suisun song sparrow (MSCS Technical Reports, 1999)[12]. Proximity to urban areas is associated with increases in the effects of feral and domestic cats and dog. Structures such as low levees or berms that allow access to interior parts of the marsh can also increase predation. The ERPP has also targeted the introduced red slider turtle for research because it may compete with the indigenous western pond turtle. Some MSCS species have specific predator/herbivore problems. For example, Suisun thistle is possibly threatened by an introduced biocontrol agent, a weevil (*Rhinocyllus conicus*) and a caterpillar, (*Phyciodes myllita*) (Suisun Ecological Workgroup, June 1999)[34].

<u>Artificially high native predation</u>
Human activities can increase populations of some native fauna or otherwise alter the environment in ways that results in artificially high predation rates on tidal wetland species. Urban areas and trash dumps can result in artificially high populations of some native species including natural predators such as raccoons, skunks, opossum, crows, gulls, ravens, and jays which in turn can increase predation on eggs and young in tidal wetlands and around shorebird nesting colonies or waterfowl nesting areas. Bare levees in transition zones to upland flooding refugia can result in high levels of predation by raptors and other predators on small mammals and rails fleeing the rising flood waters. When human activities cause new connections between nesting islands and mainland areas, this can allow predators to reach nesting colonies of shorebirds and waterbirds.

Disturbance

Human disturbance and disturbance from domestic animals such as cattle can result in trampling of vegetation and rare plants, agitation of fauna by increased noise levels and human presence, increased erosion of shores and nests, and direct collecting of species. Boat wakes result in increased erosion of shorelines and can affect California black and clapper rails by swamping nests during the breeding season and can erode shorelines on which plants such as Delta mudwort and Mason's lilaeopsis exist. Mosquito control efforts, water hyacinth control efforts and levee maintenance activities can all impact shorelines and increase the overall level of disturbance. Other human recreation activities can also increase disturbance. Illegal harvest of eggs, plants, and animals by collectors can further impact wetland species (MSCS Technical Reports, June 1999)[11].

Rip-rap, channel dredging, and levee maintenance activities in the Delta

Rip-rap and traditional levee maintenance activities decrease the amount of habitat along levees and sloughs. Although fringe wetland habitat along levees does not have the full range of ecological processes and topographic complexity, it does provide some habitat and connectivity among habitats. Mason's lilaeopsis requires eroding shores and levees in the low marsh zone, which are very sensitive to human activities (Suisun Ecological Workgroup, June 1999)[34]. Channel dredging can increase wave action and erosion of midchannel islands.

Wildlife health & Contaminants

Exposure to mercury and selenium are ongoing concerns for both waterfowl and some at-risk species such as clapper and black rails. Wetland restoration and/or channel dredging may resuspend mercury deposited in sediments decades ago during the gold mining rush. Research into mercury toxicity thresholds and bioavailability are included in several ERP milestones (DEDT-S14, DEDT-S16, SMB-S5). Industrial waste and sewage effluent can impact both flora and fauna indirectly by causing changes in nutrients and salinity and adding contaminants. Oils spills are an ongoing risk and can kill plants as well as fauna, including rare plants such as Suisun thistle and soft bird's beak (USFWS, 1997)[35]. The effects of trace metals on these rare plants are unknown. Herbicides from levee maintenance also affect some plant species such as Mason's lilaeopsis (Suisun Ecological Workgroup Final Report, June 1999)[34].

Natural Sources of Variation – climate, fire, disease

Natural factors or sources of variation that affect tidal wetlands include climate, global warming, el Niño, sea level rise, flooding, fires, disease outbreaks, natural predation and competition, species dispersal abilities, limited pollinators, species succession and landscape/soils maturity and succession (MSCS Technical Reports, June 1999[12]; Goals Project 1999[25]).

Biodiversity and at-risk species

Ideally, a variety of species should be monitored which will include community indicators, habitat indicators, sensitive species, listed species, economic species, dominant species, pest species, and practical/convenient species. (Goals Project, 1999)[25]. MSCS species can be viewed as "sensitive" and "protected" species that are the most sensitive to pressures on the system. The ERP/MSCS at-risk species are linked to pressures in tidal wetlands in table 6-1. Other more resilient species should be included as key indicator species which are more widespread and easier to monitor, show early response to pressures and/or to habitat and ecological process restoration. The Goals Project (1999)[25] lists key indicators for Suisun Marsh and San Francisco Bay. This list needs to be expanded into the Delta and tailored to CALFED's needs.

ERP Milestones[8a] & other ERP actions[8]

PROCESSES

Flow

- Develop a methodology for evaluating delta flow and hydrodynamic patterns and begin implementation of an ecologically based plan to restore conditions in the rivers and sloughs of the Delta sufficient to support targets for the restoration of aquatic resources. (DEDT-P1)
- Provide a fall or early winter outflow that emulates the first "winter" rain through the Delta. (DEDT-P3)

Sediment

- Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ of Eastside Delta Tributaries, Sacramento River Basin, San Joaquin River Basin (DEDT-P4,SACR-P5, SJR-P3)

HABITATS

Delta tidal wetlands

- Restore a minimum of 500, 500, 4,000, and 5,000 acres of tidal emergent wetland in the North, East, South, and Central and West Delta Ecological Management units respectively. (DEDT-H4)
- Restore a minimum of 500, 250, 500, and 750 acres of tidal perennial aquatic habitat in the North, East, South, and Central and West Delta Ecological Management units respectively. (DEDT-H11)
- Restore a minimum of 15 miles of slough habitat (widths less than 50 to 75 feet) in each of the North, East, South, Central and West Delta EMUs that allows for the colonization of delta mudwort and delta tule pea. (DEDT-H2)
- Restore a minimum of 125 acres of channel islands and 125 acres of shoals in the Delta. (DEDT-H6)

Suisun Marsh and North San Francisco Bay tidal wetlands

- Restore min. 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. (SMB-H2)
- Restore and manage a min. of 500 acres of seasonal wetland, and improve management of a minimum of 7,000 acres of existing, degraded seasonal wetland in a manner that provides suitable habitat for salt marsh harvest mouse, San Pablo California vole, and Suisun ornate shrew. (SMB-H4)
- Restore a minimum of 400 acres of tidal perennial aquatic habitat.(SMB-H5).
- Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. (SMB-H2)
- Bring into protection at least 25% of currently occupied, but unprotected Suisun Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management. Expand suitable tidal slough habitat for Suisun Marsh aster by 25 linear miles. (SMB-H2)
- Restore suitable, occupied slough edge habitat for delta mudwort and delta tule pea by at least 5 miles in the Suisun Bay and Marsh EMU and by at least 10 miles in the Napa River EMUs.(SMB-H3)

STRESSORS

Non-indigenous species & disturbance reduction

- Assist in the development and implementation of a black and clapper rail impact reduction program. (DEDT-S3)
- Begin aggressive program of control of non-native plant species that are threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak. (SMB-H2)
- Develop and begin implemention of a demonstration program to reduce invasive non-native plant abundance within at least one EMU in the Delta. (DEDT-S6)

Contaminants

- Encourage regulatory activity to reduce discharge of oxygen reducing substances and nutrients by unpermitted dischargers.(SMB-S3, DEDT-S12)
- Reduce pesticides (SMB-S6, DEDT-S17)
- Research on ecological/biological threshold concentrations for mercury in sediments and key organisms (DEDT-S14, SMB-S5)
- Determine methylization (part of bioaccumulation) process in Delta.· Determine sediment mercury concentration in areas that would be dredged during levee maintenance or conveyance work. Determine potential impact of ecosystem restoration work on methyl mercury levels in lower and higher trophic level organisms. (DEDT-S16)
- Research & actions to reduce pesticides, organochlorine pesticides, trace metals, selenium. (SMB-S6, S7, S8, S9; DEDT-S17, S18, S19, S20)
- Studies to identify unknown toxicity, and develop management actions as appropriate. (DEDT-S21, SMB-S10)

Redirected Effects

Redirected effects on other parts of ERP

- Conversion of one habitat type to another has effects on species associated with the original habitat type. Shorebirds and waterfowl may be negatively affected by converting diked wetlands to tidal wetlands and positively affected by other actions resulting in redistribution across the landscape and/or changes in abundance.
- ERP restoration efforts may increase spread of non-indigenous plants
- Wetland creation and breaching islands may result in sediment sinks which negatively impact nearby habitats.
- Wetland creation may resuspend mercury laden sediments and increase mercury methylation and bioaccumulation of mercury in the foodweb.

Redirected effects on other CALFED Problem Areas

Tidal wetland restoration…

- May change and hopefully improve the status of endangered fish species which may reduce constraints on pumping
- May change the amount & quality of organic carbon leaving wetlands with consequent effects on drinking water quality
- May change amount of mercury methylation which affects mercury levels in fish & waterfowl and consequently humans
- May change amounts of evapotranspiration due to increased wetland acreage
- Will cause change in levee maintenance activities
- Will cause reduction in linear extent of levees to be maintained

- May increase the tidal prism in Delta and Suisun Marsh, depending on the location and configuration of the restoration effort, which could increase or change salinity intrusion into the Delta

Monitoring recommendations
See Tables 6-2, 6-3, 6-4.

Existing Monitoring Programs / Information Sources
WRMP
SFEI
PRBO
IEP
CDFG
NOAA
CDWR
USGS
UC Davis, UC Berkeley, CSU-SF
Refuges & duck clubs
USDA-Boating & Waterways
Mosquito Abatement districts
Suisun Marsh Monitoring Program
Endangered species work…

Table 6-1. Tidal Wetland Species Linked With Pressures

The "R", "r", and Species Community Groups are linked with their associated pressures as identified in the MSCS Technical Reports (June 1999)[1,2] and the Ecosystem Restoration Program Plan (July 2000)[8]

LIMITING FACTORS/ PRESSURES	**San Pablo Song Sparrow (R)**	**Suisun Song Sparrow (R)**	California Black Rail (r)	California Clapper Rail (r)	Saltmarsh common yellowthroat (r)	**Suisun Ornate Shrew (R)**	Salt marsh harvest mouse (r)	San Pablo California vole (r)	Giant Garter Snake (r)	**Mason's Lilaeopsis (R)**	**Soft bird's Beak (R)**	**Suisun Marsh Aster (R)**	**Suisun thistle (R)**	Delta Mudwort (r)	Delta Tule Pea (r)	Point Reyes Bird's beak (r)	Shore and Wading bird guild	Waterfowl	Native anurans	Tidal Brackish & Freshwater Marsh Habitat Plant Community	Aquatic habitat plant community
Human-induced pressures																					
Habitat loss	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Habitat degradation thru altered processes		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	
Habitat fragmentation		X				X	X	X	X		X		X				X	X	X	X	
Habitat lowland disconnected with upland		X	X	X		X	X	X	X											X	
Lack Appropriate Vegetation (roosting, foraging, nesting)		X	X	X			X										X	X			
Non-indigenous - animals		X	X	X	X	X	X										X	X	X		
Non-indigenous - plants								X			X	X	X	X		X				X	X
Contaminants			X	X		X	X	X	X		X	X	X	X		X	X	X	X		
Human Activities/ Disturbance		X	X	X		X	X		X	X	X	X	X	X		X	X	X		X	
Human/vehicle trampling			X	X		X	X		X	X	X	X		X		X	X	X			
Levee/conveyance work		X				X	X		X	X		X		X	X					X	
Cattle Grazing												X		X		X					
Agricultural practices							X	X	X			X									
Erosion (boat wake)			X	X						X	X			X						X	
Illegal harvest/shooting																		X			
Rip Rap										X		?									
Mosquito abatement work											X		X								
Dredging & dumping spoils										X											X
Weed control efforts (water hyacinth)										X											
Natural pressures																					
Native Predation/ Competition									X		X						X	X			
Disease																		X			
Flooding		X	X	X		X	X		X												
Sea level rise														X						X	

Figure 6A: Simplified Tidal Wetlands Conceptual Model (TAMP): Delta, Suisun Marsh & North San Francisco Bay

Pressures

* Altered flows--timing & amount -- daily, seasonal, annual effects (WSR)
* Water diversions (WSR)
* Altered sediment supply (WSR)
* Salinity and flow control structures operations (WSR)
* Channelization reduces habitat and alters flow and sediment patterns (WSR, LSI)
* Diking of marshes alters hydrologic & geomorphic processes (LSI)
* Loss of tidal channel networks due to small patch size & diking
* Historical and current land conversion to urban & agriculture
* Habitat fragmentation relative to species dispersal
* Barriers to dispersal (levees, roads,urban areas,etc)
* Low marsh areas disconnected with high marsh & upland areas
* Loss of mosaic of habitat types due to small patch size and altered processes
* Introduction of non-indigenous plant & animal species
* Non-indigenous animals predation - foxes, Norway Rats, cats dogs, bullfrogs, predatory fish, crows
* Non-indigenous plants –affect native vegetation plant community structure & composition and degrade biotic habitat
* Changes in processes and/or habitat conditions favor non-indigenous spp.
* Levees maintenance activities (LSI)
* Rip-rap of banks (LSI)
* Boating activites/ waves erode shorelines
* Channel dredging & sediment disposal (WSR)
* Disturbance from human recreation activities, agriculture, urbanization, cattle grazing, etc.
* Contaminants (Se, Hg, oil spills, pesticide drift, loadings from mines, agriculture, urban runoff, dischargers)
* Catastrophic island flooding could cause habitat destruction & salinity intrusion (LSI)

Natural Sources of Variation

* Precipitation & climate - daily, seasonal, annual, multi-year (el Nino Southern Oscillation), floods, droughts
* Sea level rise
* Soil/sediment type, texture
* Historical topographic features & underlying parent rock materials
* Age/Maturity of habitat patch
* Earthquakes

Management Actions

ERP

* Increase area, diversity, connectivity of wetlands
  -- flood & restore islands
  -- set back levees & restore wetlands
  -- protect & enhance existing wetlands
  -- restore & reconnect sloughs
  -- reconnect diked marsh to tidal influence
  -- acquire land & convert to habitat
  -- reduce rip-rap on banks
* Reduce contaminants
* Acquire land to protect rare plants
* Plant rare plants to increase distribution
* Control non-native species
* Reduce introductions of non-native species
* Reduce effects of boat wake erosion
* Develop better hydrology models & water management strategies
* Change levee maintenance activities

Non-ERP programs

* Flood conveyance modifications, levee modifications
* Pumping operations, flow releases from dams
* Some increased dredging

State of the Environment

Sustainability: Hydrologic & Geomorphic Processes & Characteristics

* Delta Inflow & outflow of water
* Estuary tidal prism
* Extent of wetlands in various levels of tidal inundation (full, muted, none)
* Wetland hydrology (tidal regime, tidal prism, hydroperiod, water depth)
* Salinity gradient along longitudinal & latitudinal axis of estuary
* Wetland salinity (level, variability, extremes, seasonality)
* Sediment influx, deposition, erosion, & outflux
* Marsh plain elevation, accretion, erosion
* Shoreline change (accretion & erosion)
* Wetland channel extent & morphology, order
* Wetland topographic complexity: pannes, ponds
* Wave & wind action

Habitat Extent & Distribution

* Tidal wetland, managed wetlands,seasonal wetlands, and associated upland habitat extent & distribution.
* Linear extent of Delta slough habitat
* Linear extent of tidal channel habitat within wetlands
* Patch size distribution
* Patch size relative to establishing tidal channels
* Mosaic of sub-habitat types
* Extent & distribution of habitat for specific MSCS species
* Connectivity between low marsh, high marsh, and upland habitat areas
* Connectivity with other wetland patches

Sustainability: Energetics & Water Quality

* Nutrient inputs, outputs, accumulation
* Carbon inputs, outputs, accumulation
* Water quality characteristics – (TDS, (suspended sediment, turbidity, temp., conductivity, contaminant status)
* Sediment quality characteristics

Biota -Tidal Wetland Vegetation

* Vegetation establishment & succession
* Vegetation Community Structure & Composition
* Plant dispersal

Biota-Fauna

*Terrestrial biotic communities diversity & abundance
  - waterfowl
  - passerine birds
  - wading birds
  - shorebirds
  - raptors
  - native anuran amphibians
  - small mammals
  - large mammals
  - terrestrial invertebrates
  - reptiles
  - decomposers (bacteria, fungi, etc)
* Aquatic biotic communities diversity & abundance
  - benthic invertebrates
  - other invertebrates
  - phytoplankton, zooplankton, algae
  - fish
  - decomposers (bacteria, fungi, etc)
* Wildlife health
* MSCS species abundance & distribution

Anticipated Effects (terrestrial)

* Rehabilitation of hydrologic & geomophic processes that support tidal wetlands to create physically sustainable marshes
* Improvement in extent & connectivity of tidal wetlands
* Enhancement of the quality of tidal wetlands to support native species
* Reduction in abundance & distribution of important non-indigenous plants
* Increase in abundance & distribution of MSCS R & r species (San Pablo song sparrow, Suisun song sparrow, Suisun Ornate Shrew, Mason's lilaeopsis, Soft bird's-beak, Suisun marsh aster, Suisun thistle, California black rail, California clapper rail, Salt Marsh common yellowthroat, Salt Marsh Harvest Mouse, San Pablo California Vole, Delta mudwort, delta tule pea, Point Reyes bird's beak, Giant Garter Snake
* Increase in abundance, health, diversity of waterfowl, wading birds, shorebirds, native anuran amphibians
* Reduction in contaminant effects on biotic communities

Redirected Effects (on other parts of ERP)

* Conversion of one habitat type to another has effects on associated species Shorebirds and waterfowl may be negatively affected by converting diked wetlands to tidal wetlands and positively affected by other actions resulting in redistribution across the landscape and/or changes in abundance.
* ERP restoration efforts may increase spread of non-indigenous plants
* Wetland creation and breaching islands may result in sediment sinks which negatively impact nearby habitats.

Redirected Effects (on other resources of concern)

* May change status of endangered fish species which affect constraints on pumping
* May change amount & quality of organic carbon leaving wetlands with consequent effects on drinking water quality
* May change amount of mercury methylation which affect mercury levels in fish & waterfowl and consequently humans
* May change amounts of evapotranspiration due to increased wetland acreage
* Will cause change in levee maintenance activities
* Will cause reduction in linear extent of levees to be maintained
* Changes in wetland acreage may increase tidal prism in Delta

Figure 6B. Tidal Wetlands: What are the extent and distribution of tidal wetlands and what are the changes due to geomorphic and hydrologic processes, land use changes, and restoration actions?

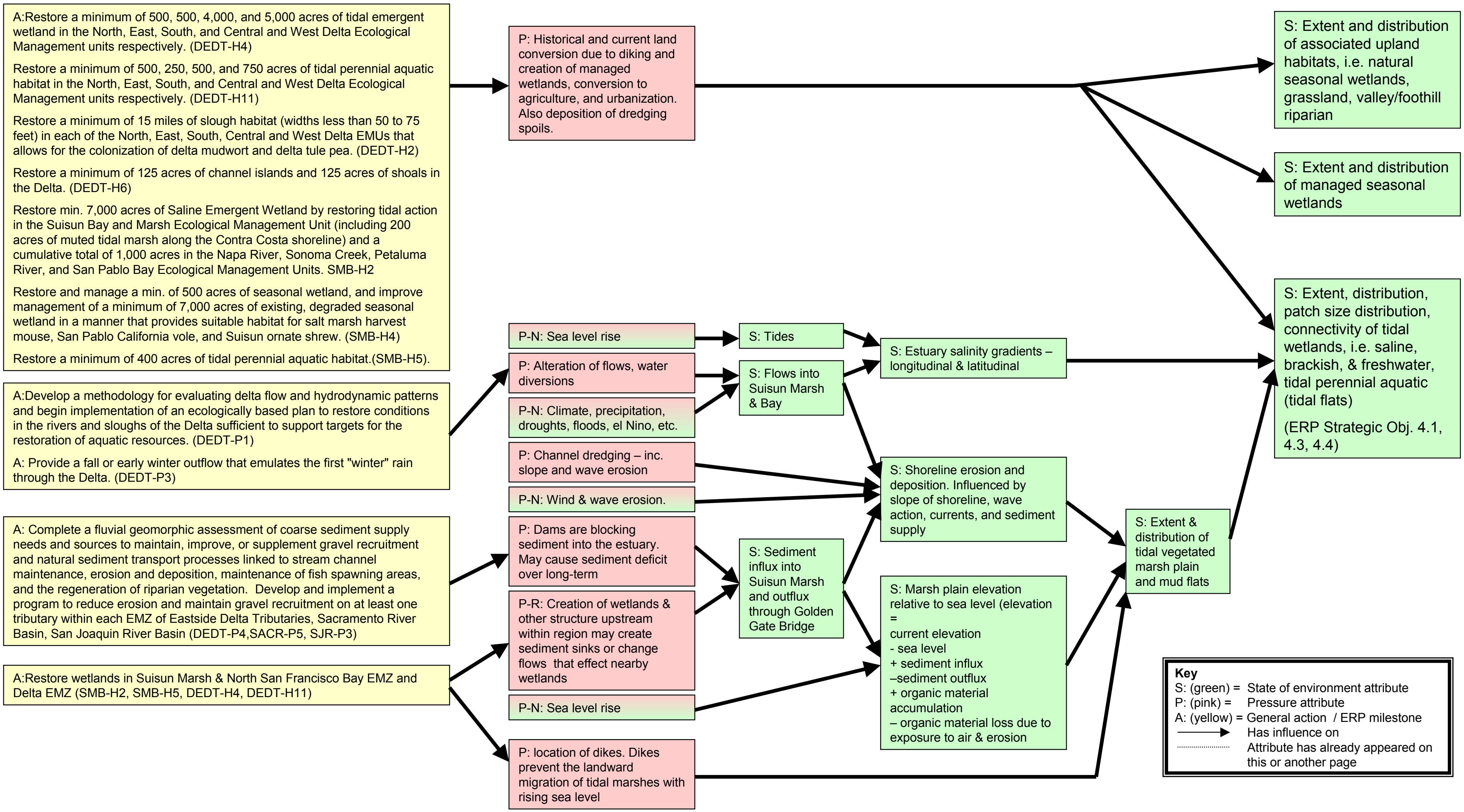

Figure 6C. Tidal Wetlands: What are the extent and distribution of vegetation communities, sub-habitats, and MSCS plants in tidal wetlands and associated upland habitats and what are the effects of hydrologic, geomorphic, and ecological processes and human activities?

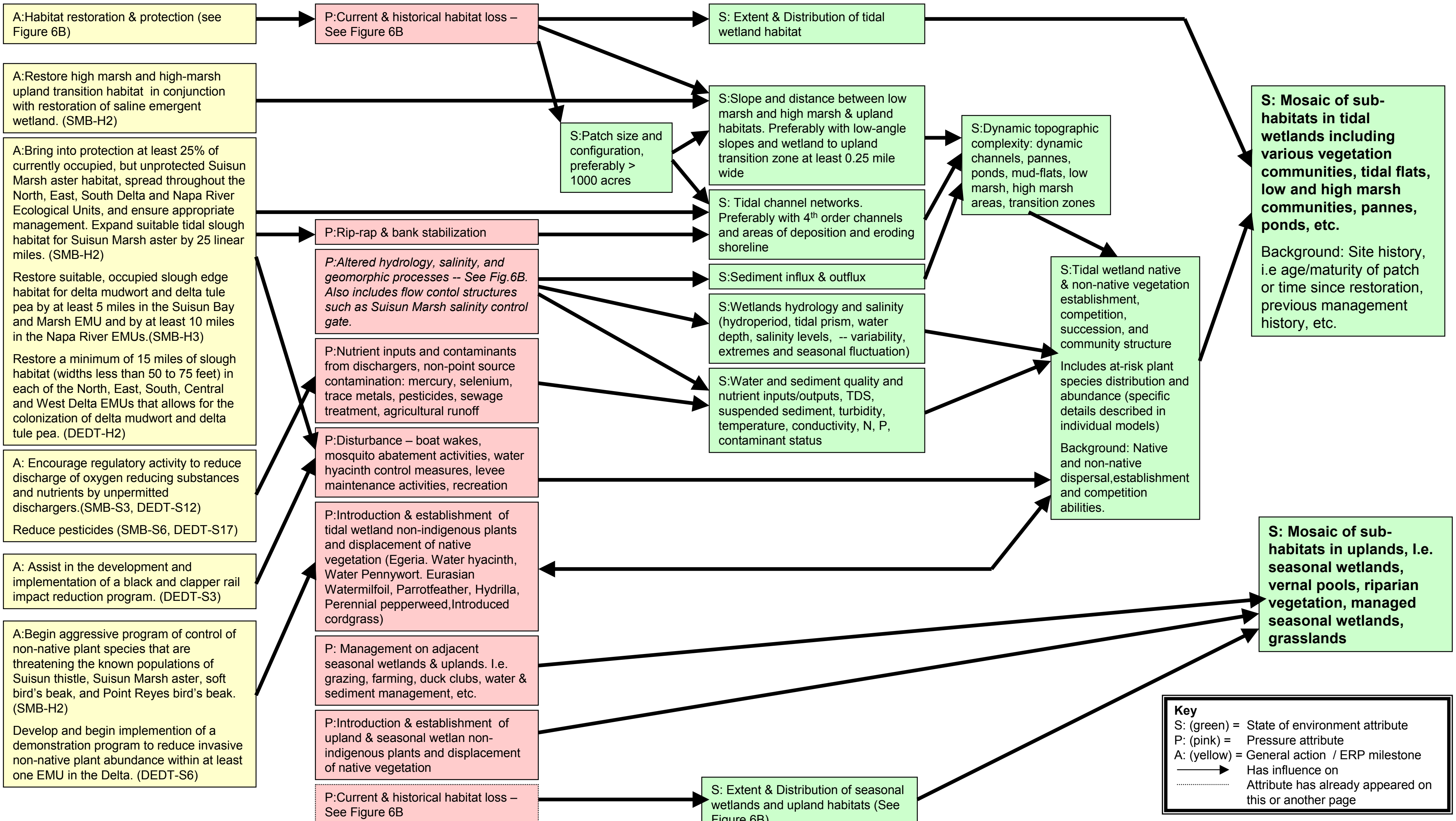

Figure 6D: Tidal Wetlands: How functional are tidal wetland habitats in support of fauna biodiversity and MSCS species?

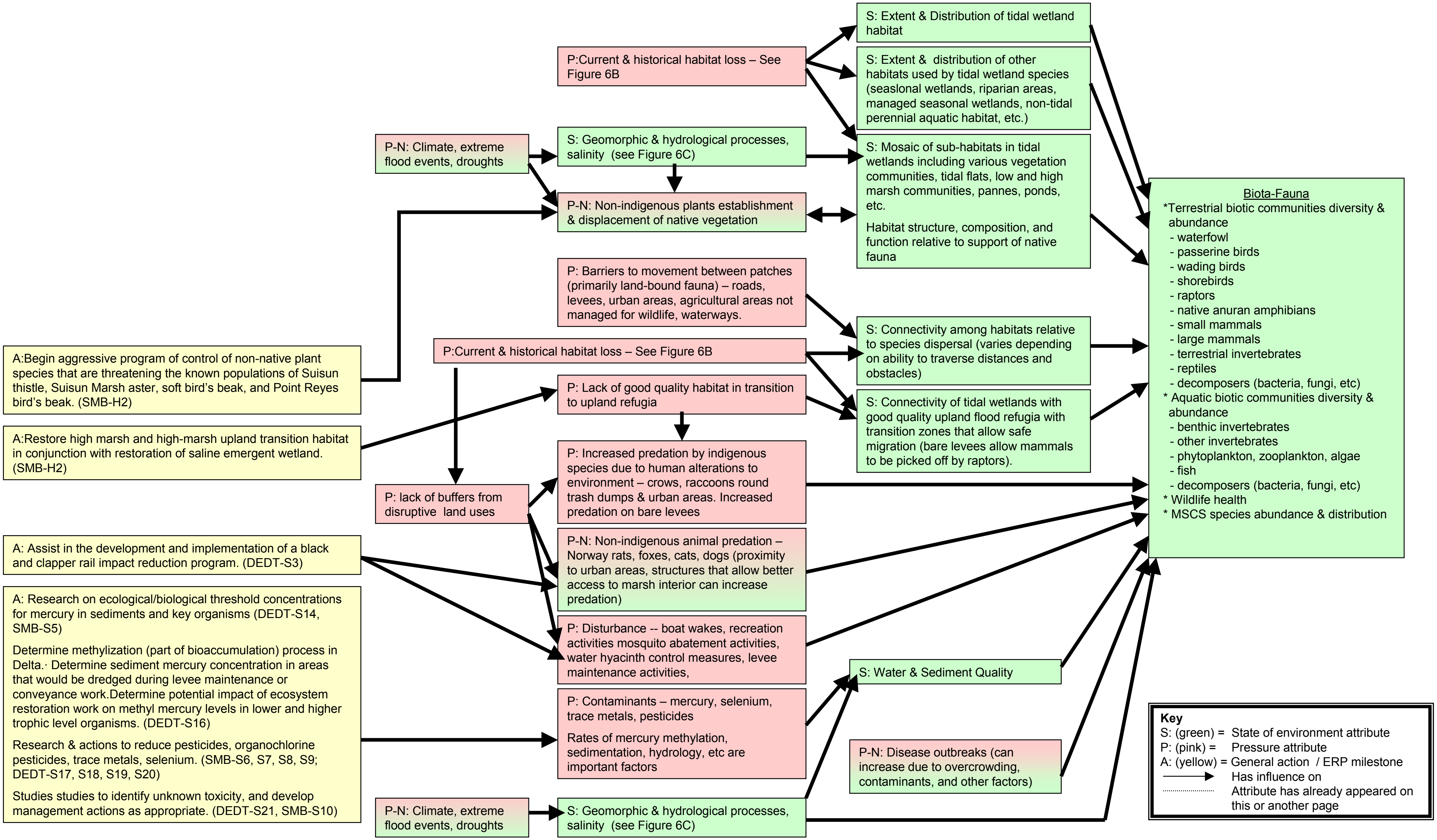

Table 6-2 - Extent and Distribution of Tidal Wetlands and the effects of geomorphic and hydrologic processes, land use changes and restoration actions.

Monitoring recommendations are sorted under status and trends of tidal wetlands and associated habitats, changes due to human activities, changes due to diminishing sediment supply, and changes due to changes in the salinity gradient in the estuary. Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs.References are given in parentheses ().
P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
What are the status and trends in the extent and distribution of tidal wetlands and associated upland habitats? (ERP Strategic Objectives 4.1, 4.3, 4.4)						
6-2.1	**Tidal wetland habitat extent & distribution** What are the status & trends in extent and spatial distribution of tidal wetland habitat since the baseline year? Extent and distribution of habitats relates directly to ERP strategic objective 4.1. Patch size distribution is included because this is an important co-factor for many other processes in tidal wetlands.	S	Extent and distribution of vegetated marsh plain receiving tidal inundation preferably identified by NCCP habitats (tidal perennial aquatic habitat, saline emergent, tidal freshwater emergent). Also specifically differentiate saline from brackish and freshwater tidal wetlands. (13)	remote sensing - mapping	High	ACOE - Habitat Restoration Feasibility Studies; CDWR-AB360 Delta Levee Maintenance subventions program; CDWR-North Delta Program; SFEI-EcoAtlas; CDFG-Suisun Marsh Vegetation Survey-mapping; Mosquito Abatement Districts; California Legacy Project; UC Berkeley, CEDR - SF Bay Delta Geodatabase (Wetlands in Bay/Delta);
			Tidally flooded area - Difference between MHHW and MLLW throughout estuary.(13)	remote sensing - mapping		
			Extent and distribution of tidal flats (part of tidal perennial aquatic)	remote sensing - mapping	High	
			patch size distribution (21)	remote sensing - mapping	High	
6-2.2	**Habitats associated with tidal wetlands extent and distribution** What are the status & trends in extent and spatial distribution of habitats associated with tidal wetlands? Relates directly to ERP strategic objective 4.1. Extent and distribution of habitats associated with tidal wetlands are critical for maintenance of many MSCS species and overall biodiversity.	S	Extent and distribution of NCCP habitats (natural seasonal wetlands, managed seasonal wetlands, grassland, valley/foothill riparian, non-tidal perennial aquatic, lacustrine, seasonally flooded agriculture, upland cropland)	remote sensing - mapping	High	(either efforts listed under 6-2.1 above or under 5-3.1)
What changes in the extent and distribution of tidal wetlands and associated upland habitats are due to land use changes? (ERP Strategic Objectives 4.1, 4.3, 4.4)						
6-2.3	**Habitat loss due to land conversion** How much of NCCP habitats have been converted to other land uses since baseline? Where is it located? Although some loss of tidal wetlands may occur, continuing loss of upland habitats is a major concern in the Suisun Marsh & North San Francisco Bay EMZ.	P	Extent and location of NCCP habitats converted to other land uses since baseline (saline emergent, tidal freshwater emergent, tidal perennial aquatic (esp. tidal flats), natural seasonal wetlands, managed seasonal wetlands, grassland, valley/foothill riparian, non-tidal perennial aquatic, lacustrine)	remote sensing - mapping	High	See 6-2.1 above
6-2.4	**Potential habitat loss due to land conversion** Where and how much tidal wetland habitat and associated habitats are anticipated to be converted to other land uses? Urbanization is continuing to cause loss of upland habitats associated with tidal wetlands. Understanding current land use, ownership, and zoning changes can help predict where future habitat losses may occur.	P	Maps of land-ownership (categories) & protection status	programmatic-mapping	High	DWR Northern District - SB 1086 Teale Data Center
			Maps of land use (categories)	remote sensing - mapping	High	CDWR-Land use data; USDA-National Resources Inventory; CDWR-Statewide Planning (Crop types)
			Planned city zoning changes may result in future habitat loss (urbanization) ; Habitat conservation plans	programmatic-mapping		

Table 6-2 - Extent and Distribution of Tidal Wetlands and the effects of geomorphic and hydrologic processes, land use changes and restoration actions.

Monitoring recommendations are sorted under status and trends of tidal wetlands and associated habitats, changes due to human activities, changes due to diminishing sediment supply, and changes due to changes in the salinity gradient in the estuary. Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs.References are given in parentheses ().
P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
What changes in the extent and distribution and protection status of tidal wetlands and associated upland habitats are due to habitat protection and restoration activities? (ERP Strategic Objectives 4.1, 4.3, 4.4)						
6-2.5	**ACTION: Restoring and/or enhance saline emergent wetland, tidal freshwater emergent wetland, tidal perennial aquatic, and seasonal wetland habitat. (details below)** Where are habitat restoration and enhancement actions occurring, what is their extent, and what is their implementation status? Where and how much land has received protection through CALFED actions? ERP Milestones: * Restore a minimum of 500, 500, 4,000, and 5,000 acres of tidal emergent wetland in the North, East, South, and Central and West Delta Ecological Management units respectively. (DEDT-H4) * Restore a minimum of 500, 250, 500, and 750 acres of tidal perennial aquatic habitat in the North, East, South, and Central and West Delta Ecological Management units respectively. (DEDT-H11) * Restore a minimum of 15 miles of slough habitat (widths less than 50 to 75 feet) in each of the North, East, South, Central and West Delta EMUs that allows for the colonization of delta mudwort and delta tule pea. (DEDT-H2) * Restore a minimum of 125 acres of channel islands and 125 acres of shoals in the Delta. (DEDT-H6) * Restore min. 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. SMB-H2 * Restore and manage a min. of 500 acres of seasonal wetland, and improve management of a minimum of 7,000 acres of existing, degraded seasonal wetland in a manner that provides suitable habitat for salt marsh harvest mouse, San Pablo California vole, and Suisun ornate shrew. (SMB-H4)	A, E	Extent, location, and Restoration status of tidal wetland restoration projects and projects in associated uplands	Programmatic / project	High	
	* Restore a minimum of 400 acres of tidal perennial aquatic habitat.(SMB-H5). * Bring into protection at least 25% of currently occupied, but unprotected Suisun Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management. (SMB-H2) * Bring at least 25% of the currently existing but unprotected occurrences of delta mudwort and delta tule into protection through purchase or conservation agreement, and ensure appropriate management.(SMB-H3)		Extent and location of land purchased or otherwise protected through CALFED actions	Programmatic / project	High	

Table 6-2 - Extent and Distribution of Tidal Wetlands and the effects of geomorphic and hydrologic processes, land use changes and restoration actions.

Monitoring recommendations are sorted under status and trends of tidal wetlands and associated habitats, changes due to human activities, changes due to diminishing sediment supply, and changes due to changes in the salinity gradient in the estuary. Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs.References are given in parentheses ().
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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
What changes in the extent and distribution of tidal wetlands are due to hydrologic and geomorphic processes? (ERP Strategic Objectives 2.1, 2.7, 4.1) With dams blocking sediment processes on most major tributaries, the amount of sediment available to sustain tidal wetlands may diminish through times. Sea level rise is a long term pressure. The combination of these factors may cause a loss of tidal wetlands due to geomorphic and hydrologic processes alone over the next 50 - 100 years. How much these processes may contribute in the 30 years of CALFED's program is unclear.						
6-2.6	**Horizontal & vertical accretion & erosion in tidal wetlands** Is marsh plain elevation being maintained relative to sea level? Maintenance of marsh plain elevation is a combination of sediment accumulation & erosion, biomass accumulation & oxidation, and sea level rise. The extent and location of mudflats reflects the amount of sediment coming into the estuary. Shoreline change shows where marsh is being lost and gained. A good topographical map can provide background information for interpreting other monitoring information.(13, 21, 4)	S	Changes in the extent and location of tidal mudflats (4)	remote sensing - mapping	High	
			changes in the extent and location of vegetated marsh plain (4)	remote sensing - mapping	High	
			Estuary shoreline change (21)	remote sensing - mapping; sampling sites network		
			vertical sediment accretion/erosion (21)	sampling sites network		
			Historical sediment accretion history from sediment cores (2)	targeted studies		
			Topographic map (not really monitoring)	remote sensing - mapping		
6-2.7	**Sediment influx into Delta and Bay** Is the sediment supply sufficient to maintain tidal wetlands? Monitoring sediment influx is highly variable and difficult to interpret. Suspended sediment monitoring does occur at some gaging stations as part of the aquatic monitoring program and could also be used by TAMP. Changes in the extent and shape of mid-channel islands and shoals in the Delta could provide a better gage for whether the sediment supply is sufficient to maintain islands in the Delta and consequently in Suisun Marsh.	S	Suspended sediment monitoring at channel gaging stations as part of aquatic monitoring program	aquatic monitoring plan		
			Changes in area of midchannel islands and shoals in Delta (early warning for Suisun Marsh & San Pablo Bay)	remote sensing - mapping		
6-2.8	**Dikes adjacent to tidal wetlands** Where will dikes prevent the landward migration of tidal wetlands? Dikes prevent the landward migration of tidal marshes with rising sea level (4)	P	Changes in extent of vegetated marsh plain in marshes with adjacent dikes.	remote sensing - mapping		
			Mapping locations of areas where dikes and urbanization will inhibit the natural migration of wetlands inland	mapping-targeted studies		
6-2.9	**Relative sea level rise** How much is sea level rise contributing to changes in the extent and distribution of wetlands in the estuary? (4,13)	P-N	Sea level at fixed points in estuary	gaging stations		NOAA - 4 stations
6-2.10	**Wind & wave erosion** This is more of a local pressure but can affect the extent and distribution of wetlands.	P-N	Possibly measured at some sampling sites	sampling sites network; targeted studies?		
6-2.11	**Flow timing, magnitude and duration of outflows into Suisun Marsh & Bay and from smaller tributaries into Suisun Marsh & Bay** The combination of flows and tides produce the extent of tidal inundation as well as the degree of salinity intrusion up the estuary. In addition, flows move sediment through the system, especially extreme flow events. Seasonality has strong influences	P-N	Flow timing, magnitude and duration of outflows into Suisun Marsh & Bay and from smaller tributaries	gaging stations		USGS, DWR, USBR stream and river gaging stations.
			6-2.1. Tidally flooded area - Difference between MHHW and MLLW throughout estuary.	remote sensing - mapping		

Table 6-2 - Extent and Distribution of Tidal Wetlands and the effects of geomorphic and hydrologic processes, land use changes and restoration actions.

Monitoring recommendations are sorted under status and trends of tidal wetlands and associated habitats, changes due to human activities, changes due to diminishing sediment supply, and changes due to changes in the salinity gradient in the estuary. Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs.References are given in parentheses ().
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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
	on sediment movement in the system and causes considerable variability in tidal flats even within seasons of the same year.		Changes in extent of mudflats and vegetated marsh plain after extreme flood events	remote sensing - mapping		Existing gaging stations
6-2.12	**Changes in sediment loads downstream of newly created wetland sites & flooded islands** Will flooding islands or diked areas to restore wetlands without restoring land elevations create sediment sinks which can affect other wetlands? (4, 25)	P-R	Targeted sampling of shoreline change and marsh plain elevation, accretion & erosion in existing wetlands near newly created wetland sites (may or may not be part of sampling sites network)	targeted studies		
			Projections of how much sediment will be required to fill in the wetland, especially if the land elevation has subsided below water level)	targeted studies		
6-2.13	**Restoring coarse sediment supplies** How effective are CALFED actions in target tributaries in restoring gravel supplies that have been blocked by dams and levees? Restoration of gravel recruitment in targeted tributaries is intended to help salmon spawning habitat. However the gravel will also help with restoring riparian areas and over the long-term will wash out into the Delta and Bay where it may contribute to tidal wetlands. A: Fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ of Eastside Delta Tributaries, Sacramento River Basin, San Joaquin River Basin (DEDT-P4,SACR-P5, SJR-P3)	A-E	Completion status of assessments and implementation status of gravel recruitment programs	Programmatic		
			Effectiveness of gravel recruitment program in restoring gravel to targeted tributaries	Programmatic / project		
What changes are occurring in the distribution of saline, brackish, and freshwater tidal wetlands due to changes in the salinity gradient in the estuary? (ERP Strategic Obj. 2.1, 4.1) Changes in export levels and flows in the Delta in combination with rising sea levels may affect the length and variability of the salinity gradient and in turn affect the composition of vegetation communities in Suisun Marsh and Bay.						
6-2.15	**Changes in the extent & distribution of tidal wetlands - by dominant plant community - saline, brackish, and freshwater** What changes are occurring in the extent and distribution of tidal saline, brackish, and freshwater wetland plant communities?	S	Vegetation community surveys	sampling sites network		
			Extent & distribution of tidal wetlands - by dominant plant community - saline, brackish, and freshwater	remote sensing - mapping		
			Surveys for changes in plant communities and/or sensitive plants at key sites (may or may not overlap with sampling sites network). Mason's lilaeopsis might be a sensitive plant species to changes in salinity levels and variability.	targeted studies or targeted sampling sites network		

Table 6-2 - Extent and Distribution of Tidal Wetlands and the effects of geomorphic and hydrologic processes, land use changes and restoration actions.

Monitoring recommendations are sorted under status and trends of tidal wetlands and associated habitats, changes due to human activities, changes due to diminishing sediment supply, and changes due to changes in the salinity gradient in the estuary. Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs.References are given in parentheses ().
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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
6-2.16	**Estuary salinity gradients – longitudinal & latitudinal** How will the longitudinal and latitudinal gradients in the estuary be affected by large-scale changes in Delta exports and channel configurations? Will Suisun Marsh and Bay change from being primarily brackish to dominated by saline emergent plant communities?	S	Salinity levels (average, variability, seasonality, extremes) (13)	sampling sites network		Other: Network of sites monitors salinity for compliance monitoring of position of "X2" in estuary relative to South Delta pumping
			Network of site monitoring salinity up longitudinal axis of estuary	gaging stations		
			Salinity levels in smaller river estuaries entering Suisun Marsh and San Pablo Bay (averages, variability, seasonality, extremes) (2)	gaging stations		?
			Research into lateral salinity gradients perpendicular from the longitudinal salinity gradient (2)	targeted studies		
6-2.17	**Flow timing, magnitude and duration of outflows into Suisun Marsh & Bay and from smaller tributaries into Suisun Marsh & Bay** Sea water intrusion into the estuary is affected by the tides and by Delta outflow.	S	Flow timing, magnitude and duration of outflows into Suisun Marsh & Bay and from smaller tributaries	gaging stations		Gaging station at Chipp's Island, other gaging stations
<6-2.9>	***<Sea level rise> <see above>***	P-N	see previous			
6-2.18	**Alteration of flows, water diversions** Water is intensively managed in California. Water outflow from the Delta is the result from careful management of reservoir releases and water diversions. The extent that sea water can intrude into the Delta is regulated and continuously monitored to maintain salinity standards and manage fish stocks.	P	See Aquatic Monitoring Plan	aquatic monitoring plan		Existing compliance monitoring
6-2.19	**Changes in channel flows due to operation of flow control structures such as the Suisun Marsh salinity control gate.** Man-made flow control structures are designed to influence flows and salinity in the areas around them. There is some controversy about what effects these changes have upon the vegetation communities.(34)	P	Flows, salinity levels resulting from structures.	aquatic monitoring plan		Existing compliance monitoring
			Surveys for changes in plant communities and/or sensitive plants at key sites (may or may not overlap with sampling sites network). Mason's lilaeopsis might be a sensitive plant species to changes in salinity levels and variability.	project monitoring		

Table 6-3 - Status and trends in the extent and distribution of vegetation communities and sub-habitats in tidal wetlands and associated upland habitats

Currently recommended for monitoring are sub-habitats, MSCS plant species, and processes that affect them such as wetland hydrology and salinity, dynamic topographic complexity, and pressures such as non-indigenous plants, climate, local disturbances, water & sediment quality. Only the highest priority items are flagged. References in (). Further work is needed in refining this list, prioritizing it, and identifying existing programs. P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
Do tidal wetlands have topographic complexity, tidal channel networks, low-to high marsh transitions, ponds and pannes to provide a mosaic of habitat types? Will hydrologic and geomorphic processes continue to provide a range of habitat types? (ERP Strategic Obj. 2.1, 2.3, 2.7)						
6-3.1	**Dynamic topographic complexity:** dynamic channels, pannes, ponds, mud-flats, low marsh, high marsh areas, transition zones. Do tidal wetlands have topographic complexity, tidal channel networks, low-to-high marsh transitions, ponds and pannes such that a mosaic of habitats will be created and maintained? Dynamic topographic complexity is critical to a healthy, functioning marsh. It helps support a diverse range of vegetation communities and sub-habitats which in turn helps support a diverse array of fauna. Having a large patch size (>1000 acres) is important to developing tidal channels and the full range of hydrologic and geomorphic processes needed to support a good quality tidal marsh. Some of the MSCS plant species depend on tidal channels and sloughs for habitat (Mason's lilaeopsis, delta mudwort, delta tule pea, Suisun Marsh aster). Others require a good quality high marsh zone (Suisun thistle, Soft bird's beak, Point Reyes birds beak). Age of habitat block and tidal elevation/topography are important background information.	S	tidal channel density -- total length of channel per unit area of ground surface (21, 4)	remote sensing - mapping	High	SFEI EcoAtlas CDFG Suisun Marsh mapping
			linear extent of tidal channels by network order	remote sensing - mapping		
			network order (21, 4)	remote sensing - mapping		
			Acreage of tidal wetlands with established tidal channel networks containing 4th order channels (11)	remote sensing - mapping		
			channel gain/channel loss	remote sensing -		
			tidal channel morphology: cross-sectional profile, longitudinal profile, meander geometry (21)	sampling sites network		
			Number, area, and location of tidal wetland patches containing ponds & pannes (4)	remote sensing - mapping	high	
			Slope and distance between low marsh and high marsh & upland habitats. Preferably with low-angle slopes and wetland to upland transition zone at least 0.25 mile wide (11)	sampling sites network	High	
			patch size (11, 21)	remote sensing - mapping	High	
			patch size distribution, number of patches > 1000 acres (11, 21)	remote sensing - mapping		
			age of patch	sampling sites		
			tidal elevation/topographic map	remote sensing - mapping		
6-3.2	**Restore high marsh & high marsh upland transition habitat** Where are wetland restoration and enhancement projects occurring, what is their extent, and what is their implementation status? How effective are projects in restoring high marsh and upland transition habitat? ERP Milestone: Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. (SMB-H2)	A,E	Location and Implementation status of restoration actions	Programmatic / project		
			Effectiveness in restoring wetlands complete with areas with high marsh and transitions to upland habitat and presence of species limited by lack of this transition zone	Programmatic / project		

Table 6-3 - Status and trends in the extent and distribution of vegetation communities and sub-habitats in tidal wetlands and associated upland habitats

Currently recommended for monitoring are sub-habitats, MSCS plant species, and processes that affect them such as wetland hydrology and salinity, dynamic topographic complexity, and pressures such as non-indigenous plants, climate, local disturbances, water & sediment quality. Only the highest priority items are flagged. References in (). Further work is needed in refining this list, prioritizing it, and identifying existing programs. P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
6-3.3	**Restore tidal channels and sloughs** Where are tidal slough restoration and enhancement projects occurring for Suisun Marsh aster, delta mudwort, and delta tule pea, what is their extent, and what is their implementation status? Are these habitats exhibiting establishment success for these species? What is the extent of Suisun Marsh aster occupied habitat that is protected, how much is unprotected, and how much habitat has been protected through CALFED actions? ERP Milestones: * Bring into protection at least 25% of currently occupied, but unprotected Suisun Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management. Expand suitable tidal slough habitat for Suisun Marsh aster by 25 linear miles. (SMB-H2) * Restore suitable, occupied slough edge habitat for delta mudwort and delta tule pea by at least 5 miles in the Suisun Bay and Marsh EMU and by at least 10 miles in the Napa River EMUs.(SMB-H3)	A,E	Location and Implementation status of restoration actions	Programmatic / project		
			Linear miles of new tidal slough habitat for Suisun Marsh; Establishment success of Suisun Marsh aster in restored habitat	Programmatic / project		
			Protection status of occupied Suisun Marsh aster habitat	Programmatic / project		
			Linear miles of new tidal slough habitat for Suisun Marsh; Establishment success of Delta mudwort and Delta tule pea in restored habitat	Programmatic / project		
What are the status and trends in the extent and distribution of vegetation communities and sub-habitats in tidal wetlands and associated upland habitats? What changes are occurring in vegetation structure, composition, and function? (ERP Strategic Obj. 1.3, Goal 1, Goal 4)						
6-3.4	**Extent and distribution of various vegetation communities and sub-habitats in tidal wetlands and associated uplands** What are the extent and distribution of the various vegetation communities and sub-habitats within tidal wetlands and associated upland habitats? This element is critical in being able to establish habitat-species relationships and monitor the extent of at-risk species habitat. Detailed vegetation mapping is needed of Suisun Marsh (and of the Delta). Detailed maps of Suisun Marsh are already available from Cal. Dept. of Fish and Game as well as the San Francisco Estuary Institute. Topography maps and history of the patch can be useful in interpreting the current vegetation.	S	detailed extent and distribution of plant communities and sub-habitats (I.e. pickleweed marsh, etc.)	remote sensing - mapping	High	see 6-2.1
			Vegetation community structure, composition- field surveys (21)	sampling sites network	High	
			species diversity, species richness (21)	sampling sites network		
			key indicator species distribution and abundance	sampling sites network		
			percent cover (21)	sampling sites network		
			standing crop (21)	sampling sites network		
			approximate ages of patches of tidal wetlands and/or time since restoration efforts	historical info		
6-3.5	**Abundance and distribution of MSCS plant species** What is the abundance (or other appropriate metric) and distribution of MSCS plant species? What is the extent and distribution of habitat for MSCS plant species and how much of it is occupied? Although related to 2.1 this has been separated to highlight its importance. CALFED is responsible for "recovering" or "contributing to the recovery of the following species found in tidal wetlands: Soft bird's beak, Suisun thistle, Mason's lilaeopsis, Suisun marsh aster, delta tule pea, delta mudwort, Point Reyes bird's-beak;	S	MSCS plant species distribution & abundance	sampling sites network	High	
			extent and distribution of specific habitats where MSCS plant species are expected to be found and are currently found	remote sensing - mapping	High	

Table 6-3 - Status and trends in the extent and distribution of vegetation communities and sub-habitats in tidal wetlands and associated upland habitats

Currently recommended for monitoring are sub-habitats, MSCS plant species, and processes that affect them such as wetland hydrology and salinity, dynamic topographic complexity, and pressures such as non-indigenous plants, climate, local disturbances, water & sediment quality. Only the highest priority items are flagged. References in (). Further work is needed in refining this list, prioritizing it, and identifying existing programs. P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
What effects are non-indigenous plants having on the structure, composition and function of tidal wetland vegetation? (ERP Strategic Obj. 5.5, 5.7)						
6-3.6	**Non-indigenous plants - relative abundance and distribution and rate of spread of key species** What are the status and trends in the relative abundance of non-indigenous plants in tidal wetlands? What are the status and trends in distribution of key non-indigenous plant species? What new introduced plant species have been observed in tidal wetlands? (13)	P	relative abundance of non-indigenous plant species (13, 21)	sampling sites network	High	
			presence/absence of key non-indigenous plant species	sampling sites network	High	
			reporting of unidentified plants	sampling sites network		
			distribution & size of patch (or other metric of abundance) of key non-indigenous plant species (water hyacinth, egeria, etc.) (13)	remote sensing - mapping	High	
			Maintain information clearinghouse to report new plants established in region	Programmatic	High	TNC
6-3.7	**Effects of temperature, climate, floods & droughts on spread of non-indigenous plants.** How do temperature, climate, floods, and droughts affect the rate of spread and changes in relative abundance of non-indigenous plants? El nino effects, droughts, and floods affect vegetation.	P-N	Rate of spread of non-indigenous plants correlated with occurrence of El Nino effects, droughts, floods	targeted studies		
6-3.8	**Control of non-indigenous plants** Where are non-native plant control efforts occurring and what is their effectiveness in reducing the threat to MSCS plant populations? ERP Milestone: * Begin aggressive program of control of non-native plant species that are threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak. (SMB-H2)	A,E	Location and implementation status of actions to control non-native plants	Programmatic / project		ICE-CALWEED
			Effectiveness of control efforts in reducing non-native plant species threatening populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak.	Programmatic / project		
What important hydrologic, water quality, and disturbance cofactors must be considered when interpreting vegetation structure, composition and function?						
6-3.9	**Wetland hydrology & salinity** Wetland hydrology & salinity levels are important covariates for vegetation community composition & structure. Variables such as tidal prism and water depth help assess habitat self-maintenance through time. (21)	S	level of tidal inundation: full, muted or none	sampling sites network; remote-sensing-mapping	High	
			palustrine hydroperiod - timing and duration of standing water (21)	sampling sites network		
			tidal regime - frequency & duration of tidal inundation (21)	sampling sites network		
			tidal prism - volume of tides passing through drainage network or channel during a tidal cycle (21)	sampling sites network		
			water depth - height of water column above the ground and below an upper limit or high water datum (21)	sampling sites network		
			soil salinity	sampling sites network		
			wetted perimeter - shoreline of perimeter corresponding to high water datum	sampling sites network; remote sensing-mapping		

Table 6-3 - Status and trends in the extent and distribution of vegetation communities and sub-habitats in tidal wetlands and associated upland habitats

Currently recommended for monitoring are sub-habitats, MSCS plant species, and processes that affect them such as wetland hydrology and salinity, dynamic topographic complexity, and pressures such as non-indigenous plants, climate, local disturbances, water & sediment quality. Only the highest priority items are flagged. References in (). Further work is needed in refining this list, prioritizing it, and identifying existing programs. P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
6-3.10	**Effects of Temperature, climate, floods & droughts on vegetation** Extreme events such as floods and droughts can often be associated with rapid changes in vegetation including rapid changes in the distribution of non-indigenous plant species.	P-N	Change in vegetation community structure after extreme climatic events (floods, droughts)	targeted studies		
			Change in extent and distribution of vegetation communities after extreme climatic events (floods, droughts)	targeted studies		
6-3.11	**local disturbances (mosquito control, hyacinth control, levee maintenance activities, boat wakes)** local disturbances to vegetation are important covariates for vegetation community composition & structure	P	Disturbance type, timing and effect on vegetation	sampling sites network		
			Locations , timing, type of mosquito abatement efforts, water hyacinth control efforts, levee maintenance, areas where boat wake erosion is causing erosion and/or threatening endangered species such as California black rail, Mason's lilaeopsis, etc. (12)	Species specific surveys		
6-3.12	**Water quality** Wetland water quality is an important covariate for vegetation community composition & structure	S	suspended sediment (21)	sampling sites network		
			turbidity (13, 21)	sampling sites network		
			Total dissolved solids	sampling sites network		
			temperature (21)	sampling sites network		
			conductivity (21)	sampling sites network		
		P?	Nutrients (nitrogen, phosphorous)(13)	sampling sites network		
		P	contaminants -- mercury, selenium, trace metals, pesticides(13)	sampling sites network		
		P	Locations of discharges likely to affect water and sediment quality in tidal marshes	Programmatic		
6-3.13	**Soil/Sediment quality** Wetland sediment quality is an important covariate for vegetation community composition & structure. Wetland sediments support plant communities, trap waterborne sediments, and entrap pollutants. (21)	S	hydraulic conductivity (21)	sampling sites network		
			bioturbation depth (21)	sampling sites network		
			sediment texture (21)	sampling sites network		
			depth of detritus (21)	sampling sites network		
			redox potential (21)	sampling sites network		
			bulk density (21)	sampling sites network		
		P	contaminants -- mercury, selenium, trace metals, pesticides(13)	sampling sites network		

Table 6-3 - Status and trends in the extent and distribution of vegetation communities and sub-habitats in tidal wetlands and associated upland habitats

Currently recommended for monitoring are sub-habitats, MSCS plant species, and processes that affect them such as wetland hydrology and salinity, dynamic topographic complexity, and pressures such as non-indigenous plants, climate, local disturbances, water & sediment quality. Only the highest priority items are flagged. References in (). Further work is needed in refining this list, prioritizing it, and identifying existing programs. P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
6-3.14	**Actions to reduce contaminants** Oxygen reducing substances can affect the plants and terrestrial fauna of tidal wetlands in 2 main ways. Typically oxygen-reducing substances are nutrients such as nitrogen and phosphorous which in the aquatic environment cause algal problems and consequently low oxygen. These nutrients also stimulate terrestrial plants which can shift the competitive balance among plant species and cause consequent shifts in vegetation. However monitoring should preferably occur in the aquatic environment where reaction to changes in water quality will be faster. Herbicides can cause problems in tidal wetlands although the problem is probably more local, such as herbicide effects from water hyacinth control efforts and control efforts from other non-indigenous plant species. ERP Milestones: * Encourage regulatory activity to reduce discharge of oxygen reducing substances and nutrients by unpermitted dischargers.(SMB-S3) * Reduce pesticides (SMB-S6)	A,E	Location and Implementation status of CALFED actions to reduce pesticides and oxygen-reducing substances	Programmatic / project		
			Changes in oxygen-reducing substances and nutrients by unpermitted discharges and pesticides in areas targeted by CALFED actions (may or may not overlap with sampling sites network)	Programmatic / project		
What is the effect of habitat restoration on increasing the availability of habitat with appropriate vegetation structure, composition and function to support biodiversity and at-risk species? (ERP Strategic Obj. 1.1, 1.3, 1.4)						
6-3.18	**ACTION: Restoring and/or enhance saline emergent wetland, tidal freshwater emergent wetland, tidal perennial aquatic, and seasonal wetland habitat.** * Restore a minimum of 500, 500, 4,000, and 5,000 acres of tidal emergent wetland in the North, East, South, and Central and West Delta Ecological Management units respectively. (DEDT-H4) * Restore a minimum of 500, 250, 500, and 750 acres of tidal perennial aquatic habitat in the North, East, South, and Central and West Delta Ecological Management units respectively. (DEDT-H11) * Restore a minimum of 15 miles of slough habitat (widths less than 50 to 75 feet) in each of the North, East, South, Central and West Delta EMUs that allows for the colonization of delta mudwort and delta tule pea. (DEDT-H2) * Restore a minimum of 125 acres of channel islands and 125 acres of shoals in the Delta. (DEDT-H6) * Restore min. 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. (SMB-H2) * Restore and manage a min. of 500 acres of seasonal wetland, and improve management of a minimum of 7,000 acres of existing, degraded seasonal wetland in a manner that provides suitable habitat for salt marsh harvest mouse, San Pablo California vole, and Suisun ornate shrew. (SMB-H4) * Restore a minimum of 400 acres of tidal perennial aquatic habitat.(SMB-H5).	A	Location, size, and implementation status of restoration actions	Programmatic / project	High	
		E	Vegetation community structure, composition & function - field surveys in restored habitats	Programmatic / project	High	
		E	Presence and/or relative abundance of MSCS at-risk plant species in restored habitats	Programmatic / project	High	
		E	Relative abundance of non-indigenous plant species in restored and enhanced habitats	Programmatic / project	High	

Table 6-4 - Support of biodiversity and MSCS species in tidal wetlands

Currently recommended for monitoring are small mammals, non-indigenous and indigenous predators, waterfowl, shorebirds, passerines and rails, reptiles (MSCS only), amphibians, and benthic and terrestrial invertebrates. Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References in (). P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Methods	Priority Level	Existing Program?
What are the status and trends in small mammals, reptiles, and amphibians in Tidal Wetlands? (ERP Strategic Obj. 1.1, 1.2, 1.3, 1.4) In addition to including some MSCS species (Salt marsh harvest mouse, Suisun ornate shrew, San Pablo California vole, giant garter snake, western pond turtle, California red-legged frog, California tiger salamander, western spadefoot toad), small mammals, reptiles and amphibians are good indicators of habitat quality at a given site throughout the year since such fauna have more difficulty in moving to other sites than birds and larger fauna and thus are continuously exposed to the pressures at a given site. They are also sensitive to habitat fragmentation and the consequent tendency to local extinctions in isolated wetland patches.						
6-4.1	**Small Mammals** What are the status and trends of MSCS mammals in tidal wetlands? CALFED does not have specific objectives for monitoring mammal communities other than MSCS species such as Suisun ornate shrew, San Pablo California vole, and salt marsh harvest mouse. However monitoring for these species can easily be expanded to included general community monitoring. Small mammals can be good indicators for patch quality since they have small ranges and little ability to escape site pressures.	S	Species diversity, richness, evenness, community composition; (13)	sampling sites network		
			Key indicator species including MSCS species -- relative abundance or presence/absence	sampling sites network	High	Salt Marsh Harvest Mouse trapping in Suisun marsh
			extent, distribution, and number of patches of quality habitat for MSCS species (Salt marsh harvest mouse, Suisun ornate shrew, San Pablo California Vole)	remote sensing - mapping		
6-4.2	**Reptiles** It is unclear whether general monitoring of reptiles should occur in tidal wetlands and associated uplands. Western pond turtle and giant garter snakes are associated with freshwater tidal wetlands and these species will require monitoring.	S	relative abundance of MSCS species (western pond turtle, giant garter snake)	sampling sites network		
			extent and distribution of habitat for MSCS species (western pond turtle & giant garter snake)	remote sensing - mapping		
6-4.3	**Amphibians** It is unclear whether general monitoring of amphibians should occur in tidal wetlands and associated uplands. Only two MSCS "m" species occur there -- California red-legged frog and California tiger salamander and only in freshwater tidal areas.	S	Species diversity, richness, evenness, community	sampling sites		
			Key indicator species including MSCS species --	sampling sites		
			extent and distribution of habitat for Cal. Red-legged frog, Cal. Tiger salamander	remote sensing - mapping		
What are the status and trends in waterfowl and shorebirds in Tidal Wetlands? (ERP Strategic obj. 1.3, 1.4) Waterfowl and shorebirds both require a mosaic of habitat types and are indicators of the relative quality and availability of habitat across the region. They are more affected by habitat loss than habitat fragmentation and are affected by the vegetation, food supply, and amount of roosting habitat available. Depending on the species, tidal wetlands can also offer breeding and rearing habitat and consequently pressures that affect nesting also apply such as contaminants, predation, and connectivity with upland.						
6-4.4	**Waterfowl** What are the status and trends in waterfowl communities in tidal wetlands? The status of waterfowl directly relates to a CALFED objective. Concerns have been raised that converting diked wetland and salt ponds to tidal wetlands will result in a loss of habitat for some types of waterfowl.	S	Species richness, community composition	sampling sites network	High	
			Key indicator species including MSCS species -- relative abundance or presence/absence	sampling sites network		
			Extent & distribution of various types of habitats preferred by various types of waterfowl	remote sensing - mapping		
			Region-wide waterfowl surveys (several times per year) (as background for interpreting data at wetland sampling sites)	region-wide surveys		USFWS & CDFG currently has September & mid-winter surveys. The number of surveys/year need to be increased.

Table 6-4 - Support of biodiversity and MSCS species in tidal wetlands

Currently recommended for monitoring are small mammals, non-indigenous and indigenous predators, waterfowl, shorebirds, passerines and rails, reptiles (MSCS only), amphibians, and benthic and terrestrial invertebrates. Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References in (). P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Methods	Priority Level	Existing Program?
6-4.5	**Shorebirds** What are the status and trends in shore bird communities in tidal wetlands? This question directly relates to a CALFED objective. Measuring status and trends in shorebirds can be difficult since they are affected by many factors outside of the ERP focus area. However coordinating with the current regional shorebird surveys is advisable. Predation by native species such as ravens, raccoons, non-native species like cats and dogs can be artificially increased by human activities near shorebird nesting colonies	S	Species diversity, richness, evenness, community composition	sampling sites network		
			Key indicator species including MSCS species -- relative abundance or presence/absence	sampling sites network		
			Extent & distribution of habitats preferred by shorebirds	remote sensing - mapping		
			Regional shorebird surveys	region-wide surveys		PRBO?
What are the status and trends in passerines and rails in tidal wetlands (ERP Strategic Obj. 1.1, 1.2, 1.3, 1.4)						
6-4.6	**Passerines and rails** What are the status and trends in passerines and rails in tidal wetlands? This includes several ERP/MSCS species California clapper rail, California black rail, Suisun song sparrow, San Pablo song sparrow, saltmarsh common yellowthroat. Measuring status and trends can be difficult since they are affected by many factors outside of the ERP focus area.	S	Species diversity, richness, evenness, community composition (13)	sampling sites network		
			Key indicator species including MSCS species -- relative abundance or presence/absence	sampling sites network		
			Extent & distribution of habitats preferred by passerines and rails	remote sensing - mapping		
What are the status and trends in benthic and terrestrial invertebrates in tidal wetlands? (ERP Strategic Obj. 1.3)						
6-4.7	**Benthic invertebrates** What changes are occurring in benthic invertebrate community composition that relate to degradation or recovery of habitat quality and contaminant loading? Benthic invertebrates can be early warnings of changes in hydrology, sedimentation, non-indigenous species, and contaminants in a system. Since benthic invertebrates are food for many birds and some small mammals, effects can have impacts on higher levels in the food web.	S	species richness and percent dominant species (2)	sampling sites network; targeted research		
			Water temperature, PH, Turbidity, Conductivity, (Background/covariates)	sampling sites network		
6-4.8	**Terrestrial invertebrates** Although status and trends in terrestrial invertebrates can show early response to pressures and actions, at a local level, what should be recommended for monitoring is unclear.	S	Taxa richness, use a suitable diversity index, and measure biomass.	targeted studies		
What is the proportion and/or extent of tidal wetlands that have adequate connectivity with uplands to support a diverse array of fauna including small mammals, rails, passerines, breeding waterfowl, etc.? (ERP Goal 4, Obj. 1.1, 1.2, 1.3, 1.4)						
6-4.9	**Connectivity with upland habitat** How much of tidal wetland habitat has sufficient connectivity with upland habitat? Small mammals, reptiles, and some birds require transitional habitat to upland areas as high water refugia. This transition habitat must have good quality cover or these species will experience increased predation from raptors and non-indigenous predators while fleeing from high flood waters (11, 12, 25)	S	Proportion/extent, & location of tidal wetland habitat patches with low-angle upland slopes at the upper edge of marshes to provide sufficient wetland to upland transition habitat zones. Transition habitat zones should be at least 0.25 mile in width and have adequate vegetative cover for species to avoid predators while seeking refuge from high flood waters. (11, 12)	remote sensing - mapping	High	
			Land use practices in the transition zones (grazing, etc)	remote sensing - mapping	High	
6-4.10	**ACTION: Restore high marsh & high marsh upland transition habitat** Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. (SMB-H2)	A	Location, size, and Implementation status of restoration actions	programmatic / project		
		E	Effectiveness in restoring wetlands complete with areas with high marsh and transitions to upland habitat	programmatic / project		

Table 6-4 - Support of biodiversity and MSCS species in tidal wetlands

Currently recommended for monitoring are small mammals, non-indigenous and indigenous predators, waterfowl, shorebirds, passerines and rails, reptiles (MSCS only), amphibians, and benthic and terrestrial invertebrates. Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References in (). P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Methods	Priority Level	Existing Program?
What is the degree of connectedness of tidal wetland habitats relative to the movements of rails, passerines, small mammals, etc? (ERP Goal 4, Obj. 1.1, 1.2, 1.3, 1.4)						
6-4.11	**Connectivity between patches & groups of patches** Distances between patches and barriers to movement between patches restrict movement and migration between patches for land-bound fauna. Barriers are typically roads, levees, urban areas, agricultural areas not managed for wildlife, waterways.	S	Distribution of distances to nearest patch relative to dispersal distances of indicator species	remote sensing - mapping	High	See 6-2.1
			Patch size	remote sensing - mapping	High	
			Location & types of barriers to movement to other patches	remote sensing - mapping	High	
			Number and location of functionally isolated patches	remote sensing - mapping	High	
			Location of groups of patches functionally isolated from other groups of patches	remote sensing - mapping	High	
			Degree of connectivity along estuary longitudinal and latitudinal salinity gradients	remote sensing - mapping	High	
What is the level of wildlife health and effect of contaminants in tidal wetlands? (ERP Strategic Obj. 1.1, 1.2, 1.3, 1.4, 6.1, 6.2)						
6-4.12	**Wildlife health** Are unusually high levels of disease, deformities, and parasites occurring in tidal wetlands? Wildlife health can be an indicator of contaminant problems, of overcrowding, or of the spread of new diseases in the region. Diseases such as the West Nile virus which is spreading along the eastern seaboard could be brought to the San Francisco Bay-Delta and cause declines in populations that are not related to the extent and quality of habitat.	P	Health of trapped individuals (evidence of disease, mutations, parasites, etc.). Unusual number of dead animals sited during surveys.	sampling sites network		
6-4.13	**Waterfowl Disease outbreaks** Overcrowding in wetlands due to a lack of habitat, can cause disease outbreaks among waterfowl.	P-N	disease outbreaks in region	region-wide surveys		
6-4.14	**Contaminants effects on fauna in tidal wetlands** Contaminants – mercury, selenium, trace metals, pesticides -- can all have effects on fauna in tidal wetlands. There is also concern that rates of mercury methylation may increase in restored wetlands. Sedimentation, hydrology, etc are important cofactors. Mercury and selenium toxicity effects are of concern in waterfowl. However what should be included in a monitoring program is unclear. Targeted studies may be more appropriate.	P	Aquatic toxicity measures (fish tissue, benthic invertebrates communities, algal communities)	aquatic monitoring plan		
			Research into toxicity effects in waterfowl eggs.	targeted studies		
			Concentrations of mercury in waterfowl tissue relative to human health concerns	targeted studies		

Table 6-4 - Support of biodiversity and MSCS species in tidal wetlands

Currently recommended for monitoring are small mammals, non-indigenous and indigenous predators, waterfowl, shorebirds, passerines and rails, reptiles (MSCS only), amphibians, and benthic and terrestrial invertebrates. Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References in (). P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Methods	Priority Level	Existing Program?
6-4.15	**Action: Reduce Contaminants** Research on ecological/biological threshold concentrations for mercury in sediments and key organisms (SMB-S5) Research & actions to reduce pesticides, organochlorine pesticides, trace metals, selenium. (SMB-S6, S7, S8, S9) Studies to identify unknown toxicity, and develop management actions as appropriate. (SM-S10)	A	<water quality monitoring>	aquatic monitoring plan		CDWR-Environmental monitoring program; DWR-D1485 program; SFEI - Regional Monitoring Program for Trace Substances; SRWP; DWR-MWQI; USGS-Polaris; DWR-Operations & Compliance Monitoring
		E	Aquatic toxicity measures (fish tissue, benthic invertebrates communities, algal communities)	aquatic monitoring plan		DWR-D1485 Program; SFEI - Regional Monitoring Program for Trace Substances; SRWP
What is the level of predation/competition pressure from non-indigenous fauna? (ERP Strategic Obj. 1.1, 1.2, 1.3, 1.4, 5.6, 5.7)						
6-4.16	**Predation by non-indigenous animals - foxes, rats, feral cats & dogs** Predation by non-indigenous animals - foxes, rats, feral cats & dogs is an important pressure on small mammals as well as breeding waterfowl, shorebirds, passerines, rails.	P	Mammal surveys to detect presence or rel. abundance of introduced foxes, Norway rats, feral cats, dogs. Also detect native predator abundance	sampling sites network		
			Habitat characteristics that are associated with non-indigenous predators (easy access to middle of marsh via roads, dikes, etc.)	sampling sites network		
6-4.17	**Buffer zones from disruptive land uses** Urbanization, trash dumps, high traffic areas, and some forms of agriculture or rangeland management can all cause increased disturbance and artificially increase the number of predators -- both native and non-native.	P,S	presence of buffer zone of grassland and/or wetland habitat from other land uses	programmatic	High	
			mapping of adjacent land use to tidal wetlands	programmatic	High	

Table 6-4 - Support of biodiversity and MSCS species in tidal wetlands

Currently recommended for monitoring are small mammals, non-indigenous and indigenous predators, waterfowl, shorebirds, passerines and rails, reptiles (MSCS only), amphibians, and benthic and terrestrial invertebrates. Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References in (). P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Methods	Priority Level	Existing Program?
What is the effect of habitat restoration on biodiversity, at-risk species, and improving the connectivity among habitats? (ERP Strategic Obj. 1.1, 1.2, 1.3, 1.4, 4.1)						
6-4.18	**ACTION: Restoring and/or enhance saline emergent wetland, tidal freshwater emergent wetland, tidal perennial aquatic, and seasonal wetland habitat.** * Restore a minimum of 500, 500, 4,000, and 5,000 acres of tidal emergent wetland in the North, East, South, and Central and West Delta Ecological Management units respectively. (DEDT-H4) * Restore a minimum of 500, 250, 500, and 750 acres of tidal perennial aquatic habitat in the North, East, South, and Central and West Delta Ecological Management units respectively. (DEDT-H11) * Restore a minimum of 15 miles of slough habitat (widths less than 50 to 75 feet) in each of the North, East, South, Central and West Delta EMUs that allows for the colonization of delta mudwort and delta tule pea. (DEDT-H2) * Restore a minimum of 125 acres of channel islands and 125 acres of shoals in the Delta. (DEDT-H6) * Restore min. 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. SMB-H2 * Restore and manage a min. of 500 acres of seasonal wetland, and improve management of a minimum of 7,000 acres of existing, degraded seasonal wetland in a manner that provides suitable habitat for salt marsh harvest mouse, San Pablo California vole, and Suisun ornate shrew. (SMB-H4) * Restore a minimum of 400 acres of tidal perennial aquatic habitat.(SMB-H5).	A	Location, size, and Implementation status of restoration actions	programmatic / project	High	
		E	Use of restored wetlands by waterfowl, shorebirds, passerines, rails, small mammals, reptiles and amphibians, benthic invertebrates	programmatic / project	High	
		E	Use of restored wetlands by MSCS/ERP at-risk species	programmatic / project	High	
What re-directed effects has habitat restoration had on waterfowl and shorebirds? (ERP Strategic Obj. 1.3)						
6-4.19	**EFFECT: Shifts in habitat use by waterfowl and shorebirds** Conversion of diked wetlands to tidal wetlands will likely result in change in waterfowl and shorebird community composition.	E, P-R	Shifts in types of and numbers of waterfowl and shorebirds in restored wetlands compared with previous land use (I.e. managed wetlands, salt ponds)	project monitoring, targeted studies	High	

7.0 FRESHWATER AND RIPARIAN WETLAND HABITAT QUALITY

This section outlines "*what*" needs to be monitored and "*why*" to assess both status and trends in the extent and distribution, sustainability, and functioning of floodplain and riparian wetlands in support of biodiversity and at-risk species and effects of CALFED ERP actions. For the purpose of this report, floodplain and riparian wetlands are defined as the NCCP habitats: *Valley foothill riparian, valley riverine aquatic, natural seasonal wetlands, managed seasonal wetlands (floodplain), non-tidal freshwater permanent emergent (floodplain), and lacustrine* and include the following ERPP habitats: *riparian and riverine aquatic habitat, seasonal wetlands.* Riverine aquatic habitat shaded by riparian vegetation, is important habitat for many species of fish, waterfowl, and wildlife. Major factors limiting these habitats include historic riparian vegetation loss or degradation and near-shore aquatic habitat alteration from channelization, stabilization of channel banks with riprap, construction of levees, and control of flows (ERPP 2000)[8].

The ERP strategic objectives[9] management questions, ERP milestones[8a], and ERP/MSCS at-risk species[8,11] are identified. Issues relating to habitat quality are discussed. Box 7a gives a general description of quality floodplain and riparian wetland habitat. Figures 7A-7D relate ERP Milestones to pressures and effects on the extent and distribution of floodplain and riparian wetlands, effects on processes and vegetation within wetlands, and effects on biodiversity and at-risk species within wetlands. Each of these three figures then relates to Tables 7-2, 7-3, and 7-4, which list the monitoring attributes and monitoring elements. The re-directed effects of floodplain and riparian wetland restoration on other parts of CALFED are given and a partial list of identified monitoring programs and information sources is included.

Many of the aspects of habitat quality are derived from the recommendations in the MSCS (2000)[11] conservation measures for ERP/MSCS at-risk species. Since the at-risk species are assumed to be the most sensitive species to degraded habitat quality, those aspects that are limiting to these species are assumed to be important for overall floodplain and riparian wetland habitat quality.

Although issues regarding floodplain and riparian wetland habitat quality are discussed briefly below, additional details are in the CMARP Fluvial Geomorphology and Riparian Issues appendix reports (CMARP Fluvial Geomorphology and Riparian Issues Group, 1998)[15,16,17,18,19] CALFED White paper on Riparian Vegetation (draft, March 2000)[7], the Sacramento and San Joaquin River Basins Comprehensive Study Ecosystem Functions Model Conceptual Design (Army Corps of Engineers, 1999)[1] and the Riparian Bird Conservation Plan (RHJV, 2000)[33].

ERP Strategic Objectives[9]

Restore large expanses of all major aquatic, wetland, and riparian habitats, and sufficient connectivity among habitats, in the Central Valley and its rivers to support recovery and restoration of native species and biotic communities and rehabilitation of ecological processes. These habitat types include riparian and shaded riverine aquatic, instream, fresh emergent wetlands, seasonal wetlands, other floodplain habitats, lacustrine, and other freshwater fish habitats.

Protect tracts of existing high quality major aquatic, wetland, and riparian habitat types, and sufficient connectivity among habitats, in the Bay-Delta estuary and its watershed to support recovery and restoration of native species and biotic communities, rehabilitation of ecological processes, and public value functions.

Manage the Yolo and Sutter Bypasses as major areas of seasonal shallow water habitat to enhance native fish and wildlife, consistent with CALFED Program objectives and solution principles.

Management Questions

What are the status and trends in the extent and distribution of habitats?

- What are the status and trends in the extent and distribution of floodplains and riparian wetlands and associated upland habitats?
- What is the extent and distribution of high quality habitat that is functional in the support of biodiversity and at-risk species?
- What changes in the extent and distribution of floodplain and riparian wetlands and associated upland habitats are due to land use changes?

How sustainable are floodplain and riparian wetlands due to hydrologic and geomorphic processes?

- What changes in the extent and distribution of floodplain and riparian wetlands are due to hydrologic and geomorphic processes?
- What is the extent of freely meandering reaches and other pre-1850 river channel forms that are functioning to support natural riverine, riparian, and floodplain habitats?
- Are floodplain hydrologic and geomorphic processes creating a mosaic of vegetation communities and habitats, i.e., flows and floodplain inundation, channel resetting floods, depth to groundwater table?
- Are sediment supplies sufficient to create a mosaic of vegetation communities and habitats?

How functional are floodplain and riparian wetlands in the support of biodiversity and at-risk species?

- What are the status and trends in the extent and distribution of vegetation communities and sub-habitats within NCCP habitat types of floodplain and riparian wetlands and associated upland habitats? What changes are occurring in vegetation structure, composition, and function?
- What effects are non-indigenous plants having on the structure, composition and function of floodplain and riparian wetland vegetation?
- What are the status and trends in small mammals, reptiles, amphibians, waterfowl and shorebirds, passerines, rails, and terrestrial, aquatic, and vernal pool invertebrates in floodplain and riparian wetlands?
- What proportion and/or extent of floodplain and riparian wetlands have adequate connectivity with uplands to support a diverse array of small mammals and reptiles?

- What is the degree of connectedness of floodplain and riparian wetland habitats relative to the movements of small mammals and neotropical migratory birds?
- What land use practices may be impacting biodiversity and at-risk species? Are the impacts outside of targeted limits (e.g., cattle grazing, wood-cutting, agriculture, etc.)?
- What are the levels of predation and/or competition pressure from non-indigenous fauna? Are they outside of tolerable limits?
- What is the level of wildlife health and effect of contaminants in floodplain and riparian wetlands? Is it within acceptable limits?

What are the effects of restoration actions?

- What changes in the extent and distribution and protection status of floodplain and riparian wetlands and associated upland habitats are due to habitat protection and restoration activities?
- Has connectivity among habitats improved?
- What is the effect of habitat restoration and/or habitat enhancement on increasing the availability of habitat with appropriate vegetation structure, composition and function to support biodiversity and at-risk species?
- What is the effect of habitat restoration on biodiversity and at-risk species?

What re-directed effects has habitat restoration had within the ERPP?

- What re-directed effects has habitat restoration had on the distribution and habitat use by wading birds, shorebirds, and waterfowl and shorebirds?
- Has habitat restoration increased pressure on levees downstream?
- Has wetland restoration affected mercury bioavailability locally or regionally?
- Has wetland restoration resulted in wetlands dominated by native or non-native plant species? Has restoration affected the rate of spread of non-native plant species?

ERP/MSCS At-risk species in Floodplain and Riparian Habitats

Biodiversity and at-risk species

Ideally, a variety of species should be monitored, including community indicators, habitat indicators, sensitive species, listed species, economic species, dominant species, pest species, and practical/convenient species. (Goals Project, 1999)[25]. MSCS species can be viewed as "sensitive" and "protected" species that are the most sensitive to pressures on the system. The ERP/MSCS at-risk species are linked to pressures in floodplain and riparian wetlands in Table 7-1. More resilient species may be selected as key indicator species as they may be widespread and easier to monitor, respond earlier to changes in pressures and/or to restoration of habitat and ecological processes. The Riparian Habitat Joint Venture recommends a list of riparian bird species as good indicator species (RHJV, 2000)[33]. The ERP/MSCS at-risk species are listed below.

(Fish are included for the sake of completeness)

Recover: *FISH:* Central Valley fall-run chinook salmon, Central valley spring-run chinook salmon, Central Valley steelhead, green sturgeon, Sacramento River winter-run chinook salmon, Sacramento splittail, *INVERTEBRATE:* Valley Elderberry Longhorn Beetle.

Contribute to Recovery:
BIRDS: Bank swallow, California black rail, California yellow warbler, Greater sandhill crane, Least Bell's vireo, Little willow flycatcher, Swainson's hawk, Western yellow-billed cuckoo, *FISH:* Sacramento Perch, *INVERTEBRATES:* Delta Green Ground Beetle, *MAMMALS:* Riparian Brush Rabbit, San Joaquin Valley Woodrat, *PLANTS:* Alkali milkvetch, Bristly sedge, Crampton's tuctoria, Delta coyote-thistle, Northern California black walnut, *REPTILES:* Giant Garter Snake.

Maintain: *AMPHIBIANS AND REPTILES:* California Red Legged Frog, California Tiger Salamander, Foothill yellow-legged frog, Western Spadefoot Toad, Alameda Whip Snake, Western Pond Turtle, *BIRDS:* Aleutian Canada goose, American peregrine falcon, Bald eagle, Black tern, Black-crowned night heron, California gull, Cooper's hawk, Double-crested cormorant, Golden eagle, Great blue heron, Great egret, Long-billed curlew, Long-eared owl, Northern harrier, Osprey, Short-eared owl, Snowy egret rookeries, tricolored blackbird, Western burrowing owl, Western least bittern, Western snowy plover, White-faced ibis, White-tailed kite, Yellow-breasted chat,*FISH:* Hardhead, *INVERTEBRATES:* Conservancy fairy shrimp, Longhorn fairy shrimp, Mid-valley fairy shrimp, Vernal pool fairy shrimp, Vernal pool tadpole shrimp, *MAMMALS:* California Wolverine, Greater western mastiff-bat, Ringtail, *PLANTS:* Ahart's dwarf rush, Boggs Lake hedge-hyssop, Brittlescale, Butte County meadowfoam, California beaked-rush, Calistoga popcornflower, Colusa grass, Contra Costa goldfields, Eel-grass pondweed, Ferris's milk-vetch, Few-flowered navarretia, Four-angled spikerush, Greene's tuctoria, Hairy orcutt grass, Heartscale, Heckard's peppergrass, Henderson's bent grass, Hispid bird's-beak, Hoover's spurge, Kenwood Marsh checkerbloom, Legenere, Lesser saltscale, Loch Lomond button-celery, Lost Hills crownscale, Mad-dog skullcap, Many-flowered navarretia, Marsh checkerbloom, Marsh skullcap, Napa blue grass, North Coast semaphore grass, Palmate-bracted bird's-beak, Pincushion navarretia, Pitkin Marsh lily, Red Hills ragwort, Rose mallow, Sacramento orcutt grass, San Joaquin spearscale, San Joaquin Valley orcutt grass, San Joaquin woolythreads, Sanford's arrowhead, Sebastopol meadowfoam, Slender orcutt grass, Slough thistle, Sonoma alopecurus, Sonoma sunshine, Spiny-sepaled button-celery, Succulent owl's-clover, White sedge.

Biological Communities: Native anuran amphibians, Neotropical Migratory birds, Shorebird and Wading bird guild, Waterfowl, Anadromous Lamprey, Native Resident Fish, Bay-Delta Foodweb Organisms, Upland game, Seasonal wetland habitat plant community, Tidal Riparian habitat plant community group.

Issues

Box 7a summarizes general attributes of floodplain and riparian habitat quality based on recommendations from MSCS conservation measures for at-risk species, the ERP white paper on riparian vegetation (draft, March 2000)[7] and the Army Corps of Engineers Comprehensive Study Ecosystem Function Model Conceptual Design (draft, January 1999)[1]. ERP/MSCS at-risk species are linked with pressures in Table 7-1.

<u>Large-scale habitat loss due to land conversion and flood management</u>

As much as 90% of riparian habitats have been lost throughout California due to land use conversion and flood management activities such as levees, channelization, rip-rap, and other bank hardening activities. This large-scale loss of habitat is coupled with fragmentation of the remaining patches which limits movement among patches for land bound fauna such as mammals, reptiles, and amphibians and decreases acreage of stop-over sites for migratory song-birds. Much remaining riparian habitat is in thin corridors directly adjacent to streams. The average size of habitat patches also decreased while pressures such as non-indigenous fauna and human disturbance increased.

<u>Connectivity with upland refugia</u>

Without connectivity and quality transition zones from floodplains and riparian habitats to upland habitats, floodplains are of limited usefulness to land-bound ERP at-risk species such as the riparian brush rabbit and San Joaquin Valley woodrat. Steep bare levees are poor quality transition zones because predation risk is high for animals fleeing rising floodwaters.

<u>Levees and rip-rap cause restriction of river meander and loss of floodplain geomorphic and hydrological processes</u>

Alluvial river floodplains typically meander, creating a succession of vegetation and habitat types (e.g., riparian habitats, seasonal wetlands, lacustrine, and riverine habitat). Much of Central Valley rivers and the Delta are currently leveed, restricting riparian habitats to a thin band along the river which is disconnected from natural flooding regimes. Without the natural flooding and river meander processes, habitats go through various stages of succession until they reach mature riparian and wetland habitats. The mosaic of habitats found in an active floodplain with diverse vegetation structure and composition supporting a diverse array of aquatic and terrestrial biotic communities is lost.

<u>Reduced sediment supply</u>

Although the reduction in coarse sediment because of dams acutely affects salmonid spawning habitat, the reduction in sediment available to create gravel bars and topographic complexity in floodplains on which new habitat establishes may also affect extent and quality of some terrestrial habitats.

Box 7a. Elements of Floodplain and Riparian habitat quality for ERP fauna and plants

- **Large patch size:** riparian and/or floodplain habitat block is of sufficient size to allow range of hydrological and geomorphic processes and to limit the effect of non-indigenous fauna such as cowbirds and feral cats on native wildlife
- **Connectivity with upland areas**: Connectivity with upland areas is necessary for providing refugia from flooding for small mammals & reptiles or providing quality nesting areas. Transition zones should include appropriate vegetative cover and low disturbance
- **Neighboring land use and buffer zones where appropriate**: Buffer zones can reduce disturbance from urban areas, agricultural activities including pesticide drift, and human recreational activities. Buffer zones can also decrease other problems by increasing distance to land uses that promote brown-headed cowbirds or disturbance from pets.
- **Natural hydrology & natural geomorphic processes:** Natural floodplain processes are present such as frequent floodplain inundation, infrequent channel-resetting floods, seasonally appropriate flows, topographic complexity, and unrestricted stream/river meander. Different areas of the floodplain should have different elevations and differing flooding frequencies. Levees if present are set well back to allow natural processes.
- **Depth to groundwater table:** Depth to groundwater is appropriate for maintaining habitat
- **Low abundance of non-indigenous plants:** Wetlands and riparian habitats have low relative abundance of invasive non-native plants
- **Low abundance of non-indigenous fauna:** Wetlands and riparian habitats should have low relative abundance of non-indigenous fauna with minimal effect on native species,
- i.e. brown-headed cowbirds, bull-frogs, introduced red foxes, cats, dogs, Norway rats, black rats, and introduced predatory fish.
- **Low human disturbance:** Wetlands and riparian habitats have low levels of disturbances with minimal effect on native species, i.e. boat wake erosion, human recreation, vehicle trampling, cattle grazing & trampling, agricultural practices such as discing, wood-cutting, illegal harvest, human-set accidental fires.
- **Low levels of contaminants (aquatic, airborne)**: Wetlands should have low aquatic contaminant problems such as mercury, pesticides, heavy metals, nutrient enrichment, fine sediment loading. Airborne pesticides can cause problems for species like the Valley Elderberry Longhorn Beetle.
- **Good wildlife health**: low occurrence of disease, tumors, deformities, etc.
- **Mosaic of different habitat types:** Floodplain contains a mosaic of successional habitat types including various ages of riparian habitat, seasonal wetlands and possibly backwaters, oxbow lakes, vernal pools, etc.
- **Specific vegetation structure, composition and function** required by sensitive ERP/MSCS species
- **Appropriate animal community groups:** neotropical migratory birds, raptors, waterfowl, wading birds, native anuran amphibians, small mammals, terrestrial invertebrates, aquatic invertebrates, reptiles, top-down predators
- **Presence of "indicator" species:** Presence of sensitive ERP/MSCS species, species requiring a mosaic of habitats, or key indicator species such as top-down predators that are associated with "quality" habitat. Neotropical bird indicator species have been identified (RHJV)[33] but other species may be needed as well.

Depth to groundwater table

Groundwater levels affect the riparian and marsh vegetation in floodplains. Actions affecting groundwater depth can influence terrestrial habitat extent and quality if water levels drop below levels that support riparian vegetation.

Non-indigenous fauna

Non-indigenous fauna affecting quality of floodplain and riparian habitats include brown-headed cowbirds, Norway and brown rats, red foxes, and feral and domestic cats and dogs. Non-indigenous species tend to increase with proximity to urban areas, proximity to land uses that provide food or shelter such as cattle feedlots for cowbirds, smaller habitat blocks that increase the impacted perimeter to center ratio, and habitat fragmentation that causes exclusion of top-level predators such as coyotes. New introductions of non-native species continue to be a concern.

Non-indigenous plants

Non-indigenous plants can alter vegetation structure, composition, and function thereby degrading the quality of habitats for native plants and fauna. Flow amount and timing can affect establishment rates of native versus introduced plant species. In turn, introduced plants such as salt-cedar, which has high transpiration rates, can affect hydrology. Other weeds cause excessive trapping of silt and sediments and affect flows, channels and habitat. The ERPP[8] targets the following introduced plants in floodplain and riparian wetlands:

Ailanthus
Arundo
Black locust
Black Walnut
Edible fig
Egeria
Eucalyptus,
Eurasian watermilfoil
German Ivy
Hydrilla
Parrotfeather
Perennial pepperweed
Purple loosestrife
Russian olive
Salt cedar (Tamarisk)
Water hyacinth
Water pennywort

The ERPP provides descriptions of these species. Additional information can be found on the Nature Conservancy web page (http://tncweeds.ucdavis.edu/esadocs.html) Information on weed control projects can be found on the Information Center for the Environment Web page (http://www.ice.ucdavis.edu/weeds/). Team Arundo Del Norte (http://ceres.ca.gov/tadn/) is working to develop control strategies for Arundo.

Contaminants
Aerial pesticide drift from agricultural areas can affect insects such as Valley elderberry longhorn beetle (MSCS Technical Reports, 1999)[12]. Rodenticides can affect riparian brush rabbits and San Joaquin Valley woodrats as well as other native small mammal species (MSCS Technical Reports, 1999)[12].

Land use in floodplains – agriculture, grazing
Some of the managed floodplain habitats include agricultural use or grazing. Bypasses are managed primarily for flood control and agriculture with additional values for fish and wildlife, especially during winter months. Effects on terrestrial wildlife depend on agricultural land use, agricultural practices, pesticides applied, and treatment of field borders

For example, grazing effects include changes in vegetation structure and composition, trampling and direct consumption of at-risk plant species, degradation of river banks and excessive siltation due to trampling of river banks, and excessive runoff due to over-grazing.

Disturbance – human recreation activities, fires, wood-cutting
Human recreational activities including boating, hiking, off-road vehicles, can all increase localized disturbance to biota and result in degradation of vegetation and habitat quality. Human recreation activities can increase the risk of fire. Disturbance from wood-cutting activities are also listed as possible pressures for riparian brush rabbit and San Joaquin Valley woodrat (MSCS Technical Reports, 1999)[12].

Restoring natural flows and sediment regimes
Restoring riparian and riverine aquatic habitats will involve reactivating or improving natural physical processes. Natural streamflows, stream meanders, and sediment transport create and sustain habitats and increase the complexity and structural diversity of habitat. For example, high winter and spring flows trigger seed dispersal and germination, move sediment, stimulate stream meander, and flood and scour riparian and riverine habitat (ERPP 2000)[8]. ERP objectives address restoration of habitats, reduction of stressors, and management of flow amounts and timing throughout the year to affect the degree of floodplain inundation, and hydrogeomorphic processes on floodplains.

ERP Milestones[8a] & ERP actions[8]

PROCESSES

Floodplain- channel connectivity and channel meander

- Develop floodplain management plans, including feasibility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary of all EMZ's except Delta and Suisun Marsh & Bay (DEDT-P5, SACR-P6, SJR-P4)
- … inYolo Basin… restore channel-floodplain connectivity and floodplain processes. … in lower Cache and Putah Creek floodplains, as well as in channels and sloughs of the upper Yolo Bypass to provide connections with the Delta in a manner consistent with flood control requirements…. (SACR-P1)

- Restore and maintain a defined <u>stream-meander zone</u> and <u>increase floodplain habitat</u> on San Joaquin River between Vernalis and mouth of Merced River (SJR-P6) and between Chowchilla Bypass and Mendota Pool (SJR-P7)
- <u>Protect 15,000 acres</u> within the Inner River Zone areas between Red Bluff & Colusa reaches within identified Sacramento River Conservation Area. Establish 3-5 habitat preserves for bank swallows… (SACR-P7)

<u>Sediment</u>

- Complete a <u>fluvial geomorphic assessment of coarse sediment supply needs</u> and sources .... Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ of Eastside Delta Tributaries, Sacramento River Basin, San Joaquin River Basin (DEDT-P4, SACR-P5, SJR-P3)
- Develop a cooperative program to restore salmonid spawning and rearing habitat in the Tuolumne, Stanislaus, and Merced Rivers that includes the following elements: (1) <u>reconstructing channels</u> at selected sites by isolating or filling in inchannel gravel extraction areas; (2) <u>increasing natural meander</u> by removing riprap and relocating other structures that impair stream meander; … (SJR-P5)

<u>Flows</u>

- Develop a methodology for evaluating <u>delta flow and hydrodynamic patterns</u> and begin implementation of an ecologically based plan to restore conditions in the rivers and sloughs of the Delta sufficient to support targets for the restoration of aquatic resources. (DEDT-P1)
- Provide for a <u>fall or early winter outflow</u> that emulates the first “winter” rain through the Delta (DEDT-P3)
- Design and begin implementation of an <u>ecologically based streamflow</u> regulation plan for Yuba River, Butte Creek, Big Chico Creek, Deer Creek, Mill Creek, Antelope Creek, Battle Creek, Cottonwood Creek, and Clear Creek (SACR-P4)

<u>HABITATS</u>

<u>Riparian</u>

- … establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary of all EMZ’s except Delta, Suisun Marsh & Bay, and West San Joaquin River (DEDT-H7, SACR-H2, SJR-H4)
- Implement 25 percent of the ERP target for diverse, self-sustaining riparian community for each EMU in Delta EMZ. and all San Joaquin River EMZ’s (DEDT-H8, SJR-H5)
- Restore min. 300 acres of self-sustaining or managed diverse natural riparian habitat along the Mokelumne River, Cosumnes River, and Calaveras River and protect existing riparian habitat. (DEDT-H9)
- Cottonwood Creek EMZ, complete …agreements with local landowners to establish, restore, and maintain riparian communities along 25 percent … of Cottonwood Creek, and develop comprehensive watershed management plan …. (SACR-H3)
- Restore 2 miles of the 10 mile target of riparian habitat restoration along the lower reaches of each of the following tributaries: Battle, Clear, Deer, Mill, Butte, Big Chico, Antelope, Feather, Yuba, and Bear Rivers. (SACR-H4)
- Restore and maintain min. 3 linear miles of riparian habitat along corridors of existing riparian scrub and shrub vegetation in each EMU (SMB-H1)

<u>Seasonal & Permanent Wetlands</u>

- Enhance, protect and restore 1,000 to 1,500 acres of seasonal wetlands in the East Delta EMU for optimum greater sandhill crane habitat. (DEDT-H10)
- … acquire, manage and restore 100 acres of vernal pools and 500 -1,000 acres of adjacent buffer areas (SMB-H6)
- Implement 25% of ERP target for enhancing, protecting, and restoring seasonal wetlands in the following EMZs: American River Basin, Butte Basin, Colusa Basin, and Feather River/Sutter Basin. (SACR-H5)
- In the West San Joaquin Basin EMZ, restore or create 100 acres of fresh emergent wetland habitat. (SJR-H2)

Wildlife friendly agriculture
- Cooperatively enhance at least 15% of the ERP target for wildlife friendly agricultural practices in Delta, American River Basin, Butte Basin, Colusa Basin, Feather River/Sutter Basin, San Joaquin River, West San Joaquin Basin EMZs . (DEDT-H1, SACR-H1, SJR-H1)

STRESSORS

Invasive species
- Develop and begin implementation of a demonstration program to reduce invasive non-native plant abundance within at least one EMU in the Delta. (DEDT-S6)
- Weed control programs to suppress expansion of tamarisk, giant reed, locust, and other invasive non-native plants degrading habitat quality and native flora (ERPP)

Contaminants
- …reduce pollutant (oxygen depleting substances, nutrients, ammonia) from discharges from concentrated animal feeding operations (DEDT-S11, SMB-S2, SACR-S8, SJR-S6, SJR-S8, SJR-S9)
- Reduce fine sediment loading to streams, especially Tuolumne, Merced, Stanislaus, Cosumnes, Napa, Petaluma Rivers, and Sonoma Creek, due to human activities… (DEDT-S13, SMB-S4, SACR-S11, SJR-S10)
- Research … threshold concentrations for mercury in sediments and key organisms…(DEDT-S14, SMB-S5, SACR-S12, SJR-S11)
- Mercury abatement work in Cache Creek watershed, Delta, Sacramento River (DEDT-S15, DEDT-S16, SACR-S13, SACR-S14)
- Pesticide work (Diazinon & chlorpyrifos) (DEDT-S17, SMB-S6, SACR-S15, SJR-S12)
- Selenium work… (DEDT-S18, SMB-S7, SJR-S13)
- Reduce organochlorine pesticide to streams… (DEDT-S19, SMB-S8, SACR-S16, SJR-S14)
- Trace metal work… (Copper, cadmium, zinc, chromium) (DEDT-S20, SBM-S9, SACR-S17, SJR-S15)
- Unknown toxicity studies… (DEDT-S21, SMB-S10, SACR-S18, SJR-S16)

Redirected effects

Redirected effects within ERP
- Conversion of one habitat type to another has effects on species associated with the original habitat type.
- ERP restoration efforts may affect establishment of non-indigenous plants
- Wetland creation and breaching islands may result in sediment sinks that negatively impact nearby habitats.
- Wetland creation may resuspend mercury-laden sediments and increase mercury methylation and bioaccumulation of mercury in the foodweb, including fish and waterfowl consumed by humans.

Redirected effects on other CALFED Problem Areas

Floodplain and riparian wetland restoration…
- May affect the status of endangered fish species which affects water management (e.g., constraints on pumping).
- Will affect levee maintenance activities

Monitoring recommendations

See Table 7-2, 7-3, 7-4.

Existing Monitoring Programs and Information Sources

Point Reyes Bird Observatory/ California Partners in Flight & partners
Cosumnes River preserve / Nature Conservancy

Sacramento River Watershed Program
CSU-Chico – floodplain mapping (get name of program)
Cosumnes Research Group -- Jeff Mount's group – Cosumnes Restoration Project
East Bay Municipal Utility District – Mokelumne River Watershed Wildlife Monitoring Plan
DWR Northern District -- Sacramento River Riparian Habitat Program, Sacramento River Atlas Project
DWR – Water and Environmental Monitoring Program
DWR – Division of Planning and local assistance
DFG – Wildlife Habitat relationships database
DFG -- Inventory and Assessment of Vernal Pool/Wetland Habitats in CA
DFG – Natural Diversity Database
Yolo County – Habitat Conservation Plan
South Sacramento County Habitat Conservation Plan
Solano County Habitat Conservation Plan
Sacramento River Bird Conservation Project
Natomas Basin Habitat Conservation Plan
ACOE -- Sacramento and San Joaquin River Basins Comprehensive Study
ACOE -- Habitat Restoration Feasibility Study

Table 7-1. Floodplain and Riparian Species Linked With Pressures

The "R", "r", and Species Community Groups are linked with their associated pressures as identified in the MSCS Technical Reports (June 1999)[12] and the Ecosystem Restoration Program Plan (July 2000)[8]

LIMITING FACTORS/ PRESSURES	Bank Swallow (r)	California Black Rail (r)	California yellow warbler (r)	Greater sandhill crane (r)	Least Bell's vireo (r)	Little willow flycatcher (r)	Swainson's hawk (r)	Western Yellow-Billed Cuckoo (r)	Riparian brush rabbit (r)	San Joaquin Valley woodrat (r)	Giant Garter Snake (r)	**Valley elderberry longhorn beetle (R)**	Delta green ground beetle (r)	Alkali Milkvetch (r)	Bristly sedge (r)	Crampton's tuctoria (r)	Delta coyote thistle (r)	Northern California Black Walnut (r)	Neotropical Migratory Bird Guild	Upland Game	Native anuran amphibians	Tidal Brackish & Freshwater Marsh Habitat Plant Community Group	Seasonal wetland plant community
Human-induced pressures																							
Habitat loss	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Habitat degradation thru altered processes	X	X				X	X	X	X	X	X	X		X	X	X	X		X			X	X
Habitat fragmentation									X	X	X	X							X		X		X
Habitat lowland disconnected with upland		X							X	X	X								X				
Lack Appropriate Vegetation (roosting, foraging, nesting)		X			X	X	X	X	X	X		X							X				
Non-indigenous - animals		X	X		X	X		X	X	X									X		X		
Non-indigenous - plants								X										X				X	X
Contaminants		X					X	X	X	X	X	X							X				X
Human Activities/ Disturbance	X	X		X		X	X	X	X	X	X	X		X	X	X			X	X		X	
Human/vehicle trampling		X		X							X					X			X	X			
Levee/conveyance work									X	X	X						X					X	
Cattle Grazing						X		X		X		X		X	X	X				X		X	
Agricultural practices							X				X	X				X							
Erosion (boat wake)	X																						
Illegal harvest/shooting				X					X			X							X				
Rip Rap	X																					X	
Natural pressures and/or sources of variation																							
Native Predation/ Competition	X			X			X		X	X	X								X				
Fire								X	X	X										X		X	X
Disease									X	X													
Flooding		X							X	X	X				X							X	X

Figure 7A: Simplified Floodplain & Riparian Wetlands Conceptual Model (TAMP)

(ERP = Ecosystem Restoration Program, WSR=Water Supply Reliability problem area, LSI = Levee System Integrity problem area)

Anthropogenic Pressures

* Historical and current land conversion to urban & agriculture
* Levees disconnect river from floodplain habitats (LSI)
* Rip-rap of banks & other bank hardening measures (LSI)
* Altered flows & water diversions--timing & amount -- daily, seasonal, annual effects (WSR)
* Altered sediment supply (WSR)
* Channelization reduces habitat and alters flow and sediment patterns (WSR, LSI)
* Boating activites/ waves erode shorelines
* Channel dredging & sediment disposal (WSR)
* Levees maintenance activities (LSI)
* Loss of mosaic of habitat types due to reduced floodplain, levees, and altered hydrology and channel morphology
* Wetlands disconnected from upland refugia during floods
* Habitat fragmentation relative to species dispersal
* Barriers to dispersal (levees, roads,urban areas,etc)
* Small patch size reduces full range of processes and ecological succession and increases effects of human activities
* Introduction of non-indigenous plant & animal species
* Human activities associated with artificial increase in abundance of native and non- native species
* Disturbance / Impacts from human recreation activities, agriculture, urbanization, cattle grazing, etc.
* Contaminants (Se, Hg,, pesticide drift, fine sediment, loadings from mines, agriculture, urban runoff, dischargers)

Redirected from Non-ERP program actions

* Flood conveyance modifications, levee modifications (WSR)
* Altered flow releases from dams (WSR)
* Some increased dredging (WSR)
* Water transfers & water use efficiency impacts on flows, groundwater, land use (WSR)

Natural Pressures / Sources of Variation

* Climate, precipitation, extreme floods, droughts, lightning strikes
* Fire
* Non-indigenous plants & animals
* Disease
* Earthquakes
* Soil/sediment type, texture
* Historical topographic features & underlying parent rock materials
* Age/Maturity of habitat patch

Management Actions

ERP

* Increase area of floodplain & river meander
  -- set back levees & restore floodplain connectivity
  -- reduce rip-rap on banks
  -- flood & restore islands
* Increase extent & connectivity of wetlands
  -- protect & enhance existing wetlands
  -- acquire land & convert to habitat
* Improve coarse sediment supply
* Alter Delta hydrology, Delta outflow, and stream hydrology to better mimic natural hydrograph for fish
* Reduce contaminants
* Acquire land to protect rare plants
* Plant rare plants to increase distribution
* Control non-native plant & animal species
* Reduce introductions of non-native plant & animal species
* Encourage wildlife-friendly agricultural practices
* Improve land management for MSCS spp
* Change levee maintenance activities

State of the Environment

Floodplain

• Floodplain extent, configuration, and topography

Hydrologic & Geomorphic Processes & Characteristics

• River Flows – variability, infrequent channel resetting floods
• Floodplain hydrology – flows, floodplain inundation, duration, frequency, seasonaility, large channel resetting floods
• Depth to groundwater table
• Sediment supply, delivery & movement
• Erosion and deposition processes

NCCP Habitat Extent & Distribution

• Extent & distribution of NCCP habitats
• Linear extent & width of riparian habitat
• Connectivity among floodplain habitats
• Patch size
• Connectivity with upland refugia from floodwaters
• Connectivity with non-floodplain habitat (grassland, upland cropland, upland scrub)

Energetics & Water Quality

• Nutrient inputs, outputs, accumulation
• Carbon inputs, outputs, accumulation
• Water quality characteristics – (TDS, (suspended sediment, turbidity, temp., conductivity, contaminant status)
• Sediment quality characteristics

Vegetation communities & habitats

• Extent & distribution of vegetation communities within NCCP habitats
• Number, type, and location of vernal pools
• Extent & distribution of habitat for specific MSCS species
• Vegetation establishment & succession
• Vegetation Community Structure & Composition
• Plant dispersal
• Relative abundance of native & non-native species

Biota-Fauna

*Terrestrial biotic communities diversity & abundance
- waterfowl
- passerine birds
- wading birds
- shorebirds
- raptors
- native anuran amphibians
- small mammals
- large mammals
- terrestrial invertebrates
- reptiles
- decomposers (bacteria, fungi, etc)

* Aquatic biotic communities diversity & abundance
- benthic invertebrates
- other invertebrates
- phytoplankton, zooplankton, algae
- fish
- decomposers (bacteria, fungi, etc)

* Wildlife health
* MSCS species abundance & distribution

Anticipated Effects (terrestrial)

* Rehabilitation of hydrologic & geomorphic processes that support freshwater and riparian wetlands to create dynamic and sustainable systems
* Increase in floodplain extent & inundation
* Increase in channel meander processes
* Improvement in extent, connectivity, patch size of freshwater & riparian wetlands
* Enhancement of the quality of wetlands to support native species
* Reduction in abundance & distribution of important non-indigenous plants
* Increase in abundance, health, diversity of neotropical migratory birds, waterfowl, wading birds, native anuran amphibians
* Reduction in contaminant effects on biotic communities
* Increase in abundance & distribution of MSCS R & r species (San Joaquin Valley Woodrat, Riparian Brush Rabbit, Giant Garter Snake, Valley Elderberry Longhorn Beetle, Delta Green Ground Beetle, Bank swallow, California yellow warbler, Greater sandhill crane, Least Bell's vireo, Little willow flycatcher, Swainson's hawk, Western yellow-billed cuckoo, Alkali milkvetch, Bristly sedge, Crampton's tuctoria, Delta coyote-thistle, Northern California black walnut)

Redirected Effects (on other parts of ERP)

* Wetland restoration efforts may increase spread of non-indigenous plants
* Tidal and floodplain wetland restoration and conversion from managed wetlands may cause redistribution of waterfowl across landscape

Redirected Effects (on other resources of concern)

* ERP actions may increase habitat extent, quality, and water temperature which may improve status of endangered fish species which could reduce constraints on pumping operations (WSR)
* Altering flow amount and timing for ERP may impact water supply reliability (WSR)
* May change amounts of evapotranspiration due to increased wetland acreage (WSR)
* Widening levees will cause changes in levee maintenance activities. (LSI)
* Widening levees upstream may increase pressure on levees downstream (LSI)
* Will cause reduction in linear extent of levees to be maintained (LSI)

Figure 7B. Floodplain & Riparian Wetlands: What are the extent and distribution of floodplains and NCCP habitats and what are the changes due to geomorphic and hydrologic processes, land use changes, and restoration actions? – Sacramento River, San Joaquin River, Delta & Eastside Delta Tributaries Regions

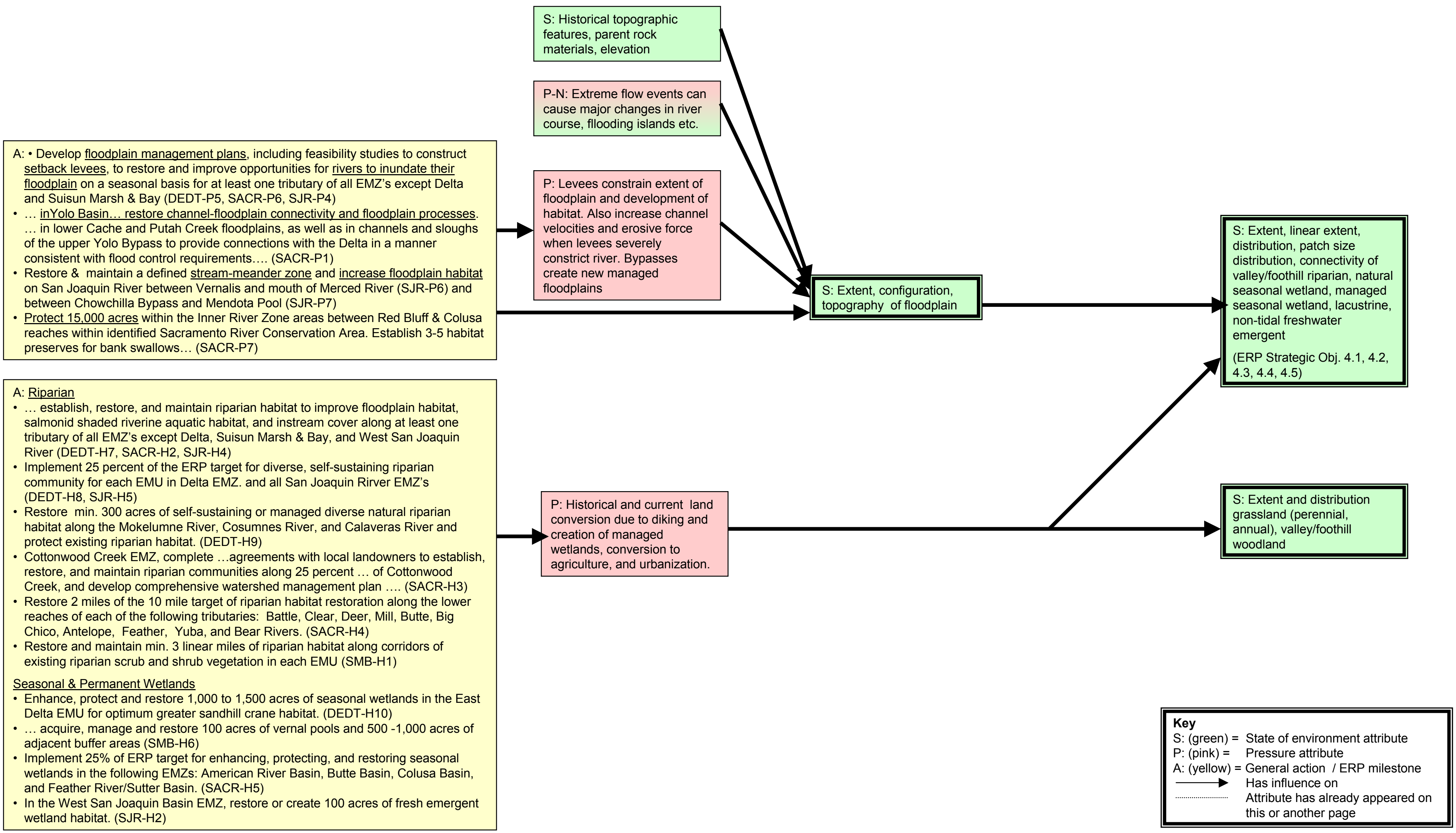

Figure 7C. Floodplain & Riparian Wetlands: What is the extent and distribution of vegetation communities & habitats within NCCP habitats and MSCS plants in floodplain and riparian wetlands and associated upland habitats and what are the effects of hydrologic, geomorphic, and ecological processes and human activities?

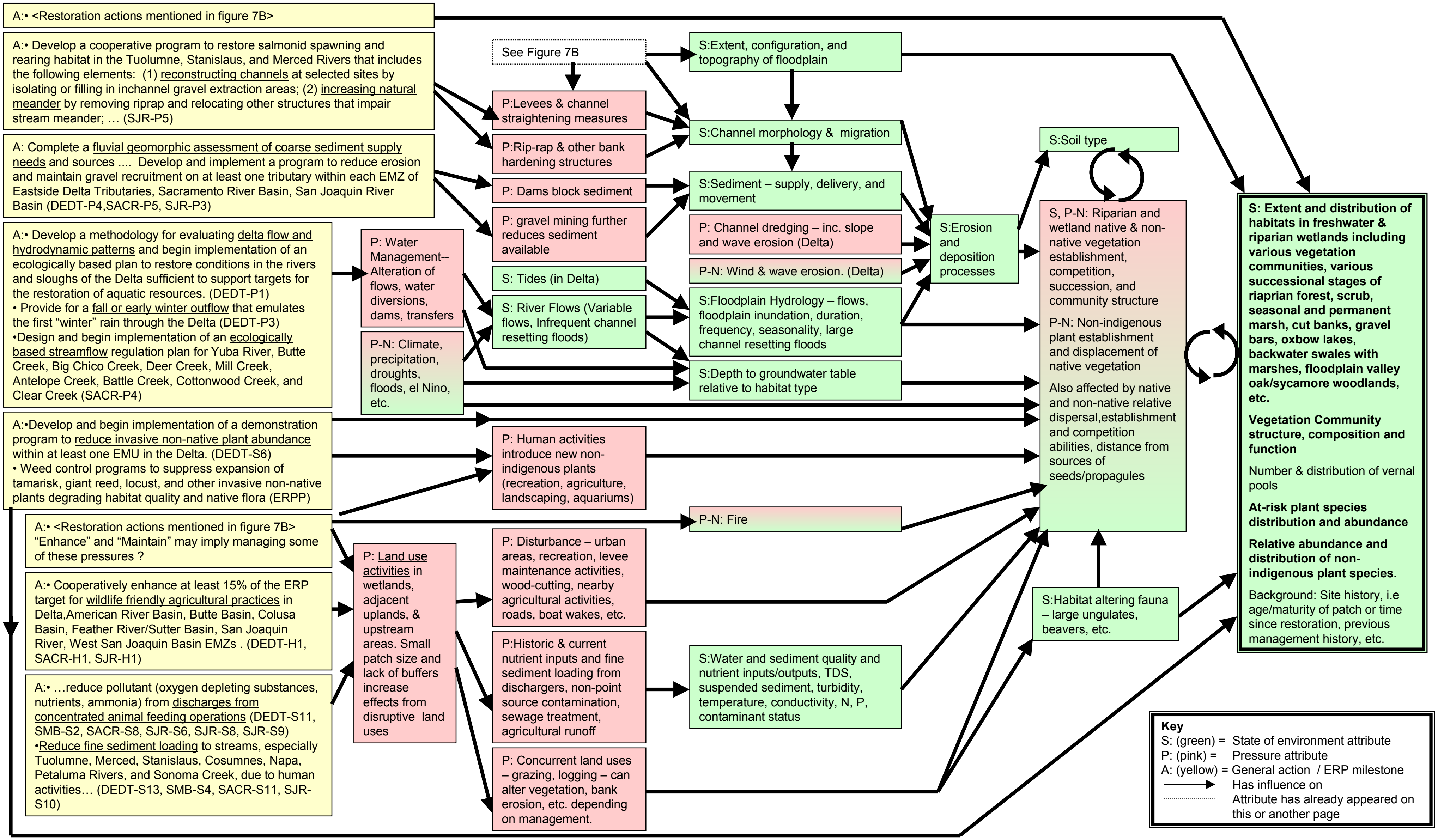

Figure 7D: Floodplain & Riparian Wetlands: How functional are floodplain & riparian wetland habitats in support of fauna biodiversity and MSCS species? – Sacramento River, San Joaquin River, Delta & Eastside Delta Tributaries Regions

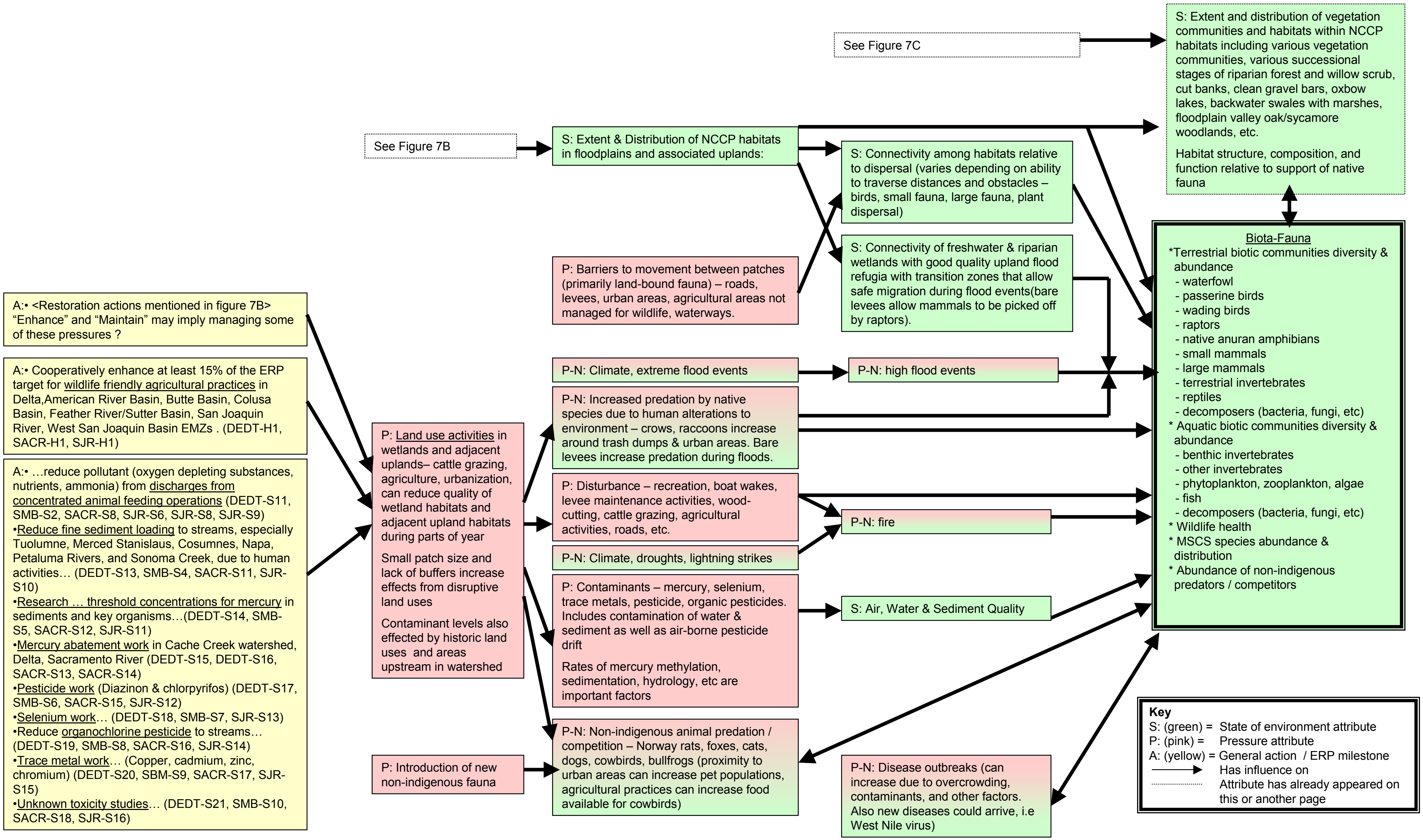

Table 7-2. Floodplain and Riparian Habitat Quality: Extent and Distribution of Floodplain & Riparian Wetlands and the effects of geomorphic and hydrologic processes, land use changes and restoration actions.

Monitoring recommendations are sorted under status and trends of floodplain wetlands and associated habitats, changes due to habitat loss, floodplain-river connectivity restoration, and habitat restoration. References are in parentheses (). P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
What are the status and trends in the extent and distribution of floodplains and associated habitats? (ERP Strategic Objectives 2.6, 4.1, 4.2, 4.3, 4.4, 4.5)						
7-2.1	**STATE: Extent of current active flooplain** What is the extent of the 2, 10, 20, and 100 year floodplain?	S	Extent of floodplain inundated (1, 18)	Remote Sensing / Mapping	High	DWR Northern District - SB 1086; DWR Delta Planning Branch - North Delta Program
			Topography (1, 16, 18)	Remote Sensing / Mapping		
7-2.2	**STATE: Floodplain habitat extent & distribution** What are the status & trends in extent and spatial distribution of floodplain wetland habitats since the baseline year? Extent and distribution of habitats relates directly to ERP strategic objective 4.1. Patch size distribution is included because this is an important co-factor for many other processes in floodplain wetlands. Connectivity is also mentioned separately as relating to birds and small fauna.	S	Extent and distribution of floodplain habitats preferably identified by NCCP habitats (natural seasonal wetlands, valley/foothill riparian, lacustrine, non-tidal permanent emergent, valley riverine aquatic, tidal freshwater emergent, tidal perennial aquatic, montane riparian, montane riverine aquatic) (15, 16, 18)	Remote Sensing / Mapping	High	ACOE - Habitat Restoration Feasibility Studies; ACOE - Comprehensive Review Study; CSU-Chico; Cosumnes River Preserve & restoration studies; CDWR-Sacramento River Riparian Habitat Program; CDWR-Reservoir sites + 1 mile buffer; CDWR-AB360 Delta Levee Maintenance subventions program; CDWR-North Delta Program; CDWR-Statewide Planning (Crop types) Habitat Conservation Plans; CDFG-Central Valley Wetland Mapping Project; Mosquito Abatement Districts; California Legacy Project; USFS w/CDF above 300' contour; USFWS National Wildlife Refuges; Dept. of Conservation - Famland Mapping & Monitoring Program; Dept. of Pesticide Regulation w/USBR - Field Borders mapping; UC Berkeley, CEDR - SF Bay Delta Geodatabase (Wetlands in Bay/Delta); USBR-Stone Lakes Wildlife Refuge Feasibility Study;
			Extent and distribution of managed floodplain habitats, preferably identified by NCCP habitats (managed seasonal wetlands, seasonally flooded agriculture). Includes bypasses. (16, 18)	Remote Sensing / Mapping	High	
			Permanent open water (e.g. sloughs, embayments, oxbows, side channels, borrow pits, ponds)	Remote sensing / mapping	high	
			linear extent of river and stream channel or floodplain with continuous habitat (1)	Remote Sensing / Mapping	High	
			Area, width, area/perimeter ratio of floodplain habitat patches.	Remote Sensing / Mapping	High	
			Contagion and/or distance between floodplain habitat patches	Remote Sensing / Mapping	High	
			Surface area, location, distribution of vernal pools	Remote Sensing / Mapping	High	CDFG - Wetlands Inventory & Conservation Unit
7-2.3	**STATE: Upland habitats associated with floodplain habitats extent and distribution** What are the status & trends in extent and spatial distribution of habitats associated with tidal wetlands? Relates directly to ERP strategic objective 4.1. Extent and distribution of habitats associated with tidal wetlands are critical for maintenance of many MSCS species and overall biodiversity.	S	Extent and distribution of NCCP habitats directly associated with floodplain habitats but not within active floodplain (grassland (differentiate annual from perennial), valley/foothill riparian, valley/foothill woodland & forest, montane woodland & forest, non-tidal perennial aquatic, lacustrine, seasonally flooded agriculture, upland cropland)	Remote Sensing / Mapping	High	see 7-2.2 above

Table 7-2. Floodplain and Riparian Habitat Quality: Extent and Distribution of Floodplain & Riparian Wetlands and the effects of geomorphic and hydrologic processes, land use changes and restoration actions.

Monitoring recommendations are sorted under status and trends of floodplain wetlands and associated habitats, changes due to habitat loss, floodplain-river connectivity restoration, and habitat restoration. References are in parentheses (). P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
What changes in the extent and distribution of floodplain and riparian wetlands and associated upland habitats are due to land use changes? (ERP Strategic Objectives 2.6, 4.1, 4.2, 4.3, 4.4, 4.5)						
7-2.4	**PRESSURE: Habitat loss due to land conversion** How much of NCCP habitats have been converted to other land uses since baseline? Where is it located? Gains due to habitat restoration could be offset by losses of habitat due to conversion to other land uses such as urbanization	P	Extent and location of NCCP habitats converted to other land uses since baseline	Remote Sensing / Mapping	High	see 7-2.2 above
7-2.5	**PRESSURE: Potential habitat loss due to land conversion** Where and how much floodplain habitat and associated upland habitats are anticipated to be converted to other land uses? Urbanization is continuing to cause habitat loss. Understanding current land use, ownership, and zoning changes can help predict where future habitat losses may occur. Changes in cropping patterns can also have effects on wildlife. Understanding these trends will improve understanding of trends in wildlife.	P	Maps of land-ownership (categories) & protection status	Programmatic	High	
			Maps of land use (categories)	Programmatic	High	
			Planned city zoning changes may result in future habitat loss (urbanization)	Programmatic		
7-2.6	**ACTION: Actions to increase extent of floodplain, improve floodplain inundation** • Develop floodplain management plans, including feasibility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary of all EMZ's except Delta and Suisun Marsh & Bay (DEDT-P5, SACR-P6, SJR-P4) • … in Yolo Basin… restore channel-floodplain connectivity and floodplain processes. … in lower Cache and Putah Creek floodplains, as well as in channels and sloughs of the upper Yolo Bypass to provide connections with the Delta in a manner consistent with flood control requirements…. (SACR-P1) • Restore & maintain a defined stream-meander zone and increase floodplain habitat on San Joaquin River between Vernalis and mouth of Merced River (SJR-P6) and between Chowchilla Bypass and Mendota Pool (SJR-P7)	A, E	Location, extent, and implementation status of floodplain restoration projects and projects in associated uplands	Programmatic	High	
			Extent & location of increased floodplain inundation	Remote Sensing / Mapping	High	
7-2.7	**ACTION: Extent & location of riparian habitat restored and protected** Where and how much riparian and seasonal wetland habitat has been restored? Following are relevant ERP milestones • … establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary of all EMZ's except Delta, SMB, and WSJR (DEDT-H7, SACR-H2, SJR-H4) Implement 25 percent of the ERP target for diverse, self-sustaining riparian community for each EMU in Delta EMZ. and all SJR EMZ's (DEDT-H8, SJR-H5) • Restore min. 300 acres of self-sustaining or managed diverse natural riparian habitat along the Mokelumne River, Cosumnes River, and Calaveras River and protect existing riparian habitat. (DEDT-H9) • Cottonwood Creek EMZ, complete …agreements with local landowners to establish, restore, and maintain riparian communities along 25 percent … of Cottonwood Creek, and develop comprehensive watershed management plan …. (SACR-H3) • Restore 2 miles of the 10 mile target of riparian habitat restoration along the lower reaches of each of the following tributaries: Battle, Clear, Deer, Mill, Butte, Big Chico, Antelope, Feather, Yuba, and Bear Rivers. (SACR-H4) • Restore and maintain min. 3 linear miles of riparian habitat along corridors of existing riparian scrub and shrub vegetation in each EMU (SMB-H1)	A, E	Extent, location & implementation status of riparian restoration projects	Programmatic; Remote sensing / mapping	High	

Table 7-2. Floodplain and Riparian Habitat Quality: Extent and Distribution of Floodplain & Riparian Wetlands and the effects of geomorphic and hydrologic processes, land use changes and restoration actions.

Monitoring recommendations are sorted under status and trends of floodplain wetlands and associated habitats, changes due to habitat loss, floodplain-river connectivity restoration, and habitat restoration. References are in parentheses (). P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
7-2.8	**ACTION: Extent & location of seasonal wetlands, and adjacent habitats restored and protected** • Enhance, protect and restore 1,000 to 1,500 acres of seasonal wetlands in the East Delta EMU for optimum greater sandhill crane habitat. (DEDT-H10) • … acquire, manage and restore100 acres of vernal pools and 500 -1,000 acres of adjacent buffer areas (SMB-H6) Implement 25% of ERP target for enhancing, protecting, and restoring seasonal wetlands in the following EMZs: American River Basin, Butte Basin, Colusa Basin, and Feather River/Sutter Basin. (SACR-H5) In the West San Joaquin Basin EMZ, restore or create 100 acres of fresh emergent wetland habitat. (SJR-H2)	A, E	Extent, location & implementation status of seasonal wetland & permanent wetland restoration projects (managed and natural seasonal wetlands,)	Programmatic; Remote sensing / mapping	High	
			Extent and location of land purchased or otherwise protected through CALFED actions	Programmatic	High	
7-2.9	**ACTION: Protect 15,000 acres within the Inner River Zone areas between Red Bluff & Colusa** reaches within identified Sacramento River Conservation Area. Establish 3-5 habitat preserves for bank swallows… (SACR-P7)	A, E	Extent and location of land purchased or otherwise protected through CALFED actions	Programmatic	High	
7-2.10	**ACTION: Change in management practices on levees to increase vegetation and habitat (no specific milestone but in ERPP)**	A, E	Changes in vegetation / habitat associated with discontinuation of vegetation removal	Remote Sensing / Mapping; Targeted study		
			Location of targeted discontinuation of vegetation removal on levees projects	Programmatic		
What changes in the extent of the floodplain are due to hydrologic and geomorphic processes? (ERP Strategic Objectives 2.6, 4.1, 4.2)						
7-2.11	**STATE: Location and extent of changes in floodplain due to major river course changes, flooding islands, etc.** During extreme flood events, freely meandering rivers will sometimes make large changes in the course of the river and consequently the location and extent of the floodplain. However, in California's tightly managed system with well-maintained levees, large permanent changes in river course and active floodplains seem unlikely -- although its possible that this might apply to smaller tributaries with few to no levees. The possible exception might be if a Delta island were breached in multiple places and was considered unrecoverable. Monitoring elements are just a repeat of those listed above.	S	Changes in the extent and distribution of the floodplain due to large changes in river course or to irreversible flooding of Delta islands.	Remote sensing / mapping		

Table 7-3. Floodplain and Riparian Habitat Quality: What is the extent and distribution of vegetation communities, sub-habitats, and MSCS plants in floodplain & riparian wetlands and associated upland habitats and what are the effects of hydrologic, geomorphic, and ecological processes and human activities

Monitoring recommendations are sorted under status and trends of extent, distribution, and composition of vegetation communities and habitats, and the hydrology, channel morphology, sediment supply, and human activities that affect them. Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
What are the status and trends in the extent and distribution of vegetation communities and sub-habitats within NCCP habitat types of floodplain and riparian wetlands and associated upland habitats? What changes are occurring in vegetation structure, composition, and function? · What effects are non-indigenous plants having on the structure, composition and function of floodplain and riparian wetland vegetation? (ERP Strategic Objectives 1.2, 1.3, 1.4, 5.5, 5.7, 6.2, 6.3)						
7-3.1	**STATE: Mosaic of vegetation communities & habitats** What are the extent and location of the various vegetation communities? Mapping of vegetation is critical to assessing status and trends in vegetation, habitat for MSCS species, and the effects of hydrologic & geomorphic processes on habitat. Patch topography, patch age, and previous land use history are important covariates for assessing current vegetation communities and the succession directions they will likely proceed upon.	S	detailed extent and distribution of plant communities and sub-habitats, different seral stages of vegetation succession (Black Willow series, Narrowleaf Willow series, White Alder Series, Buttonbush Series, Mexican Elderberry Series, Valley Oak Series, etc.) (1, 18)	Remote sensing / mapping	high	see 7-2.2
			Vegetation community structure & composition - field surveys -percent cover, canopy gap fraction, tree species diameter at breast height, tree density, size class distribution, tree mortality, canopy height, shrub and vine species and basal area, percent herbaceous cover, (15, 16, 22)	Sampling sites network		
			Species diversity, richness, community composition	Sampling sites network		
			soil survey maps (background) (16)	Remote sensing / mapping	high	USDA-NRCS
			key indicator species distribution and abundance	Sampling sites network		
			Soil type, texture, soil profile (background) (1,16)	Sampling sites network		
			topography (background, covariate) (1,16)	Sampling sites network		
			site history and age especially relative to anthropogenic disturbance (background) (16)	Sampling sites network		
7-3.2	**STATE: Abundance and distribution of MSCS plant species** Although related to 2.0 this has been separated to highlight its importance. CALFED is responsible for "recovering" or "contributing to the recovery of the following species found in floodplains and riparian habitats -- (Alkali milkvetch, Bristly sedge, Crampton's tuctoria, Delta coyote-thistle, Northern California black walnut)	S	MSCS plant species distribution & abundance in sampling sites network	Sampling sites network	High	
			extent and distribution of specific habitats where MSCS plant species are expected to be found and are currently found	Remote sensing / mapping		
			Possible species specific surveys that go beyond the sampling sites network --distribution, relative abundance, population size, number of populations	Species specific surveys	High	

Table 7-3. Floodplain and Riparian Habitat Quality: What is the extent and distribution of vegetation communities, sub-habitats, and MSCS plants in floodplain & riparian wetlands and associated upland habitats and what are the effects of hydrologic, geomorphic, and ecological processes and human activities

Monitoring recommendations are sorted under status and trends of extent, distribution, and composition of vegetation communities and habitats, and the hydrology, channel morphology, sediment supply, and human activities that affect them. Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
7-3.3	**PRESSURE: Non-indigenous plants - relative abundance and distribution and rate of spread of key species** What are the status and trends in the relative abundance of non-indigenous plants in floodplain and riparian wetlands? What are the status and trends in distribution of key non-indigenous plant species? What new introduced plant species have been observed in floodplain and riparian wetlands? (13, 18)	P	distribution & size of patch (or some other abundance metric) of key non-indigenous plant species (water hyacinth, egeria, etc.)(13)	Regional surveys	High	Cal. Dept. of Boating and Waterways - Water hyacinth CDFA Integrated Pest Control Branch - Hydrilla SFEI-Biological Invasions Program Team Arundo Del Norte US Dept. of Animal & Plant Health Inspection Service (APHIS)
			relative abundance of non-indigenous plant species (13)	Sampling sites network	High	
			presence/absence of key non-indigenous plant species	Sampling sites network	High	
			reporting of unidentified plants	Sampling sites network	High	
			Maintain information clearinghouse to report newly located non-indigenous plants and unidentified plants established in region	Programmatic	High	The Nature Conservancy http://tncweeds.ucdavis.edu/esadocs.html (natural history and control methods of non-native plants in natural habitat)
7-3.4	**PRESSURE: land use practices (grazing)** Land use such as grazing impacts vegetation structure and composition and can effect the relative abundance of native vs. non-native plant species. The effects vary with the type and intensity of management. Such management can be very important regarding maintaining vernal pools. Although agriculture is compatible with fish use of floodplains, it restricts the utility to terrestrial species to field edges or to shorebird and waterfowl use when the fields are flooded.	P	Land use / management -- categories determined by impact on vegetation, vernal pools, wildlife (16)	mapping - programmatic	High	DWR Northern District - SB 1086 Teale Data Center
7-3.5	**PRESSURE: Local disturbance / activities** Land uses such as recreation can alter vegetation to a lesser degree but increase the introduction of non-indigenous plant species. Recreation can also increase the incidence of fires. Woodcutting is another land use that alters vegetation structure and composition depending on the intensity and type of management. Levee maintenance activities and non-indigenous plant control activities can all have impacts on vegetation	P	type of disturbance and impacts on vegetation	Sampling sites network	High	
7-3.6	**PRESSURE-Natural: Fires** History of fires can be important in interpreting the extent and distribution of vegetation communities across the landscape. (Covariate / background variable	P	sampling site-history -- fires (background)	Sampling sites network		

Table 7-3. Floodplain and Riparian Habitat Quality: What is the extent and distribution of vegetation communities, sub-habitats, and MSCS plants in floodplain & riparian wetlands and associated upland habitats and what are the effects of hydrologic, geomorphic, and ecological processes and human activities

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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
7-3.7	**PRESSURE-Contaminants** The primary contaminants expected to affect vegetation structure and composition are excessive nutrient loading and possibly fine sediment loading and herbicides.	P	Water quality sampling in rivers and tributaries (Nutrients, fine sediment, pesticides) (18)	Aquatic monitoring plan		CDWR-Environmental monitoring program; DWR-D1485 program; SFEI - Regional Monitoring Program for Trace Substances; SRWP; DWR-MWQI; USGS-Polaris; DWR-Operations & Compliance Monitoring
			sediment accretion on floodplain	Sampling sites network		
			vegetation showing signs of herbicide/contaminant damage	Sampling sites network		
			Land use /management relative to contaminant problems (16)	mapping - programmatic		
			locations ofanimal feedlots contributing large nutrient loads into the watershed	mapping - programmatic		
			locations of tributaries with fine sediment loading problems	mapping - programmatic		
7-3.8	**ACTION: Reduce nutrient loading and fine sediment loading** • …reduce pollutant (oxygen depleting substances, nutrients, ammonia) from discharges from concentrated animal feeding operations (DEDT-S11, SMB-S2, SACR S8, SJR-S6, SJR-S8, SJR-S9) • Reduce fine sediment loading to streams, especially Tuolumne, Merced Stanislaus, Cosumnes, Napa, Petaluma Rivers, and Sonoma Creek, due to human activities… (DEDT-S13, SMB-S4, SACR-S11, SJR-S10)	A	Nutrient concentrations, Dissolved oxygen (aquatic concern) and fine sediment accumulation in tributaries with actions to reduce these problems.	Aquatic monitoring plan; Project monitoring	High	
			Implementation status of actions to reduce nutrient and fine sediment loading	Programmatic / project	High	
7-3.9	**ACTION: Control efforts for non-indigenous plants** Weed control programs to suppress expansion of tamarisk, giant reed, locust, and other invasive non-native plants degrading habitat quality and native flora (ERPP)	A	Number, location and effectiveness of control efforts	Programmatic / project	High	
7-3.10	**ACTION: Habitat restoration actions**	A	<see previous>	Programmatic	High	

Table 7-3. Floodplain and Riparian Habitat Quality: What is the extent and distribution of vegetation communities, sub-habitats, and MSCS plants in floodplain & riparian wetlands and associated upland habitats and what are the effects of hydrologic, geomorphic, and ecological processes and human activities

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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
Are floodplain hydrological & geomorphic processes creating a mosaic of vegetation communities and habitats? I.e. flows & floodplain inundation, channel resetting floods, depth to groundwater table. (ERP Strategic Objectives 2.1, 2.4, 2.5, 2.6)						
7-3.11	**STATE: River flows / hydrology** What is the river & floodplain hydrology? What is the river/stream hydrograph compared with the natural hydrograph? Workshop participants recommended coordinating with the Nature Conservancy's development of "Index of Hydrologic Alteration". Deviations from the natural flow patterns and seasonality affect native and non-native vegetation establishment and succession. The shift to larger flows in late spring is hypothesized to favor some non-native plant species. Floodplain & river hydrology is an important covariate for understanding floodplain inundation, channel migration processes, channel-resetting floods, groundwater levels, and vegetation establishment and succession. The term "water year" is a designation made by the Department of Water Resouces depending on the amount of water in the snowpack and available in the reservoirs and received as rainfall. It is a legal term that affects management decision-making.	S	Magnitude, timing, and variability of flow in rivers at tributary mouths compared with historic natural hydrograph (13). Includes minimum and maximums, extreme flood events. (18)	Aquatic monitoring	High	USGS, DWR, USBR stream and river gaging stations. Additional stations may be needed.
			Index of hydrologic alteration	Aquatic monitoring	High	Nature Conservancy is developing
			Water year	Water Mgmt operations		USBR/CDWR
7-3.12	**STATE: Floodplain hydrology** What is the extent, frequency, duration, timing, and variability of floodplain inundation and its affect of floodplain habitats? Floodplain inundation is an easy method of measuring the extent and functioning of the floodplain. In addition floodplain inundation is an important covariate in determining vegetation community composition and structure.	S	Acreages of floodplain inundation duration, frequency, depth, and seasonality of woody riparian, freshwater marsh, seasonal wetlands, and associated upland habitats based on synthesis from detailed topography (both channel and floodplain) (1, 13, 18))	Remote sensing; Sampling sites network	High	
7-3.13	**STATE: Groundwater Table** What is the groundwater depth relative to the habitat type? Groundwater depth and variability is an important determining factor in vegetation communities structure and composition in a given patch.	S	seasonal depth to groundwater table (1, 13, 16)	Sampling sites network		
			soil moisture levels laterally from banks (13)	Sampling sites network		
			acreages based on seasonal elevation difference between ground surface and average low-flow water surface in areas of woody riparian, freshwater marsh, and associated upland areas	mapping; targeted studies		
7-3.14	**STATE: Hydrology associations with floodplain habitats**	S	distribution and extent of floodplain habitats, including presence of permanent open water (e.g. sloughs, embayments, oxbows, side channels, borrow pits, ponds) (13)	Remote sensing / mapping	high	
7-3.15	**PRESSURE-REDIRECTED: Water Management** Water management changes including reservoir releases, water diversions and return flows, water transfers and groundwater pumping affect the amount, timing and variability of flows throughout the season from the historical hydrograph. Flows and groundwater pumping can also affect the depth to the groundwater table which in turn affects riparian vegetation. However monitoring groundwater pumping is unrealistic at this time.	P	Flow release operations on major dams	Water Mgmt operations		
			water diversions on tributaries & return flows	Water Mgmt operations		
			water transfers	Water Mgmt operations		

Table 7-3. Floodplain and Riparian Habitat Quality: What is the extent and distribution of vegetation communities, sub-habitats, and MSCS plants in floodplain & riparian wetlands and associated upland habitats and what are the effects of hydrologic, geomorphic, and ecological processes and human activities

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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
7-3.16	**PRESSURE-REDIRECTED: Water Transfers** Water transfers and water conservation measures may result in changes in water supply in some areas and reductions in seeps around levees and canals (8, 23, 24)	P-R	changes in extent and distribution of vegetation communities in response to local water transfers / changes in groundwater levels	remote sensing / mapping ; project monitoring		
			local reductions in seeps, ponds and alkali meadows due to water conservation measures and/or changes in groundwater levels	remote sensing / mapping ; project monitoring		
7-3.17	**PRESSURE-NATURAL: Climate, floods, droughts** Climate, precipitation, droughts, and floods affect vegetation community structure and the spread and relative abundance of non-indigenous plants. (covariate)	P-N	Precipitation, temperature	Weather monitoring stations	High	National Weather Service - Rain Gage Stations; CDWR-California Irrigation Management Information System (CIMIS); USBR, USGS, College research facilities, airports, etc.
			landscape altering floods, droughts			
			Water year	Water Mgmt operations		
7-3.18	**ACTION:** Develop a methodology for evaluating delta flow and hydrodynamic patterns and begin implementation of an ecologically based plan to restore conditions in the rivers and sloughs of the Delta sufficient to support targets for the restoration of aquatic resources. (DEDT-P1)	A-E	See Aquatic Monitoring Plan	Aquatic Monitoring Plan		
7-3.19	**ACTION:** Provide for a fall or early winter outflow that emulates the first "winter" rain through the Delta (DEDT-P3)	A-E	See Aquatic Monitoring Plan	Aquatic Monitoring Plan		
7-3.20	**ACTION:** Design and begin implementation of an ecologically based streamflow regulation plan for Yuba River, Butte Creek, Big Chico Creek, Deer Creek, Mill Creek, Antelope Creek, Battle Creek, Cottonwood Creek, and Clear Creek (SACR-P4)	A-E	See Aquatic Monitoring Plan	Aquatic Monitoring Plan		

Table 7-3. Floodplain and Riparian Habitat Quality: What is the extent and distribution of vegetation communities, sub-habitats, and MSCS plants in floodplain & riparian wetlands and associated upland habitats and what are the effects of hydrologic, geomorphic, and ecological processes and human activities

Monitoring recommendations are sorted under status and trends of extent, distribution, and composition of vegetation communities and habitats, and the hydrology, channel morphology, sediment supply, and human activities that affect them. Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
What is the extent of freely meandering reaches and other pre-1850 river channel forms that are functioning to support natural riverine, riparian, and floodplain habitats ? (ERP Strategic Objectives 2.8)						
7-3.21	**STATE: Natural channel morphology** Is natural channel meander occurring and resulting in a natural succession of habitat types? Channel migration is a key process in creating a mosaic of habitats across the landscape (18)	S	mapping of channel morphology -- sinuosity, width of meander belt, branching	Remote sensing-mapping	High	
			map channel geology for erosion potential and geologic control (natural hard points) (8)	Mapping -targeted studies		
			Channel cross-section change (16)	Sampling sites network; Water flow/stage gaging stations		
			channel migration (bank erosion, sediment deposition) (1)	Sampling sites network		
			distribution, extent, and succession of floodplain habitats--associations with channel changes. Includes plant seedling establishment rate and species in new sediment deposits (1)	Remote sensing-mapping; sampling sites network; targeted studies		
7-3.22	**PRESSURE: levees, channel straightening** **Straightening** of channels and levees eliminate the natural river meander processes and the habitats they support and disconnects the rivers from their floodplains. Straightened channels become trapezoidal. (18)	P	percent of river miles constrained by constructed levees	Remote sensing-mapping		CDWR
			width of meander corridor between levees	Remote sensing-mapping		ACOE?
			changes in channel planform & cross-sectional profile	sampling-sites network; gaging stations;		
7-3.23	**PRESSURE: rip-rap and other bank hardening structures** Rip-rap prevents natural channel migration by preventing bank erosion processes and disrupts natural plant community establishment.	P	length of river banks constrained by rip-rap or other channel hardening structures	mapping		
			changes in channel planform & cross-sectional profile	sampling-sites network; gaging stations;		

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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
7-3.24	**ACTION: Actions to increase extent of floodplain, improve floodplain inundation** • Develop floodplain management plans, including feasibility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary of all EMZ's except Delta and Suisun Marsh & Bay (DEDT-P5, SACR-P6, SJR-P4) • … in Yolo Basin… restore channel-floodplain connectivity and floodplain processes. … in lower Cache and Putah Creek floodplains, as well as in channels and sloughs of the upper Yolo Bypass to provide connections with the Delta in a manner consistent with flood control requirements…. (SACR-P1) • Restore & maintain a defined stream-meander zone and increase floodplain habitat on San Joaquin River between Vernalis and mouth of Merced River (SJR-P6) and between Chowchilla Bypass and Mendota Pool (SJR-P7)	A,E	Project-Extent & location of increased floodplain inundation, implementation status of actions	Programmatic / project	high	
			Project -- flood frequency, inundation, area, timing associated with project; mapping of channel morphology, channel migration, and changes in extent and distribution of floodplain habitats	Programmatic / project	high	
Are sediment supplies sufficient to create a mosaic of vegetation communities and habitats? (ERP Strategic Objective 2.7) Although restoration of sediment supplies is primarily of concern for creating salmon spawning habitat, such coarse sediment supplies also functions in creating gravel bars which form the basis for riparian and wetland plant establishment and succession.						
7-3.25	**STATE: Sediment supply, delivery, and movement processes** Is the sediment supply to floodplains sufficient and of the right texture to maintain the natural establishment and succession of vegetation? Coarse sediment supply from upper watersheds has been greatly diminished in many tributaries due to dams and gravel mining. CALFED has an objective and actions regarding re-establishing appropriate levels of coarse sediment supply to sustain salmonid breeding habitat. From a terrestrial viewpoint, the most important element to monitor is sediment deposition and erosion because these in turn affect vegetation establishment and succession. More detailed monitoring will be left to the aquatic program	S	areas, rates, locations, and textures of deposition and areas of erosion.	sampling sites network		
7-3.26	**STATE: <Support of salmonid habitat>** Changes in sediment supply will likely be targeted to benefit salmonid habitat. Monitoring for the terrestrial program will likely look to information gained from the aquatic monitoring plan.	S	<see Aquatic monitoring plan>			
7-3.27	**PRESSURE: DAMS** Dams block the natural sediment supply from reaching downstream areas.	P	Locations of dams on rivers and tributaries feeding into the Central Valley and Delta	mapping - programmatic		
7-3.28	**PRESSURE: Gravel mining** Instream gravel mining effects sediment supply on some tributaries. However this must be evaluated on a tributary by tributary basis.	P	Locations of in-stream gravel mining operations on rivers and tributaries feeding into the Central Valley and Delta	mapping - programmatic		
			tonnage sediment removed	Programmatic		

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7-3.29	**PRESSURE-NATURAL: Non-indigenous plant effects on sediment trapping (also can be indigenous plants)** Arundo, spartina, and egeria have large effects on trapping sediment and arundo can cause rapid narrowing of the channel. Perhaps this could be monitored at a few reference sites and then extrapolated to changes occurring elsewhere in the system. Changes can occur the other way also. Planting of juniper stands has been associated with decreases in sediment trapping.	P-N	Changes in waterways/wetlands due to excessive siltation caused by infestation of nonnative plants -- may need to occur outside of floodplain sampling sites network, depending on where infestations occur.	Sampling sites network; Targeted studies?		
7-3.30	**ACTION: Restoring coarse sediment supplies** How effective are CALFED actions in target tributaries in restoring gravel supplies that have been blocked by dams and levees? Restoration of gravel recruitment in targeted tributaries is intended to help salmon spawning habitat. However the gravel will also help with restoring riparian areas and over the long-term will wash out into the Delta and Bay where it may contribute to tidal wetlands. A: Fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ of Eastside Delta Tributaries, Sacramento River Basin, San Joaquin River Basin (DEDT-P4,SACR-P5, SJR-P3)	A,E	Effectiveness of gravel recruitment program in restoring gravel to targeted tributaries. Have actions changed the areas, rates, locations, and textures of deposition downstream of the actions?	Sampling sites network; Project monitoring	High	
			Completion status of assessments and implementation status of gravel recruitment programs	Programmatic	High	
			Number and location of small non-essential dams removed	Programmatic		
			Number and location of in-stream gravel mining operations moved outside of the stream channel	Programmatic	High	

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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
What are the Status and Trends in passerines and raptors in floodplain and riparian wetlands? (ERP Strategic Objectives 1.2, 2.3, 2.4, 4.4, 4.5, 5.6, 5.7, 6.1)						
7-4.1	**STATE: Passerines, raptors, etc** What are the status and trends in passerines and raptors in freshwater & riparian wetlands? In addition to being a ERPP biological community (Neotropical migratory birds), passerines and raptors can be good indicators of habitat quality. Because they are very mobile, they can respond quickly to changes in habitat condition and function.	S	Native Species diversity, richness, evenness, community composition (19)	Sampling sites network	High	Point Reyes Bird Observatory / California Partners in Flight
			Key indicator species indices of abundance or presence/absence including MSCS species (possibly Song sparrow, California Yellow warbler, Yellow-breasted chat, Common yellowthroat, Wilson's warbler, Warbling vireo, Swainson's thrush, Black-headed grosbeak, Bank swallow, Swainson's hawk, Western Yellow-billed cuckoo, American dipper, Least Bell's vireo, Little willow Flycatcher) (18, 19,33)	Sampling sites network	High	Point Reyes Bird Observatory / California Partners in Flight
			Reproductive success of selected key indicator species (possibly nesting successes, clutch size, nesting attempts per female)(19)	Sampling sites network		Point Reyes Bird Observatory / California Partners in Flight
			Extent and distribution of habitats associated with MSCS species (Bank swallow, California yellow warbler, Least Bell's vireo, Little willow flycatcher, Swainson's hawk, Western yellow-billed cuckoo)	Remote sensing - mapping	High	
Status and trends in waterfowl, wading birds, and shorebirds in floodplain wetlands (ERP Strategic Objectives 1.3, 3.3, 6.1)						
7-4.2	**STATE: Waterfowl** What are the status and trends in waterfowl communities in floodplain wetlands? The status of waterfowl directly relates to a CALFED objective. Waterfowl uses flooded floodplains and bypasses for foraging habitat during migration and a few species may use it as breeding habitat.	S	Species richness, community composition	Sampling sites network	High	
			Key indicator species indices of abundance or presence/absence including MSCS species (Aleutian Canada goose) (18)	Sampling sites network		
			Extent & distribution of various types of habitats preferred by various types of waterfowl	Remote sensing - mapping		
			Region-wide waterfowl surveys (Background for interpreting results at habitat quality sites)	regional surveys		CDFG
7-4.3	**STATE: Shorebirds** What are the status and trends in shorebird communities in floodplain and riparian wetlands?	S	Key indicator species indices of abundance or presence/absence including MSCS species (18)	Sampling sites network		PRBO
7-4.4	**STATE: Wading Birds** What are the status and trends in wading bird communities in floodplain and riparian wetlands?	S	Key indicator species indices of abundance or presence/absence including MSCS species (18)	Sampling sites network		

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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
What are the Status and Trends in Small Mammals, reptiles and amphibians in Floodplain and Riparian Wetlands (ERP Strategic Objectives 1.2, 1.3, 1.4, 5.6, 5.7, 6.1)						
7-4.5	**STATE: Small Mammals** What are status and trends in diversity and species richness of native small mammals in floodplain habitats? What are the status and trends of MSCS mammals in floodplain wetlands (San Joaquin Valley Woodrat, Riparian Brush Rabbit)? Small mammals can be good indicators for patch quality since they have small ranges and little ability to escape site pressures. They are also indicators of connectedness between patches and availability of prey for other species.	S	Native Species diversity, richness, evenness, community composition; (13)	Sampling sites network		
			Key indicator species relative abundance or presence/absence including MSCS species (San Joaquin Valley Woodrat, Riparian Brush Rabbit) (18)	Sampling sites network		
			extent, distribution, and number of patches of quality habitat for MSCS species (San Joaquin Valley Woodrat, Riparian Brush Rabbit)	Remote sensing - mapping		
7-4.6	**STATE: Larger Mammals** What are the status and trends in larger mammals species found in riparian and floodplain wetlands? Status and trends of larger mammals and bats will help complete the picture of ecological functioning at floodplain sites. However such monitoring might be restricted to more intensive monitoring sites and to restoration sites except where it overlaps monitoring for non-indigenous predators, since the monitoring methods will show a wider array of the species present other than just the target species.	S	Surveys for predators and larger mammals	Sampling sites network		
			Bat surveys	Sampling sites network		
7-4.7	**STATE: Reptiles and Amphibians** What are status and trends in diversity and species richness of native reptiles and amphibians in floodplain habitats? What are the status and trends of MSCS reptiles and amphibians in floodplain wetlands (California Red legged Frog, Western Spadefoot, Cal. Tiger salamander, western pond turtle, giant garter snakes)? Reptiles and amphibians can be good indicators for habitat quality since they have small ranges and little ability to escape site pressures. They are also indicators of connectedness between patches and availability of prey for other species.	S	Native Species diversity, richness, evenness, community composition;	Sampling sites network		
			Key indicator species relative abundance or presence/absence including MSCS Species (Giant Garter Snake, Western pond turtle, California red-legged frog, Foothill yellow-legged frog, Western spadefoot, California Tiger Salamander)	Sampling sites network		
			extent, distribution, and number of patches of quality habitat for MSCS species	Remote sensing - mapping		
Status and trends in terrestrial, vernal pool, and benthic invertebrates in floodplain & riparian wetlands (ERP Strategic Objectives 1.2, 1.3, 1.4)						
7-4.8	**STATE: Terrestrial invertebrates** Although status and trends in terrestrial invertebrates can show early response to pressures and actions, what should be recommended for monitoring is unclear. Such monitoring might be performed at restoration sites. Valley Elderberry longhorn beetle (riparian elderberry habitats) and Delta green ground beetle (vernal pools) are two species that require specific tracking.	S	Riparian, Vernal Pools -- Taxa richness, community composition, use a suitable diversity index, and measure biomass. --pollinators, herbivores, predators, parasites, detritivores, specific prey for endangered bird species. Measure variables in water such as salinity and pH.(17)	Targeted studies		
			presence/absence of MSCS species in appropriate habitats (Valley Elderberry longhorn beetle, Delta green ground beetle) (18)	sampling sites network		
			Extent and distribution of habitat used by MSCS species (elderberry, vernal pools)	remote sensing - mapping		

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No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
7-4.9	**Benthic invertebrates <see aquatic program>**	S	species richness, community composition, and percent dominant species (13, 14)	sampling sites network; Targeted studies		
			Water temperature, PH, Turbidity, Conductivity, (14)	sampling sites network; Targeted studies		
What is the degree of connectivity among floodplain and riparian habitats? (ERP Strategic Goal 4, Obj. 1.1, 1.2, 1.3, 1.4)						
7-4.10	**STATE: Connectivity between patches & groups of patches** How connected are fauna populations in floodplain and riparian wetlands with populations in other habitat blocks? Distances between patches and barriers to movement between patches restrict movement and migration for migratory bird species and for land bound fauna such as mammals, reptiles, and amphibians. "Connectedness" varies depending on the species being looked at. Birds can fly over roads that present a major barrier to mammals, reptiles and amphibians. Barriers are typically roads, levees, urban areas, agricultural areas not managed for wildlife, waterways.	S	Distribution of distances to nearest patch relative to dispersal distances of indicator species	Remote sensing - mapping	High	
			patch size distribution	Remote sensing - mapping	High	
			location and quality of movement corridors between habitat patches/blocks	Targeted studies		see Missing Linkages effort
			Use of corridors	Targeted studies		
			Location & types of barriers to movement between patches (roads, highways, bridges, canals, levees, water courses)	Remote sensing - mapping; targeted studies	High	Teale Data Center
			Location of functionally isolated patches and/or groups of patches	Remote sensing - mapping; targeted studies	High	
7-4.11	**STATE: Connectivity with upland habitat** How much of floodplains habitats have adequate connectivity with upland habitat to provide floodwater refugia and access to a mosaic of habitats? Small mammals, reptiles, and some birds require upland areas as high water refugia. This habitat must have good quality cover or these species will experience increased predation from raptors and non-indigenous predators while fleeing from high flood waters. Without refugia from flood water, floodplain habitats are of limited quality for small land-bound fauna that don't have alternate flood-coping strategies (Woodrats can retreat entirely into trees during flooding).	S	connectivity with upland -- extent and location of floodplain and riparian habitats with adequate connectivity with upland habitat to act as quality refugia from rising floodwaters	Remote sensing - mapping	High	
			Land use practices in the transition zones & floodwater refugia areas (grazing, etc)	Remote sensing - mapping	High	
What land use practices may be impacting biodiversity and at-risk species? Are the impacts outside of targeted limits? (cattle grazing, wood-cutting, agriculture, etc.) (ERP Strategic Obj. 1.1, 1.2, 1.3, 1.4)						
7-4.12	**PRESSURE: Land use / Management** Grazing can be damaging to vernal pool habitats depending on the management type Adjacent land uses which result in pesticide drift can impact MSCS species such as the Valley Elderberry Longhorn Beetle.	P	land use in and adjacent to floodplain habitats	remote sensing - mapping	high	

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7-4.13	**PRESSURE: :Lack of buffer zones from disruptive land uses** Urbanization, trash dumps, high traffic areas, and some forms of agriculture or rangeland management can all cause increased disturbance and artificially increase the number of predators.	P	distance to disruptive land uses or land uses that encourage non-indigenous fauna; presence of buffer zone of grassland and/or wetland habitat from other land uses	Remote sensing - mapping	High	see 5-3.1
			distance to land uses that increase abundance and/or impact of non-indigenous species (cowbirds, feral cats, dogs)	Remote sensing - mapping		see 5-3.1
	What are the levels of predation and/or competition pressure from non-indigenous fauna? Are they outside of tolerable limits? (ERP Strategic Obj. 1.2, 1.3, 1.4, 5.6, 5.7)					
7-4.14	**PRESSURE-NATURAL: Nest parasitism by brown-headed cowbirds** Where and to what degree are brown-headed cowbirds causing significant problems in reproductive success for riparian birds? Where are human activities and small patch size contributing to higher cowbird abundance?	P-N	Areas where brown-headed cowbirds are known to be causing problems	historical information; targeted studies		PRBO / RHJV
			<Reproductive success of selected key indicator species (possibly nesting successes, clutch size, nesting attempts per female)- see above>	Sampling sites network		USGS -Barbara Kus (targeted studies)
			abundance of brown-headed cowbird and/or rate of nest parasitism(19)	Sampling sites network		PRBO / RHJV USGS -Barbara Kus (targeted studies)
			vegetation relative to cowbird impact	Sampling sites network	high	
			patch size relative to cowbird impact	Remote sensing - mapping		
			proximity of riparian habitat to land uses that support cowbirds (feed lots?)	Remote sensing - mapping	high	USGS -Barbara Kus (targeted studies)
7-4.15	**PRESSURE-NATURAL: non-indigenous predators and/or competitors** Where and to what degree are non-indigenous fauna negatively impacting native populations?	P	Mammal surveys to detect presence or relative abundance of feral cats, dogs, norway rats, brown rats, introduced foxes	Sampling sites network		
			<Reproductive success of selected key neotropical migratory bird indicator species (possibly nesting successes, clutch size, nesting attempts per female)- see above>	Sampling sites network		
7-4.16	**PRESSURE: Predation by NATIVE predators** Are populations of native predators artificially high or low? Raccoons and ravens can artificially increase in density around urban areas and trash dumps. Coyotes can decrease in density if connectivity between habitat blocks is lost.	P	Mammal surveys to detect presence or relative abundance native predator abundance (coyotes, raccoons)	Sampling sites network		
			Proximity to urban areas and land uses which increase densities of non-indigenous predators	remote sensing - mapping		
7-4.17	**PRESSURE: Predation by bullfrogs, predatory fish** Are bullfrogs and predatory fish present in high enough numbers to impact native amphibians? Native amphibians have been strongly impacted by introduced bullfrogs and predatory fish. This is almost a moot point since very few waterways do not have bullfrogs and introduced predatory fish.	P	Presence of bullfrogs and /or predatory fish	Sampling sites network		

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7-4.18	**PRESSURE: Presence of new non-indigenous species that may become problematic.** Have new non-indigenous species become established? Unfortunately new species are introduced into the ecosystem that create new problems for native species. The ERPP has identified the red-eared slider as a possible problem species.	P	Presence of new non-indigenous species such as the red-eared slider	Sampling sites network		
What is the level of wildlife health and effect of contaminants in floodplain and riparian wetlands? Is it outside of tolerable limits? (ERP Strategic Obj. 1.1, 1.2, 1.3, 1.4, 6.1, 6.2)						
7-4.19	**PRESSURE-NATURAL: Disease effects on wildlife** Is the incidence of disease outside of normal variation? Do new diseases appear to be negatively impacting populations? New or established diseases can periodically impact passerine and raptor populations. The West Nile virus is currently strongly impacting bird populations & small mammal populations on the east coast and may reach California during the lifetime of CALFED and possibly as early as within 10 years. A chytrid fungus has been associated with declines in amphibians at higher elevations although not necessarily at lower elevations.	P-N	Health of trapped individuals (evidence of disease, mutations, parasites, etc.) (18)	Sampling sites network		
			Unusual numbers of dead animals	Sampling sites network		
			If disease outbreaks are evident and at a level to cause concern, additional targeted research may be warranted -- disease identification, tracking of carcasses, etc.	Targeted studies		
7-4.20	**PRESSURE: Contaminants effects on wildlife** Contaminants – mercury, selenium, trace metals, pesticides -- can all have effects on fauna in floodplain wetlands. However, monitoring for contaminants should be coordinated with the aquatic monitoring program, since contaminant effects are expected to be discernable faster in the aquatic environment than in the terrestrial environment. Targeted studies can be used in areas where contaminants are thought to be impacting the terrestrial species and the relationship to trends in the aquatic environment are unclear. Mercury and selenium toxicity effects are of concern in waterfowl. However what should be included in a monitoring program is unclear. Targeted studies may be more appropriate.	P	Health of trapped individuals (evidence of disease, mutations, parasites, etc.) (13)	sampling sites network		
			Aquatic toxicity measures (fish tissue, benthic invertebrates communities, algal communities) (18)	Aquatic monitoring plan		DWR-D1485 Program; SFEI - Regional Monitoring Program for Trace Substances; SRWP
			Water quality monitoring	Aquatic monitoring plan		CDWR-Environmental monitoring program; DWR-D1485 program; SFEI - Regional Monitoring Program for Trace Substances; SRWP; DWR-MWQI; USGS-Polaris; DWR-Operations & Compliance Monitoring
			Evidence of airborne pesticide drift, especially in areas with MSCS species or other sensitive areas(12)	sampling sites network		
			Research into toxicity effects in waterfowl eggs.	Targeted studies		
			Concentrations of mercury in waterfowl tissue relative to human health concerns	Targeted studies		
			Targeted studies of raptors where concerns are raised	Targeted studies		UC Davis

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P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
7-4.21	**ACTION: Reduce Contaminants** Mercury abatement work in Cache Creek watershed, Delta, Sacramento River (DEDT-S15, DEDT-S16, SACR-S13, SACR-S14) Pesticide work (Diazinon & chlorpyrifos) (DEDT-S17, SMB-S6, SACR-S15, SJR-S12) Selenium work… (DEDT-S18, SMB-S7, SJR-S13) Reduce organochlorine pesticide to streams… (DEDT-S19, SMB-S8, SACR-S16, SJR-S14) Trace metal work… (Copper, cadmium, zinc, chromium) (DEDT-S20, SBM-S9, SACR-S17, SJR-S15) Unknown toxicity studies… (DEDT-S21, SMB-S10, SACR-S18, SJR-S16) Research on ecological/biological threshold concentrations for mercury in sediments and key organisms (SMB-S5) Research & actions to reduce pesticides, organochlorine pesticides, trace metals, selenium. (SMB-S6, S7, S8, S9) Studies to identify unknown toxicity, and develop management actions as appropriate. (SM-S10)	A,E	Location and implementation status and effectiveness of actions	programmatic	High	
			Aquatic toxicity measures (fish tissue, benthic invertebrates communities, algal communities)	Aquatic monitoring plan	High	
			Water quality monitoring	Aquatic monitoring plan	high	
What site history should be used to interpret results? What floods and fires and other catastrophic events should be used when interpreting results? (ERP Strategic Obj. 1.1, 1.2, 1.3. 1.4, Goal 4)						
7-4.22	**PRESSURE-NATURAL: Floods and fires** Fires are a real threat to MSCS small mammals such as the Riparian Brush Rabbit or San Joaquin Valley Woodrat. A single fire can wipe out an entire population. Likewise extreme flood events during which refugia sites go under water (i.e. levees are overtopped, small "islands" of higher ground are overtopped) can also be devastating.	P-N	*Document fires*	Sampling sites network		
			Document floods that inundate floodwater refugia	Sampling sites network		

Table 7-4. Floodplain and Riparian Habitat Quality: Support of biodiversity and MSCS species in floodplain & riparian wetlands

Currently recommended for monitoring are passerines & raptors, waterfowl, shorebirds, wading birds, small mammals, non-indigenous and indigenous predators, reptiles, amphibians, and benthic and terrestrial invertebrates. The section on neotropical migratory birds contains a complete set of pressures and state variables. Other groups contain abbreviated lists since many of the pressures are the same. Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs.

P=Pressure, S=State of the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

No.	Attribute & Rationale	PSAE	Monitoring Element	General Method	Priority Level	Existing Program?
	What is the effect of habitat restoration on biodiversity, at-risk species, and improving the connectivity among habitats? (ERP Strategic Obj. 1.1, 1.2, 1.3, 1.4, 4.2)					
7-4.23	**ACTION: Restore Riparian habitat, seasonal wetlands and permanent wetlands** … establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary of all EMZ's except Delta, SMB, and WSJR (DEDT-H7, SACR-H2, SJR-H4) Implement 25 percent of the ERP target for diverse, self-sustaining riparian community for each EMU in Delta EMZ. and all SJR EMZ's (DEDT-H8, SJR-H5) Restore min. 300 acres of self-sustaining or managed diverse natural riparian habitat along the Mokelumne River, Cosumnes River, and Calaveras River and protect existing riparian habitat. (DEDT-H9) Cottonwood Creek EMZ, complete …agreements with local landowners to establish, restore, and maintain riparian communities along 25 percent … of Cottonwood Creek, and develop comprehensive watershed management plan …. (SACR-H3) Restore 2 miles of the 10 mile target of riparian habitat restoration along the lower reaches of each of the following tributaries: Battle, Clear, Deer, Mill, Butte, Big Chico, Antelope, Feather, Yuba, and Bear Rivers. (SACR-H4) Restore and maintain min. 3 linear miles of riparian habitat along corridors of existing riparian scrub and shrub vegetation in each EMU (SMB-H1) Enhance, protect and restore 1,000 to 1,500 acres of seasonal wetlands in the East Delta EMU for optimum greater sandhill crane habitat. (DEDT-H10) … acquire, manage and restore100 acres of vernal pools and 500 -1,000 acres of adjacent buffer areas (SMB-H6) Implement 25% of ERP target for enhancing, protecting, and restoring seasonal wetlands in the following EMZs: American River Basin, Butte Basin, Colusa Basin, and Feather River/Sutter Basin. (SACR-H5) In the West San Joaquin Basin EMZ, restore or create 100 acres of fresh emergent wetland habitat. (SJR-H2)	A,E	Location, extent, and implementation status of actions	programmatic	High	
			Use of restored habitat by passerines, waterfowl, wading birds, shorebirds, mammals	Project monitoring		
			Use of restored habitat by MSCS species (18)	Project monitoring		

8.0 OTHER HABITATS

This section identifies the monitoring elements for inland dune scrub, non-tidal wetlands, upland habitats, and wildlife friendly agriculture. Since these habitats are of lower focus in CALFED than the tidal wetland and floodplain and riparian wetland habitats the monitoring generally takes the form of
1) extent and distribution of habitats
2) status and trends of “R” and “r” species in habitats (primarily inland dune scrub)
3) location and extent of habitat protection, restoration and enhancement projects
4) effectiveness of restoration and enhancement projects in benefiting ERP/MSCS at-risk species and biological communities.

Inland Dune Scrub

Inland Dune Scrub refers to both the NCCP and ERP designations of Inland Dune Scrub habitat.

ERP Strategic Objective[9]

> Restore large expanses of all major habitat types, and sufficient connectivity among habitats, in the Delta, Suisun Bay, Suisun Marsh, and San Francisco Bay to support recovery and restoration of native species and biotic communities and rehabilitation of ecological processes. These habitat types include tidal marsh (fresh, brackish, and saline), tidal perennial aquatic (including shallow water and tide flats), nontidal perennial aquatic, tidal sloughs, midchannel island and shoal, seasonal wetlands, riparian and shaded riverine aquatic, inland dune scrub, upland scrub, and perennial grasslands.

ERP Vision[8]

> Protect and enhance existing areas and restore former habitat areas. Achieving this vision will provide high quality habitat for associated special-status plant and animal populations.

ERP/MSCS at-risk species[8,11]:
RECOVER (R): Antioch Dunes Evening Primrose, Contra Costa Wallflower, Lange’s Metalmark
MAINTAIN (m): San Joaquin whipsnake

Background and Issues
Inland dune scrub is associated with inland sand dunes adjacent to the San Joaquin River in the vicinity of the Antioch Dunes National Wildlife Refuge. The presence of wind-modified sands deposited by the river and the Delta wind patterns create a natural disturbance regime. This natural instability, combined with low nutrient conditions of the soils, limits the amount of vegetation established on the dunes. This natural disturbance threshold favors the establishment of native plants characteristic of the dunes and prevents establishment of species less tolerant of these conditions. The localized habitat supports the Antioch Dunes evening primrose, Contra Costa wallflower and Lange’s metalmark butterfly.

Direct and indirect disturbances affect the extent and quality of inland dune scrub habitat. Sand mining and other land use conversions result in habitat loss. Urban development in historical dune habitat also affects wind-flow patterns which create and maintain the sand dunes. Structures or activities that disrupt the wind-driven movement of sand affect the processes necessary to sustain dunes including establishment of native vegetation. Human disturbance (e.g., excessive foot traffic, off-road vehicles) and grazing affect erosion of dune surfaces and directly impact existing native plant species. Herbicides, pesticides, and fertilizers can also affect native species and contribute to the establishment of non-native weeds that stabilize the soil, compete with native plants and reduce habitat quality.

The following actions are identified by the ERPP to restore inland dunes:

- Removing barriers to wind-driven sand-dune movement to increase the area that would be available for natural expansion of the sand-dune base
- Importing sands from areas being developed or clean sand dredged from Bay-Delta channels to increase restoration potential and dune area
- Controlling non-native weeds to recreate conditions suitable to re-establishment of native plant community
- Reducing use of herbicides, pesticides, and fertilizers that adversely affect native dune species

<u>ERP Milestone</u>

- Conduct surveys to locate potential habitat restoration sites capable of supporting Antioch dunes evening primrose, Contra Costa wallflower, and Lange's metalmark butterfly. Enhance 50 acres of low to moderate quality Antioch inland dune scrub habitat to support these species. Annually monitor establishment success. (DEDT-H5)

<u>Management Questions</u>

What is the extent and distribution of inland dune scrub habitat?

What are the status and trends in the relative abundance and distribution of inland dune scrub ERP/MSCS at-risk species (Lange's Metalmark, Antioch Dunes evening Primrose, Contra Costa wallflower)?

What is the implementation status, location and extent of inland dune scrub habitat restoration and enhancement actions?

How effective are inland dune habitat restoration and enhancement actions on increasing the abundance and distribution of ERP/MSCS at-risk species?

<u>Monitoring for inland dune scrub</u>

Monitoring will primarily consist of coordinating with the existing USFWS monitoring programs that annually survey populations of the three at-risk species, monitoring the extent of inland dune habitat, and monitoring project success:

- Species surveys for Antioch Dunes evening primrose, Contra Costa wallflower, Lange's Metalmark (and host species naked buckwheat) – annual population counts, abundance, distribution (See Appendix G for more information on these species)

- Spatial extent & distribution of available habitat and enhanced habitat
- Monitor enhanced and restored habitat areas to determine the success of enhancement and restoration methods, and to determine the response of Antioch Dune's evening primrose, Contra Costa wallflower, and Lange's metalmark populations to management

Non-Tidal Wetlands in Delta
Non-tidal wetlands in this section refers to lacustrine and non-tidal perennial aquatic habitats disconnected from the active floodplain (i.e. ponds, marshes, levee blowout ponds on delta islands).

ERP Strategic Objectives[9]

4.1 Restore large expanses of all major habitat types, and sufficient connectivity among habitats, in the Delta, Suisun Bay, Suisun Marsh, and San Francisco Bay to support recovery and restoration of native species and biotic communities and rehabilitation of ecological processes. These habitat types include tidal marsh (fresh, brackish, and saline), tidal perennial aquatic (including shallow water and tide flats), nontidal perennial aquatic, tidal sloughs, midchannel island and shoal, seasonal wetlands, riparian and shaded riverine aquatic, inland dune scrub, upland scrub, and perennial grasslands.

4.2 Restore large expanses of all major aquatic, wetland, and riparian habitats, and sufficient connectivity among habitats, in the Central Valley and its rivers to support recovery and restoration of native species and biotic communities and rehabilitation of ecological processes. These habitat types include riparian and shaded riverine aquatic, instream, fresh emergent wetlands, seasonal wetlands, other floodplain habitats, lacustrine, and other freshwater fish habitats.

4.3 Protect tracts of existing high quality major aquatic, wetland, and riparian habitat types, and sufficient connectivity among habitats, in the Bay-Delta estuary and its watershed to support recovery and restoration of native species and biotic communities, rehabilitation of ecological processes, and public value functions.

ERP/MSCS Species and Biological Communities[8,11]

CONTRIBUTE TO RECOVERY**:** California black rail, Greater sandhill crane, Sacramento Perch, Bristly sedge, Giant Garter Snake

MAINTAIN: California red-legged frog?, Aleutian Canada goose, American peregrine falcon, Bald eagle, Black-crowned night heron, California gull, Long-billed curlew, Northern harrier, Short-eared owl, Snowy egret rookeries, tricolored blackbird, Western least bittern, White-faced ibis, White-tailed kite, Eel-grass pondweed, Marsh skullcap, Rose mallow, Western Pond Turtle

BIOLOGICAL COMMUNITIES: Native anuran amphibians, Neotropical Migratory birds, Shorebird and Wading bird guild, Waterfowl

Issues

Non-tidal wetlands include NCCP habitats "lacustrine", and "non-tidal freshwater permanent emergent" . These habitats include lakes, ponds including levee "blow-out ponds", and flooded islands as well as agricultural ditches and canals. Such habitats serve as habitat for bristly sedge, giant garter snake and possibly California black rail as well as waterfowl, shorebirds, and wading birds and numerous "m" at-risk species. Large amounts of this habitat were lost in the delta when the islands were leveed and converted to agriculture. Disturbance and lack of associated upland habitat can diminish habitat quality. Contaminants could be a problem depending on agricultural land use practices. Introduced bullfrogs and predatory fish diminish the quality in remaining wetlands for native anuran amphibians.

<u>ERP Milestone[8a]</u>

* DEDT-H3: Restore a minimum of 500, 250, 1,000, and 2,500 acres of nontidal emergent wetland in the North, East, South, and Central and West Delta Ecological Management units respectively. Establish at least one population of bristly sedge in each EMU.

<u>Management Questions</u>

What is the extent and distribution of non-tidal wetlands in the Delta?

What are the status of ERP/MSCS at-risk species (R and r) within non-tidal wetlands in the Delta?

What is the implementation status, location and extent of non-tidal wetland restoration projects?

Are restoration projects being used by ERP/MSCS at-risk species and ERP biological communities?

<u>Monitoring for non-tidal wetlands</u>

- Extent and distribution of non-tidal wetlands in Delta
- Status and trends in "r" species that use non-tidal wetlands in the Delta
- Implementation status, location and extent of non-tidal wetland restoration efforts
- Effect of restoration -- project monitoring (use by waterfowl, shorebirds, wading birds, native anuran amphibians, and ERP at-risk species)

Alluvial Uplands

Alluvial uplands refers to upland scrub, woodland, and perennial grassland habitat, especially where associated with tidal wetlands and freshwater and riparian habitats.

<u>ERP Strategic Objective[9]</u>

Restore large expanses of all major habitat types, and sufficient connectivity among habitats, in the Delta, Suisun Bay, Suisun Marsh, and San Francisco Bay to support recovery and restoration of native species and biotic communities and rehabilitation of ecological processes. These habitat types include tidal marsh (fresh, brackish, and saline), tidal perennial aquatic (including shallow water and tide flats), nontidal perennial aquatic, tidal sloughs, midchannel island and shoal, seasonal wetlands, riparian and shaded riverine aquatic, inland dune scrub, <u>upland scrub, and perennial grasslands</u>.

ERP Vision[8]

Protect and improve existing perennial grasslands and increase perennial grassland area to improve high quality habitat for special-status plant and wildlife populations and other wildlife dependent on the Bay-Delta.

ERP/MSCS Species and Biological Communities in Grasslands[8.11] in and around the Delta (i.e. in the Delta, Suisun Marsh & North San Francisco Bay, Eastside Delta Tributaries, West San Joaquin Basin, Yolo Basin Ecological Management Zones. Not all may be benefited by restoration of perennial grasslands)

CONTRIBUTE TO RECOVERY: Greater sandhill crane, Swainson's hawk,

MAINTAIN: Amphibians: California Red Legged Frog, California Tiger Salamander, Reptiles: Alameda Whipsnake, Blunt-nosed leopard lizard, San Joaquin Whipsnake, Birds: California condor, Golden eagle, Grasshopper sparrow, Long-billed curlew, Mountain plover, Northern harrier, Short-eared owl, tricolored blackbird, White-tailed kite, Invertebrate: Callippe silverspot butterfly, Mammals: Giant kangaroo rat, Greater western mastiff-bat, Nelson's antelope ground squirrel, San Joaquin kit fox, Plants: Big tarplant, Brewer's western flax, Brittlescale, Calistoga popcornflower, Clara Hunt's milk-vetch, Congdon's tarplant, Diablo helianthella, Diamond-petaled California poppy, Ferris's milk-vetch, Hartweg's golden sunburst, Heartscale, Henderson's bent grass, Hoover's eriastrum, Large-flowered fiddleneck, Lesser saltscale, Lost Hills crownscale, Marin western flax, Most beautiful jewel-flower, Mt. Diablo fairy-lantern, Mt. Diablo jewelflower, Panoche peppergrass, Recurved larkspur, Red-flowered lotus, Rock sanicle, San Joaquin spearscale, San Joaquin woolythreads, Santa Cruz tarplant, Showy Indian clover, Showy madia, Sonoma spineflower, Spiny-sepaled button-celery, Tiburon Indian paintbrush, Tiburon jewelflower, Tiburon Mariposa lily, White-rayed pentachaeta, Yellow larkspur,

BIOLOGICAL COMMUNITIES: Upland game, Native anuran amphibians, Neotropical Migratory birds, Shorebird and Wading bird guild, Waterfowl

Issues and Background

The San Joaquin and Sacramento Valleys together form the great Central Valley of California, an enormous flat-bottomed basin rimmed by the Sierra Nevada on the east, the Cascades to the north, and the Coast Ranges to the west and south. The valley floor is approximately 690 kilometers (430 miles) long and includes about 6 million hectares (15 million acres). Prior to agricultural, and later urban development, the Central Valley was dominated by extensive stands of riparian forest, tule marshes, and other wetlands. Surrounding these low, wet areas in the valley bottom was a mosaic of perennial grasslands (including annual forbs), oak woodlands, and some forms of upland scrub habitat, mostly at the southern, more xeric end of the valley.

The vast majority of these habitats have been replaced over the last 150 years by a wide array of agricultural development. What remains is a highly fragmented small remnant of natural habitats in the valley bottom, surrounded by a somewhat more intact ring of grasslands and oak woodlands on the fringe between the valley bottom and the adjoining hilly/montane region. These perennial grasslands and oak woodlands provide habitat to a wide array of plant and animal species. Most of the valley bottom is now in various forms of agricultural crops that also provide habitat value to some species of wildlife. This mixture of remnant grassland and oak woodland, mixed amongst the extensive establishment of agricultural crops, all in the valley bottom, is what is referred to as Uplands.

In addition to large-scale habitat loss, the remaining grasslands have become dominated by introduced annual grasses. Perennial grasslands dominated by native bunchgrasses have become relatively rare. Perennial grasslands provide higher quality habitat for native species throughout the long, dry summers and respond differently to ecological processes such as fires when compared with annual dominated grasslands.

Of the different types of upland habitat, the ERPP has specifically focused on restoring perennial grassland in and around the Delta, especially where it will provide quality upland habitat for wetland species. Other types of upland habitat are primarily of interest to the ERPP when they provide upland refugia habitat, buffers from other land uses, and corridors connecting wetland habitat.

ERP Milestone[8a]

- In the West San Joaquin Basin EMZ, restore or enhance 1,000 acres of perennial grassland associated with existing or proposed wildlife corridors, wetlands, or floodplain habitats. (SJR-H3)

Management Questions

What are the status and trends in the extent and distribution of perennial grasslands in and around the Delta?

What are the implementation status, location, and extent of perennial grassland restoration efforts?

What is the effectiveness of projects in restoring perennial grasslands (versus non-native annual dominated grasslands) and what is the use by perennial grasslands of MSCS species?

What are the status and trends in the extent and distribution of upland habitats (upland scrub, valley/foothill woodland) near or adjacent to floodplain and riparian wetlands and/or tidal wetlands or in movement corridors that affect those wetlands?

Monitoring for alluvial upland

Alluvial uplands are peripheral to the primary objectives of CALFED and consequently the monitoring will consist of tracking of habitats and any specific projects that occur.

- Extent and distribution of perennial grassland
- Perennial grassland restoration project monitoring – Location, extent, implementation status, and effectiveness of restoration and use of habitat by MSCS species and ERP biological communities
- Extent, distribution, and land use of upland habitats directly associated with tidal wetlands and floodplain wetlands or with habitat corridors that link them.

Wildlife-friendly Agriculture
Wildlife friendly agriculture primarily refers to seasonally flooded agriculture (i.e. rice) and upland cropland (i.e. grain crops, row crops, orchards) as well as grazing management.

<u>ERP Strategic Objective[9]</u>

Minimize the conversion of agricultural land to urban and suburban uses and maintain open space buffers in areas adjacent to existing and future restored aquatic, riparian, and wetland habitats, and manage agricultural lands in ways that are favorable to birds and other wildlife.

<u>ERP Vision[8]</u>

Improve associated wildlife habitat values to support special-status wildlife populations and other wildlife dependent on the Bay-Delta

<u>ERP/MSCS Species and Biological Communities[8,11]</u>

CONTRIBUTE TO RECOVERY (r): Greater sandhill crane, Swainson's hawk, Giant Garter Snake

MAINTAIN (m): Aleutian Canada goose, Bald eagle, California gull, Long-billed curlew, Mountain plover, Northern harrier, Short-eared owl, tricolored blackbird, White-faced ibis, White-tailed kite, San Joaquin kit fox

BIOLOGICAL COMMUNITIES: Upland game, Neotropical Migratory birds, Shorebird and Wading bird guild, Waterfowl

<u>Issues</u>

Wildlife friendly agriculture has been divided into two different NCCP habitats: Seasonally flooded agriculture (such as rice fields), and upland cropland (such as wheat, corn, orchards). Grazing is a third type of agriculture, but would probably be mapped as grassland, upland scrub, seasonal wetlands or riparian habitat.

Agricultural areas can provide varying degrees of value to wildlife depending on management. These include 1) crop type & management including fallow period management, 2) vegetation and water management along non-tilled areas such as ponds, irrigation ditches, rice checks, fence rows, etc. and 3) grazing management.

Crop type and management – grain crops such as rice can provide food for overwintering and migrating greater sandhill cranes and waterfowl, depending on crop residue management and pesticide use. They can also support small fauna which in turn can support giant garter snakes, wading birds, and other species when flooded. Timing and methods of tillage, mowing, residue management, etc. can impact species.

Management of non-tilled areas – often fence rows, field boundaries, and irrigation ditches are kept clear of vegetation to reduce water use and eliminate refugia for weeds and pests. However these areas can provide valuable habitat and migration corridors when carefully managed.

Grazing management – careful grazing management can influence the effect of grazing on vegetation, on vernal pools, and on stream and river banks and sediment loading.

ERP Milestones[8a]

- In the Sacramento-San Joaquin Delta EMZ, cooperatively enhance at least 15% of the ERP target for wildlife friendly agricultural practices. (DEDT-H1)
- In the American River Basin, Butte Basin, Colusa Basin, Feather River/Sutter Basin EMZs, cooperatively enhance at least 15 to 25% of the ERPP target for wildlife friendly agricultural practices.(SACR-H1)
- In the San Joaquin River and West San Joaquin Basin EMZs, cooperatively enhance at least 15 to 25% of the ERPP target for wildlife friendly agricultural practices (SJR-H1)

Management Questions

In critical areas such as buffers around tidal wetlands and floodplain habitats and habitat corridor areas
  - What are the status and trends in land use?
  - What is the protection status regarding such agricultural land being converted to urban development?
  - Are landowners involved in voluntary programs for wildlife-friendly agriculture? What types?
  - What crops are being grown?

What are the land uses near natural habitats?

What is the location and extent of agricultural habitat in wildlife-friendly crops? (i.e. rice, other?)

What is the acreage of land whose landowners are participating in voluntary landowner incentive programs? What type?

Are educational outreach programs having an effect on management practices?

Monitoring for wildlife-friendly agriculture

- In lands near or adjacent to tidal and floodplain wetlands or in critical habitat corridors
  - land use & crop type
  - acreage and location of conservation easements
  - acreage in which management is engaging in wildlife-friendly agricultural practices that encourage greater sandhill cranes, waterfowl, giant garter snakes, or other species
  - validation monitoring and/or targeted research of association between agricultural practices and use by greater sandhill cranes, waterfowl, and giant garter snakes and any other targeted species
  - project monitoring – implementation status and effectiveness
- Location and extent of land converted from agriculture to urban, especially land near or adjacent to tidal and floodplain wetlands
- Some measure of education outreach efforts to local farmers and the amount of response

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9.0 ERP BIOLOGICAL COMMUNITIES MONITORING RECOMMENDATIONS

This section identifies the monitoring necessary to assess status and trends in and the cumulative effects of CALFED actions on the following ERP targeted biological communities: waterfowl, shorebird guild, wading bird guild, neotropical migratory birds, native anuran amphibians, and ERP plant assemblages. This monitoring relates to the following strategic objective:

ERP Strategic Objectives 1.3: Enhance and/or conserve native biotic communities in the Bay-Delta estuary and its watershed, including the abundance and distribution of the following biotic assemblages and communities: native resident estuarine and freshwater fish assemblages, anadromous lampreys, neotropical migratory birds, wading birds, shore birds, waterfowl, native anuran amphibians, estuarine plankton assemblages, estuarine and freshwater marsh plant communities, riparian plant communities, seasonal wetland plant communities, vernal pool communities, aquatic plant communities, and terrestrial biotic assemblages associated with aquatic and wetland habitats. [9]

Monitoring for these groups overlaps somewhat with monitoring for habitat quality and monitoring for ERP at-risk species. In some cases ERP visions, objectives and targets are included because they clarify CALFED's intentions for these groups. Conceptual models and greater refinement of the monitoring recommendations are needed.

Waterfowl

The Ecosystem Restoration Program Plan (2000)[8] offers a brief conceptual model and the Baylands Ecosystem Habitat Goals Project (Goals Project, 2000)[26] a more detailed model of waterfowl in the San Francisco Bay and Central Valley, including management and habitat restoration issues. The Suisun Ecological Workgroup Final Report (June 1999)[34] identifies the issues in Suisun Marsh. The reader is referred to these resources as this document addresses only some of these issues. The USFWS *Waterfowl Population Status, 2001* report (USFWS 2001)[37] provides a discussion of nationwide trends in waterfowl abundance and includes trends in California.

ERP Vision, Targets, and Objectives[8]

ERP Vision

Maintain healthy populations at levels that can support consumptive (e.g. hunting) and nonconsumptive (e.g. birdwatching) uses consistent with the goals and objectives of the Central Valley.

ERP Target

Improve populations and distribution of waterfowl

ERP Long-term Objective

Substantially increase the numbers of resident and migratory ducks and geese that use the Bay-Delta watershed by increasing habitat available to them.

ERP Short-term Objective

Continue restoration of wetlands suitable for waterfowl production and over-wintering, while developing strategies for management of waterfowl areas that are compatible with other species, habitat, and ecosystem process restoration goals.

ERP Stage 1 Expectations

Acquisition and development of new wetlands favorable for wintering and nesting waterfowl (e.g. Yolo Basin Wildlife Area) will have continued. Significant areas of existing agriculture will be managed using wildlife friendly practices. For existing public wildlife areas, plans to reduce conflicts between waterfowl management and management for other native species, including provisions for emergency situations (e.g. levee repairs) will have been developed. For private waterfowl areas, incentives for implementing broader, ecosystem-based management goals will have improved.

<u>Management Questions</u>

What are the status and trends in types of waterfowl and key indicator species abundance, diversity, and distribution?

What are the numbers and species of waterfowl harvested? What are the trends in catch per unit effort?

What is the extent and distribution of natural habitats and managed wetlands preferred by various types of waterfowl? What is the extent and distribution of agricultural lands with management practices that provide habitat for waterfowl?

What problems in waterfowl health are occurring, i.e. what contaminants may cause problems for waterfowl, especially residential waterfowl? What disease outbreaks are occurring? Are they exacerbated by overcrowding?

What is the extent, distribution and implementation status of wetland restoration efforts? How do these restoration efforts affect waterfowl use of the habitat?

How have CALFED efforts to increase waterfowl friendly agricultural practices affected waterfowl use of agricultural lands?

How are waterfowl responding to the large changes in the distribution of waterfowl habitat across the landscape?

<u>MSCS Species</u>

MAINTAIN: Aleutian Canada goose

<u>Issues:</u>

Large-scale loss of over-wintering, migration, and breeding habitat affect waterfowl in California. Overcrowding of waterfowl onto the few remaining areas is associated with disease outbreaks. The small amount of remaining waterfowl habitat also creates challenges for management because some of the diked wetlands in Suisun Marsh and other areas of the San Francisco Bay that are considered for conversion to tidal wetlands currently support large numbers of waterfowl and shorebirds. CALFED proposes conversion of habitat in the Delta and Sacramento Valley to wetlands with lower salinity which might improve waterfowl health. CALFED also proposes waterfowl-friendly agricultural practices that could increase the amount of winter foraging habitat available to waterfowl. These large-scale habitat changes across the landscape may affect the distribution and abundance of waterfowl or changes may affect extent and management of current wetlands

Pressures -- migratory:

Pressures for migratory waterfowl include:

- Habitat loss – foraging, roosting
- Poor habitat quality – type and quality of vegetation and food availability
- Disease (exacerbated by overcrowding)
- Agricultural management that is not waterfowl friendly
- Contaminants? It is currently hypothesized that contaminants in the Central valley have little to no effect.
- Habitat loss and other pressures on breeding grounds, wintering grounds, and along migratory routes.

Pressures - residential

- Habitat loss – foraging, roosting, breeding/nesting
- Poor habitat quality – type and quality of vegetation and food availability
- Disease (exacerbated by overcrowding)
- Agricultural management that is not waterfowl friendly
- Contaminants effects on reproductive success – especially mercury and selenium
- Salinity levels and reproductive success
- Predation on young by non-indigenous and indigenous predators

CALFED Actions

- Restore 2000 acres Tidal perennial aquatic habitat, (SMB, DEDT)
- Restore min. of 7,000 acres tidal emergent wetland in Suisun Marsh and 10,000 acres, in the Delta (SMB, DEDT)
- Restore min. 4250 acres nontidal emergent wetland in Delta (DEDT)
- Restore min. 125 acres of channel islands & 125 acres of shoals (DEDT)
- Habitat restoration, enhancement & protection of 1000+ acres Seasonal wetlands (DEDT, SACR)
- Protect, enhance, & restore riparian habitat (DEDT, SMB, SACR, SJR)
- Increase acreage under wildlife friendly agricultural practices (DEDT, SJR, SacR)

Monitoring Recommendations

See Table 9-1.

Existing Monitoring Efforts

Large-scale/regional monitoring

- California Department of Fish and Game & US Fish & Wildlife Service. September and mid-winter waterfowl counts.
- U.S. Fish and Wildlife Service
  - Harvest information program,
  - May breeding waterfowl and habitat survey

Small-scale or targeted studies

- U.S. Geological Survey – Western Ecological Research Center. Targeted Studies on Pintail migration, habitat use & recovery, toxicity in waterfowl, white-fronted goose studies, waterfowl use of rice fields, and waterfowl use of salt ponds.
- U.S. Geological Survey and Central Valley Habitat Joint Venture – studies on waterfowl use patterns and relationship to created habitat.

Table 9-1. Monitoring recommendations for waterfowl.

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

WATERFOWL (ERP Strategic Objectives 1.3, 3.3, 6.1)

No.	Attribute & Rationale	Type	Monitoring Element	General Method	Priority level	Existing Program?
9-1.1	**Waterfowl abundance & Distribution** What are the status and trends in types of waterfowl and key indicator species abundance, diversity, and distribution? The status of waterfowl directly relates to a CALFED objective.	S	Waterfowl abundances by group (dabbling ducks, diving ducks, geese, swans)	Regional surveys - seasonal aerial surveys	continue	USFWS & CDFG currently has September & mid-winter surveys. The number of surveys/year need to be increased.
			key indicator species indices of abundance (the Goals Project (26) recommends Northern pintail, Mallards, canvasbacks, greater & lesser scaup, ruddy duck, bufflehead, surf scoter, tule geese. The Aleutian Canada goose should also be included (11)	Regional surveys - seasonal	continue	USFWS & CDFG
			Water Bird surveys-Waterfowl use of tidal wetlands	Sampling sites network-tidal wetland		
			Water bird surveys-Waterfowl use of floodplain habitats	Sampling sites network-floodplain		
			Resident waterfowl productivity / reproduction	Targeted studies?		
9-1.2	**Waterfowl Harvest** What are the numbers and species of waterfowl harvested? What are the trends in catch per unit effort? This is only included because CALFED lists waterfowl as a harvestable species that is to be maintained "for sustainable commercial and recreational harvest". It is not included for an ecological reason.	S	Harvest reports by species	Hunter surveys	continue	CDFG
			Catch per unit effort	Hunter surveys	continue	CDFG

Table 9-1. Monitoring recommendations for waterfowl.

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

WATERFOWL (ERP Strategic Objectives 1.3, 3.3, 6.1)						
No.	**Attribute & Rationale**	**Type**	**Monitoring Element**	**General Method**	**Priority level**	**Existing Program?**
9-1.3	**Waterfowl habitat** What is the extent and distribution of habitats preferred by various types of waterfowl?	S	Extent & distribution of habitats preferred by different types of waterfowl	Remote sensing / mapping	high	Ducks Unlimited
9-1.4	**Wetland and agricultural land use practices** Land use practices can either provide additional habitat for wildlife species or provide additional pressures. Urbanization increases effects due to non indigenous pets, recreational disturbance etc.	S/P	mapping of wetland and agricultural land use including seasonal wetlands and utility as habitat for waterfowl	Remote sensing / mapping		
9-1.5	**Contaminants - Selenium, Mercury, Other** Are contaminants affecting the survival or reproduction of waterfowl? Measuring contaminants in abiotic media or food items (e.g., aquatic toxicity) should provide earlier warning and response to changes in contaminant levels than measures in the terrestrial system. We expect that aquatic toxicity measures will be more fully detailed in the aquatic monitoring plan. Restored wetlands may increase mercury methylation, affect fish, waterfowl, and humans consuming contaminated animals	P	*<see Aquatic toxicity measures (fish tissue, benthic invertebrates communities, algal communities)>*	Aquatic Monitoring		
			Concentrations of mercury in waterfowl tissue relative to human health concerns	Targeted studies?		
			Toxicity effects on migratory and residential waterfowl reproduction - mercury, selenium	Targeted studies?		

Table 9-1. Monitoring recommendations for waterfowl.

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

WATERFOWL (ERP Strategic Objectives 1.3, 3.3, 6.1)						
No.	**Attribute & Rationale**	**Type**	**Monitoring Element**	**General Method**	**Priority level**	**Existing Program?**
9-1.6	**Disease outbreaks** What disease outbreaks are occurring? Are they exacerbated by overcrowding? Waterfowl disease outbreaks are more likely to occur when waterfowl are overcrowded.	P-N	disease outbreaks in region	Other surveys		CDFG? Duck clubs? USFWS
9-1.7	**Improve wildlife friendly agricultural practices in areas near tidal wetlands** How have CALFED efforts to increase waterfowl friendly agricultural practices affected waterfowl use of agricultural lands? CALFED actions include: Improve wildlife friendly agricultural practices in areas near tidal wetlands including * deferring fall tillage until later in year can increase quantity of forage on cornfields for waterfowl and greater sandhill cranes * shallow flooding of seasonal croplands in fall/winter can greatly increase the availability of forage for wintering waterfowl * retaining a percentage of the unharvested crop in the agricultural field would enhance the value of flooding (11)	A	Location, status, & effectiveness of efforts to improve wildlife friendly agricultural practices near tidal wetlands	Programmatic	high	

Table 9-1. Monitoring recommendations for waterfowl.

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

WATERFOWL (ERP Strategic Objectives 1.3, 3.3, 6.1)

No.	Attribute & Rationale	Type	Monitoring Element	General Method	Priority level	Existing Program?
9-1.8	**Habitat restoration & enhancement efforts** What is the extent, distribution and implementation status of wetland restoration efforts? How do these restoration efforts affect waterfowl use of the habitat?	A	Extent and distribution of habitat restoration and enhancement efforts	Programmatic	high	
			In diked wetland to tidal wetland conversion projects, conduct pre-project and post-project monitoring of waterfowl usage.	Project Monitoring	high	
9-1.9	**Land use changes that affect waterfowl distribution** How are waterfowl responding to the large changes in the distribution of waterfowl habitat across the landscape? CALFED will be decreasing waterfowl habitat by converting some diked wetlands to tidal wetlands in Suisun Marsh and increasing waterfowl habitat in the Delta and in agricultural lands.	A, P-R, E	Regional changes in extent and distribution of habitats preferred by waterfowl (restoration, conversion of diked to tidal wetlands, urbanization, land use changes)	Remote sensing / mapping	high	USGS/CVHJV - Joe Fleskes studies
			Regional changes in acreages of crops favored by waterfowl (rice, wheat, corn, millet, etc)	County records, mapping		
			Regional changes in distribution, abundances and habitat use by waterfowl	Regional surveys - seasonal, Targeted studies	high	

Shorebirds

The Ecosystem Restoration Program Plan (2000)[8] offers a brief conceptual model and the Baylands Ecosystem Habitat Goals Project (Goals Project 2000)[26] a more detailed model for shorebirds in the San Francisco Bay and Suisun Marsh including the management and habitat restoration issues. The Suisun Ecological Workgroup Final Report (June 1999)[34] addresses the issues in Suisun Marsh. The reader is referred to these resources as this document only discusses a few key points. The reader also is referred to the U.S. Shorebird Conservation Plan monitoring documents, the *North American Shorebird Assessment and Monitoring Program* (Howe *et al* 2000)[29] and *A Comprehensive Monitoring Program for North American Shorebirds* (Bart *et al* 2001)[3].

ERP Vision, Targets, and Objectives[8]

ERP Vision

Maintain healthy populations of shorebirds and wading birds through habitat protection and restoration and reduction in stressors.

ERP Target

Improve populations and distribution of shorebirds

ERP Long-term Objective

Provide sufficient high-quality tidal and shallow water foraging habitat and upland roosting habitat to maintain large populations of all members of this guild that now occur in central California, while also providing sufficient nesting habitat for species that breed in the state.

ERP Short-term Objective

Maintain wintering and breeding populations at their present levels and increase populations of all threatened species sufficiently to be able to remove them from lists of threatened species.

ERP Stage 1 Expectations

CALFED will have cooperated with the Central Valley Habitat Joint Venture to implement the Venture's goals and objectives that relate to creating habitat for shorebirds. An evaluation of threats to foraging and breeding habitats will have been conducted and ways found to alleviate threats. Areas that can be restored as foraging areas, especially tidal flats will have been identified and restoration work begun.

Management Questions

What are the status and trends in shorebird diversity, abundance of key species and distribution in tidal wetlands? What are the status and trends in breeding populations/colonies? What are the location, size, and reproductive success in nesting colonies?

What is the extent and distribution of habitats preferred by various types of shorebirds?

How has the influx of non-indigenous invertebrate species affected the invertebrate prey base for shorebirds? Are contaminants affecting survival and reproduction in shorebirds?

What is the extent, distribution and implementation status of wetland restoration efforts? How do these restoration efforts affect shorebird use of the habitat?
How are shorebirds responding to the large-scale changes in extent and distribution of shorebird habitat across the landscape?

MSCS Shorebird Species[11]
MAINTAIN: Long-billed curlew, Western snowy plover

Issues
San Francisco Bay is a very important area within the Pacific Flyway for shorebirds, supporting large numbers of 31 species especially in the winter and during migration (Goals Project, 1999)[25]. Shorebirds have been concentrated into less area as wetlands were converted to urban areas and agriculture over the past 150 years.

However some tidal wetlands were converted to salt ponds and diked wetlands which provide feeding habitat for some shorebird species in high densities. Concerns have been raised that converting this high quality foraging habitat to tidal wetland habitat will result in a net loss in quality foraging habitat for shorebirds. Although most of the salt ponds are in the south Bay, North Bay salt ponds have been considered for conversion to tidal wetlands by CALFED.

Shorebird colonies are especially sensitive to disturbance and to predation from non-indigenous predators, e.g., foxes. Shorebirds such as the western snowy plover, which builds its nests in the sand or other open habitats, have responded to beach and nest protection measures (Goals Project 1999)[25].

Questions have been raised over the response of shorebirds to changes in the invertebrate prey base because of multiple introductions of non-indigenous species (Terrestrial and Amphibious Monitoring Plan Workshop Summary, 2001)[2].

Questions also exist about the effects of contaminants such as selenium and mercury on shorebird reproduction.

The Goals Project (1999)[25] recommended the following 7 shorebirds as indicator species (Western Sandpiper, Marbled Godwit, Red Knot, Long-billed Dowitcher, Black Turnstone, Snowy Plover, Wilson's Phalarope). It's not clear whether a different set of species would be recommended for Suisun Marsh and North San Francisco Bay.

Pressures
- Habitat loss (foraging, roosting, breeding/colonies)
- Non-native and native predators in nesting colonies
- Human disturbance and off-road vehicles in nesting areas
- Contaminants, especially selenium and mercury effects on reproduction
- Possible changes in invertebrate prey base due to non-indigenous species and pollution

CALFED Actions

- Restore 2000 acres Tidal perennial aquatic habitat
- Restore min. of 21,000 acres tidal emergent wetland (SMB, DEDT)
- Restore slough habitat (SMB, DEDT)
- Restore min. 125 acres of channel islands & 125 acres of shoals (DEDT)

Monitoring Recommendations

See Table 9-2

Existing Monitoring Programs

Point Reyes Bird Observatory (PRBO) has conducted at least 7+ periodic shorebird censuses in San Francisco Bay during the past 20 years. The San Francisco Bay Bird Observatory conducts shorebird colony surveys in South San Francisco Bay.

<u>Large-scale/ regional monitoring</u>

- Point Reyes Bird Observatory. (PRBO). Periodic shorebird censuses in San Francisco Bay (www.prbo.org)

<u>Outside of ERP focus area</u>

- San Francisco Bay Bird Observatory. Conducts shorebird colony surveys in South San Francisco Bay (www.sfbbo.org)

<u>Small-scale monitoring / targeted research</u>

- U.S. Geological Survey – Research on effects of selenium on shorebird chicks, utility of salt ponds to shorebirds

Table 9-2. Monitoring recommendations for shorebirds.

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

SHOREBIRDS (ERP Strategic Objectives 1.3)

No.	Attribute & Rationale	Type	Monitoring Element	General Method	Priority level	Existing Program?
9-2.1	**Shorebirds** What are the status and trends in shore bird diversity, abundance of key species and distribution in tidal wetlands? What is the location, size, and reproductive success in nesting colonies?This question directly relates to a CALFED objective. Measuring status and trends in shorebirds can be difficult since they are affected by many factors outside of the ERP focus area. However coordinating with the current regional shorebird surveys is advisable.	S	Species diversity, richness, evenness;	Shorebird surveys	High	PRBO
			Key indicator species indices of abundance or presence/absence (Goals Project (26) Recommends western snowy plover, red knot, western sandpiper, marbled godwit, long-billed dowitcher, black turnstone, Wilson's phalarope). Should also include long-billed curlew (11).	Shorebird surveys	High	PRBO
			shorebird use of tidal wetlands	Sampling sites network	High	
			Location & size of breeding colonies	Annual surveys	High	
			Reproduction success in colonies (including predation by non-indigenous predators & indigenous predators like ravens)	Targeted studies?		
9-2.2	**Shorebird Habitats** What is the extent and distribution of habitats preferred by various types of shorebirds?	S	Extent & distribution of habitats preferred by shorebirds, esp. extent of tidal mudflats, suitable breeding habitat	Remote sensing / mapping	High	
9-2.3	**Shorebird prey abundance** Has the influx of non-indigenous invertebrate species impacted invertebrate communities that provide prey for shorebirds? How has this in turn affected shorebirds?	S/P	Studies of key shorebird prey species.	Targeted studies?		

Table 9-2. Monitoring recommendations for shorebirds.

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

SHOREBIRDS (ERP Strategic Objectives 1.3)						
No.	**Attribute & Rationale**	**Type**	**Monitoring Element**	**General Method**	**Priority level**	**Existing Program?**
9-2.4	**Contaminants - Selenium, Mercury, Other** Are contaminants affecting survival and reproduction in shorebirds? Measures of abiotic media and aquatic toxicity should provide earlier warning and response to changes in contaminant levels than measures in the terrestrial system. We expect that aquatic toxicity measures will be more fully detailed in the aquatic monitoring plan.	P	*<see Aquatic toxicity measures (fish tissue, benthic invertebrates communities, algal communities)>*	Aquatic Monitoring		
			Indicators of exposure/Effect of Contaminants on shorebird reproduction -esp. mercury, selenium	Targeted studies?		
9-2.5	**Habitat restoration & enhancement efforts** What is the extent, distribution and implementation status of wetland restoration efforts? How do these restoration efforts affect shorebird use of the habitat?	A	Extent & locations of riparian and floodplain restoration and enhancement projects	Programmatic	High	
		E	Effect of habitat restoration and enhancement efforts on shorebird habitat use, abundance, and distribution	Project Monitoring	High	
9-2.6	**Land use changes that affect shorebird distribution** How are shorebirds responding to the large-scale changes in extent and distribution of shorebird habitat across the landscape? Conversion of diked wetlands and salt ponds to tidal wetlands may occur in San Pablo Bay .	A, P-R, E	Changes in extent and distribution of habitats preferred by shorebirds (restoration, conversion of diked to tidal wetlands, urbanization, land use changes)	Remote sensing / mapping	High	
			Changes in distribution, abundances and habitat use by shorebirds	Regional surveys - seasonal, Targeted studies	High	

Wading Birds

The Ecosystem Restoration Program Plan (2000)[8] offers a brief conceptual model for wading birds in the Delta and Central Valley with detail in species sections for the greater sandhill crane, California clapper rail, California black rail, and the western least bittern. Wading birds are expected to benefit from ERP actions to restore habitat, reduce contaminants, and increase acreage under wildlife-friendly agricultural practices.

ERP Vision, Targets, and Objectives[8]

ERP Vision

Maintain healthy populations of shorebirds and wading birds through habitat protection and restoration and reduction in stressors.

ERP Target

Improve populations and distribution of wading birds

ERP Long-term Objective

Provide sufficient high-quality breeding and foraging habitat for all wading bird species so that the guild will continue to be diverse and abundant.

ERP Short-term Objective

Maintain wading bird numbers and diversity at their present level, as a minimum.

ERP Stage 1 Expectations

CALFED will have cooperated with the Central Valley Habitat Joint Venture to implement the Venture's goals and objectives that would increase foraging habitat for this guild. In addition, existing heron and egret rookeries will have been protected and other potential rookery areas identified.

Management Questions

What are the status and trends in wading bird communities in floodplain, riparian and tidal wetlands? What are the locations and size of nesting colonies?

What is the extent and distribution of habitats preferred by various types of wading birds in floodplain, riparian, and tidal wetlands?

Is contaminant exposure adversely affecting wading bird survival and reproduction?

What is the extent, distribution and implementation status of wetland restoration efforts? How do these restoration efforts affect wading bird use of the habitat?

MSCS Wading Bird Species[8,11]

CONTRIBUTE TO RECOVERY (r): California clapper rail, California black rail, greater sandhill crane

MAINTAIN (m): black-crowned night heron, great blue heron, great egret, snowy egret rookeries, western least bittern, white-faced ibis

Issues
Wading birds are a diverse group including herons, rails, cranes, egrets, bitterns, and ibis. All have been affected by the large-scale loss of tidal, non-tidal, and seasonal wetland habitats in the Delta and Central Valley. Species, such as the black-crowned night heron, great blue heron, great egret, and snowy egret, also depend on nearby riparian areas for roosting and rookeries. The great blue heron, egrets, ibis and the greater sandhill crane have partially adapted to some forms of agriculture, particularly rice farming, as well as the associated vegetated canals. Exposure to pesticides and other contaminants is a potential concern. Access to nesting areas with low levels of disturbance also is important.

Pressures
- habitat loss: foraging, roosting, breeding/rookeries
- contaminants
- disturbance to and predation in nesting colonies/nesting areas

CALFED Actions
- Restore minimum of 10,000 acres tidal emergent wetland in Delta (DEDT),
- Restore minimum 4250 acres nontidal emergent wetland in Delta (DEDT),
- Restore minimum 125 acres of channel islands & 125 acres of shoals (DEDT),
- Habitat restoration, enhancement & protection of 1000+ acres seasonal wetlands (DEDT, SACR),
- Protect, enhance, & restore riparian habitat (DEDT, SMB, SACR, SJR)
- Increase acreage under wildlife friendly agricultural practices (DEDT, SJR, SacR)
- Reduce pesticides [carbofurans, chloropyrifos, diazinon] (All regions), trace metals (All), Organochlorine pesticides in streams (All), selenium (EDT, SJR, SMB)
- Research into inventory of mercury sites, concentration, some remediation (DEDT,SACR)
- Research to evaluate ecological/biological thresholds of mercury (All regions)

Monitoring Recommendations
See Table 9-3.

Existing Monitoring Programs

<u>Large-scale / regional monitoring</u>
- Audubon Christmas bird survey
- USFWS Colonial waterbird survey

<u>Small-scale monitoring</u>
- Cypress Grove Preserve – Heron and Egret Nest Monitoring on West Marin Island. Contact: John Kelly, Audubon Canyon Ranch
- BREACH project

Table 9-3. Monitoring recommendations for Wading Birds

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

WADING BIRDS (ERP Strategic Objectives 1.3)

No.	Attribute & Rationale	Type	Monitoring Element	General Method	Priority level	Existing Program?
9-3.1	**Wading birds** What are the status and trends in wading bird communities in floodplain, riparian and tidal wetlands? What are the locations and size of nesting colonies? This question relates to a CALFED objective. Although site measures of species diversity, key indicator species, etc. can be measured, across the region, location and size of nesting colonies are essential.	S	Number, location and size of nesting colonies	Regional surveys	high	
			wading bird use of tidal wetlands	Sampling sites network	high	
			wading bird use of floodplain wetlands	Sampling sites network	high	
9-3.2	**Wading birds Habitat** What is the extent and distribution of habitats preferred by various types of wading birds in floodplain, riparian, and tidal wetlands?	S	Extent & distribution of habitats preferred by wading birds for foraging, nesting and roosting, including agricultural lands	Remote sensing / mapping		
9-3.3	**Contaminants - Selenium, Mercury, Other** What contaminants may be causing problems for wading birds? Are unusual health problems occurring? Measuring aquatic toxicity should provide earlier warning and response to changes in contaminant levels than measures in the terrestrial system. We expect that aquatic toxicity measures will be more fully detailed in the aquatic monitoring plan.	P	*<see Aquatic toxicity measures (fish tissue, benthic invertebrates communities, algal communities)>*	Aquatic Monitoring		

Table 9-3. Monitoring recommendations for Wading Birds

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

WADING BIRDS (ERP Strategic Objectives 1.3)						
No.	**Attribute & Rationale**	**Type**	**Monitoring Element**	**General Method**	**Priority level**	**Existing Program?**
9-3.4	**<u>Habitat restoration & enhancement efforts</u>** What is the extent, distribution and implementation status of wetland restoration efforts? How do these restoration efforts affect wading bird use of the habitat?	A/E	Effect of habitat restoration and enhancement efforts on wading habitat use, abundance, and distribution	Project Monitoring		

Neotropical Migratory Birds

The Ecosystem Restoration Program Plan (2000)[8] offers a brief conceptual model for neotropical migratory birds in the Delta and Central Valley with more detail given for the little willow flycatcher, western yellow-billed cuckoo, least Bell's vireo, bank swallow, Swainson's hawk, and the California yellow warbler. California Partners in Flight – Riparian Habitat Joint Venture document, *The riparian bird conservation plan: a strategy for reversing the decline of riparian associated birds in California* (RHJV, 2000)[33] contains detailed descriptions of riparian birds in California and monitoring recommendations and protocols. The reader is also referred to the *Preliminary outline for bird monitoring, assessment and research* (CMARP Fluvial Geomorphology and Riparian Issues Group, 1998)[15,16,17,18,19]. Neotropical birds are expected to benefit from ERP actions to restore habitats.

ERP Vision, Targets, and Objectives[8]

ERP Vision

Maintain and increase healthy populations of neotropical migratory birds through restoring habitats on which they depend.

ERP Target

Increase the abundance and distribution of neotropical migratory birds in the Central Valley.

ERP Long-term Objective

Substantially improve breeding and migration habitats for all neotropical migrant birds to increase their rates of reproduction and survival.

ERP Short-term Objective

Maintain neotropical migratory bird breeding populations at present levels and develop restoration projects that will benefit migrating individuals.

ERP Stage 1 Expectations

A "master plan" for the conservation of neotropical migrants in the Bay-Delta watershed that includes status reports and habitat requirements for all species will have been completed. This information will have been used to integrate neotropical migrant conservation into various CALFED restoration projects or to develop restoration projects specifically aimed at improving migration and breeding habitat for selected members of this group.

Management Questions

What are the status and trends in neotropical migratory bird diversity, abundance, distribution, and reproductive success of key species?

What is the extent and distribution of habitats preferred by various types of neotropical migratory birds? Where and to what degree are brown-headed cowbirds reducing reproductive success of open cup riparian birds?

What is the extent, distribution and implementation status of floodplain and riparian restoration and enhancement efforts? How do these restoration and enhancement efforts affect neotropical migratory bird use of the habitat?

MSCS Species[8,11]

CONTRIBUTE TO RECOVERY(r): least Bell's vireo, little willow flycatcher, bank swallow, western yellow-billed cuckoo, Swainson's hawk, California yellow warbler.

MAINTAIN (m): yellow-breasted chat

Issues

Habitat loss and fragmentation is the key pressure . Remaining habitat consists of small patch sizes which increases edge effects and disturbance. With a decrease in normal floodplain processes, the natural succession of habitats and the consequent mosaic of different vegetation communities of different ages and composition that are needed by neotropical migrants may not be occurring in many areas.

Reproductive success of cup-nest building riparian songbirds is reduced by nest parasitism by brown-headed cowbirds and by native and non-native nest predation. Cats and snakes are typical predators. These pressures are exacerbated by small patch size which increases the amount of disturbance and "edge" effect and by nearby land uses such as cattle feed lots that provide food for brown-headed cowbirds or by urbanization which increases the density of domesticated and feral cats.

Pressures

- Habitat loss and fragmentation
- Small patch size
- Nest predation by non-indigenous & indigenous predators (cats, snakes, etc.)
- Nest parasitism by Brown-headed cowbirds for cup-nesters
- Loss of specific types of vegetation and combinations of habitat needed for neotropical migrants
- Non-indigenous plants that reduce habitat value
- Disturbance from human activities

Monitoring Recommendations

See Table 9-4.

Existing Monitoring Programs

The Riparian Habitat Joint Venture and California Partners in Flight have created a cooperative effort to outline conservation, management, monitoring, and research needs for riparian birds in the Central Valley. Creation of a regional monitoring program for CALFED could be done in cooperation with this existing effort. Point Reyes Bird Observatory (PRBO) has provided much of the support for these efforts and has conducted considerable monitoring in the region.

<u>Large-scale monitoring</u>

- PRBO-Sacramento River Bird Conservation Project ?

Small-scale monitoring

- Cosumnes River Preserve
- San Joaquin River National Wildlife Refuge
- lower Clear Creek Floodway Restoration Project

Table 9-4. Monitoring recommendations for Neotropical Migratory Birds.

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

NEOTROPICAL MIGRATORY BIRDS (ERP Strategic Objectives 1.3)						
No.	**Attribute & Rationale**	**Type**	**Monitoring Element**	**General Method**	**Priority level**	**Existing Program?**
9-4.1	**Neotropical migratory birds** What are the status and trends in neotropical migratory bird diversity, abundance of key species, distribution, and reproductive success?	S	Key indicator species indices of abundance or presence/absence including MSCS species (possibly Song sparrow, California Yellow warbler, Yellow-breasted chat, Common yellowthroat, Wilson's warbler, Warbling vireo, Swainson's thrush, Black-headed grosbeak, Bank swallow, Swainson's hawk, Western Yellow-billed cuckoo, American dipper, Least Bell's vireo, Little willow Flycatcher) * Native Species diversity, richness, evenness;(19, 33)	Sampling sites network	high	Point Reyes Bird Observatory
			Reproduction success & survival rates - nest searches (19, 33)	Sampling sites network, Targeted studies?		Point Reyes Bird Observatory ?
			Adult (and Juvenile) survivorship of passerines	Targeted studies		
9-4.2	**Neotropical migratory bird habitat** What is the extent and distribution of habitats preferred by various types of neotropical migratory birds? Where is habitat fragmentation impeding bird migration and survival?	S	Extent & distribution of habitats preferred by neotropical migratory birds	Remote sensing / mapping	high	RHJV?
			Determine relationship between habitat attributes, migratory stopover use, and species survival(33)	Sampling sites network, Targeted studies?		
			Relationship between herbaceous vegetation height and avian productivity and recruitment (33)	Sampling sites network, Targeted studies?		

Table 9-4. Monitoring recommendations for Neotropical Migratory Birds.

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

NEOTROPICAL MIGRATORY BIRDS (ERP Strategic Objectives 1.3)

No.	Attribute & Rationale	Type	Monitoring Element	General Method	Priority level	Existing Program?
9-4.3	**Abundance of brown-headed cowbird** Where and to what degree are brown-headed cowbirds reducing reproductive success of open cup riparian birds? Nest parasitism by brown-headed cowbirds is an important stressor for open-cup neotropical migratory songbirds. Parasitism rates are thought to be decreased in large patch size and increased by proximity to land uses that favor cowbirds.	P	relative abundance of brown-headed cowbirds (19)	Sampling sites network	high	
			patch sizes of riparian zones across the landscape	Remote sensing / mapping	high	
			land use adjacent to riparian zones, particularly land uses that favor cowbirds (feedlots, etc.)	remote sensing / mapping, county records	high	
			nest parasitism rates coupled with nest reproductive success (especially for Willow Flycatcher, Bell's Vireo, Warbling Vireo, Common Yellowthroat, Blue Grosbeak, Wilson's Warbler, Yellow Warbler (19, 33)	Sampling sites network, Targeted studies?		PRBO / RHJV
9-4.4	**Habitat restoration & enhancement efforts** What is the extent, distribution and implementation status of floodplain and riparian restoration and enhancement efforts? How do these restoration and enhancement efforts affect neotropical migratory bird use of the habitat?	A	Extent & locations of riparian and floodplain restoration and enhancement projects	Programmatic	high	
		E	Effect of riparian and floodplain habitat restoration and enhancement efforts on neotropical migratory bird use	Project Monitoring	high	

Native Anuran Amphibians

The Ecosystem Restoration Program Plan (2000)[8] offers a brief conceptual model about native anuran amphibians (frogs & toads) in the Delta and Central Valley with more detail given under sections about the California red-legged frog and western spadefoot toad. The reader is referred to this resource and only some key points are briefly touched upon in this document. The simplified conceptual model present below was created by combining information given on the individual MSCS species with information given for native anuran amphibians. Some protocols for monitoring can be found in *Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians* (Heyer *et al* 1994)[28].

ERP Vision, Targets, and Objectives[8]

ERP Vision

Contribute to their restoration.

ERP Target

Maintain self-sustaining populations of all native anuran amphibians throughout their native ranges in the ERP Ecological Management Zones.

ERP Long-term Objective

Have self-sustaining populations of all native anuran amphibians (frogs, toads) present throughout their native ranges, in all major watersheds in the Bay-Delta watershed.

ERP Short-term Objective

Determine the causes of anuran amphibian declines in the Bay-Delta watershed, develop restoration strategies, and implement them where feasible.

ERP Stage 1 Expectations

Complete status surveys of all anuran amphibians will have been completed and the major causes of declines should be determined. Long-term plans will have been developed and instituted to create conditions that will allow populations to recover throughout their ranges.

Management Questions

What are the status and trends in the abundance, distribution, and percent area occupied for native anuran amphibian species?

Where are bullfrogs present in the sampling sites networks?

To what extent are barriers preventing movement among populations?

What contaminants may be causing problems for native anurans? Are unusual health problems occurring?

Do California amphibians reflect the worldwide decline in amphibians and if so, why?

What is the extent, distribution and implementation status of wetland restoration efforts? How do these restoration efforts affect native anuran amphibian use of the habitat?

Where are predator removal programs occurring and how successful are they in causing expansion of native anuran populations?

MSCS Species[8,11]

MAINTAIN (m):California red-legged frog, foothill yellow-legged frog, western spadefoot toad

Pressures

- Habitat loss & fragmentation
- Barriers (roads, highways, etc.)
- Non-indigenous predators – bullfrogs, predatory fish
- Contaminants
- Disease
- Unknown cause of world-wide decline in amphibians

Issues

Native anuran amphibians have been strongly affected not only by the large-scale loss of habitat and fragmentation but also by predacious introduced bullfrogs and fish. Bullfrogs have invaded California extensively and wherever bullfrogs are present the native frogs start to decline. Native anurans appear to be largely restricted to seasonal wetlands and perennial wetlands where bullfrogs have not yet invaded.

However amphibians are also declining for other reasons. Frogs and toads are disappearing throughout the Sierra's on the eastern side of the California Central Valley. It has been hypothesized that wind-blown contaminants from the valley may be having an important effect, but this is still unclear.

There has been a world-wide decline in amphibians. The cause is unclear. Disease appears to have a role in some areas, contaminants in other, but in yet other areas the cause is unclear. If this is a systematic world-wide decline, then it may be impacting California native frogs as well.

CALFED ACTION

- Habitat restoration, enhancement & protection of nontidal emergent wetland (DEDT), seasonal wetlands (SacR), fresh emergent wetlands (SJR), riparian habitat (DEDT, SACR, SMB, SJR)
- Reduce pesticides [carbofurans, chloropyrifos, diazinon] (All regions), trace metals (All), Organochlorine pesticides in streams (All), selenium (EDT, SJR, SMB)
- Research into inventory of mercury sites, concentration, some remediation (DEDT,SACR)
- Research to evaluate ecological/biological thresholds of mercury (All regions)

Monitoring Recommendations

See Table 9-5.

Existing Monitoring Programs
Most monitoring at present appears to be local small-scale monitoring projects. Systematic regional monitoring does not appear to be happening at present in the CALFED focus area although some research studies are regional in focus. The USGS Amphibian and Research Monitoring Initiative may provide information in the future, but it is unclear how many researchers will be participating at present. The USFWS red-legged frog monitoring should be followed up further to get more details.

Large-scale monitoring /regional monitoring

- USGS. Amphibian Research and Monitoring Initiative. Researchers will be using a percent area occupied statistic to measure changes in distribution. http://www.mp2-pwrc.usgs.gov/armi/index.cfm
- USGS – North American Amphibian Monitoring Program (NAAMP) – Utilizes trained volunteers to collect amphibian data http://www.mp2-pwrc.usgs.gov/naamp/

Small-scale monitoring / targeted studies

- UC Davis. Amphibian surveys.
- USFWS. Future planned California red-legged frog monitoring.
- Department of Water Resources. Delta Field Division conducts informal California red-legged frog presence/absence surveys
- East Bay Municipal Utility District. Mokelumne River Watershed Wildlife Monitoring Program. Includes monitoring for Foothill yellow-legged frog and California red-legged frog. http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=528
- Jones & Stokes, Associates. Conducting California red-legged frog surveys at Los Vaqueros Reservoir.
- U.S. Geological Survey research (Dr. Robert Fisher, Dr. Gary Fellers)

Table 9-5. Monitoring recommendations for Native Anuran Amphibians (frogs & toads)

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

Native Anuran Amphibians (ERP Strategic Objectives 1.3)

No.	Attribute & Rationale	Type	Monitoring Element	General Method	Priority level	Existing Program?
9-5.1	**Native anurans (frogs & toads)** What are the status and trends in the abundance, distribution, and/or percent area occupied for native anuran amphibian species? Although habitat loss is important, native anuran amphibian distribution appears to be more strongly linked to the presence/absence of bullfrogs and predacious fish than the extent of potential habitat available. Sampling for native anurans only at the sampling sites network will be unlikely to show those few areas of seasonal wetlands where these species continue to exist. Although monitoring for abundance is useful as a warning of problems, native anurans can experience such wide variation in populations due to climate that percent area occupied might be a better indicator for management.	S	Locations of sites with native anurans present and relative abundance at those sites -- California red-legged frog, Foothill yellow-legged frog, western spadefoot	Regional surveys	high	USGS-ARMI (DOI lands only) UC Davis - Dr. Shaffer
			relative abundance and distribution of native anurans	Sampling sites network		

Table 9-5. Monitoring recommendations for Native Anuran Amphibians (frogs & toads)

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

Native Anuran Amphibians (ERP Strategic Objectives 1.3)

No.	Attribute & Rationale	Type	Monitoring Element	General Method	Priority level	Existing Program?
9-5.2	**Native anuran QUALITY habitat** What is the extent and distribution of native anuran habitat where native anurans are currently found? Mapping where native anuran amphibians are currently found would be more useful at this point than mapping all wetlands where they could potentially be found. Wetlands with permanent standing water usually have introduced bullfrogs or introduced bass. Native anurans are frequently restricted to seasonal wetlands and non-tidal wetlands which haven't been invaded by bullfrogs yet.	S	Extent & distribution of wetlands, especially seasonal wetlands with native anurans present & bullfrogs absent or in low numbers	Regional surveys + mapping	high	
9-5.3	**Bullfrogs** Are bullfrogs present at sampling sites? When bullfrogs are present, native anurans usually aren't. Bullfrogs prey on other frog species as well as other native species. Bullfrogs will eat almost anything, including young snakes.	P	Sites surveyed for native anurans where bullfrogs+D10 found to be present	Sampling sites network + regional surveys		

Table 9-5. Monitoring recommendations for Native Anuran Amphibians (frogs & toads)

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

Native Anuran Amphibians (ERP Strategic Objectives 1.3)

No.	Attribute & Rationale	Type	Monitoring Element	General Method	Priority level	Existing Program?
9-5.4	**Barriers - semi-permeable and impermeable** To what extent are barriers preventing movement among populations? Roads, especially busy roads and highways, can decrease movement among populations and sharply increase mortality. Sometimes measures such as fencing and underpasses can decrease mortality and re-establish connectivity. However barriers can also be connecting waterways with high densities of bullfrogs and predacious fish.	P	Location & permeability of barriers between existing populations of native anuran amphibians or between an existing population and potential quality habitat where populations don't currently exist.	Targeted studies?		
9-5.5	**Native anuran health-** Contaminants - Selenium, Mercury, pesticides, Other What contaminants may be causing problems for native anurans? Are unusual health problems occurring? Measuring aquatic toxicity should provide earlier warning and response to changes in contaminant levels than measures in the terrestrial system. We expect that aquatic toxicity measures will be more fully detailed in the aquatic monitoring plan. Other diseases such as chytrid fungal disease and ranavirus have caused problems in some locations in California	P	*<see Aquatic toxicity measures (fish tissue, benthic invertebrates communities, algal communities)>*	Aquatic Monitoring		
			Effect of aquatic and airborne contaminants on native anuran amphibians	Targeted studies?		USGS?
			Evidence of disease, poor health, and deformities in native anurans	Sampling sites network, regional surveys		

Table 9-5. Monitoring recommendations for Native Anuran Amphibians (frogs & toads)

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

Native Anuran Amphibians (ERP Strategic Objectives 1.3)

No.	Attribute & Rationale	Type	Monitoring Element	General Method	Priority level	Existing Program?
9-5.6	**Other sources of decline** Do California amphibians reflect the worldwide decline in amphibians and if so, why? Amphibians are declining throughout the world. Some of this decline may be due to contaminants and non-native predatory bullfrogs and fish, but in other areas this doesn't appear the case. Targeted studies may be needed.	P	?	Targeted studies?		USGS? - targeted studies into malformations and diseases
9-5.7	**Habitat restoration & enhancement efforts** What is the extent, distribution and implementation status of wetland restoration efforts? How do these restoration efforts affect native anuran amphibian use of the habitat?	A/E	Effects of seasonal wetland restoration and enhancement on native anurans	Project Monitoring		
9-5.8	**Native anuran re-introduction and Predator removal**-- Bullfrog removal efforts and native anuran reintroduction efforts are mentioned in the ERPP but are not currently listed among the ERP milestones. This may be an action taken later in the program.	A/E	Effect of bullfrog removal on native anurans and reintroduction programs	Project Monitoring		

Other multi-habitat biological communities

Although the ERP biological communities already identified are good indicators for multiple habitats across the landscape, the ERP may wish to supplement with additional groups to gain additional information.

ERP Strategic Objective[9]

Objective 1.3: Enhance and/or conserve native biotic communities in the Bay-Delta estuary and its watershed, including the abundance and distribution of the following biotic assemblages and communities: native resident estuarine and freshwater fish assemblages, anadromous lampreys, neotropical migratory birds, wading birds, shore birds, waterfowl, native anuran amphibians, estuarine plankton assemblages, estuarine and freshwater marsh plant communities, riparian plant communities, seasonal wetland plant communities, vernal pool communities, aquatic plant communities, and terrestrial biotic assemblages associated with aquatic and wetland habitats.

ERP Biological Community	Indicates
Waterfowl	Early responder to changes in extent and distribution of wetland habitats across the region Early responder to changes in wildlife-friendly agricultural practices
Shore birds	Early responder to changes in extent and distribution of wetland habitats across the region Sensitive to effects on breeding habitat
Wading birds	Early responder to changes in extent and distribution of wetland habitats across the region Early responder to changes in wildlife-friendly agricultural practices Presence of rails indicates quality tidal wetland habitat (connectivity with upland, low pressures)
Neotropical migratory birds	Early responders to changes in riparian habitat extent, distribution and *quality* Early responder to restoration of vegetation structure, and composition
Native anuran amphibians	Sensitive to on-site pressures since have limited ability to escape such as water quality, contaminants, non-indigenous species, habitat fragmentation, barriers, stochastic events
Top-down predators	Sensitive to habitat fragmentation and barriers Early responder to changes in connectivity among habitats Presence indicates restoration of important top-down ecological process in habitats.
Other groups?	?

The presence of top-down predators and of other species that indicate connectivity of habitats across the landscape would be a good addition to ERP monitoring design. There may be other groups to consider as well.

Management Questions

Are top-down predators present and/or other species that indicate connectivity of habitats across the landscape?

To what extent are barriers preventing movement among populations?

Issues

The ERP may wish to consider tracking additional biological communities for specific purposes. Tracking presence of top-down predators through mammal monitoring in the sampling sites network is one example. Heavily fragmented habitats lose connectivity among the habitat blocks, restricting movement of species among these blocks. This can result in several consequences:

1) a gradual loss in species richness in a given habitat fragment
2) a loss in certain ecological processes such as the presence of top-down predators.

What constitutes connectivity and barriers varies species by species. However the continued presence of top-down predators indicates that at least some degree of connectivity and land-bound species movement does exist.

ERP actions

ERP restoration actions that re-establish connectivity among habitat fragments may allow the presence of top-down predators and other species that require such connectivity to move in and out of fragment habitats.

Monitoring Recommendations

See Table 9-6.

Table 9-6. Monitoring recommendations for other multi-habitat biological communities.

Other Multi-Habitat indicator species (ERP Strategic Objectives 1.3)						
No.	**Attribute & Rationale**	**Type**	**Monitoring Element**	**General Method**	**Priority level**	**Existing Program?**
9-6.1	**<u>Top-down predators</u>** Are top-down predators present and other species that indicate connectivity of habitats across the landscape? Coyotes are a top-down predator that effects ecosystem dynamics and are an indicator of connectivity across the landscape. Coyotes help control populations of introduced foxes and feral cats which cause problems for native bird and mammal populations.	S	Mammal surveys -- coyote presence	Sampling sites network		
			Movement through corridors	Targeted studies?		
9-6.2	**<u>Barriers - semipermeable and impermeable</u>** To what extent are barriers preventing movement among populations? Roads, especially busy roads and highways, and large waterways can decrease movement among populations and sharply increase mortality.	P	Location and permeability of barriers to indicator species movement (I.e. coyotes)	Remote sensing / mapping		

ERP plant assemblages

The ERPP identified the following plant community groups and ERP target.

ERP Target[8]

The target for all plant communities is to maintain the present distribution and abundance and ensure self-sustaining communities in the long-term.

ERP Plant Community Groups[8]

Aquatic Habitat Plant Community
- Pondweeds with floating and submerged leaves

Tidal Brackish and Freshwater Marsh Habitat Community
- Pickleweed series
- Saltgrass series
- Bulrush series
- Cattail series
- Common reed series

Seasonal Wetland Habitat Plant Community
- Vernal pools (northern claypan, northern hardpan)
- Seasonally flooded areas

Inland Dune Habitat Plant Community

Tidal Riparian Habitat Community
- Black willow series
- Narrowleaf willow series
- White alder series
- Buttonbush series
- Mexican elderberry series
- Valley oak series

Monitoring for these groups is covered under the monitoring identified for

tidal wetlands – includes Aquatic Habitat Plant Community and Tidal Brackish and Freshwater Marsh Habitat Plant Community

floodplain and riparian habitats – includes Seasonal Wetland Habitat Plant Community and Tidal Riparian Habitat Plant Community

inland dune scrub – includes Inland Dune Habitat Plant Community

10.0 ERP/MSCS AT-RISK SPECIES MONITORING RECOMMENDATIONS

This section identifies general monitoring recommendations for the terrestrial and amphibious at-risk species identified in the ERPP[8] and the MSCS[11]. Most of the information in this section appears in Appendix G. The relevant strategic objectives and management questions, the strategy for monitoring at-risk species, and a limited list of existing monitoring programs and information sources are discussed.

ERP Strategic Objectives[9]

Objective 1.1: **"R"** Achieve, first, recovery and then large self-sustaining populations of the following at-risk native species dependent on the Delta, Suisun Bay, and Suisun Marsh: Central Valley winter-, spring- and fall/late fall-run chinook salmon ESUs, Central Valley steelhead ESU, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, valley elderberry longhorn beetle, Suisun ornate shrew, Suisun song sparrow, soft bird's-beak, Suisun thistle, Mason's lilaeopsis, San Pablo song sparrow, Lange's metalmark butterfly, Antioch Dunes evening primrose, Contra Costa wallflower, and Suisun marsh aster.

Objective 1.2: **"r"** Contribute to the recovery of the following at-risk native species in the Bay-Delta estuary and its watershed: Sacramento perch, delta green ground beetle, giant garter snake, salt marsh harvest mouse, riparian brush rabbit, San Pablo California vole, San Joaquin Valley woodrat, least Bell's vireo, California clapper rail, California black rail, little willow flycatcher, bank swallow, western yellow-billed cuckoo, greater sandhill crane, Swainson's hawk, California yellow warbler, salt marsh common yellowthroat, Crampton's tuctoria, Northern California black walnut, delta tule pea, delta mudwort, bristly sedge, delta coyote thistle, alkali milkvetch, and Point Reyes bird's-beak.

Objective 1.4: **"m"** Maintain the abundance and distribution of the following species: hardhead, western least bittern, California tiger salamander, western spadefoot toad, California red-legged frog, western pond turtle, California freshwater shrimp, recurved larkspur, mad-dog skullcap, rose-mallow, eel-grass pondweed, colusa grass, Boggs Lake hedge-hyssop, Contra Costa goldfields, Greene's legenere, heartscale, and other species designated "maintain" in the Multi-Species Conservation Strategy.

MSCS Species[8,11]

Table 5-1 lists the ERP/MSCS "R" and "r" species linked with NCCP habitats. Appendix B gives a complete list of ERP/MSCS "R", "r", and "m" species. Appendix G provides more detailed information on ERP/MSCS "R" and "r" species.

ERP Milestones[8a]

The milestones that affect individual species are given in Appendix G. However the following milestone relates to all ERP/MSCS at-risk species:

RES-R1: Develop and implement a comprehensive monitoring, assessment and research program (CMARP) for terrestrial and aquatic habitats and species populations acceptable to the fish and wildlife agencies. Conduct range-wide surveys for all "R" and "r" covered plants and animals in the MSCS Focus Area.

Management Questions

<u>“R” and “r” species</u>

Where are the "R" and "r" species located, what is the approximate size of the population(s), and what is the condition of the population(s) and associated habitat?

What are the status and trends in populations of “R” and “r” species (Abundance, distribution, number of populations where relevant, etc.)?

What are the status and trends in the extent, connectivity and protection status of habitat for each “R” and “r” species?

If species are continuing to decline, what is the cause? What pressures are responsible for continued decline?

What climate and natural sources of variation must be taken into account when interpreting the data (i.e. El Nino years, drought years, fires, flood events)?

How vulnerable is the species to catastrophic events, i.e. fires, floods, disease, oil spills, etc.?

Are “R” and “r” species colonizing restoration sites?

Are actions to reduce pressures (non-indigenous species, boat wake erosion on nests, etc) having a positive effect on “R” and “r” species?

Are actions to establish populations in new locations successful?

Where are CALFED-related mitigation actions occurring that involve these species and how successful are these mitigation actions for these species?

<u>“m” species</u>

What are the status and trends in the extent, distribution, and connectivity of ERP/NCCP habitats?

What are status and trends of “m” species when recorded or used as indicator species in biological community or habitat quality monitoring?

Where are CALFED-related mitigation actions occurring that involve these species and how successful are these mitigation actions for these species?

Issues and Monitoring

Appendix G contains detailed information on each of the 35 non-fish “R” and “r” species. Each species description includes

CALFED ERP/MSCS Goal, i.e. Recover (R) or Contribute to recovery (r)[8,11]
MSCS Goal prescription[11]
General Monitoring Recommendations
Existing Monitoring Programs / Information sources
NCCP Habitats (from MSCS, 2000)[11]
ERP Mgmt Zone (from MSCS Technical Report, 1999)[12]
Life History & Habitat Requirements (MSCS Technical Report, 1999)[12]
Pressures (MSCS Technical Report, 1999)[12]
MSCS Conservation Measures that add detail to ERP Actions (MSCS, 2000)[11]
CALFED ERP Milestones (CALFED Record of Decision, 2000)[8a]
Simple diagrammatic conceptual model

Box 10a. General Monitoring Recommendations for at-risk species:
For the species the ERP must "Recover (R)" or "Contribute to Recovery (r)":

- Baseline inventories of locations of populations, size of populations (relative abundance, density, or area occupied, etc.), and basic condition of populations of "R" and "r" species and their associated habitats
- Population trends of targeted species (abundance, distribution, number of populations). Alternatively – monitoring of habitat extent and distribution may be used as a surrogate for species population monitoring with more occasional validation monitoring of the habitat-species relationship.
- Status and trends in habitat extent, connectivity, & protection status for each species. May include status and trends in high quality habitat as separate from marginal quality habitat.
- Re-colonization rate of restored sites
- Establishment success of population transplants
- Possible measures of species-specific pressures (e.g., competition and predation by non-indigenous species, boat wake disturbance, etc.)
- Research to improve understanding of habitat-species relationships, especially for "R" and "r" species to determine which species can be reliably tracked in the future using habitat extent and quality as a surrogate with occasional validation monitoring.

For the "Maintain (m)" species

- Monitoring habitat extent, distribution, connectivity and quality as a surrogate for direct species monitoring.
- Presence/absence or relative abundance of species monitoring as part of biological community monitoring in habitat sampling sites

The purpose of the conceptual model is to document the links between CALFED ERP milestones and at-risk species.

A general list of monitoring recommendations is given in Box 10a. The basic strategy is to have targeted monitoring for "R" and "r" species and to monitor habitat as a surrogate for monitoring "m" species. Frequency of monitoring will need to be developed for each species individually. Note that this monitoring does not substitute for pre-project listed species surveys and individual project EIS/EIR evaluations.

Different types of monitoring data will yield different levels of information with a corresponding increase in the costs involved. The Sierra Nevada Forest Plan EIS (USFS 2001)[36] summed it up well so their table is simply incorporated below. (See table 10-1). The type of monitoring conducted (presence, relative abundance, reproductive success) depends on a combination of science and management issues. How a given species should be monitored is very dependent on the management questions involved, the type of management actions possible, the value of the information required, the timeframe in which an answer is needed, and the cost-benefit of various methods as well as the monitoring protocols available and the scientific support and feasibility of the methods.

Table 10-1. Types of population monitoring data ordered by increasing level of investment and data resolution. (Taken directly from Sierra Nevada Framework EIS, Vol. 4, Appendix E-19, 2001)[36]

Monitoring Data	Definition
None	It is not appropriate to invest in monitoring populations of some species based on the range of the species or the feasibility of obtaining monitoring data relative to the level of interest or concern.
Presence	A few species are suspected to be extirpated from part or all of their range in the Sierra Nevada study area. Detecting the presence of these species is the first priority in a monitoring scheme to address their status.
Distribution	Distribution data consist of changes in the presence of species across a number of sample locations. Distribution is a spatially explicit version of frequency of occurrence data. At a spatial scale as large as the Sierra Nevada study area, changes in the distribution of species represent ecologically significant information on the status and change of populations.
Relative Abundance	Relative abundance is an index of abundance that can be derived a myriad of ways depending on the sampling method. Typically it is based on a count of individuals, but it can also be based on a count of occupied sites in a given sample area. For plants, it is the occurrence size—the number of individuals in or the area inhabited by a population or subpopulation.
Population Size	Population size is a direct estimate of number of individuals. For very rare species, it could be an absolute count (census) of the population size (vs. an estimate).
Apparent Recruitment	A qualitative or semi-quantitative measure of key stage classes for plants, often including an assessment of the proportion of the population appearing to be composed of juveniles.
Reproductive Success	Reproductive success can be measured a variety of ways, depending on the species and sampling method. Reproductive success is most often pursued for bird species, where the number of eggs and fledglings can be readily enumerated to calculate number of young produced per adult. It is also described for some taxa in terms of the proportion of females reproducing. However, an index of the number of young produced per adult or breeding pair can be derived for most species.
Population Structure	Many measures of population growth and structure are available for use in monitoring. They range from individual attributes of a population (e.g., age ratios, sex ratio) to derived rates of change (e.g., mortality rates, fecundity rates, growth rates).

A long-term strategy should be to substitute monitoring of individual species with monitoring of habitats and more occasional validation monitoring of the relationship between extent, distribution, composition, quality, and connectivity of habitats and the status of at-risk species. Monitoring of individual species is expensive, whereas monitoring of habitats is comparatively inexpensive. Environmental science has been moving towards using habitat mapping as a surrogate for individual species distributions, especially for difficult to measure species. Utilizing this method of monitoring requires several assumptions

- The targeted population is large enough and widespread enough that monitoring the extent, distribution, connectivity, composition and quality of habitats is a viable surrogate (i.e. if there are only 2 populations of a plant species, it may be less expensive to monitor the two populations directly). Monitoring habitats is not sufficient for highly vulnerable species populations with small and declining numbers on the verge of extinction.

- The limiting habitat requirements of the species are known, including foraging, migrating, reproduction, cover, and over-wintering habitat
- The habitat requirements of a given species can be easily mapped or otherwise quantified.
- Habitat extent, configuration, structure, and composition are the primary limiting factors and other stressors will not significantly interfere with this relationship. If other stressors are important (i.e. non-indigenous predators, contaminants), then some form of habitat quality rating must be incorporated into the monitoring.
- Less frequent validation monitoring will be needed to determine if the assumptions behind the habitat-species relationship continue to hold.

For example, the giant garter snake is one candidate to monitor following this model (i.e., extent, distribution, connectivity, and quality of habitats coupled with validation monitoring) since monitoring status and trends directly likely will be difficult.

The assumption is that key structural and compositional elements representing habitat quality can reliably predict species viability. Therefore, it is important to determine for these species, whether measurable attributes of vegetation structure and composition can best serve as indicators or predictors of biotic communities and species' viability and what measurable attributes reflect quality tidal wetland habitat. For species ranging over large areas, habitat use may be scale-dependent and influenced by landscape characteristics (Naugle et al. 1999)[31]. Validating models by linking habitat elements to population response is prudent given the limits in applying and uncertainty in predicting population dynamics from habitat-based monitoring (Mulder et al. 1999)[30].

The monitoring recommendations given in Appendix G need to be reviewed and refined:

- Monitoring elements must be evaluated and refined to what is <u>necessary</u> and <u>sufficient</u> to inform managers about the status and trends of each at-risk species in an adaptive management context.
- Details are needed about timing, frequency, locations and methods/protocols.
- Details are needed about the structure and compositional components of habitat quality for each species and how to monitor them
- Rough costs estimates are needed

Existing Programs

CAL-Flora, the CDFG-Natural Diversity Data Base, the CDFG-California Wildlife Habitat Relationships Database, and the CDWR Delta Levees Subventions Program all provide information on where species occurrences have been recorded, although these are not ongoing monitoring programs. Some existing monitoring programs have been identified. These are listed under each individual species and are summarized in table 10-2. Undoubtedly more monitoring is occurring, but these are the programs identified at the writing of this report. The intensity with which various MSCS species are being monitored is discussed below.

Intensive monitoring occurring

Inland dune scrub species: *Lange's metalmark butterfly, Antioch Dunes evening primrose, and Contra Costa wallflower* are already monitored annually by the USFWS Antioch Dunes National Wildlife Refuge.

San Joaquin Valley Endangered Species Program (CSU-Stanislaus) and California Department of Fish and Game are conducting monitoring and research for *riparian brush rabbit and San Joaquin Valley woodrat*.

Some regional surveys occurring or intensive research (i.e. larger than a single project)

Point Reyes Bird Observatory and the Riparian Habitat Joint Venture are conducting some limited monitoring on riparian bird species which applies to the following species: *bank swallow, little willow flycatcher, California yellow warbler, Least Bell's vireo, Western yellow-billed cuckoo.* The RHJV are hoping to expand monitoring in the future. Monitoring for these bird species together with other indicator species identified by the RHJV overlap with monitoring needed for Neotropical Migratory Birds and assessing Floodplain and Riparian Habitat Quality. It should be noted that Least Bell's vireo is not currently found in the ERP focus area so monitoring for this species will actually consist of general monitoring of riparian birds and noting if this species becomes established.

Other species for which some degree of intensive monitoring and/or research is being or has recently been conducted include: *California clapper rail, California black rail, giant garter snake, Swainson's hawk, greater sandhill crane, Mason's lilaeopsis, salt marsh harvest mouse*

Single project monitoring only identified

The following species are mentioned as being monitored in specific restoration projects. No larger scale monitoring has been identified yet. *Alkali milkvetch, San Pablo song sparrow, Valley elderberry longhorn beetle*

No monitoring projects identified

Bristly sedge, Crampton's tuctoria, Delta coyote-thistle, Delta green ground beetle, Delta mudwort, Delta tule pea, Northern California black walnut, Point Reye's bird's beak, Saltmarsh common yellowthroat, San Pablo California vole, soft bird's beak, Suisun marsh aster, Suisun ornate shrew, Suisun song sparrow, Suisun thistle

Table 10-2. ERP/MSCS species loosely linked with existing monitoring programs / information sources. No attempt is made to assess whether the geographic scope, frequency, methodology, reporting, etc. of these programs is adequate to meet the CALFED ERP information needs.Only a limited number of programs have been identified to date and CALFED needs information about additional programs.

	ERP / MSCS "R" and "r" Species																																		
Monitoring Programs & Information Sources	Alkali milkvetch	Antioch Dunes Evening-Primrose	Bank swallow	Bristly sedge	California black rail	California clapper rail	California yellow warbler	Contra Costa Wallflower	Crampton's tuctoria	Delta coyote-thistle	Delta Green Ground Beetle	Delta mudwort	Delta tule pea	Giant garter snake	Greater sandhill crane	Lange's Metalmark butterfly	Least Bell's vireo	Little willow flycatcher	Mason's lilaeopsis	Northern California black walnut	Point Reyes bird's beak	Riparian Brush Rabbit	Salt Marsh Harvest Mouse	Saltmarsh common yellowthroat	San Joaquin Valley Woodrat	San Pablo California Vole	San Pablo song sparrow	Soft bird's-beak	Suisun marsh aster	Suisun Ornate Shrew	Suisun song sparrow	Suisun thistle	Swainson's hawk	Valley Elderberry Longhorn Beetle	Western yellow-billed cuckoo	...
Avocet Research Associates for SF Bay NWR (?): California Black and Clapper Rail Monitoring					x	x																														
CDFG: Bank Swallow Monitoring			x																																	
CDFG - Greater Sandhill Crane breeding & wintering ground studies and monitoring															x																					
CDFG: Little Willow Flycatcher Monitoring																		x																		
CDFG: Riparian Brush Rabbit Monitoring																						x														
CDFG / CDWR: Suisun Marsh Salt Marsh Harvest Mouse monitoring in SMHM Conservation Areas.																							x													
CDFG Swainson's Hawk Monitoring																																	x			
CDFG: Swainson's Hawk Monitoring – Yolo County																																	x			
Cosumnes River Preserve & Univ. of California - Davis	x													x																						
East Bay Municipal Utility District: Mokelumne River Watershed Wildlife Monitoring Program														x				x				x											x			
Marin Audubon Society (funded by CALFED): Petaluma Marsh Expansion Project - Marin County					x	x																					x									
Point Reyes Bird Observatory, The Nature Conservancy, U.S. Fish & Wildlife Service: Sacramento River Bird Conservation Project – Riparian Birds			x														x	x															x		x	
Point Reyes Bird Observatory, U.S. Fish & Wildlife Service: San Joaquin Restoration – Riparian Birds			x														x	x															x		x	
San Joaquin Valley Endangered Species Program (CSU-Stanislaus): Riparian Brush Rabbit and San Joaquin Woodrat Monitoring																						x			x											
USFWS Antioch Dunes National Wildlife Refuge: Antioch Dunes Evening Primrose, Contra Costa Wallflower, Lange's metalmark butterfly monitoring		x						x								x																				
USFWS San Francisco Bay National Wildlife Refuge Complex: California Clapper Rail Monitoring in South SF Bay Marshes						x																														
USFWS / SWRCB: Phelan Island Restoration & Farming Project																																	x	x		
U. S. Geological Survey-- Giant Garter Snake Monitoring														x																						
Yolo County Habitat Conservation Plan (HCP)	x		x											x																			x	x	x	

11.0 LANDSCAPE-SCALE PRESSURES

This section deals with monitoring for non-indigenous plants, non-indigenous wildlife, and contaminants. These pressures move across the landscape and affect multiple habitats and consequently the approach to solving such problems requires a large-scale perspective as well as how they affect individual at-risk species and quality of specific habitat blocks. These pressures are so important CALFED has specific goals that relate directly to each.

> *Goal 5: Prevent the establishment of additional non-native invasive species and reduce the negative ecological and economic impacts of established non-native species in the Bay-Delta estuary and its watershed.*[9]

> *Goal 6: Improve and/or maintain water and sediment quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed; and eliminate, to the extent possible, toxic impacts to aquatic organisms, wildlife, and people.*[9]

Monitoring for these pressures is dealt with in specific sections, but is also addressed in Habitat Quality, ERP At-Risk Species, and ERP Biological Community sections.

In general the monitoring involves
1) monitoring of targeted contaminants and non-indigenous species across the landscape
2) monitoring levels of contaminants and non-indigenous species in habitat quality monitoring sites and the effect on biological communities and at-risk species
3) project monitoring – location and effectiveness in reducing contaminants or non-indigenous species and reducing the effects on at-risk species

<u>Non-indigenous plants (invasive aquatic, marsh, and riparian plants)</u>

The Ecosystem Restoration Program Plan (2000)[8] briefly describes the problems of invasive plant species in tidal wetlands, floodplains and riparian areas and specifically describes the following targeted species:

- Arundo (*Arundo donax)*
- Tarmarisk (*Tamarix chinensis, T. ramossisima, T. pentandra*)
- Ailanthus or tree of heaven (*Ailanthus altissima*)
- Edible Fig (*Ficus carica*)
- Northern California Black Walnut (*Juglans californica var hindsii)* outside of native range
- Eucalyptus (*Eucalyptus* spp.)
- Black locust (*Robinia pseudoacacia*)
- Russian olive (*Elaeagnus angustifolius*)
- Perennial pepperweed (*Lepidium latifolium*)
- German ivy (*Senecio milkanioides*)
- Introduced Cordgrass (*Spartina alterniflora, S. anglica, S. densiflora, S. patens*)

Purple loosestrife (*Lythrum salicaria*)
Egeria (*Egeria densa;* syn: *Elodea densa*)
Hydrilla (*Hydrilla verticillata*)
Water hyacinth (*Eichhornia crassipes*)
Water pennywort (*Hydrocotyle umbellate)*
Eurasian watermilfoil (*Myriophyllum spicatum)*
Parrotfeather (*Myriophyllum aquaticum*)

See Table 5-1 for a loose linkup to the associated NCCP habitats of these species. The San Francisco Estuary Institute recently completed a technical report "*Introduced Tidal Marsh Plants in the San Francisco Estuary: Regional Distribution and Priorities for Control"* (Grossinger *et* al, 1998)[27] that describes problem non-native plant species in the San Francisco Bay and some in the Delta and includes distribution maps. The CALFED Non-Indigenous Species Program has written about non-native plants and fauna in "*Managing Non-native Invasive Species: A CALFED Bay-Delta Program Strategic Plan for the San Francisco Bay-Delta Estuary/Sacramento-San Joaquin Rivers and Associated Watersheds"* (CALFED Non-native Invasive Species Agency Team and Technical Team Planning Committees, 1999)[10]. The Nature Conservancy has a web page giving descriptions of these weeds in nature reserves and wildlands as well as pictures (http://tncweeds.ucdavis.edu/esadocs.html), habitat, natural ecology, and control methods. The reader is referred to these sources for individual conceptual models of these plants and only a brief discussion of issues will be presented here.

ERP Vision, Targets, and Objectives for invasive aquatic, marsh, and riparian plants[8]

ERP Visions

Reduce their adverse effects on native species and ecological processes, water quality, and conveyance systems, and major rivers and their tributaries

ERP Strategic Objective

Halt the introduction of invasive aquatic and terrestrial plants into the Bay-Delta Estuary, its watershed, and other central California waters

Limit the spread or, when possible and appropriate, eradicate populations of nonnative invasive species through focused management efforts.

ERP Long-term Objectives

Halt the release and spread of aquarium organisms, exotic plants and aquatic pets in the Bay-Delta Watershed.

Halt the importation, sale, and use of aquatic and terrestrial plants that can have potentially harmful impacts on ecosystems in the Bay-Delta watershed.

Eliminate or control to a level of little significance, all undesirable non-native species, where feasible.

ERP Short-term Objectives

Develop and institute strategies, working with the aquarium industry and interests representing the environment and other sectors that may be affected by such introductions, to halt the introduction and spread of non-native species and exotic plants from the aquarium and pet trades.

Develop and institute strategies, working with the horticulture industry and interests representing the environment and other sectors that may be affected by such introductions, to halt the introduction and spread of invasive plant species.

Eradicate or contain those species for which this can readily be done, gaining thereby the largest benefit for the least economic and environmental cost; and to monitor for the arrival of new invasive species and, where feasible, respond quickly to eradicate them.

ERP Stage 1 Expectations

Species in the aquarium and pet trades will have been identified and evaluated for their ability to establish populations in the Bay-Delta system. With the cooperation of the aquarium / pet industry and affected interests, a plan will have been developed and instituted to greatly reduce, and eventually eliminate, the introduction of unwanted aquatic organisms from these sources into natural waters.

Plants sold in California by the horticulture industry that pose a threat to ecosystems in the Bay-Delta watershed will have been identified and evaluated for invasive potential. Special attention will be paid to plants imported into the region from other areas. Working with the horticulture industry and affected interests, a plan will have been developed and instituted to greatly reduce, and eventually eliminate, the introduction of additional invasive plant species into natural habitats.

An assessment will be completed of existing introductions to identify those with the greatest potential for containment or eradication, and consider this in prioritizing control efforts. A program will have been implemented to monitor for, and respond quickly to contain and eradicate new invasions, where this is possible. A mechanism whereby new invasions can be dealt with quickly and effectively will have been developed and implemented.

Management Questions

What are the status and trends in the relative abundance of non-indigenous plants in tidal, freshwater, and riparian wetlands?

What are the status and trends in distribution of key non-indigenous plant species?

What new introduced plant species have been observed in natural habitats in the CALFED solution area?

Where are non-indigenous plant species control efforts occurring and what is their effect in the short-term and long-term?

To what extent are restoration efforts successful in establishing native vegetation? Are restoration efforts contributing to the spread and establishment of non-indigenous plant species? What basic knowledge is available about the transport, mobility, and spread of key non-indigenous species?

Issues

Introduced plants can out-compete and displace native plants, alter vegetation structure and function for native fauna, provide habitat for introduced fauna, and alter hydrological, geomorphic and ecological processes.

Dealing with non-native plants generally involves

- Preventing the introduction of new non-native plants
- Identifying the arrival/establishment of newly introduced plant species
- Identifying which new arrivals are or will likely become problematic for native vegetation and fauna (some will die out on their own).
- Determining the level of impact non-indigenous plants are having on native vegetation & fauna
- Reducing or eliminating the spread of problematic non-native plants
- Eradicating existing populations of problematic non-native plants
- Shifting the competitive dynamic between native and non-native plants to favor native plants by re-establishing natural hydrological and ecological processes and/or introducing a biological control agent
- Preventing establishment of non-native plants in habitat restoration or enhancement projects
  (From comments at the Terrestrial and Amphibious Monitoring Plan workshops, 2000).[2]

These issues can roughly be divided into two main areas: 1) prevention of establishment of new non-native plants and 2) controlling and preferably eradicating current problem non-native species.

Both issues require better access to information and would benefit from the creation of some form of centralized clearinghouse of information:

- place to report new locations of previously identified problem species
- place to report possible new introductions of previously unidentified species
- place for people to get information about introduced species, i.e. how to identify the species, its habitat and ecology, and the latest information on successful control methods. (The Nature Conservancy web site covers this)

This would greatly facilitate individual researchers and refuge managers in better understanding what plants are out there, how to deal with them, how fast they are spreading in distribution, and what new unidentified plants or new introductions have been reported. Often both field technicians, scientists, and refuge managers may spot plants they can't identify and simply report them as "unidentified____ herb". Some of the species may be introduced plants.

Basic information on where populations of at least the problematic non-native plant species are occurring in the Delta and preferably the Sacramento and San Joaquin river is needed.

Concerns have been raised that CALFED activities may actually increase the spread of non-native plant species. Certainly restoration efforts must be carefully conducted to prevent the establishment of non-native plant species. Altered flow amounts and seasonality away from natural flow regimes may favor non-native riparian plant species. (CALFED white paper on Riparian Vegetation, 2000)[7]

ERP Milestones[8a]
DEDT-S6: Develop and begin implementation of a demonstration program to reduce invasive non-native plant abundance within at least one EMU in the Delta.

SMB-H2: Begin aggressive program of control of non-native plant species that are threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak.

Monitoring Recommendations
See table 11-1.

Existing Monitoring Efforts
Although agricultural weeds and some weeds that impact boating are tracked by the US Department of Agriculture, there is no systematic tracking of introduced plants in natural habitats.

Regional Monitoring and/or information sources

- California Department of Food and Agriculture, Integrated Pest Control Branch. Conducts agricultural weed surveys and classification of noxious weeds. http://www.cdfa.ca.gov/phpps/ipc/
- California Interagency Noxious Weed Coordinating Committee. An interagency effort to coordinate management, mapping, eradication, and education. http://www.cdfa.ca.gov/phpps/ipc/CINWCC2/index.htm
- CALWEED database. California Noxious Weed Control Projects Inventory. http://endeavor.des.ucdavis.edu/weeds/
- Team Arundo Del Norte. Some selective Arundo monitoring. http://ceres.ca.gov/tadn/

Small-scale and/or local project

- Cosumnes River Preserve. Becky Waegell, Farmlands Coordinator, Cosumnes River Preserve, http://tncweeds.ucdavis.edu/success/ca001.html

Table 11-1. Monitoring recommendations for non-indigenous plants.

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

NON-INDIGENOUS PLANTS (ERP Strategic Objectives 5.5, 5.7)

No.	Attribute & Rationale	Type	Monitoring Element	General Method	Priority level	Existing Program?
11-1.1	**New introductions of Non-indigenous plants** What new introduced plant species have been observed in natural habitats in the CALFED solution area?	P	Identify unknown plant species from individual sampling sites	Sampling sites network, individual researchers, refuge managers		
			Maintain information clearinghouse to report new plants established in region & provide information on documented non-native plants, ecology, history, and control methods	programmatic	High	The Nature Conservancy http://tncweeds.ucdavis.edu/esadocs.html (natural history and control methods of non-native plants in natural habitat)
11-1.2	**Non-indigenous plants growth, spread, competition** What are the status and trends in the relative abundance of non-indigenous plants in tidal, freshwater, and riparian wetlands? What are the status and trends in distribution of key non-indigenous plant species?	P	relative abundance of non-indigenous plants within tidal, freshwater, and riparian wetlands(21, 15)	sampling sites network		
			distribution & abundance (size of patch ?) of key non-indigenous plant species, i.e. Arundo, Tarmarisk, Ailanthus or tree of heaven, Edible Fig, Northern California Black Walnut, Eucalyptus, Black locust, Russian olive, Perennial pepperweed, German ivy, Introduced Cordgrass, Purple loosestrife, Egeria, Hydrilla, Water hyacinth, Water pennywort, Eurasian watermilfoil, Parrotfeather (8)	Regional survey	Very High - Delta High - Sac & San Joaquin Rivers	Cal. Dept. of Boating and Waterways - Water hyacinth CDFA Integrated Pest Control Branch - Hydrilla SFEI-Biological Invasions Program Team Arundo Del Norte US Dept. of Animal & Plant Health Inspection Service (APHIS)

Table 11-1. Monitoring recommendations for non-indigenous plants.

Only the highest priority items are flagged. Further work is needed in refining this list, prioritizing it, and identifying existing programs. References are in (). P=Pressure, S=State the Environment, A=Management Actions, E=Effectiveness, P-N=Natural Pressure or background, P-R=Redirected effect from CALFED action

NON-INDIGENOUS PLANTS (ERP Strategic Objectives 5.5, 5.7)

No.	Attribute & Rationale	Type	Monitoring Element	General Method	Priority level	Existing Program?
11-1.3	**Transport, Mobility, and spread of non-indigenous species.** What basic knowledge is available about the transport, mobility, and spread of key non-indigenous species?		Transport, mobility and spread of non-indigenous species	Targeted studies		
11-1.4	**Control efforts for non-indigenous plants** Where are control efforts occurring and what are their effect?	A	Number, location and effectiveness of control efforts for non-indigenous plants	programmatic	High	CALWEED database (ICE)
11-1.5	**Degree of non-indigenous plant species establishment in restoration projects** To what extent are restoration efforts successful in establishing native vegetation? Are restoration efforts contributing to the spread and establishment of non-indigenous plant species?	A	Extent and distribution of habitat restoration and enhancement efforts	Programmatic	high	
		E	Conduct pre-project (for degraded wetlands only) and post-project monitoring of type and relative abundance of non-indigenous plant species.	Project Monitoring	high	

Non-indigenous wildlife

ERP Vision[8]

Implement a program to reduce the numbers of harmful non-native wildlife species (i.e., those that threaten the diversity or abundance of native species or the ecological stability of an area).

ERP Strategic Objectives

Reduce the impact of non-native mammals on native birds, mammals, and other organisms.

Limit the spread or, when possible and appropriate, eradicate populations of non-native invasive species through focused management efforts.

Long-term Objectives

Establish mechanisms to minimize the negative effects of house cats, red fox, domestic dogs, roof rats, house mice, and other non-native predators and competitors on populations of native birds and mammals, especially at-risk species.

Eliminate or control to a level of little significance, all undesirable non-native species, where feasible.

ERP Short-term objective

Develop both the means and the public support for limiting the invasion and impacts of non-native mammals into natural areas

Eradicate or contain those species for which this can readily be done, gaining thereby the largest benefit for the least economic and environmental cost; and to monitor for the arrival of new invasive species and, where feasible, respond quickly to eradicate them.

ERP Stage 1 Expectations

An aggressive public information program on the impacts of such non-native mammals in wildlife areas will have been conducted. Plans for long-term control of invasive mammals will have been developed, with alternatives clearly spelling out the impact of no or low control.

An assessment will be completed of existing introductions to identify those with the greatest potential for containment or eradication, and consider this in prioritizing control efforts. A program will have been implemented to monitor for, and respond quickly to contain and eradicate new invasions, where this is possible. A mechanism whereby new invasions can be dealt with quickly and effectively will have been developed and implemented.

Management Questions

What are the effects of non-indigenous fauna on biological communities within tidal wetlands and floodplain and riparian wetlands such as neotropical migratory birds, waterfowl, shorebirds, and native anuran amphibians? On adult survivorship? On reproductive success?

What are the effects of non-indigenous fauna on ERP/MSCS at-risk species such as California Black rail, California clapper rail, Suisun ornate shrew, salt marsh harvest mouse, riparian brush rabbit, and San Joaquin valley Woodrat—adult survivorship and reproductive success?

What actions are being taken to control non-indigenous fauna and what are the effects on biological communities and ERP/MSCS at-risk species?

What new introduced fauna are likely to become problems, where have they been sited, and what efforts are being taken to control them?

ERP Milestones

No ERP milestones directly relate to non-indigenous animals. However the milestones relating to the increase in the amount and quality of habitat do relate indirectly since small habitat patch size and lack of connectivity for larger predators such as coyotes is associated with an increased presence on non-indigenous fauna such as foxes, feral cats and cowbirds. Often reduction efforts in non-indigenous fauna will be directly tied to improving the quality of a tidal or floodplain habitat or reducing the impact on specific MSCS species such as little willow flycatcher.

Issues

Non-indigenous animals can be a significant problem and in high numbers seriously degrade habitat quality for native fauna and especially for endangered and threatened species. Primarily the species being focused on in the ERPP include:

Domestic and feral cats & dogs
Non-indigenous foxes
Introduced Norway rats and black rats
Brown-headed cowbirds (native to central U.S. but extended range to California with expanding agriculture in past 100 years)
Bullfrogs and Predatory fish
Red-eared slider (turtle)

The general approach to reducing problems involving non-indigenous fauna include

- prevent further introductions
- limit the spread into new areas
- re-establish ecological processes that minimize the impact of non-native fauna (i.e. increasing riparian habitat patch size reduces effect of cowbirds, re-establishing connectivity for top-down predators like coyotes that control foxes & cats)
- alter land use activities within or near the natural area (e.g. unvegetated bare ground, feedlots, and some grazing practices can increase populations of brown-headed cowbirds. Shelter areas like old sheds can increase populations of feral cats. Urban areas and trash sites can increase populations of pet and feral cats and dogs, rats, and native predators such as raccoons and crows.)

- directly control non-native wildlife in highly sensitive areas (trapping of brown-headed cowbirds, feral cats, introduced foxes, bullfrogs in areas where they are impacting species of concern)

Monitoring
The monitoring for non-indigenous fauna really is covered under the habitat quality sections and the individual ERP/MSCS species and biological community monitoring.

- Types of monitoring include
  - rates of nest predation, nest parasitism, and hatchling survival for riparian songbirds
  - adult survivorship and reproductive success for rails and San Joaquin Valley woodrats
  - predation rates or reproductive success in shorebird colonies
  - patch size relative to presumed non-native predator influence
  - location of buffer zones and/or distance to urban areas or land use that increases non-indigenous fauna
  - accessibility of habitat to coyotes (associated with decreased numbers of introduced foxes and feral cats)
- Project – Location and effectiveness of control efforts for feral cats and introduced foxes, bullfrogs, brown-headed cowbirds, red-eared sliders and other non-indigenous fauna
- Clearinghouse for reporting newly introduced fauna and providing information regarding locations, description, and control measures

Existing Monitoring Programs
Existing programs primarily consist of targeted research projects and targeted predator, cowbird, or bullfrog control projects involving recovering at-risk species. Information can also be gathered from restoration project monitoring, reproductive success monitoring for birds, and recording of non-native species in mammal, reptile, amphibian, and bird community monitoring.

- Point Reyes Bird Observatory-Sacramento River Bird Conservation Project may include some studies of brown-headed cowbird nest parasitism in open-cup nesting songbirds.
- CDFG and/or USFWS may have cowbird trapping, bullfrog removal, feral cat removal, and introduced fox removal projects

CONTAMINANTS

Contaminants involve nutrient loading, fine sediment loading, and toxic compounds. This section includes listing relevant strategic objectives and ERP milestones and briefly discussing monitoring for contaminants. Monitoring for contaminants is presumed to come primarily from the aquatic monitoring plan with only supplemental monitoring from the terrestrial plan since most contaminant effects will likely show up first in the aquatic ecosystem. The terrestrial program will likely use targeted studies when health effects on wildlife are discerned.

ERP Strategic Objectives[9]

6.1) Reduce the loadings and concentrations of toxic contaminants in all aquatic environments in the Bay-Delta estuary and watershed to levels that do not adversely affect aquatic organisms, wildlife, and human health.

6.2) Reduce loadings of oxygen-depleting substances from human activities into aquatic ecosystems in the Bay-Delta estuary and watershed to levels that do not cause adverse ecological effects.

6.3) Reduce fine sediment loadings from human activities into rivers and streams to levels that do not cause adverse ecological effects.

ERP Milestones[8a]

- …reduce pollutant (*oxygen depleting substances, nutrients, ammonia*) from discharges from concentrated animal feeding operations (DEDT-S11, SMB-S2, SACR-S8, SJR-S6, SJR-S8, SJR-S9)
- *Reduce fine sediment loading* to streams, especially Tuolumne, Merced, Stanislaus, Cosumnes, Napa, Petaluma Rivers, and Sonoma Creek, due to human activities… (DEDT-S13, SMB-S4, SACR-S11, SJR-S10)
- *Research … threshold concentrations for mercury* in sediments and key organisms…(DEDT-S14, SMB-S5, SACR-S12, SJR-S11)
- *Mercury abatement work* in Cache Creek watershed, Delta, Sacramento River (DEDT-S15, DEDT-S16, SACR-S13, SACR-S14)
- *Pesticide work* (Diazinon & chlorpyrifos) (DEDT-S17, SMB-S6, SACR-S15, SJR-S12)
- *Selenium work*… (DEDT-S18, SMB-S7, SJR-S13)
- Reduce *organochlorine pesticide* to streams… (DEDT-S19, SMB-S8, SACR-S16, SJR-S14)
- *Trace metal work*… (Copper, cadmium, zinc, chromium) (DEDT-S20, SBM-S9, SACR-S17, SJR-S15)
- *Unknown toxicity studies*… (DEDT-S21, SMB-S10, SACR-S18, SJR-S16)

Monitoring for toxic contaminants

Monitoring for toxic contaminants will primarily be conducted in the aquatic environment, i.e. in the water column, sediments, benthic invertebrates, and fish tissue as well as programmatic monitoring of locations of known loading, locations and implementation status and effectiveness of actions. The Terrestrial and Amphibious Monitoring Plan defers to the Aquatic Monitoring Plan in this area. Monitoring in the terrestrial environment will likely involve

- Coordinating with monitoring in the aquatic environment (water column, sediment, benthic invertebrates, fish tissue)
- Monitoring for indicators of exposure and effects of contaminants on reproduction, esp. evidence of deformities in young birds and amphibians in the floodplain and tidal wetland sampling sites networks.
- Performing targeted research when problems are suspected.

Monitoring for nutrient loading
Nutrient loading and the associated low dissolved oxygen in the water column is a much more acute problem in the aquatic environment than in the terrestrial and will show results sooner in the aquatic environment than in changes in vegetation or fauna in the terrestrial environment.

- Coordinate with monitoring in the aquatic environment (water column (nutrients, dissolved oxygen), sediment, algal blooms, benthic invertebrates, fish

Monitoring for fine sediment loading
Fine sediment loading causes degradation in salmonid spawning habitat as well as changing sediment texture in deposits downstream. Although the turbidity and heavy fine sediment deposits can effect plant establishment, the effects are felt more quickly and acutely in salmonid habitat and by benthic invertebrates.

- Coordinate with monitoring in the aquatic environment (water column (turbidity, TDS), sediment, benthic invertebrates, salmonid spawning habitat).
- Monitoring the amount and texture of sediment deposits at floodplain sampling sites.

12.0 REDIRECTED EFFECTS

CALFED is attempting to solve problems simultaneously in four inter-related problem areas: Ecosystem Quality, Water Supply Reliability, Drinking Water Quality, and Levee System Integrity. Actions to address one problem area may have unintended consequences in another problem area. Listed below are some of the 1) expected effects of ERP action on other CALFED problem areas, 2) effects of other problem areas on the ERP, and 3) actions within a portion of the ERP affecting other areas within the ERP. This list is probably incomplete and more redirected effects will need to be added. Some of these effects are already being monitored. For others, the identification of monitoring for redirected effects will need additional work that will likely involve pulling together experts from both problem areas to identify monitoring and research needs.

Redirected effects of ERP actions on other CALFED problem areas

<u>Water Supply Reliability</u>

- (-) Increasing the acreage of tidal wetlands may cause increased water usage by the environment due to water transpiration from these wetlands. Net effect will be dependent on previous land use.
- (-/+) The threatened and endangered status of Chinook salmon, delta smelt, and possibly splittail and striped bass currently constrain reservoir operations, flows, and exports because of requirements to manage river temperature, flows, and Delta salinity standards for these species and to restrict pumping operations when the direct mortality or “take” limits of these species have been exceeded. Increasing the populations of these species through habitat restoration and other actions may in the long run increase the flexibility of water management operations. Continuing declines in these species will decrease the flexibility of water management operations.
- (-) Water transfers may be constrained when they are expected to negatively impact riparian and wetland habitats.

<u>Drinking Water Quality</u>

- (-) Increasing the acreage of tidal wetlands may cause increased release of organic carbon into the water which may affect the amount of disinfection by-product pre-curs in drinking water taken from the Delta.
- (-) Increasing the acreage of tidal wetlands may increase the tidal prism of the Delta and cause an increase in salinity and bromide intrusion into the Delta which can cause a decrease in drinking water quality.
- (+/-) Increasing the acreage of tidal wetlands may cause increased trapping of pollutants and possibly organic carbon that could be problematic for drinking water quality. However if these wetlands subsequently erode, then these pollutants will be re-released into the water column.

Levee System Integrity

- (-/+) Setback levees may increase levee maintenance complexity, expense, and vulnerability in the short-term but may result in increased levee protection in the long-term by providing buffering from wave action and decreased pressure on levees due to larger floodplains. However, in watersheds upstream of the Delta increasing the floodplain area in only part of a watershed may increase pressure on levees downstream unless levees are set back at the bottom of the watershed first
- (+) Wetland restoration may decrease the number of levee miles needing maintenance including some of the more vulnerable levee areas (i.e. corners of islands)
- (-) Wetland restoration may increase wind and wave erosion on other levees by increasing the amount of open water.

Redirected effects of actions in other CALFED problem areas on ERP

Water Supply Reliability

- (-) Changes in conveyance through the Delta and storage can affect flows and erosion in channels and subsequently wetland and riparian habitats
- (-) Altered groundwater pumping due to water transfers can affect riparian and wetland vegetation.
- (+/-) Timing and amount of flow releases can affect the relative establishment of native versus non-native plants. They also affect water temperature and flows for native fish.
- (-) Water diversions cause fish entrainment (aquatic monitoring plan)

Drinking Water Quality

No impacts of actions in the Drinking Water Quality problem area on ERP were identified.

Levee System Integrity

- Set-back levees can increase amount of riparian and wetland habitat edging rivers, channels, and sloughs
- Large-scale levee failure can result in damage to nearby wetland habitats
- Levee maintenance activities such as rip-rap or other bank hardening measures reduce habitat. Bare levees can also increase predation near wetlands during high flow events as animals seek upland refuge areas.

Possible Redirected effects of ERP actions on other parts of the environment

- Conversion of diked wetlands to tidal wetlands may have a negative impact on waterfowl and some shorebirds since the diked wetlands may provide higher quality habitat for these communities. This may cause shifts in where migratory and indigenous waterfowl over-winter. Conversion may cause loss of habitat for some species while causing an eventual gain for other species.
- Breaching subsided islands without raising the land elevation level may result in sediment sinks which trap sediment in the newly breached island and cause a deficit of sediment in nearby wetlands.
- ERP restoration efforts may increase the spread of non-indigenous plant species.

- Creation of wetland habitat may influence mercury bioavailability.
- Creation of riparian habitat can increase shading of rivers thereby lowering water temperatures and increase insect drop thereby increasing food availability for fish. This could be expected to benefit salmonids and possibly other native fish species.
- Creation of floodplain habitat can increase food supplies for splittail and outmigrating juvenile salmon as well as habitat for terrestrial species.

13.0 RELATIONSHIP TO AQUATIC MONITORING PLAN

The terrestrial and amphibious monitoring plan (TAMP) and the aquatic monitoring plan (AMP) were initially separated as a matter of expediency. Monitoring of fish, benthic invertebrates, plankton, and flows has been occurring for over 2 decades largely in response to compliance monitoring needs for the south Delta pumping facilities. The Interagency Ecological Program (IEP) helped bring a regional focus and coordination to these issues and expand the scope from simple compliance monitoring to an ongoing monitoring and research program. In contrast, regional monitoring for terrestrial issues is less developed. Given that more is known about the aquatic ecosystem and existing monitoring programs, specific recommendations on how to change and augment these monitoring programs to meet CALFED needs could be made.

However, the aquatic and terrestrial monitoring plans will eventually need to be reconciled to increase effectiveness, eliminate redundancy, and improve coordination among the different monitoring efforts. Certainly subsequent efforts to refine monitoring must include both aquatic and terrestrial components.

Assumptions
The terrestrial and amphibious monitoring plan assumes that monitoring for fish, benthic invertebrates, plankton, system hydrology, river temperatures, essential fish habitat (salmonid spawning habitat), and contaminants are covered by the aquatic program. Even though contaminants and hydrology affect the terrestrial system as well, their effects are felt sooner and more acutely in the aquatic ecosystem. Thus monitoring for contaminants in the aquatic ecosystem in general is felt to provide an early indication of problems in the terrestrial system. Similarly monitoring of flows, stage, snowpack status, reservoir status, etc. are of critical importance for both the ERP aquatic monitoring plan and the Water Supply Reliability problem area and thus coordinating with the aquatic monitoring plan to meet these needs would seem advisable.

Some differences in focus between the two plans
The main pressures differ among the two systems: the dominant pressures on the aquatic system are altered hydrology, dams, and water diversions. The dominant pressure for the terrestrial ecosystem is habitat loss and fragmentation. This produces a different emphasis on the importance of habitat mapping in the two systems. In the aquatic ecosystem, mapping of habitats is secondary to monitoring of the fish populations themselves and flows. In the terrestrial ecosystem monitoring the extent, and distribution of habitats is pivotal.

How “redirected effects” are handled is a major difference between the two plans. Endangered fish species in the aquatic monitoring plan are at the center of the conflicts with the water supply reliability problem area. In contrast redirected effects are a more peripheral concern in the terrestrial and amphibious monitoring plan. Monitoring and research regarding the redirected effects in the aquatic program will be critical for decision-making at the end of CALFED’s “Stage 1” and requires special focus. To put it simply, endangered fish species can stop the south Delta pumping facilities. Endangered birds, mammals, and reptiles do not.

The time-scale of measurements differs considerably between the two efforts. The aquatic monitoring involves real-time monitoring of flows and fish movement whereas the terrestrial and amphibious program mainly needs to know about the yearly hydrograph, and the extreme flow events that have occurred. However, this difference in timing is because the movement of listed fish species can stop CVP/SWP water exports – another CALFED problem area – whereas terrestrial and amphibious species do not. Changes in the terrestrial system are largely due to changes in extent and quality of habitat – vegetation establishment and succession occur over decades.

Discussion of overlaps between terrestrial and aquatic monitoring
The main overlaps between the aquatic and terrestrial monitoring plans are found in the hydrologic processes (river flow, stage, frequency of high flood events, floodplain inundation, salinity), geomorphic processes (sediment supply, river meander, and tidal slough formation), habitats that affect both programs (tidal wetlands, riparian habitat immediately adjacent to rivers and streams, seasonal wetlands), and common pressures (contaminants, nutrient loading, non-indigenous aquatic and marsh plants).

Table 13-1. Overlaps between Terrestrial and Aquatic Systems

Topic	Applies to both systems	Applies to Terrestrial System	Applies to Aquatic System
Central Valley stream & river flow amount, stage, timing, and seasonality		Affects floodplain plant community composition, distribution and relative abundance of non-indigenous plants over long term. Also affects recharging of aquifers and groundwater levels. Extreme floods can cause large changes in channel course and vegetatio	Affects distribution of aquatic species (short-term response)
Salinity levels and variability in Delta and Suisun Marsh		Average salinity and variability hypothesized to effect plant community composition over long term (long-term response)	Affects distribution of aquatic species (short-term response)
Bay-Delta Hydrodynamics	Affects erosion & deposition in habitats (moderate to long-term response)		Affects distribution of aquatic species (short-term response)
Sediment supply		Affects diverse topography of floodplains & new substrate for vegetation establishment (long-term response)	Creates salmonid spawning beds and increases diversity of aquatic habitat (moderate to long-term response)
River meander		Affects creation and succession of vegetation habitat types (long-term response)	Affects diversity of aquatic habitat & sediment supply (moderate to long-term response)
Sloughs and tidal channel networks		Tidal channels affect creation and succession of vegetation and provide feeding habitat for terrestrial species; vegetation and levee maintenance determine utility of Delta sloughs for terrestrial species. (long-term response)	Provides high quality aquatic habitat for fish (if not dominated by non-native fish); provides highly productive environment for planktonic & benthic organisms at base of aquatic food web (moderate to long-term response)
Tidal shallow water habitat	Important habitat for both aquatic and terrestrial systems		
Floodplain and riparian habitats		Provides important habitat for terrestrial species, but wider floodplains and riparian corridors are preferred to narrow rows of trees adjacent to rivers. Waterfowl, shorebirds, and wading birds will respond rapidly to flooding of floodplains.	Trees lower water temperatures and increase food supply for fish; Fallen trees and branches can increase diversity of aquatic habitat; seasonal floodplains provide important food sources to juvenile salmon and splittails at specific times of year
Introduced aquatic plants and marsh plants	Degrade habitat quality and provide shelter for non-indigenous predacious fish		
Contaminants - pesticides, mercury, selenium, heavy metals	Affect both systems, but effects are usually seen first in aquatic system.	Some additional concerns for some at-risk species regarding rodenticides and aerial drift of agricultural insecticides.	
Contaminants - excess nutrients		Can affect plant community composition over long term (long-term response)	Causes dissolved oxygen sags and associated fish dieoffs and changes in invertebrate communities (short-term response)

14.0 RELATIONSHIP TO WATERSHED PROGRAM

The monitoring elements identified in the Terrestrial and Amphibious Monitoring Plan were identified primarily to assist the CALFED Bay-Delta Program Ecosystem Restoration Program with assessing status and trends in the state of valued resources and the cumulative effect of CALFED actions on those resources. However the monitoring recommendations will likely be of interest to participants in the Watershed Program as well.

Although the primary focus is on the ERP focus area, some of the monitoring also relates to upper watershed areas. However, upper watersheds are likely to have additional issues that may not be of as great a concern to the ERP, such as timber cutting and grazing management, and the emphasis on the various issues may be different. In addition, watershed groups tend to take a more holistic approach to resource management and may wish to include more monitoring elements relating to direct measurement of human impacts such as population increase, total water demand, water use per capita, permeability of watershed, acreage converted from agriculture to urban, etc. The terrestrial and amphibious monitoring plan chose to measure the effects of population increase rather than population increase directly by measuring acreage of habitat lost or changes in tributary flow amount and timing.

Watershed groups will likely benefit if the ERP makes an effort to clearly publish conceptual models it develops, the reasoning behind the actions it is taking, the decision-making process it uses, and monitoring protocols and restoration methods that have proven successful, to the degree possible. This would allow watershed groups to learn from the CALFED program's information gathering, methods, experience and allow them to adapt what will work for their individual programs rather than having to start their programs from scratch.

15.0 NEXT STEPS

As discussed in Section 4.0, TAMP adopts an iterative design process. Section 15.0 identifies subsequent steps in the process, including technical review by species experts for recommendations to monitor at-risk species identified in the ERP, revisions and review of the draft TAMP report, coordinating with scientists to create an implementable monitoring programs for various sections of the watershed, and identifying the highest priority issues. Currently TAMP provides a skeleton monitoring plan with monitoring recommendations largely in the form of **"what"** should be monitored and **"why".** These recommendations are summarized in Appendix H with each monitoring element linked with the various monitoring questions from all the chapters that apply to that data. The specifics of **"how"** to monitor each element must be detailed –i.e. where, when, how, how often. Identification of and coordination with existing monitoring programs needs to continue. In addition, data management, assessment, and reporting process will need to be developed as the monitoring plan moves closer to implementation.

The most important steps include

1) <u>Review and Refine</u>: Technical and programmatic review of the framework, management questions, and individual monitoring recommendations. Also reach consensus on highest priority items and continue identification of monitoring programs and information sources, including other CALFED programs and non-CALFED activities
2) <u>Coordinate with aquatic monitoring plan and integrate with CALFED project monitoring</u>: Coordinate framework and integrate recommendations with aquatic monitoring plan. Also integrate monitoring and information acquired from CALFED projects.
3) <u>Identify monitoring at smaller scales</u>: Apply framework to smaller scales within ERP focus area, i.e. Regions, Ecological Management Zones, and Ecological Management Units.
4) <u>Implement high priority recommendations</u>: Move forward on implementation and/or coordination regarding highest priority monitoring recommendations that have some degree of consensus, i.e. a) developing or identifying existing GIS data layers for vegetation in Delta and Central Valley floodplain, land use in and around ERP habitats, physical landscape changes, b) ensuring programmatic tracking of CALFED project location, extent, implementation status and results, c) implementing baseline surveys and coordinating with other groups for "R" and "r" species and targeted non-indigenous plants
5) <u>Develop/refine sampling sites network concept for tidal wetland and floodplain and riparian habitats</u>: Move forward with research and/or pilot projects to refine monitoring design
6) <u>Develop Information feedback system:</u> Develop a data management, assessment and reporting process that will provide an effective information feedback system to aid management decision-making.

Review and Refine:

Review and refinement of the TAMP are needed to ensure that ERP management needs have been addressed sufficiently and candidate monitoring elements identified from conceptual models are technically sound. Unlike the habitat quality and multi-habitat monitoring recommendations, the at-risk species recommendations have not received any technical review. Technical expertise to develop detailed conceptual models for the individual at-risk species is necessary to refine the generic monitoring recommendations and identify appropriate monitoring elements, protocols, or indicators.

Additional monitoring programs, especially for ERP/MSCS at-risk species should be identified. The U.S. Fish and Wildlife Service, California Department of Fish and Game, and Jones and Stokes Associates personnel involved with design of CALFED's Multi-Species Conservation Strategy (2000)[11] would be good sources for this information.

Coordinate with aquatic monitoring plan and integrate with CALFED research and project monitoring:

The aquatic and terrestrial monitoring plans must be re-integrated by 1) reconciling the overall framework and 2) identification of overlapping monitoring and research needs. 3) identify gaps between the current plans, 4) prioritize needs across both aquatic and terrestrial plans.

Species of concern in the aquatic monitoring plan include:

- ERP at-risk species -- Central Valley Salmon (R), Central Valley Steelhead (R), Splittail (R), Delta Smelt (R), longfin smelt (R), Green Sturgeon (R), and Sacramento Perch (r)
- Harvestable species-- white sturgeon, striped bass, non-native warmwater gamefish, salmonids, Pacific herring, native cyprinid fishes, American shad, signal crayfish, grass shrimp
- ERP Biological community group – native resident fish

Monitoring for fish, invertebrates, and aquatic food web processes need to be integrated into monitoring for tidal wetland and floodplain and riparian wetland habitat quality. Most of the requirements for quality habitat are similar although the emphasis on what is most important may be different. Fish may be more sensitive to changes in flows, water quality, salinity, contaminants, and estuarine productivity.

Monitoring needs for special status fish species will likely include monitoring of flows and water temperatures (which are also likely included in the water management program). Whereas there is a time-lag for flow and timing of flows to affect vegetation and habitats in terrestrial and amphibious habitats, flows can immediately affect ERP at-risk fish species. Thus monitoring large-scale processes such as river flows, water temperatures, and diversions are more developed in the aquatic monitoring program. The terrestrial needs may be met simply by integrating with the aquatic monitoring plan.

Priorities for monitoring and research need to be established across the combined monitoring program for the aquatic and terrestrial systems. Since the resolution of questions at the end of Stage 1 are among the highest priority, the redirected effects among the four problem areas and especially the effects of at-risk fish species on water supply reliability will likely be of critical importance. However, for the long-term evaluation of the success of the CALFED ERPP, critical needs to initiate include: establishing baselines for the extent, distribution, and connectivity of habitats, the status of all “R” and “r” at-risk species, and research into how to effectively monitor restoration success and habitat quality.

Identify monitoring at smaller scales: To implement the general monitoring recommendations, they need to be tailored to the specific environments, issues, and CALFED actions in Ecological Management Zones and Ecological Management Units.

- Select ERP management zones in which CALFED actions will be conducted and where coordination among researchers and monitoring agencies already occurs. Some early possibilities included
  - Suisun Marsh and North San Francisco Bay – the Wetlands Regional Monitoring Plan being coordinated by the San Francisco Estuary Institute is already working to identify monitoring in this area. Other groups include the Suisun Ecological Workgroup, and The Bay Institute. Monitoring already is occurring in Suisun Marsh to assess effects of the Suisun Marsh Salinity Control Gate. Mapping of the zone occurred during the Baylands Habitat Goals Project (1999).
  - Delta and Eastside Delta tributaries – Several active groups are involved with the Cosumnes and the Mokelumne Rivers to coordinate monitoring and research (e.g., Cosumnes River Preserve, the Mokelumne River Watershed Alliance, and Cosumnes floodplain restoration consortium with UC Davis).
  - Sacramento River Zone – The Sacramento River Watershed Program and other groups are already coordinating monitoring efforts.
- Identify ERP milestones and specific targets and actions mentioned in the ERPP and the ERP Strategic Plan that apply to the relevant Ecological Management Zone.
- Identify projects already approved by CALFED in the relevant Ecological Management Zone.
- Develop conceptual models relevant to Ecological Management Zone and units.
- Identify management and scientific questions relevant to Ecological Management Zone and units.
- Implement habitat mapping and pilot projects for sampling sites network. Conduct surveys for ERP/MSCS at-risk species if relevant.

Implement high priority recommendations:
The highest priority items for immediate implementation include:

- Map natural vegetation cover and type in Delta and Central Valley floodplain, riparian, and tidal wetland habitats and obtain aerial photographs.
- Coordinate with existing programs to gain GIS layers for land use in and around ERP habitats
- Monitor and map physical landscape changes such as canals, set-back levees, etc.

- Ensure the programmatic tracking of the location, extent, implementation status and results of CALFED projects so that information is available for decision-making
- Implement surveys for “R” and “r” species where needed, implement coordination with other groups where possible. Research to develop monitoring protocols may be necessary.
- Implement surveys for targeted non-indigenous plants in Delta and preferably valley floodplain, riparian and tidal wetland habitats, implement coordination with other groups where possible
- Coordinate with aquatic monitoring plan and other programs to meet needs for contaminant monitoring and water flow, and groundwater monitoring.

CALFED should identify opportunities to combine surveys to better meet CALFED needs in a cost effective manner. This includes surveys for needs within the ERP as well as among different CALFED programs

Develop/refine sampling sites network concept for tidal wetland and floodplain and riparian habitats:
A sampling sites network to monitor habitat quality includes both intensive monitoring sites (i. e., few sites with detailed monitoring to identify cause-effect relationships) and extensive sites (i.e., greater number of sites with fewer monitoring variables). The purpose of a network is to allow an assessment of

1) overall status and changes in the sustainability of habitats and functioning in support of biodiversity
2) condition of comparison sites for restoration projects.

It is important to clearly specify the purpose of the sampling sites network during the design phase. For example, if the purpose is to track changes in biodiversity, pressures, and process effects on habitats across landscape, then monitoring should be stratified to include both high quality and poorer quality habitats so that the results can be extrapolated across the entire landscape. The site selection should be stratified random. However, if the primary purpose is only to provide comparison sites for evaluating restoration sites, then both comparable high quality reference sites and degraded, poorer quality background sites will be needed. The efficacy of actions can be more accurately assessed if “reference” sites are coupled with a nearby, otherwise similar, highly degraded “background” site and similar measurements are taken at all sites. Site selection for comparison sites usually may not be random but sites as similar as possible to the restoration or enhancement site are selected. Establishing a network that will achieve both purposes will require thought and clear articulation of objectives up front.

Research is needed to develop indicators for assessing habitat quality and for evaluating restoration success. Pilot projects likely will be needed as will research to develop monitoring protocols. Developing such sampling sites networks is at the forefront of monitoring design. Statistical consultation is advised to ensure that the sampling design contains sufficient statistical power to meet monitoring objectives.

A consistent methodology should be used at reference, background, and restoration sites. This increases the ability to analyze status and trends in the region and to evaluate the effectiveness of restoration efforts. Additionally, monitoring from network sites can be especially informative in identifying or validating indicators (e.g., restoration success criteria, habitat as a surrogate for "m" species' monitoring).

Develop Information feedback system:
The reader is referred to the CMARP summary report (1999) which discusses the data management, assessment and reporting system needs for CALFED. (http://www.calfed.water.ca.gov/environmental_docs/july2000_eis.html)

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19.0 ACRONYMS

ACOE	Army Corps of Engineers
BBS	Breeding Bird Survey
CALFED	CALFED Bay-Delta Program
CCMVCD	Contra Costa Mosquito Vector Control District
CDEC	California Data Exchange Center
CDF	California Department of Forestry
CDFA	California Department of Food and Agriculture
CDFG	California Department of Fish and Game
CDWR	California Department of Water Resources
CIMIS	CDWR – California Irrigation Management Information System
CMARP	Comprehensive Monitoring Assessment and Research Program
CPIF	California Partners in Flight
CSU	California State University
DEDT	Delta and Eastside Delta Tributaries Region (also refers to ERP milestones)
DFG	California Department of Fish and Game
DOI	U. S. Department of Interior
DWR	California Department of Water Resources
DWR-ESO	California Department of Water Resources, Environmental Services Office
EMAP	Environmental Monitoring and Assessment Program
ERP	CALFED Bay-Delta Program Ecosystem Restoration Program
ERPP	CALFED Bay-Delta Program Ecosystem Restoration Program Plan
GIS	Geographic Information System
HCP	Habitat Conservation Plan
ICE	Information Center for the Environment
IEP	Interagency Ecological Program
ISB	CALFED Ecosystem Restoration Program Interim Science Board
JSA	Jones and Stokes Associates
MHHW	Mean high-high water (in tidal wetlands)
MLLW	Mean low-low water (in tidal wetlands)
MSCS	CALFED Multi Species Conservation Strategy
MWQI	DWR – Municipal Water Quality Investigations
NIS	Non-indigenous species
NRCS	Natural Resource Conservation Service
NOAA	National Oceanic and Atmospheric Administration
NWR	National Wildlife Refuge
PRBO	Point Reyes Bird Observatory
RHJV	Riparian Habitat Joint Venture
SacR	Sacramento River Region (can also refer to ERP Milestones)
SJR	San Joaquin River Region (can also refer to ERP Milestones)
SMB	Suisun Marsh & North San Francisco Bay Region (can also refer to ERP Milestones)
SFEI	San Francisco Estuary Institute

SRWP	Sacramento River Watershed Program
TAMP	Terrestrial and Amphibious Monitoring Plan for the CALFED Bay-Delta Program
TNC	The Nature Conservancy
UC Berkeley	University of California at Berkeley
USBR	U. S. Bureau of Reclamation
UC Davis	University of California at Davis
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USGS-ARMI	USGS – Amphibian Research and Monitoring Initiative

20.0 GLOSSARY

Action - A structure, operating criteria, program, regulation, policy, or restoration activity that is intended to address a problem or resolve a conflict in the Bay-Delta system

Adaptive Management - An applied science-oriented approach to resource management that brings science and management together and allows managers to move forward in the face of uncertainty when dealing with complex ecological problems. Adaptive management tackles uncertainty about the system head-on by identifying clear objectives, developing conceptual models of the system, identifying areas of uncertainty and alternative hypotheses, testing critical assumptions, monitoring to provide feedback about the system and actions, learning from the system as actions are taken to manage it, updating the conceptual models, and incorporating what is learned into future actions.

Amphibious - Living or able to live both on land and in water. In the context of TAMP, this includes plants, mammals, reptiles, amphibians, birds, and terrestrial invertebrates but does not include fish and benthic invertebrates.

Attribute - A biological or physical feature of the ecosystem. In TAMP usually a monitoring question will relate to an "*attribute*" but may require more than one "*monitoring element*" to answer.

CMARP - a joint *San Francisco Estuary Institute, Interagency Ecological Program, U.S. Geological Survey* directed effort to develop a Comprehensive Monitoring, Assessment, and Research Program (CMARP) for CALFED. CMARP developed monitoring and research recommendations for CALFED programs involving 30 technical teams comprised of more than 250 agency and stakeholder representatives. The technical appendix, completed in March 1999, and subsequently a draft technical appendix of the Revised Draft Programmatic EIS/EIR in June 1999, is available at: http://www.calfed.water.ca.gov/environmental_docs/july2000_eis.html
CMARP evolved into the CALFED Science Program; its purpose is to provide new information and scientific interpretations necessary to implement, monitor, and evaluate the success of the CALFED Program.

Conceptual Model - (1) "Explicit statements of the hypothesized functional relationships underlying management decisions regarding environmental resources." [A Proposal for the Development of a Comprehensive Monitoring Assessment and Research Program, April 24, 1998, page 30]; (2) "A simple non-quantitative model, developed for the purpose of building a consensus regarding the most important ecological elements and linkages that characterize a stressed ecosystem." [Nick Aumen, Conceptual Modeling Workshop, UC Davis, June 17-18, 1998]

Ecological Management Unit (EMU) – Each Ecological Management Zone in the ERPP consists of one or more Ecological Management Units.

Ecological Management Zone (EMZ) - The primary geographic focus area for the Ecosystem Restoration Program Plan includes 14 zones, each characterized by a predominant physical habitat type and species assemblage: American River Basin, Butte Basin, Colusa Basin, Cottonwood Creek, East San Joaquin Basin, Eastside Delta Tributaries, Feather River/Sutter Basin, North Sacramento Valley, Sacramento River, Sacramento-San Joaquin Delta, San Joaquin River, Suisun Marsh/North San Francisco Bay, West San Joaquin Basin, Yolo Basin [Ecosystem Restoration Program Plan 2000][8]

Ecological Process – "*Ecological processes act directly, indirectly, or in combination, to shape and form the ecosystem. These include streamflow, stream channel, and floodplain processes. Stream channel processes include stream meander, gravel recruitment and transport, water temperature, and hydraulic conditions. Floodplain processes include overbank flooding and sediment retention and deposition."* [Ecosystem Restoration Program Plan 2000][8]

Ecosystem - A recognizable, relatively homogeneous unit that includes organisms, their environment, and all the interactions among them

ERP White Paper Process – an ERP-funded effort to have scientists document the extent of existing knowledge about various components of the ecosystem (tidal wetlands, open water processes, etc.) and their implications for management activities in a series of white papers.

GIS - A geographic information system (GIS) is a computer-based tool for mapping and analyzing things that exist and events that happen on earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps.

Habitats - Areas that provide specific conditions necessary to support plant, fish, and wildlife communities. Habitat elements identified in the Ecosystem Restoration Program Plan include tidal perennial aquatic habitat, nontidal perennial aquatic habitat, delta sloughs, midchannel islands and shoals, saline emergent wetland, fresh emergent wetland, seasonal wetlands, riparian and riverine aquatic habitats, inland dune scrub habitat, perennial grassland, agricultural lands, freshwater fish habitat, and essential fish habitat

Habitat Quality - Combination of biological and physical conditions of habitat, natural and anthropogenic pressures, extent and degree of fragmentation / connectivity of habitat, sustainability of habitat due to natural processes, and functioning in support of native biodiversity and at-risk species (e.g. vegetation structure, species composition, water quality, rate of sediment deposition, connectivity with upland refugia, relative abundance of non-indigenous plants, etc.). For the purpose of the TAMP report, habitat quality is defined as having 3 components
1) habitat extent & connectivity

2) maintenance and sustainability of natural habitats & vegetation relative to ecological processes
3) functioning in support of native biodiversity and at-risk species.

Indicators - Features or attributes of the system that are expected to change over time in response to implementation of CALFED and are often seen as representing or "indicating" specific environmental conditions or status of the system or program. Indicators are "*measures used to translate goals and objectives into measurable benchmarks of success. They can be direct measures of ecological attributes or can be a synthesis of several independent measures*." [Pawley, 2000][32]

"m" Species - A species in the MSCS assigned the goal of "*maintain*". These species are expected to be minimally affected by CALFED actions. For this category, CALFED will mitigate any adverse effects to the species commensurate with the level of effect on the species; thus, actions may not actually contribute to the recovery of the species, but would be expected, at a minimum, to not contribute to the need to list a species or degrade the status of a listed species. CALFED will also maximize beneficial effects on these species to the extent practicable.

MSCS - The CALFED Multi-species Conservation Strategy (MSCS) is a report that builds on the Ecosystem Restoration Program (ERP) to provide a framework for compliance with the ESA, CESA, and a second California law also dealing with listed species, the Natural Community Conservation Planning Act (NCCPA).

Monitoring - Regular measurement of attributes of interest through time. In ecosystem restoration, monitoring is the process of measuring the abundance, distribution, change or status of indicators. This will allow progress to be measured, allow actions to be modified if necessary and provide assurances that the restoration objectives are being achieved.

Monitoring Element - Any living or non-living feature, attribute of the biophysical environment or human activity that can be measured or estimated that will provide some insight into accomplishment of CALFED goals and objectives, the functioning of the ecosystem, and/or the effectiveness of management actions.

NCCP Habitat Categories - Natural Community Conservation Plan Habitat definitions. The Multi-Species Conservation Strategy (MSCS) has adopted the NCCP classification of natural communities including 18 habitat types and 2 ecologically-based fish groups. The 18 habitat types are broad habitat categories, each of which include a number of habitat or vegetation types recognized in frequently used classification systems (tidal perennial aquatic, valley riverine aquatic, montane riverine aquatic, lacustrine, saline emergent, tidal freshwater emergent, nontidal freshwater permanent emergent, natural seasonal wetlands, managed seasonal wetlands, valley/foothill riparian, montane riparian, grassland, inland dune scrub, upland scrub, valley/foothill woodland and forest, montane woodland and forest, upland cropland, seasonally flooded agriculture). [Multi-Species Conservation Strategy, July 2000][11]

Non-Indigenous Species - Also called exotic, introduced, or non-native species. Plants and animals that originate from geographic regions other than the ones they are found in and typically from outside of California. They may dominate the local species or have other negative impacts on the environment. They are typically spread to new areas through human activities, either accidentally (Norway rats hitched rides aboard ships) or deliberately (Eucalyptus was originally introduced as an ornamental).

Patch – A habitat site or habitat block large enough to do management actions upon, e.g. a habitat restoration site.

Pressure - Natural and unnatural events or activities that adversely affect ecosystem processes, habitats and species. These include habitat loss & fragmentation, altered stream and river flows, climate extremes (el Nino, droughts), wildfire, water diversions, dams, levees, bank protection, dredging and sediment disposal, gravel mining, invasive aquatic plants, invasive aquatic organisms, invasive riparian and salt marsh plants, non-native wildlife, native & non-native predation and competition, contaminants, wildfire, fish and wildlife harvest, artificial fish propagation, and disturbance. TAMP uses the term "*pressure*" as a more inclusive term than the term "*stressor*" [ERPP, 2000], to include the full array of direct and indirect activities that could affect any attribute of the system.

"R" Species – A species in the MSCS assigned the goal of "*Recover*". These species typically have ranges entirely or nearly entirely within the MSCS Focus Area affected by the CALFED Program and for which CALFED could reasonably be expected to undertake all or most of the actions necessary to recover the species. The term recover means the decline of a species is arrested or reversed, threats to the species are neutralized, and thus, the species' long-term survival in nature is assured.

"r" Species - A species in the MSCS assigned the goal of "*Contribute to the Recovery*". The CALFED Program actions affect only a limited portion of these species' ranges and/or CALFED Program actions have limited effects on the species. A goal of contributing to a species' recovery implies that CALFED will undertake some of the actions under its control within its MSCS Focus Area and Program scope necessary to recover the species.

Redirected Effect – For the purpose of this report, when the actions of one CALFED program affects the status of another CALFED program, this is called a "redirected effect". The ERP can experience redirected effects *from* other CALFED Programs (labeled a pressure) and redirected effects *on* other programs. *Redirected effects* may include uncertainties relative to the effects of large-scale wetland construction in the Delta on levels of organic carbon in drinking water or water loss through transpiration—both important concerns to other CALFED programs.

Region – CALFED ERP Regions include 1) Delta and Eastside Delta Tributaries (DEDT), 2) Suisun Marsh and North San Francisco Bay (SMB), 3) Sacramento River and Tributaries (SacR), and 4) San Joaquin River and Tributaries (SJR). Each region is further divided into two or more Ecological Management Zones.

Riparian - The strip of land adjacent to a natural water course such as a river or stream. Often supports vegetation that provides the best fish habitat values when growing large enough to overhang the bank

Riverine - Habitat within or alongside a river or channel

Species and Species Groups - "*Certain species or groups of species are given particular attention in the ERPP... This focus is based on four criteria that might be met by a species (including fish, wildlife, and plants): 1) it is a formally listed threatened or endangered species (e.g., winter-run chinook salmon, delta smelt), or it is a species proposed for listing; 2) it is economically important, supporting a sport or commercial fishery (e.g., striped bass, signal crayfish); 3) it is a native species or species community that is presently not listed but which could be if population abundance or distribution declines, or 4) it is an important prey species (e.g., Pacific herring).*" [Ecosystem Restoration Program Plan, July 2000][8]

State of Ecosystem - The integrated manifestation of ecological processes, biological composition, ecological function, and rates of change that results in the condition of the system at any given time.

Strategic Plan - Provides the conceptual framework and process that will guide the refinement, evaluation, prioritization, implementation, monitoring and revision of CALFED's Ecosystem Restoration Program [Strategic Plan for Ecosystem Restoration, July 2000][9].

Stressor – Usually synonymous with "Pressure". However in CALFED, it specifically refers to those "stressors" identified in the ERPP.

Terrestrial - Types of species of animal and plant wildlife that live on or grow from the land.

Tidal Wetlands - Shallow water habitats influence by tides. In the ERPP it includes saline emergent wetland, fresh emergent wetland, tidal perennial aquatic habitat, midchannel islands and shoals, Delta sloughs, some seasonal fringes of tidal wetlands, and some riparian and riverine aquatic habitat..

Watershed - An area that drains ultimately to a particular channel or river, usually bounded peripherally by a natural divide of some kind such as a hill, ridge, or mountain.

APPENDIX A:
CALFED ECOSYSTEM RESTORATION PROGRAM
STRATEGIC GOALS & OBJECTIVES (May 2000)[9]

Goal 1: Endangered and Other At-risk Species and Native Biotic Communities

Achieve recovery of at-risk native species dependent on the Delta and Suisun Bay as the first step toward establishing large, self-sustaining populations of these species; support similar recover of at-risk native species in San Francisco Bay and the watershed above the estuary; and minimize the need for future endangered species listings by reversing downward population trends of native species that are not listed.

Objective 1: Achieve, first, recovery and then large self-sustaining populations of the following at-risk native species dependent on the Delta, Suisun Bay, and Suisun Marsh: Central Valley winter-, spring- and fall/late fall-run chinook salmon ESUs, Central Valley steelhead ESU, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, valley elderberry longhorn beetle, Suisun ornate shrew, Suisun song sparrow, soft bird's-beak, Suisun thistle, Mason's lilaeopsis, San Pablo song sparrow, Lange's metalmark butterfly, Antioch Dunes evening primrose, Contra Costa wallflower, and Suisun marsh aster.

Objective 2: Contribute to the recovery of the following at-risk native species in the Bay-Delta estuary and its watershed: Sacramento perch, delta green ground beetle, giant garter snake, salt marsh harvest mouse, riparian brush rabbit, San Pablo California vole, San Joaquin Valley woodrat, least Bell's vireo, California clapper rail, California black rail, little willow flycatcher, bank swallow, western yellow-billed cuckoo, greater sandhill crane, Swainson's hawk, California yellow warbler, salt marsh common yellowthroat, Crampton's tuctoria, Northern California black walnut, delta tule pea, delta mudwort, bristly sedge, delta coyote thistle, alkali milkvetch, and Point Reyes bird's-beak.

Objective 3: Enhance and/or conserve native biotic communities in the Bay-Delta estuary and its watershed, including the abundance and distribution of the following biotic assemblages and communities: native resident estuarine and freshwater fish assemblages, anadromous lampreys, neotropical migratory birds, wading birds, shore birds, waterfowl, native anuran amphibians, estuarine plankton assemblages, estuarine and freshwater marsh plant communities, riparian plant communities, seasonal wetland plant communities, vernal pool communities, aquatic plant communities, and terrestrial biotic assemblages associated with aquatic and wetland habitats.

Objective 4: Maintain the abundance and distribution of the following species: hardhead, western least bittern, California tiger salamander, western spadefoot toad, California red-legged frog, western pond turtle, California freshwater shrimp, recurved larkspur, mad-dog skullcap, rose-mallow, eel-grass pondweed, colusa grass, Boggs Lake hedge-hyssop, Contra Costa goldfields, Greene's legenere, heartscale, and other species designated "maintain" in the Multi-Species Conservation Strategy.

Goal 2: Ecological Processes

Rehabilitate natural processes in the Bay-Delta estuary and its watershed to fully support, with minimal ongoing human intervention, natural aquatic and associated terrestrial biotic communities and habitats, in ways that favor native members of those communities.

Objective 1: Establish and maintain hydrologic and hydrodynamic regimes for the Bay and Delta that support the recovery and restoration of native species and biotic communities, support the restoration and maintenance of functional natural habitats, and maintain harvestable species.

Objective 2: Increase estuarine productivity and rehabilitate estuarine food web processes to support the recovery and restoration of native estuarine species and biotic communities.

Objective 3: Rehabilitate natural processes to create and maintain complex channel morphology, in-channel islands, and shallow water habitat in the Delta and Suisun Marsh.

Objective 4: Create and/or maintain flow and temperature regimes in rivers that support the recovery and restoration of native aquatic species.

Objective 5: Establish hydrologic regimes in streams, including sufficient flow timing, magnitude, duration, and high flow frequency, to maintain channel and sediment conditions supporting the recovery and restoration of native aquatic and riparian species and biotic communities.

Objective 6: Reestablish floodplain inundation and channel-floodplain connectivity of sufficient frequency, timing, duration, and magnitude to support the restoration and maintenance of functional natural floodplain, riparian, and riverine habitats.

Objective 7: Restore coarse sediment supplies to sediment-starved rivers downstream of reservoirs to support the restoration and maintenance of functional natural riverine habitats.

Objective 8: Increase the extent of freely meandering reaches and other pre-1850 river channel forms to support the restoration and maintenance of functional natural riverine, riparian, and floodplain habitats.

Goal 3: Harvestable Species

Maintain and/or enhance populations of selected species for sustainable commercial and recreational harvest, consistent with the other ERP strategic goals.

Objective 1: Enhance fisheries for salmonids, white sturgeon, pacific herring, and native cyprinid fishes.

Objective 2: Maintain, to the extent consistent with ERP goals, fisheries for striped bass, American shad, signal crayfish, grass shrimp, and nonnative warmwater gamefishes.

Objective 3: Enhance, to the extent consistent with ERP goals, populations of waterfowl and upland game for harvest by hunting and for non-consumptive recreation.

Objective 4: Ensure that chinook salmon, steelhead, trout, and striped bass hatchery, rearing, and planting programs do not have detrimental effects on wild populations of native fish species and ERP actions.

Goal 4: Habitats

Protect and/or restore functional habitat types in the Bay-Delta estuary and its watershed for ecological and public values such as supporting species and biotic communities, ecological processes, recreation, scientific research, and aesthetics.

Objective 1: Restore large expanses of all major habitat types, and sufficient connectivity among habitats, in the Delta, Suisun Bay, Suisun Marsh, and San Francisco Bay to support recovery and restoration of native species and biotic communities and rehabilitation of ecological processes. These habitat types include tidal marsh (fresh, brackish, and saline), tidal perennial aquatic (including shallow water and tide flats), nontidal perennial aquatic, tidal sloughs, midchannel island and shoal, seasonal wetlands, riparian and shaded riverine aquatic, inland dune scrub, upland scrub, and perennial grasslands.

Objective 2: Restore large expanses of all major aquatic, wetland, and riparian habitats, and sufficient connectivity among habitats, in the Central Valley and its rivers to support recovery and restoration of native species and biotic communities and rehabilitation of ecological processes. These habitat types include riparian and shaded riverine aquatic, instream, fresh emergent wetlands, seasonal wetlands, other floodplain habitats, lacustrine, and other freshwater fish habitats.

Objective 3: Protect tracts of existing high quality major aquatic, wetland, and riparian habitat types, and sufficient connectivity among habitats, in the Bay-Delta estuary and its watershed to support recovery and restoration of native species and biotic communities, rehabilitation of ecological processes, and public value functions.

Objective 4: Minimize the conversion of agricultural land to urban and suburban uses and maintain open space buffers in areas adjacent to existing and future restored aquatic, riparian, and wetland habitats, and manage agricultural lands in ways that are favorable to birds and other wildlife.

Objective 5: Manage the Yolo and Sutter Bypasses as major areas of seasonal shallow water habitat to enhance native fish and wildlife, consistent with CALFED Program objectives and solution principles.

Goal 5: Nonnative Invasive Species

Prevent the establishment of additional non-native invasive species and reduce the negative ecological and economic impacts of established non-native species in the Bay-Delta estuary and its watershed.

Objective 1: Eliminate further introductions of new species from the ballast water of ships into the Bay-Delta estuary.

Objective 2: Eliminate further introductions of new species from imported marine and freshwater baits into the Bay-Delta estuary and its watershed.

Objective 3: Halt the unauthorized introduction and spread of potentially harmful non-native introduced species of fish or other aquatic organisms in the Bay-Delta and Central Valley.

Objective 4: Halt the release of non-native introduced fish and other aquatic organisms from private aquaculture operations and the aquarium and pet trades into the Bay-Delta estuary, its watershed, and other California waters.

Objective 5: Halt the introduction of non-native invasive aquatic and terrestrial plants into the Bay-Delta estuary, its watershed, and other central California waters.

Objective 6: Reduce the impact of non-native mammals on native birds, mammals, and other organisms.

Objective 7: Limit the spread or, when possible and appropriate, eradicate populations of non-native invasive species through focused management efforts.

Objective 8: Prevent the invasion of the zebra mussel into California.

Goal 6: Water and Sediment Quality

Improve and/or maintain water and sediment quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed; and eliminate, to the extent possible, toxic impacts to aquatic organisms, wildlife, and people.

Objective 1: Reduce the loadings and concentrations of toxic contaminants in all aquatic environments in the Bay-Delta estuary and watershed to levels that do not adversely affect aquatic organisms, wildlife, and human health.

Objective 2: Reduce loadings of oxygen-depleting substances from human activities into aquatic ecosystems in the Bay-Delta estuary and watershed to levels that do not cause adverse ecological effects.

Objective 3: Reduce fine sediment loadings from human activities into rivers and streams to levels that do not cause adverse ecological effects.

APPENDIX B: ERP AT-RISK SPECIES AND BIOLOGICAL COMMUNITIES[8,11]

RECOVER (R):

Birds: Suisun song sparrow, San Pablo song sparrow,
Fish: Central Valley winter-, spring- and fall/late fall-run chinook salmon ESUs, Central Valley steelhead ESU, delta smelt, longfin smelt, Sacramento splittail, green sturgeon:
Invertebrates: Valley elderberry longhorn beetle, Lange’s metalmark butterfly;
Mammals: Suisun ornate shrew;
Plants: Soft bird’s-beak, Suisun thistle, Mason’s lilaeopsis, Antioch Dunes evening primrose, Contra Costa wallflower, and Suisun marsh aster.

CONTRIBUTE TO RECOVERY (r):

Birds: least Bell’s vireo, California clapper rail, California black rail, little willow flycatcher, bank swallow, western yellow-billed cuckoo, greater sandhill crane, Swainson’s hawk, California yellow warbler, salt marsh common yellowthroat;
Fish: Sacramento perch;
Invertebrates: delta green ground beetle;
Mammals: salt marsh harvest mouse, riparian brush rabbit, San Pablo California vole, San Joaquin Valley woodrat;
Plants: Crampton’s tuctoria, Northern California black walnut, delta tule pea, delta mudwort, bristly sedge, delta coyote thistle, alkali milkvetch, and Point Reyes bird’s-beak;
Reptiles: giant garter snake

MAINTAIN (m):

Amphibians (6): California Red Legged Frog, California Tiger Salamander, Foothill yellow-legged frog, Limestone salamander, Shasta salamander, Western Spadefoot Toad
Birds (30): Aleutian Canada goose, American peregrine falcon, Bald eagle, Black tern, Black-crowned night heron, California brown pelican, California condor, California gull, California least tern, Cooper’s hawk, Double-crested cormorant, Golden eagle, Grasshopper sparrow, Great blue heron, Great egret, Long-billed curlew, Long-eared owl, Mountain plover, Northern harrier, Northern spotted owl, Osprey, Short-eared owl, Snowy egret rookeries, tricolored blackbird, Western burrowing owl, Western least bittern, Western snowy plover, White-faced ibis, White-tailed kite, Yellow-breasted chat
Fish (3): Hardhead, Rough sculpin, Tidewater goby
Invertebrates (9): California Freshwater Shrimp, Conservancy fairy shrimp, Longhorn fairy shrimp, Mid-valley fairy shrimp, Vernal pool fairy shrimp, Vernal pool tadpole shrimp, Callippe silverspot butterfly, Monarch butterfly (roost), Shasta sideband (terrestrial mollusc)
Mammals (7): California Wolverine, Giant kangaroo rat, Greater western mastiff-bat, Merced kangaroo rat, Nelson's antelope ground squirrel, Ringtail, San Joaquin kit fox
Plants (139): Adobe-lily, Ahart's dwarf rush, Ahart's paronychia, Arburua Ranch jewelflower, Baker's larkspur, Baker's manzanita, Beaked clarkia, Bellinger's meadowfoam, Ben Lomond buckwheat, Big Bear Valley woollypod, Big tarplant, Boggs Lake hedge-hyssop, Brandegee's eriastrum, Brewer's western flax, Brittlescale, Butte County meadowfoam, California beaked-rush, California seablite, California vervain, Calistoga popcornflower, Carquinez goldenbush, Chinese Camp brodiaea, Clara Hunt's milk-vetch, Colusa grass, Congdon's lomatium, Congdon's tarplant, Contra Costa goldfields, Contra Costa manzanita, Diablo helianthella, Diamond-petaled California poppy, Dimorphic snapdragon, Drymaria-like western flax, Dwarf soaproot, Eel-grass pondweed, El Dorado bedstraw, English peak greenbriar, Ferris's milk-vetch, Few-flowered navarretia, Four-angled spikerush, Greene's tuctoria, Hairy orcutt grass,

Hall's bush mallow, Hall's tarplant, Hartweg's golden sunburst, Heartscale, Heckard's peppergrass, Henderson's bent grass, Hispid bird's-beak, Hoover's eriastrum, Hoover's spurge, Hospital Canyon larkspur, Indian Valley brodiaea, Ione buckwheat, Ione manzanita, Irish Hill buckwheat, Jepson's milk-vetch, Kenwood Marsh checkerbloom, Klamath manzanita, Large-flowered fiddleneck, Layne's ragwort, Legenere, Lesser saltscale, Loch Lomond button-celery, Lost Hills crownscale, Mad-dog skullcap, Madera linanthus, Many-flowered navarretia, Marin checkerbloom, Marin knotweed, Marin western flax, Mariposa clarkia, Marsh checkerbloom, Marsh skullcap, Mason's ceanothus, Merced phacelia, Most beautiful jewel-flower, Mt. Diablo bird's-beak, Mt. Diablo fairy-lantern, Mt. Diablo jewelflower, Mt. Diablo manzanita, Mt. Diablo phacelia, Mt. Hamilton coreopsis, Mt. Hamilton jewelflower, Mt. Tedoc linanthus, Napa blue grass, Napa western flax, North Coast semaphore grass, Pale-yellow layia, Pallid manzanita, Palmate-bracted bird's-beak, Panoche peppergrass, Parry's horkelia, Pincushion navarretia, Pine Hill ceanothus, Pine Hill flannelbush, Pitkin Marsh lily, Rawhide Hill onion, Recurved larkspur, Red Hills ragwort, Red-flowered lotus, Rock sanicle, Rose mallow, Sacramento orcutt grass, San Antonio Hills monardella, San Benito evening-primrose, San Joaquin adobe sunburst, San Joaquin spearscale, San Joaquin Valley orcutt grass, San Joaquin woolythreads, Sanford's arrowhead, Santa Cruz tarplant, Saw-toothed lewisia, Sebastopol meadowfoam, Shaggyhair lupine, Sharsmith's harebell, Sharsmith's onion, Shasta clarkia, Shasta snow-wreath, Showy Indian clover, Showy madia, Silky cryptantha, Slender orcutt grass, Slough thistle, Sonoma alopecurus, Sonoma spineflower, Sonoma sunshine, Spiny-sepaled button-celery, Stebbins' morning-glory, Succulent owl's-clover, Tehama County western flax, Thread-leaved beardtongue, Tiburon Indian paintbrush, Tiburon jewelflower, Tiburon Mariposa lily, Tree-anemone, Vernal Pool smallscale, White sedge, White-rayed pentachaeta, Yellow larkspur
Reptiles (4): Alameda Whip Snake, Blunt-nosed leopard lizard, San Joaquin Whipsnake, Western Pond Turtle

ENHANCE AND/OR CONSERVE: Native resident estuarine and freshwater fish assemblages, anadromous lampreys, neotropical migratory birds, wading birds, shore birds, waterfowl, native anuran amphibians, estuarine plankton assemblages, estuarine and freshwater marsh plant communities, riparian plant communities, seasonal wetland plant communities, vernal pool communities, aquatic plant communities, and terrestrial biotic assemblages associated with aquatic and wetland habitats.

MAINTAIN AND/OR ENHANCE HARVESTED SPECIES: Salmonids, white surgeon, pacific herring, native cyprinid fishes, striped bass, American shad, signal crayfish, grass shrimp, non-native warmwater gamefish, waterfowl, upland game.

APPENDIX C:
18 NCCP HABITATS EVALUATED IN THE MSCS

From CALFED's Multi Species Conservation Strategy (July 2000, pp. 2-2 to 2-4)[11]

Tidal Perennial Aquatic. Tidal perennial aquatic habitat is defined as deepwater aquatic (greater than 3 meters deep from mean low low tide), shallow aquatic (less than or equal to 3 meters deep from mean low low tide), and unvegetated intertidal (i.e., tideflats) zones of estuarine bays, river channels, and sloughs. Tidal perennial aquatic includes all or portions of the ERP tidal perennial aquatic, tidal and Delta sloughs, and midchannel island and shoals habitat.

Valley Riverine Aquatic. Valley riverine aquatic habitat includes the water column of flowing streams and rivers in low-gradient channel reaches below an elevation of approximately 300 feet that are not tidally influenced. This includes associated shaded riverine aquatic (SRA), pool, riffle, run, and unvegetated channel substrate (including seasonally, exposed channel bed) habitat features, and sloughs, backwaters, overflow channels, and flood bypasses hydrologically connected to stream and river channels. Valley riverine aquatic habitat includes portions of the ERP riparian and riverine aquatic habitat.

Montane Riverine Aquatic. Montane riverine aquatic habitat includes the water column of flowing streams and rivers above an elevation of approximately 300 feet. This includes associated SRA, pool, riffle, run, and unvegetated channel substrate (including seasonally exposed channel bed) habitat features, and sloughs, backwaters, and overflow channels hydrologically connected to stream and river channels. Montane riverine aquatic habitat includes portions of the ERP riparian and riverine aquatic habitat.

Lacustrine. Lacustrine habitat is defined as portions of permanent bodies of water that do not support emergent vegetation and that are not subject to tidal exchange, including lakes, ponds, oxbows, gravel pits, and flooded islands. Lacustrine habitat includes portions of the ERP nontidal perennial aquatic habitat.

Saline Emergent. Saline emergent habitat includes the portions of San Francisco, San Pablo, and Suisun Bays and the Delta that support emergent wetland plant species that are tolerant of saline or brackish conditions within the intertidal zone or on lands that historically were subject to tidal exchange (i.e., diked wetlands). Saline emergent habitat includes all or portions of the ERP saline emergent wetland tidal and Delta sloughs, and midchannel islands and shoals habitats.

Tidal Freshwater Emergent. Tidal freshwater emergent habitat includes portions of the intertidal zones of the Delta that support emergent wetland plant species that are not tolerant of saline or brackish conditions. Tidal freshwater emergent habitat includes all or portions of the ERP fresh emergent wetland tidal and Delta sloughs, and midchannel islands and shoals habitats.

Nontidal Freshwater Permanent Emergent. Nontidal freshwater permanent emergent includes permanent (natural and managed) wetlands, including meadows, dominated by wetland plant species that are not tolerant of saline or brackish conditions. Nontidal freshwater permanent emergent habitat includes all or portions of the ERP fresh emergent wetland (nontidal) and nontidal perennial aquatic habitat to be restored within nontidal freshwater permanent emergent wetlands.

Natural Seasonal Wetland. Natural seasonal wetland habitat includes vernal pools and other nonmanaged seasonal wetlands with natural hydrologic conditions that are dominated by herbaceous vegetation and that annually pond surface water or maintain saturated soils at the ground surface for enough of the year to support facultative or obligate wetland plant species. Alkaline and saline seasonal wetlands that were not historically part of a tidal regime are included in natural seasonal wetlands. Natural seasonal wetland habitat includes ERP vernal pool habitat.

Managed Seasonal Wetland. Managed seasonal wetland habitat includes wetlands dominated by native or non-native herbaceous plants, excluding croplands farmed for profit (e.g., corn and rice), that land managers flood and drain during specific periods to enhance habitat values for specific wildlife species. Ditches and drains associated with managed seasonal wetlands are included in this habitat type. Managed seasonal wetland habitat includes the ERP seasonal wetlands habitat.

Valley/Foothill Riparian. Valley/foothill riparian habitat includes all successional stages of woody vegetation, commonly dominated by willow, Fremont cottonwood, valley oak, or sycamore, within the active and historical floodplains of low-gradient reaches of streams and rivers generally below an elevation of 300 feet. Valley/foothill riparian habitat includes portions of the ERP riparian and riverine aquatic habitat.

Montane Riparian. Montane riparian habitat includes all successional stages of woody vegetation, such as willow, black cottonwood, white alder, birch, and dogwood, within the active floodplains of moderate-to-high-gradient reaches of streams and rivers generally above an elevation of 300 feet. Montane riparian habitat includes portions of the ERP riparian and riverine aquatic habitat.

Grassland. Grassland habitat includes upland vegetation communities dominated by introduced and native annual and perennial grasses and forbs, including nonirrigated and irrigated pasturelands. Grassland habitat includes all the ERP perennial grassland habitat and the much more extensive annual grassland vegetation that is not addressed in the ERP.

Inland Dune Scrub. Inland dune scrub habitat comprises vegetated stabilized sand dunes associated with river and estuarine systems. Inland dune scrub includes all the ERP inland dune scrub habitat.

Upland Scrub. Upland scrub habitat includes habitat areas dominated by shrubs characteristic of coastal scrub, chaparral, and saltbush scrub communities. Upland scrub is not included in the ERP.

Valley/Foothill Woodland and Forest. Valley/foothill woodland and forest habitat includes nonriparian forest, woodland, and savanna of valleys and foothills. These vegetation communities are commonly dominated by valley oak, blue oak, interior live oak, coast live oak, and foothill pine. Valley/foothill woodland and forest habitat is not included in the ERP.

Montane Woodland and Forest. Montane woodland and forest habitat includes nonriparian forest and woodland above the foothills. These vegetation communities are commonly dominated by pine, fir, cedar, and black oak. Montane woodland and forest habitat is not included in the ERP. Upland Cropland. Upland cropland habitat includes agricultural lands farmed for grain field, truck, and other crops for profit that are not seasonally flooded. Upland cropland is included in the ERP as agricultural lands.

Seasonally Flooded Agricultural Land. Seasonally flooded agricultural land habitat includes agricultural lands farmed for grain, rice, field, truck, and other crops for profit that require seasonal flooding for at least 1 week at a time as a management practice (e.g., for pest control and irrigation) or are purposely flooded seasonally to enhance habitat values for specific wildlife species (e.g., ducks for duck clubs), Agricultural ditches and drains associated with maintaining seasonally flooded agricultural land are included in this habitat type. Seasonally flooded agricultural land is included in the ERP as agricultural lands.

APPENDIX D: CALFED ERP Milestones (8a) and "terrestrial" related monitoring

Code	Milestones	Ecosystem Element/Water Quality Parameter	MSCS "R" and "r" Covered Species that would Benefit from Achieving Milestones	Terrestrial related monitoring Blue = Status and Trends monitoring Red = Action implementation monitoring Green = Cause & Effect Research / Validation monitoring Orange = Redirected effects monitoring Purple = Questions / clarification issues
	Delta and East Side Tributaries			
	Ecological Processes			
D-EDT P1	Develop a methodology for evaluating delta flow and hydrodynamic patterns and begin implementation of an ecologically based plan to restore conditions in the rivers and sloughs of the Delta sufficient to support targets for the restoration of aquatic resources.	Bay-Delta Hydrodynamics	Central Valley chinook salmon and steelhead, green sturgeon, delta smelt, longfin smelt, and Sacramento splittail	Possible redirected effects monitoring of sediment erosion & deposition rates, status of rare plants that live along effected banks (Mason's lilaeopsis, Delta mudwort, Delta tule pea?), and non-indigenous plant establishment and spread.
D-EDT P2	Develop and implement temperature management programs within major tributaries in the Eastside Delta Tributaries EMZ. The goal of the programs should be achievement of the ERP temperature targets for salmon and steelhead. The programs shall include provisions to: a) develop accurate and reliable water temperature prediction models; b) evaluate the use of minimum carryover storage levels and other operational tools; c) evaluate the use of new facilities such as temperature control devices; and d) recommend operational and/or physical facilities as a long□term solution.	Central Valley Stream Temperatures	Central Valley fall/late fall-run chinook salmon and steelhead	
D-EDT P3	Provide a fall or early winter outflow that emulates the first "winter" rain through the Delta.	Central Valley Streamflow	all Central Valley salmonids	
D-EDT P4	Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within the Eastside Delta Tributaries EMZ.	Coarse Sediment Supply	all races of chinook salmon, steelhead, splittail, delta smelt, green sturgeon, bank swallow, California yellow warbler, western yellow-billed cuckoo, Least Bell's vireo, valley elderberry longhorn beetle, Norther California black walnut	Map acreage and locations of floodplain habitat by habitat type Status of assessment of sediment supply needs Program implementation status and effectiveness
D-EDT P5	Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within the Eastside Delta Tributary EMZ.	Natural Floodplain and Flood Processes	all Central Valley salmonids, Sacramento splittail, delta smelt, longfin smelt, western yellow-billed cuckoo, California yellow warbler, Least Bell's vireo, San Joaquin Valley woodrat, Valley elderberry long-horn beetle, Northern California black walnut	Map acreage and locations of floodplain habitat by habitat type Number, implementation status and results of floodplain management plans Restoration project(s) implementation status and results - acreage and location of floodplain "restored" Research into restoration methods? into setback levee construction? Need definition of "restored"
	Habitats			
D-EDT H1	In the Sacramento-San Joaquin Delta EMZ, cooperatively enhance at least 15% of the ERP target for wildlife friendly agricultural practices.	Agricultural Lands	greater sandhill crane, giant garter snake, Swainson's hawk	Acreage under "wildlife friendly" agricultural practices by targeted species (I.e. ducks, sandhill cranes, shorebirds, etc.) Validation monitoring of use of these lands by targeted species Need definition of "wildlife friendly"

APPENDIX D: CALFED ERP Milestones [8a] and "terrestrial" related monitoring

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D-EDT H2	Restore a minimum of 15 miles of slough habitat (widths less than 50 to 75 feet) in each of the North, East, South, Central and West Delta EMUs that allows for the colonization of delta mudwort and delta tule pea.	Delta Sloughs	all Central Valley salmonids, delta smelt, Sacramento splittail, Sacramento perch, giant garter snake,delta mudwort, delta tule pea	Status and trends of delta mudwort and delta tule pea Map total number of miles and locations of delta sloughs Map total acreage and locations of freshwater emergent and tidal riparian habitat Implementation status and results - miles and location of sloughs "restored" - acreage and location of habitat "restored" - presence/absence or relative abundance of targeted species Research into targeted species establishment & sustainability in restored wetlands (delta tule pea and delta mudwort)? Research into restoration methods? What is the definition of restored? a project with results comparable to a reference site? specific measures of habitat quality?
D-EDT H3	Restore a minimum of 500, 250, 1,000, and 2,500 acres of nontidal emergent wetland in the North, East, South, and Central and West Delta Ecological Management units respectively. Establish at least one population of bristly sedge in each EMU.	Fresh Emergent Wetland (nontidal)	giant garter snake, California black rail, bristly sedge	Status and trends of bristly sedge including number and location of new populations Total acreage and locations of non-tidal emergent wetlands Implementation status and results - acreage and location of habitat "restored" - presence/absence or relative abundance of targeted species in restored wetlands Research into targeted species establishment & sustainability in restored wetlands (bristly sedge)? Research into restoration methods? Need definition of "restored", i.e. a project with results comparable to a reference site? some minimum thresholds of vegetation establishment? some specific measures of habitat quality?
D-EDT H4	Restore a minimum of 500, 500, 4,000, and 5,000 acres of tidal emergent wetland in the North, East, South, and Central and West Delta Ecological Management units respectively.	Fresh Emergent Wetland (tidal)	all Central Valley salmonids, green sturgeon, longfin smelt, delta smelt, Sacramento splittail, California black rail, Mason's lilaeopsis, delta mudwort, delta tule pea	Total acreage and locations of non-tidal emergent wetlands Implementation status and results - acreage and location of habitat "restored" - other project goals? Research into restoration methods Need definition of "restored"
D-EDT H5	Conduct surveys to locate potential habitat restoration sites capable of supporting Antioch dunes evening primrose, Contra Costa wallflower, and Lange's metalmark butterfly. Enhance 50 acres of low to moderate quality Antioch inland dune scrub habitat to support these species. Annually monitor establishment success.	Inland Dune Scrub	Lange's metalmark butterfly, Antioch dunes evening primrose, Contra Costa wallflower	Status and trends in Antioch Dunes evening primrose, Contra Costa wallflower, and Lange's metalmark butterfly (current refuge monitoring) Map total acreage and location of inland dune scrub habitat Status of potential habitat surveys Habitat enhancement implementation status and results - acreage and location of enhanced habitat - annually monitor establishment success of Antioch Dunes evening primrose, Contra Costa wallflower, and the host buckwheat for Lange's metalmark Research into targeted species establishment & sustainability in inland dune scrub? Research into enhancement methods? Need definition of "enhancement"

APPENDIX D: CALFED ERP Milestones [8a] and "terrestrial" related monitoring

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D-EDT H6	Restore a minimum of 125 acres of channel islands and 125 acres of shoals in the Delta.	Midchannel Islands and Shoals	all Central Valley salmonids, Sacramento splittail, delta smelt, black rail	Map total acreage and locations of channel islands and shoals Restoration project(s) implementation status and results - acreage and location of habitat "restored" Research into restoration methods? Need definition of "restored"
D-EDT H7	Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within the Eastside Delta Tributary EMZ	Riparian and Riverine Aquatic Habitats	Central Valley steelhead, fall/late fall-run chinook salmon, western yellow-billed cuckoo, Valley elderberry long horn beetle, riparian brush rabbit, California yellow warbler, Least Bell's vireo, little willow flycatcher, delta coyote thistle	Map total acreage and locations of floodplain habitat Restoration project(s) implementation status and results - acreage and location of habitat "restored" Research into restoration methods? Need definition of "restored" [Milestones H7, H8, and H9 seem to be the same. What is the difference?]
D-EDT H8	Implement 25 percent of the ERP target for diverse, self-sustaining riparian community for each EMU in the Sacramento-San Joaquin Delta EMZ.	Riparian and Riverine Aquatic Habitats	Central Valley fall/late fall-run chinook salmon, steelhead, western yellow-billed cuckoo, little willow flycatcher, California yellow warbler	See D-EDT H7
D-EDT H9	Restore a minimum of 300 acres of self-sustaining or managed diverse natural riparian habitat along the Mokelumne River, Cosumnes River, and Calaveras River and protect existing riparian habitat.	Riparian and Riverine Aquatic Habitats	Central Valley fall/late fall-run chinook salmon, steelhead, western yellow-billed cuckoo, little willow flycatcher, California yellow warbler, Valley elderberry long-horn beetle	See D-EDT H7
D-EDT H10	Enhance, protect and restore 1,000 to 1,500 acres of seasonal wetlands in the East Delta EMU for optimum greater sandhill crane habitat.	Seasonal Wetlands	greater sandhill crane, Swainson's hawk	Map total acreage and locations of seasonal wetland habitat Protection status of greater sandhill crane habitat Status and trends in greater sandhill cranes project(s) implementation status and results - acreage and location of habitat "restored", "enhanced" and/or "protected" Validation of use of enhanced, restored and protected wetlands by greater sandhill cranes Research into restoration methods? Need definition of "restored" and "enhanced"
D-EDT H11	Restore a minimum of 500, 250, 500, and 750 acres of tidal perennial aquatic habitat in the North, East, South, and Cental and West Delta Ecological Management units respectively.	Tidal Perennial Aquatic Habitat	all Central Valley salmonids, delta smelt, Sacramento splittail, longfin smelt, green sturgeon	Map total acreage and locations of tidal perennial aquatic habitat Restoration project(s) implementation status and results - acreage and location of habitat "restored" Research into restoration methods? Need definition of "restored"
	Stressors Reduction			

APPENDIX D: CALFED ERP Milestones [8a] and "terrestrial" related monitoring

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D-EDT S1	Develop and implement a program to address inadequate instream flows for steelhead and chinook salmon on streams within Eastside Delta tributaries. Where appropriate provide adequate flows for Sacramento splittail and green sturgeon.	Dams and Other Structures	steelhead, fall/late fall-run chinook salmon, green sturgeon, Sacramento splittail	
D-EDT S2	Provide unimpeded upstream and downstream passage for salmon and steelhead on Eastside Delta tributaries.	Dams and Other Structures	all Central Valley salmonids	
D-EDT S3	Assist in the development and implementation of a black and clapper rail impact reduction program.	Disturbance	California black rail, California clapper rail	Program implementation status and results Research into methods? Validation monitoring
D-EDT S4	Develop and begin implementation of a program to reduce or eliminate the influx of non-native aquatic species in ship ballast water.	Invasive Aquatic Organisms	all covered fish species	
D-EDT S5	Complete installation of fish passage facilities at Bellota Weir, Clements Dam, and Cherryland Dam on the Calaveras River and provide passage flows.	Dams and Other Structures	Central Valley fall/late fall-run chinook salmon and steelhead	
D-EDT S6	Develop and begin implemention of a demonstration program to reduce invasive non-native plant abundance within at least one EMU in the Delta.	Invasive Aquatic Plants	Susiun Marsh aster, Mason's lilaeopsis, delta mudwort, delta tule pea	Demonstration program implementation status and results
D-EDT S7	Implement a program to improve fish passage and reduce predation on juvenile salmonids below Woodbridge Dam on the lower Mokelumne River that includes the following elements: (1) improving the form and function of the stream channel; (2) rebuilding the Woodbridge Dam fish passage and diversion screening facilities to minimize losses of downstream migrating salmon and steelhead; and (3) improving the fish bypass discharge.	Predation and Competition	Central Valley fall/late fall-run chinook salmon, steelhead	
D-EDT S8	Consolidate and screen 50 small agricultural diversions in the Delta, prioritized according to size, location, and season of operation.	Water Diversions	all R and r covered fish	
D-EDT S9	Upgrade screens at Southern Energy's Contra Costa power plants with screens acceptable to the Fish and Wildlife Agencies.	Water Diversions	all R and r covered fish	
D-EDT S10	Actions to minimize or eliminate low dissolved oxygen conditions (DO sag) in lower San Joaquin River near Stockton (from Phase II Report): · Complete studies of causes for DO sag in San Joaquin River near Stockton. · Define and implement corrective measures for DO sag. · Finalization of investigation of methods to reduce constituents that cause low DO for inclusion in total maximun daily load (TMDL) recommendation by the Central Valley RWQCB. · Finalization of Basin Plan Amendment and TMDL for constituents that cause low DO in the San Joaquin River. · Implement appropriate source and other controls and other management practices, as recommended in the TMDL, to reduce anthropogenic oxygen depleting substances loadings and minimize or eliminate low DO conditions.	dissolved oxygen, oxygen depleting substances, nutrients, total organic carbon (TOC)	Salmonids, delta smelt, Sacramento splittail, longfin smelt, green sturgeon	
D-EDT S11	Develop, implement, and support measures to reduce pollutant (oxygen depleting substances, nutrients, and ammonia) discharges from concentrated animal feeding operations. (from Phase II Report)	oxygen depleting substances, nutrients, TOC, ammonia	Salmonids, Sacramento splittail	

APPENDIX D: CALFED ERP Milestones [8a] and "terrestrial" related monitoring

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D-EDT S12	Encourage regulatory activity to reduce discharge of oxygen reducing substances and nutrients by unpermitted dischargers. (from Phase II Report)	dissolved oxygen, oxygen depleting substances, nutrients	Salmonids, Sacramento splittail	
D-EDT S13	Actions to reduce fine sediment loading to streams, especially Tuolumne, Merced, Stanislaus, Cosumnes, Napa, and Petaluma Rivers, and Sonoma Creek, due to human activities (from Phase II Report and Water Quality Program Plan): · Participate in implementation of USDA sediment reduction program. · Implement sediment reduction BMPs in construction areas, on agricultural lands, for urban stormwater runoff, and other specific sites. · Implement stream restoration and revegetation work. · Quantify and determine ecological impacts of sediments in target watersheds, implement corrective actions.	turbidity/ sedimentation	Salmonids	
D-EDT S14	Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.	mercury	Salmonids, Sacramento splittail, green sturgeon, giant garter snake, salt marsh harvest mouse, California clapper rail, California black rail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
D-EDT S15	Conduct the following mercury evaluation and abatement work in the Cache Creek watershed (from Phase II Report): · Support development and implementation of TMDL for mercury. · Determine bioaccumulation effects in creek and Delta. · Source, transport, inventory, mapping and speciation of mercury. · Participate in Stage 1 remediation (drainage control) of mercury mines as appropriate. · Determine sources of high levels of bioavailable mercury	mercury	Salmonids, Sacramento splittail, green sturgeon, giant garter snake	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
D-EDT S16	Conduct the following mercury evaluation and abatement work in the Delta (from Phase II Report): · Determine methylization (part of bioaccumulation) process in Delta. · Determine sediment mercury concentration in areas that would be dredged during levee maintenance or conveyance work. · Determine potential impact of ecosystem restoration work on methyl mercury levels in lower and higher trophic level organisms.	mercury	Salmonids, Sacramento splittail, green sturgeon, giant garter snake, salt marsh harvest mouse, California clapper rail, California black rail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
D-EDT S17	Conduct the following pesticide work (from Phase II Report): · Develop diazinon and chlorpyrifos hazard assessment criteria with CDFG and the Department of Pesticide Regulations. · Support development and implementation of a TMDL for diazinon. · Develop BMPs for dormant spray and household uses. · Determine the ecological significance of pesticide discharges. · Support implementation of BMPs. · Monitor to determine effectiveness of BMPs	carbofurans, chloropyrifos,diazinon	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, giant garter snake, possibly other species depending on type of actions and specific sites.	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?

APPENDIX D: CALFED ERP Milestones [8a] and "terrestrial" related monitoring

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D-EDT S18	Conduct the following selenium work: · Conduct selenium research to fill data gaps in order to refine regulatory goals of source control actions; determine bioavailability of selenium under several scenarios (from Phase II Report). · Evaluate and, if appropriate, implement real-time management of selenium discharges (from Phase II Report). · Expand and implement source control, treatment, and reuse programs (from Phase II Report).· Coordinate with other programs; e.g., recommendations of San Joaquin Valley Drainage Implementation Program, CVPIA for retirement of lands with drainage problems that are not subject to correction in other ways (from Phase II Report). · Support development and implementation of TMDL for selenium in the San Joaquin River watershed (focus on Grassland area).	selenium	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, giant garter snake, salt marsh harvest mouse, California clapper rail, California black rail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
D-EDT S19	Conduct the following actions in reduce organochlorine pesticide inputs to streams (from Phase II Report): · Participate in implementation of USDA sediment reduction program. · Implement sediment reduction BMPs on agricultural lands and other specific sites. · Implement BMPs for urban/industrial stormwater runoff and discharges to reduce PCB and organochlorine pesticides.	chlorodane, DDT, PCBs, toxaphene	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, giant garter snake	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
D-EDT S20	Conduct the following trace metals work (from Phase II Report): · Determine spatial and temporal extent of metal pollution. · Determine ecological significance and extent of copper contamination. · Evaluate impacts of other metals such as cadmium, zinc, and chromium. · Participate in Brake Pad Partnership to reduce introduction of copper. · Partner with municipalities on evaluation and implementation of stormwater control facilities. · Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.	cadmium, copper, zinc	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, giant garter snake, salt marsh harvest mouse, California clapper rail, California black rail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
D-EDT S21	Conduct the following unknown toxicity work (from Phase II Report): · Conduct appropriate studies to identify unknown toxicity, and develop management actions as appropriate.	toxicity of unknown origin	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
	Suisun Marsh and North San Francisco Bay			
	Habitats			
SM-B H1	Restore and maintain a minimum of three linear miles of riparian habitat along corridors of existing riparian scrub and shrub vegetation in each of the Ecological Management Units of the Suisun Marsh/North San Francisco Bay Ecological Management Zone.	Riparian and Riverine Aquatic Habitats	Sacramento splittail, all Central Valley salmonids, Valley elderberry long-horn beetle, riparian brush rabbit, California yellow warbler, Least Bell's vireo, little willow flycatcher	Map total number of linear miles and locations of riparian habitat Map total acreage and locations of tidal riparian habitat Implementation status and results - miles and location of riparian habitat "restored" - acreage and location of riparian habitat "restored" Research into restoration methods? What is the definition of restored? a project with results comparable to a reference site? specific measures of habitat quality?

APPENDIX D: CALFED ERP Milestones [(8a)] and "terrestrial" related monitoring

Code	Milestones	Ecosystem Element/Water Quality Parameter	MSCS "R" and "r" Covered Species that would Benefit from Achieving Milestones	Terrestrial related monitoring Blue = Status and Trends monitoring Red = Action implementation monitoring Green = Cause & Effect Research / Validation monitoring Orange = Redirected effects monitoring Purple = Questions / clarification issues
SM-B H2	In the Suisun Marsh/North San Francisco Bay EMZ, restore a minimum of 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. Develop cooperative programs to acquire, in fee-title or through a conservation easement, the land needed for tidal restoration, and complete the needed steps to restore the wetlands to tidal action. Begin aggressive program of control of non-native plant species that are threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak. - Bring into protection at least 25% of currently occupied, but unprotected Suisun Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management. -Expand suitable tidal slough habitat for Suisun Marsh aster by 25 linear miles -Identify at least three protected and managed sites for introduction of at least three additional populations of Suisun thistle; increase overall population size at least threefold. -Establish at least one new population of soft bird's beak with high likelihood of success in restored habitat in each of the Suisun Bay and Marsh EMU, the Napa River EMU, and the Petaluma River EMU. -Establish at least one new Point Reyes bird's beak population in the Petaluma River and San Pablo Bay EMUs.	Saline Emergent Wetland	All Central Valley salmonids, delta smelt, longfin smelt, Sacramento splittail, Suisun song sparrow, San Pablo song sparrow, California Clapper rail, California black rail, Suisun thistle, soft bird's beak, Point Reyes bird's-beak, salt marsh harvest mouse, Suisun ornate shrew, San Pablo California vole, Suisun aster, salt marsh common yellow throat	Location, status and trends of populations of Suisun thistle Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak including degree of threat from non-indigenous plants Map location, linear miles, and protection status of Suisun Marsh aster habitat Map total acreage and locations of saline emergent wetland habitat including high marsh and marsh-upland transition habitat Implementation status and results - number of cooperative programs established to aquire and restore tidal wetlands and number with implemented projects - acreage and location of habitat "restored" - implementation status and effectiveness of non-indigenous plant control program near Suisun thistle Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak - newly protected Suisun marsh aster habitat - new linear miles of tidal slough habitat suitable for Suisun marsh aster - number, location, size, and trends of newly established Suisun thistle populations - number, location, size, and trends of newly established soft bird's beak populations - number, location, size, and trends of newly established Point Reyes bird's beak Research into targeted species establishment & sustainability in restored wetlands targeted species in restored wetlands Research into restoration methods? Need definition of "restored" What does "proper management" consist of ? [Need to have a botanist look this over]
SM-B H3	Restore suitable, occupied slough edge habitat for delta mudwort and delta tule pea by at least 5 miles in the Suisun Bay and Marsh EMU and by at least 10 miles in the Napa River EMUs. Bring at least 25% the currently existing but unprotected occurrences of delta mudwort and delta tule into protection through purchase or conservation agreement, and ensure appropriate management.	Saline Emergent Wetland	all Central Valley salmonids, delta smelt, Sacramento splittail, California black rail, Mason's lilaeopsis, delta mudwort, delta tule pea	Status and trends of delta mudwort and delta tule pea Map location, linear miles, and protection status of delta mudwort and delta tule pea habitat Implementation status and results - miles and location of sloughs "restored" - presence/absence or relative abundance of delta tule pea and delta mudwort - newly protected occurences of delta mudwort and delta tule pea Research into targeted species establishment & sustainability in restored wetlands? Research into restoration methods? Need definition of "restored" Need definition of "appropriate management"

APPENDIX D: CALFED ERP Milestones [(8a)] and "terrestrial" related monitoring

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SM-B H4	In the Suisun Marsh/North San Francisco Bay Ecological Management Zone, restore and manage a minimum of 500 acres of seasonal wetland, and improve management of a minimum of 7,000 acres of existing, degraded seasonal wetland in a manner that provides suitable habitat for salt marsh harvest mouse, San Pablo California vole, and Suisun ornate shrew.	Seasonal Wetlands	salt marsh harvest mouse, San Pablo California vole, Suisun ornate shrew	Status and trends of salt marsh harvest mouse, San Pablo California vole, and Suisun ornate shrew. Map location and acreage of seasonal wetlands suitable as habitat for salt marsh harvest mouse, San Pablo California vole, and Suisun ornate shrew. Implementation status and results - acreage of "restored" seasonal wetland habitat suitable for habitat for salt marsh harvest mouse, San Pablo California vole, or Suisun ornate shrew. - acreage and location of degraded seasonal wetlands under new management to provide suitable habitat for salt marsh harvest mouse, San Pablo California vole, or Suisun ornate shrew. Validation monitoring for presence/absence of salt marsh harvest mouse, San Pablo California vole, or Suisun ornate shrew in "restored" seasonal wetlands and seasonal wetlands with improved management Research into targeted species establishment & sustainability in restored wetlands? Research into restoration methods? Relationship between management methods and habitat quality for targeted species Need definition of "restored" Need definition of "appropriate management"
SM-B H5	Restore a minimum of 400 acres of tidal perennial aquatic habitat in the Suisun Marsh/North San Francisco Bay Ecological Management Zone.	Tidal Perennial Aquatic Habitat	all Central Valley salmonids, delta smelt, Sacramento splittail, longfin smelt	Map total acreage and locations of tidal perennial aquatic habitat (esp. tidal flats) Restoration project(s) implementation status and results - acreage and location of habitat "restored" Research into restoration methods? Need definition of "restored"
SM-B H6	Develop a cooperative program to acquire, manage and restore 100 acres of vernal pools and 500 to 1,000 acres of adjacent buffer areas in the Suisun Marsh/North San Francisco Bay EMZ. Protect all existing known occurrences of Crampton's tuctoria through conservation easement or purchase from willing sellers (including CNDDB Element Occurrence #2 and any new populations that are found). Identify at least two protected and managed sites for introduction of additional populations; begin introduction and monitor for success. Manage at least 250 acres of the ERP target for vernal pools near the Jepson Prairie preserve as suitable habitat for alkali milk vetch. Establish new populations on protected and appropriately managed lands. Bring 50% of currently unprotected, existing populations into protection through purchase or conservation agreement, and ensure appropriate management.	Vernal Pools	Delta green ground beetle, Crampton's tuctoria, Alkali milk- vetch	Status and trends of Crampton's tuctoria and alkali milk vetch (locations and protection status of populations) Map locations and type of vernal pools Implementation status and results - acreage of "restored" vernal pools and associated uplands - newly protected populations of Crampton's tuctoria and alkali milk vetch - locations and status of newly established populations of Crampton's tuctoria and alkali milk vetch - results of management of Crampton's tuctoria and alkali milk vetch populations Research into targeted species establishment & sustainability in restored wetlands? Research into restoration methods? Relationship between management methods and habitat quality for targeted species? Need definition of "restored" Need definition of "appropriate management"
	Stressors Reduction			
SM-B S1	Develop a program to consolidate, screen, or eliminate 25% of the unscreened diversions in Suisun Marsh.	Water Diversions	all R and r covered fish	

APPENDIX D: CALFED ERP Milestones (8a) and "terrestrial" related monitoring

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SM-B S2	Develop, implement, and support measures to reduce pollutant (oxygen depleting substances, nutrients, and ammonia) discharges from concentrated animal feeding operations. (from Phase II Report)	oxygen depleting substances, nutrients, TOC, ammonia	Salmonids, Sacramento splittail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SM-B S3	Encourage regulatory activity to reduce discharge of oxygen reducing substances and nutrients by unpermitted dischargers. (from Phase II Report)	dissolved oxygen, oxygen depleting substances, nutrients	Salmonids, Sacramento splittail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SM-B S4	Actions to reduce fine sediment loading to streams, especially Tuolumne, Merced, Stanislaus, Cosumnes, Napa, and Petaluma Rivers, and Sonoma Creek, due to human activities (from Phase II Report and Water Quality Program Plan): · Participate in implementation of USDA sediment reduction program. · Implement sediment reduction BMPs in construction areas, on agricultural lands, for urban stormwater runoff, and other specific sites. · Implement stream restoration and revegetation work. · Quantify and determine ecological impacts of sediments in target watersheds, implement corrective actions.	turbidity/ sedimentation	Salmonids	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SM-B S5	Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.	mercury	Salmonids, Sacramento splittail, green sturgeon, giant garter snake, salt marsh harvest mouse, California clapper rail, California black rail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SM-B S6	Conduct the following pesticide work (from Phase II Report): · Develop diazinon and chlorpyrifos hazard assessment criteria with CDFG and the Department of Pesticide Regulations. · Support development and implementation of a TMDL for diazinon. · Develop BMPs for dormant spray and household uses. · Determine the ecological significance of pesticide discharges. · Support implementation of BMPs. · Monitor to determine effectiveness of BMPs	carbofurans, chloropyrifos,diazinon	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, giant garter snake, possibly other species depending on type of actions and specific sites.	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SM-B S7	Conduct the following selenium work: · Conduct selenium research to fill data gaps in order to refine regulatory goals of source control actions; determine bioavailability of selenium under several scenarios (from Phase II Report). · Evaluate and, if appropriate, implement real-time management of selenium discharges (from Phase II Report). · Expand and implement source control, treatment, and reuse programs (from Phase II Report). · Coordinate with other programs; e.g., recommendations of San Joaquin Valley Drainage Implementation Program, CVPIA for retirement of lands with drainage problems that are not subject to correction in other ways (from Phase II Report). · Support development and implementation of TMDL for selenium in the San Joaquin River watershed (focus on Grassland area).	selenium	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, giant garter snake, salt marsh harvest mouse, California clapper rail, California black rail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?

APPENDIX D: CALFED ERP Milestones [8a] and "terrestrial" related monitoring

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SM-B S8	Conduct the following actions in reduce organochlorine pesticide inputs to streams (from Phase II Report): · Participate in implementation of USDA sediment reduction program. · Implement sediment reduction BMPs on agricultural lands and other specific sites. · Implement BMPs for urban/industrial stormwater runoff and discharges to reduce PCB and organochlorine pesticides.	chlorodane, DDT, PCBs, toxaphene	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, giant garter snake	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SM-B S9	Conduct the following trace metals work (from Phase II Report): · Determine spatial and temporal extent of metal pollution. · Determine ecological significance and extent of copper contamination. · Evaluate impacts of other metals such as cadmium, zinc, and chromium. · Participate in Brake Pad Partnership to reduce introduction of copper. · Partner with municipalities on evaluation and implementation of stormwater control facilities. · Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.	cadmium, copper, zinc	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, giant garter snake, salt marsh harvest mouse, California clapper rail, California black rail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SM-B S10	Conduct the following unknown toxicity work (from Phase II Report): · Conduct appropriate studies to identify unknown toxicity, and develop management actions as appropriate.	toxicity of unknown origin	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
	Sacramento River Basin			
	Ecological Processes			
SACR P1	Construct a network of channels totaling 20 miles within the Sutter and Yolo Bypasses that effectively drains flooded lands after floodflows stop entering the bypasses. The channels should be designed to allow juvenile anadromous and resident fish to move from rearing and migratory areas. Develop and begin implementation of a program in the Yolo Basin to restore channel-floodplain connectivity and floodplain processes. Design natural stream channel configurations and expand floodplain overflow areas in the lower Cache and Putah Creek floodplains, as well as in channels and sloughs of the upper Yolo Bypass to provide connections with the Delta in a manner consistent with flood control requirements. Diversions (water source) into the Yolo Basin should not result in direct or indirect adverse impacts to salmonids. Project design features would include sloughs and creek channels, setback levees, and wetlands, where feasible and consistent with flood protection.	Natural Floodplain and Flood Processes	Central Valley chinook salmon and steelhead, Sacramento splittail	

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SACR P2	Develop and implement temperature management programs within major tributaries in the Sacramento River Basin. The goal of the programs should be achievement of the ERP temperature targets for salmon and steelhead. The programs shall include provisions to: a) develop accurate and reliable water temperature prediction models; b) evaluate the use of minimum carryover storage levels and other operational tools; c) evaluate the use of new facilities such as temperature control devices; and d) recommend operational and/or physical facilities as a long□term solution.	Central Valley Stream Temperatures	Central Valley fall/late fall-run chinook salmon and steelhead	
SACR P3	Develop and implement a program to address the thermal impacts of irrigation return flows in the Sacramento River Basin. The goal of the program should be achieve Basin Plan objectives for water temperature. The program should include provisions to: a) identify locations of irrigation return flows with thermal impacts; b) develop measures to avoid or eliminate thermal impacts from irrigation return flows; and c) prioritize problem sites based on impacts to chinook salmon and steelhead. If feasible, proceed with implementation of some or all actions to address thermal impacts of irrigation return flows.	Central Valley Stream Temperatures	Central Valley fall/late fall-run chinook salmon and steelhead	
SACR P4	Design and begin implementation of an ecologically based streamflow regulation plan for Yuba River, Butte Creek, Big Chico Creek, Deer Creek, Mill Creek , Antelope Creek, Battle Creek, Cottonwood Creek, and Clear Creek.	Central Valley Streamflow	all Central Valley salmonids, green sturgeon, Sacramento splittail, western yellow-billed cuckoo, yellow warbler, Least Bell's vireo	
SACR P5	Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ in the Sacramento River Basin.	Coarse Sediment Supply	all races of chinook salmon, steelhead, splittail, delta smelt, green sturgeon, bank swallow, California yellow warbler, western yellow-billed cuckoo, Least Bell's vireo, valley elderberry longhorn beetle, Norther California black walnut	Map acreage and locations of floodplain habitat by habitat type Status of assessment of sediment supply needs Program implementation status and effectiveness
SACR P6	Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within each of the EMZs in the Sacramento River Basin. Among the areas to be included are the lower 10 miles of Clear Creek, Antelope Creek, and Deer Creek, and the lower reach of Cottonwood Creek.	Natural Floodplain and Flood Processes	all Central Valley salmonids, Sacramento splittail, delta smelt, longfin smelt, western yellow-billed cuckoo, California yellow warbler, Least Bell's vireo, San Joaquin Valley woodrat, Valley elderberry long-horn beetle, Northern California black walnut	Map acreage and locations of floodplain habitat by habitat type Number, implementation status and results of floodplain management plans Restoration project(s) implementation status and results - acreage and location of floodplain "restored" Research into restoration methods? into setback levee construction? Need definition of "restored"

APPENDIX D: CALFED ERP Milestones (8a) and "terrestrial" related monitoring

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SACR P7	Protect 15,000 acres within the Inner River Zone areas between Red Bluff and Colusa reaches within identified the Sacramento River Conservation Area. Establish between 3 and 5 habitat preserves for bank swallows along the upper reaches of the Sacramento River capable of supporting 5000 bank swallow burrows between the towns of Colusa and Red Bluff.	Stream Meander	all Central Valley salmonids, steelhead, western yellow-billed cuckoo, Least Bell's vireo, Swainson's hawk, Valley elderberry longhorn beetle, bank swallow	Protection status of inner river zone areas? (this may be aquatic) Location and size of bank swallow colonies Implementation of 3-5 habitat preserves for bank swallows Newly protected inner river zone areas (this may be aquatic) Validation monitoring to establish use of preserves by bank swallows
	Habitats			
SACR H1	In the American River Basin, Butte Basin, Colusa Basin, Feather River/Sutter Basin EMZs, cooperatively enhance at least 15 to 25% of the ERPP target for wildlife friendly agricultural practices.	Agricultural Lands	greater sandhill crane, giant garter snake, Swainson's hawk	Acreage under "wildlife friendly" agricultural practices by targeted species (I.e. ducks, neotropical migratory birds, targeted species such as valley elderberry longhorn beetle or swainson's hawk) Validation monitoring of use of these lands by targeted species Need definition of "wildlife friendly"
SACR H2	Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within each of the following Ecological Management Zones: American River Basin, Butte Basin, Colusa Basin, Cottonwood Creek, Feather River/Sutter Basin, North Sacramento Valley, Sacramento River, and Yolo Basin. While restoring habitat conditions in the American River EMZ, maintain continuous corridors of suitable riparian habitat for valley elderberry longhorn beetle. Protect existing known occurrences of northern California black walnut native stands through conservation easement or purchase. Identify at least 3 protected and managed sites for introduction of additional populations of northern California black walnut; begin introduction and monitor for success. Population creation should be part of a broader effort to restore riparian areas which historically contained walnut.	Riparian and Riverine Aquatic Habitats	all Central Valley salmonids, western yellow-billed cuckoo, Valley elderberry long-horn beetle, California yellow warbler, Least Bell's vireo, little willow flycatcher	Map total number of linear miles, width of corridor, acreage and locations of riparian habitat Map locations, acreage, and connectivity of suitable valley elderberry longhorn beetle habitat Location and protection status of native northern California black walnut stands Program Implementation status and results - miles, acreage and location of riparian habitat "restored" - locations, acreage and connectivity of suitable valley elderberry longhorn beetle habitat - newly protected California black walnut native stands - new established populations of native northern California black walnut - management activities and results Research into restoration methods? management methods? Need definition of "restored"
SACR H3	In the Cottonwood Creek EMZ, complete (1) long-term agreements with local landowners to establish, restore, and maintain riparian communities along 25 percent of the upper and 25 percent of the lower reaches of Cottonwood Creek, and (2) the development of a comprehensive watershed management plan that supports local land use decisions to protect existing riparian and restore lost riparian.	Riparian and Riverine Aquatic Habitats	all Central Valley salmonids, California yellow warbler, western yellow-billed cuckoo, Least Bell's vireo, little willow flycatcher	Map total number of linear miles, width of corridor, acreage and locations of riparian habitat Implementation status and results - status of completion of long-term agreements - status of development of watershed management plan - miles, acreage and location of riparian habitat "restored" and protected
SACR H4	Restore 2 miles of the 10 mile target of riparian habitat restoration along the lower reaches of each of the following tributaries: Battle, Clear, Deer, Mill, Butte, Big Chico, Antelope, Feather, Yuba, and Bear Rivers.	Riparian and Riverine Aquatic Habitats	all Central Valley salmonids, California yellow warbler, western yellow-billed cuckoo, little willow flycatcher, Least Bell's vireo, Valley elderberry long-horn beetle	Map total number of linear miles, width of corridor, acreage and locations of riparian habitat Program Implementation status and results - miles, acreage and location of riparian habitat "restored" Research into restoration methods? management methods? Need definition of "restored"

APPENDIX D: CALFED ERP Milestones [8a] and "terrestrial" related monitoring

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SACR H5	Implement 25 percent of the ERP target for enhancing, protecting, and restoring seasonal wetlands in the following EMZs: American River Basin, Butte Basin, Colusa Basin, and Feather River/Sutter Basin.	Seasonal Wetlands	greater sandhill crane, Swainson's hawk, giant garter snake	Map acreage, locations, and protection status of seasonal wetland habitat Program Implementation status and results - acreage and location of seasonal wetland habitat "restored", enhanced, and/or protected Research into restoration methods? management methods? What is the definition of restored? a project with results comparable to a reference site? specific measures of habitat quality?
	Stressors Reduction			
SACR S1	Develop and implement a program to address inadequate instream flows for steelhead and chinook salmon on streams within Sacramento River Basin tributaries. Where appropriate provide adequate flows for Sacramento splittail and green sturgeon.	Dams and Other Structures	all Central Valley salmonids, green sturgeon, Sacramento splittail	
SACR S2	Provide unimpeded upstream and downstream passage for salmon and steelhead on Sacramento River Basin tributaries.	Dams and Other Structures	all Central Valley salmonids, green sturgeon, Sacramento splittail	
SACR S3	On Big Chico Creek, repair the Lindo Channel weir and fishway at the Lindo Channel box culvert at the Five Mile Diversion to improve upstream fish passage.	Dams and Other Structures	all Central Valley salmonids	
SACR S4	Develop and implement a solution to improve passage of upstream migrant adult fish and downstream migrant juvenile fish Battle Creek.	Dams and Other Structures	all Central Valley salmonids, green sturgeon	
SACR S5	Evaluate the feasibility of constructing fish passage facilities at the Grays Bend-Old River-Freemont weir complex at the upper end of the Yolo Bypass.	Dams and Other Structures	all Central Valley salmonids	
SACR S6	Develop a program to reduce or eliminate fish stranding in the Sacramento, Feather and Yuba rivers and the Colusa Basin drain and Sutter Bypass in the active stream channels, floodplains, shallow ponds and borrow areas. Develop protocols for ramping flow reductions. Conduct surveys of stranding under a range of flow conditions and recommend solutions.	Stranding	all Central Valley salmonids, green sturgeon, lonfin smelt, Sacramento splittail	
SACR S7	Install positive barrier fish screens on all diversions greater than 250 cfs in all EMZs and 25% of all smaller unscreened diversions in the Sacramento River Basin. Among those diversions to be screened are the DWR Pumping Plants and 50% of small diversion located on east side of Sutter Bypass, the Bella Vista diversion in the upper Sacramento River near Redding, East□West Diversion Weir, Weir 5, Weir 3, Guisti Weir and Weir 1 in the Sutter Bypass, White Mallard Dam, Morton Weir, Drivers Cut Outfall and Colusa Shooting/Tarke Weir Outfall and associated diversion screens in the Butte Sink..	Water Diversions	all R and r covered fish	
SACR S8	Develop, implement, and support measures to reduce pollutant (oxygen depleting substances, nutrients, and ammonia) discharges from concentrated animal feeding operations. (from Phase II Report)	oxygen depleting substances, nutrients, TOC, ammonia	Salmonids, Sacramento splittail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?

APPENDIX D: CALFED ERP Milestones [8a] and "terrestrial" related monitoring

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SACR S9	Actions to minimize or eliminate inter-substrate low dissolved oxygen conditions in salmonid spawning and rearing habitat, especially in the Mokelumne, Cosumnes, American, Merced, Tuolumne, and Stanislaus Rivers (from Phase II Report and Water Quality Program Plan): · Develop inter-substrate DO testing for salmonid spawning and rearing habitat. · Conduct comprehensive surveys to assess the extent and severity of inter-substrate low DO conditions. · Develop and begin implementing appropriate best management practices (BMPs), including reducing anthropogenic fine sediment loads, to minimize or eliminate inter-substrate low DO conditions.	dissolved oxygen, turbidity/ sedimentation	Salmonids	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SACR S10	Encourage regulatory activity to reduce discharge of oxygen reducing substances and nutrients by unpermitted dischargers. (from Phase II Report)	dissolved oxygen, oxygen depleting substances, nutrients	Salmonids, Sacramento splittail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SACR S11	Actions to reduce fine sediment loading to streams, especially Tuolumne, Merced, Stanislaus, Cosumnes, Napa, and Petaluma Rivers, and Sonoma Creek, due to human activities (from Phase II Report and Water Quality Program Plan): · Participate in implementation of USDA sediment reduction program. · Implement sediment reduction BMPs in construction areas, on agricultural lands, for urban stormwater runoff, and other specific sites. · Implement stream restoration and revegetation work. · Quantify and determine ecological impacts of sediments in target watersheds, implement corrective actions.	turbidity/ sedimentation	Salmonids	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SACR S12	Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.	mercury	Salmonids, Sacramento splittail, green sturgeon, giant garter snake, salt marsh harvest mouse, California clapper rail, California black rail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SACR S13	Conduct the following mercury evaluation and abatement work in the Cache Creek watershed (from Phase II Report): · Support development and implementation of TMDL for mercury. · Determine bioaccumulation effects in creek and Delta. · Source, transport, inventory, mapping and speciation of mercury. · Participate in Stage 1 remediation (drainage control) of mercury mines as appropriate. · Determine sources of high levels of bioavailable mercury	mercury	Salmonids, Sacramento splittail, green sturgeon, giant garter snake	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SACR S14	Conduct the following mercury evaluation and abatement work in the Sacramento River (from Phase II Report): · Determine, inventory, and sources of high levels of bioavailable mercury · Refine mercury models.· Participate in remedial activities.	mercury	Salmonids, Sacramento splittail, green sturgeon, giant garter snake	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?

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SACR S15	Conduct the following pesticide work (from Phase II Report): · Develop diazinon and chlorpyrifos hazard assessment criteria with CDFG and the Department of Pesticide Regulations. · Support development and implementation of a TMDL for diazinon. · Develop BMPs for dormant spray and household uses. · Determine the ecological significance of pesticide discharges. · Support implementation of BMPs. · Monitor to determine effectiveness of BMPs	carbofurans, chloropyrifos,diazinon	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, giant garter snake, possibly other species depending on type of actions and specific sites.	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SACR S16	Conduct the following actions in reduce organochlorine pesticide inputs to streams (from Phase II Report): · Participate in implementation of USDA sediment reduction program. · Implement sediment reduction BMPs on agricultural lands and other specific sites. · Implement BMPs for urban/industrial stormwater runoff and discharges to reduce PCB and organochlorine pesticides.	chlorodane, DDT, PCBs, toxaphene	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, giant garter snake	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SACR S17	Conduct the following trace metals work (from Phase II Report): · Determine spatial and temporal extent of metal pollution. · Determine ecological significance and extent of copper contamination. · Evaluate impacts of other metals such as cadmium, zinc, and chromium. · Participate in Brake Pad Partnership to reduce introduction of copper. · Partner with municipalities on evaluation and implementation of stormwater control facilities. · Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.	cadmium, copper, zinc	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, giant garter snake, salt marsh harvest mouse, California clapper rail, California black rail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SACR S18	Conduct the following unknown toxicity work (from Phase II Report): · Conduct appropriate studies to identify unknown toxicity, and develop management actions as appropriate.	toxicity of unknown origin	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
	San Joaquin River Basin			
	Ecological Processes			
SJR P1	Develop and implement temperature management programs within major tributaries in the San Joaquin River Basin. The goal of the programs should be achievement of the ERP temperature targets for salmon and steelhead. The programs shall include provisions to: a) develop accurate and reliable water temperature prediction models; b) evaluate the use of minimum carryover storage levels and other operational tools; c) evaluate the use of new facilities such as temperature control devices; and d) recommend operational and/or physical facilities as a long□term solution.	Central Valley Stream Temperatures	Central Valley fall/late fall-run chinook salmon and steelhead	

APPENDIX D: CALFED ERP Milestones (8a) and "terrestrial" related monitoring

Code	Milestones	Ecosystem Element/Water Quality Parameter	MSCS "R" and "r" Covered Species that would Benefit from Achieving Milestones	Terrestrial related monitoring Blue = Status and Trends monitoring Red = Action implementation monitoring Green = Cause & Effect Research / Validation monitoring Orange = Redirected effects monitoring Purple = Questions / clarification issues
SJR P2	Develop and implement a program to address the thermal impacts of irrigation return flows in the San Joaquin River Basin. The goal of the program should be achieve Basin Plan objectives for water temperature. The program should include provisions to: a) identify locations of irrigation return flows with thermal impacts; b) develop measures to avoid or eliminate thermal impacts from irrigation return flows; and c) prioritize problem sites based on impacts to chinook salmon and steelhead. If feasible, proceed with implementation of some or all actions to address thermal impacts of irrigation return flows.	Central Valley Stream Temperatures	Central Valley fall/late fall-run chinook salmon and steelhead	
SJR P3	Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ within the San Joaquin River Basin. In the East San Joaquin Basin EMZ, complete fluvial geomorphic assessments on all tributaries.	Coarse Sediment Supply	all races of chinook salmon, steelhead, splittail, delta smelt, green sturgeon, bank swallow, California yellow warbler, western yellow-billed cuckoo, Least Bell's vireo, valley elderberry longhorn beetle, Northern California black walnut	Map acreage and locations of floodplain habitat by habitat type Status of assessment of sediment supply needs Program implementation status and effectiveness
SJR P4	Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within each of the EMZs in the San Joaquin River Basin. Among the areas to be included are at least 10 miles of stream channel in the West San Joaquin EMZ.	Natural Floodplain and Flood Processes	all Central Valley salmonids, Sacramento splittail, delta smelt, longfin smelt, western yellow-billed cuckoo, California yellow warbler, Least Bell's vireo, San Joaquin Valley woodrat, Valley elderberry long-horn beetle, Northern California black walnut	Map acreage and locations of floodplain habitat by habitat type Number, implementation status and results of floodplain management plans Restoration project(s) implementation status and results - acreage and location of floodplain "restored" Research into restoration methods? into setback levee construction? Need definition of "restored"
SJR P5	Develop a cooperative program to restore salmonid spawning and rearing habitat in the Tuoloumne, Stanislaus, and Merced Rivers that includes the following elements: (1) reconstructing channels at selected sites by isolating or filling in inchannel gravel extraction areas; (2) increasing natural meander by removing riprap and relocating other structures that impair stream meander; and (3) restoring more natural channel configurations to reduce salmonid predator habitat and improve migration corridors.	Stream Meander (also Predation and Competition)	Central Valley fall/late fall-run chinook salmon, steelhead, western yellow-billed cuckoo, California yellow warbler, bank swallow	
SJR P6	Restore and maintain a defined stream-meander zone and increase floodplain habitat on the San Joaquin River between Vernalis and the mouth of the Merced River.	Stream Meander	Sacramento splittail, Central Valley fall/late fall-run chinook salmon, steelhead, bank swallow	Map acreage and locations of floodplain habitat by habitat type Restoration project(s) implementation status and results - acreage and location of floodplain "restored" Research into restoration methods? into setback levee construction? Need definition of "restored"
SJR P7	Establish a river meander corridor between the Chowchilla Bypass and Mendota Pool to expand the floodway corridor to convey increased anticipated floodflows and restore floodplain habitat.	Stream Meander	Sacramento splittail, Central Valley fall/late fall-run chinook salmon, steelhead, bank swallow	Map acreage and locations of floodplain habitat by habitat type Restoration project(s) implementation status and results - acreage and location of floodplain "restored" Research into restoration methods? into setback levee construction? Need definition of "restored"
	Habitats			

APPENDIX D: CALFED ERP Milestones (8a) and "terrestrial" related monitoring

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SJR	H1	In the San Joaquin River and West San Joaquin Basin EMZs, cooperatively enhance at least 15 to 25% of the ERPP target for wildlife friendly agricultural practices	Agricultural Lands	Swainson's hawk, greater sandhill crane, giant garter snake	Acreage under "wildlife friendly" agricultural practices by targeted species (I.e. ducks, sandhill cranes) Validation monitoring of use of these lands by targeted species Need definition of "wildlife friendly"
SJR	H2	In the West San Joaquin Basin EMZ, restoring or create 100 acres of fresh emergent wetland habitat.	Fresh Emergent Wetland	giant garter snake	Map acreage, locations of freshwater emergent wetland habitat Program Implementation status and results - acreage and location of freshwater emergent wetland habitat "restored" Research into restoration methods? management methods? Need definition of "restored"
SJR	H3	In the West San Joaquin Basin EMZ, restore or enhance 1,000 acres of perennial grassland associated with existing or proposed wildlife corridors, wetlands, or floodplain habitats.	Perennial Grasslands	Swainson's hawk, greater sandhill crane	Map acreage, locations of floodplain habitats, perennial grassland habitats, and habitats that may act as wildlife corridors Program Implementation status and results - acreage and location of perennial grassland habitat "restored" or "enhanced" Research into locations of existing or potential wildlife corridors? restoration methods? Need definition of "restored" and "enhanced"
SJR	H4	Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat and instream cover along at least one tributary within the East San Joaquin and San Joaquin River EMZs.	Riparian and Riverine Aquatic Habitats	Central Valley steelhead, fall/late fall-run chinook salmon, western yellow-billed cuckoo, Valley elderberry long horn beetle, riparian brush rabbit, California yellow warbler, Least Bell's vireo, little willow flycatcher, delta coyote thistle	Map linear miles, corridor width, acreage and locations of riparian habitat Restoration project(s) implementation status and results - linear miles, acreage and location of floodplain "restored" Research into restoration methods? management methods? Need definition of "restored"
SJR	H5	Implement 25 percent of the ERP target for diverse, self-sustaining riparian community for all EMZs in the San Joaquin River Basin. Bring at least three of the currently existing but unprotected delta coyote thistle occurrences into protection through purchase or conservation agreement, and ensure appropriate management. Increase suitable habitat for delta coyote thistle by at least 20% and the number of populations and individuals by at least 10% through habitat management and protection. Establish two new riparian brush rabbit habitat preserves within the historical range of the species. Protect and enhance a minimum of 150 contiguous acres of mature, shrub-rich riparian forest and associated highwater refugia on the San Joaquin River, between the Merced River confluence and Vernalis, and on each of the east-side tributaries (the Stanislaus, Tuolumne and Merced rivers) for habitat values and as potential riparian brush rabbit re-introduction sites.	Riparian and Riverine Aquatic Habitats	San Joaquin Valley woodrat, delta coyote thistle, western yellow-billed cuckoo, Valley elderberry long-horn beetle, riparian brush rabbit	Map total number of linear miles, width of corridor, acreage and locations of riparian habitat Map locations, population size, and protection status of delta coyote thistle populations and habitat Program Implementation status and results - miles, acreage and location of riparian habitat "restored", "enhanced" or protected - location, acreage and protection status of restored/enhanced delta coyote thistle habitat - location, size, status, and protection status of newly established delta coyote thistle populations - location, acreage and protection status of riparian brush rabbit habitat - location, size, status, and protection status of newly established riparian brush rabit populations - management activities and results Research into restoration methods? target species establishment and management methods? Need definition of "restored" and "enhanced"
		Stressors Reduction			

APPENDIX D: CALFED ERP Milestones [8a] and "terrestrial" related monitoring

Code	Milestones	Ecosystem Element/Water Quality Parameter	MSCS "R" and "r" Covered Species that would Benefit from Achieving Milestones	Terrestrial related monitoring Blue = Status and Trends monitoring Red = Action implementation monitoring Green = Cause & Effect Research / Validation monitoring Orange = Redirected effects monitoring Purple = Questions / clarification issues
SJR S1	Develop and implement a program to address inadequate instream flows for steelhead and chinook salmon on streams within San Joaquin River tributaries. Where appropriate provide adequate flows for Sacramento splittail and green sturgeon.	Dams and Other Structures	steelhead, fall/late fall-run chinook salmon, green sturgeon, Sacramento splittail	
SJR S2	Provide unimpeded upstream and downstream passage for salmon and steelhead on San Joaquin River Basin tributaries.	Dams and Other Structures	steelhead, fall/late fall-run chinook salmon	
SJR S3	Initiate a feasibility study of restoring steelhead migration into upper watershed areas (e.g., upstream of major low-elevation dams) in at least one San Joaquin River Basin EMZ Tributary.	Dams and Other Structures	steelhead	
SJR S4	Install positive barrier fish screens on all diversions greater than 250 cfs in all EMZs and 25% of all smaller unscreened diversions in the San Joaquin River Basin. Among those diversions to be screened are the El Solyo, Patterson, and West Stanislaus irrigation district diversions.	Water Diversions	all R and r covered fish	
SJR S5	Actions to minimize or eliminate low dissolved oxygen conditions (DO sag) in lower San Joaquin River near Stockton (from Phase II Report): · Complete studies of causes for DO sag in San Joaquin River near Stockton. · Define and implement corrective measures for DO sag. · Finalization of investigation of methods to reduce constituents that cause low DO for inclusion in total maximun daily load (TMDL) recommendation by the Central Valley RWQCB. · Finalization of Basin Plan Amendment and TMDL for constituents that cause low DO in the San Joaquin River. · Implement appropriate source and other controls and other management practices, as recommended in the TMDL, to reduce anthropogenic oxygen depleting substances loadings and minimize or eliminate low DO conditions.	dissolved oxygen, oxygen depleting substances, nutrients, total organic carbon (TOC)	Salmonids, delta smelt, Sacramento splittail, longfin smelt, green sturgeon	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SJR S6	Develop, implement, and support measures to reduce pollutant (oxygen depleting substances, nutrients, and ammonia) discharges from concentrated animal feeding operations. (from Phase II Report)	oxygen depleting substances, nutrients, TOC, ammonia	Salmonids, Sacramento splittail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SJR S7	Actions to minimize or eliminate inter-substrate low dissolved oxygen conditions in salmonid spawning and rearing habitat, especially in the Mokelumne, Cosumnes, American, Merced, Tuolumne, and Stanislaus Rivers (from Phase II Report and Water Quality Program Plan): · Develop inter-substrate DO testing for salmonid spawning and rearing habitat. · Conduct comprehensive surveys to assess the extent and severity of inter-substrate low DO conditions. · Develop and begin implementing appropriate best management practices (BMPs), including reducing anthropogenic fine sediment loads, to minimize or eliminate inter-substrate low DO conditions.	dissolved oxygen, turbidity/ sedimentation	Salmonids	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SJR S8	Assess the ecological effects of low DO conditions in Suisun Marsh due to adding oxygen-depleted water from anthropogenic sources (from Water Quality Program Plan).	dissolved oxygen, oxygen depleting substances, nutrients, TOC	Delta smelt, Sacramento splittail, longfin smelt, salmonids, green sturgeon	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?

APPENDIX D: CALFED ERP Milestones (8a) and "terrestrial" related monitoring

Code		Milestones	Ecosystem Element/Water Quality Parameter	MSCS "R" and "r" Covered Species that would Benefit from Achieving Milestones	Terrestrial related monitoring Blue = Status and Trends monitoring Red = Action implementation monitoring Green = Cause & Effect Research / Validation monitoring Orange = Redirected effects monitoring Purple = Questions / clarification issues
SJR	S9	Encourage regulatory activity to reduce discharge of oxygen reducing substances and nutrients by unpermitted dischargers. (from Phase II Report)	dissolved oxygen, oxygen depleting substances, nutrients	Salmonids, Sacramento splittail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SJR	S10	Actions to reduce fine sediment loading to streams, especially Tuolumne, Merced, Stanislaus, Cosumnes, Napa, and Petaluma Rivers, and Sonoma Creek, due to human activities (from Phase II Report and Water Quality Program Plan): · Participate in implementation of USDA sediment reduction program. · Implement sediment reduction BMPs in construction areas, on agricultural lands, for urban stormwater runoff, and other specific sites. · Implement stream restoration and revegetation work. · Quantify and determine ecological impacts of sediments in target watersheds, implement corrective actions.	turbidity/ sedimentation	Salmonids	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SJR	S11	Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.	mercury	Salmonids, Sacramento splittail, green sturgeon, giant garter snake, salt marsh harvest mouse, California clapper rail, California black rail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SJR	S12	Conduct the following pesticide work (from Phase II Report): · Develop diazinon and chlorpyrifos hazard assessment criteria with CDFG and the Department of Pesticide Regulations. · Support development and implementation of a TMDL for diazinon. · Develop BMPs for dormant spray and household uses. · Determine the ecological significance of pesticide discharges. · Support implementation of BMPs. · Monitor to determine effectiveness of BMPs	carbofurans, chloropyrifos,diazinon	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, giant garter snake, possibly other species depending on type of actions and specific sites.	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SJR	S13	Conduct the following selenium work: · Conduct selenium research to fill data gaps in order to refine regulatory goals of source control actions; determine bioavailability of selenium under several scenarios (from Phase II Report). · Evaluate and, if appropriate, implement real-time management of selenium discharges (from Phase II Report). · Expand and implement source control, treatment, and reuse programs (from Phase II Report). · Coordinate with other programs; e.g., recommendations of San Joaquin Valley Drainage Implementation Program, CVPIA for retirement of lands with drainage problems that are not subject to correction in other ways (from Phase II Report). · Support development and implementation of TMDL for selenium in the San Joaquin River watershed (focus on Grassland area).	selenium	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, giant garter snake, salt marsh harvest mouse, California clapper rail, California black rail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?

APPENDIX D: CALFED ERP Milestones (8a) and "terrestrial" related monitoring

Code		Milestones	Ecosystem Element/Water Quality Parameter	MSCS "R" and "r" Covered Species that would Benefit from Achieving Milestones	Terrestrial related monitoring Blue = Status and Trends monitoring Red = Action implementation monitoring Green = Cause & Effect Research / Validation monitoring Orange = Redirected effects monitoring Purple = Questions / clarification issues
SJR	S14	Conduct the following actions in reduce organochlorine pesticide inputs to streams (from Phase II Report): · Participate in implementation of USDA sediment reduction program. · Implement sediment reduction BMPs on agricultural lands and other specific sites. · Implement BMPs for urban/industrial stormwater runoff and discharges to reduce PCB and organochlorine pesticides.	chlorodane, DDT, PCBs, toxaphene	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, giant garter snake	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SJR	S15	Conduct the following trace metals work (from Phase II Report): · Determine spatial and temporal extent of metal pollution. · Determine ecological significance and extent of copper contamination. · Evaluate impacts of other metals such as cadmium, zinc, and chromium. · Participate in Brake Pad Partnership to reduce introduction of copper. · Partner with municipalities on evaluation and implementation of stormwater control facilities. · Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.	cadmium, copper, zinc	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon, giant garter snake, salt marsh harvest mouse, California clapper rail, California black rail	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
SJR	S16	Conduct the following unknown toxicity work (from Phase II Report): · Conduct appropriate studies to identify unknown toxicity, and develop management actions as appropriate.	toxicity of unknown origin	Salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon	Assume primary purpose is aquatic contamination concerns and consequently monitoring wil be aquatic?
		Research Milestones			
RES	R1	Develop and implement a comprehensive monitoring, assessment and research program (CMARP) for terrestrial and aquatic habitats and species populations acceptable to the fish and wildlife agencies. Conduct rangewide surveys for all "R" and "r" covered plants and animals in the MSCS Focus Area.			Status and trends of "R" and "r" species in MSCS Focus Area either through direct monitoring or via monitoring of habitats Possible research into protocols. Possible validation monitoring for species who are monitored through extent and connectivity of associated habitats.
RES	R2	Develop and begin implementation of a study to determine appropriate conditions for the germination and establishment of riparian woody plants along the Sacramento River and San Joaquin River. Complete development of a cooperative program to plant vegetation on unvegetated riprapped banks consistent with flood control requirements.			
RES	R3	Conduct a study to investigate the effects of the road through Olcott Lake on vernal pool hydrology and impacts on vernal pool species.			
RES	R4	Conduct instream flow studies to determine the flows necessary to support all life stages of anadromous and estuarine fish species.			
RES	R5	Conduct an investigation of in-channel structures that focuses on the following issues: (1) habitat suitability for both predator and prey fishes; (2) predator-prey interactions; and (3) recommendations for reducing predation on juvenile salmonids.			
RES	R6	Conduct experimental introductions of Sacramento perch into nontidal perennial aquatic habitats			
RES	R7	Assess the impact of hatchery practices on naturally spawning populations of chinook salmon and steelhead and operate hatcheries in a manner consistent with safe genetic practices that will maintain genetic integrity of all Central Valley anadromous salmonid populations.			

APPENDIX D: CALFED ERP Milestones (8a) and "terrestrial" related monitoring

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RES R8	Through the use of existing, expanded, and new programs, monitor adult anadromous salmonid returns to each watershed within the MSCS focus area. Monitoring techniques, data compilation and analysis, and reporting should be standardized among researchers and watersheds to the greatest extent possible.			

Appendix E - Part 1. Draft List of Sources of Information and Monitoring Programs identified to date as possibly relevant to the CALFED Terrestrial & Amphibious Monitoring Plan. Additional text on some programs is given in Appendix E-Part 2.

	Agency/ Organization	Acronym	Monitoring Program	Monitoring Information	Web Page	Text in App. E-2
1	Army Corps of Engineers	ACOE	Habitat Restoration Feasibility Studies	Ecological data	http://www.spk.usace.army.mil/civ/civ.html	X
2	Army Corps of Engineers	ACOE	Sacramento and San Joaquin River Basins Comprehensive Study	Topographic and bathymetric data for Sac. and SJR systems; habitat extent, GIS	http://www.spk.usace.army.mil/civ/ssj	X
3	Audubon		Audubon Christmas Bird Count	Mid-winter bird population data	http://birdsource.cornell.edu/	X
4	Avocet Research Associates for SF Bay NWR?		California Black and Clapper Rail Monitoring	Breeding surveys in SF Bay, more focused on North Bay		
5	CA Dept of Fish & Game	CDFG	Annual waterfowl counts	Waterfowl counts		X
6	CA Dept of Fish & Game	CDFG	Bank Swallow Monitoring	Studies and annual breeding population monitoring since 1996		
7	CA Dept of Fish & Game	CDFG	Greater Sandhill Crane Monitoring	Breeding and wintering ground studies and monitoring since 1978		
8	CA Dept of Fish & Game	CDFG	Little Willow Flycatcher Monitoring	Studies and monitoring since 1982		
9	CA Dept of Fish & Game	CDFG	Natural Diversity Data Base (NDDB)	Rare plants, animals, and natural communities, GIS data	http:///www.dfg.ca.gov/whdab/cnddb.htm	X
10	CA Dept of Fish & Game	CDFG	Riparian Brush Rabbit Monitoring	Population and genetics research and captive breeding program		
11	CA Dept of Fish & Game	CDFG	Suisun Marsh Monitoring Program - Waterfowl Counts	Waterfowl abundance surveys (monthly aerial surveys in winter on hunt days)		
12	CA Dept of Fish & Game	CDFG	Suisun Marsh Vegetation Survey	Annual Vegetation survey (aerial surveys and groundtruthing)		
13	CA Dept of Fish & Game	CDFG	Swainson's Hawk Monitoring	Population monitoring and ecological and telemetry studies since 1979		
14	CA Dept of Fish & Game	CDFG	Swainson's Hawk Monitoring	Population monitoring since 1983 in Yolo County		
15	CA Dept of Fish & Game	CDFG	Wildlife Habitat Relationships Database (CWHR)	Amphibians, reptiles, birds and mammals, and habitat types, GIS data	http://www.dfg.ca.gov/whdab/cwhr/whrintro.html	X
16	CA Dept of Fish & Game & Dept. of Water Resources	CDFG / DWR	Suisun Marsh Salt Marsh Harvest Mouse and Trapping	SMHM Conservation Areas and Trapping Annually		
17	CA Dept of Fish & Game-Wetlands Inventory & Conservation Unit	CDFG	Inventory and Assessment of Vernal Pool/Wetland Habitats in CA	Information on Vernal Pools and other wetlands through out CA, GIS	http://maphost.dfg.ca.gov/wetlands/	X

	Agency/ Organization	Acronym	Monitoring Program	Monitoring Information	Web Page	Text in App. E-2
18	CA Dept. of Food and Agriculture	CDFA	Integrated Pest Control Branch surveys	Weed surveys, classification of noxious weeds	http://www.cdfa.ca.gov/phpps/ipc/	X
19	CA Dept. of Water Resources	DWR	D-1485	monitors water quality, phytoplankton, zooplankton, and benthic organisms for compliance purposes		X
20	CA Dept. of Water Resources	DWR	California Irrigation Management Information System (CIMIS)	Climatological data at >100 stations in CA, data available electronically	http://wwwdpla.water.ca.gov/cgi-bin/cimis/main.pl	X
21	CA Dept. of Water Resources	DWR	Delta Atlas	Peat thickness estimates in Delta		X
22	CA Dept. of Water Resources	DWR	Delta Field Division informal Red-legged frog surveys	Only informal presence/absence		
23	CA Dept. of Water Resources	DWR	Division of Planning and Local Assistance Water Plan (Bulletin 160 Surveys)	Land use data	http://www.dpla.water.ca.gov/cd/landwateruse	X
24	CA Dept. of Water Resources	DWR	Municipal Water Quality Investigations Program (MWQI)	monitors water quality in Delta for minerals, turbidity, total and dissolved organic carbon, bromide, and MTBE.		X
25	CA Dept. of Water Resources	DWR	DWR Operations and Compliance water quality monitoring program	Monitors State Water Project water quality from upper Feather River, thru Delta, California Aqueduct, to s. California - temperature, nutrients, metals, bromide, dissolved organic carbon, pesticides		X
26	CA Dept. of Water Resources	DWR	Water and Environmental Monitoring Program	Flow, water quality (EC and temp.) data; available near real-time from CDEC	http://wwwdwr.water.ca.gov/dwrfloodupdate/Media_CDEC-gages-intro.html	X
27	CA Dept. of Water Resources - Northern District	DWR-Northern District	Sacramento River Riparian Habitat Program, Sacramento River Atlas Project	Orthophoto mosaic of the Sac River corridor from Red Bluff to Colusa, conceptual riparian habitat management plan	Webpage not up yet	X
28	CA Dept. of Water Resources and DFG	DWR/ CDFG	(AB360) Delta Levee Maintenance Subventions Program	Levee related habitat assessments in Delta and Suisun Marsh, GIS data	http://wwwdpla.water.ca.gov/cd/flood_gis/habitat.html	X
29	CA Dept. of Water Resources & U.S. Geological Survey	DWR/ USGS	Subsidence Research	Peat thickness and subsidence rates		X
30	Cal.Dept. of Pesticide Regulation	CDPR		Water quality		

	Agency/ Organization	Acronym	Monitoring Program	Monitoring Information	Web Page	Text in App. E-2
31	CALFLORA		CALFLORA database	Database of 8375 vascular plants, descriptions, location records	www.calflora.org	X
32	California Inland Invertebrate Work Group (multiple groups)		California Inland Invertebrate Work Group	Interests include FW and terrestrial insects, crustaceans, other inverts especially Threatened or Endangered	http://ice.ucdavis.edu/California_Inland_Invertebrate_Work_Group/	X
33	California Noxious Weed Control Projects Inventory (CNWCPI) Database (Multiple agencies)	CNWCPI	California Noxious Weed Control Projects Inventory (CNWCPI) Database	Who is controlling what weeds by what methods (database)	http://endeavor.des.ucdavis.edu/weeds	
34	California Partners in Flight, Point Reyes Bird Observatory & Partners	CPIF	California Partners in Flight	Standardize monitoring of Passerines	http://www.prbo.org http://www.rsl.psw.fs.fed.us/pif/	X
35	CALTRANS	CALTRANS	GIS group			
36	Central Valley Project Improvement Act	CVPIA	Section 7: land retirement, conservation program			
37	Cosumnes River Preserve & UC Davis		Cosumnes River Preserve	Vernal pool vegetation communities + contracts to monitor songbirds, rare plants on levees, giant garter snakes		
38	Cypress Grove Preserve		Heron and Egret Nest Monitoring	Monitoring on West Marin Island		
39	East Bay Municipal Utility District	EBMUD	Mokelumne River Watershed Wildlife Monitoring Program	Brush Rabbit, Foothill Yellow-legged Frog, Giant Garter Snake, Red-legged Frog, Swainson's Hawk, Willow Flycatcher	http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=5282	
40	Information Center for the Environment & partners	ICE	Maintains databases and metadatabases including · California Rivers Assessment Interactive Web Database · Consumnes Watershed Group · California Rivers Assessment · Natural Resource Projects Inventory (Watershed Projects Inventory, California Ecological Restoration Projects Inventory, California Noxious Weed Control Projects Inventory) · California Inland Invertebrate work group · Center for Ecological Health Research · And many others.		ice.ucdavis.edu	X
41	Information Center for the Environment (ICE) and US Man and Biosphere (USMAB)	ICE-USMAB	MAB Flora and MAB Fauna databases	Vascular plant and vertebrate animal data from biosphere reserves and other protected areas including state and national parks	http://ice.ucdavis.edu/mab/	X

	Agency/ Organization	Acronym	Monitoring Program	Monitoring Information	Web Page	Text in App. E-2
42	Information Center for the Environment, California Resources Agency	ICE-CARA	CA Rivers Assessment Interactive Web Database	CARA is both a database and a link to other environmental data sources, GIS	http://endeavor.des.ucdavis.edu/newcara/	
43	Interagency ecological Program - Suisun Marsh Vegetation Survey / Suisun Marsh Preservation Agreement (USBR, CDFG, DWR, SRCD)	IEP	Suisun Marsh Vegetation Survey	Monitorng changes in vegetation via GIS vegetation mapping using aerial photos, and on-the-ground vegetation surveys - greatest emphasis in Salt Marsh Harvest Mouse and Rail habitat		X
44	Jones and Stokes for Contra Costa, Los Vaqueros Reservoir	JSA	Los Vaqueros	Redlegged frog surveys and more?		
45	Marin Audubon Society		Petaluma Marsh Expansion Project - Marin County	fish and bird use (including San Pablo Song Sparrow, Black and California Clapper Rail), sedimentation, channel formation, and recolonization of vegetation	http://endeavor.des.ucdavis.edu/nrpi/WPIProjectDescription.asp?ProjectPK=5146	
46	Mosquito Abatement Districts			Research on vegetation (including wetlands) and mosquito management		X
47	National Oceanic and Atmospheric Administration	NOAA	National Geodetic Survey Federal Base Network	Geographical data	http://www.ngs.noaa.gov/	X
48	NOAA National Weather Service	NWS	Rain Gage Stations	Precipitation and river level gages; forecasts	http://www.ngs.noaa.gov/	X
48	Natomas Basin Conservancy?		Natomas Basin Habitat Conservation Plan			
49	Point Reyes Bird Observatory	PRBO	Birds-Central Valley riparian habitat surveys	Bird monitoring May-July Sac. River, SJR, and Consumnes	http://www.prbo.org	X
50	Point Reyes Bird Observatory	PRBO	Samuel's Song Sparrow in San Pablo Bay Marshes			
51	Point Reyes Bird Observatory, US Fish & Wildlife Service	PRBO/ USFWS	San Joaquin Restoration	Riparian Birds	www.prbo.org	
52	Point Reyes Bird Observatory, The Nature Conservancy, US Fish & Wildlife Service	PRBO/ TNC/ USFWS	Sacramento River Bird Conservation Project	Riparian Birds	www.prbo.org	
53	Reclamation Districts		Levee Maintenance Flood Fighting	Levee conditions, flooding		X
54	Riparian Habitat Joint Venture	RHJV		Bird monitoring - much done by PRBO	http://ceres.ca.gov/biodiv/newsletter/v6n1/riparian.htm	X

	Agency/ Organization	Acronym	Monitoring Program	Monitoring Information	Web Page	Text in App. E-2
55	Sacramento County		South Sacramento County Habitat Conservation Plan (HCP)			
56	Sacramento County Water Agency		Section 7			
57	Sacramento River Watershed Program	SRWP	Water Quality Monitoring & Benthic Invertebrates	Including the Sacramento River Toxic Pollutant Control Program & Other Tributary Monitoring	http://www.SacRiver.org/	X
58	San Francisco Bay Bird Observatory	SFBBO	Colonial Waterbird Monitoring	Breeding populations surveys and reproductive success in SF Bay		
59	San Francisco Bay Bird Observatory	SFBBO	Coyote Creek Land Bird Banding Program	Banding and other avian information on their sites on Coyote Creek	http://www.sfbbo.org/	X
60	San Francisco Bay National Estuarine Research Reserve				National Estuarine Research Reserve webpage: http://www.nos.noaa.gov/OCRM/nerr/	X
61	San Francisco Estuary Institute	SFEI	Bay Area EcoAtlas	Habitat, vegetation, and wildlife info, GIS	http://www.sfei.org/ecoatlas/index.html	X
62	San Francisco Estuary Institute	SFEI	Biological Invasions Program	Research on invasive species in the estuary	http://www.sfei.org/invasions.html	X
63	San Francisco Estuary Institute	SFEI	Regional Monitoring Program for Trace Substances	Obtain data on toxic trace elements and organic contaminates	http://www.sfei.org/rmp/Fact_Sheets/98factsheet.html	X
64	San Francisco Estuary Institute	SFEI	Wetland Regional Monitoring Progrm	In development -- wetlands in SF Bay		
65	San Joaquin County ?		San Joaquin County Habitat Conservation Plan			
66	San Joaquin Valley Endangered Species Program (CSU-Stanislaus)		Riparian Brush Rabbit and San Joaquin Woodrat Monitoring	Monitoring at Caswell Memorial State Park and other places		
67	Solano County		Solano County Habitat Conservation Plan (HCP)			
68	Solano County Water Agency		Section 7	mapping effort for county to lead into an HCP		
69	Team Arundo Del Norte (Multiple agencies)		Team Arundo Del Norte	Arrundo monitoring (selective?)	http://ceres.ca.gov/tadn/	X
70	The Nature Conservancy	TNC	Natural Heritage Program Conservation Data Center Network	Biological inventories, aerial photos, geographic and topographic data, restoration plans	http://www.tnc.org http://www.heritage.tnc.org/	X

	Agency/ Organization	Acronym	Monitoring Program	Monitoring Information	Web Page	Text in App. E-2
71	The Nature Conservancy	TNC	TNC Wildland Invasive Species Program	Web page database containing descriptions of weeds in nature reserves and wildlands, natural history, pictures and control information, 1998/1999 Weed Survey for US.	tncweeds.ucdavis.edu	X
72	U.C. Davis	UC Davis	Amphibian Surveys			X
73	U.C. Davis	UC Davis	Center for Ecological Health Research	Varied for different watersheds	http://ice.ucdavis.edu/cehr/	
74	U.C. Davis	UC Davis	Cosumnes Research Group	Coupled Hydrogeomorphic Ecosystem Model for the Cosumnes & Mokelumne Rivers	www.ice.ucdavis.edu/crg	
75	U.C. Davis	UC Davis	Putah-Cache Bioregion Project	Riparian inventory, biomonitoring, distribution and ecology of Putah Creek fishes, Wood Ducks, CA Quail Restoration	http://wdsroot.ucdavis.edu/clients/pcbr/default.html	X
76	U.C. Davis	UC Davis		Studies regarding contaminant effects on red-tailed hawks, kestrels and ospreys		
77	U.S. Dept. of Agriculture-Natural Resources Conservation Service	USDA-NRCS	1997 National Resources Inventory	Data on cover, soil use, prime farmland soils wetland, habitat diversity, selected conservation practices, etc	http://www.nhq.nrcs.usda.gov/CCS/NRIrlse.html **CA page**: http://www.ca.nrcs.usda.gov/nri/index.html	X
78	U.S. Dept. of Agriculture-Natural Resources Conservation Service	USDA-NRCS	Ecological Site Description (ESD) and Ecological Site Inventory (ESI)	Plant characteristics, communities, site interpretations, and physiographic info for forest and rangeland	http://plants.usda.gov/esis/index.html	X
79	U.S. Dept. of Agriculture-Natural Resources Conservation Service, Santa Barbara Botanical Garden	USDA-NRCS	National Plants Data Center - California County Occurrence (CACO) Information from Botanical Literature	county records of plant occurrence data	plants.usda.gov	
80	U.S. Dept. of Agriculture-Natural Resources Conservation Service	USDA-NRCS	Soil Survey Laboratory	Soil data	http://www.ca.nrcs.usda.gov/mlra/index.html	X
81	U.S. Dept. of Animal and Plant Health	APHIS	Dept. of Animal and Plant Health Inspection Service (APHIS)	Weed and pest monitoring	http://www.ceris.purdue.edu:80/napis/caps/index.html	X
82	U.S. Environmental Protection Agency	USEPA	Environmental Monitoring and Assessment Program (EMAP)	Data on fish, macroinverts, & habitat assessment from '94 on CV Streams	http://www.epa.gov/emap/html/remap/nine/	X

	Agency/ Organization	Acronym	Monitoring Program	Monitoring Information	Web Page	Text in App. E-2
83	U.S. Environmental Protection Agency	USEPA	National Estuaries Program SF Estuary		http://www.epa.gov/owow/estuaries/sfe.htm	X
84	U.S. Fish & Wildlife Service	USFWS	[Future] Red-legged frog monitoring			
85	U.S. Fish & Wildlife Service	USFWS	Harvest Information Program (HIP)	Bird info. (hunters report birds they shoot)		X
86	U.S. Fish & Wildlife Service	USFWS	International Shorebird Survey			X
87	U.S. Fish & Wildlife Service	USFWS	Invasive Exotic Species Strategic Plan			X
88	U.S. Fish & Wildlife Service	USFWS	July Duck Production Survey			X
89	U.S. Fish & Wildlife Service	USFWS	Monitoring Avian Productivity and Survivorship	Small land birds young/adult rations & adult survivorship		X
90	U.S. Fish & Wildlife Service	USFWS	Migration Monitoring Council - Monitoring with Checklists			X
91	U.S. Fish & Wildlife Service	USFWS	Mourning Dove Call-Count Survey			X
92	U.S. Fish & Wildlife Service	USFWS	Partners for Fish and Wildlife	Exotic species monitoring		X
93	U.S. Fish & Wildlife Service	USFWS	Refuge Monitoring	Exotic species monitoring		X
94	U.S. Fish & Wildlife Service	USFWS	Winter Surveys			X
95	U.S. Fish & Wildlife Service-Antioch Dunes National Wildlife Refuge	USFWS - refuges	Antioch Dunes Evening Primrose and Contra Costa Wallflower Monitoring	Annual populations counts of both species		
96	U.S. Fish & Wildlife Service-Antioch Dunes National Wildlife Refuge	USFWS - refuges	Lange's Matalmark Butterfly Monitoring	Annual population count of flying adults in summer on refuge		
97	U.S. Fish & Wildlife Service-San Francisco Bay National Wildlife Refuge Complex	USFWS - refuges	California Clapper Rail Monitoring in South SF Bay Marshes	Spring and winter population censuses		
98	U.S. Fish & Wildlife Service-San Francisco Bay National Wildlife Refuge Complex	USFWS - refuges	Western Snowy Plover Monitoring in South SF Bay (shorebird guild)	Population and reproductive success annual census		
99	U.S. Fish & Wildlife Service, and State Water Resources Control Board	USFWS / SWRCB	Phelan Island Restoration and Farming Project	Swainson's Hawk, Valley Elderberry Longhorn Beetle	http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=4603	

	Agency/ Organization	Acronym	Monitoring Program	Monitoring Information	Web Page	Text in App. E-2
100	U.S. Fish & Wildlife Service, Canadian Wildlife Service	USFWS ' CWS	May Breeding Waterfowl and Habitat Survey			X
101	U.S. Fish & Wildlife Service, U.S. Geological Survey, CA Dept. of Fish & Game	USFWS/ USGS/ CDFG	Colonial Waterbird Monitoring			X
102	U.S. Geological Survey	USGS	Amphibian Monitoring and Research Initiative	Measuring changes in distribution of amphibians nationwide by USGS scientists. New program	http://www.mp2-pwrc.usgs.gov/armi/index.cfm	X
103	U.S. Geological Survey	USFWS	Bird Banding Lab		http://www.pwrc.nbs.gov/bbl/default.htm (USGS)	X
104	U.S. Geological Survey	USGS	Breeding Bird Survey	Breeding bird surveys with trained volunteers nationwide		X
105	U.S. Geological Survey	USGS	Giant Garter Snake Monitoring			
106	U.S. Geological Survey	USGS	Hawk Migration Monitoring			X
107	U.S. Geological Survey	USGS	Marsh Bird Monitoring			X
108	U.S. Geological Survey	USGS	Migration Monitoring			X
109	U.S. Geological Survey	USGS	National Water Quality Assessment Program (NAWQA)	studies status and trends in water quality in Sacramento River Basin, San Joaquin Basin		X
110	U.S. Geological Survey	USGS	Night Bird Monitoring			X
111	U.S. Geological Survey	USGS	North American Amphibian Monitoring Program	Amphibian surveys with trained volunteers	http://www.mp2-pwrc.usgs.gov/naamp/	X
112	U.S. Geological Survey	USGS	Polaris	Monitors water quality in San Francisco Bay		X
113	Yolo County		Yolo County Habitat Conservation Plan (HCP)	Alkali Milk-vetch, Bank Swallow, California Yellow Warbler, California Yellow-billed Cucko, Crampton's Tuctoria, Giant Garter Snake, Swainson's Hawk, Valley Elderberry Longhorn Beetle	http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=3170	

Appendix E-Part 2: Descriptions of Terrestrial Monitoring Programs and Information Sources Relevant to CALFED

Environmental monitoring programs relevant to terrestrial baseline monitoring

Army Corps of Engineers
Sacramento and San Joaquin River Basins Comprehensive Study
The Comprehensive Study will develop a new master plan for flood management for the Sacramento and San Joaquin River systems. Implementation plans and programmatic EIS/EIRs will be completed by the end of Phase II in 2002. In development of the flood management plan, extensive topographic and bathymetric data describing the contour of existing land surface and river channels of the Sacramento and San Joaquin River basins are being collected. Hydrologic, hydraulic and Ecosystems Function Models (EFMs) are being developed. The EFM will be used to evaluate the effects of hydrologic and hydraulic changes on existing and potential aquatic wetland, and riparian habitats. The Comprehensive Study is supported by an extensive Geographic Information System (GIS) resource database assembled with existing information available from numerous agencies and commercial sources.

Army Corps of Engineers Habitat Restoration Feasibility Studies
The Army Corps of Engineers performs habitat restoration projects in the CALFED study area such as the Prospect Island Ecosystem Restoration Project, the Yolo Basin Wetlands, and the Cache Slough mitigation project. For these projects, the Corps performed habitat feasibility studies and post-project monitoring that may be of use to CALFED. Habitat feasibility studies and post-project monitoring may include elevation, vegetation and wildlife data.

Audubon Christmas Bird Count
Begun in 1900, each year the National Audubon Society holds a Christmas bird count throughout North America. It is the largest bird survey ever conducted with 50,000 participants covering 1800 count circles across the Western Hemisphere. The count in mid-winter serves as an important base line to assess the numbers and health of bird species.

California Department of Fish and Game: Annual Waterfowl Counts
DFG conducts three different waterfowl counts. Surveys of breeding populations are conducted in the spring. Aerial surveys are conducted throughout California. In the fall, there are periodic aerial surveys through portions of the Central Valley, though sampling sites and methods are not consistent from year to year. There is a midwinter waterfowl survey conducted in January. The midwinter waterfowl survey was used to establish Central Valley Habitat Joint Venture Goals. Data from the three surveys are not published on the web or in reports, but are available in database form from DFG.

California Department of Fish and Game: Natural Diversity Data Base
The Natural Diversity Data Base (NDDB) is a continually refined and updated, computerized inventory of location information on California's rarest plants, animals, and

natural communities. It is part of the nationwide Natural Heritage Network established by The Nature Conservancy. NDDB data are organized geographically and taxonomically. Information can be retrieved by taxa or by United States Geological Survey (USGS) map sheet (1:24,000, 1:62,500, 1:100,000 or 1:250,000 scale).

California Department of Fish and Game: Suisun Marsh Monitoring Program Annual Waterfowl Counts

The Department of Fish and Game Wildlife Management Division conducts waterfowl abundance surveys in Suisun Marsh to fulfill the Suisun Marsh Monitoring Agreement and Suisun Marsh Preservation Agreement. DFG does monthly aerial surveys of Suisun Marsh from September through January. They fly on Wednesdays, which are hunt days, because on those days the ducks tend to congregate in the refuge areas and are therefore easier to count. Because of this "clumping" of the birds, they do not fly the entire marsh -- they go "where the birds are".

California Department of Fish and Game: California Wildlife Habitat Relationships Database

California Wildlife Habitat Relationships (CWHR) is a comprehensive information system for California wildlife. Information on 675 species of amphibians, reptiles, birds, and mammals and 59 habitat types are included in CWHR. The information is produced as predictive computer habitat relationships models, GIS data and supporting publications. CWHR is a predictive model. It lists species predicted to occur in a given location under certain habitat conditions. It also predicts the suitability of those conditions for breeding, cover and feeding for each modeled species. CWHR includes terrestrial vertebrates only.

California Department of Fish and Game – Wetlands Inventory and Conservation Unit.

Has inventory and assessment of Vernal Pool Habitats in California
http://maphost.dfg.ca.gov/wetlands/

California Department of Food and Agriculture: Integrated Pest Control Branch

DFA conducts detection surveys throughout California for noxious weeds. DFA classifies weeds depending upon their impact on agriculture and their susceptibility to control or eradication. For weeds that DFA is most concerned about and for which control or eradication is feasible, DFA regularly returns to survey sites along with county agricultural departments to gauge progress and continue treatments.

California Department of Water Resources: D-1485

The D-1485 program is a DWR program to monitor water quality, phytoplankton, zooplankton and benthic organisms to comply with DWR's water right. Approximately 28 sites are sampled for different combinations of water quality, phytoplankton, zooplankton and benthic organisms. Eleven sites are sampled by boat on a monthly basis and 8 sites are sampled from land-based stations that sample continuously. This data is used for program compliance and is made available to other researchers in the Delta as part of the Interagency Ecological Program. Special studies such as investigations of dissolved oxygen sag conditions in the Stockton Ship Channel are also a part of the program. Annual reports and special studies reports are produced regularly.

California Department of Water Resources: California Irrigation Management Information System (CIMIS)

CIMIS is a repository of climatological data collected at more than 100 computerized weather stations located in many areas of California. CIMIS helps agricultural growers and turf managers administering parks, golf courses and other landscapes to develop water budgets for determining when to irrigate and how much water to apply. Weather data is collected from each weather station site and automatically transmitted to a central computer located in Sacramento. Based on the weather data, the CIMIS computer estimates the amount of water evaporated from the soil and the amount used by irrigated grass (transpiration) at the weather station site. This combined value for pasture grass is called "reference evapotranspiration" or "ETo". Changes in ETo can be used as a guide to changes in crop or landscape water use. Using a conversion factor(s) and ETo, water use by a given crop or landscape can be estimated. These conversion factors are called crop coefficients (Kc).

California Department of Water Resources Delta Atlas

Published by DWR, the 1993 Delta Atlas has peat thickness estimates throughout the Delta.

California Department of Water Resources: Land Use Data

Since 1950, DWR has conducted over 250 land use surveys. These surveys locate and quantify agricultural land use by specific crops by water source and crop groups, general urban development, and wetlands. Counties are surveyed on a rotating schedule every several years. Counties with large amounts of irrigated agricultural acreage are surveyed about every five to seven years; counties that are primarily urban and those with less agricultural development are surveyed less often. For non-survey years, DWR Land and Water Use Analysts estimate annual land use acreage using information available from other sources. Information collected by the regular surveys is used to develop the estimates of present and future water demands for the California Water Plan Update (DWR Bulletin 160 series). DWR land use data are useful for other purposes including studies estimating groundwater use, routing of agricultural water supplies, depletion of water supplies, agricultural drainage, agricultural water quality, identifying wetlands, water transfer potential, and urban encroachment. In 1992, DWR began using geographic information system (GIS) technology for the land use survey program to replace the traditional cut-and-weigh method of estimating land use acreage.

California Department of Water Resources: Municipal Water Quality Investigations Program (MWQI)

The Municipal Water Quality Investigations Program is a DWR program to determine and evaluate the sources of contaminants that affect the drinking water quality of the Sacramento-San Joaquin Delta. Fifteen stations in the Delta are sampled at least monthly for minerals, turbidity, total and dissolved organic carbon, bromide, and MTBE (an organic drinking water contaminant). Other analyses such as total trihalomethane formation potential and coliform analyses are also conducted on a more infrequent basis. The program is coordinated with water agencies that receive State Water Project water. Annual reports and special study reports are produced regularly.

California Department of Water Resources: Operations and Compliance Monitoring

The DWR Operations and Compliance water quality monitoring program monitors SWP water quality from the upper Feather River watershed through the Delta, along the California Aqueduct to terminal reservoirs in southern California. The program ensures that DWR maintains its contract to deliver water that meets Article 19 objectives. Standard water quality parameters such as temperature, specific conductance as well as nutrients, metals, bromide, dissolved organic carbon and pesticides are analyzed. Sampling frequencies range from hourly (at 20 automated stations) to monthly and seasonal. Results are available on a DWR web page, in a monthly report, and in a DWR biennial report.

California Department of Water Resources Water and Environmental Monitoring Program

DWR maintains a network of flow and water quality (specific conductance and temperature) recorders throughout the State. The data are telemetered to the California Data Exchange Center maintained by DWR.

California Department of Water Resources: Sacramento River Riparian Habitat Program (Northern District) - Sacramento River Atlas Project

For this program, DWR is preparing an orthophoto mosaic of the entire Sacramento River corridor from Red Bluff to Colusa. This project utilizes high resolution aerial photos (1:12,000) flown in May of 1997. Mosaics will soon be available for the reach from Red Bluff to Highway 32. The remaining portions will be completed as soon as possible. A Fisheries and Riparian Habitat Management Plan was developed by the Sacramento River Advisory Council after more than 50 lengthy meetings and workshops to address fisheries and riparian habitat concerns along the river. The report includes a specific and action-oriented fisheries plan addressing both the mainstem and tributaries, and a conceptual riparian habitat management plan for the mainstem.

California Department of Water Resources (AB360) Delta Levee Maintenance Subventions Program

The Levee Subventions program is administered by the California Departments of Water Resources and Fish and Game to work with reclamation districts to restore and create diverse aquatic and terrestrial habitats associated with levee maintenance and improvement projects within the jurisdictional Delta and a portion of eastern Suisun Marsh. This program has habitat assessments where levee work may occur for many properties in the Delta and Suisun Marsh. The Program has data on the location and extent of invasive plants associated by levees in the Delta.

A comprehensive levee related habitat assessment is required before levee repairs or improvements can be undertaken by reclamation districts. The assessments provide a basis for determining project impacts to special status species and to fish and wildlife habitats. The assessments may also be used to assist DFG, DWR, and reclamation districts in locating preferred sites for habitat improvements along a levee associated with a levee project. Districts and DFG are updating and conducting habitat assessments along the levee alignments within the program area and have been integrating this information into a geographic information system (GIS).

California Department of Water Resources/USGS Subsidence Research

For ongoing research on peat thickness and subsidence rates, the DWR and USGS are conducting studies to determine the effect of three different water management practices on carbon inputs and outputs and subsidence on Twitchell Island in the western Delta. The water management practices which are being considered in the plans for the development of wetlands on Twitchell and other Delta islands are (1) seasonal flooding from early fall through winter; (2) flooding from early fall through winter and irrigating twice during the summer and (3) permanent shallow (about 1 foot) flooding. The carbon inputs and outputs were measured for each site. Carbon is output as methane (CH_4) and carbon dioxide (CO_2). Carbon is input as decaying plant material. In cooperation with CALFED, a GIS was used to integrate data for historic land-surface elevation changes and peat depths to delineate priority areas for future subsidence data collection and subsidence mitigation. A CALFED category 3 project started in 2000 will examine the potential for restoring land-surface elevations using sediment transported onto Twitchell Island from the San Joaquin River.

CALFlora

This database contains and continues to update various types of data--herbarium specimen records, species lists compiled by professional botanists for known locations, rare plant occurrences documented by the **Natural Diversity Database**, checklists for nature preserves, parks and other geographic areas, and plot species lists from sampling projects carried out by land management agencies. http://www.calflora.org

California Noxious Weed Control Projects Inventory (CNWCPI) Database

The California Interagency Noxious Weed Coordinating Committee is a group of sixteen State and Federal agencies meeting quarterly, in conjunction with stakeholders, to coordinate activities with respect to noxious weed control. The group is creating an Internet accessible database, which will act as a clearing-house for noxious weed control projects in California. The database will contain information on who is controlling which noxious weeds in California and what methods they are using. This information will be searchable by keywords.

California Inland Invertebrate Work Group

The California Inland Invertebrate Work Group is a group of individuals from the academic, public, private and regulatory sectors whose purpose is to foster communication of technical information related to the ecology, distribution, and

management of California's inland invertebrates. The groups interests include freshwater and terrestrial insects, crustaceans and other invertebrates, especially those recognized as candidates or as Threatened or Endangered by the California Department of Fish and Game and the U. S. Fish and Wildlife Service. Fairy and tadpole shrimp are currently a major focus. Richard Hill voice : (916) 653-8417 e-mail : rehill@ix.netcom.com,
http://ice.ucdavis.edu/California_Inland_Invertebrate_Work_Group/

California Partners in Flight/Aves de las Americas

Partners in Flight is an international network of ornithologists, birders, environmental educators, land managers, academic institutions, government agencies, and nongovernmental organizations working together to enhance bird populations. The focus of Partners in Flight (PIF) began with 255 species of landbirds that breed in the U.S. and Canada and spend the winter south of the U.S. border and has expanded to include 800+ species of birds, including waterfowl, shorebirds, colonial waterbirds, and sea birds. There is an extensive network of monitoring stations throughout the Americas. (See also Point Reyes Bird Observatory and Riparian Habitat Joint Venture)

Information Center for the Environment (ICE)

A "*cooperative effort of environmental scientists at the University of California, Davis and collaborators at over thirty private, state, federal, and international organizations interested in environmental protection." (http://ice.ucdavis.edu/)* This group has compiled numerous databases and metadatabases potentially useful to CALFED. Among them are

- California Rivers Assessment Interactive Web Database
- Consumnes Watershed Group
- California Rivers Assessment
- Natural Resource Projects Inventory (Watershed Projects Inventory, California Ecological Restoration Projects Inventory, California Noxious Weed Control Projects Inventory)
- California Inland Invertebrate work group
- Center for Ecological Health Research
- And many others.

Information Center for the Environment and U.S. Man and the Biosphere

(U.S. MAB) Program - MABFlora (for vascular plants) and MABFauna (for vertebrate animals) databases: information collected on the world's biosphere reserves and other protected areas (including CA's national and state parks), continually updated.
http://ice.ucdavis.edu/mab/

Interagency Ecological Program: Suisun Marsh Vegetation Survey

The Survey includes a vegetation map based on collected field data and analysis which will be updated as necessary. A Vegetation Sampling Protocol was developed by the California Native Plant Society (CNPS) Vegetation Committee. Although the sample allocation protocol used in this project stresses representation of all forms of vegetation in the project area, particular attention is given to SMHM set-aside areas and known

Clapper Rail sites. These sites are allocated additional vegetation samples to assist in monitoring the correlations between vegetation dynamics and population data collected in on-going studies in the areas. The field collected vegetation data are entered into the California Vegetation Information System (CVIS), a database designed specifically to archive vegetation plot data. This database accommodates all information recorded at field sampling locations, including impacts, abiotic environmental data, and ecological information.

Mosquito Abatement Districts

The mosquito abatement districts regulate open water throughout California and manage mosquito populations. Also, in association with the University of California, they conduct research on vegetation (including wetlands) and mosquito management.

National Oceanic and Atmospheric Administration: National Geodetic Survey Federal Base Network

The National Geodetic Survey (NGS), an office of NOAA's National Ocean Service, coordinates a network of continuously operating reference stations (CORS) that provide Global Positioning System (GPS) carrier phase and code range measurements in support of 3-dimensional positioning activities throughout the United States and its territories.

National Oceanic and Atmospheric Administration: National Weather Service Rain Gage Stations

The California-Nevada River Forecast Center (CNRFC) is a field office of the National Weather Service (NWS) located in Sacramento, California. The NWS is an agency of the National Oceanic Atmospheric and Administration (NOAA) under the United States Department of Commerce. The CNRFC receives data from more than 700 precipitation and gages and 275 river level gages. In addition, associated Weather Forecast Offices provide continuous hydrometeorological data assimilation, river basin modeling, and hydrologic forecast preparation.

Point Reyes Bird Observatory – Central Valley riparian habitat surveys

This program monitors birds in Central Valley riparian habitat to assess the overall health of these bird populations. Thirteen principal sites along the Sacramento River, the San Joaquin River and Cosumnes River upstream of the Delta are monitored. Most of the monitoring takes place during the avian breeding season, May through July, although other periods are sampled as well. Many avian indices including bird species richness, bird species diversity, absence or presence of certain riparian species, reproductive success, avian productivity and absolute abundance of breeders are monitored. There is no overall annual report, but specific reports are prepared for different agencies for each area. For example, an annual report for the Lower Sacramento River Area is prepared for The Nature Conservancy and the Sacramento National Wildlife Refuge. White papers are produced for the general public and papers are published in scientific literature.

Reclamation Districts
Reclamation districts have authority for both maintenance of levees and flood fighting. See DWR Delta Levee Subventions Program for more information.

Riparian Habitat Joint Venture
The Riparian Habitat Joint Venture (RHJV) goal is to double the existing riparian habitat which is providing effective habitat for resident and migratory landbirds, and to enhance 25% of the habitat which is now considered degraded. The plan is to implement a layered strategy to achieve the larger, statewide goal by 2008. The strategy begins with the development of conservation plans for the riparian obligate species that the RHJV has determined are the highest priority. The conservation plans will be written by a cadre of species and habitat experts, detailing the best information available to date on each of the priority species. The plans will include information on where populations are extinct, where they have recently been lost, and where they might easily be re-established. Habitat parameters necessary for successful breeding will be delineated and management strategies will be established. The information will be used by regional working committees to develop priority sites for restoration, acquisition and enhancement. The RHJV will work with established partnerships, and public and private landowners to develop, fund and implement a network of functional riparian corridors throughout the state.

Sacramento River Watershed Program
The Sacramento River Watershed Program is a stakeholder-driven effort to restore and protect beneficial uses of the Sacramento River Basin. Stakeholders include representatives of local municipalities and districts, local watershed conservancies, state and federal agencies, water districts, agriculture, mining, forest products, environmental organizations, landowners, universities, and technical consultants. The first-year monitoring effort (1997) is comprised of regular monitoring events (monthly, semi-annual, and/or annual) at over sixty sites on the Sacramento main stem, major tributaries, and selected smaller tributaries. The program is coordinated with many monitoring programs including the USGS National Water Quality Assessment project for the Sacramento River (see NAWQA description). http://www.SacRiver.org/ Monitoring Program run by Tom Grovhoug, Larry Walker & Associates.

San Francisco Bay Bird Observatory – Coyote Creek Land Bird Banding Program and many other bird banding programs including seabirds and shorebirds of the bay. Janet Hanson is the Executive Director. http://www.sfbbo.org/

San Francisco Bay National Estuarine Research Reserve (proposed)
The Estuarine Research Federation is an active organization, supported primarily by dedicated and hard-working volunteers that produces the journal Estuaries. In their newsletter, they reported that they support the Marine Conservation Biology Institute's proposal for a "Long Term Marine Conservation Biology Research and Monitoring Program from Exxon Valdez Restoration Reserve Funds."

San Francisco Estuary Institute: Bay Area EcoAtlas

The Bay Area EcoAtlas is a Geographic Information System of past and present local ecology of the bays, baylands, and adjacent habitats of the San Francisco Bay Area. It is designed to support regional environmental planning and management. The EcoAtlas was developed with a wide selection of database, GIS and graphics software on multiple operating systems functioning in a collaborative mix of science, government and public participation. The Atlas is also a spatial template to view possible scenarios for environmental management in the future, and a geographic index for spatially-related data and their sources. The EcoAtlas is currently being used to support the San Francisco Estuary Baylands Ecosystem Goals.

San Francisco Estuary Institute: Biological Invasions Program

The Biological Invasions Program conducts scientific and policy research on the introduction of exotic species into marine and freshwater ecosystems. The research program is directed toward five objectives: (1) Understanding how factors in the environment affect the success of invasions. (2) Assessing the impacts of invasions. (3) Assisting efforts to prevent future invasions through research on the nature and control of mechanisms responsible for introducing exotic species. (4) Developing effective regional monitoring programs to identify new invasions and track the spread of exotic species. (5) Prioritizing and assessing efforts to control exotic species.

San Francisco Estuary Institute: Regional Monitoring Program for Trace Substances

The RMP is designed to obtain data describing the concentration of toxic trace elements and organic contaminants. Ultimately, the RMP will provide information on how contaminant concentrations in the Estuary are responding to pollution prevention and reduction measures and thus if the financial resources devoted to these efforts are improving water quality. http://www.sfei.org/rmp/Fact_Sheets/98factsheet.html

The Regional Monitoring Program monitors contaminant concentrations in water, sediments and fish and shellfish tissue in San Francisco Bay and Delta. Samples are taken three times a year: during the rainy season (March-April), during a period of declining Delta outflow (May-June) and during the dry season (August-September) to capture seasonal variability of the system. There are 24 sampling stations located throughout the Estuary and at its major tributaries. The program also utilizes data from USGS water quality and phytoplankton data collected monthly (see USGS Polaris program description) and USGS suspended sediment measurements. Annual reports and special studies reports are produced regularly.

Team Arundo Del Norte

Team Arundo del Norte is a partnership that is dedicated to the reduction and eventual elimination of Arundo donax (Giant Reed), where it threatens rivers, creeks and wetlands in Central and Northern California. The team is comprised of representatives from several public agencies, private organizations, and academia. Among the entities represented in the group are the San Francisco Estuary Institute, the California Department of Water Resources, the Sonoma Ecology Center, the U.S. Environmental Protection Agency, and the California Department of Fish and Game. During its early meetings, the team identified several areas of focus including public education efforts, the development of scientific and technical information related to giant cane spread and control, and the need for coordinated efforts related to funding and information exchange.

The Nature Conservancy – Natural Heritage Program and Conservation Data Center Network

The Nature Conservancy is committed to biodiversity protection based on sound science. The Conservancy's goal is the long-term survival of all viable native species and community types through the design and conservation of portfolios of sites within ecoregions. Conservancy scientists and stewardship staff conduct detailed field inventories and prepare management plans based on the biological requirements of the species and ecological communities found there; they also employ aerial photography and other geographic and topographic data to understand the surrounding ecological matrix. They draw on experts in such fields as biohydrology, invasive weeds management, and fire management to help them design strategies that take into account, for example, a region's water recharge requirements or the need for prescribed burns to rejuvenate an ecosystem. To understand what species, ecological communities, and ecosystems are most threatened, the Conservation Science programs helped create a network of databases called the Natural Heritage Program and Conservation Data Center Network.

The Nature Conservancy – Wildland Invasive Species Program

The Nature Conservancy has a web page giving descriptions of the weeds in nature reserves and wildlands as well as pictures, habitat, natural ecology, and control methods. 1998/1999 Weed survey for US -- reports available: weed reports, animal pest reports, state weed woe reports (weed and control methods), and state weed reports. (http://tncweeds.ucdavis.edu/esadocs.html),

University of California at Davis: Amphibian Surveys

Dr. Shaffer has conducted surveys of amphibians 1) throughout the central valley, including the San Joaquin, the Sacramento, the inner coast range valleys, and the Sierra foothills, 2) intensively in the Carmel Valley/Salinas area, 3) intensively in Sonoma County, 4) fairly intensively in central and southern Mendocino County, particularly along the coast. There is no definite schedule for future sampling, though sampling is likely to continue.

University of California at Davis: Putah-Cache Bioregion Project:

Biomonitoring, Peter B. Moyle - Riparian Inventory and Biomonitoring Program (also Distribution and Ecology of Putah Creek Fishes, Wood Duck Study, California Quail Restoration Study, Feral House Cat Ecology Study)

U.S. Department of Agriculture: Natural Resources Conservation Service

1997 National Resources Inventory (NRI): It captures data from 800,000 statistically selected locations on cover, land use, soil erosion, prime farmland soils, wetlands, habitat diversity, selected conservation practices, and other natural resource

information. The information is statistically reliable for national, statewide, and multi-county use. http://www.nhq.nrcs.usda.gov/CCS/NRIrlse.html,
CA page : http://www.ca.nrcs.usda.gov/nri/index.html

U.S. Department of Agriculture: Natural Resources Conservation Service – two resources: Ecological Site Description (ESD) and Ecological Site Inventory (ESI). ESD: Site characteristics, plant comminutes, site interpretations (management), and support info for forestland and rangeland. ESI: Plant info and some physiographic info for rangeland and forestland. http://plants.usda.gov/esis/index.html

U.S. Department of Agriculture: Natural Resources Conservation Service – National Plants Data Center: California County Occurrence Information from Botanical Literature, CACO is a cooperative project between SBBG (Santa Barbra Botanical Garden) and the USDA NRCS(Nat. Res. Conserv. Sci.) PLANTS Data Center. They develop this database, but it is available only (and partially) through USDA PLANTS (plants.usda.gov). They currently have about 90,000 county records entered from over (currently) 900 publications. The current USDA version is about 1 year old and includes ca. 65,000 county records and ca. 650 literature citations. Last on webpage: http://elib.cs.berkeley.edu/calflora/occ/about-data.html

U.S. Department of Agriculture: Natural Resources Conservation Service – Soil Survey Laboratory

The database of the Soil Survey Laboratory (SSL), National Soil Survey Center, currently contains analytical data for more than 20,000 pedons of U. S. Standard morphological pedon descriptions are available for about 15,000 of these pedons. Partial data for pedons currently being analyzed may be unavailable. Soil fertility measurements, such as those made by Agricultural Experiment Stations, were not made. Most of the data were obtained over the last 40 years. About 3/4 of the data is less than 20 years old. Analytical data for most of the pedons are fairly complete, according to the prevailing view of the research and characterization needs when the pedon was sampled. Generally, the kinds of analyses have increased over time.

US Dept. of Animal and Plant Health Inspection Service (APHIS)

To monitor plant pests, APHIS' Plant Protection and Quarantine (PPQ) works with the States in a project called the Cooperative Agricultural Pest Survey. Survey data on weeds, insects, and plant diseases and pests are entered into a nationwide database, the National Agricultural Pest Information System (NAPIS). This database can be accessed from anywhere in the country by persons with an authorized account.

NAPIS data can assist pest forecasting, early pest warning, quicker and more precise delimiting efforts, and better planning for plant pest eradication or control efforts. NAPIS contains survey data files as well as text and graphics files. The data can be downloaded and analyzed with geographic information systems (GIS) to provide graphic representation of information.

The Cooperative Agricultural Pest Survey (CAPS) is a combined effort by Federal and State agricultural organizations to conduct surveillance, detection, and monitoring of agricultural crop pests and biological control agents. Survey targets include weeds, plant diseases, insects, nematodes, and other invertebrate organisms. Components of the program include (1) survey, detection, and identification activities in the field and the laboratory; (2) State level databases; (3) a National database - the National Agricultural Pest Information System (NAPIS); and (4) electronic information exchange systems.

US Environmental Protection Agency: Environmental Monitoring and Assessment Program (EMAP)

The Environmental Monitoring and Assessment Program (EMAP) is a research program to develop the tools necessary to monitor and assess the status and trends of national ecological resources. EMAP's goal is to develop the scientific understanding for translating environmental monitoring data from multiple spatial and temporal scales into assessments of ecological condition and forecasts of the future risks to the sustainability of natural resources

The EMAP National Inventory presents the 34 national research and monitoring programs that comprise the majority of the federal environmental monitoring budget. Programs are organized by sampling design into three tiers recognized by the National Environmental Monitoring Initiative.
Inventories and Remote Sensing Programs: Coastal Change Analysis Program, Gap Analysis Program, Multi Resolution Land Characteristics and National Wetlands Inventory. National and Regional Surveys: Breeding Bird Survey, Clean Air Status and Trends Network, Forest Health Monitoring, Forest Inventory and Analysis, National Atmospheric Deposition Program/ National Trends Network, National Air Monitoring Stations/ State and Local Monitoring Stations, National Stream Gaging Network, National Water Quality Assessment Program, National Resources Inventory, National Status and Trends (Mussel Watch Program), Photochemical Assessment Monitoring Stations, Remote Automatic Weather Stations, Snowpack Telemetry. Intensive Monitoring and Research Sites: Acid Rain Watersheds, Agricultural Research Service Water Database, Forest Service Experimental Forest and Rangeland Sites, Land Margin Ecosystem Research, Long Term Ecological Monitoring and Research, Man and the Biosphere Reserve Program, National Stream Quality Accounting Network, Coastal Ocean Program, National Estuarine Research Reserve, National Marine Fisheries Service, National Marine Sanctuary Programs, Benchmark Network, Water, Energy, and Biogeochemical Budgets.

US Environmental Protection Agency: National Estuaries Program San Francisco Estuary

The National Estuary Program was established in 1987 by amendments to the Clean Water Act to identify, restore, and protect nationally significant estuaries of the United States. Unlike traditional regulatory approaches to environmental protection, the NEP targets a broad range of issues and engages local communities in the process. The program focuses not just on improving water quality in an estuary, but on maintaining the integrity of the whole system --its chemical, physical, and biological properties, as well as its economic, recreational, and aesthetic values.

Stronger planning, improved regulation and increased acquisition and restoration are the main thrust of 12 wetland management actions called for in the San Francisco Estuary Project's (SFEP) long-term management plan. One element, the setting of goals for what types of wetlands are necessary where and in what quantities to maintain the ecosystem's health, will provide the biological foundation for the regional wetlands management plan.

<u>US Fish & Wildlife Service Invasive Exotic Species Strategic Plan</u>

The National Strategy for Invasive Plant Management outlines a nationwide effort to stem the tide of potentially invasive plants arriving in the United States; to control or eradicate those that are already a problem; and to restore full function to our degraded agricultural lands, rangelands, forests, and ecosystems. This Strategy proposes three National Goals: Prevention, Control, and Restoration. The Fish and Wildlife Service is committed to the prevention and control of invasive species on all Service-managed lands and waters and is working with private landowners and other partners to help control invasive species nationwide.

<u>US Fish & Wildlife Service Refuge Monitoring (Exotic Species Monitoring)</u>

USFWS refuges inventory flora and fauna on the refuges. Refuge managers are tasked with restoring and rehabilitating the refuge. The managers then monitor the success of their rehabilitation efforts.

<u>US Fish & Wildlife Service: Partners for Fish and Wildlife</u>

The Partners for Fish and Wildlife program, conducted since 1987 by the U.S. Fish and Wildlife Service, restores important fish and wildlife habitats on private lands. This program has been successfully carried out through the cooperation of landowners, who voluntarily offer drained wetlands and degraded uplands for restoration. With this voluntary arrangement, habitats are restored at no cost for participating landowners who agree to protect their restored wetlands and uplands for a minimum of 10 years. The program requires a monitoring program.

<u>US Fish & Wildlife Service Bird Monitoring</u>

The Office of Migratory Bird Management undertakes a number of surveys in conjunction with the U.S. Fish and Wildlife Regional Offices, the Canadian Wildlife Service, and State and Provincial wildlife-management agencies. Some of these are listed below, along with other surveys by other organizations.

<u>US Fish & Wildlife Service: Harvest Information Program (HIP)</u>

Hunters report the birds that they shoot.

US Fish & Wildlife Service: July Duck Production Survey
In July a portion of the lines surveyed in May during the Breeding Waterfowl Survey are surveyed to obtain information on duck production. These counts yield measures of duck production and give an idea of the timing of nesting chronology for the year, assess water body abundance, and result in a qualitative assessment of July habitat conditions. The July brood counts are not adjusted for visibility bias and thus provide only a relative index rather than a direct estimate. The July Duck Production Survey is helpful in predicting the number of ducks to be expected during the Fall hunting season.

US Fish & Wildlife Service: May Breeding Waterfowl and Habitat Survey
Each May and June the Canadian Wildlife Service and the U.S. Fish and Wildlife Service survey breeding waterfowl from the north-central U.S. throughout Canada and Alaska. Survey biologists estimate numbers and species from airplanes flown along transects. A portion of the transects are then surveyed from the ground by biologists who census all waterfowl. The ground census corrects for birds not counted by the aerial team. This survey is the most extensive wildlife survey in the world, and its results are a major factor used in setting annual duck-hunting regulations. Excellent survey data exist in the form of graphs for mallards, gadwall, American wigeon, green-winged teal, blue-winged teal, northern shoveler, northern pintail, redhead, canvasback, and scaup.

US Fish & Wildlife Service: Winter Surveys
Many geese and ducks can't be counted in the spring and summer on breeding areas because they either can't be surveyed using airplanes or they nest in remote and inaccessible Arctic areas. Abundance indices for these species are obtained from surveys on wintering areas. Most of these surveys are targeted at specific species or populations. A nationwide effort to survey all waterfowl is conducted annually in January. This, the Midwinter Survey, provides information on population trends for some species, distribution on the wintering grounds, and habitat use.

US Fish & Wildlife Service: Mourning Dove Call-Count Survey
The Mourning Dove Call-Count Survey was developed to provide an index to population size and to detect annual changes in mourning dove breeding populations in the U.S. The survey consists of numerous routes throughout the U.S., which are surveyed in late May and early June. The resulting estimates of relative abundance and population trends comprise the principal information used in the annual setting of mourning dove hunting seasons.

US Fish & Wildlife Service: Colonial Waterbird Monitoring
Colonial waterbirds include a wide variety of species that nest in colonies, ranging from freshwater wading birds such as herons and egrets to seabirds such as murres and puffins. Numerous colonial waterbird surveys have been conducted since the early 1970s by various Federal, State, and private agencies. However, little effort has been made to standardize the collection and storage of the data. Recommendations for a standard monitoring protocol are found at the colonial-nesting waterbird site. The ultimate goal is to develop a national database.

US Fish & Wildlife Service: International Shorebird Survey
The ISS was organized by the Manomet Observatory in 1974 to gather standardized information on the numbers of shorebirds congregating at migratory stopover sites in the spring and fall.

US Fish & Wildlife Service: Monitoring Avian Productivity and Survivorship
This monitoring scheme, developed by the Institute for Bird Populations, provides demographic information such as young/adult ratios and adult survivorship for a variety of small land birds. Its goal is to assess the underlying causes of bird population trends detected by surveys such as the Breeding Bird Survey. The Fish and Wildlife Service provided funding for the initial development of MAPS.

US Fish & Wildlife Service: Migration Monitoring Council -- Monitoring with Checklists
Many bird species are regular migrants through the continental United States but, because they nest at high latitudes or winter in the tropics, are not well covered by any of the existing bird-monitoring schemes. To fill that void, the Migration Monitoring Council has developed a protocol for monitoring bird population changes using checklists.

US Fish & Wildlife Service, US Geological Survey: Colonial Waterbird Inventory and Monitoring Program
The USFWS, USGS-BRD, and state agencies are collaborating to create a system of periodic inventories of colonial waterbirds in the U.S. An effort will be made to complete a thorough census of colonial waterbirds in each state on a 5-10 year rotating basis. Data are being stored in a standardized and consolidated database, making data from all states available and in the same format. Data collection has begun on the East Coast and will move westward in the following years.

US Geological Survey: Amphibian Monitoring and Research Initiative (ARMI)

ARMI is a program begun in 1998 whose primary objective is to initiate long-term monitoring to determine trends in amphibian populations and conduct research into causes of amphibian declines and malformations. Initially the primary focus is on Department of Interior (DOI) and federal lands while providing a framework for incorporating data from non-federal lands. Pilot projects are proceeding forward in testing statistically robust Percent Area Occupied protocols and developing a nationwide database and reporting structure. Unlike the North American Amphibian Monitoring Program (NAMP- described below) which uses trained volunteers, this effort is primarily conducted under the direct supervision of USGS scientists. http://www.mp2-pwrc.usgs.gov/armi/index.cfm

U.S. Geological Survey: Bird Banding Lab
Every year the U.S. Fish and Wildlife Service, the Canadian Wildlife Service and State and Provincial wildlife management agencies band about 300,000 migratory game birds. Management agencies, ornithological institutions, researchers, and private individuals also band approximately 700,000 nongame birds annually. These banded

birds and their recoveries are an important data source used in the management of migratory birds. The Bird Banding Laboratory (BBL) of the U.S. Geological Survey and the Banding Office of the Canadian Wildlife Service jointly manage the bird-banding program in North America. Analysis of banding data allows calculation of important population parameters such as survival rates and harvest rates.

US Geological Survey: North American Breeding Bird Survey (BBS)

The Breeding Bird Survey (BBS), a roadside survey designed to monitor population trends of land birds, was initiated by the Fish and Wildlife Service on an experimental basis in 1976. In the mid-1980s, the BBS became an operational survey coordinated by the Office of Migratory Bird Management. In 1993, the BBS was transferred to the newly created National Biological Survey and at present is part of the U.S. Geological Survey, Biological Resources Division, the research arm of the Department of the Interior. The BBS Home Page has information on status and trends of more than 250 species with over 3,500 routes are surveyed in June by experienced birders. The primary objective of the BBS has been the estimation of population change for songbirds. However, the data have many potential uses, and investigators have used the data to address a variety of research and management objectives. Breeding Bird Surveys are conducted during the peak of the nesting season, primarily in June, although surveys in desert regions and some southern states, (where the breeding season begins earlier), are conducted in May. Each route is 24.5 miles long, with a total of fifty stops located at 0.5 mile intervals along the route. Summary information on population change by region and time period, relative abundance and species richness data are available.

US Geological Survey: Hawk Migration Monitoring

Hawk counting stations and observatories dot the ridge crests and migratory funnels of North America. Most of these sites are linked through membership in the Hawk Migration Association of North America. Data are available on a web site.

US Geological Survey: Marsh Bird Monitoring

The Marsh Monitoring Program (MMP) began in 1994 to monitor the condition of marshes in the great Lakes Basin, using marsh birds and amphibians as indicator species. Volunteers survey marsh birds or amphibians, or both. Four to eight survey stations comprise a route, which is visited in the evening two or three times between April and July. Species are identified by sound or sight. The Marsh Monitoring Program is a cooperative venture of Environment Canada and the Long Point Bird Observatory. A larger effort by USFWS, USGS, and CWS has also begun (1998) to look at the feasibility of monitoring marsh birds throughout North America.

US Geological Survey: Migration Monitoring

A group of Canadian and US ornithologists have joined together to design and implement monitoring systems for birds during migration. Counts taken during migration suffer from high variability in counts and captures. However, for boreal zone migrants, such as Gray-cheeked Thrush, Cape May Warbler, and Bay-breasted Warblers, counts during migration are the only real opportunity to track population changes. To fill that information gap USGS has initiated a new program to count birds as they migrate north and south. The program consists of a network of migration monitoring stations (e.g., bird observatories, migration banding stations, and daily migrant counts) and a more extensive program to collect daily field checklists from birders.

US Geological Survey: National Water Quality Assessment Program (NAWQA)
The National Water-Quality Assessment (NAWQA) Program is designed to describe the status and trends in the quality of the Nation's ground- and surface-water resources and to provide a sound understanding of the natural and human factors that affect the quality of these resources. Study units in California are the San Joaquin - Tulare Basins Study Unit, the Sacramento River Basin and the Santa Ana Basin. The San Joaquin-Tulare Basin study includes investigations of surface-water chemistry, contaminants in sediment and in tissue of aquatic organisms, and aquatic ecology. The Sacramento River Basin study includes investigations of trace metals especially from abandoned mines, pesticide contamination of surface water and potential contamination of ground water, nitrate contamination of ground water, urban runoff and volatile-organic- chemical contamination, and other issues such as dam management and streamflow. Data are published in papers in peer-reviewed journals and in USGS reports.

US Geological Survey: Night Bird Monitoring
As part of an effort to develop a network of calling amphibian surveys throughout North America night birds will also be recorded. While the survey will be optimized to collect information on spring and early summer calling amphibians many of the caprimulgids (e.g., whip-poor-wills,chuck-will's-widow), owls, and marsh birds will be calling. These species, while recorded on the BBS and CBC are only poorly represented. In the case of some of the marsh birds and caprimulgids there are major concerns about the populations status.

US Geological Survey: North American Amphibian Monitoring Program
The goal of the North American Amphibian Monitoring Program (AMP) is to provide a statistically defensible program to monitor the distributions and relative abundance of amphibians in North America, with applicability at the state, provincial, ecoregional, and continental scales. The program includes: calling surveys, terrestrial salamander monitoring, aquatic surveys, atlassing and western surveys. The program relies on volunteers to gather data. California has one regional coordinator for the northern half of the state.

Scientists around the world have volunteered their efforts toward amphibian conservation. In 1991, they came together to form the Declining Amphibian Populations Task Force (DAPTF) which serves as the umbrella organization for regional amphibian conservation groups all over the world. The NAAMP is one of these groups.

US Geological Survey: Polaris
The USGS Polaris program is a program to monitor water quality in San Francisco Bay and to assess the effects of changes in land use, hydrology, water currents, nutrients,

toxic contaminants, geologic structure and biological communities in the Bay. Specific objectives of the sampling change from year to year. Salinity, temperature, suspended solids, dissolved oxygen and chlorophyll concentration data are collected at least monthly (but more frequently depending upon specific study objectives that year) using submersible instruments at 39 stations in the Bay. Many peer-reviewed articles are produced in scientific journals.

APPENDIX F. DRAFT Inventory of Geographic Information System Data Sources with Potential Application for the CALFED Bay-Delta Program Tier 1 EIR/EIS (Assembled by Ray McDowell)

Resource Topic	Organization	Program	Staff contact	Geographic coverage	Data type	Date(s) of record	Nominal mapping scale	Software platform	On internet?	Comments
Habitats										
Eelgrass beds	California State Lands Commission	NMFS Report		San Francisco Bay	polygon	1992	1:24,000	ARC/INFO	Y	www.slc.ca.gov
Shallow water fish habitat	California State Lands Commission			San Francisco/San Pablo/Honker Bays	polygon	1993	1:80,000	ARC/INFO	Y	www.slc.ca.gov
Natural communities - Delta	DWR Central District Delta GIS Program	Delta Levees Subventions Program (SB34)	Kent Nelson	Legal Delta	polygon	various	1:24,000	Geo/SQL	N	
Habitat mitigation areas - Delta	DWR Central District Delta GIS Program	Delta Levees Subventions Program (SB34)	Kent Nelson	Legal Delta	polygon/line	various	1:24,000	Geo/SQL	N	
Levee habitat types - Delta	Harding Lawson Associates	Delta Levees Subventions Program (SB34)		Legal Delta	polygon	1991	1:1,000		N	privately held, may be available for a fee
Wetlands - Bay/Delta	CEDR, UC Berkeley	San Francisco Bay/Delta Geodatabase	Howard Foster	Bay/Delta (by 7.5' quad, incomplete)	raster	1985	1:24,000	GRASS	view only	
Wetlands - North Delta	DWR Delta Planning Branch	North Delta Program	Ray McDowell	North Delta	raster, polygon	1991, 1992	1:9,600	GRASS, ARC/INFO	N	
Bay lands (mudflats, tidal marsh, diked baylands, riparian)	San Francisco Estuary Institute		Ted Daum	Bay / Delta downstream from Broad Slough	polygon	1985 (NWI base)	1:24,000	ARC/INFO	N	
Seasonal wetlands - North Bay	San Francisco Estuary Institute	SF Bay Area Ecosystem Goals Project	Ted Daum	North Bay (Carquinez Straight - San Rafael Bridge)	polygon	1985	1:12,000	ARC/INFO	N	
Wetlands - Yolo Basin	Jones & Stokes Associates	Central Valley Habitat Joint Venture	Bruce Boyd	Yolo Basin	polygon	various	1:24,000	ARC/INFO	N	
Wetlands - Central Valley	DFG	Central Valley Wetland Mapping Project	Kari Lewis	Central Valley	polygon	various	1:100,000		N	
Wetlands - California	USFWS	National Wetland Inventory		California (by 7.5'quad, incomplete	polygon	various	1:24,000	ARC/INFO	Y (DLGs)	
Special-status natural communities	DFG Natural Heritage Division	California Natural Diversity Data Base	Patrick Gaul	California	region, point	various	1:24,000	ARC/INFO	N	no public distribution
Native vegetation - Stone Lakes Study Area	Bureau of Reclamation	Stone Lakes Wildlife Refuge Feasibility Study	Chuck Johnson	Southwestern Sacramento County	polygon		1:48,000		N	
Historic habitats										
Historic tidal wetlands	CEDR, UC Berkeley	San Francisco Bay/Delta Geodatabase	Howard Foster	12 Bay - Delta counties	raster	1851-1897	1:125,000	GRASS	view only	
Historic vegetation - Yolo Basin	Jones & Stokes Associates	Central Valley Habitat Joint Venture	Bruce Boyd	Yolo Basin	polygon	various	1:24,000	ARC/INFO	N	
Historic riparian habitat - Upper Sacrament River	DWR Northern District	SB 1086	Stacey Cepello	Sacramento River from Verona to Keswick	polygon			Geo/SQL	N	

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Historical Vegetation Map - Weislander	USBR		Chuck Johnson	California	polygon	1949	1:1,000,000	ARC/INFO	Y	
Potential Natural Vegetation - Kuchler	USBR		Chuck Johnson	California	polygon	1976	1:1,000,000	ARC/INFO	Y	www.slc.ca.gov
Species habitats										
American shad habitat	California State Lands Commission			San Pablo/Suisun Bay	polygon	1992	1:80,000	ARC/INFO	Y	www.slc.ca.gov
Young chinook salmon habitat	California State Lands Commission			South San Pablo Bay	polygon	1992	1:80,000 and 1:24,000	ARC/INFO	Y	www.slc.ca.gov
Potential clapper rail habitat	California State Lands Commission			San Francisco Bay Estuary	polygon	1979	1:24,000	ARC/INFO	Y	www.slc.ca.gov
Species occurrences										
Delta special status species	DWR Central District Delta GIS Program	Delta Levees Subventions Program (SB34)	Kent Nelson	Legal Delta	point	various	1:24,000	Geo/SQL	N	
Special-status animal and plant species	DFG Natural Heritage Division	California Natural Diversity Data Base	Patrick Gaul	California	region/ point	various	1:24,000	ARC/INFO	N	no public distribution
Neomysis - zooplankton (and physical parameters)	DFG (DWR)	IESP	Lee Mecum	San Pablo Bay - Delta (San Pablo Bay - Hood - Stockton)	points	1972 - present	N/A (50 points)	currently not in GIS, can be implemented	N	
Salmon smolts and juveniles (and physical parameters)	USFWS (DFG)	IESP	Pat Brandes/ Spencer Hovekamp	Delta - Sacramento River (Benicia - Princeton - Mossdale)	points	1991 - present (portions started in 1978)	N/A (40 points)	currently not in GIS, can be implemented	N	
Striped bass (eggs, larvae, adults)	DFG	IESP	Lee Miller	San Pablo Bay - Delta (San Pablo Bay - Rio Vista - Stockton)	points	1959 (summer adults) 1968 (eggs, larvae) 1967 (winter adults) -	N/A (147 - 190 points)	currently not in GIS, can be implemented	N	
Delta smelt	DFG, DWR, UC DAVIS, USFWS, USBR	IESP	Geir Aasen, Dale Sweetnam	San Pablo Bay - Delta (San Pablo Bay - Knights Landing Tracy, Byron)	points	1992 - present (portions from 1959)	N/A (174 points)	portions in GIS	N	
Fish and crustaceans	DFG	IESP (Delta Outflow/San Francisco Bay Study)	Kathy Hieb	Bay - Delta (South Bay - Threemile Slough - Antioch Bridge)	points	1980 - present	N/A (85 points)	currently not in GIS, can be implemented	N	
Entrainment of eggs, larvae and fish (+ physical parameters)	DFG, DWR	IESP (Delta Entrainment and Delta Agricultural Diversion Evaluation)	Stephani Spaar	Delta	points	1985 - present	N/A (12 points)	currently not in GIS, can be implemented	N	
Land use										

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Delta Canal Service Areas	CEDR, UC Berkeley	San Francisco Bay/Delta Geodatabase	Howard Foster	12 Bay - Delta counties	raster	1987	1:100,000	GRASS	view only	
County General Plans	CEDR, UC Berkeley	San Francisco Bay/Delta Geodatabase	Howard Foster	12 Bay - Delta counties	raster	1980-1990	1:100,000	GRASS	view only	
Farmland (according to importance)	Department of Conservation	Farmland Mapping and Monitoring Program	Greg Posely	Bay and Delta Counties and most of the Central Valley	polygon	1992, preliminary 1994 data may be available in Spring	1:24,000	Intergraph	N	
Crop types - Delta	DWR Statewide Planning	Crop Mapping Program	Tom Hawkins	Legal Delta	polygon	1991	1:24,000	Geo/SQL	N	
Crop types - Central Valley	DWR Statewide Planning	Crop Mapping Program	Tom Hawkins	Most of Central Valley by county	polygon	Solano Co. 1994, Yolo Co. 1989, Sacramento Co. 1993, San Joaquin 1988, Others at various years	1:24,000	Geo/SQL	N	
Delta levee maintenance information	DWR Central District Delta GIS Program	Delta Levees Subventions Program (SB34)	Kent Nelson	Legal Delta	polygon/line	various	1:24,000	Geo/SQL	N	
Land use - Stone Lakes Study Area	Bureau of Reclamation	Stone Lakes Wildlife Refuge Feasibility Study	Chuck Johnson	Southwestern Sacramento County	polygon		1:48,000		N	
Property ownership - Upper Sacramento River	DWR Northern District	SB 1086	Stacey Cepello	Sacramento River from Verona to Keswick	polygon			Geo/SQL	N	
Public lands (ownership)	Teale Data Center		Pam Leonard	California	polygon	various	1:100,000	ARC/INFO	N	
Infrastructure										
Roads - California	Teale Data Center		Pam Leonard	California	line	various	1:100,000	ARC/INFO	N	
Railroads and transmission lines - California	Teale Data Center		Pam Leonard	California	line	various	1:100,000	ARC/INFO	N	
Political boundaries										
Reclamation districts (incl. levee miles) - Delta	DWR Central District Delta GIS Program	Delta Levees Subventions Program (SB34)	Kent Nelson	Legal Delta	polygon	various	1:24,000	Geo/SQL	N	
Statutory Defined Delta	Department of Conservation	Farmland Mapping and Monitoring Program	Greg Posely	Delta	polygon		1:24,000	Intergraph	N	
Cities - California	Teale Data Center		Pam Leonard	California	line	1990	1:100,000	ARC/INFO	N	
Counties - California	Teale Data Center		Pam Leonard	California	line	1990	1:100,000	ARC/INFO	N	
Physical geography										

APPENDIX F. DRAFT Inventory of Geographic Information System Data Sources with Potential Application for the CALFED Bay-Delta Program Tier 1 EIR/EIS (Assembled by Ray McDowell)

Resource Topic	Organization	Program	Staff contact	Geographic coverage	Data type	Date(s) of record	Nominal mapping scale	Software platform	On internet?	Comments
Elevation (1 m intervals) - Bay/Delta	CEDR, UC Berkeley	San Francisco Bay/Delta Geodatabase	Howard Foster	12 Bay - Delta counties	raster		1:250,000DEMS	GRASS	view only	
Lands below 1 foot elevation contour - Delta	CEDR, UC Berkeley	San Francisco Bay/Delta Geodatabase	Howard Foster	12 Bay - Delta counties	raster	1987	1:100,000	GRASS	view only	
Basins - Bay/Delta	CEDR, UC Berkeley	San Francisco Bay/Delta Geodatabase	Howard Foster	12 Bay - Delta counties	raster	1986 (base:1978)	1:100,000	GRASS	view only	
Watersheds - Bay/Delta	CEDR, UC Berkeley	San Francisco Bay/Delta Geodatabase	Howard Foster	12 Bay - Delta counties	raster	1986 (base:1978)	1:100,000	GRASS	view only	
Drainage specific watersheds - Bay/Delta	CEDR, UC Berkeley	San Francisco Bay/Delta Geodatabase	Howard Foster	12 Bay - Delta counties	raster	1975 & 1987 (base:1972)	1:500,000	GRASS	view only	
Islands - Delta	CEDR, UC Berkeley	San Francisco Bay/Delta Geodatabase	Howard Foster	12 Bay - Delta counties	raster	1987	1:800,000	GRASS	view only	
Watersheds - California	Teale Data Center	CALWATER	Pam Leonard	California	polygon	varius	1:24,000	ARC/INFO	N	
Principal surface waters	CEDR, UC Berkeley	San Francisco Bay/Delta Geodatabase	Howard Foster	12 Bay - Delta counties	raster	1986 (base:1993)	1:24,000 & 1:52,000	GRASS	view only	
Geology - Bay	CEDR, UC Berkeley	San Francisco Bay/Delta Geodatabase	Howard Foster	12 Bay - Delta counties	raster	1972-1978	1:100,000	GRASS	view only	
Natural Runoff Coefficient - Bay/Delta	CEDR, UC Berkeley	San Francisco Bay/Delta Geodatabase	Howard Foster	12 Bay - Delta counties	raster	1974	1:500,000	GRASS	view only	
Precipitation (mean annual) - Bay/Delta	CEDR, UC Berkeley	San Francisco Bay/Delta Geodatabase	Howard Foster	12 Bay - Delta counties	raster	1971	1:500,000	GRASS	view only	
Land forms - Yolo Basin	Jones & Stokes Associates	Central Valley Habitat Joint Venture	Bruce Boyd	Yolo Basin	polygon	various	1:24,000	ARC/INFO	N	
Soil types - Yolo Basin	Jones & Stokes Associates	Central Valley Habitat Joint Venture	Bruce Boyd	Yolo Basin	polygon	various	1:24,000	ARC/INFO	N	
Hydric Soils - Yolo Basin	Jones & Stokes Associates	Central Valley Habitat Joint Venture	Bruce Boyd	Yolo Basin	polygon	various	1:24,000	ARC/INFO	N	
Historic Meanders - Upper Sacrament River	DWR Northern District	SB 1086	Stacey Cepello	Sacramento River from Verona to Keswick	polygon	1896 - 1992 (?)		Geo/SQL	N	
Geology - Upper Sacramento River area	DWR Northern District	SB 1086	Stacey Cepello	Sacramento River from Verona to Keswick	polygon			Geo/SQL	N	
Projected erosion rates - Upper Sacramento River	DWR Northern District	SB 1086	Stacey Cepello	Sacramento River from Verona to Keswick	polygon			Geo/SQL	N	
Shoreline	State Lands Commission			California (including Bay/Delta downstream of Sherman Island)	line	various	1:24,000	ARC/INFO	Y	

APPENDIX F. DRAFT Inventory of Geographic Information System Data Sources with Potential Application for the CALFED Bay-Delta Program Tier 1 EIR/EIS (Assembled by Ray McDowell)

Resource Topic	Organization	Program	Staff contact	Geographic coverage	Data type	Date(s) of record	Nominal mapping scale	Software platform	On internet?	Comments
100-year flood plain - Upper Sacramento River	DWR Northern District	SB 1086	Stacey Cepello	Sacramento River from Verona to Keswick	polygon			Geo/SQL	N	
100-year flood plain - Delta	DWR Delta Planning Branch	North Delta Program	Ray McDowell	North Delta	raster, polygon	1994	1:24,000	GRASS	N	
Hydrography - nationwide	USEPA	Reach File 3	Cheryl Henly	Nationwide	line	various	1:100,000	ARC/INFO	N	
Hydrography - California	Teale Data Center		Pam Leonard	California	line	various	1:100,000	ARC/INFO	N	
Elevation (Digital Elevation Models) - California	Teale Data Center		Pam Leonard	California	points	various	approximately 72 m intervals	ARC/INFO	N	
Trace substances	San Francisco Estuary Institute	Regional Monitorinfg Program for Trace Substances (RMP)	Ted Daum	Day/Delta downstream from Sherman Island	point			ARC/INFO	N	sampling stations only - data with RMP
Bathymetry - Bay	San Francisco Estuary Institute		Ted Daum	Bay downstream from Carquinez Straight	points			ARC/INFO	N	
Water quality - Bay/Delta	DWR, DFG, USBR	D-1485 Compliance Monitoring (IESP)	Karl Jacobs	San Pablo Bay - Delta (Point San Pablo - Green's Landing - Vernalis)	points	1971- present	N/A (98 points)	currently not in GIS, can be implemented	in part	
Hydrodynamics - Bay	USGS	IESP	Rick Oltmann	San Francisco Bay - Freeport Old and Middle River	points	1984 - present (Bay) 1992 - presen (Delta)	N/A (16 points)	currently not in GIS, can be implemented	N	
Imagery										
Landsat Thematic Mapper image bands 3,4,5 - California	University of California, Santa Barbara	California Gap Analysis Program	David Stoms	California	raster	1991	1:250,000 (100 m cells)	BIP	N	
Spotview image (panchromatic)	DWR, DFG, USBR and other state and federal agencies		Paul Veisze (DFG)	California	raster	1992-1994	1:24,000 (10 m cells)	BIL	N	no public distribution
Digital aerial photography - Delta and Suisun Marsh	UC Berkeley	UC Berkeley Digital Library Project	Ken Gardels	Delta (incomplete), Suisun Marsh	raster	1993	1:24,000	J-PEG	Y	Color Infra Red (Delta), Color (Suisun Marsh)
Cultural resources										
Archaeological sites - Delta	DWR Delta Planning Branch	North Delta Program	Ray McDowell	North Delta	points	1994	1:24,000	GRASS	N	no public distribution
Historic sites - Delta	DWR Delta Planning Branch	North Delta Program	Ray McDowell	North Delta	points	1994	1:24,000	GRASS	N	no public distribution

APPENDIX G: Preliminary Draft Monitoring Recommendations for ERP/MSCS “R” and “r” Species

Table of Contents

Introduction

This section assembles information on MSCS “Recover (R)” and “Contribute to recovery (r)” species to assist development of monitoring recommendations for these species. Information is directly copied from the MSCS Technical Appendix (June 1999)[12], the Multi-Species Conservation Strategy (2000)[11], and ERP Milestones[8a] to put all the available information into one place. Diagrams show the hypothesized relationships between ERP milestone actions, pressures and the status of the MSCS species. Identified monitoring programs are listed although more probably exist. Basic “straw-dog” monitoring recommendations are made and monitoring recommendations in the MSCS are included for the purpose of generating discussion. It is assumed that an immediate next step will be to get technical advice from researchers to develop and refine monitoring recommendations and conceptual models for these species.

ERP "R" and "r" species linked with NCCP habitats

Species	CATEGORY	Saline Emergent	Tidal Freshwater Emergent	Non-tidal Freshwater Perm. Emergent	Natural Seasonal Wetlands	Managed Seasonal Wetlands	Valley Riverine Aquatic	Valley/Foothill Riparian	Montane Riparian	Grassland	Inland Dune Scrub	Upland Scrub	Valley/Foothill Woodland	Seasonally Flooded Agriculture	Upland Cropland
Alkali milkvetch	r				x										
Antioch Dunes Evening-Primrose	R										x				
Bank swallow	r						x	x							
Bristly sedge	r			x											
California black rail	r	x	x	x											
California clapper rail	r	x													
California yellow warbler	r							x	x						
Contra Costa Wallflower	R										x				
Crampton’s tuctoria	r				x										
Delta coyote-thistle	r			x				x							
Delta Green Ground Beetle	r				x										
Delta mudwort	r		x												
delta tule pea	r	x	x												
Giant Garter Snake	r		x	x		x		x						x	
Greater sandhill crane	r			x	x	x				x				x	x
Lange's Metalmark butterfly	R										x				
Least Bell's vireo	r							x	x						
Little willow flycatcher	r							x	x						
Mason’s lilaeopsis	R		x												
Northern California black walnut	r							x							
Point Reyes bird's beak	r	x													
Riparian Brush Rabbit	r							x							
Salt Marsh Harvest Mouse	r	x													
Saltmarsh common yellowthroat	r	x													
San Joaquin Valley Woodrat	r							x							
San Pablo California Vole	r	x													
San Pablo song sparrow	R	x													
Soft bird’s-beak	R	x													
Suisun marsh aster	R		x												
Suisun Ornate Shrew	R	x	x												
Suisun song sparrow	R	x	x												
Suisun thistle	R	x													
Swainson's hawk	r				x	x		x		x		x	x	x	x
Valley Elderberry Longhorn Beetle	R							x	x						
Western yellow-billed cuckoo	r							x							

Alkali milkvetch

Scientific Name *Astragalus tener var. tener*

Legal Status[11]: CNPS List 1B

CALFED ERP GOAL **"Contribute to Recovery (r)"**

MSCS Goal prescription
Protect extant populations, and reintroduce species near extirpated populations.

Straw-dog Monitoring Recommendations
* Number, size, and location of existing & newly established populations
* Protection status of populations

Existing Monitoring Program / Information Sources
Yolo County Habitat Conservation Plan (HCP) – Includes Alkali Milk-vetch, Bank Swallow, California Yellow Warbler, California Yellow-billed Cucko, Crampton's Tuctoria, Giant Garter Snake, Swainson's Hawk, Valley Elderberry Longhorn Beetle
Contact:Terry Roberts, City of West Sacramento Community Development, (916-373-5854)
http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=3170
Cosumnes River Preserve & Univ. of California - Davis: Cosumnes River Preserve – includes vernal pool vegetation communities + contracts to monitor songbirds, rare plants on levees, giant garter snakes
Contact: Valerie Calegari ?

NCCP Habitats Natural Seasonal Wetlands

ERP Mgmt Zone Colusa Basin, East San Joaquin Basin, Eastside Delta Tributaries, Sacramento River, San Joaquin River, Suisun Marsh/North San Francisco Bay, West San Joaquin Basin, Yolo Basin

Life History & Habitat Requirements (MSCS Technical Reports, 1999)
"The historical distribution of alkali milk-vetch includes the southern Sacramento Valley, northern San Joaquin Valley, and the eastern San Francisco Bay Area. This species is believed extirpated from all historical occurrences except for those in Merced and Yolo Counties.

Alkali milk-vetch is an annual herb of the legume family (Fabaceae) that grows 4-30 centimeters tall (Hickman 1993). This species is associated with the clay soils of alkaline flats and meadows, valley and foothill grasslands, and alkaline vernal pools. The blooming period of alkali milk-vetch is March through June (Skinner and Pavlik 1994)."

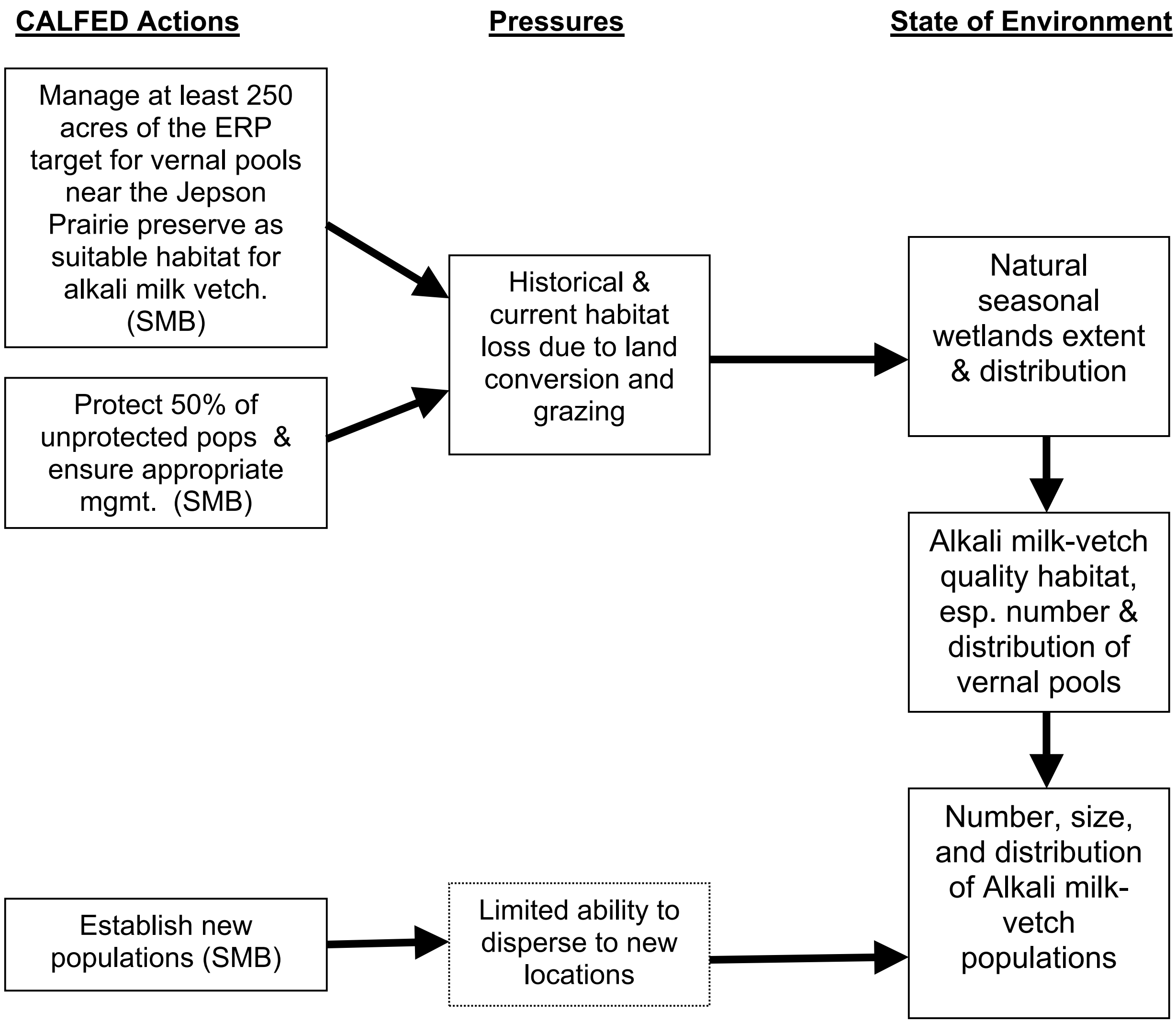
Pressures (MSCS Technical Reports, 1999)
"…threatened by destruction of its habitat, especially from agricultural conversion and livestock grazing".

MSCS Conservation Measures - That add detail to ERP actions
1. Protect extant populations, and reintroduce species near extirpated populations.
2. Monitor status and distribution of populations for the duration of CALFED, and designand implement conservation measures if a decline in population size or vigor is observed.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)
<u>Suisun Marsh & North San Francisco Bay</u>
HABITAT
* Develop a cooperative program to acquire, manage and restore 100 acres of vernal pools and 500 to 1,000 acres of adjacent buffer areas in the Suisun Marsh/North San Francisco

Bay EMZ. Protect all existing known occurrences of Crampton's tuctoria through conservation easement or purchase from willing sellers (including CNDDB Element Occurrence #2 and any new populations that are found). Identify at least two protected and managed sites for introduction of additional populations; begin introduction and monitor for success. Manage at least 250 acres of the ERP target for vernal pools near the Jepson Prairie preserve as suitable habitat for alkali milk vetch. Establish new populations on protected and appropriately managed lands. Bring 50% of currently unprotected, existing populations into protection through purchase or conservation agreement, and ensure appropriate management.

Figure G-1. Alkali milk-vetch Diagrammatic Conceptual Model



<u>Antioch Dunes Evening-Primrose</u> **Scientific Name** *Oenothera deltoides ssp. Howellii*

Legal Status[11]: Federal endangered (FESA), California endangered (CESA), CNPS list 1B

CALFED ERP GOAL[8] "Recover (R)"

MSCS Goal prescription[11]
Continue protection of and expand the size of these species' Antioch Dunes populations, enhance and restore suitable habitat at and in the vicinity of the Antioch Dunes, and achieve recovery goals identified in the USFWS recovery plan.

Straw-dog Monitoring Recommendations
* number & location of populations, annual population counts (existing program)
* spatial extent & distribution of available habitat and enhanced habitat
* Annually monitor establishment success and modify establishment and management techniques as needed using adaptive management

Existing Monitoring Programs / Information Sources
USFWS Antioch Dunes National Wildlife Refuge: Antioch Dunes Evening Primrose and Contra Costa Wallflower – Monitoring Annual populations counts of both species
Contact: Ivette Loredo

NCCP Habitats[11] Inland Dune Scrub

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay, Yolo Basin

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]
"Antioch Dunes evening-primrose is endemic to the Antioch Dunes, south of the confluence of the Sacramento and San Joaquin Rivers, up to an elevation of 50 feet. Its historical distribution was probably not much more extensive than its present distribution of 70 acres of remnant dunes at Antioch. In 1970, the primrose was introduced to the Brannan Island State Recreation Area; by 1988, one small population remained there (California Department of Fish and Game 1992, Natural Diversity Data Base 1998).

"Antioch Dunes evening-primrose is a perennial herb of the evening primrose family (Onagraceae), grows up to 2.5 feet tall, and occurs in loose sand and semistabilized dunes associated with the Sacramento-San Joaquin River Delta. It requires freshly disturbed sand for the establishment and survival of succeeding generations. Seedlings are unable to survive on the clay soils in areas where overlaying dune sand has been removed; seedlings cannot become established in heavily vegetated areas—the species is a colonizer after wildfires. The flowers of this plant open in early evening and usually close by midmorning. Flowering time is March through May and briefly in September."

Pressures (MSCS Technical Reports, 1999)[12]
"Industrial development, sand mining, and agricultural conversion have resulted in loss of habitat. Fire control activities, off-road-vehicle use, and the invasion of non-native species have further degraded remaining habitat (California Department of Fish and Game 1992). Limited seed production is linked to a deficiency of pollinators (Pavlik et al. 1988). Designated Critical Habitat: Inland dune habitat near Antioch at T2N, R2E, Section 17 SW ¼ and Section 18 E b of S a was designated as critical habitat (42 FR 26, February 8, 1977)."

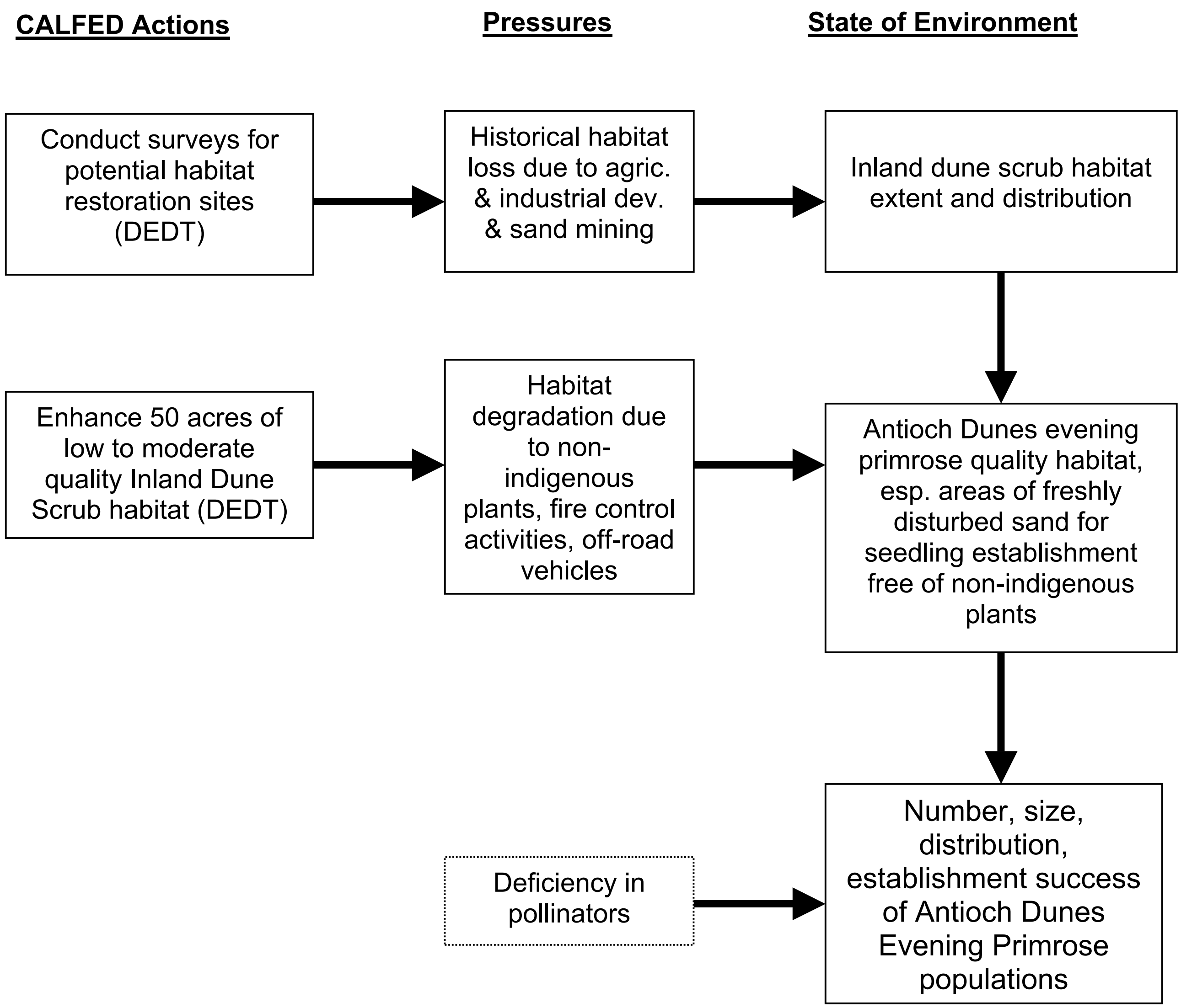
MSCS Conservation Measures - That add detail to ERP actions[11]
1. Coordinate protection and restoration of inland dune scrub habitats with other programs (e.g., USFWS recovery plans and management of the Antioch Dunes Preserve) that could affect management of occupied and historical habitat. Coordination would avoid conflicts

among management objectives and identify opportunities for achieving multiple management objectives.
2. Conduct surveys to locate potential habitat restoration sites on Tinnin soils. Identify opportunities for and implement permanent protection, restoration, and management of habitat to enhance habitat conditions for these species.
3. Enhance and maintain existing occurrences.
4. Annually monitor establishment success and modify establishment and management techniques as needed using adaptive management.

CALFED ERP Milestones[8a] (CALFED actions during Stage 1, the first 7 years)
<u>Delta & Eastside Delta Tributaries</u>
HABITAT

* Conduct surveys to locate potential habitat restoration sites capable of supporting Antioch dunes evening primrose, Contra Costa wallflower, and Lange's metalmark butterfly. Enhance 50 acres of low to moderate quality Antioch inland dune scrub habitat to support these species. Annually monitor establishment success.

Figure G-2. Antioch Dunes evening primrose Diagrammatic Conceptual Model



Bank swallow **Scientific Name** *Riparia riparia*

Legal Status[11]: California threatened species (CESA)

CALFED ERP GOAL[8] **"Contribute to Recovery (r)"**

MSCS Goal prescription[11]

Allow reaches of the Sacramento River and its tributaries that are unconfined by flood control structures (i.e., bank revetment and levees) to continue to meander freely, thereby creating suitable bank nesting substrates through the process of bank erosion.

Straw-dog Monitoring Recommendations

* Number, location, and size of active nesting colonies
* Linear extent and location of river with unconstrained river meander where habitat can be formed
* Responsiveness of bank swallows to restoration of stream meander belts and riparian habitats
* Number, location, and size of active nesting colonies in habitat preserves established to protect them.

Existing Monitoring Program / Information Sources

Cal. Dept. of Fish & Game: Bank Swallow Monitoring – Studies and annual breeding population monitoring since 1996
Contact: Ron Schlorff

Yolo County Habitat Conservation Plan (HCP) – Includes Alkali Milk-vetch, Bank Swallow, California Yellow Warbler, California Yellow-billed Cuckoo, Crampton's Tuctoria, Giant Garter Snake, Swainson's Hawk, Valley Elderberry Longhorn Beetle
Contact:Terry Roberts, City of West Sacramento Community Development, http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=3170

Point Reyes Bird Observatory, The Nature Conservancy, U.S. Fish & Wildlife Service: Sacramento River Bird Conservation Project – Riparian Birds
Contact: Stacy Small (www.prbo.org)

Point Reyes Bird Observatory, U.S. Fish & Wildlife Service: San Joaquin Restoration – Riparian Birds
Contact: Geoff Geupel (www.prbo.org)

NCCP Habitats[11] Valley Riverine Aquatic, Valley/Foothill Riparian

ERP Mgmt Zone[12] Sacramento River, possibly San Joaquin River, North Sacramento Valley, Feather River/Sutter Basin, Eastside Delta Tributaries, Butte Basin, Yolo Basin, American River Basin

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"The bank swallow historically occurred along the larger lowland rivers throughout California, with the exception of southern California, where the species occurred principally along the coast and at the mouths of large rivers such as the Los Angeles River (Humphrey and Garrison 1987, Laymon et al. 1988). This species has now been extirpated from southern California and its range has been reduce by 50% since 1900 (Laymon et al. 1988, California Department of Fish and Game 1997). It is currently confined to the Sacramento River above the town of Colusa and is scattered in colonies in northern California. During a survey conducted in 1987, 111 colonies were located statewide and the statewide population was estimated at 18,800 pairs, about 70% of which occurred along the Sacramento River (Laymon et al. 1988, California Department of Fish and Game 1993). The last stronghold for the bank swallow is along the banks of the Sacramento River (California Department of Fish and Game 1992) and its major tributaries (Humphrey and Garrison 1987). The current population estimate of 4,990 nesting pairs, based on annual California Department of Fish and Game (DFG) monitoring surveys, indicates a population decline of about 73% since 1987.

"The bank swallow is a migrant that breeds primarily in the Central Valley of California and winters in South America. It arrives in California in mid-March, with numbers of birds peaking in May (Humphrey and Garrison 1987, Laymon et al. 1988). The bank swallow requires bluffs or banks with soft sand and sandy loam soil primarily immediately adjacent to still or running water. The species constructs burrows of 2-3 feet deep into the nearly vertical eroding banks where it chooses to establish nesting colonies. The bank swallow breeds and lays a clutch of 4-5 eggs in April; the young hatch in May and 2-3 young are fledged by July each year in a single breeding attempt. The adults and young of the year remain along the riverbanks until they migrate in fall."

Pressures (MSCS Technical Reports, 1999)[12]

The bank swallow has been eliminated from southern California because almost every river and natural waterway has been converted into flood control channels. Elsewhere in California, riprapping of natural riverbanks and flood control projects have been the major causes for the decline of this species (California Department of Fish and Game 1997).

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Coordinate protection and restoration of channel meander belts and existing bank swallow colonies with other federal and State programs (e.g., the Senate Bill [SB] 1086 program and USACE's Sacramento and San Joaquin Basin Comprehensive Study) that could affect management of current and historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
2. Proposed ERP actions designed to protect or restore stream meander belts should initially be implemented along reaches of the Sacramento River and its tributaries that support nesting colonies or nesting habitat.
3. Monitor to determine the response of bank swallows to restoration of stream meander belts and riparian habitat.
4. Coordinate with the U.S. Bureau of Reclamation and California Department of Water Resources (DWR) to phase spring-summer reservoir releases in a manner that would reduce the potential for adverse effects on nesting colonies that could result from large, pulsed releases.
5. To the extent consistent with CALFED objectives, protect all known nesting colonies from future changes in land use or activities that could adversely affect colonies.

CALFED ERP Milestones[8a] (CALFED actions during Stage 1, the first 7 years)

<u>Delta & Eastide Delta Tributaries</u>

PROCESSES

* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within the Eastside Delta Tributaries EMZ.

<u>Sacramento River Basin</u>

PROCESSES

* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish

spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ in the Sacramento River Basin.

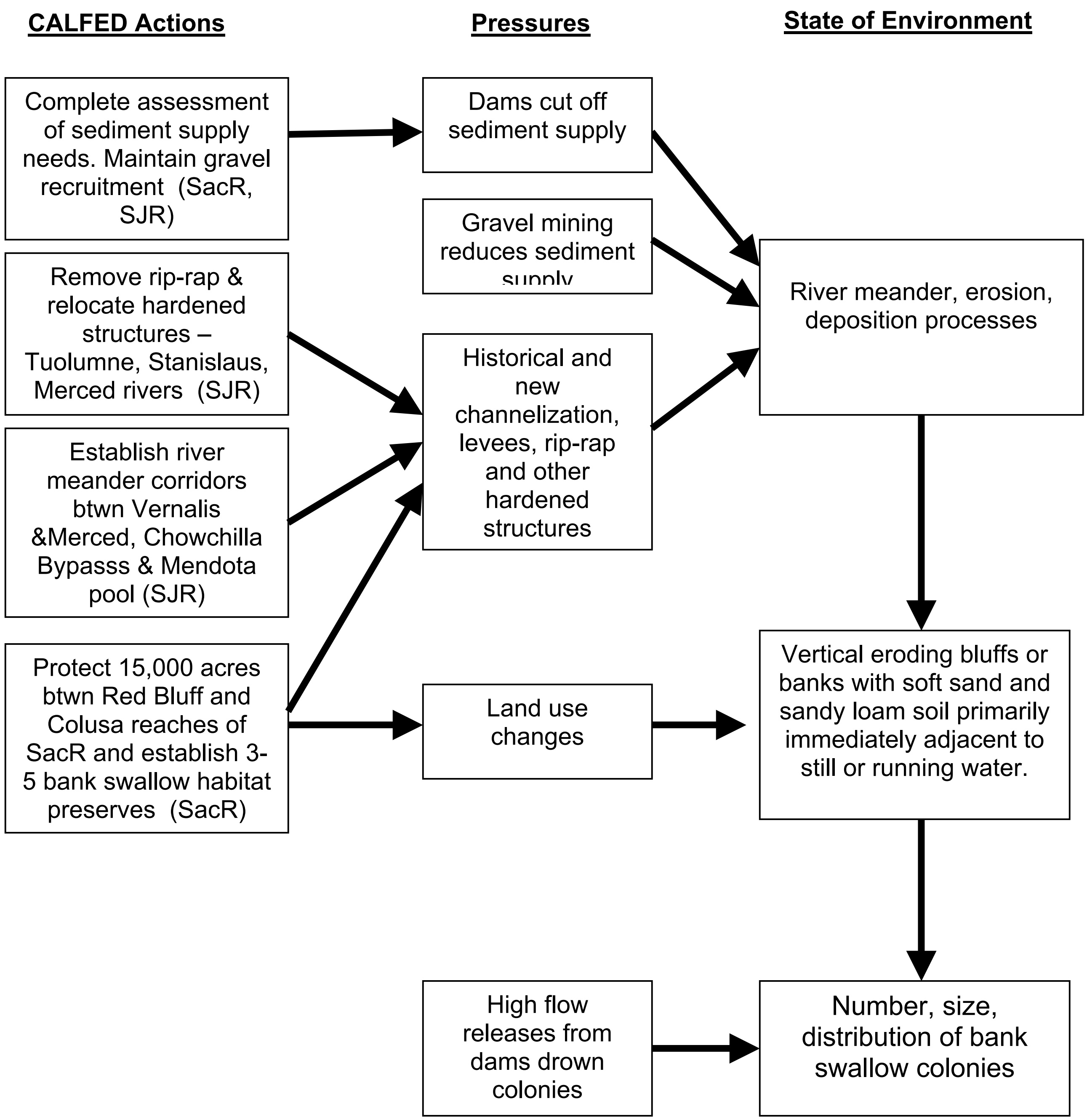
* Protect 15,000 acres within the Inner River Zone areas between Red Bluff and Colusa reaches within identified the Sacramento River Conservation Area. Establish between 3 and 5 habitat preserves for bank swallows along the upper reaches of the Sacramento River capable of supporting 5000 bank swallow burrows between the towns of Colusa and Red Bluff.

<u>San Joaquin River Basin</u>

PROCESSES

* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ within the San Joaquin River Basin. In the East San Joaquin Basin EMZ, complete fluvial geomorphic assessments on all tributaries.
* Develop a cooperative program to restore salmonid spawning and rearing habitat in the Tuoloumne, Stanislaus, and Merced Rivers that includes the following elements: (1) reconstructing channels at selected sites by isolating or filling in inchannel gravel extraction areas; (2) increasing natural meander by removing riprap and relocating other structures that impair stream meander; and (3) restoring more natural channel configurations to reduce salmonid predator habitat and improve migration corridors.
* Restore and maintain a defined stream-meander zone and increase floodplain habitat on the San Joaquin River between Vernalis and the mouth of the Merced River.
* Establish a river meander corridor between the Chowchilla Bypass and Mendota Pool to expand the floodway corridor to convey increased anticipated floodflows and restore floodplain habitat.

Figure G-3. Bank Swallow Diagrammatic Conceptual Model



Bristly sedge

Scientific Name *Carex comosa*

Legal Status[11]: CNPS List 2

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]

Research habitat requirements and use knowledge gained to develop and implement specific recovery measures.

Straw-dog Monitoring Recommendations

* number & distribution of populations
* Extent and distribution of available habitat & restored habitat

Existing Monitoring Program / Information Sources

?

NCCP Habitats Nontidal Freshwater Permanent Emergent

ERP Mgmt Zone Delta, Suisun Marsh/North San Francisco Bay, North Sacramento Valley, West Sacramento River Watershed

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"Bristly sedge has a significant distributional range including the inner north Coast Ranges, high Cascade Range, Central Valley, northern central coast, San Francisco Bay region, San Bernardino Mountains and the Modoc Plateau of California (Hickman 1993). The species has not been regularly collected, so specific information about its distribution is limited (Skinner and Pavlik, 1994) Bristly sedge is know from less than five extant occurences from Contra Costa, Lake, Shasta, and Sonoma Counties (Natural Diversity Data Base 1998).

"Bristly sedge is a rhizomatous perennial herb of the sedge family (Cyperaceae) that grows 50 to 100 cm tall (Hickman 1993, Skinner and Pavlik 1994). It is found in marshes, alon lake margins, and other wet places. Bristly sedge is widely distributed from California through Washington and blooms from May through September (Skinner and Pavlik 1994)."

Pressures (MSCS Technical Reports, 1999)[12]

"threatened by agriculture, grazing, flooding from the Delta Wetlands project, and marsh drainage (Natural Diversity Data Base 1998, Skinner and Pavlik 1994)."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Identify and implement opportunities to restore suitable wetland habitat within ERP nontidal freshwater marsh restoration actions.

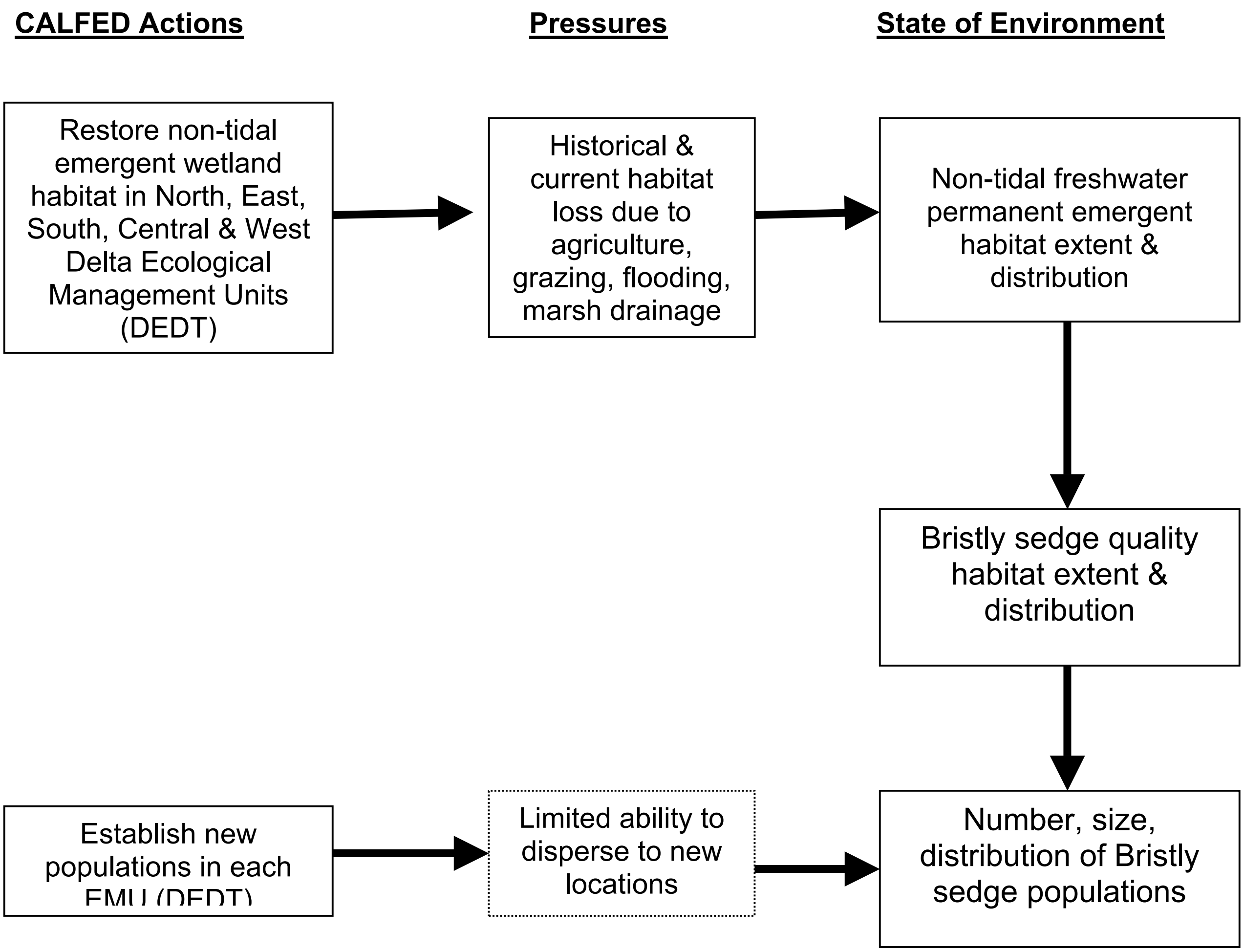
CALFED ERP Milestones[8a] (CALFED actions during Stage 1, the first 7 years)

<u>Delta & Eastside Delta Tributaries</u>

HABITAT

* Restore a minimum of 500, 250, 1,000, and 2,500 acres of nontidal emergent wetland in the North, East, South, and Central and West Delta Ecological Management units respectively. Establish at least one population of bristly sedge in each EMU.

Figure G-4. Bristly Sedge Diagrammatic Conceptual Model



California black rail **Scientific Name** *Laterallus jamaicensis coturniculus*

Legal Status[11]: California threatened (CESA), fully protected under California Dept. of Fish and Game code

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]
Maintain the current distribution and existing populations of the California black rail, and reestablish and maintain viable species' populations throughout its historical range in portions of the Delta and Bay Regions within the ERP Focus Area.

Straw-dog Monitoring Recommendations
* Abundance index ? or extent of occupied habitat?
* extent & distribution of available, protected, enhanced and restored California black rail habitat
* extent, distribution, and number of patches of quality California black rail habitat (patches with tidal exchange, large enough to develop 4th order channels [at least 1000 acres], low angle upland slopes, and wetland to upland transition habitat at least 0.25 mile in width, etc.)
* Connectivity among patches relative to black rail dispersal
* Use of restored marsh habitat and rate at which restored habitats are colonized

Existing Monitoring Programs / Information Sources
Avocet Research Associates for SF Bay NWR (?): California Black and Clapper Rail Monitoring
Breeding surveys in SF Bay, more focused on North Bay
Marin Audubon Society (funded by CALFED): Petaluma Marsh Expansion Project - Marin County
Includes fish and bird use (including San Pablo Song Sparrow, Black and California Clapper Rail), sedimentation, channel formation, and recolonization of vegetation
Contact: Barbara Salzman, Marin Audubon Society
http://endeavor.des.ucdavis.edu/nrpi/WPIProjectDescription.asp?ProjectPK=5146

NCCP Habitats[11] Saline Emergent, Tidal Freshwater Emergent, Nontidal Freshwater Permanent Emergent

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay, Delta, Feather River/Sutter Basin (?), American River Basin (?)

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]
"Historically, the California black rail occurred in saline and brackish emergent wetlands in the San Francisco Bay, coastal Marin County, coastal wetlands of southern California, and isolated interior areas of southern California (Grinnell and Miller 1944). The current distribution of the California black rail is restricted to the Sacramento-San Joaquin Delta, Suisun Marsh, San Francisco Bay, isolated tidal and freshwater wetlands in southern California, and the Colorado River (California Department of Fish and Game 1992). In recent years, the species has also been observed in freshwater marshes in Placer County.

"The California black rail occupies saline and brackish emergent wetlands and freshwater marshes. Vegetation in these wetlands is generally dominated by pickleweeds, cord grasses, tules, or cattails, all of which are used for nesting. The species nests from mid-March through July in the lower cord-grass-dominated marsh zones, near networks of small tidal sloughs (Zeiner et al. 1990). These sloughs provide protected routes for movement and foraging for the adults and young. During winter, black rails may be widely distributed in the marshes and may use the upper marsh vegetation for cover, especially during extreme high tides (Zeiner et al.

1990). They are prey to several predators, including herons and domestic cats (Zeiner et al. 1990). Black rails feed primarily on invertebrates."

Pressures (MSCS Technical Reports, 1999)[12]
"Loss of tidal and freshwater marshes is the primary reason for the decline of the California black rail. Many of the remaining marshes lack extensive high marsh habitat and have steep earthen levees, making them unsuitable for rails. Additionally, pollution from sewage effluent, industrial discharges, and urban runoff has contaminated the species' food sources. Predation on young and eggs by the introduced red fox may be responsible for the recent rapid decline of the black rail population in south San Francisco Bay."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. The geographic priorities for implementing ERP actions to protect, enhance, and restore saline emergent wetlands and associated habitats for the California black rail within the Bay Region should be (1) western Suisun Marsh, (2) Gallinas/Ignacio marshes, Napa marshes, and eastern Suisun Marsh, (3) Sonoma marshes, Petaluma marshes, and Highway 37 marshes west of Sonoma Creek, (4) Point Pinole marshes, (5) Highway 37 marshes east of Sonoma Creek, and (6) the Contra Costa County shoreline.
2. Coordinate protection, enhancement, and restoration of saltmarsh, freshwater marsh, and associated habitats with other federal, State, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project and USFWS species recovery plans) that could affect management of current and historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
3. Restore wetland and perennial grassland habitats adjacent to occupied nesting habitats to create a buffer of natural habitat. This buffer would protect nesting pairs from adverse effects that could be associated with future changes in land use on nearby lands and provide suitable foraging habitat and nesting habitat suitable for the natural expansion of populations.
4. Initial species recovery efforts should be directed to locations where there are immediate opportunities for protection, enhancement, or restoration of suitable habitat.
5. To the extent practicable, design dikes constructed in enhanced and restored saline emergent wetlands to provide optimal wetland-to-upland transitional habitat.
6. Direct ERP saltmarsh and freshwater marsh enhancement efforts toward existing degraded marshes that are of sufficient size and configuration to develop fourth order tidal channels (marshes would most likely need to be at least 1,000 acres).
7. To the extent practicable, design saltmarsh and freshwater marsh enhancements and restorations that provide low-angle upland slopes at the upper edge of marshes to provide suitable and sufficient wetland-to- upland transition habitat. Transition habitat zones should be at least 0.25 mile wide.
8. Manage enhanced and restored habitat to avoid or minimize impacts on the California black rail that could be associated with recreational uses on lands acquired or managed under conservation easements.
9. Direct ERP habitat restorations toward improving tidal circulation to diked wetlands that currently sustain partial tidal exchange.
10. Direct some habitat enhancements and restorations toward increasing habitat connectivity among existing and restored tidal marshes.
11. To the extent practicable, control non-native predator populations in occupied habitat and saltmarshes and freshwater marshes enhanced and restored under the ERP.
12. Identify and implement feasible methods for controlling invasive non- native marsh plants.
13. Monitor to determine use of restored saltmarsh and freshwater marsh habitats by California black rails and the rate at which restored habitats are colonized.

14. Acquire conservation easements in occupied habitat to adjust grazing regimes and enhance wetland-to-upland transition habitat conditions.

CALFED ERP Milestones[8a] (CALFED actions during Stage 1, the first 7 years)

Delta & Eastside Delta Tributaries

HABITAT

* Restore a minimum of 500, 500, 4,000, and 5,000 acres of tidal emergent wetland in the North, East, South, and Central and West Delta Ecological Management units respectively.
* Restore a minimum of 500, 250, 1,000, and 2,500 acres of nontidal emergent wetland in the North, East, South, and Central and West Delta Ecological Management units respectively. Establish at least one population of bristly sedge in each EMU.
* Restore a minimum of 125 acres of channel islands and 125 acres of shoals in the Delta.

STRESSORS

* Assist in the development and implementation of a black and clapper rail impact reduction program.
* Conduct the following mercury evaluation and abatement work in the Delta (from Phase II Report): Determine methylization (part of bioaccumulation) process in Delta. Determine sediment mercury concentration in areas that would be dredged during levee maintenance or conveyance work. Determine potential impact of ecosystem restoration work on methyl mercury levels in lower and higher trophic level organisms.
* Conduct the following selenium work: Conduct selenium research to fill data gaps in order to refine regulatory goals of source control actions; determine bioavailability of selenium under several scenarios (from Phase II Report). Evaluate and, if appropriate, implement real-time management of selenium discharges (from Phase II Report). Expand and implement source control, treatment, and reuse programs (from Phase II Report). Coordinate with other programs; e.g., recommendations of San Joaquin Valley Drainage Implementation Program, CVPIA for retirement of lands with drainage problems that are not subject to correction in other ways (from Phase II Report). Support development and implementation of TMDL for selenium in the San Joaquin River watershed (focus on Grassland area).
* Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.
* Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.

Suisun Marsh & North San Francisco Bay

HABITAT

* In the Suisun Marsh/North San Francisco Bay EMZ, restore a minimum of 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. Develop cooperative programs to acquire, in fee-title or through a conservation easement, the land needed for tidal restoration, and complete the needed steps to restore the wetlands to tidal action. Begin aggressive program of control of non-native plant species that are threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak. - Bring into protection at least 25% of currently occupied, but unprotected Suisun

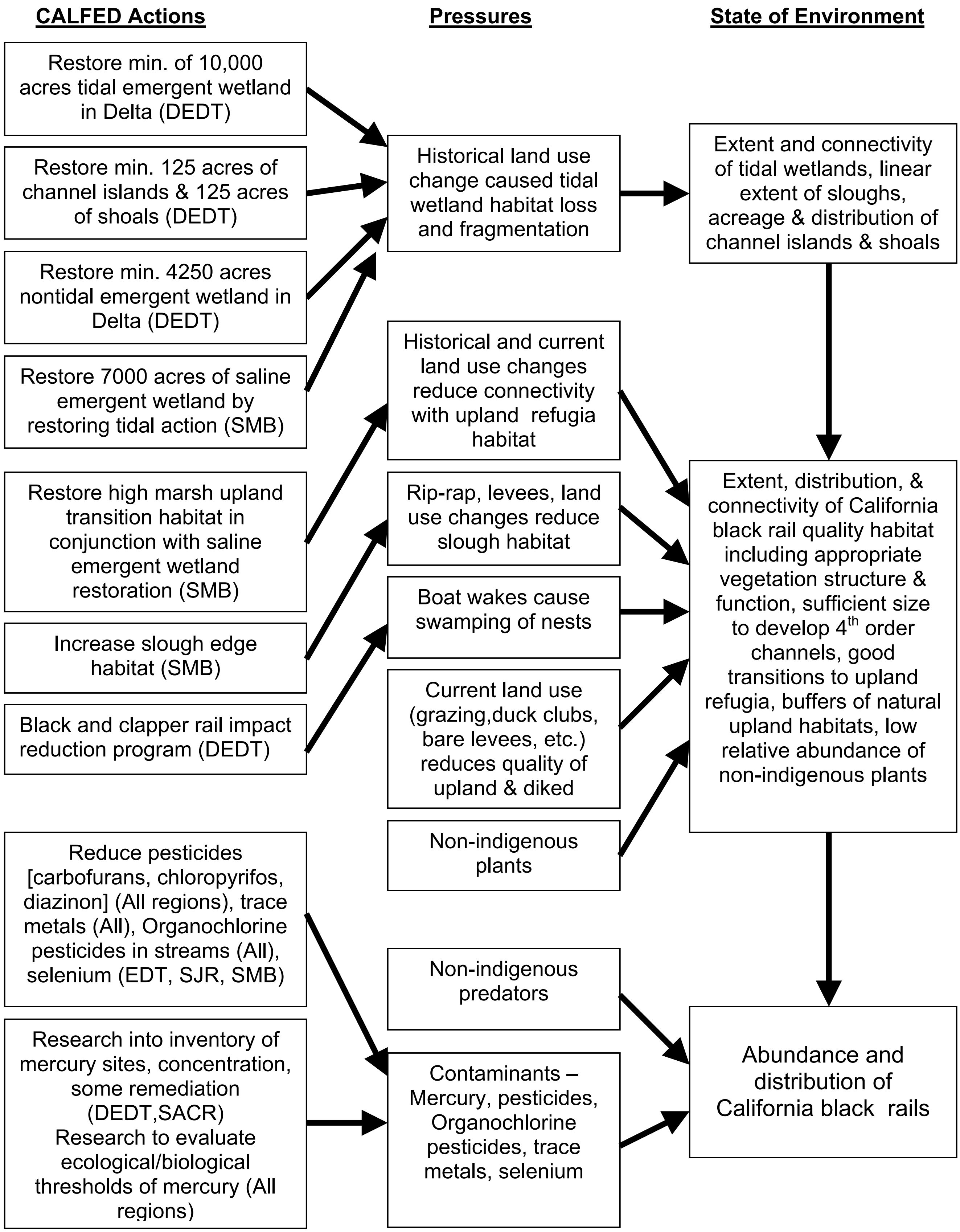
Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management.
-Expand suitable tidal slough habitat for Suisun Marsh aster by 25 linear miles.
-Identify at least three protected and managed sites for introduction of at least three additional populations of Suisun thistle; increase overall population size at least threefold.
-Establish at least one new population of soft bird's beak with high likelihood of success in restored habitat in each of the Suisun Bay and Marsh EMU, the Napa River EMU, and the Petaluma River EMU.
-Establish at least one new Point Reyes bird's beak population in the Petaluma River and San Pablo Bay EMUs.
*Restore suitable, occupied slough edge habitat for delta mudwort and delta tule pea by at least 5 miles in the Suisun Bay and Marsh EMU and by at least 10 miles in the Napa River EMUs. Bring at least 25% the currently existing but unprotected occurrences of delta mudwort and delta tule into protection through purchase or conservation agreement, and ensure appropriate management.
STRESSORS
* Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.
* Conduct the following selenium work: Conduct selenium research to fill data gaps in order to refine regulatory goals of source control actions; determine bioavailability of selenium under several scenarios (from Phase II Report). Evaluate and, if appropriate, implement real-time management of selenium discharges (from Phase II Report). Expand and implement source control, treatment, and reuse programs (from Phase II Report). Coordinate with other programs; e.g., recommendations of San Joaquin Valley Drainage Implementation Program, CVPIA for retirement of lands with drainage problems that are not subject to correction in other ways (from Phase II Report). Support development and implementation of TMDL for selenium in the San Joaquin River watershed (focus on Grassland area).
* Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.
<u>Sacramento River Basin</u>
STRESSORS
* Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.
* Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.
<u>San Joaquin River Basin</u>
STRESSORS
*Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with

municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.

*Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.

*Conduct the following selenium work: Conduct selenium research to fill data gaps in order to refine regulatory goals of source control actions; determine bioavailability of selenium under several scenarios (from Phase II Report). Evaluate and, if appropriate, implement real-time management of selenium discharges (from Phase II Report). Expand and implement source control, treatment, and reuse programs (from Phase II Report). Coordinate with other programs; e.g., recommendations of San Joaquin Valley Drainage Implementation Program, CVPIA for retirement of lands with drainage problems that are not subject to correction in other ways (from Phase II Report). Support development and implementation of TMDL for selenium in the San Joaquin River watershed (focus on Grassland area).

Figure G-5. California Black Rail Diagrammatic Conceptual Model



<u>California clapper rail</u> **Scientific Name** *Rallus longirostris obsoletus*

Legal Status[11]: Federal endangered (FESA), California endangered (CESA), fully protected under California Fish and Game Code.

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]

Maintain the current distribution and existing populations of the California clapper rail, and reestablish and maintain viable species' populations throughout its historical range in the portion of the Bay Region within the ERP Focus Area.

Straw-dog Monitoring Recommendations

* Abundance index? Or extent of occupied habitat?
* extent & distribution of available, protected, enhanced, and restored California clapper rail habitat
* extent, distribution, and number of patches of quality California clapper rail habitat (patches with tidal exchange, large enough to develop 4th order channels [at least 1000 acres], low angle upland slopes, and wetland to upland transition habitat at least 0.25 mile in width, etc.)
* Connectivity among patches relative to clapper rail dispersal
* Use of restored marsh habitat and rate at which restored habitats are colonized

Existing Monitoring Programs / Information Sources

Avocet Research Associates for SF Bay NWR (?): California Black and Clapper Rail Monitoring
Breeding surveys in SF Bay, more focused on North Bay

Marin Audubon Society (funded by CALFED): Petaluma Marsh Expansion Project - Marin County
Includes fish and bird use (including San Pablo Song Sparrow, Black and California Clapper Rail), sedimentation, channel formation, and recolonization of vegetation
Contact: Barbara Salzman, Marin Audubon Society
http://endeavor.des.ucdavis.edu/nrpi/WPIProjectDescription.asp?ProjectPK=5146

USFWS San Francisco Bay National Wildlife Refuge Complex: California Clapper Rail Monitoring in South SF Bay Marshes – Spring and winter population censuses
Contact: Joy Albertson

NCCP Habitats[11] Saline Emergent

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"Historically, the largest populations of California clapper rail occurred in saline emergent wetlands throughout south San Francisco Bay (Grinnell and Miller 1944). Smaller populations were present in marshes along the San Mateo coast and those adjacent to Monterey Bay and the Elkhorn Slough (U.S. Fish and Wildlife Service 1984). The historical distribution may have included coastal marshes of Humboldt and Morro Bays (Brooks 1940).

"Overharvest by commercial and sport hunters led to the depletion of the California clapper rail by the early 1900s (U.S. Fish and Wildlife Service 1984). Protection from harvesting was afforded to the species through the establishment of the Migratory Bird Treaty Act of 1913. Clapper rail populations appeared to recover with protection; however, habitat loss accelerated in the early 1900s when marshes were converted to other uses (DeGroot 1927). By the late 1970s, more than 2,800 acres of marsh habitat had been lost.

"The current distribution of the California clapper rail is restricted to San Francisco Bay, where as few as 300 individuals may occupy the remnant native marshes (California Department of

Fish and Game 1992). Recently, California clapper rails have been seen in Suisun Marsh, an area historically not occupied by the species (U.S. Fish and Wildlife Service 1984). It is believed that the increased salinity of Suisun Marsh resulting from decreased flows from the Delta have allowed the clapper rail to expand into this area (U.S. Fish and Wildlife Service 1984). Over 90% of the population, however, is still found in south San Francisco Bay (California Department of Fish and Game 1992).

"The California clapper rail occupies saline and brackish emergent wetlands. Vegetation in these wetlands is generally dominated by pickleweeds or cord grasses, both of which are used for nesting (U.S. Fish and Wildlife Service 1984). Clapper rail populations have declined in areas where alkali bulrushes dominate (U.S. Fish and Wildlife Service 1984). Clapper rails nest from mid-March through July in the lower cord-grass-dominated marsh zones near networks of small tidal sloughs (DeGroot 1927, U.S. Fish and Wildlife Service 1984). These sloughs provide protected routes for movement and foraging for the adults and young (U.S. Fish and Wildlife Service 1984). Vegetation and drift material are used in the construction of a canopy over the platform nest (U.S. Fish and Wildlife Service 1984). Cord-grass habitat and associated nesting materials may provide more protection from high tides because of the ability of nests to float. Additionally, the uniform, dense cover of the cord grass may provide more protection for young and adults than other more patchy upper marsh areas. During winter, clapper rails may be more widely distributed in the marshes and may use the upper marsh vegetation for cover, especially during extreme high tides (U.S. Fish and Wildlife Service 1984). The California clapper rail feeds primarily on invertebrates; in south San Francisco Bay, the introduced horse mussel, spider clams, and yellow shore crabs are primary food items (Moffitt 1941)."

Pressures (MSCS Technical Reports, 1999)[12]

"Loss of tidal marshes is the primary reason for the decline of the California clapper rail. Many of the remaining marshes lack extensive high marsh habitat and have steep earthen levees, making them unsuitable for clapper rails. Additionally, pollution from sewage effluent, industrial discharges, and urban runoff has contaminated the species' food sources. Predation on young and eggs by the introduced red fox may be responsible for the recent rapid decline of the clapper rail population in south San Francisco Bay."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. The geographic priorities for implementing ERP actions to protect, enhance, and restore saline emergent wetlands and associated habitats for the California clapper rail should be (1) Gallinas/Ignacio marshes and Napa marshes, (2) Sonoma marshes, Petaluma marshes, and Highway 37 marshes west of Sonoma Creek, (3) Point Pinole marshes, (4) Highway 37 marshes east of Sonoma Creek, and (5) the Contra Costa County shoreline.
2. Coordinate protection, enhancement, and restoration of saltmarsh and associated habitats with other federal, State, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project and USFWS species recovery plans) that could affect management of current and historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
3. Restore wetland and perennial grassland habitats adjacent to occupied nesting habitats to create a buffer of natural habitat. This buffer would protect nesting pairs from adverse effects that could be associated with future changes in land use on nearby lands and provide suitable foraging habitat and nesting habitat suitable for the natural expansion of populations.
4. Initial species recovery efforts should be directed to locations where there are immediate opportunities for protection, enhancement, or restoration of suitable habitat.
5. To the extent practicable, design dikes constructed in enhanced and restored saline

emergent wetlands to provide optimal wetland-to-upland transitional habitat.

6. Direct ERP saltmarsh enhancement efforts toward existing degraded marshes that are of sufficient size and configuration to develop fourth- order tidal channels (marshes would most likely need to be at least 1,000 acres).

7. To the extent practicable, design saltmarsh enhancements and restorations that provide low-angle upland slopes at the upper edge of marshes to provide suitable and sufficient wetland-to-upland transition habitat. Transition habitat zones should be at least 0.25 mile wide.

8. Manage enhanced and restored habitat to avoid or minimize impacts on the California clapper rail that could be associated with recreational uses on lands acquired or managed under conservation easements.

9. Direct ERP restoration actions toward improving tidal circulation to diked wetlands that currently sustain partial tidal exchange.

10. Direct some habitat enhancements and restorations toward increasing habitat connectivity among existing and restored tidal marshes.

11. To the extent practicable, control non-native predator populations in occupied habitat and saltmarshes enhanced and restored under the ERP.

12. Identify and implement feasible methods for controlling invasive non- native marsh plants.

13. Monitor to determine use of restored saltmarsh habitat by California clapper rails and the rate at which restored habitats are colonized.

CALFED ERP Milestones[8a] (CALFED actions during Stage 1, the first 7 years)

<u>Delta & Eastside Delta Tributaries</u>

STRESSORS

* Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.
* Assist in the development and implementation of a black and clapper rail impact reduction program.
* Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.
* Conduct the following selenium work: Conduct selenium research to fill data gaps in order to refine regulatory goals of source control actions; determine bioavailability of selenium under several scenarios (from Phase II Report). Evaluate and, if appropriate, implement real-time management of selenium discharges (from Phase II Report). Expand and implement source control, treatment, and reuse programs (from Phase II Report). Coordinate with other programs; e.g., recommendations of San Joaquin Valley Drainage Implementation Program, CVPIA for retirement of lands with drainage problems that are not subject to correction in other ways (from Phase II Report). Support development and implementation of TMDL for selenium in the San Joaquin River watershed (focus on Grassland area).
* Conduct the following mercury evaluation and abatement work in the Delta (from Phase II Report): Determine methylization (part of bioaccumulation) process in Delta. Determine sediment mercury concentration in areas that would be dredged during levee maintenance or conveyance work. Determine potential impact of ecosystem restoration work on methyl mercury levels in lower and higher trophic level organisms.

<u>Sacramento River Basin</u>

STRESSORS

* Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.
* Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.

San Joaquin River Basin

STRESSORS

* Conduct the following selenium work: Conduct selenium research to fill data gaps in order to refine regulatory goals of source control actions; determine bioavailability of selenium under several scenarios (from Phase II Report). Evaluate and, if appropriate, implement real-time management of selenium discharges (from Phase II Report). Expand and implement source control, treatment, and reuse programs (from Phase II Report). Coordinate with other programs; e.g., recommendations of San Joaquin Valley Drainage Implementation Program, CVPIA for retirement of lands with drainage problems that are not subject to correction in other ways (from Phase II Report). Support development and implementation of TMDL for selenium in the San Joaquin River watershed (focus on Grassland area).
* Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.
* Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.

Suisun Marsh & North San Francisco Bay

HABITAT

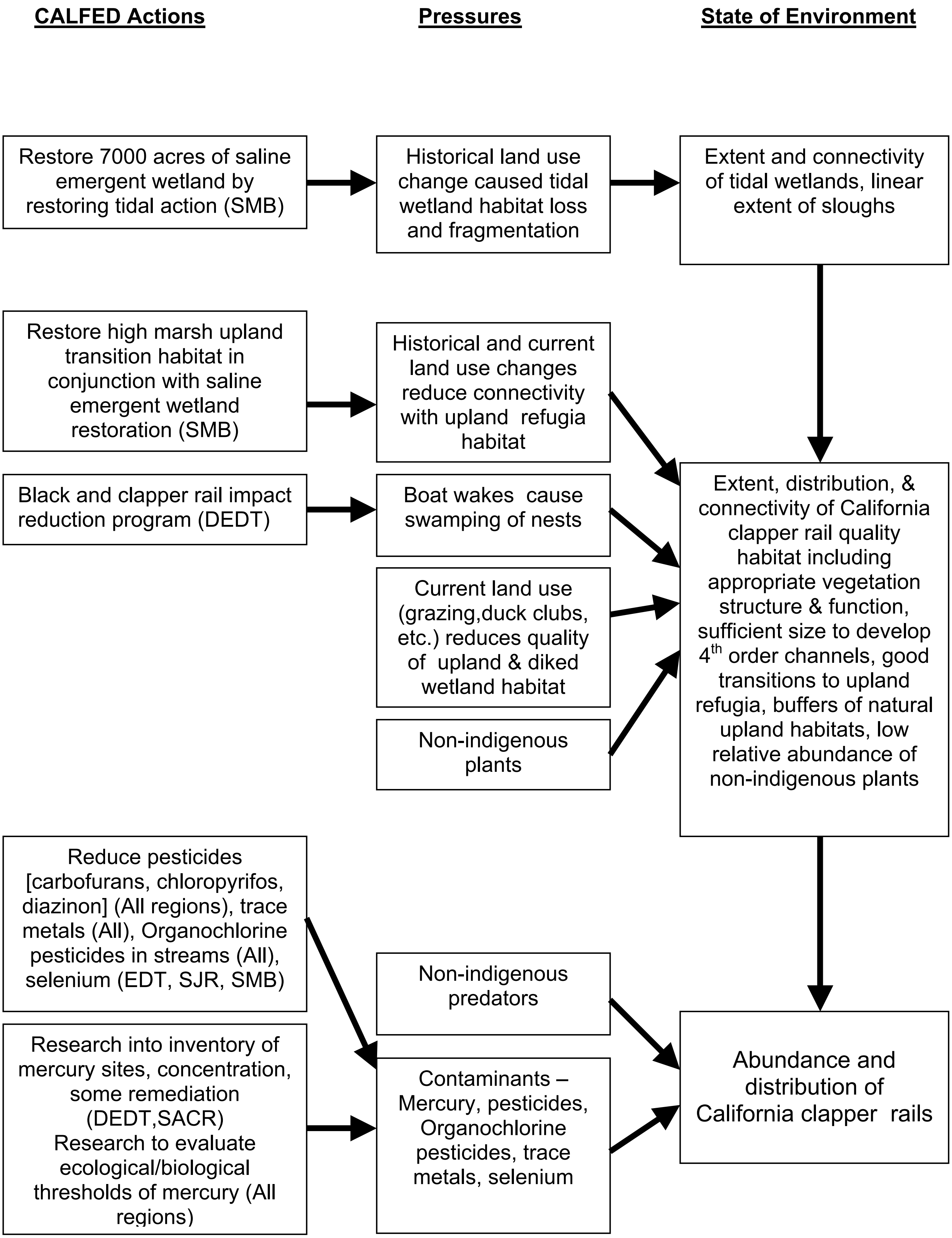
* In the Suisun Marsh/North San Francisco Bay EMZ, restore a minimum of 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. Develop cooperative programs to acquire, in fee-title or through a conservation easement, the land needed for tidal restoration, and complete the needed steps to restore the wetlands to tidal action. Begin aggressive program of control of non-native plant species that are threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak.
  - Bring into protection at least 25% of currently occupied, but unprotected Suisun Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management.
  - Expand suitable tidal slough habitat for Suisun Marsh aster by 25 linear miles.
  - Identify at least three protected and managed sites for introduction of at least three additional populations of Suisun thistle; increase overall population size at least threefold.
  - Establish at least one new population of soft bird's beak with high likelihood of success in restored habitat in each of the Suisun Bay and Marsh EMU, the Napa River EMU, and the Petaluma River EMU.

-Establish at least one new Point Reyes bird's beak population in the Petaluma River and San Pablo Bay EMUs.

STRESSORS

* Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.
* Conduct the following selenium work: Conduct selenium research to fill data gaps in order to refine regulatory goals of source control actions; determine bioavailability of selenium under several scenarios (from Phase II Report). Evaluate and, if appropriate, implement real-time management of selenium discharges (from Phase II Report). Expand and implement source control, treatment, and reuse programs (from Phase II Report). Coordinate with other programs; e.g., recommendations of San Joaquin Valley Drainage Implementation Program, CVPIA for retirement of lands with drainage problems that are not subject to correction in other ways (from Phase II Report). Support development and implementation of TMDL for selenium in the San Joaquin River watershed (focus on Grassland area).
* Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.

Figure G-6. California Clapper Rail Diagrammatic Conceptual Model



California yellow warbler **Scientific Name** *Dendroica petechia brewsteri*

Legal Status[11]: Federal endangered (FESA), California endangered (CESA), fully protected under California Fish and Game Code

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]
Maintain and enhance suitable riparian corridor migration habitats and restore suitable breeding habitat within the historical breeding range of these species in the Central Valley.

Straw-dog Monitoring Recommendations
* Abundance at sampling stations for riparian neotropical migratory birds
* Extent & distribution of available, protected, restored, and enhanced migration and breeding habitat with appropriate vegetation structure and function
* Extent & distribution of breeding habitat patches with factors that should contribute to low brown-headed cowbird abundance (presumably larger patches without adjacent land-uses that encourage the cowbirds) and occasional validation of cowbird abundance.

Existing Monitoring Program / Information Sources
Yolo County Habitat Conservation Plan (HCP) – Includes Alkali Milk-vetch, Bank Swallow, California Yellow Warbler, California Yellow-billed Cuckoo, Crampton's Tuctoria, Giant Garter Snake, Swainson's Hawk, Valley Elderberry Longhorn Beetle
Contact:Terry Roberts, City of West Sacramento Community Development
http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=3170
Point Reyes Bird Observatory, The Nature Conservancy, U.S. Fish & Wildlife Service: Sacramento River Bird Conservation Project – Riparian Birds
Contact: Stacy Small (www.prbo.org)
Point Reyes Bird Observatory, U.S. Fish & Wildlife Service: San Joaquin Restoration – Riparian Birds
Contact: Geoff Geupel (www.prbo.org)

NCCP Habitats[11] Valley/Foothill Riparian, Montane Riparian

ERP Mgmt Zone[12] North Sacramento Valley, Butte Basin, Colusa Basin, Cottonwood Creek, Sacramento River, Eastside Delta Tributaries

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]
"The California yellow warbler was once common throughout the entire northern portion of California, the Coast Ranges from the Oregon border to the Mexican border, the Central Valley, the Lower Colorado River Valley, the western and eastern slopes of the Sierra Nevada, and the foothills of the Transverse and Peninsular Ranges (Small 1994). This species has virtually disappeared in the Sacramento and San Joaquin Valleys with only 5% of available habitat being occupied in the upper Sacramento Valley (Remsen 1978). There are still breeding populations in the Sierra Nevada, coastal mountains, Owens Valley (Mono and Inyo Counties), and along the Mojave River (San Bernardino County). The largest breeding populations in southern California are in the Santa Ynez River Valley (San Bernardino County) and South Kern River Preserve (Kern County) (Small 1994).

"The California yellow warbler is a migrating bird that arrives in California to breed in April. By October, this warbler has left the state for wintering grounds (Zeiner et al. 1990). The species' breeding season is mid-April to early August, peaking in June (Zeiner et al. 1990). It nests in riparian habitats of the lowlands and foothill canyons, but will also nest in chaparral habitats with scattered trees and in montane coniferous forest below an elevation of 9,000 feet (Small 1994). The California yellow warbler feeds on insects and spiders (Zeiner et al. 1990)."

Pressures (MSCS Technical Reports, 1999)[12]
"The main reason for the decline of the California yellow warbler is brood parasitism by the brown-headed cowbird (Zeiner et al. 1990). The destruction and degradation of riparian habitat, especially in valleys and lowlands, has also contributed to the decline of this species (Remsen 1978)."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Coordinate protection and restoration of riparian habitat with other federal, State, and nonprofit programs (e.g., the Riparian Habitat Joint Venture, the SB1086 program, and USACE's Sacramento and San Joaquin Basin Comprehensive Study) that could affect management of current and historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
2. To the extent consistent with CALFED objectives, protect existing suitable riparian habitat corridors from future changes in land use or other activities that could result in the loss or degradation of habitat.
3. A portion of restored riparian habitat should be designed to include riparian scrub communities.
4. To the extent practicable, restore riparian habitats in patch sizes sufficient to discourage nest parasitism by brown-headed cowbirds.

CALFED ERP Milestones[8a] (CALFED actions during Stage 1, the first 7 years)
<u>Delta & Eastside Delta Tributaries</u>
PROCESSES
* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within the Eastside Delta Tributaries EMZ.
* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within the Eastside Delta Tributary EMZ.

HABITAT
* Implement 25 percent of the ERP target for diverse, self-sustaining riparian community for each EMU in the Sacramento-San Joaquin Delta EMZ.
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within the Eastside Delta Tributary EMZ
* Restore a minimum of 300 acres of self-sustaining or managed diverse natural riparian habitat along the Mokelumne River, Cosumnes River, and Calaveras River and protect existing riparian habitat.

<u>Sacramento River Basin</u>
PROCESSES
* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ in the Sacramento River Basin.
* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a

seasonal basis for at least one tributary within each of the EMZs in the Sacramento River Basin. Among the areas to be included are the lower 10 miles of Clear Creek, Antelope Creek, and Deer Creek, and the lower reach of Cottonwood Creek.

* Design and begin implementation of an ecologically based streamflow regulation plan for Yuba River, Butte Creek, Big Chico Creek, Deer Creek, Mill Creek , Antelope Creek, Battle Creek, Cottonwood Creek, and Clear Creek.

HABITAT

* Restore 2 miles of the 10 mile target of riparian habitat restoration along the lower reaches of each of the following tributaries: Battle, Clear, Deer, Mill, Butte, Big Chico, Antelope, Feather, Yuba, and Bear Rivers.
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within each of the following Ecological Management Zones: American River Basin, Butte Basin, Colusa Basin, Cottonwood Creek, Feather River/Sutter Basin, North Sacramento Valley, Sacramento River, and Yolo Basin. While restoring habitat conditions in the American River EMZ, maintain continuous corridors of suitable riparian habitat for valley elderberry longhorn beetle. Protect existing known occurrences of northern California black walnut native stands through conservation easement or purchase. Identify at least 3 protected and managed sites for introduction of additional populations of northern California black walnut; begin introduction and monitor for success. Population creation should be part of a broader effort to restore riparian areas which historically contained walnut.
* In the Cottonwood Creek EMZ, complete (1) long-term agreements with local landowners to establish, restore, and maintain riparian communities along 25 percent of the upper and 25 percent of the lower reaches of Cottonwood Creek, and (2) the development of a comprehensive watershed management plan that supports local land use decisions to protect existing riparian and restore lost riparian.

<u>San Joaquin River Basin</u>

PROCESSES

* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ within the San Joaquin River Basin. In the East San Joaquin Basin EMZ, complete fluvial geomorphic assessments on all tributaries.
* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within each of the EMZs in the San Joaquin River Basin. Among the areas to be included are at least 10 miles of stream channel in the West San Joaquin EMZ.
* Develop a cooperative program to restore salmonid spawning and rearing habitat in the Tuoloumne, Stanislaus, and Merced Rivers that includes the following elements: (1) reconstructing channels at selected sites by isolating or filling in inchannel gravel extraction areas; (2) increasing natural meander by removing riprap and relocating other structures that impair stream meander; and (3) restoring more natural channel configurations to reduce salmonid predator habitat and improve migration corridors.

HABITAT

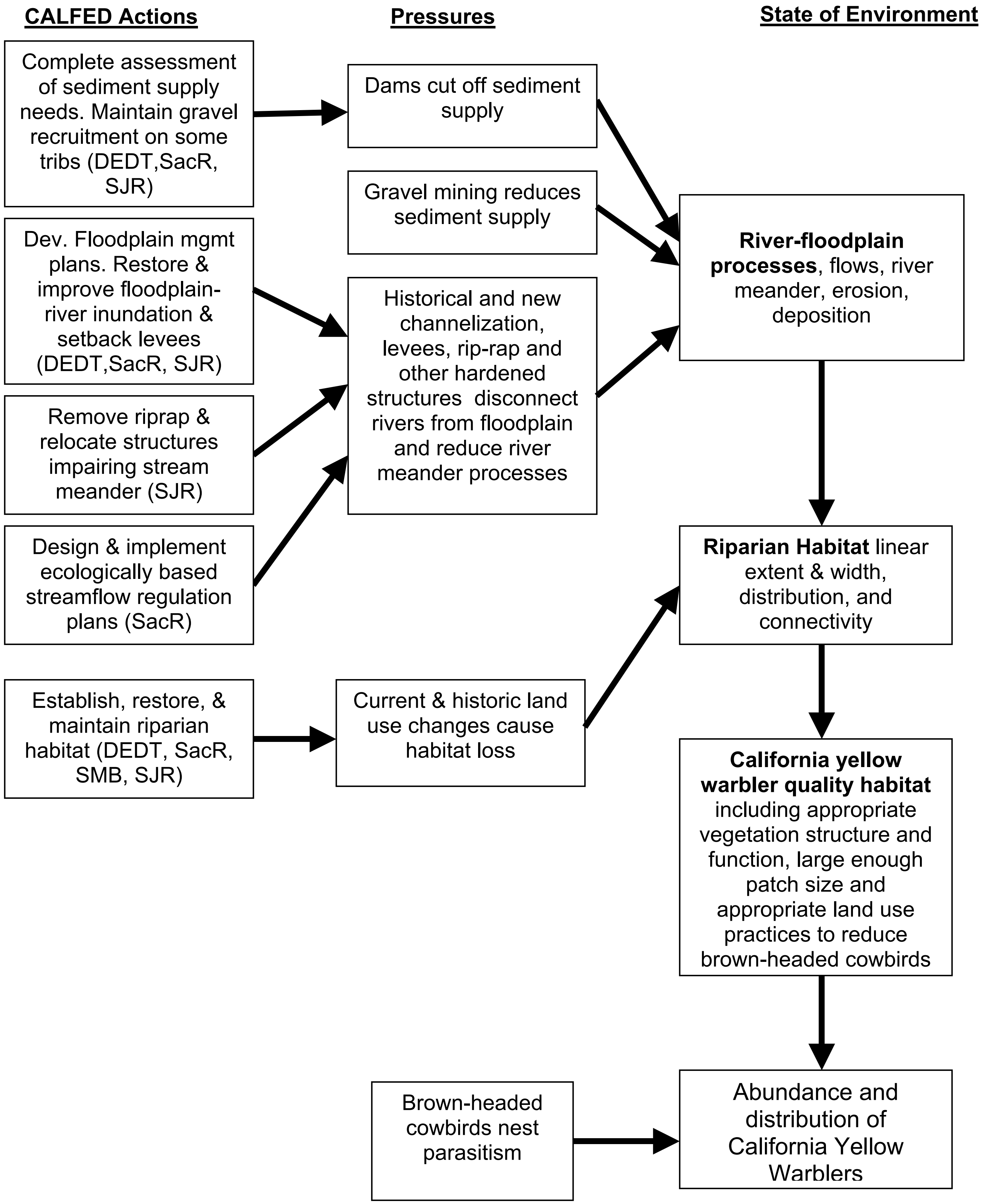
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat and instream cover along at least one tributary within the East San Joaquin and San Joaquin River EMZs.

Suisun Marsh & North San Francisco Bay

HABITAT

* Restore and maintain a minimum of three linear miles of riparian habitat along corridors of existing riparian scrub and shrub vegetation in each of the Ecological Management Units of the Suisun Marsh/North San Francisco Bay Ecological Management Zone.

Figure G-7. California Yellow Warbler Diagrammatic Conceptual Model



<u>Contra Costa Wallflower</u> **Scientific Name** *Erysimum capitatum ssp. Angustatum*

Legal Status[11]**:** Federal endangered (FESA), California Endangered (CESA), CNPS List 1B

CALFED ERP GOAL[8,11] **"Recover (R)"**

MSCS Goal prescription[11]

Continue protection of and expand the size of these species' Antioch Dunes populations, enhance and restore suitable habitat at and in the vicinity of the Antioch Dunes, and achieve recovery goals identified in the USFWS recovery plan.

Straw-dog Monitoring Recommendations

* number & location of populations, annual population counts (existing program)
* spatial extent & distribution of available habitat and enhanced habitat
* Annually monitor establishment success and modify establishment and management techniques as needed using adaptive management

Existing Monitoring Programs / Information Sources

USFWS Antioch Dunes National Wildlife Refuge: Antioch Dunes Evening Primrose and Contra Costa Wallflower – Monitoring Annual populations counts of both species
Contact: Ivette Loredo

NCCP Habitats[11] Inland Dune Scrub

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay, Yolo Basin

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"Contra Costa wallflower is endemic to Antioch Dunes in northern Contra Costa County, near the confluence of the Sacramento and San Joaquin Rivers, at an elevation of from 50 to 80 feet. Its historical range may not have been much greater than its current range, a 70-acre area of sandy bluffs overlooking the San Joaquin River (Natural Diversity Data Base 1998).

"Contra Costa wallflower, a member of the mustard family (Brassicaceae), is a coarse-stemmed, erect, herbaceous biennial, 20-80 centimeters tall. It grows in fine sand with some clay among grasses, shrubs, and other forbs on and near the tops of remnants of ecologically stabilized interior dunes. Flowering time is March-July."

Pressures (MSCS Technical Reports, 1999)[12]

"Interior dune habitat found in the Sacramento-San Joaquin Delta has been reduced to a fragment of its original extent by industrial development and sand mining. The remaining habitat has been disturbed and degraded by rototilling for fire control, off-road-vehicle activity, and the establishment of and competition by aggressive non-native plants (California Department of Fish and Game 1992). Designated Critical Habitat. Inland dune habitat near Antioch at T2N, R2E, Section 17 SW ¼, and Section 18 E b of S a was designated as critical habitat (42 FR no.26, February 8, 1977)."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Coordinate protection and restoration of inland dune scrub habitats with other programs (e.g., USFWS recovery plans and management of the Antioch Dunes Preserve) that could affect management of occupied and historical habitat. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
2. Conduct surveys to locate potential habitat restoration sites on Tinnin soils. Identify opportunities for and implement permanent protection, restoration, and management of habitat

to enhance habitat conditions for these species.

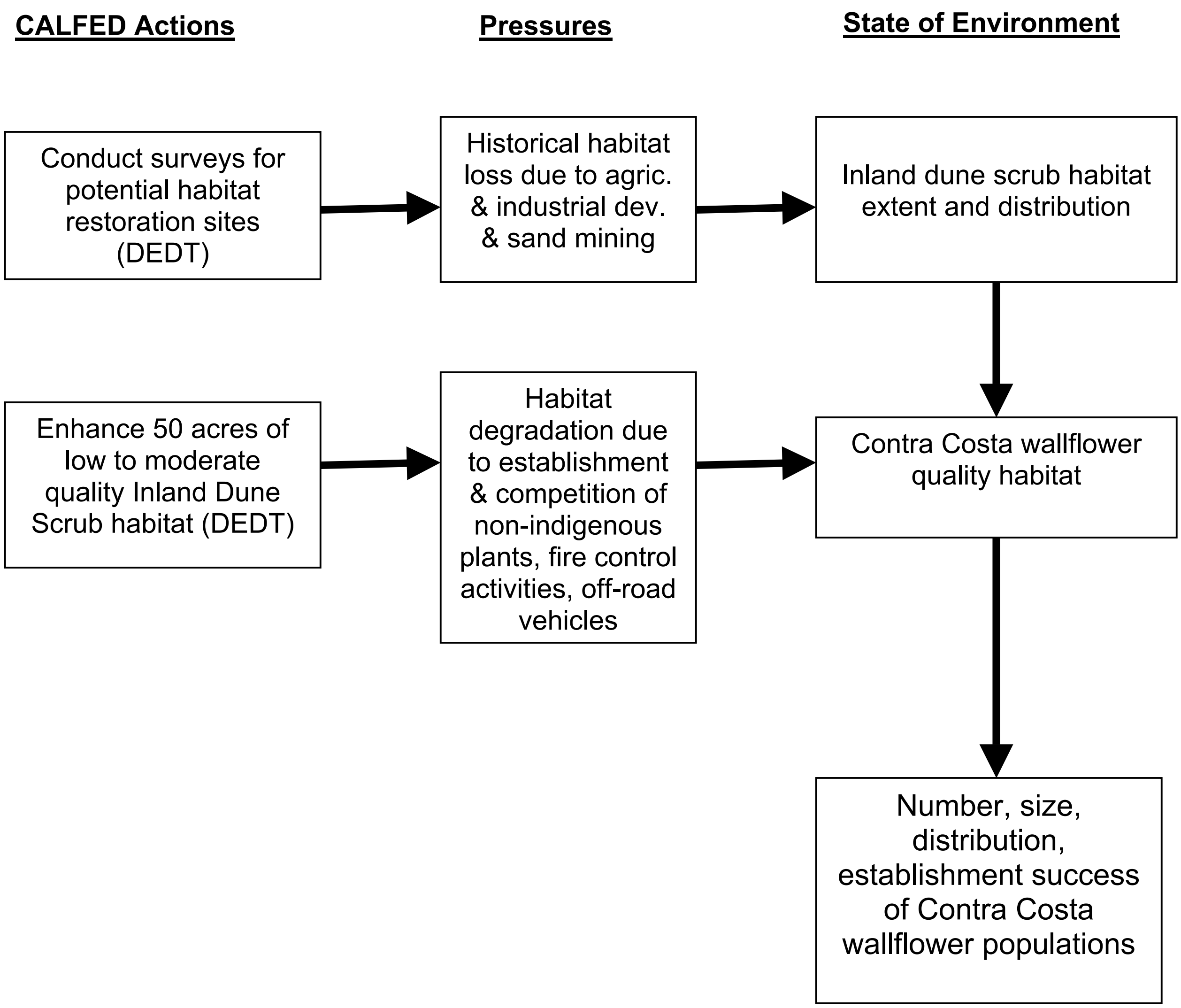
3. Enhance and maintain existing occurrences.
4. Annually monitor establishment success and modify establishment and management techniques as needed using adaptive management.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

DELTA & EASTSIDE DELTA TRIBUTARIES

* Conduct surveys to locate potential habitat restoration sites capable of supporting Antioch dunes evening primrose, Contra Costa wallflower, and Lange's metalmark butterfly. Enhance 50 acres of low to moderate quality Antioch inland dune scrub habitat to support these species. Annually monitor establishment success.

Figure G-8. Contra Costa Wallflower Diagrammatic Conceptual Model



<u>Crampton's tuctoria</u> **Scientific Name** *Tuctoria mucronata*

Legal Status[11]: Federal endangered (FESA), California Endangered (CESA), CNPS List 1B

CALFED ERP GOAL[8,11] **"Contribute to Recovery (r)"**

MSCS Goal prescription[11]

Review and update recovery plan targets, protect all extant occurrences, and manage habitat to benefit Crampton's tuctoria (e.g., manage grazing).

Straw-dog Monitoring Recommendations

* Number & distribution of populations, including number of newly established populations

Existing Monitoring Program / Information Sources

?

NCCP Habitats[11] Natural Seasonal Wetlands

ERP Mgmt Zone[12] Delta, Yolo Basin

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"Crampton's tuctoria is endemic to the western Sacramento Valley. Its historical range was most likely limited to this area; however, much of its potential habitat was eliminated before the species was recognized. Crampton's tuctoria is presently known from three locations: two sites south of the city of Dixon in Solano County and one on the U.S. Air Force Communications Facility south of the city of Davis in Yolo County. (California Department of Fish and Game 1996.)

"Crampton's tuctoria is a sticky, aromatic annual in the grass family (Poaceae). It is less than 12 centimeters tall and grows in the clay bottoms of drying vernal pools and vernal lakes surrounded by grassland. Flowering time is June-July. (Natural Diversity Data Base 1998.)"

Pressures (MSCS Technical Reports, 1999)[12]

"…may have declined precipitously when intense agricultural development began in the Sacramento Valley. Threats to the remaining populations include off-road-vehicle use, agricultural operations, trampling by livestock, and hydrologic alterations. Roads and utility corridors have also degraded habitats. (California Department of Fish and Game 1992.)"

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Establish three new self-sustaining populations in conjunction with establishment of Delta green ground beetle populations.
2. Maintain existing populations.

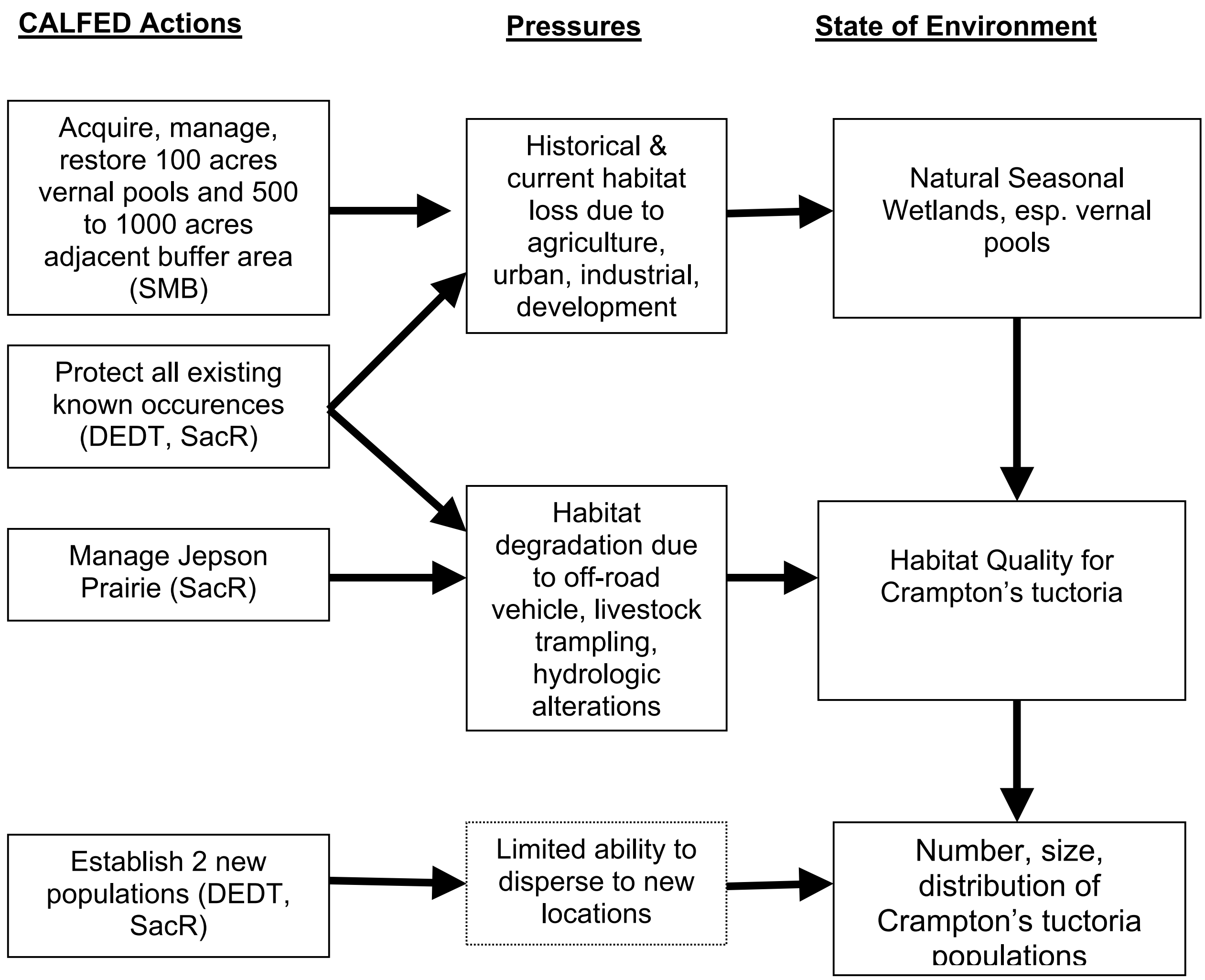
CALFED ERP Milestones[8a] **(CALFED actions during Stage 1, the first 7 years)**

<u>Suisun Marsh & North San Francisco Bay</u>

HABITAT

* Develop a cooperative program to acquire, manage and restore 100 acres of vernal pools and 500 to 1,000 acres of adjacent buffer areas in the Suisun Marsh/North San Francisco Bay EMZ. Protect all existing known occurrences of Crampton's tuctoria through conservation easement or purchase from willing sellers (including CNDDB Element Occurrence #2 and any new populations that are found). Identify at least two protected and managed sites for introduction of additional populations; begin introduction and monitor for success. Manage at least 250 acres of the ERP target for vernal pools near the Jepson Prairie preserve as suitable habitat for alkali milk vetch. Establish new populations on protected and appropriately managed lands. Bring 50% of currently unprotected, existing populations into protection through purchase or conservation agreement, and ensure appropriate management.

Figure G-9. Crampton's tuctoria Diagrammatic Conceptual Model



Delta coyote-thistle **Scientific Name** *Eryngium racemosum*

Legal Status[11]**:** California Endangered (CESA), CNPS List 1B

CALFED ERP GOAL[8,11] **"Contribute to Recovery (r)"**

MSCS Goal prescription[11]

Survey all extant populations and potential suitable habitat across the range of the species and update population status and land ownership information. Based on survey results, bring at least 10 of the largest naturally occurring populations that are viable in the long term, and that are not presently protected, into permanent protected status. Also based on survey results, bring at least 50% of all extant populations and individuals under permanent protected status. Manage all protected populations for long-term viability.

Increase suitable habitat by at least 50% over its existing extent (based on survey results). Increase populations and individuals by at least 25% over their existing numbers, based on survey results. Newly discovered populations will be evaluated for protection based on geographic representation, viability, genetics, ecology, and opportunity for long-term protection.

Straw-dog Monitoring Recommendations

* Number, size, distribution & protection status of populations at 2-year intervals
* Extent and distribution of available habitat, protected habitat, restored habitat, and enhanced habitat

Existing Monitoring Program / Information Sources

?

NCCP Habitats[11] Nontidal Freshwater Permanent Emergent, Valley/Foothill Riparian

ERP Mgmt Zone[12] Eastside Delta Tributaries, East San Joaquin Basin, San Joaquin River, West San Joaquin Basin

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"Delta coyote-thistle's historical distribution includes Calaveras, Merced, Stanislaus, and San Joaquin Counties. Of the approximately 20 known occurrences, about one-third have been extirpated, including all occurrences in San Joaquin County and most in Stanislaus County. Most extant occurrences are found in Merced County along the San Joaquin River (California Department of Fish and Game 1998, Natural Diversity Data Base 1998).

"Delta coyote-thistle is a herbaceous perennial in the carrot family (Apiaceae). It grows 10-50 centimeters tall and occurs at elevations of 15-75 feet. Delta coyote-thistle occurs on clay soils on sparsely vegetated margins of seasonally flooded floodplains and swales, freshwater marshes, and riparian areas. Suitable habitat is supported by periodic flooding, which maintains seasonal wetland hydrology and reduces competition through scouring (California Department of Fish and Game 1998). Flowering time is July-October."

Pressures (MSCS Technical Reports, 1999)[12]

Flood control activities and conversion of lowlands to agriculture have affected many populations. Friant Dam on the San Joaquin River and an extensive levee system have greatly reduced the frequency and flooding of floodplain habitat. Riparian restoration or waterfowl enhancement projects could also threaten the species if habitat areas are artificially flooded during critical stages in the life cycle (California Department of Fish and Game 1998).

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Survey all extant populations and other suitable habitat and update ecological, population,

and land ownership information.

2. Based on survey results, bring at least an additional 10 of the largest naturally occurring populations that are viable in the long term into permanent protected status and provide sufficient buffers for each. New populations will be evaluated based on geographic representation, viability, genetics, ecology, and opportunity for long-term protection. The objective is to establish a collection of protected populations that represent the full range of the species' biological and ecological amplitude.

3. Manage the protected populations for long-term viability. This measure includes research into the coyote-thistle's ecological requirements (biotic and abiotic) and appropriate management strategies. Evaluate and implement appropriate habitat management measures for maintaining populations and suitable habitat.

4. Establish and protect new populations in newly created floodplain habitat along the San Joaquin River and associated sloughs in Merced and Stanislaus counties. Study the genetic structure of extant populations before establishment activities begin so that new populations are created using appropriate genetic stock.

5. Restore, enhance, and protect unoccupied suitable habitat near existing populations, and avoid impacts on existing populations to the greatest extent practicable during restoration activities.

6. Monitor population trends for all natural protected and unprotected populations once every 5 years for the life of CALFED.

7. Once methods for successful population creation, restoration, and repatriation have been tested, evaluated, and implemented, monitor trends for these populations once a year for 5 years and then once every 2 years for an additional 6 years. When any of these populations demonstrates successful establishment, monitor trends every 5 years for the remainder of CALFED.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

<u>Delta & Eastside Delta Tributaries</u>

HABITAT

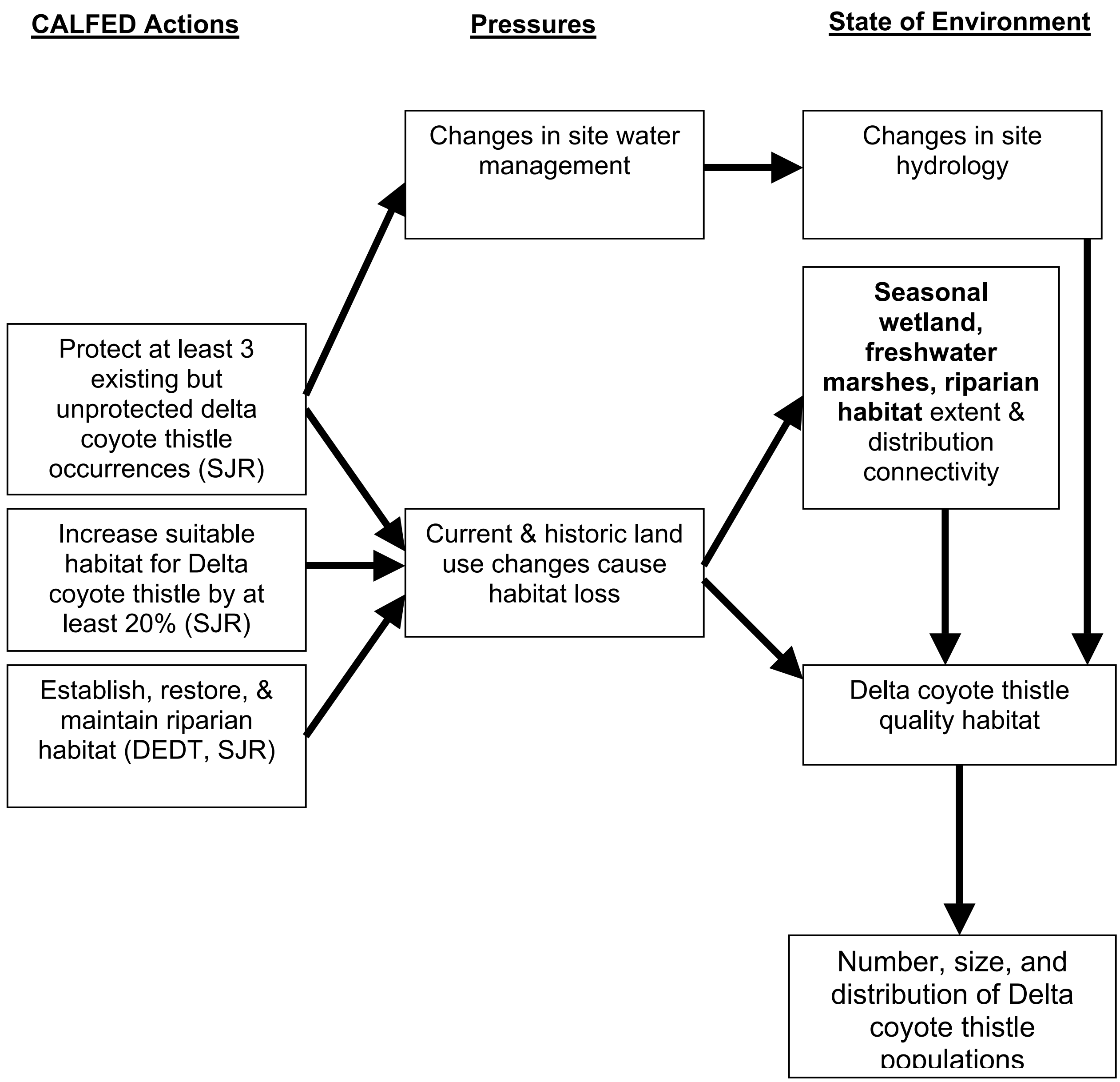
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within the Eastside Delta Tributary EMZ

<u>San Joaquin River Basin</u>

HABITAT

* Implement 25 percent of the ERP target for diverse, self-sustaining riparian community for all EMZs in the San Joaquin River Basin. Bring at least three of the currently existing but unprotected delta coyote thistle occurrences into protection through purchase or conservation agreement, and ensure appropriate management. Increase suitable habitat for delta coyote thistle by at least 20% and the number of populations and individuals by at least 10% through habitat management and protection. Establish two new riparian brush rabbit habitat preserves within the historical range of the species. Protect and enhance a minimum of 150 contiguous acres of mature, shrub-rich riparian forest and associated highwater refugia on the San Joaquin River, between the Merced River confluence and Vernalis, and on each of the east-side tributaries (the Stanislaus, Tuolumne and Merced rivers) for habitat values and as potential riparian brush rabbit re-introduction sites.
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat and instream cover along at least one tributary within the East San Joaquin and San Joaquin River EMZs.

Figure G-10. Delta Coyote Thistle Diagrammatic Conceptual Model



<u>Delta Green Ground Beetle</u> Scientific Name *Elaphrus viridis*

Legal Status[11]: Federal threatened (FESA)

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]

Protect all known occupied habitat from adverse effects associated with current and future land uses, and establish three additional populations of the delta green ground beetle within its current and/or historical range.

Straw-dog Monitoring Recommendations

* Number, location, & protection status of populations
* Extent and distribution of available, protected, restored and enhanced habitat with appropriate vegetation structure and composition

Existing Monitoring Program / Information Sources

?

NCCP Habitats[11] Natural Seasonal Wetlands

ERP Mgmt Zone[12] Yolo Basin

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"The delta green ground beetle's historical distribution is largely unknown, although it is believed to have once been widely distributed over the wetland and grassland habitat of the California Central Valley. Currently, this beetle is known from only two sites in Solano County, California, south of Dixon at the Jepson Prairie Preserve (Jones and Stokes file information).

"Delta green ground beetle habitat is disputed. Some entomologists suggest that its habitat is mainly dense vegetation, while others suggest that it can be found mostly in more open habitats, including open borders of vernal pools. It has been found among Erodium sp. and other low-growing plants (Arnold 1983). Behavioral data on the delta green ground beetle is limited, but available information indicates that adult activity begins in February and continues until mid-May, when it enters a period of dormancy. E. viridis most likely has only one generation per year (Arnold 1983). Adults tend to be diurnal and are active during the warmest time of the day. Observations suggest that activity may be dependent on minimal wind and ambient temperatures."

Pressures (MSCS Technical Reports, 1999)[12]

"The delta green ground beetle has declined from agricultural, urban, and industrial development of California wetland habitat (Jones and Stokes file information)."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Coordinate protection, enhancement, and restoration of delta green ground beetle populations and its habitat with other federal and State programs (e.g., USFWS species recovery plans and management of the Jepson Prairie Preserve) that could affect management of current and historical habitat. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
2. Direct ERP actions toward protecting, enhancing, and restoring suitable vernal pool and associated grassland habitat within the species historical range, including expansion of Jepson Prairie Preserve westward to Travis Air Force Base.
3. To the extent consistent with ERP objectives, direct ERP actions toward protection of the Davis Antenna Site population.
4. Conduct surveys to identify suitable habitat, including enhanced and restored habitats,

for establishment of additional populations in the Delta and Bay Regions, and implement species introductions to establish three additional populations.

5. To the extent consistent with CALFED objectives, manage lands purchased or acquired under conservation easements that are occupied by the species to maintain or increase current population levels, and enhance occupied habitat.

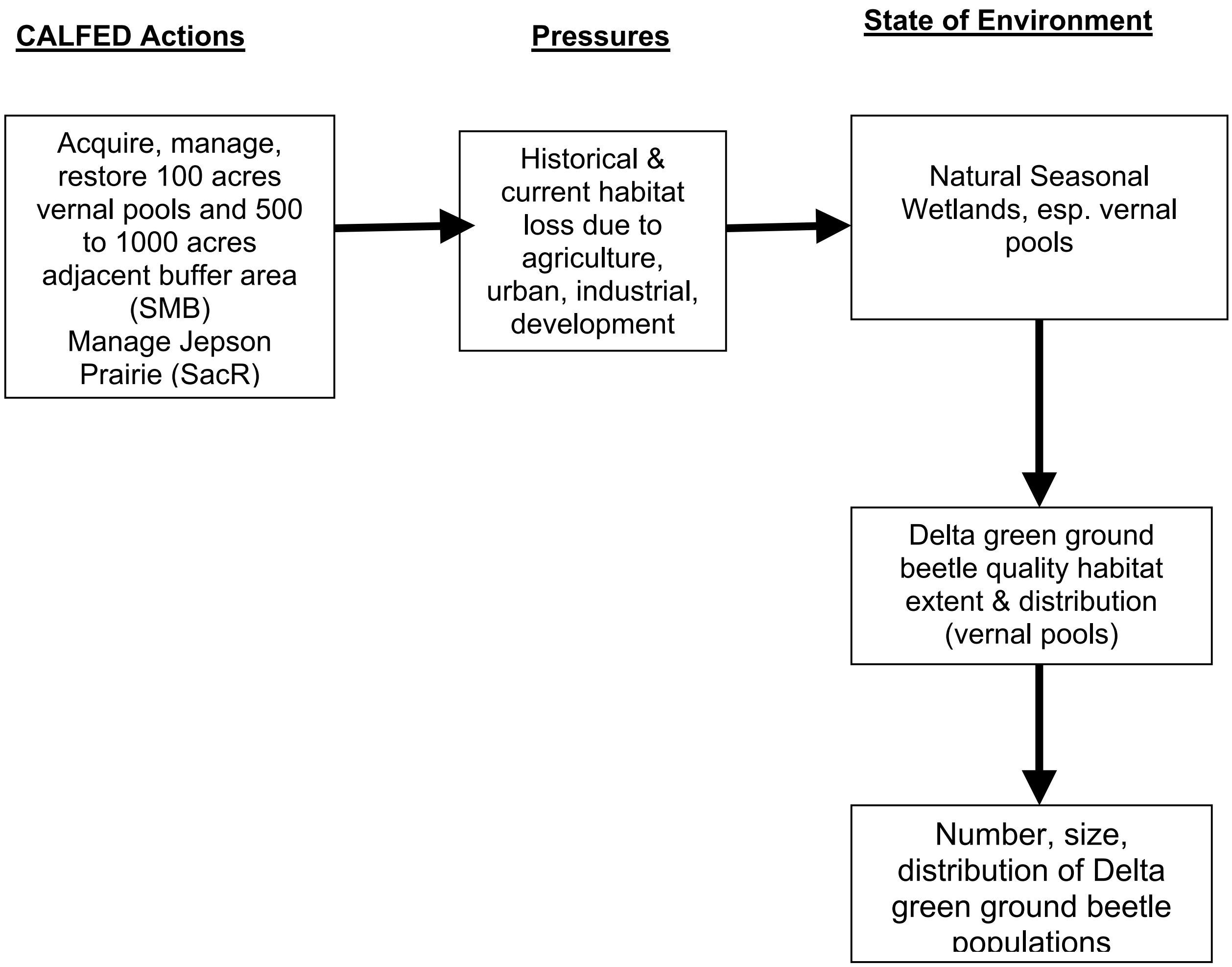
CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

<u>Suisun Marsh & North San Francisco Bay</u>

HABITAT

* Develop a cooperative program to acquire, manage and restore 100 acres of vernal pools and 500 to 1,000 acres of adjacent buffer areas in the Suisun Marsh/North San Francisco Bay EMZ. Protect all existing known occurrences of Crampton's tuctoria through conservation easement or purchase from willing sellers (including CNDDB Element Occurrence #2 and any new populations that are found). Identify at least two protected and managed sites for introduction of additional populations; begin introduction and monitor for success. Manage at least 250 acres of the ERP target for vernal pools near the Jepson Prairie preserve as suitable habitat for alkali milk vetch. Establish new populations on protected and appropriately managed lands. Bring 50% of currently unprotected, existing populations into protection through purchase or conservation agreement, and ensure appropriate management.

Figure G-11. Delta green ground beetle Diagrammatic Conceptual Model



Delta mudwort Scientific Name *Limosella subulata*

Legal Status[11]: CNPS List 2

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]

Protect at least 90% of occupied habitat, including 90% of high-quality habitat, throughout the range of the species to protect geographic diversity, and expand suitable and occupied habitat by 100 linear miles.

Straw-dog Monitoring Recommendations

* linear miles & location of occupied habitat
* linear miles & location of available habitat, protected habitat, restored habitat

Existing Monitoring Program / Information Sources

?

NCCP Habitats[11] Tidal Freshwater Emergent

ERP Mgmt Zone[12] Eastside Delta Tributaries, Suisun Marsh/North San Francisco Bay, Yolo Basin

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"Delta mudwort is distributed throughout Contra Costa, Sacramento, San Joaquin, and Solano Counties. The 30 known occurrences are on private, California Department of Fish and Game (DFG), and California Department of Parks and Recreation property (Natural Diversity Data Base 1998).

"Delta mudwort is a small rhizomatous perennial of the figwort family (Scrophulariaceae) that grows in tufted mats. The species grows along eroding banks inundated by the tide where freshwater is prevalent, especially along edges of channel islands where competition is limited. Delta mudwort produces white flowers on single stalks and generally blooms from May through August (Hickman 1993, Skinner and Pavlik 1994)."

Pressures (MSCS Technical Reports, 1999)[12]

"…threatened by trampling by livestock, recreational activities, competition from non-native plants, erosion by wave action, rises in sea level, and water quality degradation (Natural Diversity Data Base 1998)."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Maintain processes that support the dynamic habitat of Delta mudwort and Delta tule pea throughout the species' range and associated with existing source populations.
2. To the extent consistent with CALFED objectives, create unvegetated, exposed substrate at tidal margins of restored and created tidal fresh emergent wetland and riparian habitat.
3. To the extent consistent with CALFED objectives, incorporate suitable habitat for these species into levee designs.
4. Incorporate sufficient edge habitat to support the species in levee set back and channel island habitat restoration designs.
5. Maximize sinuosity of restored and created slough channels to increase water-land edge habitat.
6. Maintain and restore habitat and populations throughout the species geographic ranges, and expand the species ranges to the historical and ecological ranges based on hydrological, salinity, and other habitat attributes.
7. Monitor existing populations and their habitat at 5-year intervals.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

Delta & North San Francisco Bay

HABITAT

* Restore a minimum of 15 miles of slough habitat (widths less than 50 to 75 feet) in each of the North, East, South, Central and West Delta EMUs that allows for the colonization of delta mudwort and delta tule pea.
* Restore a minimum of 500, 500, 4,000, and 5,000 acres of tidal emergent wetland in the North, East, South, and Central and West Delta Ecological Management units respectively.

STRESSORS

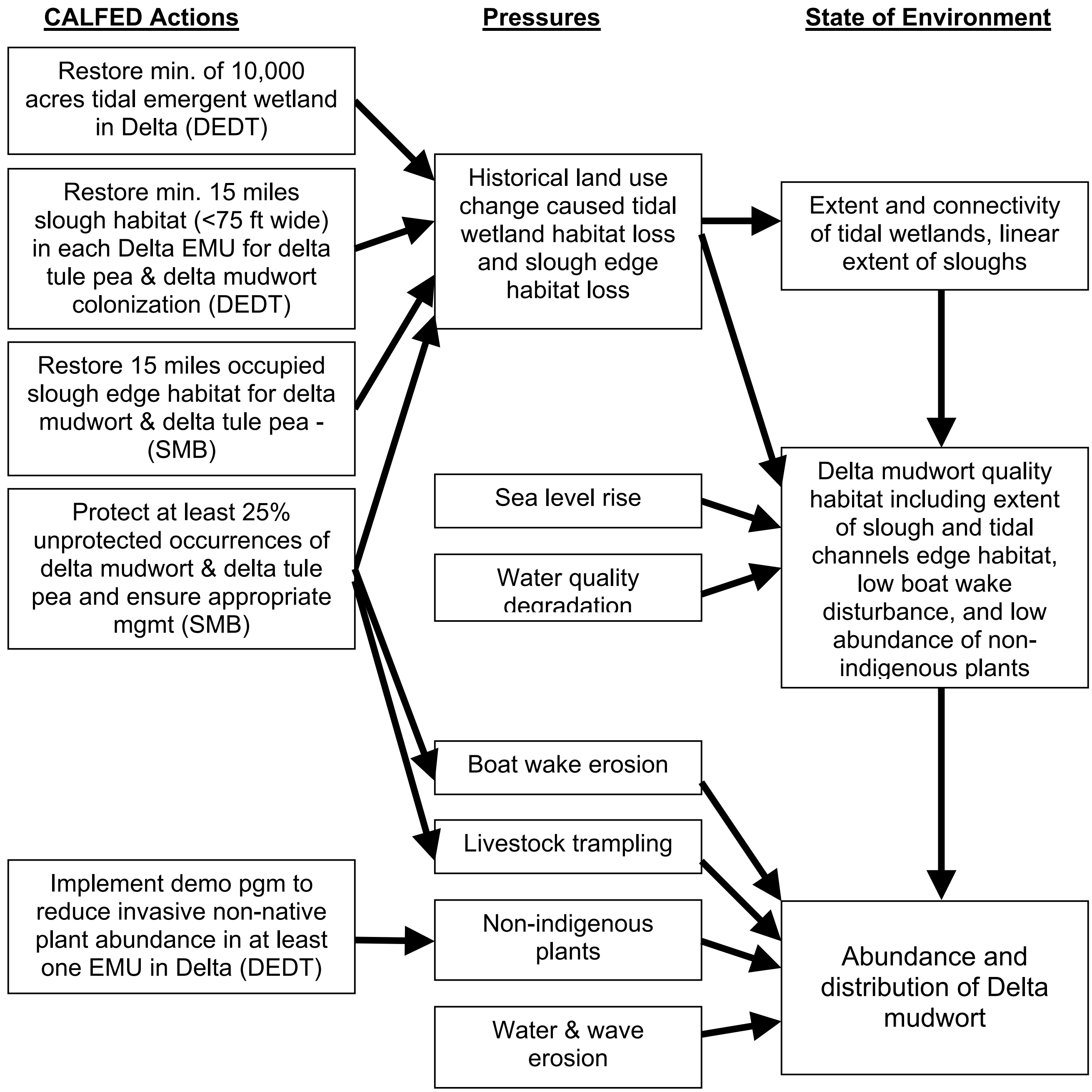
* Develop and begin implemention of a demonstration program to reduce invasive non-native plant abundance within at least one EMU in the Delta.

Suisun Marsh & North San Francisco Bay

HABITAT

* Restore suitable, occupied slough edge habitat for delta mudwort and delta tule pea by at least 5 miles in the Suisun Bay and Marsh EMU and by at least 10 miles in the Napa River EMUs. Bring at least 25% the currently existing but unprotected occurrences of delta mudwort and delta tule into protection through purchase or conservation agreement, and ensure appropriate management.

Figure G-12. Delta Mudwort Conceptual Model



<u>Delta tule pea</u> **Scientific Name** *Lathyrus jepsonii var. jepsonii*

Legal Status[11]: CNPS List 1B

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]

Protect at least 90% of occupied habitat, including 90% of high-quality habitat, throughout the range of the species to protect geographic diversity, and expand suitable and occupied habitat by 100 linear miles.

Straw-dog Monitoring Recommendations

* linear miles & location of occupied habitat
* linear miles & location of available habitat, protected habitat, restored habitat

Existing Monitoring Program / Information Sources

?

NCCP Habitats[11] Saline Emergent, Tidal Freshwater Emergent

ERP Mgmt Zone[12] Delta, Suisun Marsh/North San Francisco Bay

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

?

Pressures (MSCS Technical Reports, 1999)[12]

"…threatened by marsh habitat alteration and loss. Factors leading to marsh habitat alteration and loss include development, agriculture, recreation, channelization, channel maintenance activities, and marsh drainage."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Maintain processes that support the dynamic habitat of Delta mudwort and Delta tule pea throughout the species' range and associated with existing source populations.
2. To the extent consistent with CALFED objectives, create unvegetated, exposed substrate at tidal margins of restored and created tidal fresh emergent wetland and riparian habitat.
3. To the extent consistent with CALFED objectives, incorporate suitable habitat for these species into levee designs.
4. Incorporate sufficient edge habitat to support the species in levee set back and channel island habitat restoration designs.
5. Maximize sinuosity of restored and created slough channels to increase water-land edge habitat.
6. Maintain and restore habitat and populations throughout the species geographic ranges, and expand the species ranges to the historical and ecological ranges based on hydrological, salinity, and other habitat attributes.
7. Monitor existing populations and their habitat at 5-year intervals.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

<u>Delta & Eastside Delta Tributaries</u>

HABITAT

* Restore a minimum of 15 miles of slough habitat (widths less than 50 to 75 feet) in each of the North, East, South, Central and West Delta EMUs that allows for the colonization of delta mudwort and delta tule pea.
* Restore a minimum of 500, 500, 4,000, and 5,000 acres of tidal emergent wetland in the North, East, South, and Central and West Delta Ecological Management units respectively.

STRESSORS

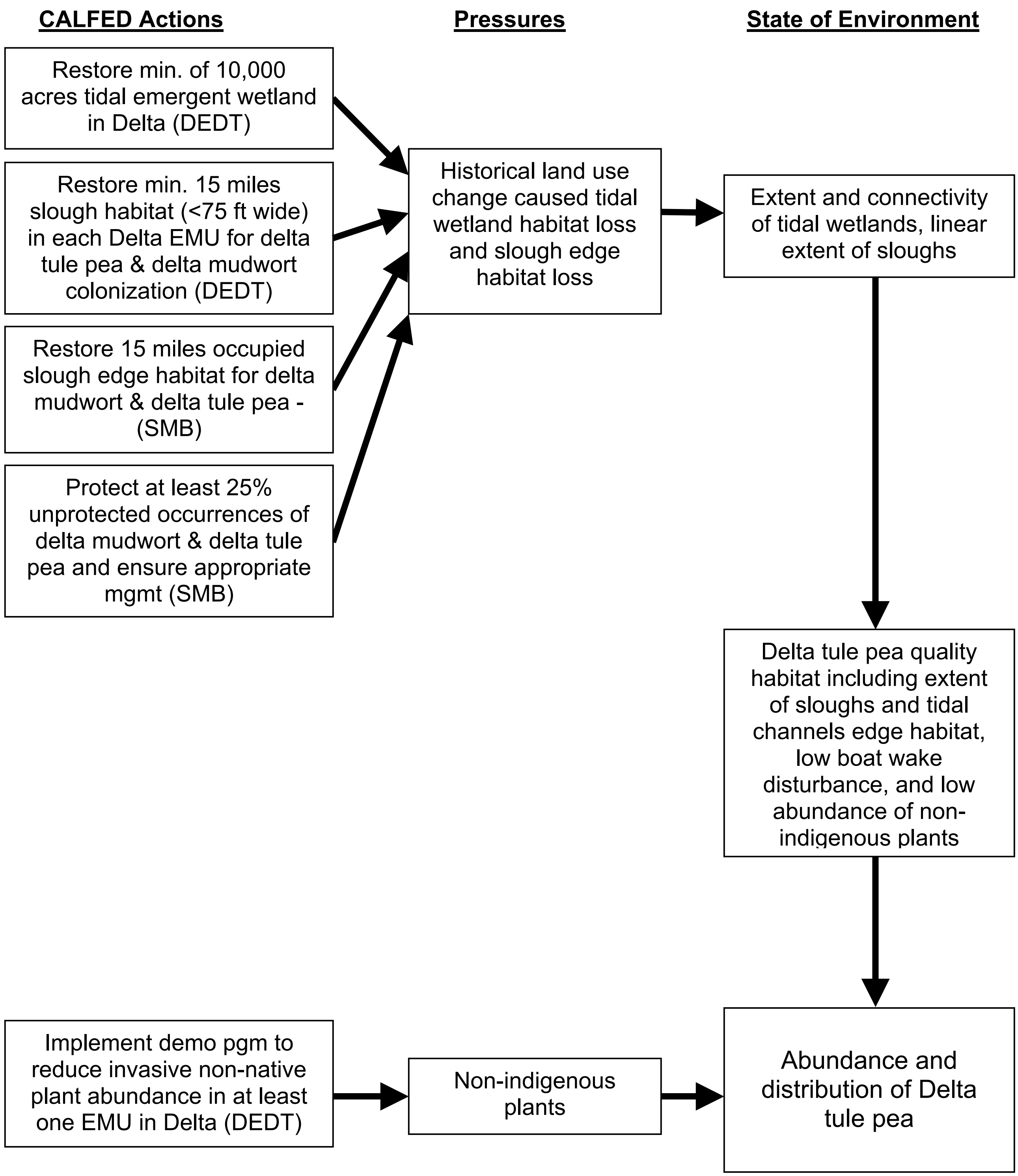
* Develop and begin implementation of a demonstration program to reduce invasive non-native plant abundance within at least one EMU in the Delta.

<u>Suisun Marsh & North San Francisco Bay</u>

HABITAT

* Restore suitable, occupied slough edge habitat for delta mudwort and delta tule pea by at least 5 miles in the Suisun Bay and Marsh EMU and by at least 10 miles in the Napa River EMUs. Bring at least 25% the currently existing but unprotected occurrences of delta mudwort and delta tule into protection through purchase or conservation agreement, and ensure appropriate management.

Figure G-13. Delta Tule Pea Conceptual Model



<u>Giant Garter Snake</u>

Scientific Name *Thamnophis gigas*

Legal Status[11]: Federal threatened (FESA), California threatened (CESA)

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]

Protect the existing population and habitat within the Delta Region, and restore, enhance, and manage suitable habitat adjacent to known populations to encourage the natural expansion of the species.

Straw-dog Monitoring Recommendations

* Extent & distribution of available, protected, enhanced, and restored natural giant garter snake habitat
* Extent & distribution of enhanced agricultural habitat.
* Occasional validation monitoring for species presence in presumed giant garter snake habitat in Delta
* Monitor suitable wetlands restored in the Delta Region adjacent to or near occupied habitats to assess if and when (relative to habitat maturity) giant garter snakes occupy restored habitat or to identify reasons they are not using restored and apparently suitable habitat.

Existing Monitoring Programs / Information Sources

Cosumnes River Preserve – Some giant garter snake monitoring,
Contact:Valerie Calegari (?)

East Bay Municipal Utility District: Mokelumne River Watershed Wildlife Monitoring Program
Includes Riparian Brush Rabbit, Foothill Yellow-legged Frog, Giant Garter Snake, Red-legged Frog, Swainson's Hawk, Willow Flycatcher
Contact: Kent Reeves, East Bay Municipal Utility District
http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=5282

U. S. Geological Survey – Biological Resources Division: Giant Garter Snake Monitoring
Contact: Glenn Wylie – USGS, John Beam - DFG in SJ Valley (coordinated with USGS)

Yolo County Habitat Conservation Plan
Contact: Terry Roberts, City of West Sacramento Community Development

NCCP Habitats[11] Tidal Freshwater Emergent, Nontidal Freshwater Permanent Emergent, Managed Seasonal Wetlands, Valley/Foothill Riparian, Seasonally Flooded Agriculture

ERP Mgmt Zone[12] Butte Basin, Feather River/Sutter Basin, Colusa Basin, Yolo Basin, American River Basin, Eastside Delta Tributaries, Delta, East San Joaquin Basin, West San Joaquin Basin

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"Historically, the giant garter snake was found throughout the Central Valley, from Butte County south to Kern County. Habitat loss resulting from wetland reclamation and agricultural development extirpated the giant garter snake from the southern one-third of its range from the 1940s to 1950s (Hansen and Brode 1980). Presently, populations of the snake are limited to ponds, sloughs, marshes, and rice fields of Sacramento, Sutter, Butte, Colusa, and Glenn Counties, although remnant populations exist along the western border of the Yolo Bypass in Yolo County and along the eastern fringes of the Delta from the Laguna Creek-Elk Grove region of Sacramento County south to Stockton, San Joaquin County (Hansen 1986; 58 FR 54053, October 20, 1993). The U.S. Fish and Wildlife Service (USFWS) recognized the existence of 13 populations of giant garter snake (58 FR 54053, October 20, 1993). Some populations may not be viable because they are small, highly fragmented, and restricted to small patches of habitat of limited quality. Populations in the Colusa, Butte, Sutter, and American River basins are associated with rice production and occupy the agricultural water delivery and drainage ditches (58 FR 54053, October 20, 1993). The largest extant population inhabits the water channels and ditches of agricultural lands in the American River basin at the confluence of the American and Sacramento Rivers (58 FR 54053, October 20, 1993).

"The giant garter snake is endemic to emergent wetlands in the Central Valley. The species' habitat includes marshes; sloughs; ponds; small lakes; and low-gradient waterways, such as small streams, irrigation and drainage canals, and rice fields (58 FR 54053, October 20, 1993). The giant garter snake requires adequate water with herbaceous, emergent vegetation for protective cover and foraging habitat. Primary food items include fish, tadpoles, and frogs (Hansen and Brode 1980). Open areas and grassy banks are needed for basking. Small mammal burrows and other small crevices at higher elevations provide winter hibernation sites and refuge from floodwaters (58 FR 54053, October 20, 1993). All three habitat components (cover and foraging habitat, basking areas, and protected hibernation sites) are needed. Because of their lack of basking areas and the lack of prey populations, riparian woodlands usually do not support the giant garter snake (Hansen and Brode 1980). Additionally, because of predation by introduced fish, larger rivers generally do not support the snake (58 FR 54053, October 20, 1993)."

Pressures (MSCS Technical Reports, 1999)[12]

"Habitat loss to agricultural development has been the primary factor in the decline of giant garter snake populations. Small remaining populations are susceptible to predation by fish, mammals, and birds. Additional causes of mortality include vehicular traffic, agricultural practices, and maintenance of water channels."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. A substantial portion of tidal wetlands to be restored under the ERP should be restored in the North Delta (the Yolo Basin and Bypass).
2. To the extent consistent with CALFED objectives, protect existing and restore additional habitat in the east Delta to create a corridor of suitable habitat linking Stone Lakes, the Cosumnes River, and White Slough.
3. To the extent practicable, design setback levees in the restored Stone Lakes/Cosumnes River/White Slough habitat corridor to include a mosaic of habitats.
4. Identify opportunities for implementing levee maintenance practices in the Delta that will maintain suitable levee habitat or minimize the impacts of necessary maintenance on the species and its habitat.
5. Incorporate restoration of permanent or seasonal flooded (April–October) suitable habitat as part of a mosaic of the seasonal wetland and agricultural land enhancements to be implemented under the ERP.
6. To the extent consistent with CALFED objectives, locate ERP nontidal marsh restorations near existing occupied habitat, and design restorations to include suitable upland habitat at least 200 feet around restored wetlands.
7. To the extent consistent with CALFED objectives, design levees to be upgraded for flood protection or conveyance to incorporate restoration of suitable wetland and upland habitats for the giant garter snake.
8. Include improvements to and maintenance of suitable agricultural infrastructure habitat (i.e., ditches, drains, canals, and levees) as part of ERP actions to improve wildlife habitat values associated with agricultural lands.
9. To the extent consistent with CALFED objectives, manage lands purchased or acquired under conservation easements that are occupied by the species to maintain or increase their current population levels.
10. Monitor suitable wetlands restored in the Delta Region adjacent to or near occupied habitats to assess if and when (relative to habitat maturity) giant garter snakes occupy restored

habitat or to identify reasons they are not using restored and apparently suitable habitat.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]
<u>Delta & Eastside Delta Tributaries</u>
PROCESSES
HABITAT

* Restore a minimum of 500, 250, 1,000, and 2,500 acres of nontidal emergent wetland in the North, East, South, and Central and West Delta Ecological Management units respectively. Establish at least one population of bristly sedge in each EMU.
* Restore a minimum of 15 miles of slough habitat (widths less than 50 to 75 feet) in each of the North, East, South, Central and West Delta EMUs that allows for the colonization of delta mudwort and delta tule pea.
* In the Sacramento-San Joaquin Delta EMZ, cooperatively enhance at least 15% of the ERP target for wildlife friendly agricultural practices.

STRESSORS

* Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.
* Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.
* Conduct the following actions in reduce organochlorine pesticide inputs to streams (from Phase II Report): Participate in implementation of USDA sediment reduction program. Implement sediment reduction BMPs on agricultural lands and other specific sites. Implement BMPs for urban/industrial stormwater runoff and discharges to reduce PCB and organochlorine pesticides.
* Conduct the following selenium work: Conduct selenium research to fill data gaps in order to refine regulatory goals of source control actions; determine bioavailability of selenium under several scenarios (from Phase II Report). Evaluate and, if appropriate, implement real-time management of selenium discharges (from Phase II Report). Expand and implement source control, treatment, and reuse programs (from Phase II Report). Coordinate with other programs; e.g., recommendations of San Joaquin Valley Drainage Implementation Program, CVPIA for retirement of lands with drainage problems that are not subject to correction in other ways (from Phase II Report). Support development and implementation of TMDL for selenium in the San Joaquin River watershed (focus on Grassland area).
* Conduct the following pesticide work (from Phase II Report): Develop diazinon and chlorpyrifos hazard assessment criteria with CDFG and the Department of Pesticide Regulations. Support development and implementation of a TMDL for diazinon. Develop BMPs for dormant spray and household uses. Determine the ecological significance of pesticide discharges. Support implementation of BMPs. Monitor to determine effectiveness of BMPs
* Conduct the following mercury evaluation and abatement work in the Cache Creek watershed (from Phase II Report): Support development and implementation of TMDL for mercury. Determine bioaccumulation effects in creek and Delta. Source, transport, inventory, mapping and speciation of mercury. Participate in Stage 1 remediation (drainage control) of mercury mines as appropriate. Determine sources of high levels of bioavailable mercury
* Conduct the following mercury evaluation and abatement work in the Delta (from Phase II Report): Determine methylization (part of bioaccumulation) process in Delta. Determine

sediment mercury concentration in areas that would be dredged during levee maintenance or conveyance work. Determine potential impact of ecosystem restoration work on methyl mercury levels in lower and higher trophic level organisms.

Sacramento River Basin

HABITAT

* Implement 25 percent of the ERP target for enhancing, protecting, and restoring seasonal wetlands in the following EMZs: American River Basin, Butte Basin, Colusa Basin, and Feather River/Sutter Basin.
* In the American River Basin, Butte Basin, Colusa Basin, Feather River/Sutter Basin EMZs, cooperatively enhance at least 15 to 25% of the ERPP target for wildlife friendly agricultural practices.

STRESSORS

* Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.
* Conduct the following mercury evaluation and abatement work in the Sacramento River (from Phase II Report): Determine, inventory, and sources of high levels of bioavailable mercury Refine mercury models. Participate in remedial activities.
* Conduct the following pesticide work (from Phase II Report): Develop diazinon and chlorpyrifos hazard assessment criteria with CDFG and the Department of Pesticide Regulations. Support development and implementation of a TMDL for diazinon. Develop BMPs for dormant spray and household uses. Determine the ecological significance of pesticide discharges. Support implementation of BMPs. Monitor to determine effectiveness of BMPs
* Conduct the following actions in reduce organochlorine pesticide inputs to streams (from Phase II Report): Participate in implementation of USDA sediment reduction program. Implement sediment reduction BMPs on agricultural lands and other specific sites. Implement BMPs for urban/industrial stormwater runoff and discharges to reduce PCB and organochlorine pesticides.
* Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.
* Conduct the following mercury evaluation and abatement work in the Cache Creek watershed (from Phase II Report): Support development and implementation of TMDL for mercury. Determine bioaccumulation effects in creek and Delta. Source, transport, inventory, mapping and speciation of mercury. Participate in Stage 1 remediation (drainage control) of mercury mines as appropriate. Determine sources of high levels of bioavailable mercury

San Joaquin River Basin

HABITAT

* In the San Joaquin River and West San Joaquin Basin EMZs, cooperatively enhance at least 15 to 25% of the ERPP target for wildlife friendly agricultural practices
* In the West San Joaquin Basin EMZ, restoring or create 100 acres of fresh emergent wetland habitat.

STRESSORS

* Conduct the following pesticide work (from Phase II Report): Develop diazinon and chlorpyrifos hazard assessment criteria with CDFG and the Department of Pesticide Regulations. Support development and implementation of a TMDL for diazinon. Develop

BMPs for dormant spray and household uses. Determine the ecological significance of pesticide discharges. Support implementation of BMPs. Monitor to determine effectiveness of BMPs

* Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.
* Conduct the following selenium work: Conduct selenium research to fill data gaps in order to refine regulatory goals of source control actions; determine bioavailability of selenium under several scenarios (from Phase II Report). Evaluate and, if appropriate, implement real-time management of selenium discharges (from Phase II Report). Expand and implement source control, treatment, and reuse programs (from Phase II Report). Coordinate with other programs; e.g., recommendations of San Joaquin Valley Drainage Implementation Program, CVPIA for retirement of lands with drainage problems that are not subject to correction in other ways (from Phase II Report). Support development and implementation of TMDL for selenium in the San Joaquin River watershed (focus on Grassland area).
* Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.
* Conduct the following actions in reduce organochlorine pesticide inputs to streams (from Phase II Report): Participate in implementation of USDA sediment reduction program. Implement sediment reduction BMPs on agricultural lands and other specific sites. Implement BMPs for urban/industrial stormwater runoff and discharges to reduce PCB and organochlorine pesticides.

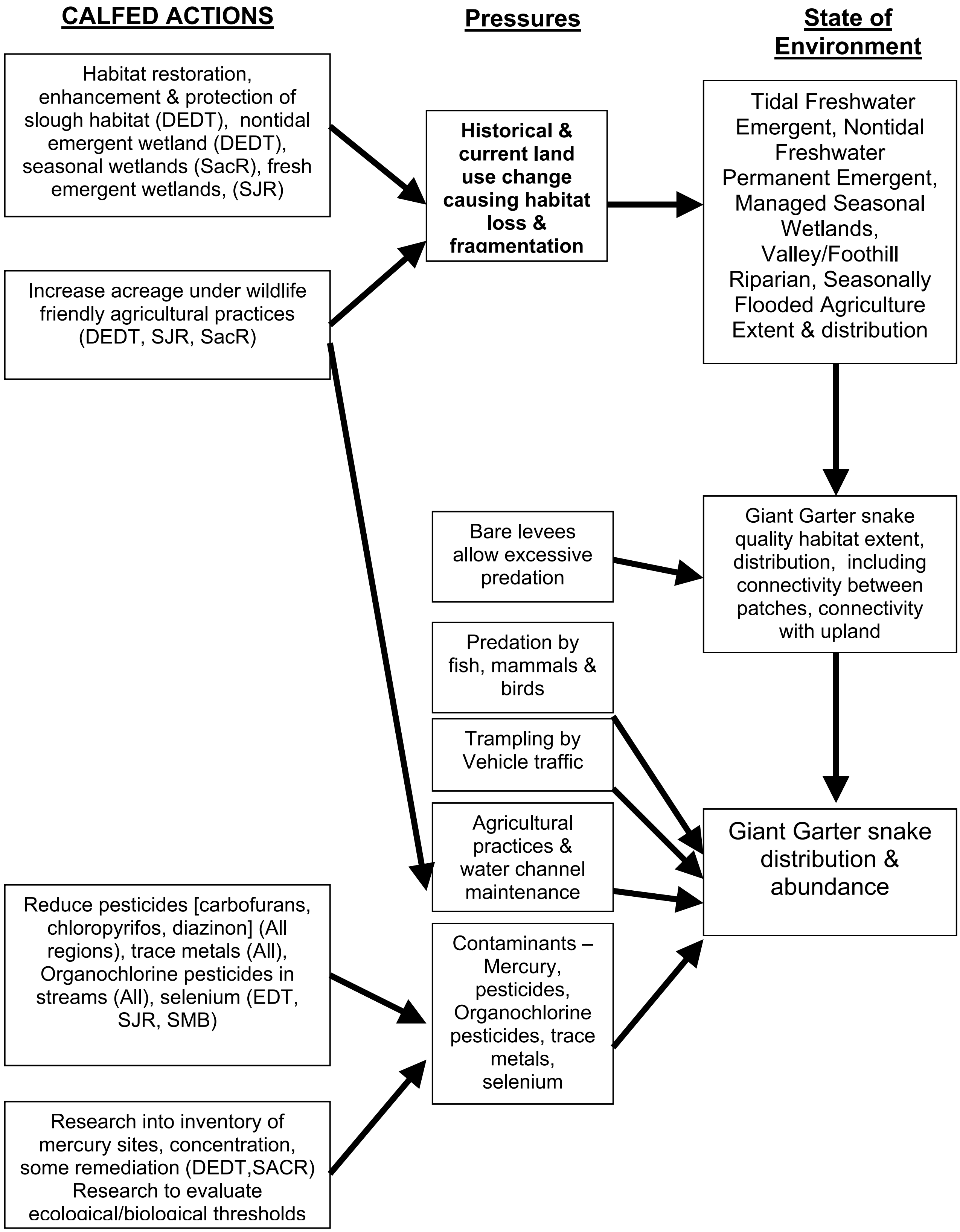
<u>Suisun Marsh & North San Francisco Bay</u>

STRESSORS

* Conduct the following actions in reduce organochlorine pesticide inputs to streams (from Phase II Report): Participate in implementation of USDA sediment reduction program. Implement sediment reduction BMPs on agricultural lands and other specific sites. Implement BMPs for urban/industrial stormwater runoff and discharges to reduce PCB and organochlorine pesticides.
* Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.
* Conduct the following pesticide work (from Phase II Report): Develop diazinon and chlorpyrifos hazard assessment criteria with CDFG and the Department of Pesticide Regulations. Support development and implementation of a TMDL for diazinon. Develop BMPs for dormant spray and household uses. Determine the ecological significance of pesticide discharges. Support implementation of BMPs. Monitor to determine effectiveness of BMPs
* Conduct the following selenium work: Conduct selenium research to fill data gaps in order to refine regulatory goals of source control actions; determine bioavailability of selenium under several scenarios (from Phase II Report). Evaluate and, if appropriate, implement real-time management of selenium discharges (from Phase II Report). Expand and implement source control, treatment, and reuse programs (from Phase II Report). Coordinate with other programs; e.g., recommendations of San Joaquin Valley Drainage Implementation Program, CVPIA for retirement of lands with drainage problems that are not subject to correction in other ways (from Phase II Report). Support development and implementation of TMDL for selenium in the San Joaquin River watershed (focus on Grassland area).

* Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.

Figure G-14. Giant Garter Snake Simple Diagrammatic Conceptual Model
(DEDT = Delta & Eastside Tributaries, SACR = Sacramento River Basin, SJR = San Joaquin River Basin)



Greater sandhill crane **Scientific Name** *Grus canadensis tabida*

Legal Status[11]: California threatened (CESA), fully protected under California Fish and Game Code

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]
Achieve recovery objectives identified in the Pacific Flyway Management Plan for the Central Valley population of greater sandhill cranes and Assembly Bill (AB) 1280 legislation that are applicable to the CALFED Problem Area, the Butte Sink, and other species' use areas.

Straw-dog Monitoring Recommendations
* Abundance & distribution in core wintering areas
* Extent & distribution of available, protected, restored, and enhanced habitats in core wintering areas
* Monitor to determine amount and use of protected, restored, and enhanced habitats by sandhill cranes in core wintering areas

Existing Monitoring Programs / Information Sources
California Department of Fish and Game - Breeding and wintering ground studies and monitoring since 1978. Contact: Ron Schlorff

NCCP Habitats[11] Nontidal Freshwater Permanent Emergent, Natural Seasonal Wetlands, Managed Seasonal Wetlands, Grassland, Upland Cropland, Seasonally Flooded Agriculture

ERP Mgmt Zone[12] North Sacramento Valley, Butte Basin, Colusa Basin, Yolo Basin, Feather River/Sutter Basin, American River Basin, Delta

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]
"Historically, greater sandhill cranes nested in eastern Siskiyou County, northeastern Shasta County, and at Honey Lake in Lassen County (California Department of Fish and Game 1992). In the most recent study of crane reproduction in 1988, nesting populations were found in Lassen (75 pairs), Modoc (165 pairs), Plumas (seven pairs), Shasta (one pair), Sierra (one pair), and Siskiyou (27 pairs) Counties (Littlefield 1989, Littlefield et al. 1994, California Department of Fish and Game 1997, Pacific Flyway Council 1997).

"Between 3,400 and 6,000 greater sandhill cranes winter in the Sacramento Valley and Sacramento-San Joaquin River Delta (Pogson and Lindstedt 1991, California Department of Fish and Game 1997, Pacific Flyway Council 1997).

"Greater sandhill cranes nest in open areas of wet meadows that are often interspersed with emergent marsh and usually build their nests over shallow water. During the nesting season, cranes feed on a wide variety of invertebrates, amphibians, and small mammals (California Department of Fish and Game 1997). During winter, they feed on grasses, forbs, waste grains, small mammals, amphibians, snakes, and invertebrates (Zeiner et al. 1990). They feed in pastures, flooded grain fields, and seasonal wetlands."

Pressures (MSCS Technical Reports, 1999)[12]
"The greater sandhill crane has declined for a variety of reasons, including loss of wetlands in breeding and wintering habitats, human disturbance at nesting sites, and mower-caused mortality on the breeding grounds (Littlefield 1982, Littlefield et. al 1994, California Department of Fish and Game 1997)."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. To the extent consistent with CALFED objectives, implement ERP actions in concert

with the species recovery strategies identified in AB1280 and the Pacific Flyway Plan.

2. Implementation of proposed ERP actions to enhance agricultural habitats should give priority to improving the abundance and availability of upland agricultural forage (e.g., corn and winter wheat) in the core use area centered around Bract Tract.

3. Implementation of proposed ERP actions to restore wetlands should give priority to restoring and managing wetland habitat within the core use area centered on Bract Tract that would provide suitable roosting habitat.

4. Avoid or minimize recreational uses in the core area centered on Bract Tract that could disrupt crane habitat use patterns from October through March.

5. To the extent consistent with CALFED objectives, at least 10% of agricultural lands to be enhanced under the ERP in the Delta and the Butte Sink should be managed to increase forage abundance and availability for cranes. Priority should be given to implementing these habitat improvements within 10 miles of the core habitat centered on Bract Tract.

6. Monitor to determine use of protected, restored, and enhanced habitats by sandhill cranes in core wintering areas.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

Delta & Eastside Delta Tributaries

HABITAT

* Enhance, protect and restore 1,000 to 1,500 acres of seasonal wetlands in the East Delta EMU for optimum greater sandhill crane habitat.
* In the Sacramento-San Joaquin Delta EMZ, cooperatively enhance at least 15% of the ERP target for wildlife friendly agricultural practices.

Sacramento River Basin

HABITAT

* Implement 25 percent of the ERP target for enhancing, protecting, and restoring seasonal wetlands in the following EMZs: American River Basin, Butte Basin, Colusa Basin, and Feather River/Sutter Basin.
* In the American River Basin, Butte Basin, Colusa Basin, Feather River/Sutter Basin EMZs, cooperatively enhance at least 15 to 25% of the ERPP target for wildlife friendly agricultural practices.

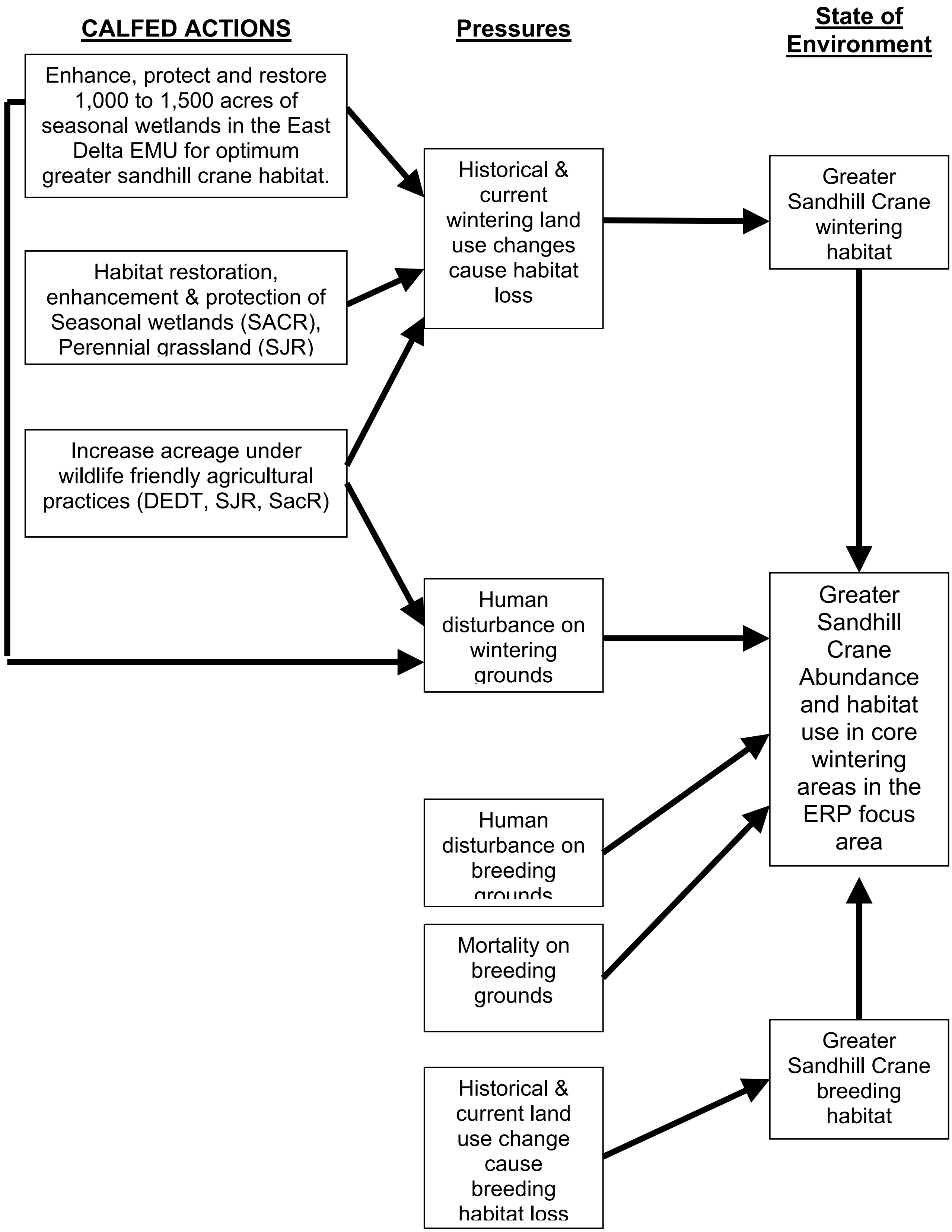
San Joaquin River Basin

HABITAT

* In the San Joaquin River and West San Joaquin Basin EMZs, cooperatively enhance at least 15 to 25% of the ERPP target for wildlife friendly agricultural practices
* In the West San Joaquin Basin EMZ, restore or enhance 1,000 acres of perennial grassland associated with existing or proposed wildlife corridors, wetlands, or floodplain habitats.

Figure G-15. Greater Sandhill Crane Simple Diagrammatic Conceptual Model

(DEDT = Delta & Eastside Tributaries, SACR = Sacramento River Basin, SJR = San Joaquin River Basin)



Lange's Metalmark butterfly **Scientific Name** *Apodemia mormo langei*

Legal Status[11]: Federal endangered (FESA)

CALFED ERP GOAL[8,11] "Recover (R)"

MSCS Goal prescription[11]

Continue protection of and expand the size of the Antioch Dunes population of the Lange's metalmark butterfly; enhance and restore suitable habitat at and in the vicinity of the Antioch Dunes; and achieve recovery goals identified in the USFWS recovery plan.

Straw-dog Monitoring Recommendations

* Population size & distribution
* Population size and distribution of naked stemmed buckwheat
* Spatial extent & distribution of available habitat and enhanced habitat
* Monitor enhanced and restored habitat areas to determine the success of enhancement and restoration methods, and to determine the response of Lange's metalmark populations to management

Existing Monitoring Programs / Information Sources

USFWS Antioch Dunes National Wildlife Refuge: Lange's Matalmark Butterfly Monitoring
Annual population count of flying adults in summer on refuge
Contact: Ivette Loredo

NCCP Habitats[11] Inland Dune Scrub

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

Lange's metalmark butterfly is restricted to areas supporting its larval host plant, naked-stemmed buckwheat *(Eriogonum nudu*m), within the Antioch Dunes National Wildlife Refuge in Contra Costa County. The species' historical distribution is unknown.

Lange's metalmark butterfly adults are found in close association with its host plant, naked-stemmed buckwheat (Eriogonum nudum). Adults emerge in late summer and live for approximately 1 week. Eggs are deposited on the host buckwheat and remain dormant until it begins to rain, usually in late fall, and the buckwheat begins to grow. Larvae feed on the new growth throughout winter and spring and pupate early in the following summer.

Pressures (MSCS Technical Reports, 1999)[12]

Lange's metalmark butterfly has declined as a result of sand mining at the Antioch Dunes, which has considerably diminished its habitat, and invasive non-native vegetation that outcompetes its host plant.

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Coordinate protection and restoration of inland dune scrub habitats with other programs (e.g., USFWS recovery plans and management of the Antioch Dunes Preserve) that could affect management of occupied and historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
2. Conduct surveys to locate potential habitat restoration sites on Tinnin soils and identify opportunities for and implement permanent protection, restoration, and management of these habitat to enhance habitat conditions for the Lange's metalmark.
3. Monitor enhanced and restored habitat to determine the success of enhancement and restoration methods, and to determine the response of the Lange's metalmark populations to management.

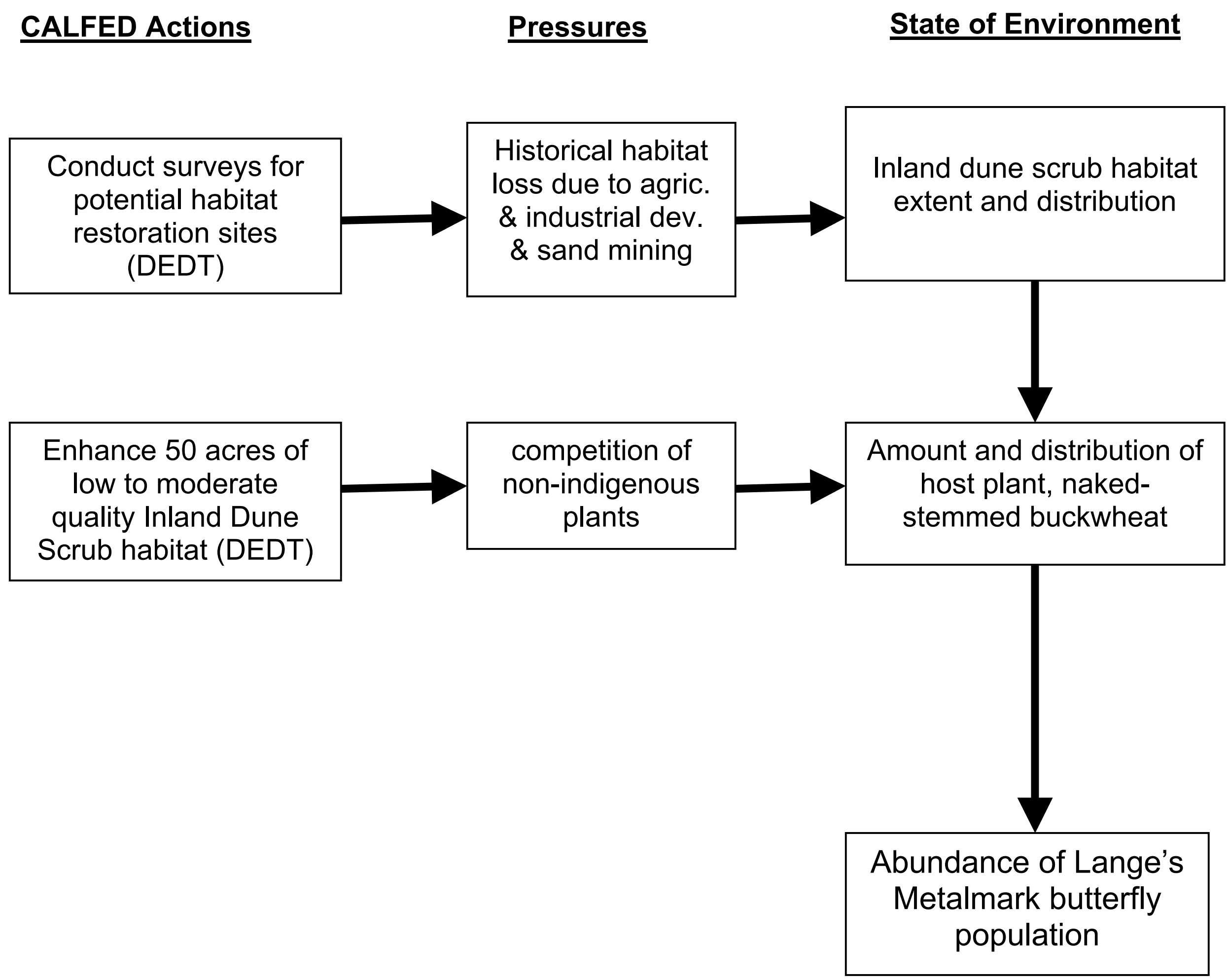
CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

Delta & Eastside Delta Tributaries

HABITAT

* Conduct surveys to locate potential habitat restoration sites capable of supporting Antioch dunes evening primrose, Contra Costa wallflower, and Lange's metalmark butterfly. Enhance 50 acres of low to moderate quality Antioch inland dune scrub habitat to support these species. Annually monitor establishment success.

Figure G-16. Lange's Metalmark butterfly Conceptual Model



Least Bell's vireo **Scientific Name** *Vireo bellii pusillus*

Legal Status[11]: Federal endangered (FESA), California endangered (CESA)

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]
Achieve recovery objectives identified in the least Bell's vireo recovery plan (U.S. Fish and Wildlife Service 1998) applicable to the ERP focus study area.

Straw-dog Monitoring Recommendations
* Abundance at sampling stations for riparian neotropical migratory birds
* Investigations of reported sitings
* Extent & distribution of available, protected, restored, and enhanced migration and breeding habitat with appropriate vegetation structure and function
* Extent & distribution of breeding habitat patches with factors that should contribute to low brown-headed cowbird abundance (presumably larger patches without adjacent land-uses that encourage the cowbirds) and occasional validation of cowbird abundance.

Existing Monitoring Program / Information Sources
Point Reyes Bird Observatory, The Nature Conservancy, U.S. Fish & Wildlife Service:
Sacramento River Bird Conservation Project – Riparian Birds
Contact: Stacy Small (www.prbo.org)
Point Reyes Bird Observatory, U.S. Fish & Wildlife Service: San Joaquin Restoration – Riparian Birds
Contact: Geoff Geupel (www.prbo.org)

NCCP Habitats[11] Valley/Foothill Riparian, Montane Riparian

ERP Mgmt Zone[12] none currently; historically Delta, Suisun Marsh/North San Francisco Bay, Sacramento River, North Sacramento Valley, San Joaquin River

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]
"The least Bell's vireo's historical range once spread from interior northern California near Red Bluff (Tehama County) south through the Sacramento and San Joaquin Valleys, and in the Coast Ranges from Santa Clara County south to approximately San Fernando in Baja California (California Department of Fish and Game 1992).

"The current breeding range is restricted to two intermittent localities in the Salinas River Valley (Monterey and San Benito Counties): one along the Armagosa River (Inyo County) and numerous small populations from southern California (primarily Santa Barbara, Riverside, Ventura, and San Diego Counties) into northwest Baja California.

"This insectivorous species inhabits dense, willow-dominated riparian habitats with lush understory vegetation, which is limited to the immediate vicinity of watercourses. Unlike its other subspecies, the least Bell's vireo does not frequent upland sites and is especially vulnerable to the loss and fragmentation of riparian habitats (51 FR [85]:16474-16483, May 2 1986). It is a summer resident of the following riparian habitats: willow (Salix sp.), cottonwood (Populs fremontii) forests, oak (usually Quercus agrifolia) forests, shrubby thicket (often composed solely of willow species, usually narrowleaf willow, Salix dexigua or black willow, Salix gooddingii), and dry washes (with willow thickets at the edges to provide foraging habitat and nest sites) (California Department of Fish and Game 1992)."

Pressures (MSCS Technical Reports, 1999)[12]
"Loss and fragmentation of willow-dominated riparian areas is the major cause of the decline of

the least Bell's vireo. Brood parasitism by the brown-headed cowbird has also contributed to the decline of this species (California Department of Fish and Game 1992)."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Coordinate protection and restoration of riparian habitat with other federal, State, and nonprofit programs (e.g., the least Bell's vireo recovery plan team, Riparian Habitat Joint Venture, and USACE's Sacramento and San Joaquin Basin Comprehensive Study) that could affect management of historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
2. To the extent consistent with CALFED objectives, protect existing riparian habitat from future changes in land use or other activities that could result in the loss or degradation of habitat that would be suitable for reintroductions or natural colonization of the species.
3. A portion of restored riparian habitat should be designed to include riparian scrub communities.
4. To the extent practicable, restore riparian habitats in patch sizes sufficient to discourage nest parasitism by brown-headed cowbirds.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

<u>Delta & Eastside Delta Tributaries</u>

PROCESSES

* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within the Eastside Delta Tributaries EMZ.
* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within the Eastside Delta Tributary EMZ.

HABITAT

* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within the Eastside Delta Tributary EMZ

<u>Sacramento River Basin</u>

PROCESSES

* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ in the Sacramento River Basin.
* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within each of the EMZs in the Sacramento River Basin. Among the areas to be included are the lower 10 miles of Clear Creek, Antelope Creek, and Deer Creek, and the lower reach of Cottonwood Creek.
* Protect 15,000 acres within the Inner River Zone areas between Red Bluff and Colusa reaches within identified the Sacramento River Conservation Area. Establish between 3 and 5 habitat preserves for bank swallows along the upper reaches of the Sacramento River capable of supporting 5000 bank swallow burrows between the towns of Colusa and Red Bluff.

* Design and begin implementation of an ecologically based streamflow regulation plan for Yuba River, Butte Creek, Big Chico Creek, Deer Creek, Mill Creek , Antelope Creek, Battle Creek, Cottonwood Creek, and Clear Creek.

HABITAT

* In the Cottonwood Creek EMZ, complete (1) long-term agreements with local landowners to establish, restore, and maintain riparian communities along 25 percent of the upper and 25 percent of the lower reaches of Cottonwood Creek, and (2) the development of a comprehensive watershed management plan that supports local land use decisions to protect existing riparian and restore lost riparian.
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within each of the following Ecological Management Zones: American River Basin, Butte Basin, Colusa Basin, Cottonwood Creek, Feather River/Sutter Basin, North Sacramento Valley, Sacramento River, and Yolo Basin. While restoring habitat conditions in the American River EMZ, maintain continuous corridors of suitable riparian habitat for valley elderberry longhorn beetle. Protect existing known occurrences of northern California black walnut native stands through conservation easement or purchase. Identify at least 3 protected and managed sites for introduction of additional populations of northern California black walnut; begin introduction and monitor for success. Population creation should be part of a broader effort to restore riparian areas which historically contained walnut.
* Restore 2 miles of the 10 mile target of riparian habitat restoration along the lower reaches of each of the following tributaries: Battle, Clear, Deer, Mill, Butte, Big Chico, Antelope, Feather, Yuba, and Bear Rivers.

<u>San Joaquin River Basin</u>

PROCESSES

* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ within the San Joaquin River Basin. In the East San Joaquin Basin EMZ, complete fluvial geomorphic assessments on all tributaries.
* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within each of the EMZs in the San Joaquin River Basin. Among the areas to be included are at least 10 miles of stream channel in the West San Joaquin EMZ.

HABITATS

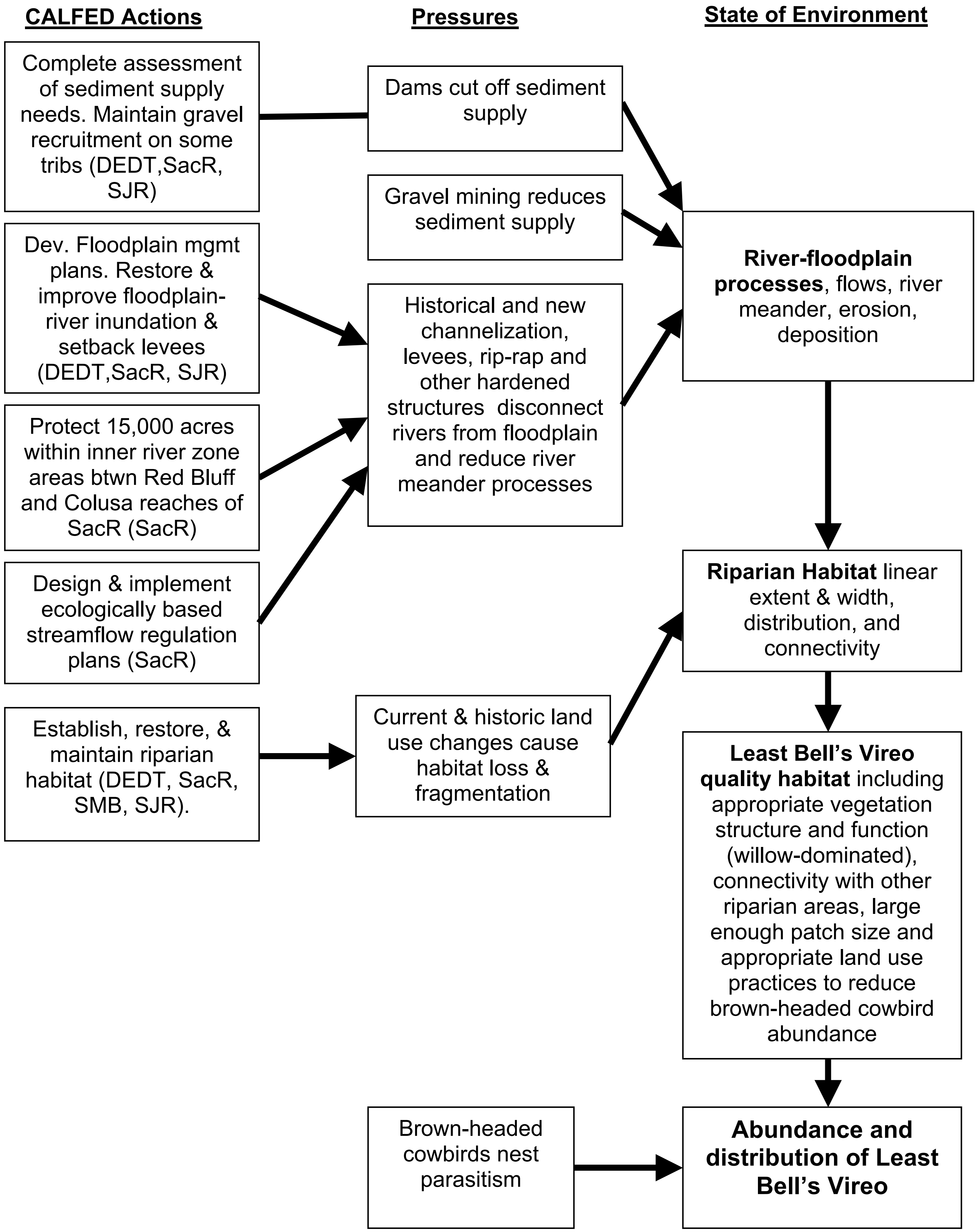
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat and instream cover along at least one tributary within the East San Joaquin and San Joaquin River EMZs.

<u>Suisun Marsh & North San Francisco Bay</u>

HABITAT

* Restore and maintain a minimum of three linear miles of riparian habitat along corridors of existing riparian scrub and shrub vegetation in each of the Ecological Management Units of the Suisun Marsh/North San Francisco Bay Ecological Management Zone.

Figure G-17. Least Bell's Vireo Diagrammatic Conceptual Model



Little willow flycatcher **Scientific Name** *Empidonax traillii brewsteri*

Legal Status[11]:

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription

Maintain and enhance suitable riparian corridor migration habitats and restore suitable breeding habitat within the historical breeding range of these species in the Central Valley.

Straw-dog Monitoring Recommendations

* Abundance at sampling stations for riparian neotropical migratory birds
* Extent & distribution of available, protected, restored, and enhanced migration and breeding habitat with appropriate vegetation structure and function
* Extent & distribution of breeding habitat patches with factors that should contribute to low brown-headed cowbird abundance (presumably larger patches without adjacent land-uses that encourage the cowbirds) and occasional validation of cowbird abundance.

Existing Monitoring Program / Information Sources

Cal. Dept. of Fish & Game: Little Willow Flycatcher Monitoring – Studies and monitoring since 1982, Contact: Ron Schlorff

East Bay Municipal Utility District: Mokelumne River Watershed Wildlife Monitoring Program Includes Riparian Brush Rabbit, Foothill Yellow-legged Frog, Giant Garter Snake, Red-legged Frog, Swainson's Hawk, Willow Flycatcher
Contact: Kent Reeves, East Bay Municipal Utility District
http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=5282

Point Reyes Bird Observatory, The Nature Conservancy, U.S. Fish & Wildlife Service: Sacramento River Bird Conservation Project – Riparian Birds
Contact: Stacy Small (www.prbo.org)

Point Reyes Bird Observatory, U.S. Fish & Wildlife Service: San Joaquin Restoration – Riparian Birds
Contact: Geoff Geupel (www.prbo.org)

NCCP Habitats[11] Valley/Foothill Riparian, Montane Riparian

ERP Mgmt Zone12 migrating species in all zones

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"Historically, the little willow flycatcher was a common nesting species in the Sierra Nevada, Central Valley, and the central and northern Coast Ranges. Now, it is found only in isolated populations in the Sierra Nevada and the Cascade Range (Harris et al. 1988, California Department of Fish and Game 1997).

"The little willow flycatcher nests in dense willow thickets in montane meadows and streams with meadows. The species forages in riparian and meadow habitats during the nesting season. It arrives on the breeding grounds in May and June and departs for South America in August (Harris et al. 1988, Zeiner et al. 1990)."

Pressures (MSCS Technical Reports, 1999)[12]

"This species has declined for a variety of reasons, including nest parasitism by brown-headed cowbirds, loss and degradation of riparian and meadow habitats, and disturbance of nest sites by cattle (Zeiner et al. 1990, California Department of Fish and Game 1997)."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Coordinate protection and restoration of riparian habitat with other federal, State, and nonprofit programs (e.g., the Riparian Habitat Joint Venture, the SB1086 program, and

USACE's Sacramento and San Joaquin Basin Comprehensive Study) that could affect management of current and historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.

2. To the extent consistent with CALFED objectives, protect existing suitable riparian habitat corridors from future changes in land use or other activities that could result in the loss or degradation of habitat.

3. A portion of restored riparian habitat should be designed to include riparian scrub communities.

4. To the extent practicable, restore riparian habitats in patch sizes sufficient to discourage nest parasitism by brown-headed cowbirds.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

<u>Delta & Eastside Delta Tributaries</u>

HABITAT

* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within the Eastside Delta Tributary EMZ
* Restore a minimum of 300 acres of self-sustaining or managed diverse natural riparian habitat along the Mokelumne River, Cosumnes River, and Calaveras River and protect existing riparian habitat.
* Implement 25 percent of the ERP target for diverse, self-sustaining riparian community for each EMU in the Sacramento-San Joaquin Delta EMZ.

<u>Sacramento River Basin</u>

HABITAT

* In the Cottonwood Creek EMZ, complete (1) long-term agreements with local landowners to establish, restore, and maintain riparian communities along 25 percent of the upper and 25 percent of the lower reaches of Cottonwood Creek, and (2) the development of a comprehensive watershed management plan that supports local land use decisions to protect existing riparian and restore lost riparian.
* Restore 2 miles of the 10 mile target of riparian habitat restoration along the lower reaches of each of the following tributaries: Battle, Clear, Deer, Mill, Butte, Big Chico, Antelope, Feather, Yuba, and Bear Rivers.
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within each of the following Ecological Management Zones: American River Basin, Butte Basin, Colusa Basin, Cottonwood Creek, Feather River/Sutter Basin, North Sacramento Valley, Sacramento River, and Yolo Basin. While restoring habitat conditions in the American River EMZ, maintain continuous corridors of suitable riparian habitat for valley elderberry longhorn beetle. Protect existing known occurrences of northern California black walnut native stands through conservation easement or purchase. Identify at least 3 protected and managed sites for introduction of additional populations of northern California black walnut; begin introduction and monitor for success. Population creation should be part of a broader effort to restore riparian areas which historically contained walnut.

<u>San Joaquin River Basin</u>

HABITAT

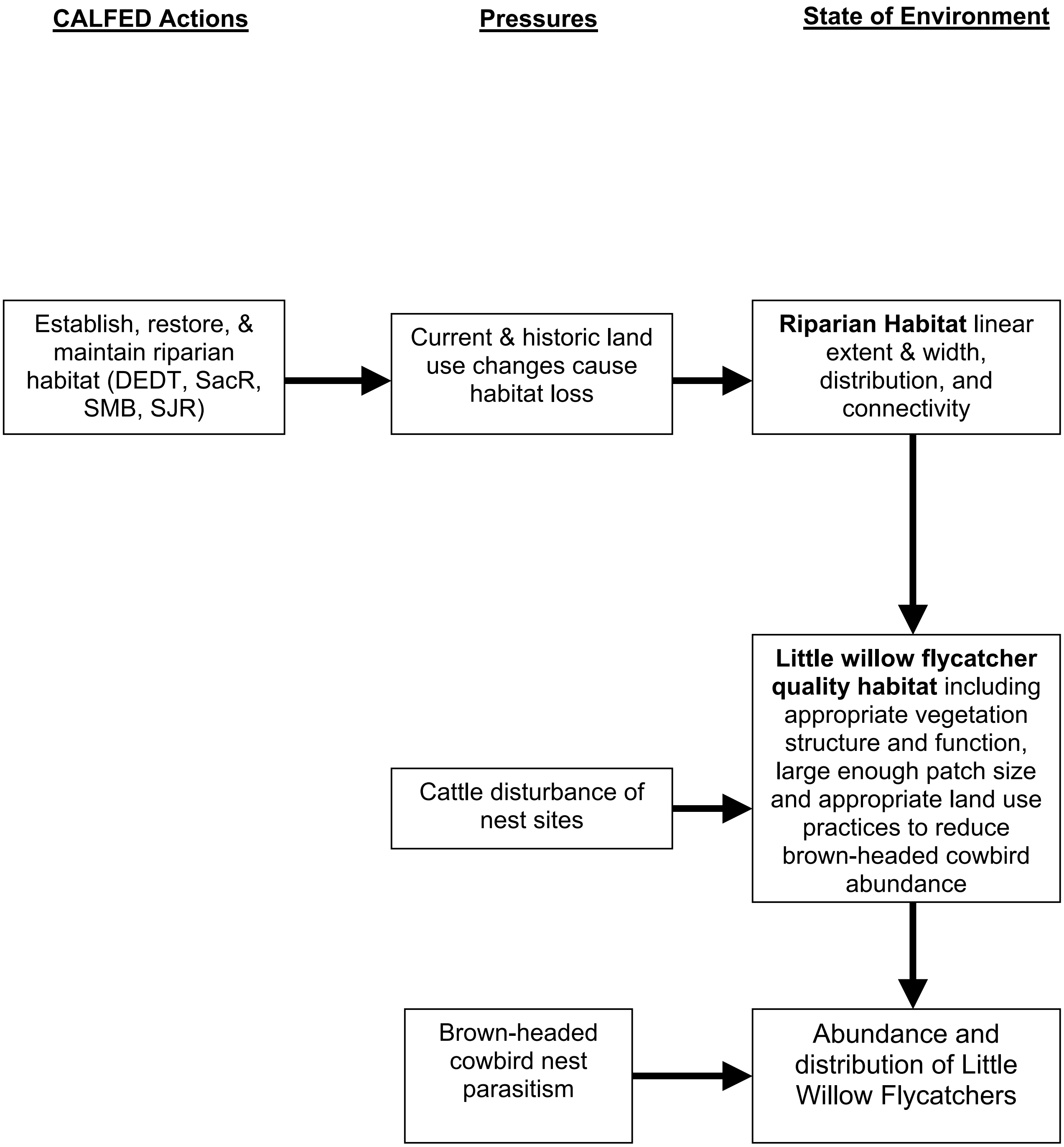
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat and instream cover along at least one tributary within the East San Joaquin and San Joaquin River EMZs.

Suisun Marsh & North San Francisco Bay

HABITAT

* Restore and maintain a minimum of three linear miles of riparian habitat along corridors of existing riparian scrub and shrub vegetation in each of the Ecological Management Units of the Suisun Marsh/North San Francisco Bay Ecological Management Zone.

Figure G-18. Little Willow Flycatcher Diagrammatic Conceptual Model



Mason's lilaeopsis

Scientific Name *Lilaeopsis masonii*

Legal Status[11]: Listed as rare under California Native Plant Protection Act, CNPS List 1B

CALFED ERP GOAL[8,11] "Recover (R)"

MSCS Goal prescription[11]

Expand suitable and occupied habitat by 100 linear miles and protect at least 90% of the currently occupied habitat, including 90% of high-quality habitat. The high-quality habitat should include occurrences in the North, South, and East Delta and Napa River Ecological Management Units.

Straw-dog Monitoring Recommendations

* Monitor status and distribution of the species at five-year intervals
* linear miles of available habitat, occupied habitat, protected habitat, and restored habitat

Existing Monitoring Program / Information Sources

?

NCCP Habitats[11] Tidal Freshwater Emergent

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay, Eastside Delta Tributaries, West San Joaquin Basin, American River Basin, Yolo Basin

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"Mason's lilaeopsis' known distribution extends from the margins of the Napa River in Napa County, east to the channels and sloughs of the Sacramento-San Joaquin Delta in Contra Costa, Solano, Sacramento, Yolo, and San Joaquin Counties (Natural Diversity Data Base 1998). Some of the largest and healthiest populations have been reported from uninhabited islands in Suisun Bay, where there is no riprap and little human disturbance (Fielder and Golden 1990). Much of the habitat is privately owned. Several state and federal agencies have jurisdiction over the Delta waterways where the species occurs. One site is protected in Solano County on a California Department of Fish and Game (DFG) Ecological Reserve (California Department of Fish and Game 1992).

"Mason's lilaeopsis is a minute, turf-forming perennial plant of the carrot family (Apiaceae). This species is semi-aquatic and is usually found on saturated clay soils in areas where freshwater is prevalent and are regularly inundated by waves and tidal action. Entire plants have been observed floating in the sloughs, suggesting that vegetative reproduction may be an important factor in colonization. It is likely that some populations comprise mostly clones from individuals that initially colonized the habitat. Flowering time is April-October. (California Department of Fish and Game 1992.)"

Pressures (MSCS Technical Reports, 1999)[12]

"Reasons for decline include flood control projects (especially where riprap has been used), widening of Delta channels for water transport, levee construction and protection, bank erosion, dredging and dumping of spoils, recreational development, weed control (especially for water hyacinth), saltwater intrusion, and changes in water quality resulting from decreased flows in the Delta."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Maintain processes that support the dynamic habitat distributed throughout the species' range and associated with existing source populations (species occurs on eroding margins of levees).
2. To the extent practicable, design restoration of tidal habitats to create unvegetated, exposed substrate habitat at tidal margins of tidal fresh emergent wetlands and riparian habitat.

3. To the extent consistent with CALFED objectives, incorporate sufficient edge habitat to support the species in levee setback and channel island habitat restoration designs.
4. To the extent practicable, maximize sinuosity of restored and created slough channels to increase water-land edge habitat.
5. To the extent consistent with CALFED objectives, maintain and restore habitat and populations throughout the species' geographic ranges and expand habitat and populations to their historical and ecological ranges based on hydrologic, salinity, and other habitat requirements of the species.
6. Consistent with CALFED objectives, incorporate suitable habitat for these species in bank protection designs used in CALFED actions.
7. Monitor status and distribution of the species at 5-year intervals and document expansion of the species into restored habitat for the duration of the program.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

Delta & Eastside Delta Tributaries

HABITAT

* Restore a minimum of 500, 500, 4,000, and 5,000 acres of tidal emergent wetland in the North, East, South, and Central and West Delta Ecological Management units respectively.

STRESSORS

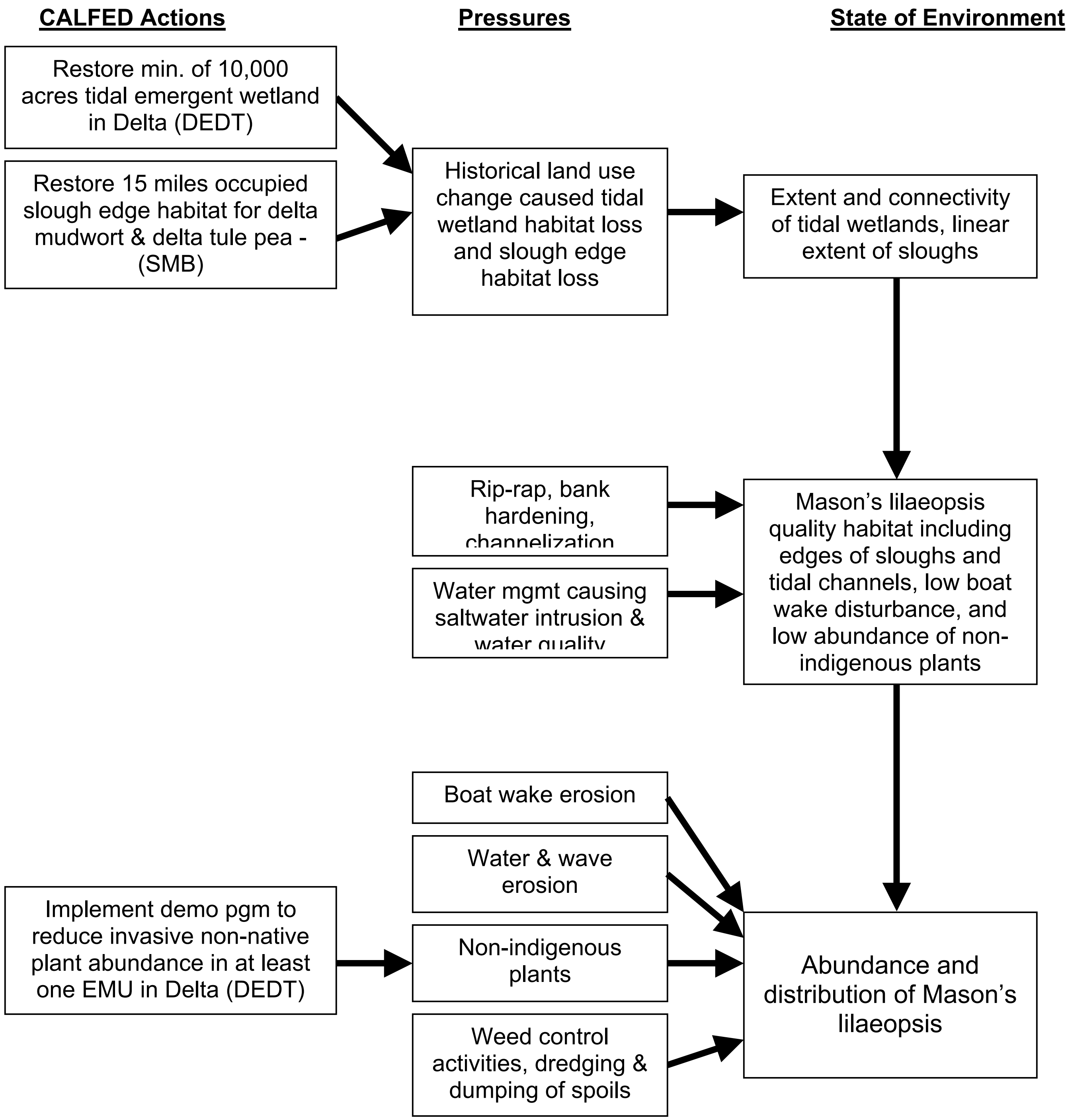
* Develop and begin implemention of a demonstration program to reduce invasive non-native plant abundance within at least one EMU in the Delta.

Suisun Marsh & North San Francisco Bay

HABITAT

* Restore suitable, occupied slough edge habitat for delta mudwort and delta tule pea by at least 5 miles in the Suisun Bay and Marsh EMU and by at least 10 miles in the Napa River EMUs. Bring at least 25% the currently existing but unprotected occurrences of delta mudwort and delta tule into protection through purchase or conservation agreement, and ensure appropriate management.

Figure G-19. Mason's Lilaeopsis Conceptual Model



Northern California black walnut **Scientific Name** *Juglans califonica var. hindsii*

Legal Status[11]: CNPS List 1B

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]
Protect and maintain the remaining stands, and establish 5–10 naturally regenerating black walnut stands within its historical range.

Straw-dog Monitoring Recommendations
* Number, size, and location of native Northern California black walnut stands within the species' historical range including newly established naturally regenerating stands

Existing Monitoring Program / Information Sources
?

NCCP Habitats[11] Valley/Foothill Riparian

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay, Yolo Basin

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]
"The original distribution of northern California black walnut is unknown. Stands along Walnut and Lafayette creeks in Contra Costa County, near Walnut Grove in Sacramento County, and near Wooden Valley in Napa County are cited as the "native" stands of this species and are considered endangered (California Native Plant Society 1994, Natural Diversity Data Base 1992). Northern California black wlanut and various crosses have become widely naturalized in riparian forests of the Central Valley and surrounding foothills (California Native Plant Society 1994, Griffin and Critchfield 1972, Natural Diversity Data Base 1992). Many of these trees are located near Indian settlements, and were undoubtedly established by the residents of these settlements (Munz and Keck 1908).

"Northern California black walnut is a deciduous tree of the walnut family (Juglandaceae) that grows 15 to 25 meters tall (Hickman 1993). Northern California black walnut is associated with deep alluvial soil near creeks, streams, or springs that provide summer water (California Native Plant Society 1994). The flowering period of the northern California black walnut is April and May (Skinner and Pavlik 1994)."

Pressures (MSCS Technical Reports, 1999)[12]
"…Threatened by hybridization with English walnut and black walnut of the eastern United States, both of which were widely used in the early walnut industry. Few original "native" stands still survive as pure genetic stock (California Native Plant Society 1994)"

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Protect, manage, and maintain existing native stands in conjunction with

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]
<u>Delta & Eastside Delta Tributaries</u>
PROCESSES

* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within the Eastside Delta Tributaries EMZ.
* Develop floodplain management plans, including feasiblility studies to construct setback

levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within the Eastside Delta Tributary EMZ.

Sacramento River Basin

PROCESSES

* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within each of the EMZs in the Sacramento River Basin. Among the areas to be included are the lower 10 miles of Clear Creek, Antelope Creek, and Deer Creek, and the lower reach of Cottonwood Creek.
* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ in the Sacramento River Basin.

HABITAT

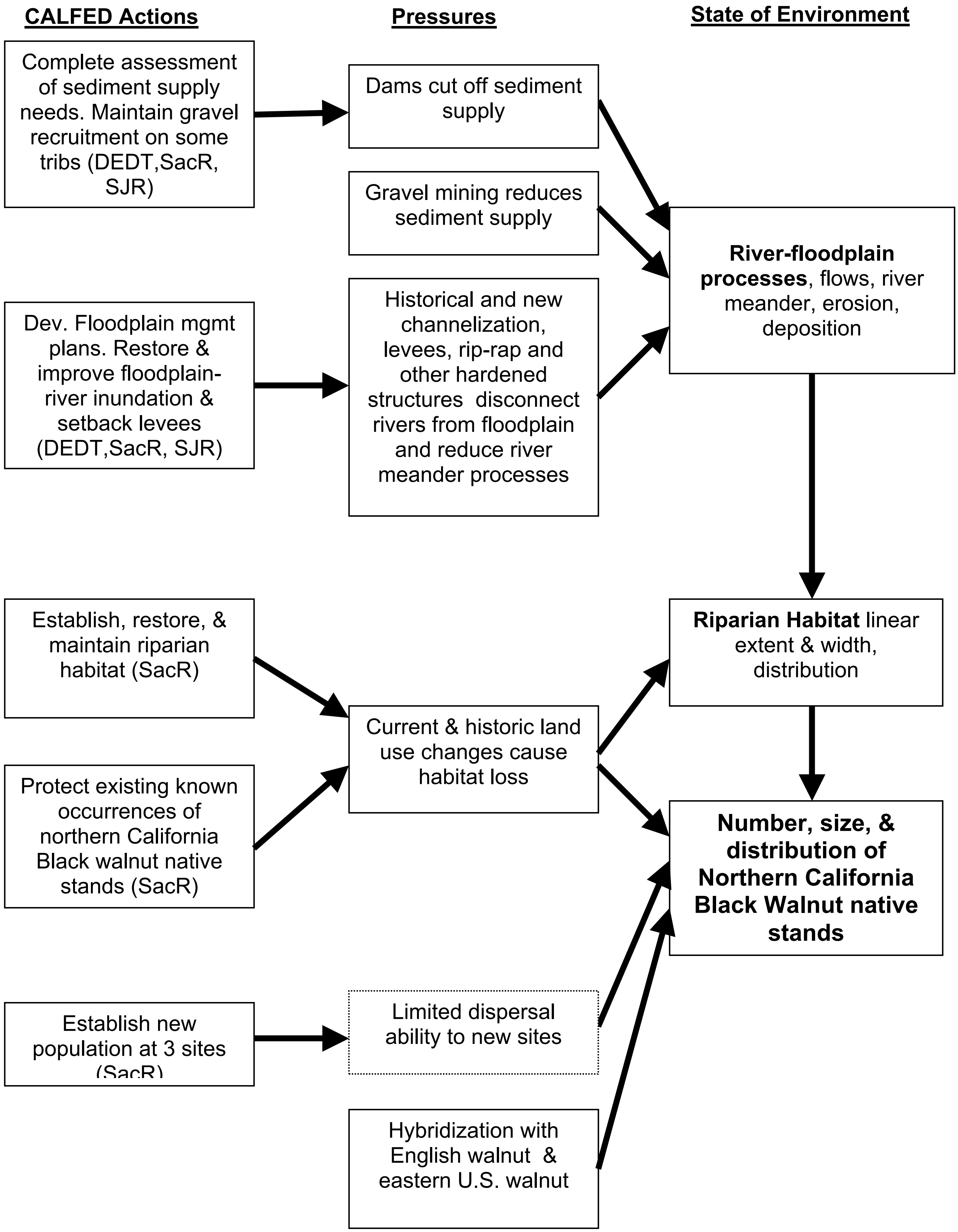
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within each of the following Ecological Management Zones: American River Basin, Butte Basin, Colusa Basin, Cottonwood Creek, Feather River/Sutter Basin, North Sacramento Valley, Sacramento River, and Yolo Basin. While restoring habitat conditions in the American River EMZ, maintain continuous corridors of suitable riparian habitat for valley elderberry longhorn beetle. Protect existing known occurrences of northern California black walnut native stands through conservation easement or purchase. Identify at least 3 protected and managed sites for introduction of additional populations of northern California black walnut; begin introduction and monitor for success. Population creation should be part of a broader effort to restore riparian areas which historically contained walnut.

San Joaquin River Basin

PROCESSES

* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ within the San Joaquin River Basin. In the East San Joaquin Basin EMZ, complete fluvial geomorphic assessments on all tributaries.
* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within each of the EMZs in the San Joaquin River Basin. Among the areas to be included are at least 10 miles of stream channel in the West San Joaquin EMZ.

Figure G-20. Northern California Black Walnut Diagrammatic Conceptual Model



Point Reyes bird's beak

Scientific Name *Cordylanthus maritimus ssp. palustris*

Legal Status[11]: CNPS List 1B

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]

Maintain, enhance, and restore suitable high marsh and high marsh-to-upland transition habitat around San Pablo Bay.

Straw-dog Monitoring Recommendations

* populations size and vigor of all the extant occurrences at two-year intervals for the duration of the CALFED program.
* Number & distribution of populations, including new populations
* spatial extent & distribution of available habitat, restored habitat, protected habitat
* Percent cover and/or degree of threat and type of non-indigenous species in current and potential Point Reyes bird's beak habitat

Existing Monitoring Program / Information Sources

?

NCCP Habitats[11] Saline Emergent

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"Point Reyes bird's-beak is distributed through the northern portion of the north coast and the northern portion California's central coast (Hickman 1993). The species is known from approximately 30 occurrences from Humboldt, Marin, San Mateo, and Sonoma Counties (Natural Diversity Data Base 1998). Historical occurrences are also known from Santa Clara County (Natural Diversity Data Base 1998). Point Reyes bird's-beak is believed extirpated from Alameda, Santa Clara, and San Mateo Counties (Skinner and Pavlik 1994). Populations vary in size from 1 to 10,000 plants. Occurrences exist on land owned by private individuals and corporations, as well as cities, counties, the University of California, and federal agencies (Natural Diversity Data Base 1998).

"Point Reyes bird's-beak is a hemiparasitic, annual herb of the figwort family (Scrophulariaceae) that grows 10-40 centimeters tall (Hickman 1993). The species grows in coastal saltmarshes. The blooming period for Point Reyes bird's-beak is from June through October (Skinner and Pavlik 1994)."

Pressures (MSCS Technical Reports, 1999)[12]

"The current range reduced by development. Other threats include foot traffic and trampling, competition from non-native plants, altered marsh hydrology and pollution, and cattle grazing (Natural Diversity Data Base 1998, Skinner and Pavlik 1994)."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Identify and implement restoration of suitable habitat in high marsh and marsh/upland transition areas. Incorporate suitable high marsh and margin habitat in ERP saltmarsh restoration actions.
2. Maintain, enhance, and restore Point Reyes bird's-beak habitat around San Pablo Bay in conjunction with restoration of saline emergent wetlands.
3. Prepare and implement a management plan to control and reduce non- native weeds near existing and new populations.

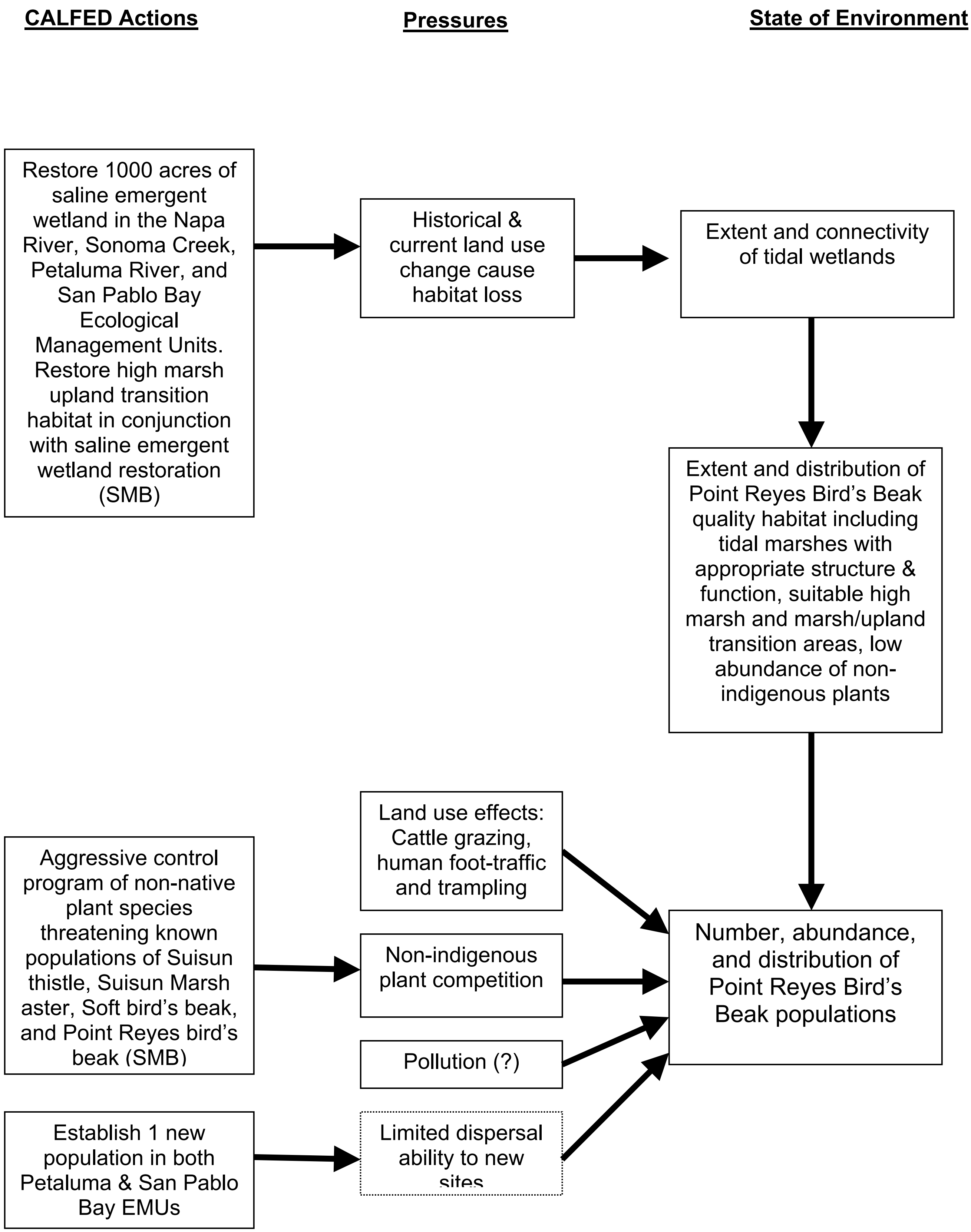
CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

Suisun Marsh & North San Francisco Bay

HABITAT

* In the Suisun Marsh/North San Francisco Bay EMZ, restore a minimum of 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. Develop cooperative programs to acquire, in fee-title or through a conservation easement, the land needed for tidal restoration, and complete the needed steps to restore the wetlands to tidal action. Begin aggressive program of control of non-native plant species that are threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak.
  - Bring into protection at least 25% of currently occupied, but unprotected Suisun Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management.
  - Expand suitable tidal slough habitat for Suisun Marsh aster by 25 linear miles.
  - Identify at least three protected and managed sites for introduction of at least three additional populations of Suisun thistle; increase overall population size at least threefold.
  - Establish at least one new Point Reyes bird's beak population in the Petaluma River and San Pablo Bay EMUs.

Figure G-21. Point Reyes Bird's Beak Diagrammatic Conceptual Model



Riparian Brush Rabbit **Scientific Name** *Sylvilagus bachmanii riparius*

Legal Status[11]: Federal endangered (FESA), California endangered (CESA)

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]

Protect the Caswell Memorial State Park population; protect, enhance, and expand the species' Caswell Memorial State Park population; and restore four additional self-sustaining populations in the Delta and along the San Joaquin River by 2020.

Straw-dog Monitoring Recommendations

* Number, size (rel. abundance?) & location of populations, including number of new populations
* Extent and distribution of available, protected, restored and enhanced habitat with appropriate vegetation structure and composition
* extent, distribution, and number of patches of quality Riparian Brush Rabbit habitat (with upland refugia from flooding)
* Connectivity among patches relative to dispersal

Existing Monitoring Programs / Information Sources

Cal. Dept. of Fish & Game: Riparian Brush Rabbit Monitoring – Population and genetics research and captive breeding program. Contact: Ron Schlorff

East Bay Municipal Utility District: Mokelumne River Watershed Wildlife Monitoring Program – includes Riparian Brush Rabbit, Foothill Yellow-legged Frog, Giant Garter Snake, Red-legged Frog, Swainson's Hawk, Willow Flycatcher. Contact: Kent Reeves, East Bay Municipal Utility District http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=5282

San Joaquin Valley Endangered Species Program (CSU-Stanislaus): Riparian Brush Rabbit and San Joaquin Woodrat Monitoring – Monitoring at Caswell Memorial State Park and other places. Contact: Laurissa Hamilton, Dan Williams

NCCP Habitats[11] Valley/Foothill Riparian

ERP Mgmt Zone[12] East San Joaquin Basin; historically occurred in San Joaquin River, West San Joaquin Basin, and Delta.

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"The riparian brush rabbit inhabits riparian communities along the lower portions of the San Joaquin and Stanislaus Rivers in the northern San Joaquin Valley, California. Because the subspecies was not described until after it is believed to have been extirpated from most of its historical range, definitive information on its former distribution is lacking. It apparently has been extirpated from the Sacramento-San Joaquin River Delta and most of the lower San Joaquin River and its tributaries—the Stanislaus, Tuolumne, and Merced Rivers (Williams 1986). The range of the subspecies probably extended farther upstream than the Merced River, assuming that suitable habitat historically occurred along the length of the San Joaquin River system (Williams and Basey 1986).

"The riparian brush rabbit is currently restricted to a single population at Caswell Memorial State Park, San Joaquin County, along the Stanislaus River (Williams and Basey 1986). Surveys conducted in all potential habitat along the Merced, San Joaquin, Stanislaus, and Tuolumne Rivers during 1985 and 1986 failed to find any additional populations of riparian brush rabbits (Williams 1988). The most recent estimates indicate the population comprises 170-608 individuals over 198 acres (Williams 1993). Williams (1988) estimated a population low of 10 or fewer individuals following severe winter flooding in 1985 and 1986. The flooding during winter 1996-1997 has also severely affected the population. The riparian brush rabbit population is declining (California Department of Fish and Game 1992).

"Habitat for the riparian brush rabbit consists of riparian forests with a dense understory shrub layer. Common plants in the habitat include California wild rose, Pacific blackberry, wild grape, Douglas' coyote bush, and various grasses (Williams 1988, Basey 1990). Brush rabbits have small home ranges that usually conform to the size of available brushy habitat (Basey 1990)."

Pressures (MSCS Technical Reports, 1999)[12]

"Potential threats to this species include habitat conversion to agriculture, wildfire, disease, predation, flooding, clearing of riparian vegetation, and the use of rodenticides. There has been a statewide reduction of riparian communities by nearly 90% because of elimination and modification of riparian forests along valley floor river systems to urban, commercial, and agricultural development; wood cutting; reclamation and flood control activities; heavy groundwater pumping; river channelization; dam building; and water diversion. The species is at risk from the lack of elevated mounds with protective cover to serve as flood refuges within remaining riparian habitat."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Coordinate protection, enhancement, and restoration of riparian brush rabbit populations and its habitat with other federal and State programs (e.g., U.S. Fish and Wildlife Service [USFWS] species recovery plans) that could affect management of current and historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
2. Conduct surveys to identify suitable habitat for establishment of additional populations in the Delta and along the San Joaquin River, and implement introductions to establish five additional populations in these areas by 2020.
3. Direct ERP actions proposed for the Stanislaus River toward protecting, enhancing, and restoring table riparian and associated flood refuge habitats in and adjacent to occupied habitat at Caswell Memorial State Park.
4. Develop and implement a monitoring plan to assess population status and trends.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

<u>Delta & Eastside Delta Tributaries</u>

HABITAT

* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within the Eastside Delta Tributary EMZ

<u>San Joaquin River Basin</u>

HABITAT

* Implement 25 percent of the ERP target for diverse, self-sustaining riparian community for all EMZs in the San Joaquin River Basin. Bring at least three of the currently existing but unprotected delta coyote thistle occurrences into protection through purchase or conservation agreement, and ensure appropriate management. Increase suitable habitat for delta coyote thistle by at least 20% and the number of populations and individuals by at least 10% through habitat management and protection. Establish two new riparian brush rabbit habitat preserves within the historical range of the species. Protect and enhance a minimum of 150 contiguous acres of mature, shrub-rich riparian forest and associated highwater refugia on the San Joaquin River, between the Merced River confluence and Vernalis, and on each of the east-side tributaries (the Stanislaus, Tuolumne and Merced rivers) for habitat values and as potential riparian brush rabbit re-introduction sites.

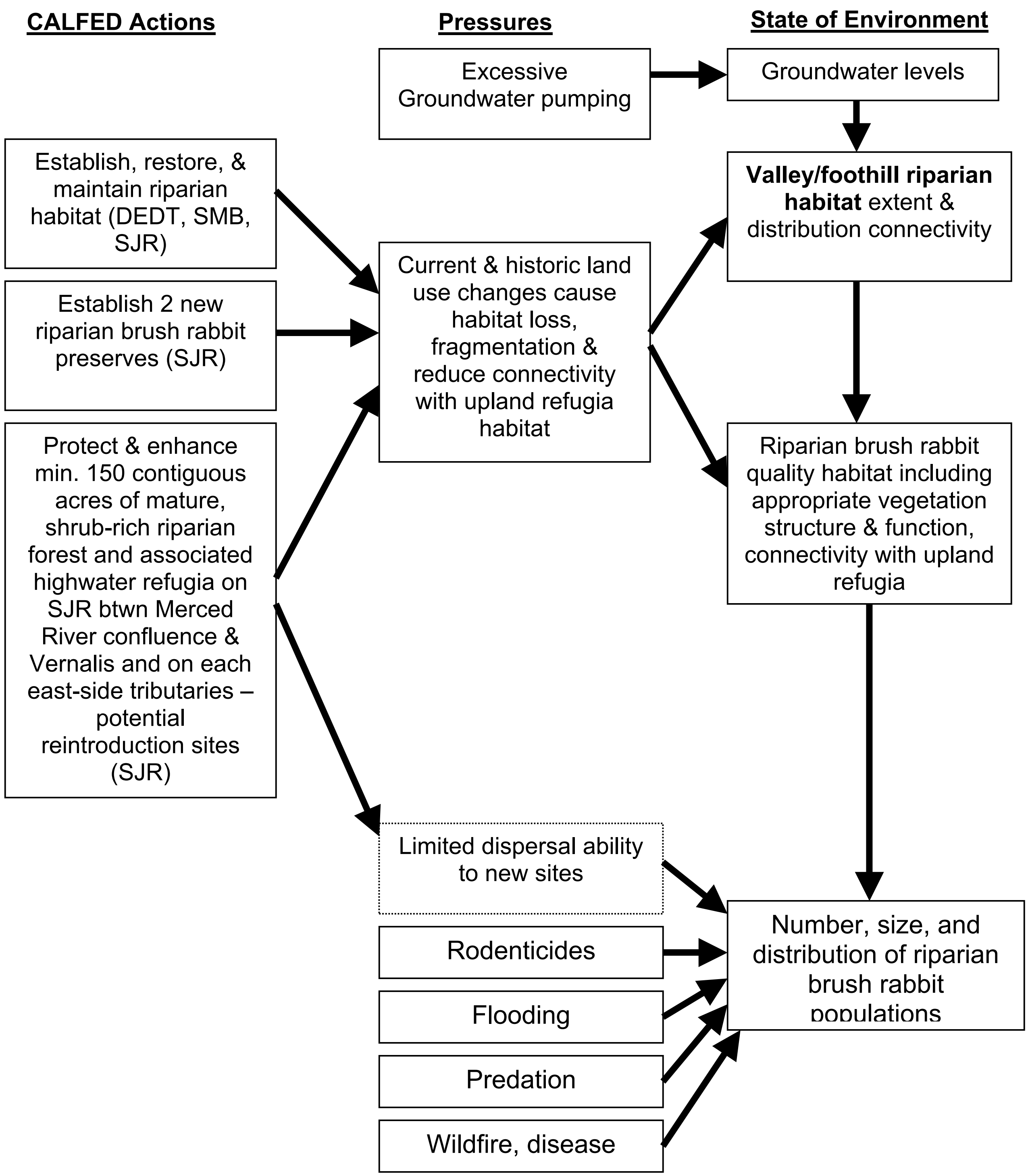
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat and instream cover along at least one tributary within the East San Joaquin and San Joaquin River EMZs.

Suisun Marsh & North San Francisco Bay

HABITAT

* Restore and maintain a minimum of three linear miles of riparian habitat along corridors of existing riparian scrub and shrub vegetation in each of the Ecological Management Units of the Suisun Marsh/North San Francisco Bay Ecological Management Zone.

Figure G-22. Riparian Brush Rabbit Diagrammatic Conceptual Model



<u>Salt Marsh Harvest Mouse</u> **Scientific Name** *Reithrodontomys raviventris*

Legal Status[11]: Federal endangered (FESA), California endangered (CESA), Fully protected under California Fish and Game Code

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]

Maintain the current distribution and existing populations of the salt marsh harvest mouse and reestablish and maintain viable species' populations throughout its historical range in the portion of the Bay Region within the ERP Focus Area.

Straw-dog Monitoring Recommendations

* Number & distribution of populations including number of new populations
* Extent and distribution of available, protected, restored and enhanced habitat with appropriate vegetation structure and composition
* extent, distribution, and number of patches of quality salt marsh harvest mouse habitat (patches with tidal exchange, large enough to develop 4th order channels [at least 1000 acres], low angle upland slopes, and wetland to upland transition habitat at least 0.25 mile in width, etc.)
* Connectivity among patches relative to dispersal
* Use of restored marsh habitat and rate at which restored habitats are colonized

Existing Monitoring Programs / Information Sources

Cal. Dept. of Fish & Game / Cal. Dept. Water Resources: Suisun Marsh Salt Marsh Harvest Mouse and Trapping in SMHM Conservation Areas. Contact: Laurie Briden, CDFG

NCCP Habitats[11] Saline Emergent

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"The salt marsh harvest mouse is endemic to saltwater and brackish water marshes adjoining San Francisco Bay and its tributaries (Shellhammer 1982). It was formerly found throughout the extensive marshes that once bordered San Francisco, San Pablo, and Suisun Bays (California Department of Fish and Game 1980). The species is now restricted to fragmented and widely separated saline or brackish emergent wetlands. Known populations of salt marsh harvest mice exist at the Leslie Salt intake and Mare Island in Solano County, lower Tubbs Island in Sonoma County, Novato and Gallinas Creeks in Marin County, Albrad Slough and Triangle Marsh in Alameda County, Bair and Bird Islands in San Mateo County (U.S. Fish and Wildlife Service 1984), the Palo Alto Bay saltmarsh in Santa Clara County (Wondolleck et al. 1976), Petaluma Marsh in Sonoma County, and in tidal marshes located near Napa in Napa County. The species has also been found along the Sacramento River Delta at Grizzly and Joice Island Wildlife Management Areas (Schaub 1971) and near Collinsville (Shellhammer 1979) in Solano County.

"The salt marsh harvest mouse breeds from May to November and may produces up to two litters per year. Optimal habitat for this species is saline emergent wetland with 100% plant cover, consisting predominantly of pickleweeds in association with fat hen and alkali heath (Shellhammer 1982). Suitable wetlands are 100 or more acres, with an upper edge of peripheral halophytes (salt-loving plants) for refuge during high tides or floods(Shellhammer 1982). The salt marsh harvest mouse will also use marginal upland habitats (Zetterquist 1977, Botti et al. 1986)."

Pressures (MSCS Technical Reports, 1999)[12]

"Habitat destruction is the greatest threat to this species (U.S. Fish and Wildlife Service 1984). By 1979, filling, flooding, or other conversions of marshes in the San Francisco Bay Area for commercial purposes had removed 79% of the tidal marshes (Jones & Stokes Associates et al. 1979). Additionally, much of the remaining area was converted to diked wetland, most of which became marginal or unsuitable habitat for the salt marsh harvest mouse (U.S. Fish and Wildlife Service 1984). Marsh subsidence, changes in salinity, plowing, mowing, burning, and artificial flushing have caused adverse impacts on this species' habitat by changing plant species composition or reducing vegetation used for cover (Shellhammer 1982)."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. The geographic priorities for implementing ERP actions to protect, enhance, and restore saline emergent wetlands and associated habitats for the salt marsh harvest mouse should be (1) western Suisun Marsh, (2) Gallinas/Ignacio marshes, Napa marshes, and eastern Suisun Marsh, (3) Sonoma marshes, Petaluma marshes, and Highway 37 marshes west of Sonoma Creek, (4) Point Pinole marshes, (5) Highway 37 marshes east of Sonoma Creek, and (6) the Contra Costa County shoreline.
2. Coordinate protection, enhancement, and restoration of saltmarsh and associated habitats with other federal, State, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project and USFWS species recovery plans) that could affect management of current and historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
3. Restore wetland and perennial grassland habitats adjacent to occupied habitats to create a buffer of natural habitat. This buffer would protect populations from adverse effects that could be associated with future changes in land use on nearby lands and provide habitat suitable for the natural expansion of populations.
4. Initial species recovery efforts should be directed to locations where there are immediate opportunities for protection, enhancement, or restoration of suitable habitat.
5. To the extent practicable, design dikes constructed in enhanced and restored saline emergent wetlands to provide optimal wetland-to-upland transitional habitat.
6. To the extent practicable, direct ERP saltmarsh enhancement efforts toward existing degraded marshes that are of sufficient size and configuration to develop fourth-order tidal channels (marshes would most likely need to be at least 1,000 acres).
7. To the extent practicable, design saltmarsh enhancements and restorations that provide low-angle upland slopes at the upper edge of marshes to provide suitable and sufficient wetland-to-upland transition habitat. Transition habitat zones should be at least 0.25 mile wide.
8. Manage enhanced and restored habitat to avoid or minimize impacts on the salt marsh harvest mouse that could be associated with recreational uses on lands acquired or managed under conservation easements.
9. Direct restoration efforts toward restoration of lands adjacent to occupied habitat.
10. Direct restoration efforts toward improving tidal circulation to diked wetlands that currently sustain partial tidal exchange.
11. Direct some habitat enhancements and restorations toward increasing habitat connectivity among existing and restored tidal marshes.
12. To the extent practicable, control non-native predator populations in occupied habitat and saltmarshes enhanced and restored under the ERP.
13. Control non-native invasive plants in existing saltmarshes where non-native plants have degraded habitat quality and in saltmarshes restored under the ERP.
14. Monitor the use of restored saltmarsh habitats by salt marsh harvest mice and the rate at which restored habitats are colonized.

15. Acquire conservation easements to adjust grazing regimes and enhance wetland-to-upland transition habitat conditions.

16. To the extent consistent with CALFED objectives, manage lands purchased or acquired under conservation easements that are occupied by the species to maintain or increase their current population levels.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

Delta & Eastside Delta Tributaries

STRESSORS

* Conduct the following mercury evaluation and abatement work in the Delta (from Phase II Report): Determine methylization (part of bioaccumulation) process in Delta. Determine sediment mercury concentration in areas that would be dredged during levee maintenance or conveyance work. Determine potential impact of ecosystem restoration work on methyl mercury levels in lower and higher trophic level organisms.
* Conduct the following selenium work: Conduct selenium research to fill data gaps in order to refine regulatory goals of source control actions; determine bioavailability of selenium under several scenarios (from Phase II Report). Evaluate and, if appropriate, implement real-time management of selenium discharges (from Phase II Report). Expand and implement source control, treatment, and reuse programs (from Phase II Report). Coordinate with other programs; e.g., recommendations of San Joaquin Valley Drainage Implementation Program, CVPIA for retirement of lands with drainage problems that are not subject to correction in other ways (from Phase II Report). Support development and implementation of TMDL for selenium in the San Joaquin River watershed (focus on Grassland area).
* Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.
* Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.

Sacramento River Basin

STRESSORS

* Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.
* Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.

San Joaquin River Basin

STRESSORS

* Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.
* Conduct the following selenium work: Conduct selenium research to fill data gaps in order to refine regulatory goals of source control actions; determine bioavailability of selenium under several scenarios (from Phase II Report). Evaluate and, if appropriate, implement real-time

management of selenium discharges (from Phase II Report). Expand and implement source control, treatment, and reuse programs (from Phase II Report). Coordinate with other programs; e.g., recommendations of San Joaquin Valley Drainage Implementation Program, CVPIA for retirement of lands with drainage problems that are not subject to correction in other ways (from Phase II Report). Support development and implementation of TMDL for selenium in the San Joaquin River watershed (focus on Grassland area).

* Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.

<u>Suisun Marsh & North San Francisco Bay</u>

HABITAT

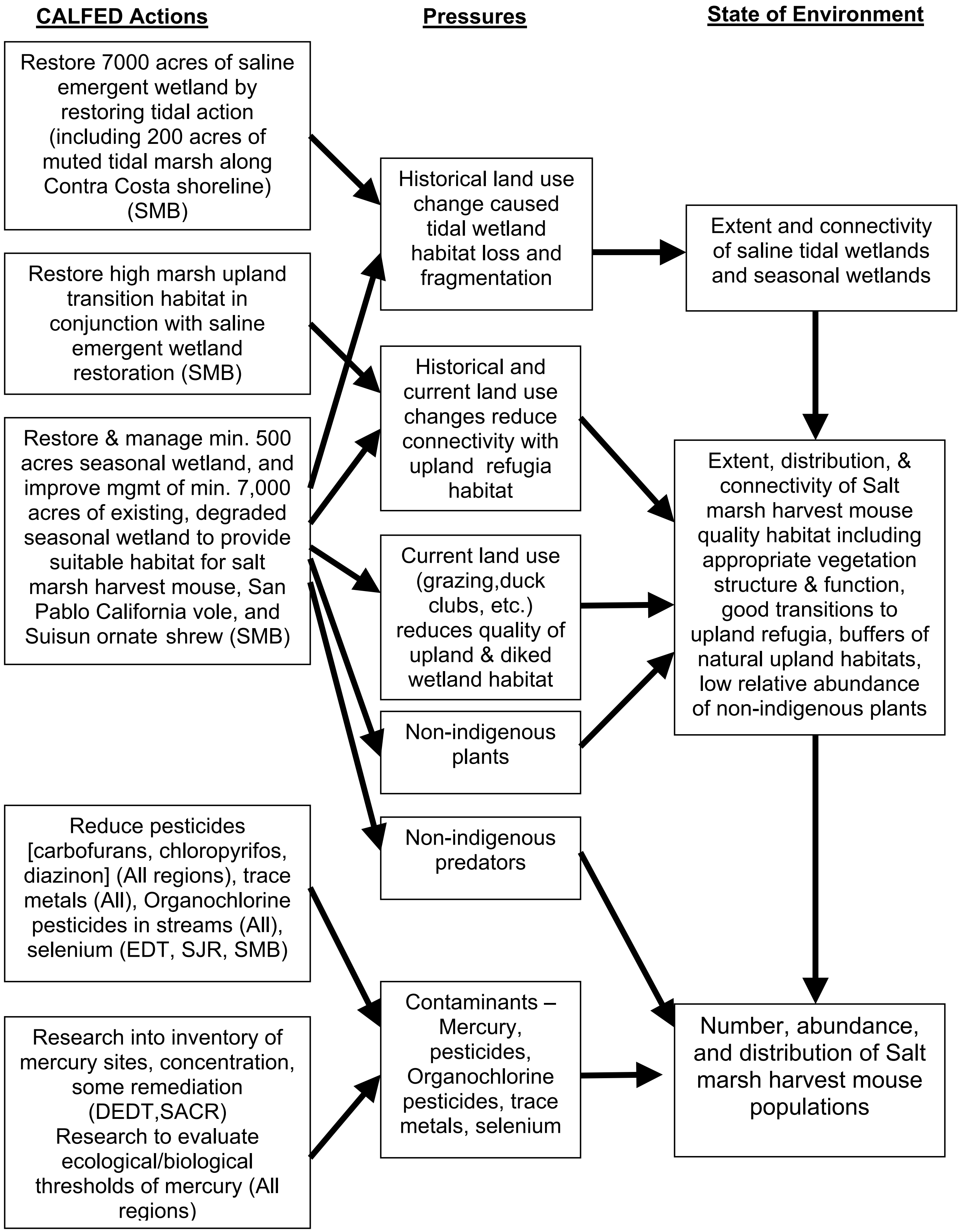
* In the Suisun Marsh/North San Francisco Bay Ecological Management Zone, restore and manage a minimum of 500 acres of seasonal wetland, and improve management of a minimum of 7,000 acres of existing, degraded seasonal wetland in a manner that provides suitable habitat for salt marsh harvest mouse, San Pablo California vole, and Suisun ornate shrew.
* In the Suisun Marsh/North San Francisco Bay EMZ, restore a minimum of 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. Develop cooperative programs to acquire, in fee-title or through a conservation easement, the land needed for tidal restoration, and complete the needed steps to restore the wetlands to tidal action. Begin aggressive program of control of non-native plant species that are threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak.
  - Bring into protection at least 25% of currently occupied, but unprotected Suisun Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management.
  -Expand suitable tidal slough habitat for Suisun Marsh aster by 25 linear miles.
  -Identify at least three protected and managed sites for introduction of at least three additional populations of Suisun thistle; increase overall population size at least threefold.
  -Establish at least one new population of soft bird's beak with high likelihood of success in restored habitat in each of the Suisun Bay and Marsh EMU, the Napa River EMU, and the Petaluma River EMU.
  -Establish at least one new Point Reyes bird's beak population in the Petaluma River and San Pablo Bay EMUs.

STRESSORS

* Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.
* Conduct the following trace metals work (from Phase II Report): Determine spatial and temporal extent of metal pollution. Determine ecological significance and extent of copper contamination. Evaluate impacts of other metals such as cadmium, zinc, and chromium. Participate in Brake Pad Partnership to reduce introduction of copper. Partner with municipalities on evaluation and implementation of stormwater control facilities. Participate in remediation of mine sites as part of local watershed restoration and Delta restoration.

* Conduct the following selenium work: Conduct selenium research to fill data gaps in order to refine regulatory goals of source control actions; determine bioavailability of selenium under several scenarios (from Phase II Report). Evaluate and, if appropriate, implement real-time management of selenium discharges (from Phase II Report). Expand and implement source control, treatment, and reuse programs (from Phase II Report). Coordinate with other programs; e.g., recommendations of San Joaquin Valley Drainage Implementation Program, CVPIA for retirement of lands with drainage problems that are not subject to correction in other ways (from Phase II Report). Support development and implementation of TMDL for selenium in the San Joaquin River watershed (focus on Grassland area).

Figure G-23. Salt Marsh Harvest Mouse Diagrammatic Conceptual Model



<u>Saltmarsh common yellowthroat</u> **Scientific Name** *Geothlypis trichas sinuosa*

Legal Status[11]: California species of special concern

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]
Maintain the current distribution and existing populations of the saltmarsh common yellowthroat, and reestablish and maintain viable species' populations throughout its historical range in the portion of the Bay Region within the ERP focus area.

Straw-dog Monitoring Recommendations
* Number, size, and distribution of populations
* Extent & distribution of available, protected, restored, and enhanced breeding habitat with appropriate vegetation structure and function

Existing Monitoring Program / Information Sources
?

NCCP Habitats[11] Saline Emergent

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]
"The historical distribution of the saltmarsh common yellowthroat was the San Francisco Bay Area, from Tomales Bay (Marin County) and Napa Sloughs south to San Jose (Santa Clara County) during the breeding season, and San Francisco Bay south along the coast to San Diego County during winter (Grinnell and Miller 1944). Although the range has remained relatively stable, the total population of the subspecies has decreased (Laymon pers. comm.).

"During the breeding season, April to July, the saltmarsh common yellowthroats build nests among dense vegetation in fresh- or brackish water marshes. Associated plant species include cattails, tules and other sedges, young willow trees, and blackberry vines. The species is found near saltwater marshes more often during fall and winter months (Grinnell and Miller 1944)."

Pressures (MSCS Technical Reports, 1999)[12]
"Loss of suitable habitat around the San Francisco Bay and along the coast is the main reason for the decline of the species. Brood parasitism by brown-headed cowbirds has also negatively affected numbers in some localities (Laymon pers. comm.)."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. The geographic priorities for implementing ERP actions to protect, enhance, and restore saline emergent wetlands and associated habitats for the saltmarsh common yellowthroat should be (1) Gallinas/Ignacio marshes and Napa marshes, (2) Sonoma marshes, Petaluma marshes, and Highway 37 marshes west of Sonoma Creek, (3) Point Pinole marshes, (4) Highway 37 marshes east of Sonoma Creek, and (5) the Contra Costa County shoreline.
2. Coordinate protection, enhancement, and restoration of saltmarsh and associated habitats with other federal, State, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project and USFWS species recovery plans) that could affect management of current and historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
3. Restore wetland and perennial grassland habitats adjacent to occupied nesting habitats to create a buffer of natural habitat. This buffer would protect nesting pairs from adverse effects that could be associated with future changes in land use on nearby lands and provide

suitable foraging habitat and nesting habitat suitable for the natural expansion of populations.

4. Initial species recovery efforts should be directed to locations where there are immediate opportunities for protection, enhancement, or restoration of suitable habitat.

5. To the extent practicable, design dikes constructed in enhanced and restored saline emergent wetlands to provide optimal wetland-to-upland transitional habitat.

6. Direct ERP saltmarsh enhancement efforts toward existing degraded marshes that are of sufficient size and configuration to develop fourth- order tidal channels (marshes would most likely need to be at least 1,000 acres).

7. To the extent practicable, design saltmarsh enhancements and restorations that provide low-angle upland slopes at the upper edge of marshes to provide suitable and sufficient wetland-to-upland transition habitat. Transition habitat zones should be at least 0.25 mile wide.

8. Manage enhanced and restored habitat to avoid or minimize impacts on the saltmarsh common yellowthroat that could be associated with recreational uses on lands acquired or managed under conservation easements.

9. Direct ERP restorations toward improving tidal circulation to diked wetlands that currently sustain partial tidal exchange.

10. Direct some habitat enhancements and restorations toward increasing habitat connectivity among existing and restored tidal marshes.

11. To the extent practicable, control non-native predator populations in occupied habitat and saltmarshes enhanced and restored under the ERP.

12. Identify and implement feasible methods for controlling invasive non- native marsh plants.

13. Monitor to determine the use of restored saltmarsh habitat by saltmarsh common yellowthroats and the rate at which restored habitats are colonized.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

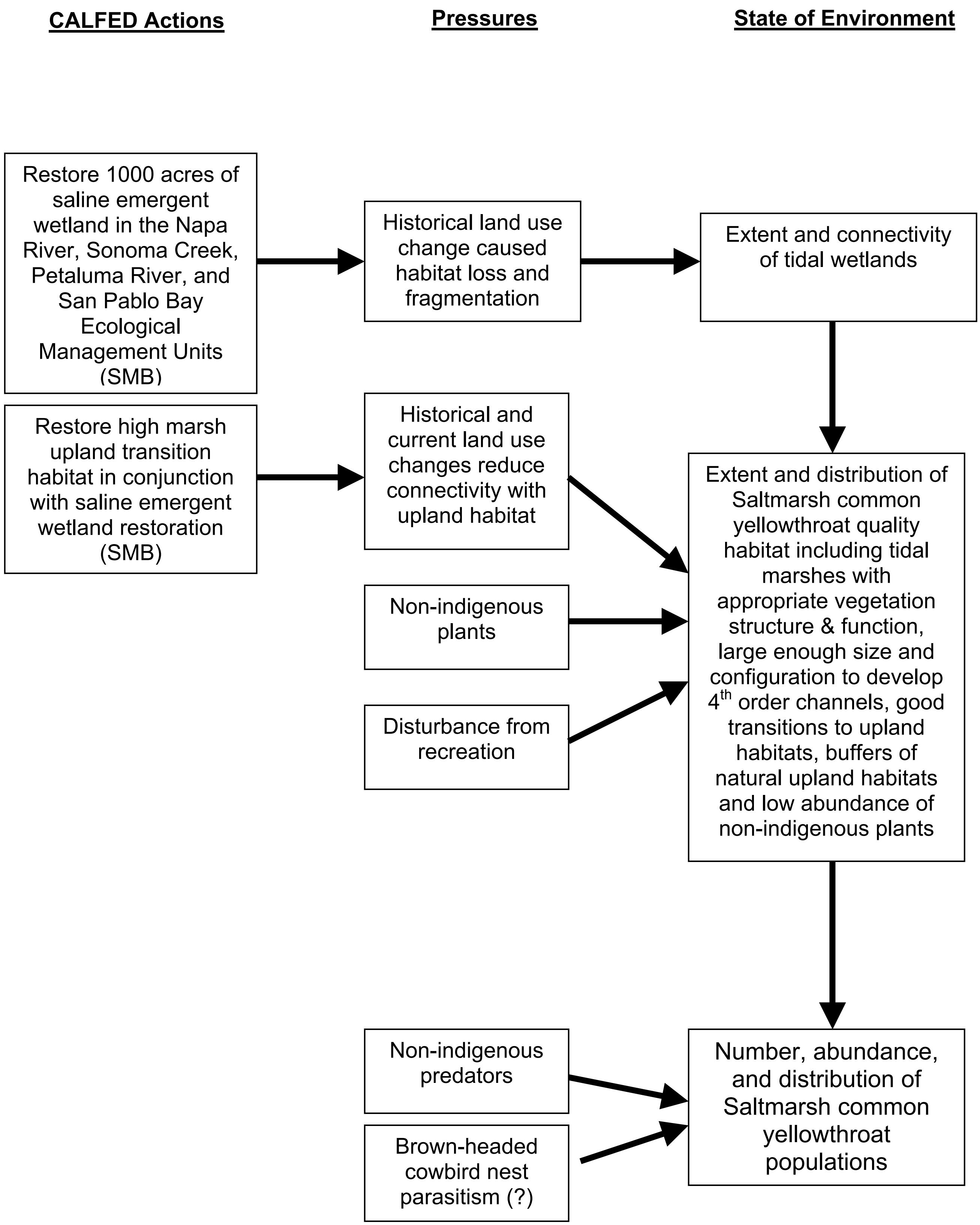
Suisun Marsh & North San Francisco Bay

HABITAT

* In the Suisun Marsh/North San Francisco Bay EMZ, restore a minimum of 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. Develop cooperative programs to acquire, in fee-title or through a conservation easement, the land needed for tidal restoration, and complete the needed steps to restore the wetlands to tidal action. Begin aggressive program of control of non-native plant species that are threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird’s beak, and Point Reyes bird’s beak.

- Bring into protection at least 25% of currently occupied, but unprotected Suisun Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management.
- Expand suitable tidal slough habitat for Suisun Marsh aster by 25 linear miles.
- Identify at least three protected and managed sites for introduction of at least three additional populations of Suisun thistle; increase overall population size at least threefold.
- Establish at least one new population of soft bird’s beak with high likelihood of success in restored habitat in each of the Suisun Bay and Marsh EMU, the Napa River EMU, and the Petaluma River EMU.
- Establish at least one new Point Reyes bird’s beak population in the Petaluma River and San Pablo Bay EMUs.

Figure G-24. Saltmarsh common yellowthroat Diagrammatic Conceptual Model



<u>San Joaquin Valley Woodrat</u> **Scientific Name** *Neotoma fuscipes riparia*

Legal Status[11]: Federal Endangered (FESA), California species of special concern

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]

Protect the Caswell Memorial State Park population; protect, enhance, and expand the species' Caswell Memorial State Park population; and improve habitat connectivity and genetic interchange among isolated populations.

Straw-dog Monitoring Recommendations

* Number, abundance, & location of populations, including number of new populations
* Extent and distribution of available, protected, restored and enhanced habitat with appropriate vegetation structure and composition
* extent, distribution, and number of patches of quality San Joaquin Valley woodrat habitat (with upland refugia from flooding)
* Connectivity among patches relative to dispersal

Existing Monitoring Programs/Information Sources

San Joaquin Valley Endangered Species Program (CSU-Stanislaus): Riparian Brush Rabbit and San Joaquin Woodrat Monitoring at Caswell Memorial State Park and other places. Contact: Laurissa Hamilton, Dan Williams

NCCP Habitats[11] Valley/Foothill Riparian

ERP Mgmt Zone[12] East San Joaquin Basin, West San Joaquin Basin (?), Historically San Joaquin River, Delta, West San Joaquin Basin

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"The San Joaquin Valley woodrat inhabits San Joaquin Valley communities along the lower portions of the San Joaquin and Stanislaus Rivers in the northern San Joaquin Valley, California. Historical records for the San Joaquin Valley woodrat indicate that the species was distributed in communities along the San Joaquin, Stanislaus, and Tuolumne Rivers; along Corral Hollow in San Jose County; elsewhere in San Joaquin and Stanislaus Counties, and in Merced County (Hooper 1938, Williams 1986). Before the statewide reduction of San Joaquin Valley communities by nearly 90% (Katibah 1984), the San Joaquin Valley woodrat probably ranged throughout the extensive San Joaquin Valley forests along major streams flowing onto the floor of the northern San Joaquin Valley. Today, San Joaquin Valley woodrat populations are greatly depleted, with the only known population at Caswell Memorial State Park and a possible second population near Vernalis, San Joaquin County. Williams (1993) estimated a peak population at Caswell of 437 animals, based on a mean density of 4.8 woodrats per hectare on 223 acres of suitable habitat.

"San Joaquin Valley woodrats are most abundant where shrub cover is dense and least abundant in open areas. In San Joaquin Valley areas, highest densities of woodrats and their nests are often encountered in willow thickets with an oak overstory. The species is common where there are deciduous valley oaks but few live oaks. Mostly active at night, the woodrat's diet is diverse and principally herbivorous, comprising leaves, fruits, terminalshoots of twigs, flowers, nuts, and fungi. The young are born in stick nest structures or "lodges" (located on the ground) that are 2-3 feet high and 4-6 feet in diameter. Most lodges are positioned over or against logs (Cook 1992, cited in Williams 1993). Unlike other subspecies of the dusky-footed woodrat, the San Joaquin Valley woodrat occasionally builds nests in cavities in trees and artificial wood-duck nest boxes (Williams 1986)."

Pressures (MSCS Technical Reports, 1999)[12]

"Potential threats to this species include habitat conversion to agriculture, wildfire, disease, predation, flooding, drought, clearing of San Joaquin Valley vegetation, use of rodenticides, and browsing and trampling by ungulates. There has been a statewide reduction of San Joaquin Valley communities by nearly 90% (Katibah 1984) from elimination and modification of San Joaquin Valley forests along valley-floor river systems to urban, commercial, and agricultural development; wood cutting; reclamation and flood control activities; heavy groundwater pumping; river channelization; dam building; and water diversion."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Coordinate protection, enhancement, and restoration of San Joaquin Valley woodrat populations and its habitat with other federal and State programs (e.g., USFWS species recovery plans and the U.S. Army Corps of Engineers' [USACE's] Sacramento and San Joaquin Basin Comprehensive Study) that could affect management of current and historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
2. Direct ERP actions proposed for the Stanislaus River toward protecting, enhancing, and restoring suitable riparian and associated flood refuge habitats in and adjacent to occupied habitat at Caswell Memorial State Park.
3. Direct ERP actions proposed for the San Joaquin River and its major tributaries within the current range of the species toward protecting and enhancing existing occupied habitat, restoring suitable habitat adjacent to occupied habitat, and restoring suitable riparian habitat to create habitat corridors linking isolated populations.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

<u>Delta & Eastside Delta Tributaries</u>

PROCESSES

* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within the Eastside Delta Tributary EMZ.

<u>Sacramento River Basin</u>

PROCESSES

* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within each of the EMZs in the Sacramento River Basin. Among the areas to be included are the lower 10 miles of Clear Creek, Antelope Creek, and Deer Creek, and the lower reach of Cottonwood Creek.

<u>San Joaquin River Basin</u>

PROCESSES

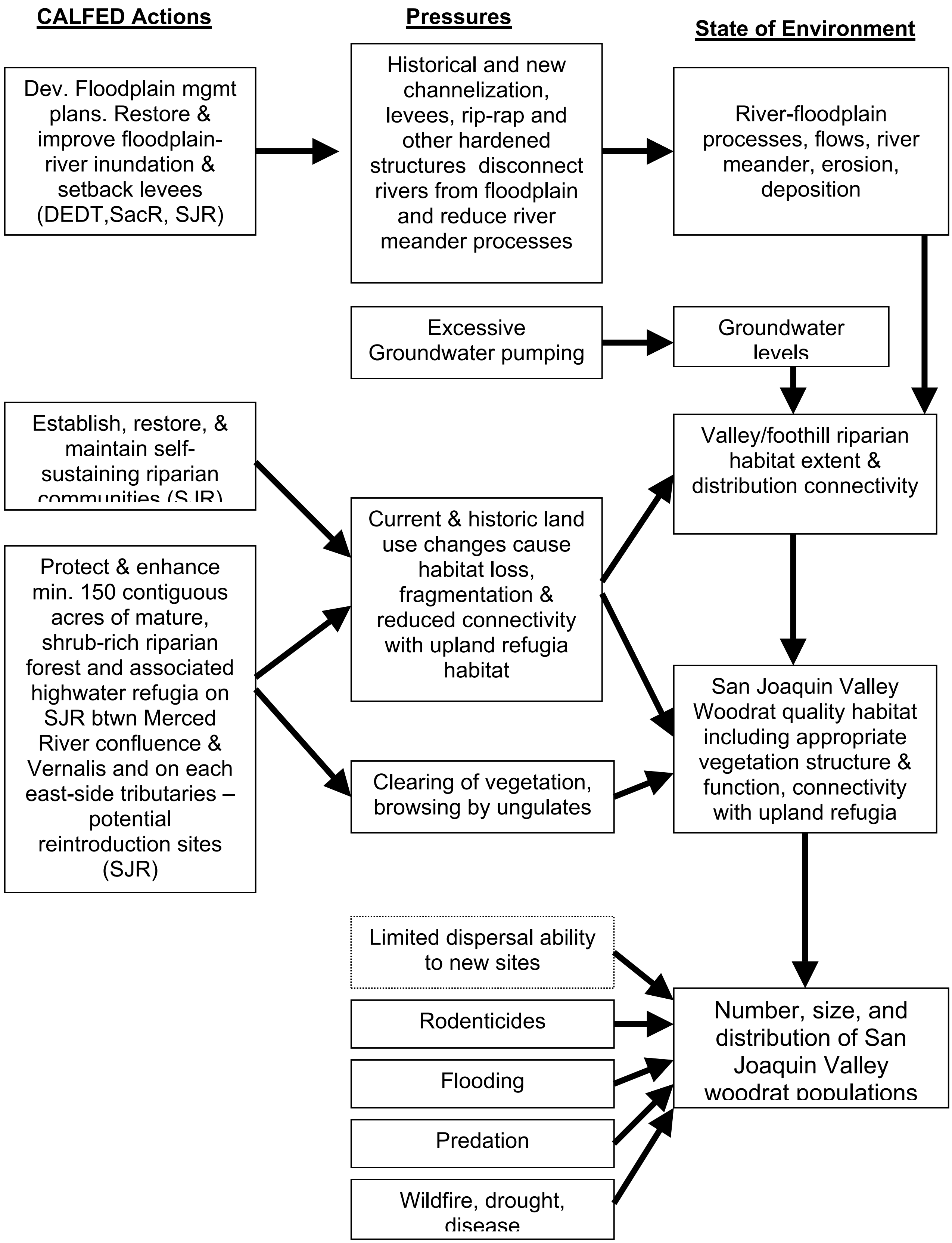
* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within each of the EMZs in the San Joaquin River Basin. Among the areas to be included are at least 10 miles of stream channel in the West San Joaquin EMZ.

HABITAT

* Implement 25 percent of the ERP target for diverse, self-sustaining riparian community for all EMZs in the San Joaquin River Basin. Bring at least three of the currently existing but unprotected delta coyote thistle occurrences into protection through purchase or conservation agreement, and ensure appropriate management. Increase suitable habitat for delta coyote thistle by at least 20% and the number of populations and individuals by at least 10% through habitat management and protection. Establish two new riparian brush rabbit habitat preserves within the historical range of the species. Protect and enhance a minimum

of 150 contiguous acres of mature, shrub-rich riparian forest and associated highwater refugia on the San Joaquin River, between the Merced River confluence and Vernalis, and on each of the east-side tributaries (the Stanislaus, Tuolumne and Merced rivers) for habitat values and as potential riparian brush rabbit re-introduction sites.

Figure G-25. San Joaquin Valley Woodrat Diagrammatic Conceptual Model



San Pablo California Vole **Scientific Name** *Microtus californicus sanpabloensis*

Legal Status[11]: California species of special concern

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]
Maintain the current distribution and existing populations of the San Pablo California vole, and reestablish and maintain viable species' populations throughout its historical range in portions of the Delta and Bay Regions within the ERP
focus area.

Straw-dog Monitoring Recommendations
* Number, abundance & distribution of populations including number of new populations
* Extent and distribution of available, protected, restored and enhanced habitat with appropriate vegetation structure and composition
* extent, distribution, and number of patches of quality San Pablo California vole habitat (patches with tidal exchange, large enough to develop 4th order channels [at least 1000 acres], low angle upland slopes, and wetland to upland transition habitat at least 0.25 mile in width, etc.)
* connectivity between patches relative to vole dispersal

Existing Monitoring Program / Information Sources
?

NCCP Habitats[11] Saline Emergent

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]
"Little is known about the historical distribution of the San Pablo California vole, but it currently inhabits the saltmarshes of San Pablo Creek on the south shore of San Pablo Bay (Contra Costa County) (Williams 1986).

"The species nests and forages in the saltmarshes of San Pablo Creek. It requires upland habitat for refugia from high tides."

Pressures (MSCS Technical Reports, 1999)[12]
"Loss of saltmarsh habitat and adjacent uplands is the main reason for the species' decline."

MSCS Conservation Measures - That add detail to ERP actions[11]
1. Coordinate protection, enhancement, and restoration of saltmarsh and associated habitats with other federal, State, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project and USFWS species recovery plans) that could affect management of current and historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
2. Restore wetland and perennial grassland habitats adjacent to occupied habitats to create a buffer of natural habitat. This buffer would protect populations from adverse effects that could be associated with future changes in land use on nearby lands and provide habitat suitable for the natural expansion of populations.
3. Manage enhanced and restored habitat to avoid or minimize impacts on the San Pablo California vole that could be associated with recreational uses on lands acquired or managed under conservation easements.

4. To the extent practicable, acquire, restore, and manage historical tidal saltmarshes and surrounding lands occupied by the San Pablo California vole along the west side of Point Pinole to tidal marsh with sufficient wetland-to-upland transition and adjacent upland habitat to improve habitat conditions for the species.
5. To the extent practicable, control non-native predator populations in occupied habitat and saltmarshes enhanced and restored under the ERP.
6. Identify and implement feasible methods for controlling invasive non-native marsh plants.
7. To the extent consistent with CALFED objectives, manage lands purchased or acquired under conservation easements that are occupied by the species to maintain or increase their current population levels.

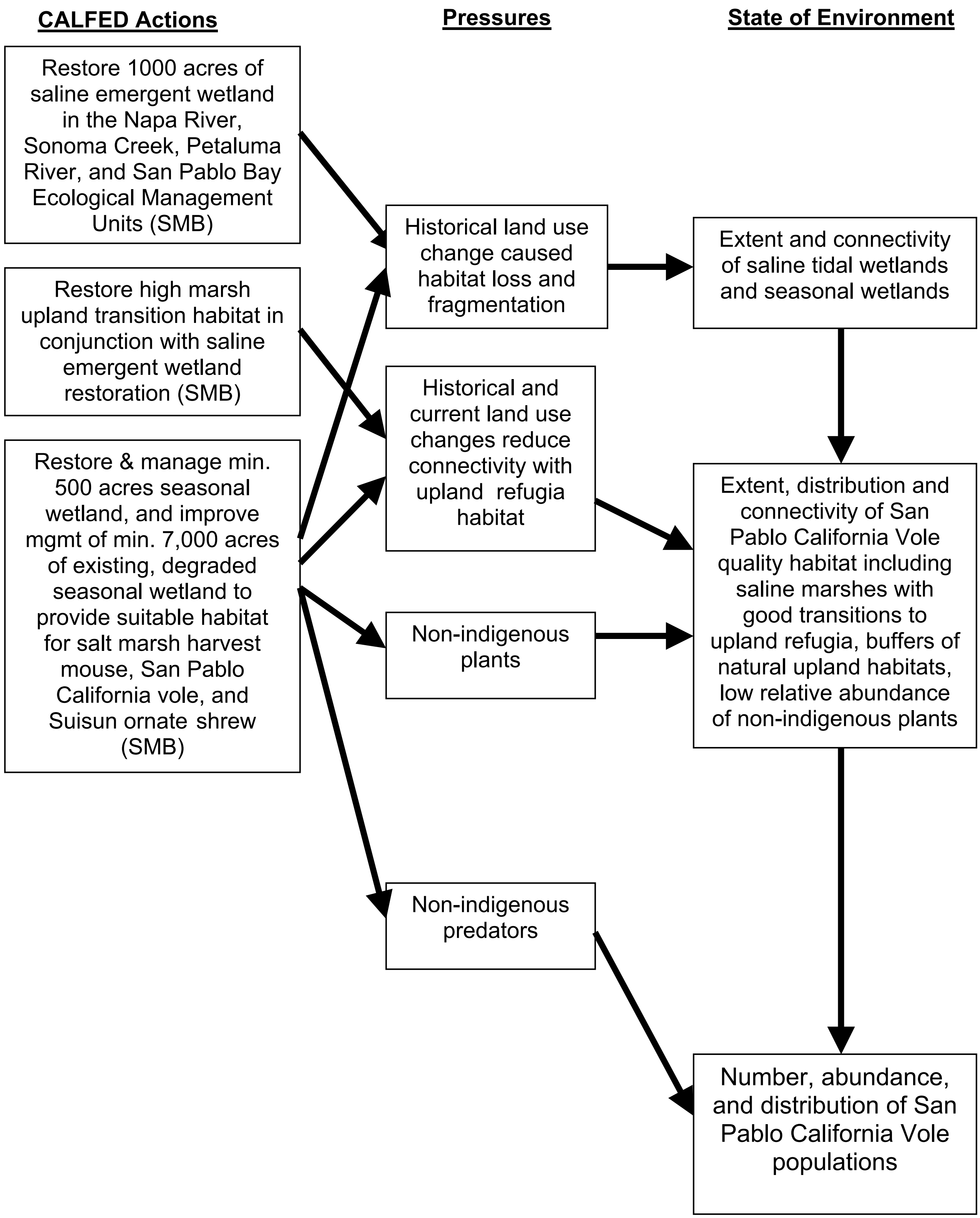
CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

Suisun Marsh & North San Francisco Bay

HABITAT

* In the Suisun Marsh/North San Francisco Bay EMZ, restore a minimum of 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. Develop cooperative programs to acquire, in fee-title or through a conservation easement, the land needed for tidal restoration, and complete the needed steps to restore the wetlands to tidal action. Begin aggressive program of control of non-native plant species that are threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak.
  - Bring into protection at least 25% of currently occupied, but unprotected Suisun Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management.
  - Expand suitable tidal slough habitat for Suisun Marsh aster by 25 linear miles.
  - Identify at least three protected and managed sites for introduction of at least three additional populations of Suisun thistle; increase overall population size at least threefold.
  - Establish at least one new population of soft bird's beak with high likelihood of success in restored habitat in each of the Suisun Bay and Marsh EMU, the Napa River EMU, and the Petaluma River EMU.
  - Establish at least one new Point Reyes bird's beak population in the Petaluma River and San Pablo Bay EMUs.
* In the Suisun Marsh/North San Francisco Bay Ecological Management Zone, restore and manage a minimum of 500 acres of seasonal wetland, and improve management of a minimum of 7,000 acres of existing, degraded seasonal wetland in a manner that provides suitable habitat for salt marsh harvest mouse, San Pablo California vole, and Suisun ornate shrew.

Figure G-26. San Pablo California Vole Diagrammatic Conceptual Model



San Pablo song sparrow **Scientific Name** *Melospiza melodia samuelis*

Legal Status[11]: California species of special concern

CALFED ERP GOAL[8,11] "Recover (R)"

MSCS Goal prescription[11]

Maintain the current distribution and existing populations of the San Pablo song sparrow, and reestablish and maintain viable species' populations throughout its historical range in the portion of the Bay Region within the ERP Focus Area.

Straw-dog Monitoring Recommendations

* Number, size & distribution of populations
* Spatial extent & distribution of available habitat, protected habitat, enhanced habitat & restored habitat
* Spatial extent, distribution and number of patches of quality San Pablo song sparrow habitat (patches large enough for 4th order tidal channels, transition zones to upland, buffer zones, appropriate vegetation, low non-indigenous plants & predators, low disturbance, etc.)

Existing Monitoring Programs / Information Sources

Marin Audubon Society (funded by CALFED): Petaluma Marsh Expansion Project - Marin County, Includes fish and bird use (including San Pablo Song Sparrow, Black and California Clapper Rail), sedimentation, channel formation, and recolonization of vegetation
Contact: Barbara Salzman, Marin Audubon Society
http://endeavor.des.ucdavis.edu/nrpi/WPIProjectDescription.asp?ProjectPK=5146

NCCP Habitats[11] Saline Emergent

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"The San Pablo song sparrow inhabits the tidal flats of San Pablo Bay. This sparrow is often associated with grindelia bushes, which it utilizes for nesting sites, song posts, and refuge from high tides. Nests are often built in a singular linear row in shrubs high enough to escape high tides (Walton 1975). This sparrow forages for seeds and insects on mudflats, at the water's edge, and under shrubs (Grinnell and Miller 1944)."

Pressures (MSCS Technical Reports, 1999)[12]

"The loss of tidal marshes from development and other uses is the principle reason for the San Pablo song sparrow's decline."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. The geographic priorities for implementing ERP actions to protect, enhance, and restore saline emergent wetlands and associated habitats for the San Pablo song sparrow should be (1) Gallinas/Ignacio marshes and Napa marshes, (2) Sonoma marshes, Petaluma marshes, and Highway 37 marshes west of Sonoma Creek, (3) Point Pinole marshes, and (4) Highway 37 marshes east of Sonoma Creek.
2. Coordinate protection, enhancement, and restoration of saltmarsh and associated habitats with other federal, State, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project and USFWS species recovery plans) that could affect management of current and historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
3. Restore wetlands and perennial grassland habitats adjacent to occupied nesting habitats to create a buffer of natural habitat. This buffer would protect nesting pairs from adverse effects that could be associated with future changes in land use on nearby lands and

provide suitable foraging habitat and nesting habitat suitable for the natural expansion of populations.

4. Initial species recovery efforts should be directed to locations where there are immediate opportunities for protection, enhancement, or restoration of suitable habitat.

5. Design dikes constructed in enhanced and restored saline emergent wetlands to provide optimal wetlands-to-upland transitional habitat.

6. To the extent practicable, direct ERP saltmarsh enhancement efforts toward existing degraded marshes that are of sufficient size and configuration to develop fourth-order tidal channels (marshes would most likely need to be at least 1,000 acres).

7. To the extent practicable, design saltmarsh enhancements and restorations that provide low-angle upland slopes at the upper edge of marshes to provide suitable and sufficient wetlands-to-upland transition habitat. Transition habitat zones should be at least 0.25 mile wide.

8. Manage enhanced and restored habitat to avoid or minimize impacts on the San Pablo song sparrow that could be associated with recreational uses on lands acquired or managed under conservation easements.

9. Identify and implement feasible methods for controlling invasive non- native marsh plants.

10. Conduct research to determine use of restored saltmarsh habitats by San Pablo song sparrows and the rate at which restored habitats are colonized.

11. To the extent practicable, control non-native predator populations in occupied habitat and saltmarshes enhanced and restored under the ERP.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

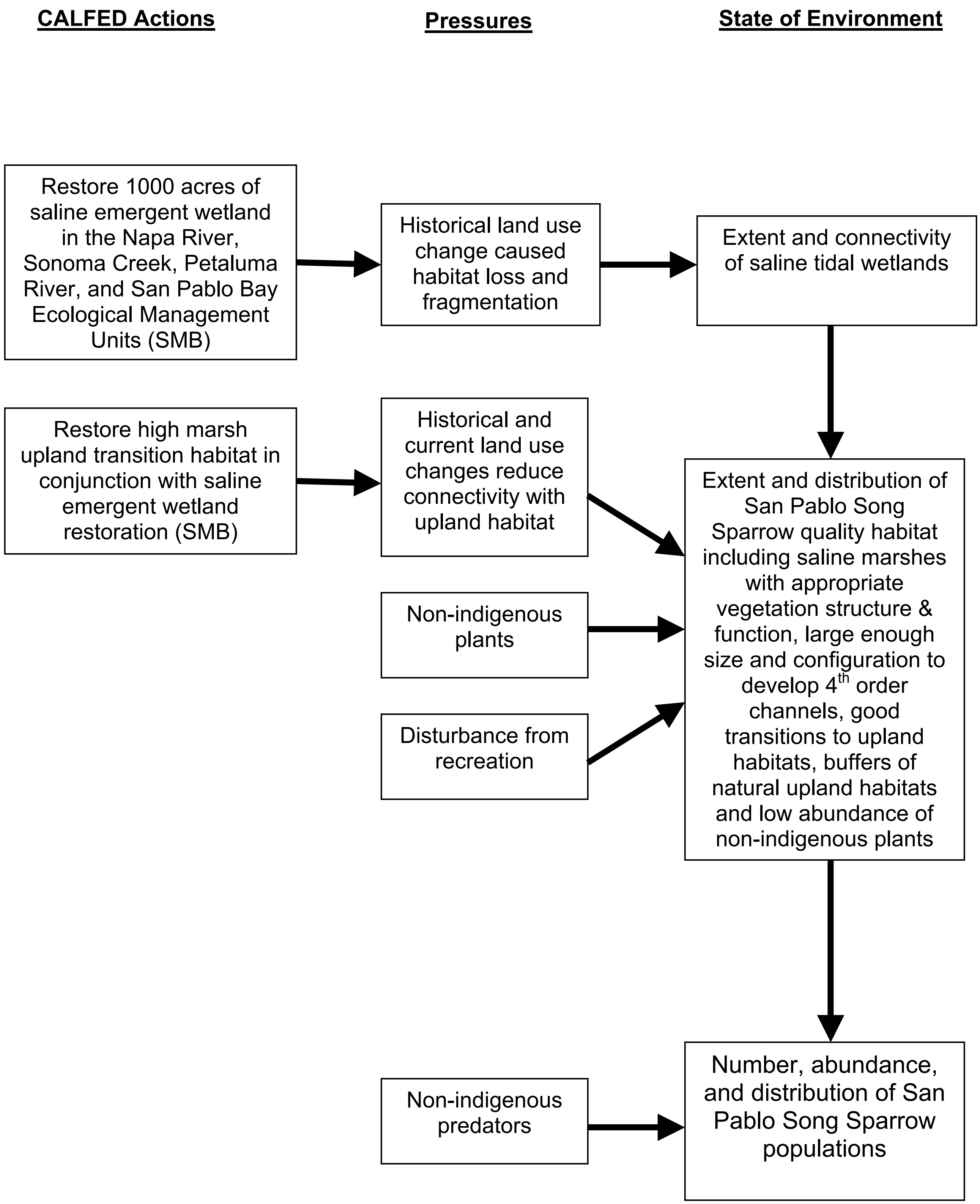
Suisun Marsh & North San Francisco Bay

HABITAT

* In the Suisun Marsh/North San Francisco Bay EMZ, restore a minimum of 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. Develop cooperative programs to acquire, in fee-title or through a conservation easement, the land needed for tidal restoration, and complete the needed steps to restore the wetlands to tidal action. Begin aggressive program of control of non-native plant species that are threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak.

- Bring into protection at least 25% of currently occupied, but unprotected Suisun Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management.
- Expand suitable tidal slough habitat for Suisun Marsh aster by 25 linear miles.
- Identify at least three protected and managed sites for introduction of at least three additional populations of Suisun thistle; increase overall population size at least threefold.
- Establish at least one new population of soft bird's beak with high likelihood of success in restored habitat in each of the Suisun Bay and Marsh EMU, the Napa River EMU, and the Petaluma River EMU.
- Establish at least one new Point Reyes bird's beak population in the Petaluma River and San Pablo Bay EMUs.

Figure G-27. San Pablo Song Sparrow Diagrammatic Conceptual Model



Soft bird's-beak **Scientific Name** *Cordylanthus mollis ssp. mollis*

Legal Status[11]: Federal endangered (FESA), Listed as rare under California Native Plant Protection Act, CNPS List 1B

CALFED ERP GOAL[8,11] "Recover (R)"

MSCS Goal prescription[11]
Maintain the current distribution and existing populations of soft bird's-beak and reestablish and maintain viable populations throughout its historical range.

Straw-dog Monitoring Recommendations
* population size and vigor of all the extant occurrences at two-year intervals for the duration of the CALFED program.
* Number & distribution of populations, including new populations
* spatial extent & distribution of available habitat, occupied habitat, restored habitat, protected habitat, high quality habitat,
* Percent cover and type of non-indigenous species in current and potential Soft bird's beak habitat

Existing Monitoring Program / Information Sources
?

NCCP Habitats[11] Saline Emergent

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]
"Soft bird's-beak is a semiparasitic herbaceous annual plant in the figwort family (Scrophulariaceae). It grows 25-40 centimeters tall and occurs in coastal saltmarshes and brackish marshes. The species is restricted to a narrow tidal band, typically in higher elevation zones within larger tidal marshes that have fully developed tidal channel networks. It usually does not occur in smaller fringe tidal marshes that are generally less than 300 feet wide or in nontidal areas. Flowering time is July-September."

Pressures (MSCS Technical Reports, 1999)[12]
"Habitat conversion, water pollution, changes in salinity, indirect effects of urbanization, mosquito abatement activities, off-road-vehicle use, competition with non-native vegetation, insect predation, erosion, and other human-induced actions contributed to decline. The sensitivity of the species to changes in environmental conditions is evidenced by the extreme fluctuations in annual population size. (California Department of Fish and Game 1992.)"

MSCS Conservation Measures - That add detail to ERP actions[11]
1. Expand potential habitat by improving tidal circulation to diked wetlands that sustain some existing exchange.
2. Identify opportunities for establishing new populations or expanding existing populations and habitat.
3. Establish soft bird's-beak populations to existing and restored suitable habitat.
4. Control and reduce populations of non-native marsh species with potential effects on soft bird's-beak and potential soft bird's-beak habitat.
5. Monitor the population size and vigor of all extant occurrences at a 2-year interval for the duration of program; design and implement remediation measures if the recovery goal is not met.
6. Modify conservation measures according to the adaptive management process as more understanding is developed of recovery needs.

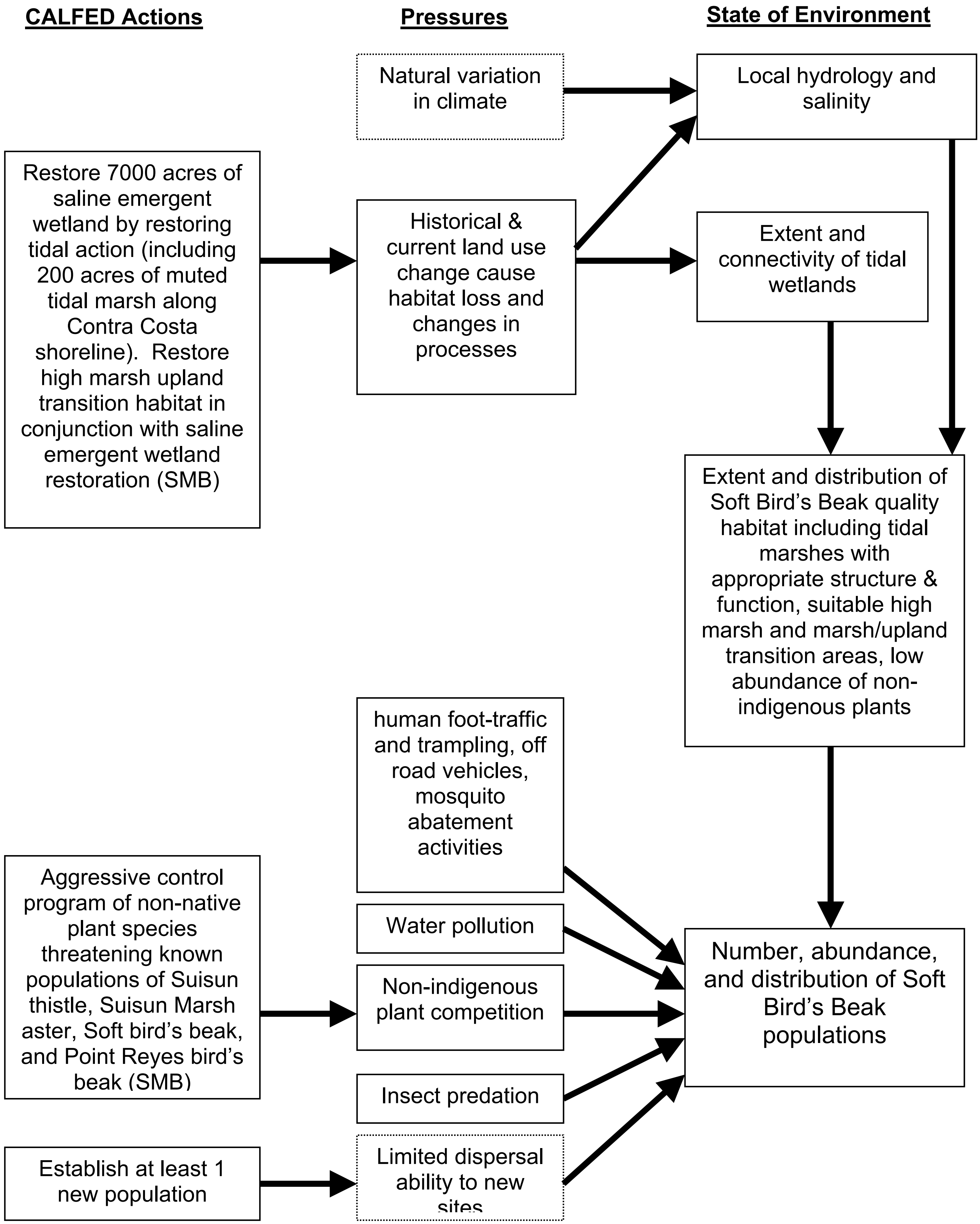
CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

Suisun Marsh & North San Francisco Bay

HABITAT

* In the Suisun Marsh/North San Francisco Bay EMZ, restore a minimum of 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. Develop cooperative programs to acquire, in fee-title or through a conservation easement, the land needed for tidal restoration, and complete the needed steps to restore the wetlands to tidal action. Begin aggressive program of control of non-native plant species that are threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak.
  - Bring into protection at least 25% of currently occupied, but unprotected Suisun Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management.
  - Expand suitable tidal slough habitat for Suisun Marsh aster by 25 linear miles.
  - Identify at least three protected and managed sites for introduction of at least three additional populations of Suisun thistle; increase overall population size at least threefold.
  - Establish at least one new population of soft bird's beak with high likelihood of success in restored habitat in each of the Suisun Bay and Marsh EMU, the Napa River EMU, and the Petaluma River EMU.

Figure G-28. Soft Bird's Beak Diagrammatic Conceptual Model



<u>Suisun marsh aster</u> **Scientific Name** *Aster lentus*

Listed Species[11]: CNPS List 1B

CALFED ERP GOAL[8,11] "Recover (R)"

MSCS Goal prescription[11]
Expand suitable and occupied habitat by 100 linear miles and protect at least 90% of the currently occupied habitat, including 90% of high-quality habitat. The high-quality habitat should include occurrences in the North, South, and East Delta and Napa River Ecological Management Units.

Straw-dog Monitoring Recommendations
* status and distribution of the species at five-year intervals
* linear miles of available habitat, high quality habitat, occupied habitat, restored habitat, and protected habitat

Existing Monitoring Program / Information Sources
?

NCCP Habitats[11] Tidal Freshwater Emergent

ERP Mgmt Zone[12] Eastside Delta Tributaries, Suisun Marsh/North San Francisco Bay, Yolo Basin

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]
"Suisun Marsh aster has a historical range that most likely included the margins of northern San Francisco Bay, Suisun Marsh, and the lower Sacramento-San Joaquin Delta. Its current distribution extends from Suisun Marsh east through the western and central regions of the Delta. More than 100 occurrences of Suisun Marsh aster are known from Contra Costa, Solano, San Joaquin, Sacramento, and Napa Counties. These occurrences vary in size from 1 to more than 130 plants and are found on California Department of Fish and Game (DFG), California Department of Parks and Recreation, Sacramento County, and private property (Natural Diversity Data Base 1998).

"Suisun Marsh aster is a slightly succulent perennial herb of the sunflower family (Asteraceae) that grows over 3 feet tall (Hickman 1993). The species inhabits tidal streams and marsh areas throughout the lower Delta where freshwater is prevalent. It typically occurs along sloughs and riverbanks affected by tidal fluctuations, usuallyaround the mid- to high-tide mark. The flowering period for the Suisun Marsh aster is from late May through November (Skinner and Pavlik 1994)."

Pressures (MSCS Technical Reports, 1999)[12]
"…threatened by marsh alteration, trampling by livestock, recreational use, riprap, levee repair and maintenance, competition from non-native plants, and habitat loss (Natural Diversity Data Base 1998, Skinner and Pavlik 1994)."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Maintain processes that support the dynamic habitat distributed throughout the species' range and associated with existing source populations (species occurs on eroding margins of levees).
2. To the extent practicable, design restoration of tidal habitats to create unvegetated, exposed substrate habitat at tidal margins of tidal fresh emergent wetlands and riparian habitat.
3. To the extent consistent with CALFED objectives, incorporate sufficient edge habitat to support the species in levee setback and channel island habitat restoration designs.
4. To the extent practicable, maximize sinuosity of restored and created slough channels

to increase water-land edge habitat.

5. To the extent consistent with CALFED objectives, maintain and restore habitat and populations throughout the species' geographic ranges and expand habitat and populations to their historical and ecological ranges based on hydrologic, salinity, and other habitat requirements of the species.

6. Consistent with CALFED objectives, incorporate suitable habitat for these species in bank protection designs used in CALFED actions.

7. Monitor status and distribution of the species at 5-year intervals and document expansion of the species into restored habitat for the duration of the program.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

Delta & Eastside Delta Tributaries

STRESSORS

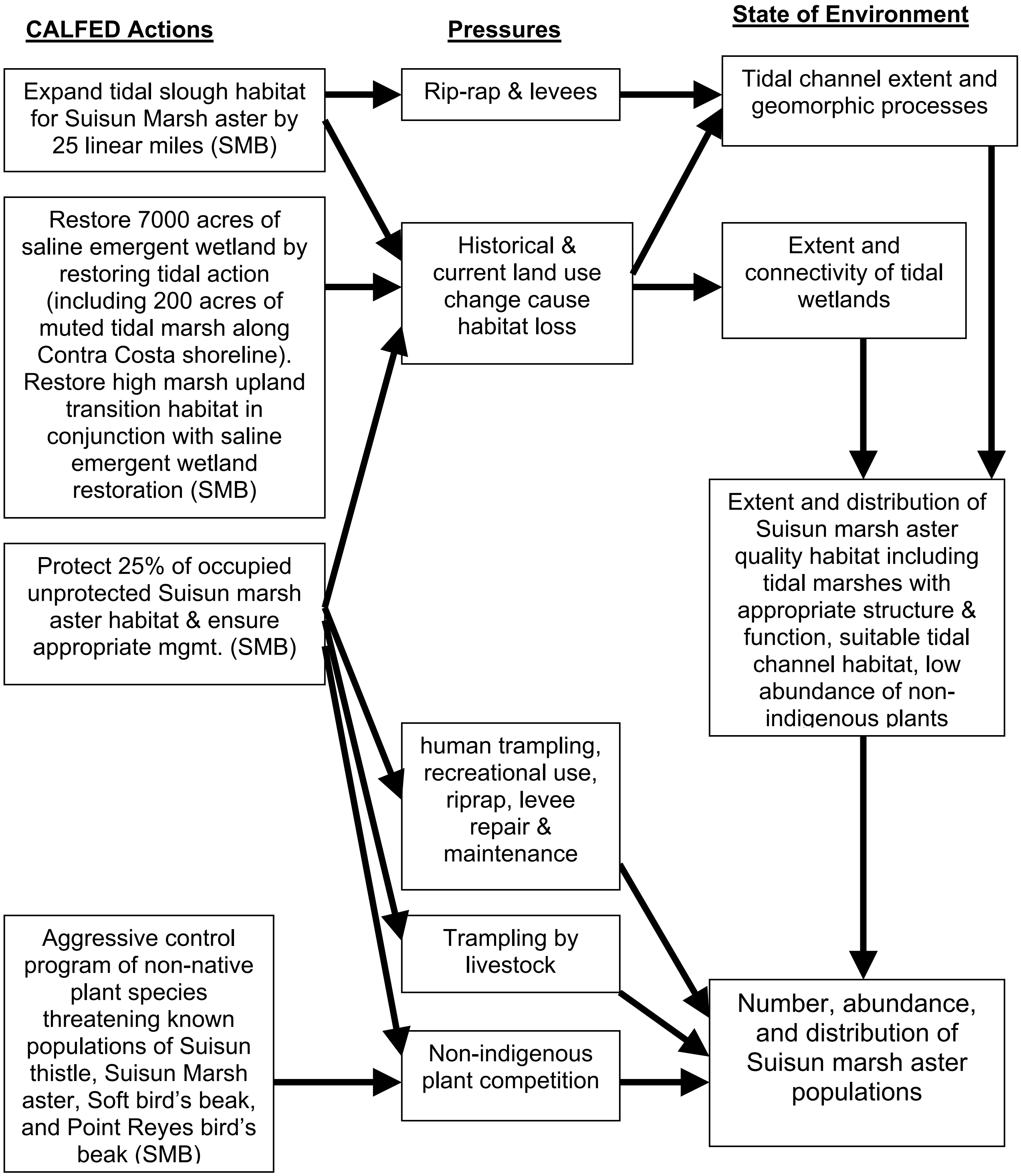
* Develop and begin implemention of a demonstration program to reduce invasive non-native plant abundance within at least one EMU in the Delta.

Suisun Marsh & North San Francisco Bay

HABITAT

* In the Suisun Marsh/North San Francisco Bay EMZ, restore a minimum of 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. Develop cooperative programs to acquire, in fee-title or through a conservation easement, the land needed for tidal restoration, and complete the needed steps to restore the wetlands to tidal action. Begin aggressive program of control of non-native plant species that are threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak.
  - Bring into protection at least 25% of currently occupied, but unprotected Suisun Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management.
  - Expand suitable tidal slough habitat for Suisun Marsh aster by 25 linear miles.
  - Identify at least three protected and managed sites for introduction of at least three additional populations of Suisun thistle; increase overall population size at least threefold.
  - Establish at least one new population of soft bird's beak with high likelihood of success in restored habitat in each of the Suisun Bay and Marsh EMU, the Napa River EMU, and the Petaluma River EMU.
  - Establish at least one new Point Reyes bird's beak population in the Petaluma River and San Pablo Bay EMUs.

Figure G-29. Suisun marsh aster Diagrammatic Conceptual Model



Suisun Ornate Shrew

Scientific Name *Sorex ornatus sinnuosus*

Listed Species[11]: California species of special concern

CALFED ERP GOAL[8,11] "Recover (R)"

MSCS Goal prescription[11]

Maintain the current distribution and existing populations of the Suisun ornate shrew, and reestablish and maintain viable species' populations throughout its historical range in the portion of the Bay Region within the ERP Focus Area.

Straw-dog Monitoring Recommendations

* Number, size, distribution of populations, including number of new populations
* extent & distribution of available, protected, enhanced, and restored Suisun ornate shrew habitat
* extent, distribution, and number of patches of quality shrew habitat (patches with sufficient vegetation cover, invertebrate abundance, upland slopes, and wetland to upland transition habitat at least 0.25 mile in width, etc.)
* Connectivity among patches relative to shrew dispersal
* Use of restored marsh habitat and rate at which restored habitats are colonized

Existing Monitoring Program / Information Sources

?

NCCP Habitats[11] Saline Emergent, Tidal Freshwater Emergent

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay, Yolo Basin (?)

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"The historical range of the Suisun ornate shrew included San Pablo and Suisun Bays when both contained extensive salt- and brackish water marshes. The shrew is restricted to areas having both necessary marshland vegetation and upland areas to escape high tides. The current distribution of this subspecies is more restrictive than that of the salt marsh harvest mouse, an endangered species (Williams 1986).

"The Suisun ornate shrew occupies tidal marshes with dense, low-lying cover and abundant invertebrates. This shrew also requires upland habitat at the boundaries of the marshes to escape flooding and driftwood and other debris at or above the high-tide water line for nesting and foraging sites. Shrew occupancy of an area is related more to the growth form (i.e., canopy structure) of the plant community than to the plant species composition (Williams 1986)."

Pressures (MSCS Technical Reports, 1999)[12]

"Loss of marsh habitat and upland refugia has been the main cause for the Suisun ornate shrew's decline. Marsh management practices, such as encouraging the growth of tules (Scirpus spp.) without including upland refugia from flooding have also had negative impacts on this shrew."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. The geographic priorities for implementing ERP actions to protect, enhance, and restore saline emergent wetlands and associated habitats for the Suisun ornate shrew should be (1) western Suisun Marsh, (2) Napa marshes and eastern Suisun Marsh, and (3) Sonoma marshes and Highway 37 marshes west of Sonoma Creek.
2. Coordinate protection, enhancement, and restoration of saltmarsh and associated habitats with other federal, State, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project and U.S. Fish and Wildlife Service [USFWS] species recovery plans) that could affect management of current and historical habitat use areas. Coordination

would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.

3. Initial species recovery efforts should be directed to locations where there are immediate opportunities for protection, enhancement, or restoration of suitable habitat.

4. To the extent practicable, direct ERP saltmarsh enhancement efforts toward existing degraded marshes that are of sufficient size and configuration to develop fourth-order tidal channels (marshes would likely need to be at least 1,000 acres).

5. Restore wetlands and perennial grassland habitats adjacent to occupied habitats to create a buffer of natural habitat. This buffer would protect populations from adverse effects that could be associated with future changes in land use on nearby lands and provide habitat suitable for the natural expansion of populations.

6. To the extent practicable, design saltmarsh enhancements and restorations that provide low-angle upland slopes at the upper edge of marshes to provide suitable and sufficient wetlands-to-upland transition habitat. Transition habitat zones should be at least 0.25 mile wide.

7. Manage enhanced and restored habitat to avoid or minimize impacts on the Suisun ornate shrew that could be associated with recreational uses on lands acquired or managed under conservation easements.

8. Direct saltmarsh habitat enhancements and restorations toward increasing habitat connectivity among existing and restored tidal marshes within the range of the Suisun ornate shrew.

9. To the extent practicable, design dikes constructed in enhanced and restored saline emergent wetlands to provide optimal wetlands-to-upland transitional habitat.

10. Identify and implement feasible methods for controlling invasive non- native marsh plants.

11. To the extent practicable, control non-native predator populations in occupied habitat and saltmarshes enhanced and restored under the ERP.

12. Provide interim management of occupied saltmarshes to maintain source populations until restored habitats have developed sufficiently to provide suitable habitat.

13. Acquire conservation easements to adjust grazing regimes to enhance wetlands-to-upland transition habitat conditions in occupied habitat.

14. Conduct research to determine use of restored saltmarsh habitats by Suisun ornate shrews and the rate at which restored habitats are colonized.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

<u>Suisun Marsh & North San Francisco Bay</u>

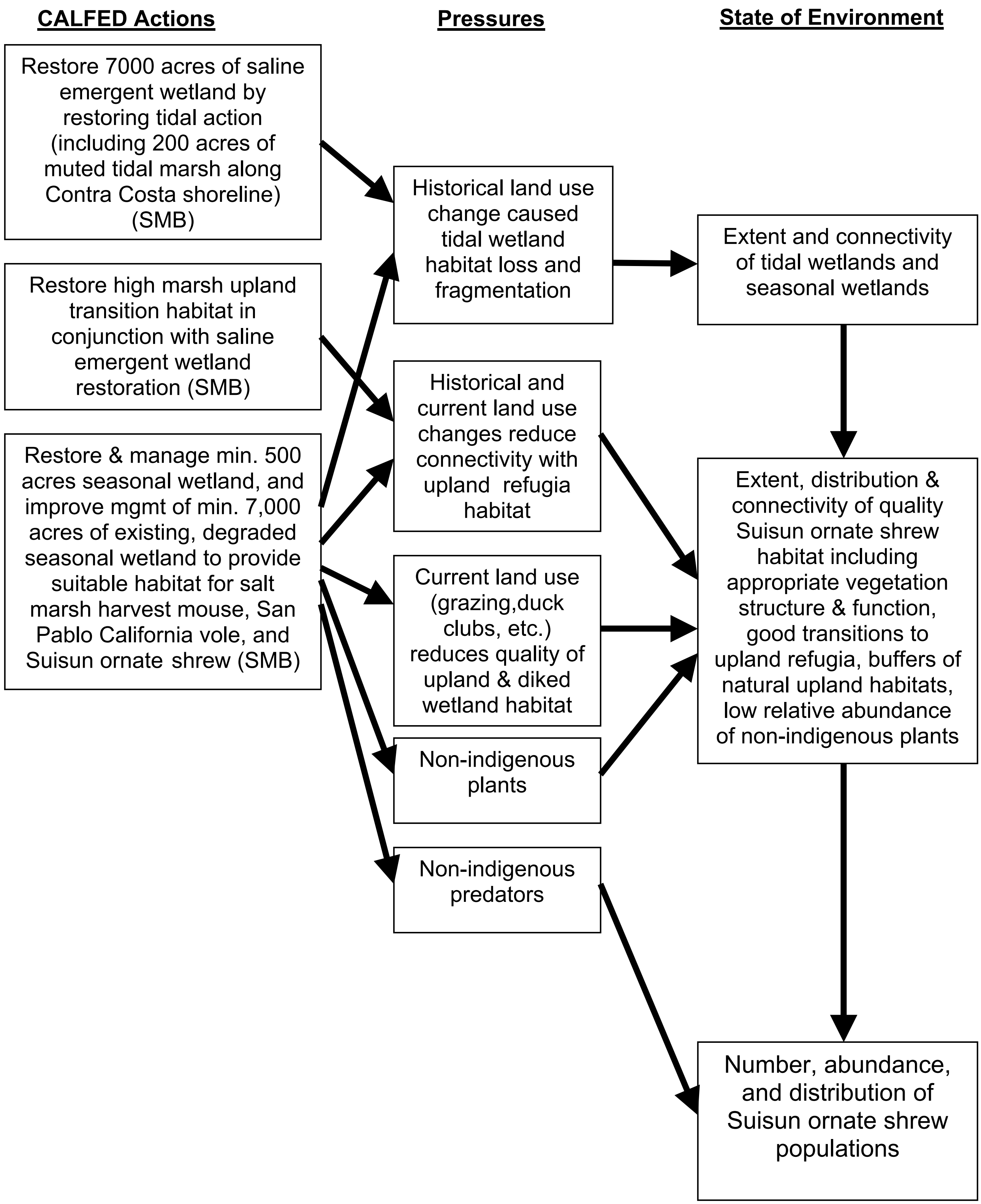
HABITAT

* In the Suisun Marsh/North San Francisco Bay Ecological Management Zone, restore and manage a minimum of 500 acres of seasonal wetland, and improve management of a minimum of 7,000 acres of existing, degraded seasonal wetland in a manner that provides suitable habitat for salt marsh harvest mouse, San Pablo California vole, and Suisun ornate shrew.
* In the Suisun Marsh/North San Francisco Bay EMZ, restore a minimum of 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. Develop cooperative programs to acquire, in fee-title or through a conservation easement, the land needed for tidal restoration, and complete the needed steps to restore the wetlands to tidal action. Begin aggressive program of control of non-native plant species that are

threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak.

- Bring into protection at least 25% of currently occupied, but unprotected Suisun Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management.
-Expand suitable tidal slough habitat for Suisun Marsh aster by 25 linear miles.
-Identify at least three protected and managed sites for introduction of at least three additional populations of Suisun thistle; increase overall population size at least threefold.
-Establish at least one new population of soft bird's beak with high likelihood of success in restored habitat in each of the Suisun Bay and Marsh EMU, the Napa River EMU, and the Petaluma River EMU.
-Establish at least one new Point Reyes bird's beak population in the Petaluma River and San Pablo Bay EMUs.

Figure G-30. Suisun ornate shrew Diagrammatic Conceptual Model



Suisun song sparrow **Scientific Name** *Melospiza melodia maxillaris*

Listed Species[11]: California species of special concern

CALFED ERP GOAL[8,11] "Recover (R)"

MSCS Goal prescription[11]

Maintain the current distribution and existing populations of the Suisun song sparrow and reestablish and maintain viable species' populations throughout its historical range in portions of the Delta and Bay Regions within the ERP Focus Area.

Straw-dog Monitoring Recommendations

* Number, size, distribution of populations
* Spatial extent & distribution of available habitat, protected habitat, enhanced habitat & restored habitat
* Spatial extent, distribution and number of patches of quality Suisun song sparrow habitat (patches large enough for 4th order tidal channels, transition zones to upland, buffer zones, appropriate vegetation, low non-indigenous plants & predators, low disturbance, etc.)

Existing Monitoring Program / Information Sources

?

NCCP Habitats[11] Saline Emergent, Tidal Freshwater Emergent

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"The Suisun song sparrow inhabits the brackish water marshes of the Suisun Bay area. Vegetation in these marshes is dominated by cattails, tules, and other sedges and salicorinia (Grinnell and Miller 1944). The species forages on the ground among the vegetation and mudflats, but never in the water. Its diet consists of seeds, predominately from tules (Scirpus), and insects and other invertebrates. The Suisun song sparrow breeding season starts 15 days earlier than that of upland song sparrows at the same latitude. This is an adaptation to avoid nesting during the highest spring tides. Breeding occurs from March to June, with up to three nesting attempts, depending on nest success. Nests are placed high in vegetation to avoid high tides and are never used more than once. Several nests may be used in one season (Hunt 1989)."

Pressures (MSCS Technical Reports, 1999)[12]

"The loss and fragmentation of brackish water marshes are the causes for the dramatic decline of the Suisun song sparrow."

MSCS Conservation Measures - That add detail to ERP actions[11]

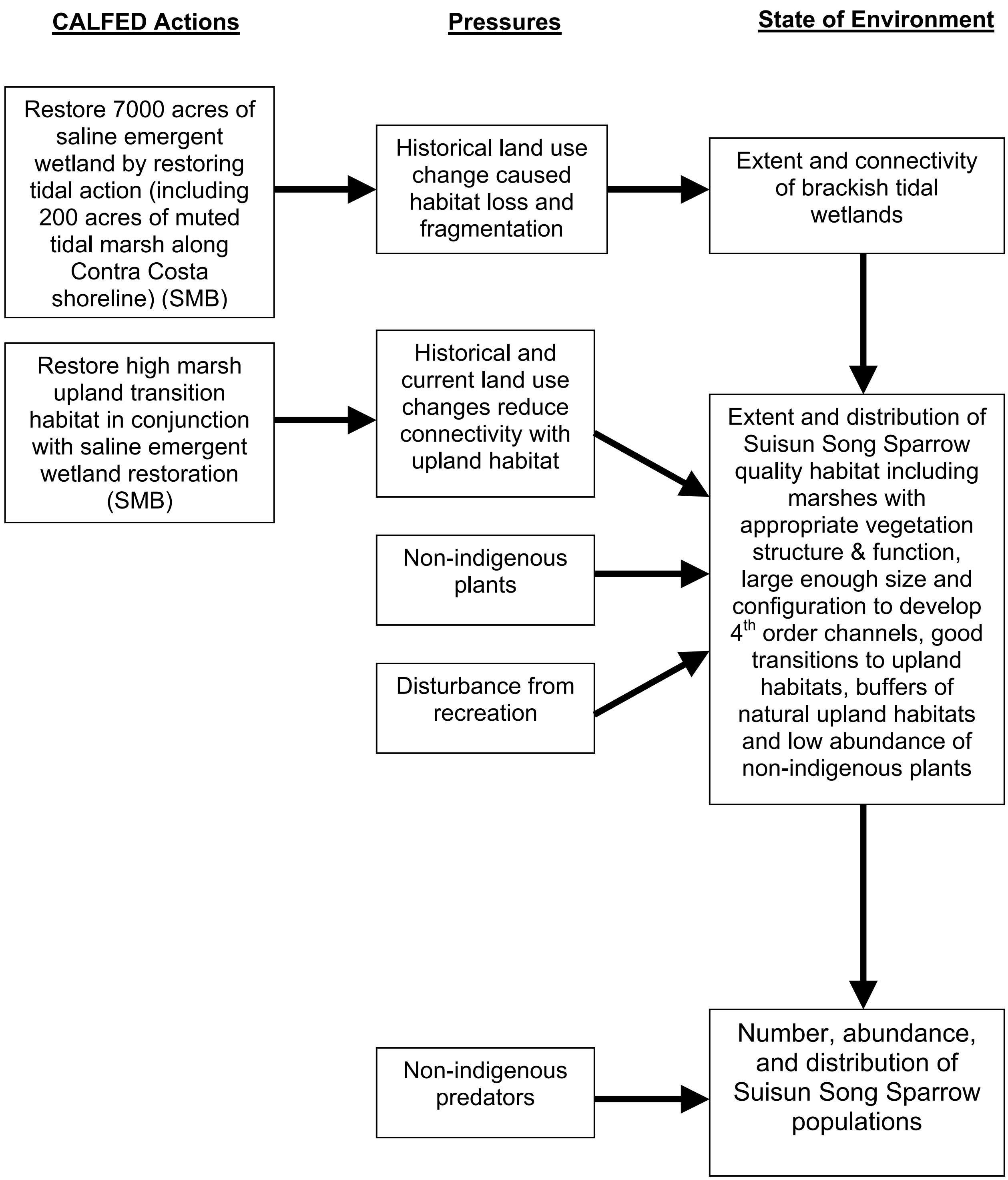
1. The geographic priorities for implementing ERP actions to protect, enhance, and restore saline emergent wetlands and associated habitats for the Suisun song sparrow should be (1) western Suisun Marsh, (2) eastern Suisun Marsh, and (3) the Contra Costa County shoreline.
2. Coordinate protection, enhancement, and restoration of saltmarsh and associated habitats with other federal, State, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project and USFWS species recovery plans) that could affect management of current and historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
3. Restore wetlands and perennial grassland habitats adjacent to occupied nesting habitats to create a buffer of natural habitat. This buffer would protect nesting pairs from adverse effects that could be associated with future changes in land use on nearby lands and provide suitable foraging habitat and nesting habitat suitable for the natural expansion of populations.
4. Initial species recovery efforts should be directed to locations where there are immediate

opportunities for protection, enhancement, or restoration of suitable habitat.
5. To the extent practicable, design dikes constructed in enhanced and restored saline emergent wetlands to provide optimal wetlands-to-upland transitional habitat.
6. To the extent practicable, direct ERP saltmarsh enhancement efforts toward existing degraded marshes that are of sufficient size and configuration to develop fourth-order tidal channels (marshes would most likely need to be at least 1,000 acres).
7. To the extent practicable, design saltmarsh enhancements and restorations that provide low-angle upland slopes at the upper edge of marshes to provide suitable and sufficient wetlands-to-upland transition habitat.Transition habitat zones should be at least 0.25 mile wide.
8. Control non-native invasive plants in existing saltmarshes where non-native plants have degraded habitat quality and in saltmarshes restored under the ERP.
9. Manage enhanced and restored habitat to avoid or minimize impacts on the Suisun song sparrow that could be associated with recreational uses on lands acquired or managed under conservation easements on the Suisun song sparrow.
10. Direct saltmarsh habitat enhancements and restorations toward increasing habitat connectivity among existing occupied and restored tidal marshes.
11. To the extent practicable, direct ERP restorations to improve tidal circulation to diked wetlands that currently sustain partial tidal exchange.
12. To the extent practicable, control non-native predator populations in occupied habitat and saltmarshes enhanced and restored under the ERP.
13. Identify and implement feasible methods for controlling invasive non-native marsh plants.
14. Conduct research to determine use of restored saltmarsh habitats by Suisun song sparrows and the rate at which restored habitats are colonized.
15. Acquire conservation easements to adjust grazing regimes to enhance wetlands-to-upland transition habitat conditions.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]
Suisun Marsh & North San Francisco Bay
HABITAT

* In the Suisun Marsh/North San Francisco Bay EMZ, restore a minimum of 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. Develop cooperative programs to acquire, in fee-title or through a conservation easement, the land needed for tidal restoration, and complete the needed steps to restore the wetlands to tidal action. Begin aggressive program of control of non-native plant species that are threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak.
  - Bring into protection at least 25% of currently occupied, but unprotected Suisun Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management.
  -Expand suitable tidal slough habitat for Suisun Marsh aster by 25 linear miles.
  -Identify at least three protected and managed sites for introduction of at least three additional populations of Suisun thistle; increase overall population size at least threefold.
  -Establish at least one new population of soft bird's beak with high likelihood of success in restored habitat in each of the Suisun Bay and Marsh EMU, the Napa River EMU, and the Petaluma River EMU.
  -Establish at least one new Point Reyes bird's beak population in the Petaluma River and San Pablo Bay EMUs.

Figure G-31. Suisun Song Sparrow Diagrammatic Conceptual Model



Suisun thistle

Scientific Name *Cirsium hydrophilum var. hydrophilum*

Legal Status[11]: Federal endangered (FESA), CNPS List 1B

CALFED ERP GOAL[8,11] "Recover (R)"

MSCS Goal prescription[11]

Maintain the current distribution and existing populations of Suisun thistle, establish 10 new populations, and increase overall population size tenfold.

Straw-dog Monitoring Recommendations

* Number, size, protection status, and distribution, of populations including newly established populations
* Spatial extent & distribution of available habitat, protected habitat, enhanced habitat & restored habitat
* Spatial extent, distribution and number of patches of quality Suisun thistle habitat (patches large enough for 4th order tidal channels, transition zones to upland, buffer zones, appropriate vegetation, low non-indigenous plants & predators, low disturbance, etc.)
* Percent cover and type of non-indigenous species in current and potential Suisun thistle habitat

Existing Monitoring Program / Information Sources

?

NCCP Habitats[11] Saline Emergent

ERP Mgmt Zone[12] Suisun Marsh/North San Francisco Bay

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"Suisun thistle is known from four locations, three of which are on California Department of Fish and Game (DFG) land in Suisun Marsh and one on Solano County Farmland and Open Space Foundation land (Natural Diversity Data Base 1998). It is likely that this species was more widespread in the past because its saltmarsh was more widespread. This habitat has been extremely reduced during this century (Macdonald 1977).

"Suisun thistle is a perennial herb in the sunflower family (Asteraceae) and reaches a height of 3-4.5 feet. It occurs on the edges of salt- and brackish marshes that are periodically inundated during high tides. It is restricted to a narrow tidal band, typically in higher elevation zones within larger tidal marshes that have fully developed tidal channel networks. The species usually does not occur in smaller fringe tidal marshes that are less than 300 feet wide or in nontidal areas. Flowering time is July-September."

Pressures (MSCS Technical Reports, 1999)[12]

"Drainage or filling of saltmarshes, and possibly water pollution, may have contributed to the decline of Suisun thistle (Niehaus 1977). Its restricted distribution increases its susceptibility to catastrophic events such as disease or pest outbreak, severe drought, oil spills, or other natural or human-induced disasters. Continued habitat conversion, habitat fragmentation, indirect effects from urban development, increased salinity, alteration of natural tidal regime, mosquito abatement activities, and competition with non-native plants (60 CFR 112)."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Identify opportunities for establishing new populations or expanding existing populations and habitat.
2. Control and reduce populations of non-native marsh species that might affect Suisun thistle and potential Suisun thistle habitat.

3. Monitor the population size and vigor of all extant occurrences at a 2-year interval for the duration of the program.

4. Modify conservation measures according to the adaptive management process as more understanding of recovery needs is developed.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

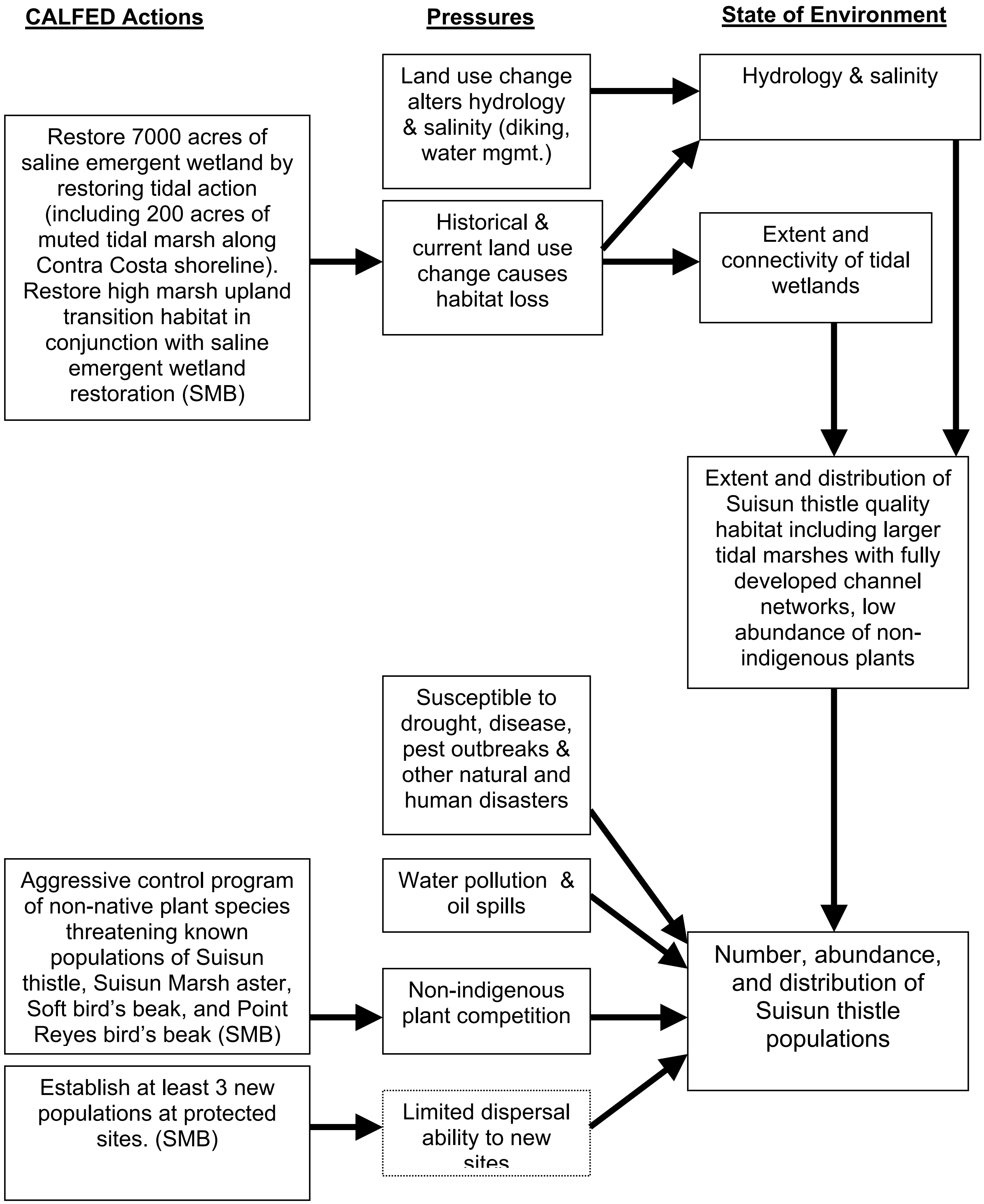
Suisun Marsh & North San Francisco Bay

HABITAT

* In the Suisun Marsh/North San Francisco Bay EMZ, restore a minimum of 7,000 acres of Saline Emergent Wetland by restoring tidal action in the Suisun Bay and Marsh Ecological Management Unit (including 200 acres of muted tidal marsh along the Contra Costa shoreline) and a cumulative total of 1,000 acres in the Napa River, Sonoma Creek, Petaluma River, and San Pablo Bay Ecological Management Units. Restore high marsh and high-marsh upland transition habitat in conjunction with restoration of saline emergent wetland. Develop cooperative programs to acquire, in fee-title or through a conservation easement, the land needed for tidal restoration, and complete the needed steps to restore the wetlands to tidal action. Begin aggressive program of control of non-native plant species that are threatening the known populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak.

- Bring into protection at least 25% of currently occupied, but unprotected Suisun Marsh aster habitat, spread throughout the North, East, South Delta and Napa River Ecological Units, and ensure appropriate management.
- Expand suitable tidal slough habitat for Suisun Marsh aster by 25 linear miles.
- Identify at least three protected and managed sites for introduction of at least three additional populations of Suisun thistle; increase overall population size at least threefold.
- Establish at least one new population of soft bird's beak with high likelihood of success in restored habitat in each of the Suisun Bay and Marsh EMU, the Napa River EMU, and the Petaluma River EMU.
- Establish at least one new Point Reyes bird's beak population in the Petaluma River and San Pablo Bay EMUs.

Figure G-32. Suisun thistle Diagrammatic Conceptual Model



Swainson's hawk **Scientific Name** *Buteo swainsoni*

Legal Status[11]: California threatened (CESA)

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]

Protect, enhance, and increase habitat sufficient to support a viable breeding population. The interim prescription is to Increase the current estimated population of 1,000 breeding pairs in the Central Valley to 2,000 breeding pairs. This prescription will be modified based on results of a population viability analysis being conducted by the California Department of Fish and Game (DFG).

Straw-dog Monitoring Recommendations

* Abundance index of Swainson's hawk in Central Valley
* Extent and distribution of available natural habitat, restored habitat, and enhanced habitat
* Extent and distribution of land under wildlife friendly mangement practices expected to benefit Swainson's hawks.
* Rodent populations in restored seasonal wetlands

Existing Monitoring Program / Information Sources

Cal. Dept. of Fish & Game: Swainson's Hawk Monitoring – Population monitoring and ecological and telemetry studies since 1979
Contact: Ron Schlorff

Cal. Dept. of Fish & Game: Swainson's Hawk Monitoring – Population monitoring since 1983 in Yolo County
Contact: Jim Estep

Yolo County Habitat Conservation Plan (HCP) – Includes Alkali Milk-vetch, Bank Swallow, California Yellow Warbler, California Yellow-billed Cuckoo, Crampton's Tuctoria, Giant Garter Snake, Swainson's Hawk, Valley Elderberry Longhorn Beetle
Contact:Terry Roberts, City of West Sacramento Community Development)
http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=3170

Point Reyes Bird Observatory, The Nature Conservancy, U.S. Fish & Wildlife Service: Sacramento River Bird Conservation Project – Riparian Birds
Contact: Stacy Small (www.prbo.org)

Point Reyes Bird Observatory, U.S. Fish & Wildlife Service: San Joaquin Restoration – Riparian Birds
Contact: Geoff Geupel (www.prbo.org)

East Bay Municipal Utility District: Mokelumne River Watershed Wildlife Monitoring Program Includes Riparian Brush Rabbit, Foothill Yellow-legged Frog, Giant Garter Snake, Red-legged Frog, Swainson's Hawk, Willow Flycatcher
Contact: Kent Reeves, East Bay Municipal Utility District
http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=5282

USFWS and State Water Resources Control Board: Phelan Island Restoration and Farming Project. Includes Swainson's Hawk, Valley Elderberry Longhorn Beetle
Contact: Sam Lawson
http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=4603

NCCP Habitats[11] Natural Seasonal Wetlands, Managed Seasonal Wetlands, Valley/Foothill Riparian, Grassland, Upland Scrub, Valley/Foothill Woodland & Forest, Upland Cropland, Seasonally Flooded Agriculture

ERP Mgmt Zone[12] Sacramento River, North Sacramento Valley, Cottonwood Creek, Butte Basin, Feather River/Sutter Basin, American River Basin, Yolo Basin, San Joaquin River, Eastside Delta Tributaries, Delta, East San Joaquin Basin, West San Joaquin Basin, Suisun Marsh/North San Francisco Bay

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"The Swainson's hawk's breeding range is from southwestern Canada to northern Mexico (Godfrey 1986, Semenchuk 1992, Howell and Webb 1995, Smith 1996, England et al. 1997). Nearly all North American populations of Swainson's hawks winter in South America and Mexico; however, some small populations regularly winter in the United States in southern Florida (Stevenson and Anderson 1994) and in the Sacramento-San Joaquin Delta of central California (Yee et al. 1991, Herzog 1996).

"Historically, the Swainson's hawk's breeding range in California included the Great Basin; the Sacramento and San Joaquin Valleys; along the coast in Marin, Monterey, Ventura, Los Angeles, and San Diego Counties and along Catalina Island; and a few scattered sites in the Colorado and Mojave Deserts (Bloom 1980). Today, Swainson's hawks nest in some of the previously occupied regions of the state, but the number of breeding birds has been greatly reduced throughout major portions of the species' range and the species has been extirpated in coastal central and southern California (Bloom 1980, California Department of Fish and Game 1994). Approximately 30 birds have wintered in the Sacramento-San Joaquin Delta annually since 1991 and are the only confirmed regularly wintering population in California (Yee et al. 1991, Herzog 1996).

"Bloom (1980) estimated that the breeding population of Swainson's hawks in California had declined by over 90% from historical times and estimated the current number at about 400 pairs statewide. A statewide survey conducted in 1988 found 320 active territories; approximately 241 were in the Central Valley and 78 were in the Great Basin in northeastern California (California Department of Fish and Game 1988). Additional surveys done in California during the 1990s indicate that the total statewide population estimate is 500-1,000 breeding pairs, with a likely average of about 700 pairs, 80% of which are in the Central Valley, with Yolo, San Joaquin, and Sacramento Counties being the most important nesting areas that remain in the state (California Department of Fish and Game 1994).

"Declines during the early part of the century were probably the result of habitat loss, shooting (this kite was considered a pest species), and, to a much lesser extent, egg collecting (Shuford 1993). In the past 20 years, habitat loss has been accelerated, including conversion of agricultural lands to urban/residential; however, declines have occurred even in areas such as Santa Barbara County, where agricultural lands have experienced little conversion. Kite populations also fluctuate greatly with cycles of prey abundance, which, in turn, are significantly correlated with rainfall (Pruett-Jones et al. 1980). Such cycles result in natural bottlenecks when the species may be extremely vulnerable to human disturbance. These fluctuations make determination of long-term population trends difficult. The most important threat still facing this species is loss of habitat. Although kites appear able to withstand some habitat alteration because of grazing and farming, large stretches of agricultural areas devoid of natural vegetation and urbanized areas are not suitable habitat."

Pressures (MSCS Technical Reports, 1999)[12]

"Several hypotheses have been suggested to explain the decline of Swainson's hawks in California: mortality during migration and on the wintering grounds in South America; poisoning by toxic chemicals, including pesticides, in South America; thin eggshells resulting from pesticides; habitat loss on wintering grounds; disturbance on the breeding grounds; loss or degradation of habitat on the breeding grounds; and increased competition with other species."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Proposed ERP actions designed to restore valley/foothill riparian habitat should initially be implemented in the Delta.
2. To the extent practicable, design restored seasonal wetlands in occupied habitat to provide overwinter refuge for rodents to provide source prey populations during spring and summer.
3. To the extent consistent with CALFED objectives, enhance at least 10% of agricultural lands to be enhanced under the ERP in the Delta, Sacramento River, and San Joaquin River Regions to increase forage abundance and availability within 10 miles of occupied habitat.
4. To the extent consistent with CALFED objectives, manage lands purchased or acquired under conservation easements that are occupied by the species to maintain or increase their current population levels.
5. To the extent practicable, manage restored or enhanced habitats under the ERP to maintain desirable rodent populations and minimize impacts associated with rodent control.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

<u>Delta & Eastside Delta Tributaries</u>

HABITAT

* In the Sacramento-San Joaquin Delta EMZ, cooperatively enhance at least 15% of the ERP target for wildlife friendly agricultural practices.
* Enhance, protect and restore 1,000 to 1,500 acres of seasonal wetlands in the East Delta EMU for optimum greater sandhill crane habitat.

<u>Sacramento River Basin</u>

PROCESSES

* Protect 15,000 acres within the Inner River Zone areas between Red Bluff and Colusa reaches within identified the Sacramento River Conservation Area. Establish between 3 and 5 habitat preserves for bank swallows along the upper reaches of the Sacramento River capable of supporting 5000 bank swallow burrows between the towns of Colusa and Red Bluff.

HABITAT

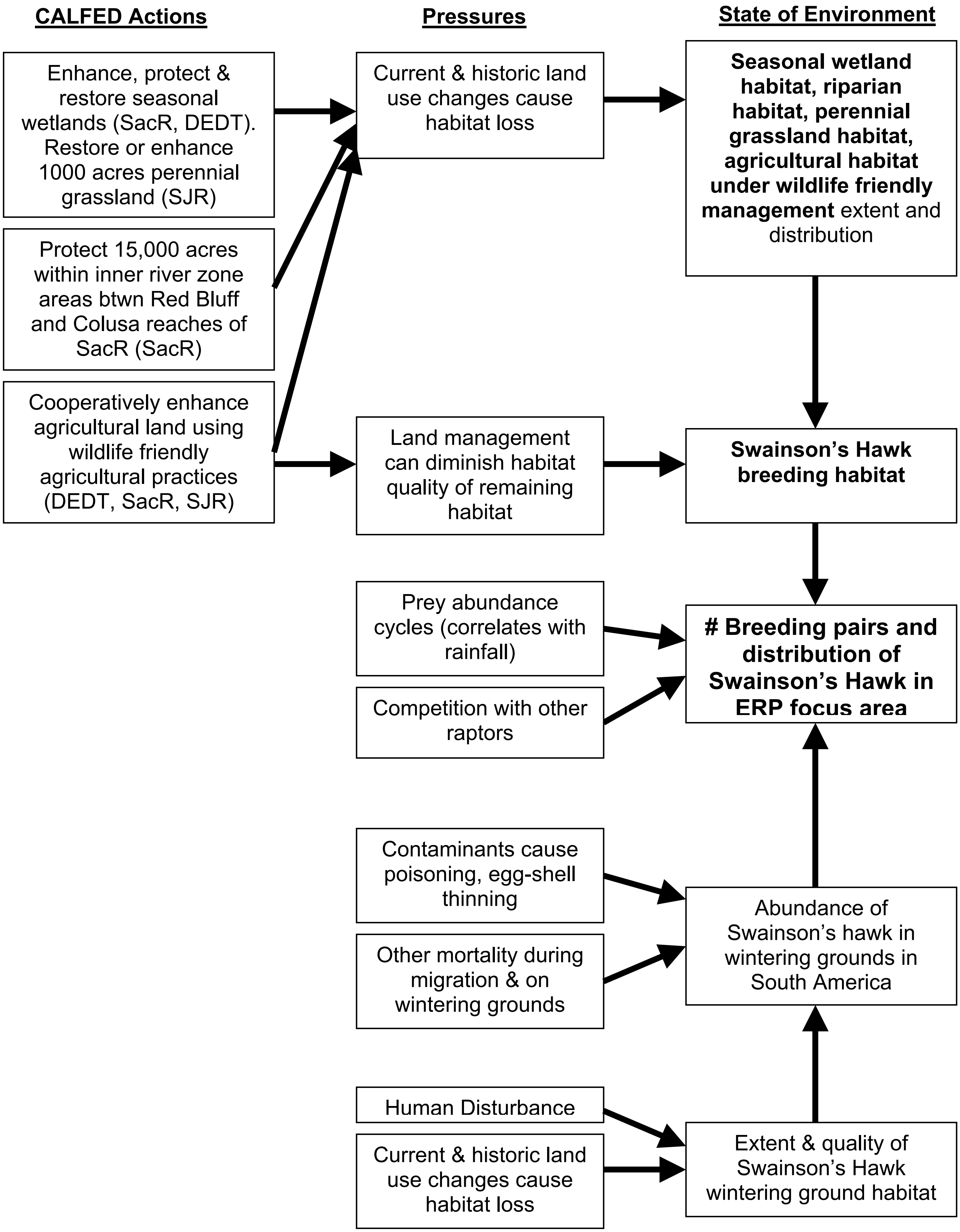
* In the American River Basin, Butte Basin, Colusa Basin, Feather River/Sutter Basin EMZs, cooperatively enhance at least 15 to 25% of the ERPP target for wildlife friendly agricultural practices.
* Implement 25 percent of the ERP target for enhancing, protecting, and restoring seasonal wetlands in the following EMZs: American River Basin, Butte Basin, Colusa Basin, and Feather River/Sutter Basin.

<u>San Joaquin River Basin</u>

HABITAT

* In the San Joaquin River and West San Joaquin Basin EMZs, cooperatively enhance at least 15 to 25% of the ERPP target for wildlife friendly agricultural practices
* In the West San Joaquin Basin EMZ, restore or enhance 1,000 acres of perennial grassland associated with existing or proposed wildlife corridors, wetlands, or floodplain habitats.

Figure G-33. Swainson's Hawk Diagrammatic Conceptual Model



Valley Elderberry Longhorn Beetle **Scientific Name** *Desmocerus californicus dimorphus*

Legal Status[11]: Federal threatened (FESA)

CALFED ERP GOAL[8,11] "Recover (R)"

MSCS Goal prescription[11]

Maintain and restore connectivity among riparian habitats occupied by the valley elderberry longhorn beetle and within its historical range along the Sacramento and San Joaquin Rivers and their major tributaries.

Straw-dog Monitoring Recommendations

* Extent & distribution of potential and occupied elderberry habitat
* Degree of protection for occupied habitat, i.e. buffer zones to reduce pesticide drift and cattle browsing
* Connectivity among patches relative to beetle dispersal

Existing Monitoring Programs / Information Sources

USFWS and State Water Resources Control Board: Phelan Island Restoration and Farming Project
Includes Swainson's Hawk, Valley Elderberry Longhorn Beetle
Contact: Sam Lawson
http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=4603

Yolo County Habitat Conservation Plan (HCP) – includes Alkali Milk-vetch, Bank Swallow, California Yellow Warbler, California Yellow-billed Cuckoo, Crampton's Tuctoria, Giant Garter Snake, Swainson's Hawk, Valley Elderberry Longhorn Beetle
Contact:Terry Roberts, City of West Sacramento Community Development
http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=3170

NCCP Habitats[11] Valley/Foothill Riparian, Montane Riparian

ERP Mgmt Zone[12] All zones

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"The valley elderberry longhorn beetle is found in scattered populations throughout its historical distribution. The species' range includes most of the California Central Valley north to Trinity County, south to San Diego County, and east to San Bernardino County (Barr 1991).

"The adults feed on elderberry (Sambucus mexicanus) foliage and are active from early March through early June. The beetles mate in May and females lay eggs on living elderberry shrubs. Larvae bore through the stems of the shrubs to create an opening in the stem within which they pupate. After metamorphosing into an adult, the beetle chews a circular exit hole through which it emerges (Barr 1991). Current information on the habitat of the beetle indicate that it is found only with its host plant, the elderberry."

Pressures (MSCS Technical Reports, 1999)[12]

"The elderberry is common in the riparian forests of the Central Valley. Urban and agricultural development, as well as aggregate mining, have eliminated a high percentage of these forests, reducing and fragmenting the available habitat for the beetle (Barr 1991)."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Coordinate protection and restoration of riparian habitats with other federal and State programs (e.g., USFWS recovery plans, the SB1086 program, and USACE's Sacramento and San Joaquin Basin Comprehensive Study) that could affect management of occupied and

historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.

2. Within the species' current range, design ERP riparian habitat enhancements and restorations to include suitable riparian edge habitat, including elderberry savanna.

3. Initially direct ERP riparian habitat actions toward enhancement and restoration of habitat located near occupied habitat to encourage the natural expansion of the species' range.

4. Include sufficient buffer habitat around suitable restored and enhanced habitat within the species' range to reduce adverse effects associated with pesticide drift.

5. To the extent consistent with CALFED objectives, implement levee maintenance guidelines to protect suitable habitat.

6. To the extent consistent with CALFED objectives, design levees to encourage the establishment and long-term maintenance of suitable habitat.

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

<u>Delta & Eastside Delta Tributaries</u>

PROCESSES

* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within the Eastside Delta Tributaries EMZ.
* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within the Eastside Delta Tributary EMZ.

HABITAT

* Restore a minimum of 300 acres of self-sustaining or managed diverse natural riparian habitat along the Mokelumne River, Cosumnes River, and Calaveras River and protect existing riparian habitat.
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within the Eastside Delta Tributary EMZ

<u>Sacramento River Basin</u>

PROCESSES

* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ in the Sacramento River Basin.
* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within each of the EMZs in the Sacramento River Basin. Among the areas to be included are the lower 10 miles of Clear Creek, Antelope Creek, and Deer Creek, and the lower reach of Cottonwood Creek.
* Protect 15,000 acres within the Inner River Zone areas between Red Bluff and Colusa reaches within identified the Sacramento River Conservation Area. Establish between 3 and 5 habitat preserves for bank swallows along the upper reaches of the Sacramento River capable of supporting 5000 bank swallow burrows between the towns of Colusa and Red Bluff.

HABITAT

* Restore 2 miles of the 10 mile target of riparian habitat restoration along the lower reaches of each of the following tributaries: Battle, Clear, Deer, Mill, Butte, Big Chico, Antelope, Feather, Yuba, and Bear Rivers.
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within each of the following Ecological Management Zones: American River Basin, Butte Basin, Colusa Basin, Cottonwood Creek, Feather River/Sutter Basin, North Sacramento Valley, Sacramento River, and Yolo Basin. While restoring habitat conditions in the American River EMZ, maintain continuous corridors of suitable riparian habitat for valley elderberry longhorn beetle. Protect existing known occurrences of northern California black walnut native stands through conservation easement or purchase. Identify at least 3 protected and managed sites for introduction of additional populations of northern California black walnut; begin introduction and monitor for success. Population creation should be part of a broader effort to restore riparian areas which historically contained walnut.

<u>San Joaquin River Basin</u>

PROCESSES

* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ within the San Joaquin River Basin. In the East San Joaquin Basin EMZ, complete fluvial geomorphic assessments on all tributaries.
* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within each of the EMZs in the San Joaquin River Basin. Among the areas to be included are at least 10 miles of stream channel in the West San Joaquin EMZ.

HABITAT

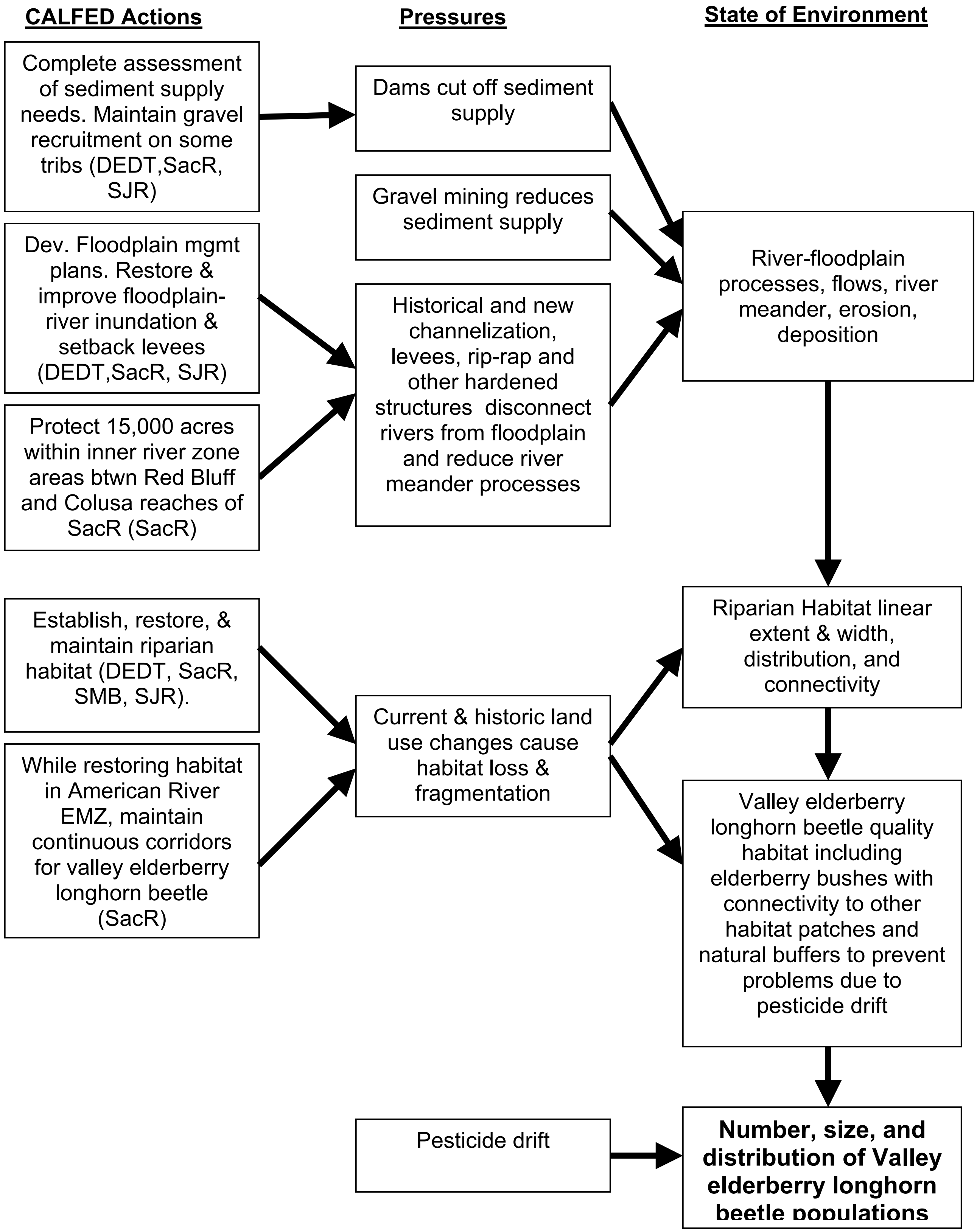
* Implement 25 percent of the ERP target for diverse, self-sustaining riparian community for all EMZs in the San Joaquin River Basin. Bring at least three of the currently existing but unprotected delta coyote thistle occurrences into protection through purchase or conservation agreement, and ensure appropriate management. Increase suitable habitat for delta coyote thistle by at least 20% and the number of populations and individuals by at least 10% through habitat management and protection. Establish two new riparian brush rabbit habitat preserves within the historical range of the species. Protect and enhance a minimum of 150 contiguous acres of mature, shrub-rich riparian forest and associated highwater refugia on the San Joaquin River, between the Merced River confluence and Vernalis, and on each of the east-side tributaries (the Stanislaus, Tuolumne and Merced rivers) for habitat values and as potential riparian brush rabbit re-introduction sites.
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat and instream cover along at least one tributary within the East San Joaquin and San Joaquin River EMZs.

<u>Suisun Marsh & North San Francisco Bay</u>

HABITAT

* Restore and maintain a minimum of three linear miles of riparian habitat along corridors of existing riparian scrub and shrub vegetation in each of the Ecological Management Units of the Suisun Marsh/North San Francisco Bay Ecological Management Zone.

Figure G-34. Valley elderberry longhorn beetle Diagrammatic Conceptual Model



Western yellow-billed cuckoo **Scientific Name** *Coccyzus americanus occidentalis*

Legal Status[11]: California endangered (CESA)

CALFED ERP GOAL[8,11] "Contribute to Recovery (r)"

MSCS Goal prescription[11]

Protect existing suitable riparian forest habitat within the species' historical range, and increase the area of suitable riparian forest habitat sufficiently to allow the natural expansion of the Sacramento Valley population.

Straw-dog Monitoring Recommendations

* Population status & distribution of yellow-billed cuckoo
* Extent (length and width) & distribution of available habitat, protected habitat and restored habitat of appropriate structure & composition
* Extent & distribution of projected available habitat based upon existing patches of riparian habitat in earlier successional stages that will mature into cuckoo habitat in future.

Existing Monitoring Program / Information Sources

Yolo County Habitat Conservation Plan (HCP) – Includes Alkali Milk-vetch, Bank Swallow, California Yellow Warbler, California Yellow-billed Cuckoo, Crampton's Tuctoria, Giant Garter Snake, Swainson's Hawk, Valley Elderberry Longhorn Beetle
Contact:Terry Roberts, City of West Sacramento Community Development, http://endeavor.des.ucdavis.edu/CERPI/ProjectDescription.asp?ProjectPK=3170

Point Reyes Bird Observatory, The Nature Conservancy, U.S. Fish & Wildlife Service: Sacramento River Bird Conservation Project – Riparian Birds
Contact: Stacy Small (www.prbo.org)

Point Reyes Bird Observatory, U.S. Fish & Wildlife Service: San Joaquin Restoration – Riparian Birds
Contact: Geoff Geupel (www.prbo.org)

NCCP Habitats[11] Valley/Foothill Riparian

ERP Mgmt Zone[12] Sacramento River, Feather River/Sutter Basin, possibly migrating, Yolo Basin, American River Basin, Delta, San Joaquin River, Eastside Delta Tributaries, East San Joaquin Basin, West San Joaquin Basin

Life History & Habitat Requirements (MSCS Technical Reports, 1999)[12]

"The western yellow-billed cuckoo has a smaller range and more restrictive habitat requirements than other subspecies. It breeds in scattered locations where suitable habitat is available throughout California, Idaho, Utah, Arizona, New Mexico, extreme western Texas, and possibly Nevada and western Colorado (Gaines and Laymon 1984).

"A statewide survey of western yellow-billed cuckoos in California conducted during 1986 and 1987 found 30-33 pairs and 31 unmated males at nine localities (Laymon and Halterman 1989). The majority of the cuckoos were concentrated along the upper Sacramento River from Red Bluff to Colusa (18 pairs and 19 unmated males) and at the South Fork Kern River (seven pairs and three unmated males). The remaining cuckoos were found at scattered locations, including along the Feather River, Prado Flood Control Basin, Mojave River, Owens Valley, Amargosa River, and along the Colorado River (Laymon and Halterman 1989).

"More recent surveys on the Sacramento River from 1988 through 1990 found a fluctuating population of 23-35 pairs, depending on the year (Halterman 1991). Continuous surveys on the South Fork Kern River from 1985 through 1996 found a population that varied from a low of two pairs in 1990 to a high of 24 pairs in 1992 (Laymon et al. 1997). These two sites are the only localities in California that sustain breeding populations of yellow-billed cuckoos. During the early 1990s, two cuckoo nesting territories were also observed in the Westside Borrow Pit (the Westside drainage channel) of the southern Sutter Bypass (Jones & Stokes Associates file data).

"Western yellow-billed cuckoos generally arrive in California during June (Gaines and Laymon1984) and begin nesting shortly thereafter. The species begins its fall migration in early August and most have left California by mid-September (Gaines and Laymon 1984). Western yellow-billed cuckoos are primarily foliage-gleaning insectivores, but also hover glean, hawk, and even hop on the ground to obtain their prey. In California, the diet of cuckoos includes green caterpillars (predominately sphinx moth larvae), tree frogs, katydids, and grasshoppers. The cuckoos in California are confined during the breeding season to cottonwood-willow riparian habitat that is at least 300 feet wide. They have large home ranges, often exceeding 50 acres and sometimes approaching 100 acres (Laymon and Halterman 1985)."

Pressures (MSCS Technical Reports, 1999)[12]

"Riparian habitat loss on the breeding grounds is the primary threat. Loss has resulted from several activities, including agricultural development, flood control projects, reservoir construction, groundwater reduction, urban and suburban development, invasion by non-native vegetation, and long-term intensive year-round cattle grazing. Important temporary losses of riparian habitat also result from wildfires and trees being cut for firewood."

MSCS Conservation Measures - That add detail to ERP actions[11]

1. Coordinate protection and restoration of riparian habitat with other federal, State, and nonprofit programs (e.g., the Riparian Habitat Joint Venture, the SB1086 program, and USACE's Sacramento and San Joaquin Basin Comprehensive Study) that could affect management of current and historical habitat use areas. Coordination would avoid conflicts among management objectives and identify opportunities for achieving multiple management objectives.
2. Initially direct ERP actions to restore suitable valley/foothill riparian forest and woodland along at least 10 contiguous miles of channels in the Delta to create a riparian forest corridor at least 200 meters wide.
3. Restore contiguous blocks of suitable valley/foothill riparian forest and woodland at least 200 meters wide and 500 acres in size along reaches of the Sacramento River adjacent to occupied habitat (Red Bluff to Colusa).

CALFED ERP Milestones (CALFED actions during Stage 1, the first 7 years)[8a]

<u>Delta & Eastside Delta Tributaries</u>

PROCESSES

* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within the Eastside Delta Tributaries EMZ.
* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within the Eastside Delta Tributary EMZ.

HABITAT

* Implement 25 percent of the ERP target for diverse, self-sustaining riparian community for each EMU in the Sacramento-San Joaquin Delta EMZ.

* Restore a minimum of 300 acres of self-sustaining or managed diverse natural riparian habitat along the Mokelumne River, Cosumnes River, and Calaveras River and protect existing riparian habitat.
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within the Eastside Delta Tributary EMZ

<u>Sacramento River Basin</u>

PROCESSES

* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ in the Sacramento River Basin.
* Protect 15,000 acres within the Inner River Zone areas between Red Bluff and Colusa reaches within identified the Sacramento River Conservation Area. Establish between 3 and 5 habitat preserves for bank swallows along the upper reaches of the Sacramento River capable of supporting 5000 bank swallow burrows between the towns of Colusa and Red Bluff.
* Design and begin implementation of an ecologically based streamflow regulation plan for Yuba River, Butte Creek, Big Chico Creek, Deer Creek, Mill Creek , Antelope Creek, Battle Creek, Cottonwood Creek, and Clear Creek.
* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within each of the EMZs in the Sacramento River Basin. Among the areas to be included are the lower 10 miles of Clear Creek, Antelope Creek, and Deer Creek, and the lower reach of Cottonwood Creek.

HABITAT

* In the Cottonwood Creek EMZ, complete (1) long-term agreements with local landowners to establish, restore, and maintain riparian communities along 25 percent of the upper and 25 percent of the lower reaches of Cottonwood Creek, and (2) the development of a comprehensive watershed management plan that supports local land use decisions to protect existing riparian and restore lost riparian.
* Restore 2 miles of the 10 mile target of riparian habitat restoration along the lower reaches of each of the following tributaries: Battle, Clear, Deer, Mill, Butte, Big Chico, Antelope, Feather, Yuba, and Bear Rivers.
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within each of the following Ecological Management Zones: American River Basin, Butte Basin, Colusa Basin, Cottonwood Creek, Feather River/Sutter Basin, North Sacramento Valley, Sacramento River, and Yolo Basin. While restoring habitat conditions in the American River EMZ, maintain continuous corridors of suitable riparian habitat for valley elderberry longhorn beetle. Protect existing known occurrences of northern California black walnut native stands through conservation easement or purchase. Identify at least 3 protected and managed sites for introduction of additional populations of northern California black walnut; begin introduction and monitor for success. Population creation should be part of a broader effort to restore riparian areas which historically contained walnut.

<u>San Joaquin River Basin</u>

PROCESSES

* Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport

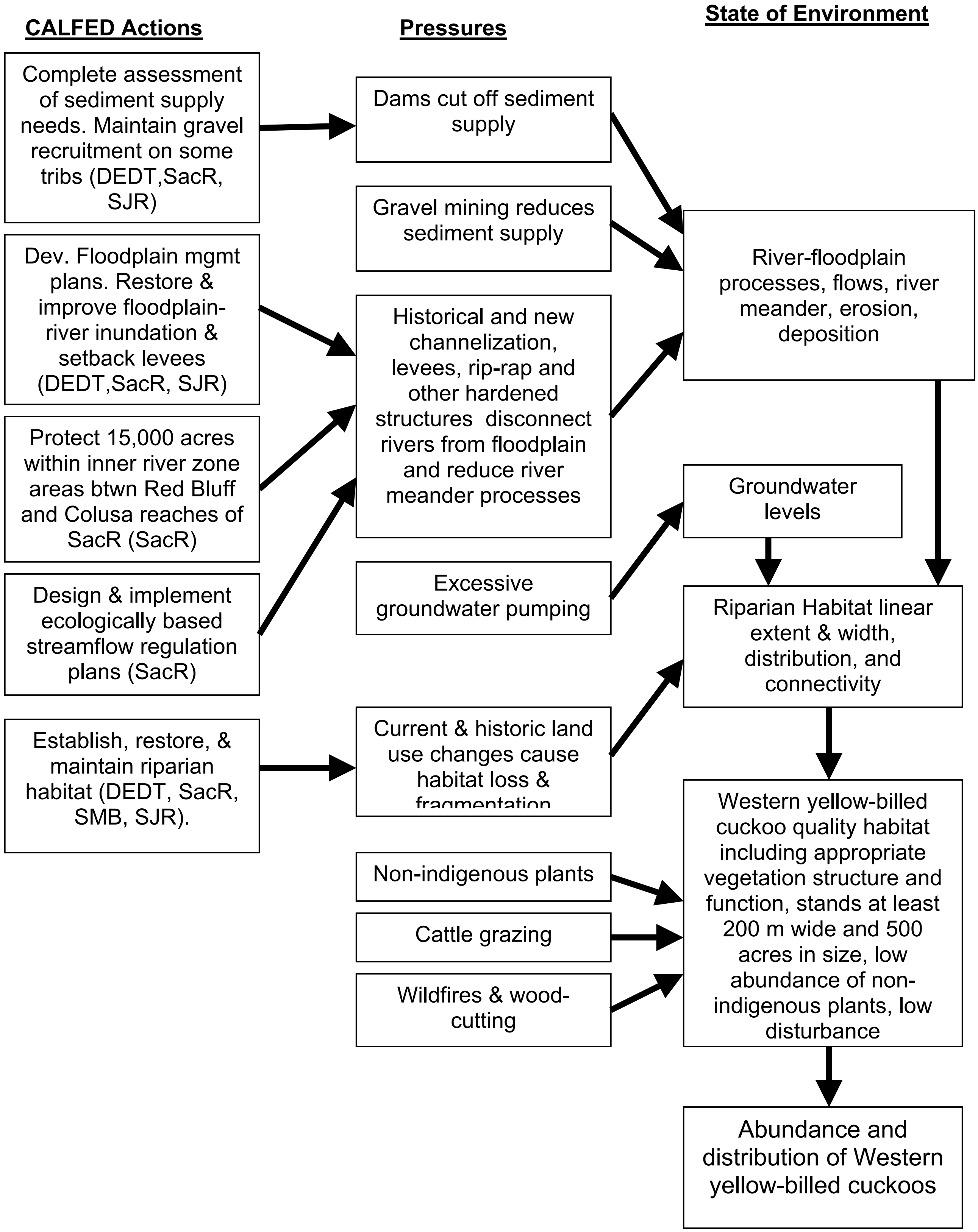
processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ within the San Joaquin River Basin. In the East San Joaquin Basin EMZ, complete fluvial geomorphic assessments on all tributaries.

* Develop floodplain management plans, including feasiblility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within each of the EMZs in the San Joaquin River Basin. Among the areas to be included are at least 10 miles of stream channel in the West San Joaquin EMZ.
* Develop a cooperative program to restore salmonid spawning and rearing habitat in the Tuoloumne, Stanislaus, and Merced Rivers that includes the following elements: (1) reconstructing channels at selected sites by isolating or filling in inchannel gravel extraction areas; (2) increasing natural meander by removing riprap and relocating other structures that impair stream meander; and (3) restoring more natural channel configurations to reduce salmonid predator habitat and improve migration corridors.

HABITAT

* Implement 25 percent of the ERP target for diverse, self-sustaining riparian community for all EMZs in the San Joaquin River Basin. Bring at least three of the currently existing but unprotected delta coyote thistle occurrences into protection through purchase or conservation agreement, and ensure appropriate management. Increase suitable habitat for delta coyote thistle by at least 20% and the number of populations and individuals by at least 10% through habitat management and protection. Establish two new riparian brush rabbit habitat preserves within the historical range of the species. Protect and enhance a minimum of 150 contiguous acres of mature, shrub-rich riparian forest and associated highwater refugia on the San Joaquin River, between the Merced River confluence and Vernalis, and on each of the east-side tributaries (the Stanislaus, Tuolumne and Merced rivers) for habitat values and as potential riparian brush rabbit re-introduction sites.
* Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat and instream cover along at least one tributary within the East San Joaquin and San Joaquin River EMZs.

Figure G-35. Western Yellow-Billed Cuckoo Diagrammatic Conceptual Model



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#	General Monitoring Elements	Monitoring Questions	Priority	Frequency	5.0 Large scale habitats & processes	6.0 Tidal Wetlands	7.0 Freshwater & Riparian Wetlands	8.0 Other Habitats	9.0 ERP Biological Communities	10.0 MSCS At-risk species	11.0 Non-native species, contaminants	Existing Program
		Remote sensing / mapping										
1.001	Habitats: Coarse resolution mapping of extent and location of ERP Habitat Types and MSCS-NCCP habitat types: ERP habitats: Tidal Perennial Aquatic Habitat, Nontidal perennial aquatic habitat, Saline emergent wetlands, Fresh emergent wetland, Seasonal wetlands, Riparian and Riverine aquatic habitats, Inland dune scrub habitat, Perennial grassland MSCS- NCCP habitats: Tidal Perennial Aquatic, Valley Riverine Aquatic, Montane Riverine Aquatic, Lacustrine, Saline Emergent, Tidal Freshwater Emergent, Non-tidal Freshwater Permanent Emergent, Natural Seasonal Wetland, Managed Seasonal Wetland, Valley/Foothill Riparian, Montane Riparian, Grassland, Inland Dune Scrub, Upland Scrub, Valley/Foothill Woodland and Forest, Montane Woodland and Forest, Upland Cropland, Seasonally Flooded Agricultural Land	What are the status & trends in extent and spatial distribution of ERP and NCCP habitats? Are CALFED objectives being achieved? Are sufficient amounts of habitat being maintained for MSCS species? Where is habitat being lost and gained due to human activities and natural processes? What is the extent and distribution of floodplain habitats? What changes in the extent of the floodplain are due to hydrologic and geomorphic processes, including irreversible levee breaches? What changes are due to human activities? What are the extent and distribution of tidal wetland habitats?	High	1-3 years	x	x	x	x	x	x		ACOE - Habitat Restoration Feasibility Studies; ACOE - Comprehensive Review Study; CSU-Chico; Cosumnes River Preserve & restoration studies; CDWR-Sacramento River Riparian Habitat Program; CDWR-Reservoir sites + 1 mile buffer; CDWR-AB360 Delta Levee Maintenance subventions program; CDWR-North Delta Program; CDWR-Statewide Planning (Crop types) Habitat Conservation Plans; SFEI-EcoAtlas; CDFG-Suisun Marsh Vegetation Survey-mapping; CDFG-Central Valley Wetland Mapping Project; Mosquito Abatement Districts; California Legacy Project; USFS w/CDF above 300' contour; USFWS National Wildlife Refuges; Dept. of Conservation - Farmland Mapping & Monitoring Program; Dept. of Pesticide Regulation w/USBR - Field Borders mapping; UC Berkeley, CEDR - SF Bay Delta Geodatabase (Wetlands in Bay/Delta); USBR-Stone Lakes Wildlife Refuge Feasibility Study;

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Remote sensing / mapping - continued												
1.002	Habitats: Connectivity (especially for tidal wetlands and for floodplain and riparian wetlands) * Patch size distribution, * Habitat pattern indices (patch contagion & interspersion, patch cohesion, inter-patch distance, distribution, etc. * location of habitat corridors & acreage of contiguous habitat relative to movement of different biological communities * linear extent of river and stream channel or floodplain with continuous habitat * location of functionally isolated patches and/or groups of patches * Distribution of distances to nearest patch relative to dispersal distances of indicator species * Location & types of barriers to movement between patches	What is the distribution of habitat blocks? To what degree are various habitat blocks connected? Where do corridors exist? Where have they been lost? Is habitat connectivity being maintained along longitudinal and latitudinal salinity gradients in estuary to allow migration in case of sea level rise? Along other gradients?	high	1-3 years	x	x	x	x	x	x		Missing Linkages effort? See efforts listed in 1.001 above
1.003	Land use: Mapping of land use, esp. within and near ERP targeted habitats.	What types of land use occur within habitats? In lands adjacent to habitats? Where is land use change occurring, especially change that results in the loss or gain of habitats, habitat buffers, and/or corridors? Where are land uses occurring that could be increasing the level of stressors within habitats and/or corridors? I.e. urban areas increasing feral pets, lighting, roadkill, trash dumps, contaminants, feed lots increasing cowbird density. What is the distance between ERP habitats and these land uses? What is distance between riparian habitats and land uses that promote high cowbird densities? Where are wildlife friendly crops being grown?	High		x	x	x	x	x	x	x	CDWR-Land use data; USDA-National Resources Inventory; CDWR-Statewide Planning (Crop types)

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Remote sensing / mapping - continued												
1.004	Tidal wetlands-habitat: Detailed (high resolution) Tidal Wetland vegetation mapping - detailed extent and distribution of plant communities and sub-habitats (I.e. pickleweed marsh, etc.);	What are the status and trends in the extent and distribution of vegetation communities and sub-habitats in tidal wetlands and associated upland habitats?	High	3-5 years		x				x		ACOE - Habitat Restoration Feasibility Studies SFEI-EcoAtlas CDFG-Suisun Marsh Vegetation Survey-mapping CDWR-AB360 Delta Levee Maintenance subventions program Mosquito Abatement Districts
1.005	Tidal Wetlands: * Estuary Shoreline Change * Extent & location of tidal mud flats * Extent of vegetated marsh plain	What are the changes in the extent and distribution of tidal wetlands shoreline due to hydrologic and geomorphic processes? what changes are due to human activities and land use changes? (I.e. urbanization & levees) What are the extent and location of tidal mudflats as an indicator of ERP tidal perennial aquatic habitat? Is the sediment supply into the estuary sufficient to sustain tidal mudflats? Is the extent of vegetated marsh plain sustainable in the light of a changing sediment supply and rising sea level? Is the sediment supply sufficient to maintain the natural establishment and success of habitats in tidal wetlands? Is marsh plain elevation being maintained relative to sea level?	High	1-3 years	x	x						SFEI EcoAtlas CDFG Suisun Marsh mapping
1.006	Changes in estuary MHHW level	How much is sea level rise contributing to changes in the extent and distribution of wetlands in the estuary?				x						
1.007	Tidal Wetlands: Extent & distribution of tidal wetlands by degree of tidal control (full, muted, none)	What is the extent of tidal wetlands that are actually receiving tidal action? What are managed seasonal wetlands?		1-3 years		x						

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Remote sensing / mapping - continued												
1.008	Tidal wetland-Mapping of tidal channels, ponds, pans * tidal channel density -- total length of channel per unit area of ground surface * network order * channel gain/loss * locations of ponds & pannes * patch size	What are the status and trends in tidal channel density? What is the extent and distribution and number of sites of tidal wetland sites containing 3rd and 4th order tidal channel network (usually <1000 acres)? Do these also have other indicators of topographic complexity such as ponds and pannes? What are the trends in the gain and loss of tidal channels (is it outside of the normal maturation process of tidal wetlands)? Do tidal wetlands have topographic complexity, tidal channel networks, low- to high marsh transitions, ponds and pannes to provide a mosaic of habitat types? Will hydrologic and geomorphic processes continue to provide a range of habitat types?	High	3-5 years		x						SFEI EcoAtlas CDFG Suisun Marsh mapping
1.009	Tidal Wetlands: areas of midchannel islands and shoals	What are the status and trends of midchannel islands and shoals? Are they being eroded by boat wave action? Is there sufficient sediment supply to sustain them?	High	3-5 years	x	x						
1.010	Tidal wetland connectivity with upland: Proportion/extent, & location of tidal wetland habitat patches with low-angle upland slopes at the upper edge of marshes to provide sufficient wetland to upland transition habitat zones. Transition habitat zones should be at least 0.25 mile in width and have adequate vegetative cover for species to avoid predators while seeking refuge from high flood waters.	Where do tidal wetlands exhibit good connectivity with upland habitat and a full range of low marsh to high marsh zones to support a range of MSCS plant and animal species? Do tidal wetlands have topographic complexity, tidal channel networks, low- to high marsh transitions, ponds and pannes to provide a mosaic of habitat types? Will hydrologic and geomorphic processes continue to provide a range of habitat types?	High	3-5 years		x						
1.011	Tidal wetland-Topographic map / tidal elevation of tidal wetland sampling sites in sampling sites network	Provides background information for interpretation of other variables				x	x					

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Remote sensing / mapping - continued												
1.012	Floodplain & riparian habitat: detailed (high resolution) mapping in floodplain and riparian habitats and associated uplands of the extent and distribution of plant communities and sub-habitats (Black Willow series, Narrowleaf Willow series, White Alder Series, Buttonbush Series, Mexican Elderberry Series, Valley Oak Series, etc.) and associated permanent open water (e.g. sloughs, embayments, oxbows, side channels, borrow pits, ponds)	What are the status and trends in the extent and distribution of vegetation communities and sub-habitats within NCCP habitat types of floodplain and riparian wetlands and associated upland habitats? What changes in ERP/NCCP habitats are attributable to changes in flood management and land/levee erosion control activities? Is a natural succession of new to older habitat types occurring? Is new vegetation being established on gravel deposits followed by succession?	High	3-5 years			x					ACOE - Habitat Restoration Feasibility Studies; ACOE - Comprehensive Review Study; CSU-Chico w/DWR SB1086; Cosumnes River Preserve & restoration studies; CDWR-Sacramento River Riparian Habitat Program; Habitat Conservation Plans
1.013	floodplain & riparian habitat: Location, area, depth, of vernal pools	What are the status & trends in extent and spatial distribution of floodplain wetland habitats since the baseline year?	High	3-5 years			x					CDFG - Wetlands Inventory & Conservation Unit
1.014	Floodplain & riparian wetland connectivity with upland -- extent and location of floodplain and riparian habitats with adequate connectivity with upland habitat to act as quality refugia from rising floodwaters & land use in the refugia areas	How much of floodplains habitats have adequate connectivity with upland habitat to provide floodwater refugia for small mammals and herpetofauna and access to a mosaic of habitats?	High				x					
1.015	Floodplain-Extent of floodplain inundated	What is the extent of the 2, 10, 20, and 100 year floodplain?	High	major flood events			x					DWR Northern District - SB 1086; DWR Delta Planning Branch - North Delta Program
1.016	Floodplain-width of river meander corridor between levees	Is natural channel meander occurring and resulting in a natural succession of habitat types? What is the extent of freely meandering reaches and other pre-1850 river channel forms that are functioning to support natural riverine, riparian, and floodplain habitats ?	High				x					ACOE?
1.017	Floodplain-mapping of channel morphology -- sinuosity, width of meander belt, branching	Is natural channel meander occurring and resulting in a natural succession of habitat types? What is the extent of freely meandering reaches and other pre-1850 river channel forms that are functioning to support natural riverine, riparian, and floodplain habitats ?	High				x					

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Remote sensing / mapping - continued												
1.018	Floodplains: areas of new sediment deposits and erosion in rivers and tributaries	Is the sediment supply in rivers and tributaries sufficient to create gravel bars and create diverse topography in floodplains to support a range of vegetation community succession?			x	x						
1.019	Floodplain-mapping of rivers and tributaries by type of control, I.e. levees, rip-rap, no levees, etc.	Where do levees restrict river meander and extent of the floodplain? Where have bank stabilization measures been applied that cause loss of habitat and restrict river meander processes? What changes in ERP/NCCP habitats are attributable to changes in flood management and land/levee erosion control activities? Is natural channel meander occurring and resulting in a natural succession of habitat types? What is the extent of freely meandering reaches and other pre-1850 river channel forms that are functioning to support natural riverine, riparian, and floodplain habitats ? What is the percent of river miles constrained by constructed levees?			x		x					CDWR
1.020	Dendritic nature of streams: landscape-level survey of feeder creeks and tributaries to identify whether or not they reach the river or are truncated and combined.	This issue was identified in the TAMP workshops and may be more of a watershed program issue than an ERPP issue.			x							Phillip Williams & Associates
1.021	MSCS Species-habitats: Status and trends in habitat extent and connectivity for each "R" and "r" MSCS species. May include status and trends in high quality habitat as separate from marginal quality habitat. Status & trends of occupied habitat.	What are the status and trends in the extent and connectivity of habitat for each "R" and "r" species?	High	3-5 years						x		CDWR-Central District Delta GIS Program - Delta Levees Subventions Program; CDFG - California Wildlife Habitat Relationships Database
1.022	Biological communities Habitats: Extent & distribution of various types of habitats preferred by various types of waterfowl & shorebirds	What are the trends in the extent and distribution of various types of habitats preferred by various types of waterfowl and shorebirds? What changes in the extent and distribution of habitats and use are occurring across the landscape due to large-scale habitat restoration and increase in wildlife-friendly agriculture?	High	3-5 years		x	x		x			Ducks Unlimited (waterfowl habitat)

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Remote sensing / mapping - continued												
1.023	Biological communities Habitats: Extent & distribution of habitats preferred by wading birds for foraging, nesting and roosting, including agricultural lands	What is the extent and distribution of habitats preferred by various types of wading birds in floodplain, riparian, and tidal wetlands?		3-5 years					x			
1.024	Biological communities Habitats: Extent & distribution of habitats preferred by neotropical migratory birds	What are the status and trends in the extent and distribution of habitat preferred by neotropical migratory birds?	High	3-5 years					x			CPIF / RHJV
1.025	Non-indigenous Species: location/distribution & size of patch of key non-indigenous plant species (water hyacinth, egeria, etc.)	What are the status and trends in distribution of key non-indigenous plant species?	High	3-5 years		x					x	CDFA-Integrated Pest Control Branch; US Dept. of Animal & Plant Health Inspection Service (APHIS)
MSCS Species Surveys for "R" and "r" species												
1.026	MSCS Species: Baseline inventories of locations of populations, size of populations (relative abundance, density, or area occupied, etc.), and basic condition of populations of "R" and "r" species	Where are the "R" and "r" species located, what is the approximate size of the population(s), and what is the condition of the population(s) and associated habitat?	Very High	Immediate						x		See Section 10 & Appendix G CAL-Flora CDFG-Natural Diversity Data Base CDFG-California Wildlife Habitat Relationships Database
1.027	MSCS Species: Population trends of targeted species (abundance, distribution, number of populations). Alternatively – monitoring of habitat extent and distribution may be used as a surrogate for species population monitoring with more occasional validation monitoring of the habitat-species relationship, depending on the species.	What are the status and trends in populations of "R" and "r" species (Abundance, distribution, number of populations where relevant, etc.)?	High							x		See Section 10 & Appendix G
1.028	MSCS Species: For "R" and "r" species, track possible measures of species-specific pressures (e.g., competition and predation by non-indigenous species, boat wake disturbance, disturbance by mosquito abatement efforts, water hyacinth control efforts, levee maintenance activities, etc.)	If species are continuing to decline, what is the cause? What pressures are responsible for continued decline? Are actions to reduce pressures (non-indigenous species, boat wake erosion on nests, etc) having a positive effect on "R" and "r" species?	High			x				x		Mosquito Abatement Districts, CDWR

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ERP Biological Communities - Regional Surveys												
1.029	Amphibians: Locations of sites with native anurans present and relative abundance at those sites -- California red-legged frog, Foothills yellow-legged frog, western spadefoot	What are the status and trends in the abundance, distribution, and/or percent area occupied for native anuran amphibian species?	High						x			USGS-ARMI (DOI lands only) UC Davis - Dr. Shaffer
1.030	Amphibians: Evidence of disease, poor health, and deformities in native anurans	Where are unusual health problems occurring in native anurans occurring?					x		x			
1.031	Non-indigenous plants: distribution & abundance (size of patch ?) of key non-indigenous plant species, i.e. Arundo, Tarmarisk, Ailanthus or tree of heaven, Edible Fig, Northern California Black Walnut, Eucalyptus, Black locust, Russian olive, Perennial pepperweed, German ivy, Introduced Cordgrass, Purple loosestrife, Egeria, Hydrilla, Water hyacinth, Water pennywort, Eurasian watermilfoil, Parrotfeather	What are the status and trends in distribution of key non-indigenous plant species?	Very High - Delta High - Sac & San Joaquin Rivers	3-5 years							x	Cal. Dept. of Boating and Waterways - Water hyacinth CDFA Integrated Pest Control Branch - Hydrilla SFEI-Biological Invasions Program Team Arundo Del Norte US Dept. of Animal & Plant Health Inspection Service (APHIS)
1.032	Shorebirds - aerial surveys * Species diversity, richness, evenness; * Key indicator species indices of abundance or presence/absence (Goals Project, 2000. Recommends western snowy plover, red knot, western sandpiper, marbled godwit, long-billed dowitcher, black turnstone, Wilson's phalarope) Should also include long-billed curlew (MSCS, 2000)	What are the status and trends in shore bird diversity, abundance of key species and distribution in tidal wetlands? How do these trends relate to tidal wetland habitat use? What changes are occurring in habitat use across the landscape given the large-scale changes due to restoration?		Annual		x			x			PRBO?
1.033	Shorebirds: Location & size of breeding colonies	What is the location, size, and reproductive success in nesting colonies?		Annual					x			
1.034	Wading birds: Number, location and size of nesting colonies	What are the status and trends in wading bird communities in floodplain, riparian and tidal wetlands? What are the locations and size of nesting colonies?							x			

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ERP Biological Communities - Regional Surveys - continued												
1.035	Waterfowl - aerial surveys * abundances by group (dabbling ducks, diving ducks, geese, swans) * key indicator species indices of abundance (the Goals Project (2000) recommends Northern pintail, Mallards, canvasbacks, greater & lesser scaup, ruddy duck, bufflehead, surf scoter, tule geese. The Aleutian Canada goose should also be included (MSCS, 2000))	What are the status and trends in types of waterfowl and key indicator species abundance, diversity, and distribution? What changes are occurring in habitat use across the landscape given the large-scale changes due to restoration and wildlife friendly agriculture?		seasonal aerial surveys		x			x			USFWS & CDFG currently has September & mid-winter surveys. The number of surveys/year need to be increased.
1.036	Waterfowl: disease outbreaks in region	Is overcrowding causing disease outbreaks among waterfowl?				x			x			
Tidal Wetlands Habitat - Sampling Sites Network (in addition to remote sensing monitoring)												
1.037	Passerine & rail surveys - * key indicator species relative abundance or presence/absence, esp. MSCS species * Species diversity, richness, evenness;	What are the status and trends of MSCS rails and passerines in tidal wetlands? What are the status and trends of species diversity?				x				x		
1.038	Reptile & amphibian monitoring * presence/absence of MSCS species (western pond turtle, giant garter snake) * relative abundance or presence/absence of key indicator species * species diversity, richness, evenness	What are the status and trends of MSCS reptiles and amphibians in tidal wetlands? What are the status and trends of species diversity?				x				x		
1.039	Small mammal monitoring * species diversity, richness, evenness; * Key indicator species including MSCS species -- relative abundance or presence/absence	What are the status and trends of MSCS mammals in tidal wetlands? What are the status and trends of species diversity?				x				x		Salt Marsh Harvest Mouse trapping in Suisun Marsh
1.040	Waterfowl and shorebirds - * Species richness, * Key indicator species including MSCS species -- relative abundance or presence/absence	What waterfowl and shorebirds are using tidal wetlands?				x			x			
1.041	benthic invertebrates -- species richness and percent dominant species	What are the status and trends of species diversity? What are the associations with contaminants and habitat quality in tidal wetlands?				x						

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Tidal Wetlands Habitat - Sampling Sites Network (in addition to remote sensing monitoring) - continued												
1.042	MSCS plant species distribution & abundance	What MSCS plant species are present, what is their distribution and abundance in sampling sites network sites?	High			x				x		
1.043	Medium to Large Mammal surveys to detect presence or rel. abundance of introduced foxes, Norway rats, feral cats, dogs. Also detect native predator abundance	Are larger predators such as coyotes present? What is the activity level of non-indigenous predators such as cats and dogs and introduced foxes? Is the activity level of native predators such as raccoons & coyotes unnaturally high?				x					x	
1.044	Habitat characteristics that are associated with non-indigenous predators (easy access to middle of marsh via roads, dikes, etc.)	Are there physical structures, habitat characteristics, and human factors that may be increasing the abundance of non-indigenous predators?				x					x	
1.045	Vegetation surveys - Vegetation community structure, composition, species diversity, species richness, key indicator species distribution and abundance, percent cover, standing crop, relative abundance of non-indigenous plants	How does high resolution mapping relate to vegetation structure and composition on the ground? What is the relative abundance of non-indigenous plants? How functional is the vegetation structure and composition in support of MSCS species and ERP biological communities? What changes are occurring in vegetation structure, composition and function? Are vegetation communities shifting from freshwater to brackish or from brackish to saline?	High			x					x	
1.046	Non-indigenous plants: relative abundance of non-indigenous plant species, presence/absence of key non-indigenous plant species, reporting of unidentified plants	What are the status and trends in the relative abundance of non-indigenous plants in tidal wetlands? What are the status and trends in distribution of key non-indigenous plant species? What new introduced plant species have been observed in tidal wetlands? What effects are non-indigenous plants having on the structure, composition and function of tidal wetland vegetation?	High			x					x	

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Tidal Wetlands Habitat - Sampling Sites Network (in addition to remote sensing monitoring) - continued												
1.047	Tidal Wetland - hydrology: * palustrine hydroperiod - timing and duration of standing water * tidal regime - frequency & duration of tidal inundation * tidal prism - volume of tides passing through drainage network or channel during a tidal cycle * water depth - height of water column above the ground and below an upper limit or high water datum * level of tidal inundation: full, muted or none * soil salinity * wetted perimeter - shoreline of perimeter corresponding to high water datum	How do wetland hydrology & salinity levels influence interpretation of other variables such as vegetation, water quality, and benthic invertebrates? (important covariates)				x						
1.048	Shoreline change	What are the changes in the extent and distribution of tidal wetland shoreline due to hydrologic and geomorphic processes? Is the sediment supply sufficient to maintain tidal wetlands relative to sea level rise? Where is wave action and boat wakes causing excessive shoreline erosion?				x						
1.049	tidal channel morphology: cross-sectional profile, longitudinal profile, meander geometry					x						
1.050	vertical sediment accretion/erosion in marsh plain	Is the sediment supply sufficient to maintain tidal wetlands relative to sea level rise?				x						
1.051	Water Quality -- suspended sediment, turbidity, Total dissolved solids, temperature, conductivity, Nutrients (nitrogen, phosphorous)	How do differences in water quality variables affect interpretations of differences in vegetation communities and biological communities? (largely a covariate)										
1.052	Soil/sediment quality - hydraulic conductivity, bioturbation depth, sediment texture, depth of detritus, redox potential, bulk density, contaminants -- mercury, selenium, trace metals, pesticides,	How do differences in soil/sediment quality affect interpretations of differences in vegetation communities and biological communities? (largely a covariate)				x						

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Tidal Wetlands Habitat - Sampling Sites Network (in addition to remote sensing monitoring) - continued												
1.053	Contaminants (water, sediment) mercury, selenium, trace metals, pesticides	Are level of contaminants in water and sediment enough to cause toxicity problems in terrestrial biota? In aquatic biota?				x						
1.054	Disturbance type, timing and effect on vegetation and fauna?	What human activities are causing disturbance to vegetation and fauna?				x						
1.055	site history: approximate ages of patches of tidal wetlands and/or time since restoration efforts	What is the age of the site? This is an important covariate for interpreting vegetation structure and composition.				x						
Freshwater & Riparian Habitat Sampling Sites Network (in addition to remote sensing monitoring)												
1.056	Amphibians & Reptiles: * Native Species diversity, richness, evenness; * Key indicator species relative abundance ore presence/absence including MSCS Species (Giant Garter Snake, Western pond turtle, California red-legged frog, Foothills yellow-legged frog, Western spadefoot, California Tiger Salamander)	What are status and trends in diversity and species richness of native reptiles and amphibians in floodplain habitats? What are the status and trends of MSCS mammals in floodplain wetlands (California Red legged Frog, Western Spadefoot, Cal. Tiger salamander, western pond turtle, giant garter snakes)?					x			x		
1.057	Bat surveys	What are status and trends in species richness of bats?					x					
1.058	benthic invertebrate: species richness and percent dominant species	What are the status and trends in benthic invertebrate communities indexes?					x					
1.059	Invertebrates: presence/absence of MSCS species in appropriate habitats (Valley Elderberry longhorn beetle, Delta green ground beetle)	Are MSCS invertebrate species present?					x					

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Freshwater & Riparian Habitat Sampling Sites Network (in addition to remote sensing monitoring) - continued												
1.060	Passerines, raptors, etc.: * Key indicator species indices of abundance or presence/absence including MSCS species (possibly Song sparrow, California Yellow warbler, Yellow-breasted chat, Common yellowthroat, Wilson's warbler, Warbling vireo, Swainson's thrush, Black-headed grosbeak, Bank swallow, Swainson's hawk, Western Yellow-billed cuckoo, American dipper, Least Bell's vireo, Little willow Flycatcher) * Native Species diversity, richness, evenness; * Presence and/or relative abundance of brown-headed cowbirds?	What are the status and trends in passerines and raptors in freshwater & riparian wetlands? Are cowbirds present? Are they present in high enough numbers to be a concern for native bird populations?	High				x		x	x		Point Reyes Bird Observatory / California Partners in Flight
1.061	Passerines: Reproductive success of selected key indicator species (possibly nesting successes, clutch size, nesting attempts per female); rate of nest parasitism by brown-headed cowbirds	What are the status and trends in passerines and raptors in freshwater & riparian wetlands? Is a lack of reproductive success contributing to a decline? Are brown-headed cowbirds significantly impacting native riparian bird reproductive success?					x		x			Point Reyes Bird Observatory / California Partners in Flight
1.062	Small mammals: * Native Species diversity, richness, evenness; * Key indicator species relative abundance or presence/absence including MSCS species (San Joaquin Valley Woodrat, Riparian Brush Rabbit)	What are status and trends in diversity and species richness of native small mammals in floodplain habitats? What are the status and trends of MSCS mammals in floodplain wetlands (San Joaquin Valley Woodrat, Riparian Brush Rabbit)? What non-native small mammals are present (Norway rats, etc.) and/or what is their relative abundance?					x			x		
1.063	Medium to large mammals: Surveys for predators and larger mammals	Are larger predators such as coyotes present? What is the activity level of non-indigenous predators such as cats and dogs and introduced foxes? Is the activity level of native predators such as **raccoons** & coyotes unnaturally high?					x					
1.064	Wading birds & shorebirds: Key indicator species indices of abundance or presence/absence including MSCS species	Are shorebirds and wading birds using floodplain and riparian habitats?					x		x			

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Freshwater & Riparian Habitat Sampling Sites Network (in addition to remote sensing monitoring) - continued												
1.065	Waterfowl: * Species richness * Key indicator species indices of abundance or presence/absence including MSCS species (Aleutian Canada goose)	Are waterfowl using floodplain and riparian habitats?	High				x		x			
1.066	MSCS plant species distribution & abundance	What MSCS plant species are present, what is their distribution and abundance in sampling sites network?	High				x					
1.067	Health of trapped individuals (evidence of disease, mutations, parasites, etc.) Unusual numbers of dead animals	Are unusually high levels of disease, deformities and level of parasites occurring in freshwater and riparian wetlands? Do new diseases appear to be negatively impacting populations?					x					
1.068	Vegetation community structure & composition - field surveys -percent cover, canopy gap fraction, tree species diameter at breast height, tree density, size class distribution, tree mortality, canopy height, shrub and vine species and basal area, percent herbaceous cover, species richness, species diversity, relative abundance of non-indigenous plant species, presence & distribution of targeted non-indigenous plant species, reporting of unidentified plants (3, 21)	What changes are occurring in vegetation structure, composition, and function? · What effects are non-indigenous plants having on the structure, composition and function of floodplain and riparian wetland vegetation? What are the status and trends in habitats of MSCS species?	High				x				x	
1.069	Non-indigenous plants: relative abundance of non-indigenous plant species, presence/absence of key non-indigenous plant species, reporting of unidentified plants	What are the status and trends in the relative abundance of non-indigenous plants in tidal wetlands & floodplain and riparian wetlands? What are the status and trends in distribution of key non-indigenous plant species? What new introduced plant species have been observed? What effects are non-indigenous plants having on the structure, composition and function of vegetation? Where and to what degree are non-indigenous plants impacting MSCS plant species?	High				x			x	x	
1.070	Non-indigenous species: Presence of bull-frogs and /or predatory fish	Are bull-frogs and predatory fish present in high enough numbers to impact native amphibians?					x					

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Freshwater & Riparian Habitat Sampling Sites Network (in addition to remote sensing monitoring) - continued												
1.071	Non-indigenous species: Presence of new non-indigenous fauna species such as the red-eared slider	Have new non-indigenous species become established?					x					
1.072	Changes in waterways/wetlands due to excessive siltation caused by infestation of nonnative plants -- may need to occur outside of floodplain sampling sites network, depending on where infestations occur.	Are non-native plants affecting sediment/silt deposition and consequently affecting waterways and habitats?					x				x	
1.073	Hydrology - Acreages of floodplain inundation duration, frequency, depth, and seasonality of woody riparian, freshwater marsh, seasonal wetlands, and associated upland habitats based on synthesis from detailed topography (both channel and floodplain) (1, 11))	What is the extent, frequency, duration, timing, and variability of floodplain inundation and its affect on floodplain habitats? Are floodplain hydrological & geomorphic processes creating a mosaic of vegetation communities and habitats?					x					
1.074	channel migration (bank erosion, sediment deposition	Is natural channel meander occurring and resulting in a natural succession of habitat types?					x					
1.075	areas, rates, locations, and textures of deposition and areas of erosion.	Is the sediment supply to floodplains sufficient and of the right texture to maintain the natural establishment and succession of vegetation?					x					
1.076	Channel cross-section change	Is natural channel meander occurring and resulting in a natural succession of habitat types?					x					
1.077	sediment accretion on floodplain	Is sediment supply sufficient to create a mosaic of habitat types in floodplains?					x					
1.078	site topography (background, covariate)	Important covariate for interpreting status and changes in vegetation communities					x					
1.079	Soil type, texture, soil profile (background)	Soil texture and composition can be an important covariate when interpreting status and changes in vegetation communities					x					
1.080	soil survey maps (background)	Soil texture and composition can be an important covariate when interpreting status and changes in vegetation communities					x					USDA-NRCS

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Freshwater & Riparian Habitat Sampling Sites Network (in addition to remote sensing monitoring) - continued												
1.081	seasonal depth to groundwater table (11) soil moisture levels laterally from banks (11)	What is the groundwater depth relative to the habitat type? Are decreases in groundwater levels causing impacts on floodplain vegetation? Are floodplain hydrological & geomorphic processes creating a mosaic of vegetation communities and habitats?					x					
1.082	Water Quality in rivers and tributaries -- suspended sediment, turbidity, Total dissolved solids, temperature, conductivity, Nutrients (nitrogen, phosphorous), temperature, pH	How do differences in water quality variables affect interpretations of differences in vegetation communities and biological communities, I.e. benthic invertebrates, etc.? (largely a covariate)					x					
1.083	Contaminants: Evidence of airborne pesticide drift	Are airborne herbicides and pesticides from nearby areas impacting native habitats and fauna?					x					
1.084	Disturbance: type of disturbance and impacts on vegetation	What land uses are impacting vegetation such as grazing, recreation, woodcutting, fires, herbicide drift?					x					
1.085	site history and age, anthropogenic disturbance, fires, extreme flood events (background)	Important background and covariate for interpreting status and changes in vegetation communities					x					
1.086	Floodplain & riparian: plant seedling establishment rate and species in new sediment deposits	Is natural channel meander occurring and resulting in a natural succession of habitat types?					x					
1.087	Passerines: Adult (and Juvenile) survivorship of passerines	What are the status and trends in survivorship? Is survivorship below levels needed to sustain the population?							x			
1.088	Passerines: Determine relationship between habitat attributes, migratory stopover use, and species survival	What is the relationship between habitat attributes, migratory stopover use, and species survival?							x			
1.089	Passerines: Relationship between herbaceous vegetation height and avian productivity and recruitment (RHJV,2000)	What is the relationship between herbaceous vegetation height and avian productivity and recruitment?							x			
1.090	Passerines: Reproduction success & survival rates, nest parasitism rates - nest searches, especially for Willow Flycatcher, Bell's Vireo, Warbling Vireo, Common Yellowthroat, Blue Grosbeak, Wilson's Warbler, Yellow Warbler (RHJV,2000)	What are the status and trends in reproductive success? Is reproductive success below levels needed to sustain the population? Where and to what degree is brown-headed cowbirds reducing reproductive success of open cup riparian birds?							x			PRBO

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	Aquatic Monitoring Program - Information Needs											
1.091	Hydrology * Magnitude, timing, and variability of flow in rivers at tributary mouths compared with historic natural hydrograph (14, 8, 11, 1) * Index of hydrologic alteration of rivers and tributaries * Delta Inflow * Outflow through Golden Gate * Water year, including drought & wet years * Occurrence of extreme flood events, capable of major changes in channel and river course (overlaps with monitoring above)	Are river and tributary flows magnitude, timing, and variability contributing to sustainability and natural succession of NCCP habitats? What changes in NCCP habitats were caused by extreme flood events and/or droughts? Are large flow events occurring frequently enough to cause large changes in channel migration and the associated diverse array of habitats associated with those changes? What are Sacramento river, San Joaquin River,and tributaries hydrographs compared with the natural hydrographs? Are flows sufficient to keep the Delta water fresh and Suisun Marsh water brackish? What is the hydrology (flow amount, velocity, stage, turbidity) relative to interpretation of other monitoring elements in tidal wetlands and freshwater and riparian wetlands? Hydrology is often an important covariate for interpretting other environmental variables and habitat changes in TAMP. How do changes in hydrology relate to changes in global weather patterns?	High		x	x	x			x	x	USGS, DWR, USBR stream and river gaging stations. Additional stations may be needed. TNC developing index of hydrologic alteration
1.092	Water Management Operation Structures: Flows, salinity levels resulting from water management operation structures in Delta and Suisun Marsh	What is relationship between water management structures and flows and salinity levels?				x						
1.093	Salinity: salinity measured along longitudinal axis in estuary - average, range, variability, seasonality, extremes	Are flows sufficient to keep the Delta water fresh and Suisun Marsh water brackish? What changes in vegetation communities are attributable to changes in average salinity or variability in salinity?			x	x						Network of sites monitoring salinity for compliance monitoring of "X2" in estuary relative to south Delta water exports
1.094	Sea level rise: relative sea level rise measured at fixed point in estuary (I.e. Golden Gate Bridge)	Is sea level rise changing the extent and distribution of vegetated marsh plain			x	x						NOAA has 4 stations
1.095	Sediment supply: Suspended sediment monitoring at channel gaging stations as part of aquatic monitoring program	How do current sediment accretion and erosion levels compare with historic levels? Is the sediment supply sufficient to maintain tidal wetlands relative to sea level rise?				x						

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Aquatic Monitoring Program - Information Needs - Continued												
1.096	Sediment supply: Location and quality of salmonid spawning habitat gravel	Are changes in sediment supply affecting the location and quality of salmonid spawning habitat as an indicator of sediment supply sufficient to maintain natural floodplain habitats?			x		x					IEP, see Aquatic Monitoring Program
1.097	Water Quality - pesticides, trace metals, suspended sediment, turbidity, total dissolved solids, dissolved oxygen, nutrients, pH, conductivity, temperature	Are water quality variables within normal variability? Are contaminants contributing to wildlife health problems? Is excessive nutrient loading in the system occurring?				x	x				x	CDWR-Environmental monitoring program; DWR-D1485 program; SFEI - Regional Monitoring Program for Trace Substances; SRWP; DWR-MWQI; USGS-Polaris; DWR-Operations & Compliance Monitoring
1.098	Contaminants -- Aquatic toxicity measures (fish tissue, benthic invertebrates communities, algal communities)	Are level of contaminants in water and sediment enough to cause toxicity problems in aquatic biota? In terrestrial biota?				x					x	DWR-D1485 Program; SFEI - Regional Monitoring Program for Trace Substances; SRWP
Other Information												
1.099	Climate: Weather, climate, precipitation, spring & summer temperatures, occurrence of el nino effects, droughts, floods,	How do weather, climate, etc. affect interpretation of changes in other variables such as changes in extent and distribution of habitats and changes in the relative abundance of plant and animal species?			x	x	x	x	x	x	x	National Weather Service - Rain Gage Stations; CDWR-California Irrigation Management Information System (CIMIS); USBR, USGS, College research facilities, airports, etc.
1.100	Crop type - acreage by county of wildlife friendly crops	What is the acreage in different counties of crops useful to waterfowl and sandhill cranes?						x				County records? CDWR-Statewide Planning (Crop types)
1.101	Outreach - Wildlife friendly agriculture: Some measure of education outreach efforts to local farmers and the amount of response	What is the attitude of the agricultural community towards implementing wildlife friendly agriculture practices? To what degree are they doing so? What effect has CALFED's program had on increasing the amount of wildlife friendly agriculture practices?						x				
1.102	Waterfowl harvest reports by species; catch per unit effort	What are the numbers and species of waterfowl harvested? What are the trends in catch per unit effort? (useful relative to ERP Goal 3, but not useful ecologically)	continue	Annual					x			CDFG; USFWS

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Programmatic - land use & protection												
1.103	Habitat protection-land use: Mapping of land ownership (by categories, not parcels) & protection status. Include conservation easements.	What areas of land are already have some protection status for habitats? What areas of land containing habitat and adjacent to habitats have some degree of protection from conversion to urbanization? When combined with species distribution information, to what extent are MSCS "R" and "r" species habitats protected?	High	Annual	x	x	x	x	x	x		DWR Northern District - SB 1086 Teale Data Center
1.104	Habitat-land use: Wildlife friendly agricultural practices: acreage by county in which management is engaging in wildlife-friendly agricultural practices that encourage greater sandhill cranes, waterfowl, giant garter snakes, or other species	What acreage of land is currently engaged in wildlife friendly agricultural practices? What acreage is not doing so that could with friendly incentives?		Annual				x				
1.105	Habitat protection-land use: Maps of planned future changes to land use or boundaries of planning efforts	Where is urbanization expected to impact ERP targeted habitats and associated buffers and corridors? Where are current HCP, county, and watershed group planning efforts targeting land acquisition and protection?	High		x							
1.106	Habitat Protection-MSCS Species: Proportion/extent of each "R" and "r" MSCS species habitat under some degree of protection status	What proportion of "R" and "r" species habitat has some degree of protection status and what kind?	High	1-3 years						x		
1.107	Habitat-land use: proportion/extent of tidal wetlands with a buffer zone of grassland and/or wetland habitat from other land uses (especially urban areas)	Where are tidal wetlands protected by buffer zones from land uses that degrade habitat quality?	High	3-5 years		x					x	
1.108	Management actions-habitat: Mapping of extent and location of land purchased or otherwise protected through CALFED actions	Where and how much land has received protection through CALFED actions?	High	Annual	x	x	x	x	x	x		

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	Programmatic - Non-indigenous Species											
1.109	Non-indigenous Species: Maintain information clearinghouse to report non-indigenous plants and fauna locations in region and provide basic information on such species and provide a central place to assist researchers to identify unknown species and report new immigrants	What are the status and trends in distribution of key non-indigenous plant species? What new introduced plant species have been observed in tidal wetlands? Also useful would be -- What basic information is available for these species? What control methodologies are available?	high			x	x				x	The Nature Conservancy http://tncweeds.ucdavis.edu/esadocs.html (natural history and control methods of non-native plants in natural habitat)
1.110	Management actions-NIS: Location and implementation status of actions to control non-native plants	Where are non-native plant control efforts occurring and what is their effectiveness?	High			x	x				x	CALWEED database (ICE)
1.111	Management actions-NIS: Effectiveness of control efforts in reducing non-native plant species threatening populations of Suisun thistle, Suisun Marsh aster, soft bird's beak, and Point Reyes bird's beak and other MSCS plant species.	Where are non-native plant control efforts effective in reducing threats to MSCS plant species?	High			x				x	x	
1.112	Management Actions-NIS: Effect of bullfrog removal on native anurans and reintroduction programs	Are bullfrog removal programs successful in restoring native anuran populations?							x			
	Programmatic - Habitat Restoration / Enhancement Project tracking & monitoring; including transplantation of MSCS species											
1.113	Management actions-habitat: Mapping, tracking, and monitoring restoration and enhancement projects	Where are habitat restoration and enhancement efforts occurring? What is their size and configuration? What is their implementation status? What is their effectiveness at achieving their stated goals? What is the quality of habitat and sustaining processes achieved at these sites? Are MSCS "R" and "r" plant and animal species colonizing restoration sites?	High		x	x	x	x	x	x	x	
1.114	Management actions-habitat: location and extent of floodplain restoration activities due to set-back levees, increase in available floodplain	Where and to what extent have levee set-back and restoration activities increased the effective extent of the floodplain? What changes in ERP/NCCP habitats are attributable to changes in flood management and land/levee erosion control activities?	High		x		x					

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Programmatic - Habitat Restoration / Enhancement Project tracking & monitoring; including transplantation of MSCS species - continued												
1.115	Management actions-habitat: Use of restored or enhanced habitat by passerines, waterfowl, wading birds, shorebirds, mammals Use of restored habitat by MSCS species	Are restored and enhance habitat sites being used by ERP biological communities and MSCS species?	High		x	x	x	x	x	x		
1.116	Management Actions-MSCS Species: Locations and degree of establishment success of population transplants for "R" and "r" species	Are actions to establish populations in new locations successful?	High							x		See Section 10
Programmatic - Other management Actions												
1.117	Management actions-sediment: Completion status of assessments and implementation status of gravel recruitment programs. Effectiveness of gravel recruitment programs in restoring sediment supplies?	Where are sediment supplies reduced due to human activities such as dams and gravel mining activities? How effective are CALFED actions in target tributaries in restoring gravel supplies that have been blocked by dams and levees?				x	x					
1.118	Management actions-sediment: location, implementation status and effectiveness of actions to restore coarse sediment supplies	Where are actions occurring to increase coarse sediment supplies such as small dam removal or moving gravel mining operations out of active stream channel? What is their implementation status and effectiveness at restoring coarse gravel supplies downstream?			x		x					
1.119	Management actions-contaminants: Location and Implementation status of CALFED actions to reduce pesticides and oxygen-reducing substances and effects of those actions in changing levels of oxygen-reducing substances and nutrients by unpermitted discharges and pesticides in areas targeted by CALFED actions (may or may not overlap with sampling sites network)	Where are efforts to reduce excessive nutrient loading occurring and what is the effect? How has the decrease in nutrient loading affected vegetation communities and aquatic species?				x					x	
1.120	Management actions-contaminants: location, implementation status and effectiveness of actions to reduce fine sediment loading	Where are actions occurring to decrease excessive fine sediment loading? What is their implementation status and effectiveness at reducing fine sediment loading downstream?			x		x				x	

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#	General Monitoring Elements	Monitoring Questions	Priority	Frequency	5.0 Large scale habitats & processes	6.0 Tidal Wetlands	7.0 Freshwater & Riparian Wetlands	8.0 Other Habitats	9.0 ERP Biological Communities	10.0 MSCS At-risk species	11.0 Non-native species, contaminants	Existing Program
Programmatic - Other management Actions - continued												
1.121	Redirected effects: Monitoring of Redirected effects of non-ERP projects such as changes in acreage of wetlands due to lining canals, or water conservation measures that reduce ponds or alkali meadows, or changes in riparian habitats due to dropping groundwater levels related to water transfers or changes in wetland sediment erosion and deposition due to alterations to hydrology and sediment balance [requires more targeted evaluation than present in this report]	What redirected effects on ERP habitats are occurring due to actions in the Water Supply Reliability problem area and ERP problem area? (Are decreasing groundwater levels impacting riparian habitats? Is habitat significant to MSCS species being lost due to lining of canals? Is wetland creation in subsided areas causing sediment sinks and causing sediment loss in other wetlands? Are hydrologic changes in the delta altering flows and sediment deposition and erosion in tidal wetlands?)			x	x	x	x				
	Programmatic - tracking of human activities & infrastructure											
1.122	Human activities / structures: Mapping of roads, highways, bridges, canals, water courses, levees	Where do roads, highways, canals, water courses limit connectivity and create mortality sinks for land-bound flora and fauna? Or create connectivity where it did not exist historically? This also provides basic planning information.			x	x	x		x			Teale Data Center
1.123	Human activities / structures: location & type of dams (large & small), location and size of gravel mining activities (tonnage removed), location of human activities such as timber harvest, poor grazing management, agricultural runoff contributing to fine sediment loading in rivers?	Where are dams and gravel mining activities decreasing coarse gravel sediment supplies in rivers and tributaries? Where are human activities causing excessive fine sediment loading?			x	x	x					
1.124	Human activities: Locations of discharges likely to affect water and sediment quality in tidal wetlands and freshwater & riparian wetlands; locations of animal feedlots contributing large nutrient loads into the watershed.	Where are dischargers located that could affect water and sediment quality in ERP habitats?				x						
1.125	Human Activities-Disturbance: Area subjected to mosquito control and invasive aquatic plant species control in the Bay-Delta. Area subjected to levee maintenance activities that influence tidal wetlands	Where are human activities occurring that cause increased disturbance in tidal wetlands?				x	x					

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Targeted Studies - Will CALFED actions (e.g. restoration) contribute to species recovery? How can actions in one program affect goals in another program (redirected effects)?												
1.126	Corridors -- Habitat movement corridors, especially for tidal wetlands and for floodplain & riparian wetlands: location and quality of movement corridors between habitat patches/blocks Use of corridors by various types of fauna	To what degree are various habitat blocks connected? Where do corridors exist? What fauna are using the corridors and how frequently? Do corridors provide movement connectivity for top-down predators? Genetic connectivity for small mammals and herpetofauna?										
1.127	Freshwater & Riparian habitat: location and effectiveness of bank-stabilization measures that do not require loss of habitat	Can alternate bank stabilization measure successfully control bank location in critical area without losing habitat?			x		x					Existing - CALFED funded research
1.128	Freshwater & Riparian habitat: map channel geology for erosion potential and geologic control (natural hard points)	Combined issue with levee system integrity program. Where is erosion most likely to be occurring?					x					
1.129	Freshwater & Riparian Habitats: acreages based on seasonal elevation difference between ground surface and average low-flow water surface in areas of woody riparian, freshwater marsh, and associated upland areas (1)	What is the seasonal elevation difference between ground surface and average low-flow water surface in areas of woody riparian, freshwater marsh and associated upland areas					x					
1.130	MSCS Species: Improve understanding of habitat-species relationships, especially for "R" and "r" species in order to determine which species can be reliably tracked via habitat extent and quality with occasional validation monitoring	How can the level of effort in monitoring be reduced for "R" and "r" species by using habitat monitoring as a surrogate? For what species is this feasible? For what species is this not feasible? What degree of validation monitoring must continue to take place?	High							x		
1.131	MSCS Species: Re-colonization rate of restored sites	Are “R” and “r” species colonizing restoration sites?	High							x		
1.132	Non-indigenous species: Changes in waterways/wetlands due to excessive siltation caused by infestation of nonnative plants -- may need to occur outside of floodplain sampling sites network, depending on where infestations occur.	Are non-native plants affecting sediment/silt deposition and consequently affecting waterways and habitats?					x				x	

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Targeted Studies - continued												
1.133	Non-indigenous species: Rate of spread of non-indigenous plants correlated with occurrence of El nino effects, droughts, floods	How do temperature, climate, floods, and droughts affect the rate of spread and changes in relative abundance of non-indigenous plants?				x					x	
1.134	Non-indigenous Species: Transport, mobility and spread of non-indigenous species	Targeted studies									x	
1.135	Redirected effects of restoring subsided sites: Targeted sampling of shoreline change and marsh plain elevation, accretion & erosion in existing wetlands near newly created wetland sites (may or may not be part of sampling sites network); projections of how much sediment will be required to fill in the subsided wetlands	Will flooding islands or diked areas to restore wetlands without restoring land elevations create sediment sinks which can affect other wetlands?				x						BREACH study
1.136	Salinity Change effect on vegetation: Surveys for changes in plant communities and/or sensitive plants at key sites for detecting change in response to increasing salinity levels (may or may not overlap with sampling sites network). Mason's lilaeopsis might be a sensitive plant species to changes in salinity levels and variability.	What changes are occurring in the extent and distribution of tidal saline, brackish, and freshwater wetland plant communities?				x						
1.137	Salinity: Research into lateral salinity gradients perpendicular from the longitudinal salinity gradient	What is the relationship between changes in the longitudinal salinity gradient up the estuary and latitudinal changes and changes in tidal wetlands?				x						
1.138	Tidal wetlands - sediment: Historical sediment accretion history from sediment cores along axis of estuary	How do current sediment accretion and erosion levels compare with historic levels? Is the sediment supply sufficient to maintain tidal wetlands relative to sea level rise?				x						
1.139	Tidal Wetlands: Mapping locations of areas where dikes and urbanization will inhibit the natural migration of wetlands inland with rising sea levels	Where will the inland migration of tidal wetlands be constrained due to existing dikes?				x						

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Targeted Studies - continued												
1.140	Water management operations: Surveys for changes in plant communities and/or sensitive plants at key sites in response to changes in water management structures (may or may not overlap with sampling sites network). Mason's lilaeopsis might be a sensitive plant species to changes in salinity levels and variability.	What is relationship between operations of water management structures and changes in distribution of plant communities and sensitive plant species?				x				x		
1.141	Wildlife friendly agricultural practices: validation monitoring and/or targeted research of association between agricultural practices and use by greater sandhill cranes, waterfowl, and giant garter snakes and any other targeted species	What agricultural practices best promote use of lands by targeted MSCS species and waterfowl?						x				