R2/ES-SE
2-21-95-F-216 April 30, 1997

Memorandum

TO: Regional Director, Bureau of Reclamation,
Lower Colorado Regional Office, Boulder City, NV

From: Regional Director

Subject: Biological and Conference Opinion on Lower Colorado River Operations and Maintenance - Lake Mead to Southerly International Boundary

The U.S. Fish and Wildlife Service (Service) has reviewed your request for consultation and its attached biological assessment (BA) entitled Description and Assessment of Operations, Maintenance, and Sensitive Species of the Lower Colorado River (USBR 1996). This operations and maintenance program occurs along the Lower Colorado River (LCR) through Nevada, Arizona, and California, from Lake Mead to the Southerly International Boundary with Mexico and is anticipated to be ongoing for a period up to five years from the date of issuance of the final biological and conference opinion. Your August 9, 1996, request was received on August 15, 1996. This document represents the Service's biological and conference opinion on the effects of that action on the following listed and proposed species: bonytail chub (*Gila elegans*), endangered, with critical habitat; razorback sucker (*Xyrauchen texanus*), endangered, with critical habitat; southwestern willow flycatcher (*Empidonax traillii extimus*), endangered; Yuma clapper rail (*Rallus longirostris yumanensis)*, endangered; and flat-tailed horned lizard (*Phrynosoma mcallii*), proposed threatened; in accordance with section 7 of the Endangered Species Act of 1973, as amended (ESA), (16 U.S.C. 1531 et seq.).

This biological and conference opinion is based on information provided in your August, 1996, BA; information supplements *via* memoranda detailed in the Consultation History, below; telephone conversations among several Bureau of Reclamation (Reclamation) and Service offices; meetings detailed in the Consultation History; field investigations; and other sources. A complete administrative record of this consultation is on file in this office. Literature cited in this opinion is not a complete bibliography of all literature available on the species of concern, river or reservoir management activities and effects, or on other subjects considered in this opinion. Our review of the literature was extensive; however, literature cited is limited to that necessary to document the effects of the proposed action.
<u>Memorandum</u>

It is the finding of the Service that the proposed action is not likely to jeopardize the continued existence of the proposed threatened flat-tailed horned lizard nor the endangered Yuma clapper rail. No critical habitat has been proposed for these two species, thus destruction or adverse modification of proposed critical habitat would not occur. Ten terms and conditions are described to reduce the amount of take of these two species.

It is the finding of the Service that the proposed action is likely to jeopardize the continued existence of the bonytail chub, razorback sucker, and southwestern willow flycatcher. No critical habitat has been proposed for the flycatcher in this area, so no destruction or adverse modification of its proposed critical habitat would occur. Both bonytail chub and razorback sucker have designated critical habitat on the Lower Colorado River and destruction or adverse modification of proposed critical habitat is likely to occur. A Reasonable and Prudent Alternative (RPA) with seventeen provisions is identified. Fourteen terms and conditions are described to reduce the amount of incidental take of these three species.

We appreciate Reclamation's strong interest in conservation of listed species and species of concern in the LCR ecosystem. For further information on this biological and conference opinion, please contact Tom Gatz or Ted Cordery at the Arizona Ecological Services Field Office, 602/640-2720. Please refer to the consultation number 2-21-95-F-216, in future correspondence concerning this project.

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Nancy M. Kaufman
Regional Director

BIOLOGICAL OPINION

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CONSULTATION HISTORY

On February 6, 1995, Service personnel met with Reclamation personnel at Boulder City, Nevada, to discuss development of a BA for operations and maintenance of the lower Colorado River. This began an informal consultation process. The target was to have a Final BA in November of 1995. In August of 1995 accelerated efforts of the Lower Colorado Multi-Species Conservation Program (MSCP), and a strategy to unite the section 7 consultation process and the section 10 processes of the ESA into one plan for the entire area, caused a slowing of the informal consultation process. Because of public uncertainty about the MSCP process, Reclamation continued preparation of the BA and published a public review draft in March, 1996, the same month that the two agencies executed a consultation agreement. The agreement set the stage for Reclamation's public review process for both the BA draft and the Biological Opinion (BO). The final BA was completed in August, 1996. The following chronology describes the remainder of the consultation history.

September 5, 1996	Memorandum from Reclamation with 1986 maps and mapping methods and vegetation changes along the lower Colorado River (LCR), Summary of 1996 Southwestern willow flycatcher surveys, Colorado River front work and levee system maps, and disc with BA text.
September 6, 1996	Meeting on BA and BO information needs.
September 25, 1996	Memorandum from Reclamation with title sheet and index for Colorado River front work and levee system, annual operating plan for 1996, and final report on Colorado River Floodway Protection Act, and Colorado River Floodway maps.
September 25, 1996	Meeting on BA and BO information needs.
October 4, 1996	Memorandum from the Arizona Ecological Services Field Office acknowledged receipt of Reclamation's formal consultation and conference request. The memorandum acknowledged that sufficient information was available to initiate formal consultation/conference and documented changes to Reclamation's effect determinations for the flat-tailed horned lizard and bald eagle. The memorandum also requested supplemental information and clarification on several items pertaining to southwestern willow flycatchers and Lake Mead.
October 16, 1996	Meeting on BA and BO information needs, discussion of possible jeopardy and/or adverse modification for three species. Discussion of some potential reasonable and prudent alternatives (RPA).
October 18, 1996	Reclamation presents Service with preliminary survey data on the southwestern willow flycatcher.
October 29, 1996	Memorandum from Reclamation with maps of the 5-mile zone and features like 242 well field.

November 4, 1996	Meeting on BA supplemental information and BO information needs. Discussion of potential RPA parts.
November 4, 1996	Memorandum from Reclamation with: description of determining annual surplus water, references on equalization between Mead and Powell, draft project description, summary table of flycatcher survey data, references on the Goodding willow community and willow inundation, report on revegetation on lower Colorado, Virgin River riparian study and field maps, biological investigation of the lower Virgin River, flycatcher results for lower Virgin River, Environmental report of the Virgin River, Fish and Wildlife Coordination Act report for lower Virgin River Water Quality Improvement Program, drawings of 242 well field, drainage channel, sludge area, and flat-tailed horned lizard habitat.
November 15, 1996	Memorandum from Reclamation with two tables, water depths at Lake Mead Delta, and southwestern willow flycatcher coordinates and other information.
November 18, 1996	Memorandum from Reclamation with preliminary bathymetric contour maps, Lake Mead Delta.
November 25, 1996	Meeting on BA and BO development, discussions of possible reasonable and prudent actions. Corrected acreages to match corrected vegetation maps in Technical Memorandum below and memorandum with explanation of bathymetric maps.
November 25, 1996	Memorandum from Reclamation with revised draft project description, complete set of bathymetric maps to replace those of November 18, GIS vegetation maps of the LCR, GIS maps overlaying southwestern willow flycatcher sites on vegetation maps, Technical Memorandum describing vegetation mapping methods, and satellite imagery of the LCR.
December 3, 1996	Meeting on BO development with continuing discussions regarding RPAs.
December 17, 1996	Meeting on BO development, with continuing discussions regarding RPAs.
December 18, 1996	Meeting on BO development with LCR Wildlife Refuges personnel and Reclamation regarding possible RPAs.
December 24, 1996	Conference call with Reclamation regarding the BO.
December 30, 1996	Memorandum signed by Regional Directors of the Service and Reclamation mailed to all LCR interested parties regarding timing of the Consultation Agreement.
January 22, 1997	Service sends rough internal draft BO to Reclamation.
February 4, 1997	Reclamation Memorandum to Service on lack of discretion in controlling water levels in Lake Mead. Meeting between Service and Reclamation on rough internal draft BO RPA and Incidental Take Statement.

February 21, 1997 Service sends internal draft BO to Reclamation.

March 4, 1997 Meeting between Service and Reclamation on RPA and Incidental Take Statement.

March 6, 1997 Service sends revised draft RPA and Incidental Take Statement to Reclamation.

April 29, 1997 Memorandum signed by Regional Directors of the Service and Reclamation regarding revisions to timing of the Consultation Agreement.

May 1, 1997 Service sends BO to Reclamation.

DESCRIPTION OF PROPOSED ACTION

Introduction

The following is a summary of the proposed action description in the document entitled *Description and Assessment of Operations, Maintenance, and Sensitive Species of the Lower Colorado River, August 1996, Final Biological Assessment Prepared for U.S. Fish and Wildlife Service and Lower Colorado River Multi-Species Conservation Program by U.S. Bureau of Reclamation, Lower Colorado Region* (hereinafter, the Biological Assessment, or BA). The full BA should be referenced for additional detail and explanation regarding the Proposed Action and the extent of Reclamation's discretion involved in it.

Scope of the Proposed Action

This biological and conference opinion (BO) addresses Reclamation's discretionary program of continuing operations of Lower Colorado River (LCR) dam facilities, maintenance of river control features, and other activities such as endangered species conservation for the next five years. **Table 1**, at the end of this section, summarizes the extent of Reclamation's discretion during this period. The geographic area of the proposed action is generally in the mainstream of the LCR and its 100-year floodplain from the upper end of Lake Mead at Pierce Ferry over a distance of 412 river miles to the Southerly International Boundary (SIB) with Mexico (**Fig. 1**). Additionally, some of Reclamation's facilities under consultation, such as the Senator Wash pump storage, the 242 wellfield, and ancillary facilities near Yuma, lie outside the 100-year floodplain.

The temporal scope of the proposed action, and of this BO, is for a period of up to five years from the date of issuance of this BO, which is projected to occur on or before May 15, 1997, or until the LCR long-term Multi-Species Conservation Program (MSCP) is developed, whichever comes first. The projected ending date for the consultation period is on or before May 15, 2002. Due to the complexity of issues involved, this time frame is necessary to formulate and begin to implement a comprehensive, effective MSCP, which will address broader and longer-term issues including, but extending beyond, those issues covered in this BO. The MSCP's development, and Reclamation's involvement in it, are integral parts of this proposed action. Under the "reinitiation of formal consultation" provisions of 50 CFR 402.16, Reclamation would need to reinitiate consultation on Reclamation's implementation of its portion of the MSCP (assuming the latter is developed) prior to the end of the five year period. Alternatively, if for some reason no MSCP is developed prior to the end of the five year period, Reclamation also would need to reinitiate consultation in order to continue its operations and maintenance program described herein.

Fig. 1. Detail of the Colorado River description area

Past and present human actions within, or that affect, the proposed action area are considered under the "Environmental Baseline" section of this BO. Several earlier Federal actions in or near the action area associated with water diversion and distribution facilities or related actions have undergone ESA review. These are discussed in the "Previous and Ongoing Section 7 Consultations" section as part of the environmental baseline. Projected future non-Federal actions that likely would occur within, or likely would affect, the action area in the next five years are considered under the "Cumulative Effects" sections. The following types of actions are outside the scope of this BO: 1) actions outside the action area if they do not have effects within the action area, 2) future actions within the action area that would be subject to ESA section 7 reviews, and 3) future non-Federal actions within the action area that are projected to occur after the five year consultation period for this BO.

Fig. 2 depicts the action area as defined for this consultation, generally within the 100 year floodplain of the Colorado River. Uses, facilities, and transport of water and power outside the action area generally fall in one of the following categories: 1) private uses beyond the realm of discretion or authority of Reclamation and under private or State authority where compliance with section 10(a)(1)(b) of the ESA is appropriate if threatened or endangered animals are affected, or 2) already consulted upon for threatened or endangered species (see the list of projects in the "Previous and Ongoing Section 7 Consultations" section of the "Environmental Baseline" section herein).

Effects of the uses depicted in **Fig. 2** on listed species outside the action area are not addressed in this consultation. They either have been addressed in other consultations, may require future consultations, or involve non-Federal actions. The uses are:

- Southern Nevada water uses of 0.285 million acre feet (maf) from Lake Mead (addressed in the consultation for the Southern Nevada Water system Facilities Improvement Project; the species involved was limited to the desert tortoise).
- Power uses to California, Nevada, and Arizona from Hoover Dam.
- Quarries used by Reclamation for maintenance of banklines and other features within the 100 year floodplain (consultation in progress; to be completed before this BO becomes final).
- The 0.015 maf used in Nevada from near Davis Dam.
- Power to Nevada, California, and Arizona from Davis Dam.
- Arizona water uses below Davis Dam.

Fig. 2. Schematic of water and power uses outside the lower Colorado River action area

- California water uses from Lake Havasu totaling 1.2 maf.
- Arizona water uses from Lake Havasu *via* the Central Arizona Project totaling 1.5 maf (addressed in previous consultations).
- Power to California and Arizona from Parker Dam.
- Municipal and irrigation water to California users between Parker Dam and the Northerly International Boundary (NIB) totaling 3.9 maf.
- Municipal and irrigation water uses to Arizona users between Parker Dam and the SIB totaling 1.3 maf.
- Mexico water uses of 1.5 maf.

Management of Colorado River water resources is a complex undertaking involving physical, biological, socioeconomic, and legal considerations. Management of the river is governed by an international treaty with Mexico and several official Minutes of meetings of the International Boundary and Water Commission (IBWC), two major interstate compacts, a Decree of the U.S. Supreme Court, various statutes, and contracts between the United States and water and power customers. These collectively are known as the "Law of the River" (**Table 2**). Reclamation serves as custodian for the Secretary of the Interior (Secretary) in his role as the Watermaster. Reclamation is obligated to deliver, when available, at least 9.0 maf of water annually to the lower basin states and Mexico. As Watermaster, the Secretary's three operational priorities are: 1) river regulation, improvement of navigation, and flood control, 2) irrigation and domestic uses, including the satisfaction of present perfected water rights, and 3) power generation. Through Article II of the 1964 U.S. Supreme Court Decree in *Arizona vs. California*, the United States and its officers, attorneys, agents, and employees are enjoined from operating its LCR facilities for purposes other than these three priorities. (Detailed descriptions of these facilities and related structures are provided in Appendix D of the BA.) Reclamation's routine operation and maintenance activities necessary to meet these requirements, and its discretion in carrying out these activities, are covered by this consultation.

In **Table 1**, at the end of this section, Reclamation acknowledges that in seven instances, it has "limited discretion" over certain operations and maintenance activities. What the precise limitations are, what agencies or groups have the remaining discretion, and how that discretion is exercised, remains unclear. The Service received a memorandum from the LCR Regional Director of Reclamation datdum clarified that "for all practical purposes and to all measurable effects" Reclamation lacks discretion over the management of [[[insert table 2]]]]

reservoir levels in Lake Mead.

Reclamation actions involving projects in the planning or implementation phase or that are mitigation for past projects may require additional section 7 consultation to address site-specific issues. Other activities not expressly included in the following description of the proposed action are not covered under this consultation, such as, but not limited to, changes in criteria for developing Annual Operating Plans or for declaring water surpluses (beyond the parameters in the description of the proposed action, below), new water contracts, new power production or transmission facilities, and changes in flood control regulations by the Army Corps of Engineers.

Actions

1. **Flood control**

Flood control operations have the first priority on the LCR as mandated by the Boulder Canyon Project Act. Section 7 of the Flood Control Act of 1944 established that the Secretary of War (now the Army Corps of Engineers [COE]) will prescribe regulations for flood control for projects authorized by that Act. The COE is responsible for developing the flood control operation plan for Hoover Dam and Lake Mead as indicated in 43 CFR 208.11. The plan is the result of a coordinated effort by the COE and Reclamation, but the COE is responsible for providing the flood control regulations and has authority for final approval. Any deviations from the flood control operating instructions must be authorized by the COE. The Secretary is responsible for operating Hoover Dam in accordance with these regulations; therefore, Reclamation has only limited discretion in managing Lake Mead elevations for flood control.

Flood control regulations promulgated by the COE for Lake Mead were established to deal with two distinct types of flooding: rain and snowmelt. Snowmelt constitutes about 70 percent of the annual runoff of the Colorado River into Lake Mead. Lake Mead's uppermost 1.5 maf of storage capacity, between elevations 1219.6 and 1229.0 mean sea level (msl), is allocated exclusively to control floods from rain events. Within this capacity allocation, 1.218 maf of flood storage is above elevation 1221.4, which is the top of the raised spillway gates.

Flood control regulations specify that once flood releases exceed 40,000 cubic feet per second (cfs), the releases shall be maintained at the highest rate until the reservoir drops to elevation 1221.4. Releases may then be gradually reduced to 40,000 cfs until the prescribed seasonal storage space is available. The flood control regulations set forth two primary criteria to deal with snowmelt: 1) preparatory reservoir space requirements, and 2) application of runoff forecasts to determine releases.

In preparation for the coming year's season of snow accumulation and associated runoff, progressive expansion of total Colorado River system reservoir space is required during the latter half of each year. Minimum available flood control space increases from 1.5 maf on August 1 to 5.35 maf on January 1. Required flood storage space can be located within Lake Mead and in specified upstream projects: Lakes Powell and Navajo, and Blue Mesa, Flaming Gorge and Fontenelle Reservoirs. Minimum Lake Mead space required for exclusive flood control is 1.5 maf.

Releases from Lake Mead are initially scheduled by taking the scheduled consumptive use downstream of Hoover Dam, adding any additional volume of water required to meet reservoir target storage levels for Lake Mohave and Lake Havasu, and subtracting the net volume of gains and losses for the month for all reaches of the system downstream of Hoover Dam. Releases in excess of the initial release schedule can be caused by either: 1) Lake Mead exceeding maximum capacity or target storage levels; 2) excess releases scheduled to avoid spills; or, 3) releases dictated by flood control requirements. Reclamation is not consulting on COE's existing flood control regulations for Lake Mead.

The COE is not responsible for the flood control criteria related to Davis Dam and Parker Dam, although the lake elevations behind these dams are affected by flood control releases from Hoover Dam. Releases through Davis and Parker Dams for flood control fall within the Secretary's discretion and are managed by Reclamation. Therefore, Reclamation is consulting on flood control operations at Parker and Davis Dams. Lake Havasu's elevations corresponding to Reclamation's discretion over flood control are depicted in **Fig. 3**. Although not anticipated to occur within the five-year time frame of this consultation, flood control releases are made if reservoir elevations exceed those depicted by the dashed line (450.5 ft), labeled "flood control". At Lake Mohave, the reservoir elevation is adjusted monthly to accommodate potential side-channel inflow, as shown in **Fig. 4**. For example, the decreasing target elevation for Lake Mohave during June to October corresponds to the period of greatest likelihood of side-channel inflow. Superimposed on these flood-control elevations are the elevations desired for raising and transplanting razorback suckers, also described under the "Endangered Species Conservation Activities" section in this document and on pages 61-62 of the BA.

2. Storage and Delivery of Entitlement Waters

a. Equalizing Lakes Powell and Mead

Articles II(3) and II(4) of the *Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs* (Operating Criteria)(developed pursuant to the Colorado River Basin Project Act of 1968, Public Law 90-537) specify that "If, in the plan of operation, the Upper Basin Storage Reservoirs' active storage forecast for September 30 of the current water year is greater than the quantity of 602(a) [of the Act] storage determination for that date, water shall be released annually from Lake Powell at a rate greater than 8.23 maf per year to the extent necessary . . . to maintain, as nearly as practicable, active storage in Lake Mead equal to the active storage in Lake Powell." Furthermore, the annual release made for equalization purposes ". . . will be made to the extent

[[[insert Fig. 3. Lake Havasu operational constraints, landscape

[[[insert Fig. 4. Lake Mohave operational constraints, landscape]]

that it can be passed through Glen Canyon Power plant when operated at the available capability of the powerplant. Any water thus retained in Lake Powell to avoid bypass of water at the Glen Canyon Powerplant will be released through Glen Canyon Powerplant as soon as practicable to equalize the active storage in Lake Powell and Lake Mead."

Reservoir equalization scheduling is assisted by computer modeling simulation with the following steps. First, the model computes the quantity of 602(a) storage required by the criteria. Next, the model predicts the End Of Water Year (EOWY) contents of Lake Powell, Lake Mead, and the sum of Upper Basin reservoirs. Next, the model makes two checks to see if the reservoirs should be equalized: 1) if the sum of Upper Basin reservoir contents is greater than the 602(a) storage quantity, and 2) if the predicted EOWY contents of Lake Powell are greater than the predicted EOWY contents of Lake Mead; then the contents of Lake Powell and Lake Mead are equalized by releasing water through Glen Canyon Dam.

b. Interstate and international waters

Fig. 2, above, and **Fig. 5** illustrate the LCR water that is released and diverted yearly. Based on the Law of the River, entitlements to the beneficial use of Colorado River water in the lower basin have been established in the following four ways.

- Court decrees for 4,156,847 acre-feet which includes the water rights perfected by the States (which existed prior to the effective date of the Boulder Canyon Project), Indian reservations water entitlements, and other Federal entitlements listed in the Court decrees.

- Secretarial reservations for Federal uses, such as the Bureau of Land Management, Fish and Wildlife Service, and Reclamation.

- Contractual entitlements under section 5 of the Boulder Canyon Project Act.

- The International Treaty with Mexico for 1.5 maf.

The 1964 United States Supreme Court Decree in *Arizona vs. California*, in Article II, states "The United States, its officers, attorneys, agents and employees are hereby severally enjoined from releasing water controlled by the United States for irrigation and domestic use in the States of Arizona, California and Nevada, except as follows:

[[[insert **Fig. 5. Side-view schematic of LCR from Pierce Ferry to SIB, landscape]]**

> (1) If sufficient mainstream water is available for release, as determined by the Secretary of the Interior, to satisfy 7,500,000 acre-feet of annual consumptive use in the aforesaid three states, then of such 7,500,000 acre-feet of consumptive use, there shall be apportioned 2,800,000 acre-feet for use in Arizona, 4,400,000 acre-feet for use in California, and 300,000 acre-feet for use in Nevada; and
>
> (2) If sufficient mainstream water is available for release, as determined by the Secretary of the Interior, to satisfy annual consumptive use in the aforesaid states in excess of 7,500,000 acre-feet, such excess consumptive use is surplus, and 50% thereof shall be apportioned for use in Arizona and 50% for use in California; provided, however, that if the United States so contracts with Nevada, then 46% of such surplus shall be apportioned for use in Arizona and 4% for use in Nevada;" Surplus declarations are described more fully under "Annual Operating Plan", below.

Similarly, if a State will not use all of its apportioned water for the year, the Secretary may allow the other States to use the unused apportionment in that year. The unused apportionment water can be used when declared available by the Secretary; the use must be provided for by a contract with the Secretary and must be considered a beneficial use. Beneficial use is described as all uses of Colorado River water which are: (1) for non-Federal entitlement holders, consistent with relevant State law, or as otherwise permitted by the Secretary; (2) for non-Indian Federal entitlement holders, consistent with decreed entitlements, applicable contracts, administrative reservations of water entitlements, or the purposes for which the reservations were created; and (3) for Indian Federal entitlement holders, consistent with relevant Federal and tribal laws.

The Secretary is responsible for managing the lower basin and for providing for the delivery of Colorado River water entitlements to entitlement holders. When an entitlement holder schedules water in a normal year or surplus year, the Secretary has no option but to deliver the water as prescribed by law and contract in the amounts and at the times requested, so long as it does not exceed that reasonably required for beneficial consumptive use. Deliveries of Colorado River water will not exceed those reasonably required for beneficial use, however, the Regional Director of Reclamation's Lower Colorado Region, on behalf of the Secretary, may make annual determinations as to whether beneficial use requirements are being met. In this regard, Reclamation has discretion regarding:

- determining which water contractors will be consulted (may exclude contractors and permittees of small quantities of water and contractors for municipal and industrial water);
- determining if water orders are, or are not, within that reasonably required for beneficial use; and,
- determining the amount that water orders are reduced to reasonably meet beneficial use requirements.

Although the Secretary may have limited discretion over such determinations as non-use, non-beneficial use, or water conservation, the Secretary has no effective meaningful discretion over meeting an entitlement holder's valid request for water for beneficial use. Other than the beneficial-use determinations outlined above, the discretionary actions associated with the use of Colorado River water relate to non-consumptive water uses for which Reclamation is not prohibited by law. For example, such non-consumptive uses could include recreation on the reservoirs and the Colorado River, increased flushing flows at Topock Marsh, and fish habitat within or adjacent to the mainstream of the Colorado River. If any of the activities would have a consumptive use, the party responsible for the use would have to acquire a water entitlement to account for the water consumptively used as required by the Court decree.

c. Annual Operating Plan

Each year, Reclamation consults with the lower basin States, the Indian Tribes, and Colorado River water users regarding water conservation and the use of Colorado River water. Reclamation's authority for such activities is found in section 602 of the Colorado River Basin Project Act. Reclamation also may review specific uses under 43 CFR 417 which provides the authority for Reclamation to conduct consultations with each public or private organization that is entitled to Colorado River water. Water users are contacted by Reclamation to discuss water needs and are requested to furnish monthly estimates for the upcoming year. The purposes of the consultations are to make annual recommendations relating to water conservation measures and operating practices in the use of Colorado River water and to determine if estimated water requirements for the next year will exceed reasonable beneficial use.

All of the information gathered is used to develop an Annual Operating Plan (AOP) as required by the Colorado River Basin Project Act, after taking into consideration probable runoff, depletions, and consumptive uses. The AOP is formulated for the upcoming year under a variety of possible conditions. The plan is developed based on projected requirements, existing storage conditions, and probable inflows. It is prepared by Reclamation, acting on behalf of the Secretary, in cooperation with the seven basin States (CA, AZ, NV, NM, UT, CO, and WY), other Federal agencies, Indian tribes, State and local agencies, and the general public, including environmental interests.

The AOP is designed to govern the general operation of the river system on a seasonal and annual basis and specifies, as an objective, the minimum amount of water to be released from Lake Powell through Glen Canyon Dam for the year. The AOP determines whether demands will be met according to shortage, surplus, or normal water year supply conditions. A forecast of water supply, reported water use to date, and projected water use for the year is produced monthly as the information becomes available to Reclamation. The forecarequest.

d. Declaration of surplus

In accordance with the Operating Criteria, discussed above, the Secretary shall determine from time to time when mainstream water in quantities greater than "normal" is available for either pumping or release from Lake Mead pursuant to Article II(b)(2) of the Supreme Court Decree in *Arizona v. California*, where "normal" is the quantity required to satisfy 7.5 maf of consumptive use. Consumptive use in excess of 7.5 maf is defined as "surplus." Some of the relevant factors to be considered in making such a determination include current and projected contents of Lake Mead and Upper Basin Reservoirs, the estimated inflow to Lake Mead, and the requests for water by holders of mainstream water rights in the United States.

A "surplus" condition for a calendar year, if warranted, will be made after consideration of all relevant factors in the Operating Criteria, and after consultation with the Basin States and other interested parties. Generally, a surplus will be declared when there is a high probability that flood control releases will occur, so that water otherwise wasted may be beneficially used. It is highly likely that this will occur within the next five years, therefore, Reclamation is consulting on this likelihood.

e. Fulfilling water orders

Under normal operating conditions, Reclamation's Yuma Area Office (YAK) receives daily water orders for those water entitlement holders within the United States and Mexico below Parker Dam. Water orders are totaled and submitted to Hoover Dam personnel who then coordinate releases to meet downstream water demand and power demands from Parker, Davis, and Hoover Dams.

Mexico submits a daily water order each Wednesday, to cover the following week, through IBWC at Yuma; however, Mexico cannot change its daily water order once it is received, except in the case of an emergency. United States water entitlement holders below Parker Dam also furnish their water orders to YAK each Wednesday; however, United States water entitlement holders may modify their master schedule of water orders at least 3 days in advance of water releases from Parker Dam, and they may also vary from their master schedule on a daily basis if necessary. Release requirements from Parker Dam are equal to the water required by Mexico and United States users downstream of Parker Dam and system losses resulting from transporting the water from Parker Dam to Imperial Dam.

When either more or less water than needed by United States entitlement holders arrives at Imperial Dam, storage behind Imperial Dam, Laguna Dam, and Senator Wash Dam is utilized to attempt to regulate incoming Colorado River flows in order to meet actual water demand and prevent over deliveries of water to Mexico. Regulating flows involve either pumping water into storage if more water arrives than is demanded, or releasing water into the river when there is not enough to meet demands. Changes to water demand may result from a change in weather (rainfall, frost warnings, wind, high temperatures, cooler temperatures, etc.), holidays, or structural failure of an irrigation facility.

f. Water releases and power production

The release of water through Davis and Parker Dams is subject to water orders, need to manage flood waters, and hydropower obligations. The authorizing legislation for Parker and Davis Dams required the generation of power and granted exclusive rights of the facility's power capacity and energy to priority-use power customers. Priority-use power customers are customers who were the first project power recipients after the project was complete; this entitlement is held in perpetuity. "Capacity" in this usage means the electrical generating capacity of on-line generator units, whether or not they are actually producing power at any specific time. The capacity and energy utilized by the Parker-Davis electric service customers is termed "firm electric service power." The users have firm capacity and firm energy contracts with the United States which are in effect until midnight, mountain standard time, September 30, 2008.

Each Parker-Davis electric service contract contains essentially the same language. As an example, subsection 5.1 of Contract No. 87-BCA-10108 with Yuma Irrigation District is entitled "Western's [Western Area Power Authority] Energy and Capacity Obligations." Paragraph 5.1.1 of that subsection states in pertinent part: "The Contract Rate of Delivery [CROD] will be available in any hour within the billing period." This means that if the "firm" electric service customer requests a capacity within its minimum seasonal CROD, at any hour, and water is available to supply that capacity, the United States is obligated to make the power resource available (that is, put the generator units on-line and release the water through them).

The scheduling and subsequent release of water through Davis and Parker Dams affect daily fluctuations in river flows, depths, and water surface elevations downstream of these structures. Typical seasonal flow patterns are illustrated for representative gauging locations on the LCR (**Figs. 6 through 10**). (The location of the representative gauging stations are shown in **Fig. 5**, above; their names and distance, in miles, from the SIB are: Davis Dam, 275.4; Parker Dam, 192.2; Water Wheel, 152; Taylor Ferry, 106.6; and below Cibola Valley, 87.3. Typical seasonal flows, in cfs, and water surface elevations, in feet msl, are shown for each of the five stations.)

Figs. 6 and **7** demonstrate that the water surface elevation fluctuates most noticeably in the river reaches closest to the dams. The magnitude of the fluctuations diminish as the distance downstream increases, as shown in **Figs. 9** and **10**. The Mohave Valley and Parker Divisions of the river are most affected by fluctuations on a daily basis. The Imperial, Laguna and Yuma Divisions are the least affected, being farther downstream from the dams. The river fluctuates seasonally with the highest water levels occurring during the summer and the lowest water levels [[[insert **Fig. 6. Typical season flow of Colorado River below Davis Dam** landscape]]] [[[insert **Fig. 7. Typical spring flows on Colorado River below Parker Dam** landscape]]]

[[[insert **Fig. 8. Typical summer flows on Colorado River below Parker Dam**
landscape]]]

[[[insert **Fig. 9. Typical fall flows on Colorado River below Parker Dam** landscape]]] [[[insert **Fig. 10. Typical winter flows on Colorado River below Parker Dam** landscape]]] occurring during the late fall and winter, except during flood releases. Variations in water depths are illustrated for representative stations in Appendix E of the BA.

Flows arriving at Imperial Dam normally range from a high of) to a low of about 2,500 cfs (which usually only occurs after a heavy local rainfall over the entire area below Imperial Dam, usually November or December, and when water entitlement holders are not taking water). Mexico's water order has to be delivered regardless of excess rainfall.

Flows below Laguna Dam usually range between 300 and 500 cfs. Occasionally flows may range up to 4,000 cfs or higher if a heavy rainfall has occurred. Flows below Imperial Dam into the Colorado River Channel (California Sluiceway) normally range from about 250 cfs to about 350 cfs and are made up principally of return flows from the All-American desilting basins and gate leakage from the California sluiceway gates at Imperial Dam.

Sluicing flows are released to remove sediment accumulated from the desilting basins in the sluiceway channel. These sluicing flows usually occur 2 to 3 times a month and consist of flows ranging from 8,000 to 10,000 cfs which are released for periods of about 20 minutes. These flows carry sediment to the Laguna Desilting Basin located about 2 miles downstream from Imperial Dam.

Normal operational variances in elevation at Imperial Dam are from 180 feet to 180.9 feet msl. The top of the spillway at Imperial Dam is approximately 181 feet; this elevation is seldom exceeded. If water demand exceeds flows arriving at Imperial Dam for extended periods, the elevation behind Imperial Dam may, on very rare occasions (1 to 3 times per year), be drawn down to elevation 178.5 feet. Elevations are returned to normal within 3 days, the amount of time required for water to travel from Parker Dam. Elevations of the reservoir above Imperial Dam continuously fluctuate, to some degree, from day to day and during the day. Fluctuations are due to variability in the flows arriving at the dam and water entitlement holders' demand changes.

Normal operational variances in elevation at Laguna Dam are from 138 feet to 151.3 feet msl. The top of the spillway at Laguna Dam is elevation 151.3 feet msl. The maximum elevation is met a few times a year when the storage is used to prevent or reduce over deliveries to Mexico. The lower elevations occur when it is necessary to use the water stored in Laguna Reservoir to meet Mexico's water order. This normally occurs when water demand has increased after releases have already been made from Parker Dam and the water supply is reduced. Elevations behind Laguna Dam continuously change due to the changing water demand at Imperial Dam.

Normal operational variances in elevation at Senator Wash reservoir are from 210 feet to 240 feet msl. The reservoir is currently on an elevation restriction at 240 feet msl for safety concerns regarding seepage above that level. tion restriction of 240 feet msl, the normal range in elevation was from 210 feet to 251 feet msl (the top of the spillway). Several potential repairs for Senator Wash that could allow full utilization of its storage capacity are under current review, but it will be a number of years before repairs can be accomplished. The reservoir elevation is continually fluctuating because Senator Wash is used to regulate flows arriving at Imperial Dam.

3. Water Deliveries to Mexico

Mexico is entitled to receive a total of 1.5 maf of water delivered at the NIB and SIB each year - of which at least 1.36 maf are to be delivered via the Colorado River (normally consisting of releases from Colorado River system storage and drainage returns) to the NIB. Up to 140,000 acre-feet of Colorado River water (normally consisting of drainage returns and wasteway flows) can be delivered at the SIB. In the event of a declared shortage, water deliveries to Mexico would be reduced in the same proportion as consumptive uses in the United States are reduced.

In December of each year, Mexico provides the United States with an advance monthly water order for the following year. This water order can only be changed by providing the United States 30 days' advance notice, and each monthly water order can be increased or decreased by no more than 20 percent of the original monthly water order. The treaty further stipulates that Mexico's total water order must be no less than 900 cfs and no more than 5,500 cfs during the months of January, February, October, November, and December. During the remainder of the year, Mexico's water order must be no less than 1,500 cfs and no more than 5,500 cfs. Daily water orders are usually not allowed to increase or decrease by more than 500 cfs.

4. Power Operations

Each of the major LCR hydroelectric facilities have legislative authorization for the production of electric power. Reclamation is the Federal agency authorized to produce this power. Water is released from Hoover Dam (approximate elevation 1,200 msl) through a combination of 19 dedicated generator pipes into Lake Mohave (approximately 640 feet in elevation). Water is then released through Davis Dam through a combination of five dedicated generator pipes into Lake Havasu (approximate elevation 448 feet). Since Parker Dam is the last major United States-owned, Reclamation-administered, hydroelectric facility on the LCR and there is no other significant downstream storage, all releases scheduled from Parker Dam are in response to downstream water orders or reservoir regulation requirements.

Although Reclamation is the Federal agency authorized to produce this power, Western Area Power Administration (WAPA) is the Federal agency authorized to market this power. WAPA enters into electric service contracts on behalf of the United States with private and municipal entities. Reclamation is obligated to meet the Hoover, Parker, and Davis Dams' power generation schedules which are produced by WAPA in accordance with existing electric service contracts, subject to water availability. The released water generates power, but water is not released for the sole purpose of generating power. Reclamation has the discretion to ask the electrical service customers to renegotiate their contracts, but the United States could be responsible for direct financial reimbursement to customers if contractual obligations are not met. (The analysis here assumes that the Secretary will abide by all existing contractual obligations and will not act unilaterally to void such arrangements.) Additionally, the Secretary is obligated to fulfill the provisions of applicable Federal regulations, such as operational requirements set forth in 43 CFR Part 431.

5. Channel Maintenance and Levee System

The Colorado River Front Work and Levee System (CRFWLS) Act of 1946 (as amended) provides that for the purposes of controlling floods, improving navigation, and improving the flow of the Colorado River, Reclamation will (i) operate and maintain the CRFWLS in Arizona, Nevada and California, (ii) construct, improve, extend, operate and maintain protection and drainage works and systems, (iii) control the river, and improve, modify, straighten, and rectify its channel, and (iv) conduct related investigations and studies in connection.

Although these directions and responsibilities are relatively explicit as to what must be done, the details of the works, and the "how" and "when" parameters, are left to the discretion of the Secretary and Reclamation. The channel maintenance and levee system processes are considered discretionary for the Secretary and are covered within this assessment and consultation.

The routine maintenance on existing stabilized banklines consists of placing riprap on bankline areas where the existing riprap has eroded or otherwise needs repair. Other routine maintenance involving riprap includes repair of jetties and training structures. Again, this repair consists of replacing riprap where it has eroded or otherwise needs replacing. Some riprap is needed occasionally for repair of levee armoring.

Associated with the maintenance of the banklines, levees, and river control structures is maintenance of access and bankline roads. Roads are maintained on the levees and adjacent areas to stabilize banklines. The maintenance is routine road repair required for gravel roads. While these roads are also used by the public for various reasons, the roads are maintained for operation and maintenance of Reclamation project facilities and are not maintained up to public road standards. Reclamation anticipates that up to 80,000 cubic yards of rock and gravel will be needed to maintain the CRFWLS facilities on a yearly basis.

Except during an emergency, no new constructe period of this consultation for channel and levee maintenance.

6. Dredging

Reclamation routinely dredges two types of areas: sedimentation basins and headworks. Reclamation maintains two dredging basins - the Topock Dredge Basin located near Needles, California, and the Laguna Dredge Basin, located between Imperial and Laguna Dams. In addition, Reclamation routinely dredges material from the headworks of the All-American Canal and the Gila Gravity Main Canal at Imperial Reservoir. These dredging operations are confined to the areas mentioned above. The dredging uses a hydraulic dredge, and the material is deposited on spoil areas proximate to the dredging basins. In the case of the headworks of the All-American Canal and the Gila Gravity Main Canal, the dredged material is deposited into the California Sluiceway below Imperial Dam and sluiced to the Laguna Dredge Basin for removal.

7. Yuma Desalting Plant

Minute 242 defines the salinity requirements of Colorado River water delivered to Mexico. A salinity monitoring program is conducted at points below Parker Dam to the NIB. Computations are made projecting the annual salinity requirements from these data. If necessary, actions are taken to reduce salinity, such as reducing drainage pumping, or operating the Yuma Desalting Plant (YDP). Operating the YDP for salinity control is not expected to occur within the next five years.

The BA addresses discretionary one-third operation of the YDP. Discretionary operation of the YDP at one-third capacity may occur to market approximately 26,200 acre-feet of the 110,000-132,000 acre-feet of water currently discharged annually to the Cienega de Santa Clara, a marsh complex located in Sonora, Mexico, near the Sea of Cortez. The one-third operation is addressed programmatically in the BA, because a specific plan and agreement for marketing the desalinated water have not been completed at this time. Reclamation will initiate a new consultation if and when a specific marketing proposal is quantified.

8. 5-Mile Zone

The 5-mile zone is a 36,000-acre area 10 miles south of Yuma, Arizona, containing Reclamation-acquired and other lands needed to construct, operate, and maintain a well field providing water to Mexico in partial fulfillment of the 1944 Treaty with Mexico and as required by Title I of the Salinity Control Act. Reclamation's discretionary activities in the zone are limited to maintaining the 21 wells in the well field, ingress and egress routes, the associated delivery canal, and the YDP sludge disposal site.

9. Endangered Species Conservation Activities

Reclamation has discretion in conducting the types of activities that are beneficial to threatened and endangered species under section 7(a)(1) of the ESA. Under the ESA, Reclamation and other Federal agencies are permitted to:

> "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species listed pursuant to section 4 of this Act".

In addition to aiding the recovery of listed species, Reclamation's endangered species program also has, as an objective, the conservation of non-listed species of concern to prevent their future listing. Specific programs are described below.

a. Endangered bonytail chub and razorback sucker conservation

Reclamation has an active program for the conservation and recovery of endangered razorback suckers and bonytail chub. The specific immediate needs, as determined by Reclamation working in concert with the Biological Subcommittee of the LCR MSCP and other fisheries biologists, for razorback sucker and bonytail are summarized as follows:

- Razorback Sucker (by year 2000)
  add 50,000 adults to Lake Mohave
  add 25,000 adults to Lake Havasu

- Bonytail Chub (by year 2005)
  add 25,000 adults to Lake Mohave
  add 25,000 adults to Lake Havasu

As part of this effort, the ad hoc Native Fish Work Group (NFWG) on Lake Mohave was formed in 1989 to replace the aging population of adult razorback suckers resident to Lake Mohave. Replacing the sunset population of razorback suckers with immature fish spawned by Lake Mohave's wild population will help maintain the population's genetic diversity and viability. The founding members of the NFWG include Reclamation, the Service, Nevada Division of Wildlife (NDOW), Arizona Game and Fish Department, National Park Service, and Arizona State University. (Further discussion of how these efforts relate to other projects are found in the Environmental Baseline and Status of the Species sections, below, for the two fish.)

In terms of accomplishing the goals, as specified above for each fish and lake, Reclamation has committed to fund and provide other necessary resources to accomplish at least half of such goals.

Specific methods to effect such numbers are described below:

i. Willow Beach National Fish Hatchery (WBNFH)

Since 1994, Reclamation has been working with the Service at WBNFH to retrofit portions of this cold water facility in order to rear native warm-water fishes. In 1994, Reclamation engineers designed and installed heating systems for the hatch house for initial rearing of eggs and larvae. Approximately 8,000 young razorback suckers were produced and reared for stocking into rearing ponds at Lake Havasu. In 1995, the first of six paired outside raceways received solar-heated water in a closed circuit loop, providing a warm water rearing area for razorback suckers and bonytail chub. In 1996 and 1997, five more raceway units will be developed. Reclamation is also providing funds and staff for feeding and maintaining the fishes in these modified facilities. Reclamation is committed to this cooperative program with the Service to develop warm water rearing capabilities at Willow Beach that will assist in achieving the goals for the two endangered fish described above.

ii. HAVFISH project

Reclamation is an active partner of the multi-agency Lake Havasu Fishery Improvement Project, HAVFISH. One of the objectives of this multi-agency program is to release 25,000 razorback suckers and 25,000 bonytail chub into Lake Havasu over the next ten years.

iii. Boulder City Golf Course native fish rearing project

Reclamation and NDOW signed an interagency agreement with the City of Boulder City, Nevada, to use the ponds at Boulder City Golf Course for rearing of native fishes. During 1994 the first lake on the course was drained and a new liner and aeration system were installed. In October 1994 approximately 1,400 juvenile razorback suckers (3-4 inches total length) were stocked into the pond. During 1995, over 400 of these suckers reached the target length of 10 inches and were stocked into Lake Mohave. During the 1996 spring spawning period, at least five of these tagged fish were captured and re-released during monitoring efforts in Lake Mohave. This program is expanding with the development of three more ponds on the golf course, one each in 1996, 1997, and 1998.

iv. Hualapai native fish rearing facility

Reclamation is providing technical and financial support to the Hualapai Tribe in northern Arizona for the potential development of a prototype native fish rearing facility. This facility may raise razorback suckers, bonytail chub, humpback chub and other native fish for reintroduction into the Colorado River and its tributaries, within Grand Canyon, and on tribal lands. The assessment of this potential project began in 1992 and is expected to continue.

b. Native riparian plant restoration

Reclamation is committed to maintaining and expanding the cooperative native riparian plant restoration programs initiated along the LCR. These partnership activities include the establishment of native plant nurseries, demonstration plantings, enhancement projects, and research. Reclamation will commit at least $100,000 per year for the five year period covered by this consultation for native riparian plant restoration. In its resource management agreement with the Service, Reclamation is ready to implement portions of native habitat restoration proposals identified for the Service's four National Wildlife Refuges located along the LCR.

c. Three-Finger Lake project

In 1993, Reclamation and the Service began a cooperative project to restore Three-Finger Lake (**Fig. 11**). Approximately 120 acres of channels and shallow backwater areas, plus one 20-acre native fish rearing pond, were dredged in 1995. The final phases of this project, including construction of the water intake system, the construction of protective levees and bankline structures, and the planting of native riparian vegetation will be completed by spring of 1997. The total of this cost-share project will be approximately $4 million. Reclamation is prepared to work with the Service and others in developing cells within the restored lake for the rearing and natural recruitment of the two endangered fish.

d. Lower Imperial Division wetland enhancement

This project will restore and maintain streamflow of sufficient quality and quantity to enhance and assist in recovering and protecting riparian, wetland, and aquatic habitats for fish and wildlife, including ESA-listed species associated with such habitat. The proposed area covers 30 miles of the LCR from Imperial Dam, 25 miles north of Yuma, to the northern boundary of Imperial National Wildlife Refuge and includes approximately 6,100 acres of riparian woodland, wetlands, and 150 backwater lakes. To help fund the restoration, Reclamation has received a $580,000 grant from the Arizona Water Protection Fund. The project has been presented at public meetings in Yuma and Parker, Arizona, and Blythe, California and has received considerable public and political support. Reclamation will match Arizona's $580,000 grant and will enter into a contract with the State for the restoration. This project which is anticipated to restore approximately 50% of the previous wetland-riparian habitat, will begin during the first half of 1997, with completion proposed for 1998.

e. Flat-tailed horned lizard conservation

As a result of the Flat-Tailed Horned Lizard Rangewide Management Strategy, in which Reclamation is participating member, Reclamation has proposed to preserve approximately 16,000 acres within the 5-mile zone southeast of Yuma as a flat-tailed horned lizard preserve and has agreed to no new land use within the preserve boundaries. However, Reclamation proposes to reserve the right to maintain the existing Minute 242 well field authorized by Public Law 93-320. Reclamation would also reserve the right to expand the well field, but expansion would be closely coordinated with the Service with regard to possible impacts to the flat-tailed horned lizard. Mitigation features would be those outlined in the rangewide management strategy. Reclamation will actively implement the management actions outlined in the strategy as described below, to

Fig. 11. Three-Finger Lake Project

minimize loss or degradation of habitat in the area. These actions, usually in conjunction with other agencies, are:

* Designate the Yuma Desert Management Area
* Limit land uses that would cause surface disturbance within the Management Area
* Retain lands in Management Area
* Maintenance in existing Rights-of-Way may continue
* No new roads in Management Area
* Limit vehicle use to designated routes and close routes where route density is high
* Coordinate with U.S. Border patrol on routes and agreements in Management Area
* No competitive recreational events in management area
* No new recreational facilities
* No sale of plant products
* Limit fire suppression methods
* Limit other surface-disturbing or cover-reducing activities consistent with above
* Rehabilitate damaged and degraded habitat
* Maintain prioritized list of parcels for acquisition
* Seek funds for and attempt to acquire inholdings
* Limit or mitigate activities in movement corridors
* Coordinate with Mexico and Immigration and Naturalization Service
* Establish Management Oversight Group
* Hold semi-annual Interagency Coordinating Committee meetings
* Provide law enforcement
* Provide public information and education
* Require permits for research
* Encourage and support research into a variety of topics, including flat-tailed horned lizard demographics, monitoring techniques, effects of conflicting activities, genetic variation, and other aspects
* Monitor implementation
* Document habitat disturbance and loss
* Mitigate and compensate for conflicting uses
* Limit or mitigate activities in movement corridors

f. Lower Colorado River Multi-Species Conservation program development

The MSCP is a cooperative Federal-Lower Basin States-Tribal-Private effort to conserve ESA-listed and sensitive species dependent on the river. The Department of the Interior (DOI) and the Lower Basin States have committed to cooperate and cost share (1:1 ratio) in the development of the MSCP, and the active participation of Native Americans, environmental and other interested parties is being encouraged. This program has the goal of benefitting more than 100 Federal- or State-listed, candidate and sensitive species (called the "included species") and their habitats within the States of California, Nevada and Arizona, ranging from aquatic, wetland and riparian, to upland areas.

The MSCP Steering Committee, Work Group and associated subcommittees have had considerable discussion on the topic of what the word conservation means to the LCR. Within the context of the ESA, the phrase "to conserve" means to use all methods and procedures which are necessary to bring any endangered or threatened species to the point at which the measures provided pursuant to the ESA are no longer necessary.

To this end, the purpose of the LCR MSCP is to:

- conserve habitat and work toward the recovery of "included species" within the 100-year floodplain of the LCR, pursuant to the ESA, and attempt to reduce the likelihood of additional species listings under the ESA; and,

- accommodate current water diversions and power production and optimize opportunities for future water and power development, to the extent consistent with law.

In addition, the Regional Director of the Service, Southwest Region, under the authorities set forth in section 4(f)(2) of the ESA, has designated the LCR MSCP Steering Committee as the LCR Ecosystem Conservation and Recovery Implementation Team (ECRIT). This ECRIT includes representatives from Reclamation, the Service, other Department of the Interior agencies (Bureau of Land Management, National Park Service, Bureau of Indian Affairs), Indian tribes (Colorado River Indian Tribes, Hualapai Tribe), environmental groups (American Rivers, Defenders of Wildlife), and State (California, Arizona, and Nevada) wildlife, water and power agencies, committed to developing and implementing a 50 year plan for the LCR.

As part of MSCP development, Reclamation has dedicated resources to initiate the process and has agreed, along with other DOI agencies, to pursue additional resources, subject to Congressional authorization and allocations, in order to complete the cooperative development of the MSCP over approximately the next three years. Reclamation has already provided funding for some conservation measures for the razorback sucker and bonytail chub and is committed to providing additional and substantial funding for LCR MSCP program development and interim conservation measures, as specified in the June 26, 1996, cooperative funding agreement between DOI and the Lower Basin States.

Table 1. Summary of Reclamation's discretion over Lower Colorado River operations and maintenance.

Operation and Maintenance Activity	Reclamation Non-Discretion	Reclamation Discretion	Biological Assessment Reference (Pages)
Lake Mead water elevation	(1) amount of yearly upper-basin runoff (2) flood-control operation, coordinated with COE (3) supplying downstream water orders (4) supplying water to Mexico	(1) limited discretion over timing of releases from Glen Canyon Dam (2) allowed to renegotiate downstream water contracts	20, 35-42, 49, 56, 72
Lake Mohave water elevation	(1) hourly fluctuations in releases from Hoover Dam responding to instantaneous demands for hydropower (2) hydropower contracts administered by Sec'y of Energy (3) supplying downstream water orders	(1) limited discretion over monthly water elevations (2) flood-control operation (3) allowed to request Sec'y of Energy to renegotiate hydropower contracts with electric service customers, or seek voluntary mgmt alternatives.	29-30, 52, 72-73
Lake Havasu water elevation	(1) maintaining elevations high enough to permit diversion into CR and CAP aqueducts (2) supplying downstream water orders (3) supplying water to Mexico (4) hourly fluctuations in releases from Parker and Davis Dams due to hydropower contracts; hydropower contracts administered by Sec'y of Energy	(1) limited discretion to regulate high, stable reservoir elevations (2) flood-control operation (3) allowed to renegotiate downstream water contracts (4) allowed to request Sec'y of Energy to renegotiate hydropower contracts with electric service customers, or (5) seek voluntary mgmt alternatives for (3) and (4)	29-30, 50-52, 72-73
Senator Wash Reservoir water elevation	(1) side-channel inflow upstream to Parker Dam driven by local precipitation (2) change in water orders diverted at Imperial Dam	(1) no discretion over short-term fluctuations, limited discretion over long-term fluctuations	48, 73
Mittry Lake water elevation	(1) managed cooperatively with Ariz. Game and Fish Dept.	(1) limited discretion	19
flow-rate below Hoover Dam	(1) daily & seasonal fluctuations due to supplying downstream water orders (2) hourly fluctuations in releases from Hoover Dam responding to instantaneous demands for hydropower; hydropower contracts administered by Sec'y of Energy	(1) allowed to renegotiate downstream water contracts (2) allowed to request Sec'y of Energy to renegotiate hydropower contracts with electric service customers, or (3) seek voluntary mgmt alternatives for (1) and (2) above	29-34, 72-73

Operation and Maintenance Activity	Reclamation Non-Discretion	Reclamation Discretion	Biological Assessment Reference (Pages)
water releases from Davis Dam	(1) daily and seasonal fluctuations due to supplying downstream water orders (2) hourly fluctuations in releases from Davis Dam due to hydropower contracts; hydropower contracts administered by Sec'y of Energy	(1) limited discretion due to stabilized elevations of Lake Havasu (2) allowed to renegotiate downstream water contracts (3) allowed to request Sec'y of Energy to renegotiate hydropower contracts with electric service customers, or (4) seek voluntary modifications to (2) and (3) above	29-31, 72-73
water releases from Parker Dam	(1) seasonal fluctuations in flows due to varying irrigation demands (2) hourly fluctuations in releases from Parker Dam due to hydropower generation; hydropower contracts administered by Sec'y of Energy	(1) allowed to renegotiate downstream water contracts (2) allowed to request Sec'y of Energy to renegotiate hydropower contracts with electric service customers, or (3) seek voluntary mgmt changes to (1) and (2)above	29-31, 72-73
controlling flow-rate below Imperial Dam	(1) required to meet Mexico's irrigation demands within Int'l Treaty requirements	(1) limited discretion in flows by-passing Laguna Division via Pilot Knob and Calif. Wasteway at Siphon Drop	27-28, 72
controlling flow-rate below Morelos Dam	(1) water diverted by Mexico for irrigation	(1) no discretion	19,72
declaring surplus, normal, and shortage years	(1) rights to surplus water delineated in decree, contracts, and other obligations	(1) limited discretion over contracts using surplus water and unused apportionment	26-27
containing flows outside of reservoirs	(1) required to prevent flooding and convey water to meet water orders	(1) discretion over method of conveying water and achieving flood control	56,60,74
maintaining river channel and related structures	(1) required if needed to control flooding, deliver water, and maintain navigability	(1) discretion over method of maintaining facilities	34,56,60,74
operating quarries	(1) required if needed to control flooding and deliver water	(1) discretion over location of quarries (2) stockpiling enables discretion over timing of quarrying	34,56,74
maintaining dams and related structures	(1) required for flood control and hydropower	(1) maintenance method discretionary	31-32
operating Yuma desalting plant at one-third capacity	(1) desired to offset cost of facility	(1) discretionary	34,49,60, 74

Operation and Maintenance Activity	Reclamation Non-Discretion	Reclamation Discretion	Biological Assessment Reference (Pages)
delivering water to Mexico at San Luis, Mexico, including operating 242 well field	(1) water deliveries negotiated with Mexico through IBWC	(1) discretion over percent of Mexico's allotment if approved by IBWC (2) discretion over operation and maintenance of well field	28,72
dredging at Imperial Dam and at Laguna Settling Basin	(1) required to enable meeting water deliveries at Imperial Dam and SIB	(1) discretion over timing and method	60,74

STATUS OF THE SPECIES

Listed species/critical habitat:

Bonytail Chub

Listing History

The bonytail chub was first proposed for listing under the ESA on April 24, 1978, as an endangered species. The bonytail chub was listed as an endangered species on April 23, 1980, with an effective date of the rule of May 23, 1980. In the final rule, the Service determined that at that time there were no known areas with the necessary requirements to be determined critical habitat. Critical habitat was designated in 1994 and is discussed elsewhere in this section.

Species Description

The bonytail chub is one of three closely related members of the genus *Gila* found in the Colorado River. Confusion about the proper taxonomy and the degree of hybridization between the bonytail chub, the humpback chub, (*Gila cypha*), and roundtail chub, (*G. robusta*), has complicated examinations of the status of these fish. The bonytail chub was originally described from specimens taken in Arizona (Baird and Girard 1853). The bonytail chub is a highly streamlined fish with a very thin, pencil-like, caudal peduncle and large, falcate fins (Allan and Roden 1978). A nuchal hump may be present behind the head. Maximum length is about 600 millimeters (mm), with 300-350 mm more common (USFWS 1990). Weights are generally less than one kilogram (kg) (Vanicek and Kramer 1969). Bonytail chub are long-lived fish; some have reached at least 49 years of age (Minckley 1985).

Life History

Life history information for the bonytail chub was recently summarized in the recovery plan (USFWS 1990) and in the biological support document for the critical habitat designation (USFWS 1993a). It is important to note that life history information on this species is limited. The information presented in this BO is primarily taken from these sources.

The bonytail chub was once abundant in the Colorado River and its major tributaries throughout the Basin, occupying 3,500 miles of river in the United States and Mexico (USFWS 1993a). With the confusion between the bonytail chub and roundtail chub arising from use of the common names "bonytail chub" and "trout" for both species, specific information on abundance may be lacking. However, the Service is reasonably certain that records from the LCR were bonytail chub and not roundtail chub. Records from the late 1800's and early 1900's indicated the species was abundant in the lower Colorado and Gila River drainages (Baird and Girard 1853, Kirsch 1889, Gilbert and Scofield 1898, Miller 1961).

With their streamlined bodies, bonytail chub appear to be adapted to the Colorado River and large tributary streams. Even with these adaptations, this species does not select areas of high velocity currents and use of pools and eddies by the fish is significant (Vanicek 1967, Vanicek and Kramer 1969). Grinnell in 1914 captured bonytail chubs in a backwater along the LCR. There is limited information on migrations or other movements.

Spawning takes place in the late spring to early summer (Jonez and Sumner 1954, Wagner 1955) in water temperatures about 18° C (Vanicek and Kramer 1969). Riverine spawning of the bonytail chub has not been documented; however in reservoirs, gravel bars or shelves are used (Jonez and Sumner 1954). Bonytail chub may be flexible in their spawning habitat needs as evidenced from successful spawning in hatchery ponds at Dexter National Fish Hatchery and raceways at Willow Beach National Fish Hatchery.

Habitat needs of laytail chubs are not well known. Few larvae have been identified in the Lower Basin; in the Upper Basin, there is confusion between larvae of the bonytail chub and other chubs, so interpreting data is difficult. It is known that young fish prey on aquatic invertebrates, especially chironomid larvae and mayfly nymphs (Vanicek and Kramer 1969). It is likely that quiet water habitats are preferred habitats for young fish, given the success of raising them in man-made ponds.

Population Dynamics

The bonytail chub is adapted to the widely fluctuating physical environment of the historical Colorado River. Adults can live 45-50 years, and apparently produce viable gametes even when quite old. The ability to spawn in a variety of habitats is also a survival adaption. In the event of several consecutive years with little or no recruitment (due to either too much or too little water), the demographics of the population as a whole might shift, but future reproduction would not be compromised. Fecundity measurements taken on adult females in the hatchery ranged from 1,015 to 10,384 eggs per fish with a mean of 4,677 (USFWS 1990). With the fecundity of the species, it would be possible to quickly repopulate after a catastrophic loss of adults.

Severe reductions in both population numbers and individual bonytail chub numbers can be traced largely to impounding the LCR and introducing non-native fish into the modified environment. Dams created reservoirs that favored survival and expansion of species adapted to lentic systems. Deep water releases from large reservoirs created habitat immediately downstream of reservoirs that was ideal for cold water species. Conversely the bonytail chub had adapted to a riverine system tied to periodic flooding of the free flowing Colorado River. With physical modification of the free flowing river and introduction of many non-native species, non-native species in the LCR system far exceed the number of native species.

Rangewide Present Status

The bonytail chub was listed as an endangered species due to massive declines in or extirpation of all populations throughout the range of the species. The causes of these declines are changes to biological and physical features of the habitat. The effects of these changes have been most noticeable by the almost complete lack of natural recruitment to any population in the historic range of the species. Populations are generally small and composed of aging individuals. Recovery efforts under the Recovery Implementation Program in the Upper Basin have begun, but significant recovery results have not been seen for this species. In the Lower Basin, augmentation efforts along the LCR propose to replace the aging populations in Lakes Havasu and Mohave with young fish from protected-rearing site programs. This may prevent the imminent extinction of the species in the wild, but appears less capable of ensuring long term survival or recovery of the bonytail chub. Overall, the status of the bonytail chub in the wild continues to be precarious.

A summary discussion on the species' response to the proposed action is provided for the two endangered fish species following the fish critical habitat section.

Razorback Sucker

Listing History

The razorback sucker was first proposed for listing under the ESA on April 24, 1978, as a threatened species. The proposed rule was withdrawn on May 27, 1980, due to changes to the listing process included in the 1978 amendments to the ESA; the amendments required all listings to be completed within two years of publication of the proposed rule and that deadline was not met. The 1978 amendments also required that critical habitat be included in the listing of most species; however, no critical habitat package was developed for the proposed listing of the species.

In March, 1989, the Service was petitioned by a consortium of environmental groups to list the razorback sucker as an endangered species. The Service made a positive finding on the petition in June, 1989, that was published in the Federal Register on August 15, 1989. The finding stated that a status review was in progress and provided for submission of additional information through December 15, 1989. The proposed rule to list the species as endangered was published on May 22, 1990, and the final rule was published on October 23, 1991. The effective date of the rule was November 22, 1991. Critical habitat was designated in 1994 and is discussed elsewhere in this section.

Species Description

The razorback sucker is the only representative of the genus *Xyrauchen* and was described from specimens taken from the "Colorado and New Rivers" (Abbott 1861) and Gila River (Kirsch 1889) in Arizona. This native sucker is distinguished from all others by the sharp edged, bony keel that rises abruptly behind the head. The body is robust with a short and deep caudal peduncle (Bestgen 1990). The razorback sucker may reach lengths of one meter and weigh five to six kg (Minckley 1973). Adult fish in Lake Mohave reached about half this maximum size and weight (Minckley 1983). Razorback suckers are long-lived, reaching the age of at least the mid-40's (McCarthy and Minckley 1987).

Life History

Life history information for the razorback sucker was recently summarized in the status review for the species (Bestgen 1990), in *Battle Against Extinction: Native Fish Management in the American West* (Minckley and Deacon 1991), and in the biological support document for critical habitat designation (USFWS 1993a). The life history information presented in this BO is primarily taken from these sources.

The razorback sucker was once abundant in the Colorado River and its major tributaries throughout the Basin, occupying 3,500 miles of river in the United States and Mexico (USFWS 1993a). Records from the late 1800's and early 1900's indicated the species was abundant in the lower Colorado and Gila River drainages (Kirsch 1889, Gilbert and Scofield 1898, Minckley 1983, Bestgen 1990).

Adult razorback suckers utilize most of the available riverine habitats, although there may be an avoidance of whitewater type habitats. Main channel habitats used tend to be low velocity ones such as pools, eddies, nearshore runs, and channels associated with sand or gravel bars (summarized in Bestgen 1990). Backwaters, oxbows, and sloughs were well-used habitat areas adjacent to the main channel; flooded bottomlands are important in the spring and early summer (summarized in Bestgen 1990). Razorback suckers may be somewhat sedentary, however considerable movement over a year has been noted in several studies (USFWS 1993a). Spawning migrations have been observed or inferred in several locales (Jordan 1891, Minckley 1973, Osmundson and Kaeding 1989, Bestgen 1990, Tyus and Karp 1990).

Spawning takes place in the late winter to early summer depending upon local water temperatures. Various studies have presented a range of water temperatures at which spawning occurs. In general, temperatures between 10° to 20° C are appropriate (summarized in Bestgen 1990). Spawning areas include gravel bars or rocky runs in the main channel (Tyus and Karp 1990), and flooded bottomlands (Osmundson and Kaeding 1989). There is an increased use of higher velocity waters in the spring, although this is countered by the movements into the warmer, shallower backwaters and inundated bottomlands in early summer (McAda and Wydoski 1980, Tyus and Karp 1989, Osmundson and Kaeding 1989).

Habitat needs of larval razorback suckers are not well known. Warm, shallow water appears to be important. Shallow shorelines, backwaters, inundated bottomlands and similar areas have been identified (Sigler and Miller 1963, Marsh and Minckley 1989, Tyus and Karp 1989, 1990, Minckley et al. 1991). For the first period of life, larval razorbacks are nocturnal and hide during the day. Diet during this period is mostly plankton (Marsh and Langhorst 1988, Papoulias 1988). Young fish grow fairly quickly with growth slowing once adult size is reached (McCarthy and Minckley 1987). Little is known of juvenile habitat preferences.

Population Dynamics

The razorback sucker is adapted to the widely fluctuating physical environment of the historical Colorado River. Adults can live 45-50 years and, once reaching maturity between two and seven years of age (Minckley 1983), apparently produce viable gametes even when quite old. The ability of razorback suckers to spawn in a variety of habitats, flows and over a long season are also survival adaptations. In the event of several consecutive years with little or no recruitment (due to either too much or too little water), the demographics of the population as a whole might shift, but future reproduction would not be compromised. Average fecundity recorded in studies ranged from 100,800 to 46,740 eggs per female (Bestgen 1990). With a varying age of maturity and the fecundity of the species, it would be possible to quickly repopulate after a catastrophic loss of adults.

Rangewide Present Status

The razorback sucker was listed as an endangered species due to declining or extirpated populations throughout the range of the species. The causes of these declines are changes to biological and physical features of the habitat. The effects of these changes have been most clearly noted by the almost complete lack of natural recruitment to any population in the historic range of the species. Populations are generally small and composed of aging individuals. A recovery plan is being drafted for this species. Recovery efforts under the Recovery Implementation Program in the Upper Basin have begun, but significant recovery results have not been achieved for this species. In the Lower Basin, efforts to reintroduce the species in the Gila, Salt and Verde rivers have not been successful in establishing self-sustaining populations. Reintroduction efforts are currently ongoing only in the Verde River. Augmentation efforts along the LCR propose to replace the aging populations in Lakes Havasu and Mohave with young fish from protected-rearing site programs. This may prevent the imminent extinction of the species in the wild, but appears less capable of ensuring long term survival or recovery. Overall, the status of the razorback sucker in the wild continues to decline.

Bonytail chub and razorback suckers were key components of the sparse fish fauna that historically occupied the LCR. Spawning and nursery areas were provided largely during spring floods that provided space, food and protection during early life stages of both species. Initiation of spawning was tied closely to the hydrologic cycle of the river. As flows rose and began to create nursery habitat, spawning occurred. Ample space and food was provided for the young fish.

Conversely, clear water impoundments provided ideal habitat for a variety of non-native fish. Impoundments and severely modified flows interrupted this creation of habitat critical for survival. Non-native fish were introduced and rapidly became established throughout most of the Lower Basin. Non-natives were effective competitors and predators on native fish. As a result, essentially all the native fish species are either listed as threatened or endangered or their numbers have decreased significantly.

A summary discussion on the species' response to the proposed action is provided for the two endangered fish species following the fish critical habitat section.

Critical Habitat - Bonytail Chub and Razorback Sucker

Critical habitat is defined in the ESA to include areas whether occupied or not that are essential to the conservation of the species. Conservation is defined in the ESA as that needed to bring about the complete recovery of the species. Efforts to designate critical habitat began with the proposed rule to list the razorback sucker in 1990.

The May 22, 1990, proposed rule to list the razorback sucker did not contain a proposal to designate critical habitat. The final rule listing the razorback sucker as an endangered species stated that critical habitat was not determinable at the time of listing. This gave the Service an additional year to obtain further habitat information. On October 30, 1991, the Service received a notice of intent to sue from the Sierra Club Legal Defense Fund over failure to designate critical habitat at the time of listing. After review of additional information available, the Service concluded on December 6, 1991, that designation of critical habitat was both determinable and prudent. After a ruling that the Service had violated the ESA by not designating critical habitat with the listing of the species, the U.S. District Court in Denver, Colorado, ordered the Service to publish a proposed rule to designate critical habitat within 90 days of the Court's order.

The Service determined that since the habitats of the razorback sucker overlapped with those of the bonytail chub, Colorado squawfish (*Ptychocheilus lucius*) and humpback chub (*Gila cypha*), and the issues facing these species were very similar, that designating critical habitat for all four species at the same time would be appropriate. The proposed rule was published on January 29, 1993, and contained proposed critical habitat for the four listed native Colorado River fish. The final rule to designate critical habitat was published on March 21, 1994, with an effective date of April 20, 1994.

Critical habitat for the bonytail chub includes portions of the Colorado, Green, and Yampa Rivers in of designation. Within the project area, critical habitat includes the Colorado River from Hoover Dam to Davis Dam (including Lake Mohave to its full pool elevation) and Lake Havasu (to its full pool elevation).

Critical habitat for the razorback sucker includes portions of the Colorado, Duchesne, Green, Gunnison, San Juan, White and Yampa Rivers in the Upper Basin and the Colorado, Gila, Salt and Verde Rivers in the Lower Basin. All critical habitat reaches were considered to be occupied at the time of designation. Within the project area, critical habitat includes the Colorado River from Pierce Ferry to Hoover Dam (including Lake Mead to its full pool elevation); Hoover Dam to Davis Dam (including Lake Mohave to its full pool elevation); and Parker Dam to Imperial Dam (including the 100-year floodplain).

The designation of critical habitat for the Colorado River fishes highlighted two important issues for these species:

> (1) Specific problems with habitat have resulted in the extirpation of these species from most of their historic range. Areas considered for designation as critical habitat are evaluated against the constituent elements deemed essential to species conservation. The conservative definition of critical habitat includes only those areas undisturbed or unmodified, and therefore possessing all the constituent elements in the correct proportion, but this definition fails to address the existing situation of the Colorado River fishes. There is little aquatic habitat in the Colorado River Basin that has not been affected in some way by development activities. Thus the designated areas do not support all the constituent elements in the same way as an undisturbed system might.
>
> (2) The rangewide status of these species has been greatly impacted. The bonytail chub is almost functionally extinct, the razorback sucker is not far from that status. For these two species the immediate need to provide for the conservation of the species is to prevent extinction in the wild. For that reason, any location that contained even a remnant population of bonytail chub and razorback sucker was included in critical habitat designation. The management of such areas is crucial to ensuring that activities undertaken there do not adversely affect what is left of these populations.

Large reservoirs such as Lakes Mead, Mohave and Havasu are not natural features of the Basin and do not represent historic habitat types, even though they are within the historic ranges of the species; but, these large reservoirs are where these two fish species have their last large populations. These reservoirs are now essential to the conservation of the species. Critical habitat determinations include analysis of those areas that may require special management considerations or protection. Post-designation management actions to improve the quality of the critical habitat to support the listed species is part of the survival and recovery processes.

Species' General Response to Proposed Action - Bonytail Chub and Razorback Sucker

This discussion looks, in a general way, at the types of changes that have occurred in the LCR and what the effects to the historic habitats were. It is intended to be an introduction to the types of effects that have impacted these species in the past, and it is neither detailed nor does it specifically analyze the action under consultation.

Historically, the Colorado River and its tributaries possessed a remarkable degree of variance of physical conditions which created fish habitats. Extremes in flows of both seasonally and yearly cycles, water quality, velocity of flows, distribution of types of habitats and geographic factors of distance and elevation were the defining features of the river. The native fish species, including the bonytail chub and razorback sucker, had evolved in and with that variance and had strategies to maintain their place in the system. Both species live to 45-50 years of age and maintain fecundity and fertility well into old age. A long-lived and fertile species can ride out periods of too much or too little water in the system to allow for successful recruitment to the population. The age structure of the population might change, but even that might be within the normal pattern of the species. Adults also avoid areas of highest velocity waters and take refuge in flooded areas, lessening risk of injury, death or removal from the local population during the danger period. Avoiding seasonal low water or drought-related mortality was more difficult, but the fecundity of the survivors would enable a short time to recovery of population size. In the event of local extirpation of a population, the interconnected tributaries provided access throughout the basin for migrants.

The LCR now has experienced actions that have changed the historical patterns of variance and have greatly altered the system as a whole. A general chronology of these actions within the action area and their effects can be found in the section of this BO describing the environmental baseline. Specific areas have been more or less affected, some completely changed, others only somewhat changed. In only a very few places have the bonytail chub and razorback sucker persisted.

River shores and floodplains are often developed for agriculture, recreational activities, residential and other urban/suburban facilities. Such development results in losses to riparian, marsh and backwater habitats in the floodplain. Placement of levees and bank stabilization structures to keep the river from flooding out these developments is an associated impact. Destabilized shores may be altered by placement of beaches, boat launch facilities, docks, and construction right at waters' edge. Losses of habitats within the floodplains and along shorelines can be significant and further compound problems associated with native fish habitat.

The placement of dams, large or small, inundates riverine habitats and creates reservoirs or ponded areas and blocks migration upstream from the location. Depending on the type and size of the dam, downstream movements are also affected. Creation of reservoirs and ponded areas drowns the floodplain and the associated riparian areas, marshes, and backwaters upstream. Riverine main channel habitats are also lost. Spawning and nursery habitats may be compromised or lost completely. For fish species accustomed to small backwaters, reservoirs the size of Lake Mead represent new habitats and individuals must adapt to thein order to survive. Waters released from deep within the reservoir are cold year round; these releases create water temperatures that are generally too cold to support the native fish fauna of the Lower Colorado. However, cold water is conducive to trout reintroduction and establishment, thus these releases result in loss of habitat available to native fish and in maintenance of a non-native predator.

Dam operators release water primarily in response to entitlements and contract orders and to prevent flood damage. Changes in flows from dams have effects to natural channel migrations, creation, maintenance and destruction of marshes, backwaters and stands of riparian vegetation, spawning or migratory cues based on flow levels, and water quality parameters. When water is diverted from the river, flow reductions are apparent below each diversion. Fluctuations in daily, weekly and monthly releases and diversions have significant adverse effects to shallow water areas. For the native fish species, effects to local migration, spawning and nursery areas, and alteration in habitat patterns and distribution occur.

Control of the released water is also necessary. Rapid transport of water from the dam to the diversion point minimizes loss to evaporation and seepage into the groundwater. Straight, stabilized channels achieve this, but with a resultant loss of meanders, often cutting backwaters and marshes off from the mainstem river. Even if not cut off, higher velocity water in the channel cuts a deeper bed, permitting water to drain from wetland areas. The fish species in this consultation depend considerably on backwater type habitats or main channel habitats with lower velocities. Because flows and velocities will vary over a day or week depending upon release, entrapment and stranding become threats to individuals.

Non-native fish introductions have resulted in the establishment of a much more diverse fish fauna than existed in the past. Many of these fish species are potentially predators or competitors with the native fish. Survival strategies that worked successfully before the non-natives arrived have not appeared to work since. While specific evidence for predation or competition between native and non-native fish is often not available, sufficient evidence exists to indicate that these effects occur (Bestgen 1990, Minckley et al. 1991). The effects range from predation on eggs, larvae and juveniles to contemporaneous use of the same habitats resulting in some level of competition for food, space, and protection. The adaptability of the non-native fish is evident even in relatively undisturbed river reaches such as those found in portions of the Upper Basin, where non-native fish have established populations and native fish populations have declined.

Almost all areas of designated critical habitat for native fish were degraded by past actions and have been kept in that condition by the presence of non-native fish, development activities, and maintenance and operation of dams in the Colorado River Basin. Additional actions that continue these types of effects will continue to adversely affect critical habitat.

The result, in 1996, of the human activities in the area is the near extinction of the bonytail chub, and the imminent loss of the last large razorback sucker population. Efforts to rejuvenate the aging bonytail chub and razorback sucker populations in Lakes Mohave and Havasu and similar programs in the Upper Basin are critically needed to forestall the extinction of these species in the wild. These efforts are providing time in which to address the larger problems, but old age is decimating the wild populations. The young fish from the hatchery and pond programs are, although surviving, all within the same age range. Without successful recruitment, limited ability to recover these fish exists. Without natural habitats, recruitment may be limited to captured wild larvae and hatchery production, an alternative that does not represent long-term recovery. These fish still do have the capacity to restore their own numbers if the situation allows for recruitment. Protecting the remaining constituent elements of critical habitat and providing management to restore degraded conditions may increase the opportunity for recruitment into these populations.

Southwestern Willow Flycatcher

Listing History

The Service included the southwestern willow flycatcher on its Animal Notice of Review as a category 2 candidate species on January 6, 1989 (USFWS 1989). This flycatcher was proposed for listing as endangered, with critical habitat, on July 23, 1993 (USFWS 1993b). A final rule listing the southwestern willow flycatcher as endangered was published on February 27, 1995 (USFWS 1995). The listing became effective on March 29, 1995. Following the review of comments received during the public comment period, the Service deferred the designation of critical habitat, invoking an extension on this decision until July 23, 1995. A moratorium on listing actions under the Act passed by Congress in April, 1995, required the Service to cease work on the designation of critical habitat. The moratorium has since been removed, but under the Service's priority system, completion of the critical habitat package has been delayed until high priority listing packages have been completed. The States of California and New Mexico also list the southwestern willow flycatcher as endangered (CDFG 1992, NMDGF 1988). The State of Arizona considers the southwestern willow flycatcher a Species of Special Concern (AGFD 1996).

Species Description

The southwestern willow flycatcher is a small passerine bird (Order Passeriformes; Family

Tyrannidae) measuring approximately 15 centimeters (cm) (5.75 inches) in length from the tip of the bill to the tip of the tail and weighing only 11 grams (0.4 ounces). It has a grayish-green back and wings, whitish throat, light gray-olive breast, and pale yellowish belly. The eye ring is faint or absent. The upper mandible is dark, the lower is light yellow grading to black at the tip. As its name implies, it is an insectivore typically perching on a branch and making short direct flights, or sallying, to capture flying insects. The southwestern willow flycatcher is a riparian obligate, nesting along rivers, streams, and other wetlands where dense growths of willow (*Salix* sp.), *Baccharis*, buttonbush (*Cephalanthus* sp.), box elder (*Acer negundo*), saltcedar (*Tamarix* sp.) or other plants are present, often with a scattered overstory of cottonwood (*Populus* sp.) or willow or both.

Empidonax traillii extimus is one of five currently-recognized willow flycatcher subspecies (Phillips 1948, Unitt 1987, Browning 1993). It is a neotropical migratory species that breeds in the southwestern U.S. and migrates to Mexico, Central America, and possibly northern South America during the non-breeding season (Phillips 1948, Stiles and Skutch 1989, Peterson 1990, Ridgely and Tudor 1994, Howell and Webb 1995). The historical range of the southwestern willow flycatcher included southern California, Arizona, New Mexico, western Texas, southwestern Colorado, southern Utah, extreme southern Nevada, and extreme northwestern Mexico (Sonora and Baja)(Unitt 1987).

Life History

The southwestern willow flycatcher is an insectivore, foraging within and above dense riparian vegetation, taking insects on the wing or gleaning them from foliage (Wheelock 1912, Bent 1960). No information is available on specific prey species. However, fecal samples containing identifiable invertebrate body parts were collected during banding operations from more than 70 southwestern willow flycatchers in California, Arizona, and southwestern Colorado (M. Sogge, pers. comm.); however, analyses of these samples have not yet been conducted.

The southwestern willow flycatcher begins arriving on breeding grounds in late April and May (Sogge and Tibbitts 1992, Sogge et al. 1993, Sogge and Tibbitts 1994, Muiznieks et al. 1994, Maynard 1995, Sferra et al. 1995). Migration routes are not completely known. However, willow flycatchers have been documented migrating through specific locations and drainages in Arizona that do not currently support breeding populations, including the upper San Pedro River (BLM, unpubl. data), Colorado River through Grand Canyon National Park (Sogge and Tibbitts 1992, Sogge et al. 1993, Sogge and Tibbitts 1994), LCR (Muiznieks et al. 1994, Spencer et al. 1996), Verde River tributaries (Muiznieks et al. 1994), and Cienega Creek (Bureau of Land Management, *in litt.*). These observations probably also include subspecies *E.t. brewsteri* and *E.t. adastus*. *Empidonax* flycatchers rarely sing during fall migration, so distinguishing different subspecies of migrating *Empidonax* without specimens in hand is not feasible (Blake 1953, Peterson and Chalif 1973). However, willow flycatchers have been reported to sing and defend winter territories in Mexico and Central America (Gorski 1969, McCabe 1991).

Southwestern willow flycatchers begin nesting in late May and early June and fledge young from late June through mid-August (Willard 1912, Ligon 1961, Brown 1988, Whitfield 1990, Sogge and Tibbitts 1992, Sogge et al. 1993, Muiznieks et al. 1994, Whitfield 1994, Maynard 1995). They typically lay three to four eggs per clutch (range = 2-5). The breeding cycle, from laying of the first egg to fledging, is approximately 28 days. Eggs are laid at one-day intervals (Bent 1960, Walkinshaw 1966, McCabe 1991); they are incubated by the female for approximately 12 days; and young fledge approximately 12 to 13 days after hatching (King 1955, Harrison 1979). Southwestern willow flycatchers typically raise one brood per year but have been documented raising two broods during one season (Whitfield 1990). Renesting has been documented after nest failure (Whitfield 1990, Sogge and Tibbitts 1992, Sogge et al. 1993, Sogge and Tibbitts 1994, Muiznieks et al. 1994, Whitfield 1994, Whitfield and Strong 1995).

Whitfield (Kern River Preserve, pers. comm.), who has accumulated the largest data set on *E.t. extimus*, reported the following data on survivorship of adults and young: of 58 nestlings banded since 1993, 21 (36%) returned to breed; of 57 birds banded as adults (after hatch year) since 1989, 18 (31%) returned to breed at least one year (10 males, 8 females), five (9%) returned to breed for two years (all males), and two (3.5%) returned to breed for three years. Whitfield (1995) also documented statistically significant variation in return rates of juveniles as a function of fledging date; approximately 21.9% of juveniles fledged on or before July 20th returned to her study area the following year, whereas only 6.4% of juveniles fledged after July 20th returned the following year.

Walkinshaw (1966), who studied *E.t. traillii* in Michigan, estimated that 40.9% of the males at his study site returned to breed for at least two years, 22.7% returned for at least three years, 13.6% returned for at least four years, and at least 4.5% returned during their fifth year. Female return rates were substantially lower. Only 22.6% returned to breed for one year. Neither of the Whitfield nor Walkinshaw incorporate potential emigration rates into their estimates of returns and, thus, may underestimate actual survivorship. However, these data are consistent with survival rates for other passerines (Gill 1990, chap. 21) suggesting that the lifespan of moobably two to three years (i.e., most flycatchers survive to breed one or two seasons).

Brood parasitism of southwestern willow flycatcher nests by the brown-headed cowbird (*Molothrus ater*) has been documented throughout the flycatcher's range (Brown 1988, Whitfield 1990, Muiznieks et al. 1994, Whitfield 1994, Hull and Parker 1995, Maynard 1995, Sferra et al. 1995, Sogge 1995b). Cowbirds lay their eggs in the nests of other species, directly affecting their hosts by reducing nest success. Cowbird parasitism reduces host nest success in several ways. Cowbirds may remove some of the host's eggs, reducing overall fecundity. Hosts may abandon parasitized nests and attempt to renest, which can result in reduced clutch sizes, delayed fledging, and reduced overall nesting success and fledgling survivorship (Whitfield 1994, Whitfield and Strong 1995). Cowbird eggs, which require a shorter incubation period than those of many passerine hosts, hatch earlier giving cowbird nestlings a competitive advantage over the host's young for parental care (Bent 1960, McGeen 1972, Mayfield 1977, Brittingham and Temple 1983). Where studied, high rates of cowbird parasitism have coincided with southwestern willow flycatcher population declines (Whitfield 1994, Sogge 1995a, Sogge 1995c, Whitfield and Strong 1995), or resulted in reduced or complete elimination of nesting success (Muiznieks et al. 1994, Whitfield 1994, Maynard 1995, Sferra et al. 1995, Sogge 1995a, Sogge 1995c, Whitfield and Strong 1995). Whitfield and Strong (1995) found that flycatcher nestlings fledged after July 20th had a significantly lower rate of survival, and that cowbird parasitism was often the cause of delayed fledging.

Habitat Use

The southwestern willow flycatcher occurs in dense riparian habitats from sea level in California to over 7000 feet in Arizona and southwestern Colorado. Throughout its wide geographic and elevation range, its riparian habitat can be broadly classified into five types based on plant species composition and habitat structure (**Table 3**).

Table 3. Generalized riparian habitat types occupied by the southwestern willow flycatcher based on plant species composition and vegetation structure[1].

		Plant Species Composition		
Vegetation Structure	Monotypic Native	Monotypic Non-Native	Multiple Species Native	Multiple Species Native/ Non-Native Mix
Single Stratum No Distinct Canopy	I	II		
Multiple Strata Distinct Canopy & Sub-canopies	III		IV	V

[1] Roman numerals reference descriptive narrative in text.

The matrix in **Table 3** provides a framework for understanding the most conspicuous attributes of flycatcher habitat, but not necessarily the most important. These attributes are identifiable from photographs or during site visits. There are other important dimensions or characteristics of southwestern willow flycatcher habitat, including: size, shape, and distribution of vegetation patches; hydrology; prey types and abundance; parasites; predators; environmental factors (e.g. temperature, humidity); and interspecific competition. Other factors related to population dynamics, such as demography (i.e. birth and death rates, age-specific fecundity), the distribution of breeding groups across the landscape, flycatcher dispersal patterns, migration routes, site fidelity, philopatry, and degree of conspecific sociality (e.g. colonialness) generally are not well understood for the southwestern willow flycatcher. However, some of these factors may be critical to population dynamics and habitat use. For example, characterizations of suitable breeding habitat may be significantly biased if observed patterns of habitat use are influenced by intrinsic dispersal patterns and capabilities rather than habitat quality.

The ultimate measure of habitat suitability is a combination of reproductive success and survivorship that results in a positive rate of population growth. Without long-term data that correlate or experimentally verify which of the combinations of the above attributes contribute to population growth, habitat descriptions should be viewed broadly. For example, the matrix in **Table 3**, combined with photographic comparisons and quantitative and qualitative descriptions could be used to characterize "suitable survey habitat," a limited set of characteristics that describe areas where recent breeding attempts have been documented. Below, descriptions are given that correspond to the habitat classes in **Table 3**.

Rangewide, occupied habitat for the southwestern willow flycatcher can be characterized by dense patches of riparian shrubs or trees including the following general habitat types:

I) monotypic, dense stands of willow (often *S. exigua* or *S. geyeriana* above 7000 feet in AZ)

9 to 20 feet in height with no distinct overstory; difficult to penetrate; vertical foliage density uniformly high (>60%) from ground to canopy (Spencer et al. 1996) (Type I **Table 3**).

II) monotypic, dense stands of saltcedar 12 to 35 feet in height forming a nearly continuous, closed canopy (i.e. no distinct overstory); vertical foliage density increases with height; canopy density uniformly high (approx. 90%); difficult to penetrate (Spencer et al. 1996) (Type II **Table 3**).

III) dense stands of mostly Goodding's willow 12 to 40 feet in height characterized by trees of different size classes, a distinct overstory, subcanopy strata, fallen but living trees creating dense tangles difficult to penetrate (Type IV **Table 3**).

IV) dense mixtures of native broadleaf trees and shrubs including cottonwood, willows, boxelder, ash, alder, buttonbush, and stinging nettle, characterized by a distinct overstory of cottonwood or willow with subcanopies and a dense understory of mixed species also difficult to penetrate (Type IV **Table 3**).

V) dense mixtures of native broadleaf trees and shrubs as in number 4 above mixed with exotics such as saltcedar or Russian olive primarily in the understory; dense ground-level tangles difficult to penetrate sometimes interspersed with small openings (Type V **Table 3**).

The size and shape of occupied riparian habitat patches vary considerably. Southwestern willow flycatchers have been found nesting in patches as small as 0.8 hectare (ha) (e.g. Grand Canyon) and as large as several hundred hectares (e.g. Roosevelt Lake, Lake Mead). When viewed from above, the mixed vegetation types (numbers III - V, above) often appear as a mosaic of plant species and patch shapes and sizes. In contrast, narrow, linear riparian habitats one or two trees wide do not appear to contain attributes attractive to nesting flycatchers. However, flycatchers have been found using these habitats during migration.

Open water, cienegas, marshy seeps, or saturated soil are typically in the vicinity of flycatcher nests. Southwestern willow flycatchers have been documented nesting in areas where nesting substrates (that is, trees or shrubs) were in standing water (Sferra et al. 1995 and 1996, R. McKernan unpubl. data). At some locations, particularly during drier years, water or saturated soil is only present early in the breeding season (i.e., May and part of June). However, the total absence of water or visibly saturated soil has been documented at sites where the river channel has been modified (e.g., creation of artificial channels), where modification of subsurface flows has occurred (e.g., agricultural seepage), or as a result of natural changes in river channel configuration.

Nest Placement and Nesting Substrate

Southwestern willow flycatcher nests are typically placed in the fork of a branch with the nest cup supported by several small-diameter vertical stems. The main branch from which the fork originates may be oriented vertically, horizontally, or at another angle; stem diameter for the main supporting branch can be as small as three to four centimeters (cm). Vertical stems supporting the nest cup are typically one to two cm in diameter. Occasionally, southwestern willow flycatchers place their nests at the juncture of stems from separate plants, sometimes different plant species. Those nests are also characterized by vertically-oriented stems supporting the nest cup. Spencer et al. (1996) measured the distance between flycatcher nests and shrub/tree center for 38 nests in monotypic saltcedar and mixed native broadleaf/saltcedar habitats. In monotypic saltcedar stands (n=31), nest placement varied from 0.0 meters(m) (center stem of shrub or tree) to 2.5 m. In the mixed riparian habitat (n=7), nest placement varied from 0.0 to 3.3 m.

Nest height relative to the base of the nest substrate also varies across the southwestern willow flycatcher's range. **Table 4** presents data on nest heights in different riparian habitat types across the flycatcher's range. Southwestern willow flycatcher nests have been found as low as 0.6 m above the ground to 14 m above the ground.

The data presented in **Table 4** demonstrate that flycatchers that use predominantly native broadleaf riparian habitats place their nests relatively low to the ground (between 1.8 m and 2.1 m on average), whereas those using mixed native/exotic and monotypic exotic riparian habitats place their nests relatively high above the ground (between 4.3 m and 7.4 m on average).

Historic egg/nest collections and species' descriptions from throughout the southwestern willow flycatcher's range confirm the bird's widespread use of willow for nesting (Phillips 1948, Phillips et al. 1964, Hubbard 1987, Unitt 1987, T. Huels *in litt.* 1993, San Diego Natural History Museum 1995). Of the 34 nests found by Brown in 1902 near Yuma on the lower Colorado and Gila rivers, 33 were in Goodding's willow and one was in arrowweed. Data from historic egg collections from southern California and more current studies indicate that 75 to 80% of nests were placed in willows (San Diego Natural History Museum 1995). Currently, southwestern willow flycatchers use a wide variety of plant species for nesting substrates. At the monotypic willow stands that characterize high elevation sites in Arizona, Geyer willow was used almost exclusively for nesting (Muiznieks et al. 1994)Gooding's willow was the primary nesting substrate (R. McKernan unpubl. data). Along a 20-mile stretch of the Gila River in Grant County, New Mexico, where boxelder is the dominant understory species, 76% of flycatcher nests were placed in boxelder, with the remainder in Russian olive and saltcedar (Skaggs 1996). At the inflows of Tonto Creek and Salt River to Roosevelt Lake in Gila County, Arizona, both of which are comprised of monotypic stands of saltcedar, 100% of flycatcher nests were placed in saltcedar (Muiznieks et al. 1994, Sferra et al. 1995, Spencer et al. 1996, Corman et al. 1996). On the San Luis Rey River in San Diego County, California, approximately 90% of flycatcher nests were placed in live oak (*Quercus agrifolia*), typically an upland species, which became the dominant plant species adjacent to the stream after willows were removed in the 1950s as a water conservation measure and a reservoir upstream reduced flood frequency and streamflow volume (San Diego Natural History Museum 1995, W.Haas, pers. comm.). Other plant species where southwestern willow flycatcher nests have been documented include: buttonbush, black twinberry (*Lonicera involucrata*), Fremont cottonwood, white alder (*Alnus rhombifolia*), blackberry (*Rubus ursinus*), Russian olive, and *Salix hindsiana*.

[insert table 4, landscape]]

Territory Size

Southwestern willow flycatcher territory size, as defined by song locations of territorial birds, probably changes with population density, habitat quality, and nesting stage. Early in the season, territorial flycatchers may move several hundred meters between singing locations (Sogge et al. 1995, Petterson and Sogge 1996, R. Marshall pers. obs.). It is not known whether these movements represent polyterritorial behavior or active defense of the entire area encompassed by singing locations. However, during incubation and nestling phases, territory size, or at least the activity centers of pairs, can be very small and restricted to an area less than one-half hectare. Sogge et al. 1995 estimated a breeding territory size of 0.2 ha for a pair of flycatchers occupying a 0.6 ha patch on the Colorado River in Grand Canyon. Activity centers may expand after young are fledged but while still dependent on adults.

Reproductive Success

Intensive nest monitoring efforts in California, Arizona, and New Mexico have revealed that: (1) sites with both relatively large and small numbers of pairs have experienced extremely high rates of brood parasitism; (2) high levels of cowbird parasitism in combination with nest loss due to predation have resulted in low reproductive success and, in some cases, population declines; (3) at some sites, levels of cowbird parasitism remain high across years, while at others parasitism varies temporally with cowbirds absent in some years; (4) the probability of a flycatcher successfully fledging its own young from a nest that has been parasitized by cowbirds is low (i.e., < 5%); (5) cowbird parasitism and nest loss due to predation often result in reduced fecundity in subsequent nesting attempts, delayed fledging, and reduced survivorship of late-fledged young; and, (6) nest loss due to predation appears more constant from year to year and across sites, generally in the range of 30 to 50%.

On the South Fork Kern River (Kern Co., CA), Whitfield (1993) documented a precipitous decline in the flycatcher breeding population from 1989 to 1993 (44 to 27 pairs). During that same period cowbird parasitism rates between 50% and 80% were also documented (Whitfield 1993) (**Table 5**).

A cowbird trapping program initiated in 1993 reduced cowbird parasitism rates to < 20%. Flycatcher population numbers appear to have stabilized at 32 to 34 pairs in 1993, 1994, and 1995 (Whitfield 1994, Whitfield and Strong 1995). Predation rates have remained relatively constant in the range of 33 to 47% (**Table 5**). Flycatcher nest success increased from 26% prior to cowbird trapping to 48% after trapping was implemented (Whitfield and Strong 1995). In addition, the number of young fledged also increased from 1.01 young/pair to 1.73 young/pair during the same period.

Table 5. Nest predation and brood parasitism rates documented for the southwestern willow flycatcher across its range[1].

Location	Pre-1993	1993	1994	1995
S. Fork Kern River (Kern Co., CA)				
% nests parasitized[2]	50 - 80	38*	16*	19*
% nests depredated	33 - 42	37	47	34
San Luis Rey River (San Diego Co. CA)	-*	-*	0*	0*

% nests parasitized	-	-	28	5
% nests depredated				
Colorado River (Coconino Co., AZ)				
% nests parasitized	≥50	100	44	100
% nests depredated	-	30	78	0
Verde River (Yavapai Co., AZ)				
% nests parasitized	-	100	50	extirpated
% nests depredated	-	100	50	
Little Colorado River (Apache Co., AZ)				
% nests parasitized	-	-	22	0
% nests depredated	-	-	33	28
Rio Grande (Socorro Co., NM)				
% nests parasitized	-	-	20	66
% nests depredated	-	-	40	60
Gila River (Grant Co., NM)				
% nests parasitized	-	-	-	16 - 27
% nests depredated	-	-	-	45

[1] Sources: Sogge and Tibbitts (1992), Sogge et al. (1993), Brown (1988), Griffith and Griffith (1994), Maynard 1994, Muiznieks et al. (1994), Sogge and Tibbitts (1994), Cooper (1995), (W.Haas, San Diego Nat'l History Museum, pers. comm.), Skaggs (1995), Sogge (1995a), Sogge et al. (1995), Spencer et al. (1995), Whitfield and Strong (1995).

[2] Proportion of nests containing at least one brown-headed cowbird egg.

* Brown-headed cowbird control program implemented.

Whitfield and Strong (1995) found that, besides lowering nest success, fecundity, and the number of young produced, cowbird parasitism may also lower survivorship of flycatcher young fledged late in the season. Southwestern willow flycatchers that abandon parasitized nests, or renest after fledging cowbirds, lay fewer eggs in subsequent clutches and, if successful, fledge flycatcher young late in the season. Whitfield and Strong (1995) determined that cowbird parasitism delayed successful flycatcher nesting by at least 13 days and this delay resulted in significantly different return rates of juveniles. Only 6.4% of flycatcher young that came from late nests were recaptured in subsequent years, whereas 21.9% of young that came from early nests were recaptured. If these recapture rates mirror actual survivorship, then even though some parasitized flycatchers eventually fledge their own young, nest loss due to parasitism or depredation may have the more insidious effect of reducing overall juvenile survivorship.

Despite the cowbird trapping program and increased reproductive success, Whitfield has not observed a population increase at her study area. Whitfield and Strong (1995) speculate that other factors in addition to cowbird parasitism, such as habitat loss, pesticide use on wintering grounds, and stochastic events such as storms resulting in mortality, may be keeping population numbers low.

The number of unmated, territorial flycatchers and paired flycatchers detected along the Colorado River in the Grand Canyon has remained low since monitoring began in 1982. Brown (1988) reported that at least 50% of flycatcher nests monitored in the Grand Canyon between 1982 and 1987 were parasitized by brown-headed cowbirds, but he did not report data on productivity. Since 1992, 10 known pairs of willow flycatchers have made 14 nesting attempts in the Grand Canyon, two of which successfully fledged a total of four flycatchers (Sogge and Tibbitts 1992, Sogge et al. 1993, Sogge and Tibbitts 1994, Sogge et al. 1995). This low rate of reproduction indicates that, even with the protections provided annually by the National Park Service (i.e., camping and other activities are prohibited at flycatcher breeding sites), this area is a population sink (Pulliam 1988) where reproduction is not adequate to replace adults and population persistence requires emigration from other breeding areas.

Elsewhere in Arizona, population loss or undetected dispersal of breeding groups has been documented since 1993. For example, surveys in 1993 estimated five territorial males at Dudleyville Crossing on the San Pedro River (Pinal Co.). However, surveys in 1994 and 1995 failed to detect any flycatchers at that location (Muiznieks et al. 1994, Sferra et al. 1995, Spencer et al. 1996). On the Verde River at Clarkdale in Yavapai Co., four pairs of flycatchers were present in 1992. Due to cowbird parasitism and nest predation, there was poor reproductive success at this site each successive year. By 1996, no flycatchers remained, although a new site 2.4 km away, Tavasci Marsh, was found to have one nesting pair. Flycatchers detected in 1993 at Soza Wash on the San Pedro River were not detected in followup surveys in 1995, and a flycatcher observed at Ister Flat on the Verde River was not detected in followup surveys during 1994. It is not known whether these events represent mortality of flycatchers, changes in habitat quality, or simply a tendency to move inherent to this species. At other locations on the San Pedro River in Pinal Co., such as Cook's Lake and PZ Ranch, flycatcher breeding group size remained stable until 1996. In 1996 a catastrophic fire destroyed much of the breeding habitat at PZ Ranch resulting indonment of that site and, perhaps, mortality of adults (Paxton et al. 1996).

The data presented above and in **Table 5** demonstrate that cowbird parasitism and nest depredation are adversely affecting southwestern willow flycatchers throughout their range. Cowbirds have been documented at more than 90% of sites surveyed (Sogge and Tibbitts 1992, Sogge et al. 1993, Camp Pendleton 1994, Muiznieks et al. 1994, Sogge and Tibbitts 1994, T. Ireland 1994 *in litt.*, Whitfield 1994, C. Tomlinson 1995 *in litt.*, Griffith and Griffith 1995, Holmgren and Collins 1995, Kus 1995, Maynard 1995, McDonald et al. 1995, Sferra et al. 1995, Sogge 1995a, Sogge 1995b, Sogge et al. 1995, Cooper 1996, San Diego Natural History Museum 1995, Stransky 1995, Whitfield and Strong 1995, Griffith and Griffith 1996 *in litt.*, Skaggs 1996, Spencer et al. 1996). Parasitism rates have been highly variable, at the same sites, from one year to the next. Thus, the potential for cowbirds to be a persistent and widespread threat remains high. Cowbird trapping has been demonstrated to be an effective management strategy for increasing reproductive success for the southwestern willow flycatcher, as well as for other endangered Passerines (e.g., least Bell's vireo [*Vireo bellii pusillus*], black-capped vireo [*V. atricapillus*], and golden-cheeked warbler [*Dendroica chrysoparia*]). However, cowbird trapping should not be used alone, without protecting existing habitat and expanding riparian areas to reduce the ultimate problem of habitat fragmentation and the resultant vulnerability to cowbirds.

Nest loss due to predation is common among small Passerines. The rates documented for southwestern willow flycatchers are also typical for small Passerines (i.e., rates < 50%). However, even at these "typical" levels, nest loss due to predation is a significant factor contributing to low reproductive success. Nest predation presents a difficult management challenge because of the variety of predator taxa involved and the difficulty in developing an effective management plan for more than one taxon. Until specific predators on southwestern willow flycatcher nests are identified, measures to reduce potential predator populations should focus on reducing human activities that attract predators, such as camping, picnicking, etc. where pets are loose and refuse is concentrated.

Distribution and Abundance

Unitt (1987) noted that taxonomic confusion between *E. trailli* and *E. alnorum* (alder flycatcher) and among other *Empidonax* species that migrate through the southwestern U.S. probably accounted for the relative lack of research on the southwestern willow flycatcher. The alder and willow flycatchers, formerly known as Traill's flycatcher, were not officially recognized as separate species until the American Ornithologist's Union published its sixth edition Checklist of North American Birds (AOU 1983). The lack of systematic, rangewide collections of *E.t. extimus* preclude a complete description of this subspecies' former distribution and abundance. However, the more than 600 egg, nest, and specimen records available from museums throughout the U.S. in combination with State, county, and local faunal accounts from the first half of the 20th Century indicate that, historically, the southwestern willow flycatcher was more widespread and, at least, locally abundant.

Phillips (1948) first described *E.t. extimus* from a specimen collected by Gale Monson on the lower San Pedro River near Feldman, AZ (Pinal Co.). The taxonomic validity of *E.t. extimus* was subsequently reviewed by Hubbard (1987), Unitt (1987), and Browning (1993), and has been accepted by most authors (e.g., Aldrich 1951, Behle and Higgins 1959, Phillips et al. 1964, Oberholser 1974, Monson and Phillips 1981, Harris et al. 1987, Schlorff 1990, Harris 1991). Unitt (1987) reviewed historical and contemporary records of *E.t. extimus* throughout its range, determining that it had "declined precipitously..." and that,

> "although the data reveal no trend in the past few years, the population is clearly much smaller now than 50 years ago, and no change in the factors responsible for the decline seem likely."

Overall, Unitt (1987) documented the loss of more than 70 breeding locations rangewide, including locations along the periphery and within core drainages that form this subspecies' range. Unitt estimated that, rangewide, the southwestern willow flycatcher population probably was comprised of 500 to 1000 pairs. Because more recent rangewide survey data was not available at the time of Unitt's review, he did not evaluate potential dispersal and recolonization that may have occurred following extirpation. Data presented below, however, indicates that after four years of rangewide surveys fewer than 500 southwestern willow flycatchers have been documented.

Below is a State-by-State comparison of historic and current data. Since 1992 more than 800 historic and new locations have been surveyed rangewide to document the status of the southwestern willow flycatcher (some sites in southern California have been surveyed since the late 1980s). Survey efforts in most States were done under the auspices of the Partners In Flight program, which served as the coordinating body for survey training sessions and review and synthesis of data. The extensive and, in some case, intensive nature of these efforts have provided a critical baseline on current distribution, abundance, and reproductive success rangewide.

California

The historic range of *E.t. extimus* in California apparently included all lowland riparian areas in the southern third of the State. It was considered a common breeder where suitable habitat existed (Wheelock 1912, Willett 1912, 1933, Grinnell and Miller 1944). Unitt (1984, 1987) concluded that it was once common in the Los Angeles basin, the San Bernardino/Riverside area, and San Diego

County. Specimen and egg/nest collections confirm its former distribution in all coastal counties from San Diego Co. north to San Luis Obispo Co., as well as in the inland counties, i.e., Kern, Inyo, Mohave, San Bernardino, and Imperial. Unitt (1987) documented that the flycatcher had been extirpated, or virtually extirpated (i.e., few territories remaining) from the Santa Clara River (Ventura Co.), Los Angeles River (Los Angeles Co.), Santa Ana River (Orange and Riverside counties), San Diego River (San Diego Co.), lower Colorado River (Imperial and Riverside counties and adjacent counties in AZ), Owen's River (Inyo Co.), and the Mohave River (San Bernardino Co.). Its former abundance in California is evident from the 72 egg and nest sets collected in Los Angeles County, alone, between 1890 and 1912, and from Herbert Brown's 34 nests and nine specimens taken in June of 1902 from the lower Colorado River near Yuma. Local collections of this magnitude suggest both a keen understanding of flycatcher habitat use on the part of the collector and that this subspecies was locally very abundant.

Survey and monitoring efforts since the late 1980s have confirmed the southwestern willow flycatcher's presence at 18 locations on 11 drainages in southern California (including the Colorado River). Current known flycatcher breeding sites are restricted to four counties, San Diego, Riverside, Santa Barbara, and Kern. Combining survey data for all sites surveyed since the late 1980s for a composite population estimate, the total known southwestern willow flycatcher population in southern California is 114 terr

Of the 18 sites where flycatchers have been documented in California, 72% (13) contain five or fewer territorial flycatchers; 17% (3) contain six to 10 territorial flycatchers; and 11% (2) contain 20 or more territorial flycatchers. Of all the sites statewide, 22% (four sites) have single pairs or unmated territorial birds and only three drainages are known to have 20 or more flycatcher territories in total, i.e., the San Luis Rey River (San Diego Co.), South Fork Kern River (Kern Co.), and Santa Ynez River (Santa Barbara Co.).

[[insert table 6 landscape]]]

Arizona

Historic records for Arizona indicate the former range of the southwestern willow flycatcher included portions of all major river systems (Colorado, Salt, Verde, Gila, Santa Cruz, and San Pedro) and major tributaries, such as the Little Colorado River and headwaters, and the White River. Unitt (1987) noted that "probably the steepest decline in the population levels of *extimus* has occurred in Arizona." The bird has been extirpated, or virtually extirpated from the Santa Cruz River (Pima Co.), upper San Pedro River (Cochise Co.), lower San Pedro River at PZ Ranch (Pinal Co.), Blue River (Greenlee Co.), Colorado River at Lees Ferry (Coconino Co.), Colorado River (Yuma Co.), Gila River (Yuma Co.), and Verde River at Tuzigoot Bridge (Yavapai Co.). Currently, 150 territories are known from 39 sites along nine drainages statewide, including the Colorado River (**Table 6**). As in California, the majority of breeding groups in Arizona are extremely small; of the 39 sites where flycatchers have been documented, 74% (29) contain five or fewer territorial flycatchers, and of these 29 sites six or seven are comprised of single, unmated territorial birds.

New Mexico

Unitt (1987) considered New Mexico as the State with the greatest number of *extimus* remaining. After reviewing the historic status of the flycatcher and its riparian habitat in New Mexico, Hubbard (1987) concluded,

> "[it] is virtually inescapable that a decrease has occurred in the population of breeding willow flycatchers in New Mexico over historic time. This is based on the fact that wooded sloughs and similar habitats have been widely eliminated along streams in New Mexico, largely as a result of the activities of man in the area."

Unitt (1987), Hubbard (1987), and more recent survey efforts have documented extirpation or virtual extirpation in New Mexico on the San Juan River (San Juan Co.), near Zuni (McKinley Co.), Blue Water Creek (Cibola Co.), and Rio Grande (Dona Ana Co. and Socorro Co.). Survey and monitoring efforts since 1993 have documented 173 flycatcher territories on eight drainages (**Table 6**). Approximately 135 of these territories occur in remnant strips of riparian forest within a 20-mile stretch of the Gila River in Grant County (Skaggs 1996). This area contains the largest known breeding group rangewide. Outside of Grant County, however, few flycatchers remain. Statewide, 84% (16) of the 19 sites with flycatchers contain five or fewer territorial birds. Six sites are comprised of single pairs or unmated territorial flycatchers, and six others are comprised of two pairs or two unmated territorial birds.

Texas

The Pecos and Rio Grande rivers in western Texas are considered the easternmost boundary for the southwestern willow flycatcher. Unitt (1987) found specimens from four locations in Brewster, Hudspeth, and Loving counties where the subspecies is no longer believed to be present. Landowner permission to survey riparian areas on private property has not been obtained; thus current, systematic survey data is not available for Texas. There have been no other recent reports, anecdotal or incidental, of willow flycatcher breeding attempts in the portion of western Texas where *E.t. extimus* occurred historically. Given that surveys in adjacent Dona Ana County, New Mexico, have failed to document breeding along historically-occupied portions of the Rio Grande, the Service believes the southwestern willow flycatcher has been extirpated from Texas.

Colorado

The taxonomic status and the historic distribution and abundance of willow flycatchers in southwestern Colorado remains unclear due to a lack of specimen data and breeding records. Preliminary data on song dialects suggests that the few birds recently documented in southwestern Colorado may be *E.t. extimus*. These sightings have prompted State and Federal agencies to delineate provisional boundaries for *E.t. extimus* and sponsor statewide survey efforts. Survey efforts since 1993 have documented a total of six locations in Delta, Mesa, and San Miguel counties where willow flycatchers have been found (**Table 6**). Two locations have single, unmated males; two locations have single pairs; the remaining two locations are comprised of four to five territories each.

Utah

Specimen data reveal that *E.t. extimus* historically occurred in southern Utah along the Colorado River, San Juan River, Kanab Creek, Virgin River, and Santa Clara River (Unitt 1987). The northern boundary of *E.t. extimus* in south-central Utah remains unclear due to a lack of specimen data from that region. The southwestern willow flycatcher no longer occurs along the Colorado River in Glen Canyon where Lake Powell inundated historically-occupied habitat, nor in unflooded portions of Glen Canyon near Lee's Ferry where flycatchers were documented nesting in 1938. Similarly, recent surveys on the Virgin River and its tributaries and Kanab Creek have failed to document the presence of flycatchers (McDonald et al. 1995). Single, territorial males and possibly a pair of flycatchers were documented at two locations on the San Juan River (San Juan Co.) in 1995, but breeding was not confirmed (Sogge 1995b, R. Marshall, pers. obs.). The population totals for Utah are summarized in **Table 6**.

Nevada

Unitt (1987) documented three locations in Clark County from which *E.t. extimus* had been collected, but not found after 1970. Current survey efforts have documented a single location with two unmated males on the Virgin River in Clark County (Tomlinson *in litt.*)(**Table 6**).

Rangewide Present Status

Rangewide, the current known population of southwestern willow flycatchers stands at approximately 454 territories (**Table 6**). These results indicate a critical population status; more than 75% of the locations where flycatchers have been found are comprised of five or fewer territorial birds and up to 20% of the locations are comprised of single, unmated individuals. The distribution of breeding groups is highly fragmented, with groups often separated by considerable distances (e.g., approximately 88 km straight-line distance between breeding flycatchers at Roosevelt Lake, Gila Co., AZ, and the next closest breeding groups known on either the San Pedro River, Pinal Co., or Verde River, Yavapai Co.). Additional survey efforts, particularly in southern California, may discover additional small breeding groups. However, rangewide survey efforts have yielded positive results in less than 10% of surveyed locations. Moreover, survey results reveal a consistent pattern rangewide: the southwestern willow flycatcher population as a whole is comprised of extremely small, widely-separated, breeding groups or unmated flycatchers.

The data presented in **Table 6** represents a composite of surveys conducted since 1992. Locations that had flycatchers for only one year were tabulated as if the location is still extant. Given that extirpation has been documented at several locations during the survey period, this method of analysis introduces a bias that may overestimate the number of breeding groups and overall population size.

In addition, females have been documented singing as frequently as males. Because the established survey method relies on singing birds as the entity defining a territory (Tibbitts et al. 1994), double-counting may be another source of sampling error that biases population estimates upward. The figure of 454 southwestern willow flycatcher territories is an approximation based on considerable survey effort, both extensive and intensive. Given sampling errors that may bias population estimates positively or negatively (e.g., incomplete survey effort, double-counting males/females, composite tabulation methodology), natural population fluctuation, and random events, it is likely that the total population of *E.t. extimus* is fluctuating between 300 and 500 territories with a substantial proportion of individuals remaining unmated. This figure is alarming because, at such low population levels, random demographic, environmental, and genetic events could lead to extirpation of breeding groups and eventually render this species extinct, even if all extant sites were fully protected. The high proportion of unmated individuals documented during recent survey efforts suggests the southwestern willow flycatcher may already be subject to a combination of these factors (e.g., uneven sex ratios and low probability of finding mates in a highly fragmented landscape). A recovery plan for the southwestern willow flycatcher has not yet been prepared.

Effects to Species' Status from Past Consultations

Federal actions that have undergone formal section 7 consultation have also affected the status of the species rangewide. To date, the Service has completed or begun at least 21 consultations for the southwestern willow flycatcher **(Table 7)**. Eleven of the 15 completed or draft biological [[[insert Table 7 - landscape]]]

opinions released to the public were anticipated to result in take of flycatchers, permanent loss of habitat, or destruction of proposed critical habitat. Eight of the 15 biological opinions determined that the original action proposed would jeopardize the continued existence of the southwestern willow flycatcher or result in destruction of proposed critical habitat. Even with Reasonable and Prudent Alternatives, several of the projects are anticipated to result in long-term effects to occupied habitat and in reduced survivorship and productivity of breeding flycatchers (**Table 7**). For example, Reclamation was permitted maximum flexibility to operate the modified Roosevelt Dam, including total inundation and habitat loss of occupied breeding sites that now comprise the largest breeding group in Arizona, since a 1996 fire on the San Pedro River burned what was then Arizona's largest breeding site. Forty-four flycatcher territories were estimated at Roosevelt Lake in 1996, approximately 10% of the total known southwestern willow flycatcher population.

In California, the Service has issued a one-year biological opinion and incidental take statement for all take that will occur in the 567-ha South Fork Wildlife Area as the result of the COE's operations of the Lake Isabella Reservoir. A biological opinion on the long-range operation of the reservoir is currently under development. That area is currently occupied by breeding flycatchers and represents a potential recovery area for the flycatcher. It is contiguous with one of two sites in California that is comprised of more than 20 breeding pairs, the South Fork of the Kern River. This is one of two sites rangewide where a comprehensive, long-term cowbird management program has the potential to promote recovery in nearby and adjacent habitat. Preventing use of the South Fork Wildlife Area through habitat inundation or creating a "reproductive trap" for flycatchers by inundating nesting birds, as happened in 1995, precludes the opportunity for southwestern willow flycatcher recovery at the South Fork Wildlife Area.

These actions, as well as others identified in **Table 7**, have negatively affected the flycatcher's status significantly by reducing productivity and survivorship of flycatchers and by reducing habitat necessary for survival and recovery. Because no short-term alternatives could be identified to reduce the probability of extirpation at those sites where the action agency was permitted maximum operational flexibility (e.g., Roosevelt Dam, Lake Isabella), the Reasonable and Prudent Alternatives developed in these consultations relied on long-term strategies such as research, monitoring, and habitat acquisition. The effectiveness of this approach, however, is contingent upon maintaining survival of the species in the short term, which requires high levels of reproduction at the largest flycatcher breeding sites. For the Roosevelt Dam consultation in Arizona, the Reasonable and Prudent Alternative largely consisted of research, monitoring, management, and habitat acquisition on the lower San Pedro River 88 km southeast of Roosevelt Lake. That area had the largest concentration of flycatchers in Arizona and suitable habitat for population expansion. However, a June 1996 fire burned 1.2 km of occupied habitat that contained up to 18 pairs of flycatchers. Nests were lost and surviving birds were forced to disperse, resulting in delayed and, possibly, foregone reproduction (if suitable habitat and mates were not found). This catastrophic event significantly reduced the reproductive potential upon which the Reasonable and Prudent Alternative in the Roosevelt Dam consultation was based (Paxton et al. 1996). As a result of the habitat loss and mortality/dispersal of flycatchers on the San Pedro River, the unprotected Roosevelt Lake breeding group is now Arizona's largest.

Yuma Clapper Rail

Listing History

The first list of rare and endangered wildlife published by the Service (USFWS 1966) included the

Yuma clapper rail (*Rallus longirostris yumanensis*). It was listed in the Federal Register on March 11, 1967 (32 FR 4001) as endangered under the Federal endangered species legislation enacted in 1966 (Public Law 89-669) without critical habitat. The State of California listed it as rare in 1971 and later redesignated it as threatened (Thelander 1994). The State of Arizona is proposing to include this species on its list of "Wildlife of Special Concern in Arizona" (AGFD, in prep.). The Yuma clapper rail was listed as an endangered species because of the low numbers of birds detected and the loss of breeding habitat on the LCR resulting from channelization and dredging projects.

Species Description

The Yuma clapper rail is a chicken-shaped marsh bird with a long, down-curved beak. Both sexes are slate brown above, with light cinnamon underparts and barred flanks. This subspecies is slightly lighter in color and slightly thinner than other clapper rails. Fully grown, the bird measures 14 to 16 inches long. Rarely visible in the dense marsh vegetation it inhabits, it can be detected by its call. While other rail species are vocal year round, the Yuma clapper rail is nearly silent in winter.

The taxonomic status of the Yuma clapper rail was clarified with field work beginning in 1970. Forty-one clapper rails were collected in selected areas of the LCR and coastal areas of the Sea of Cortez in Mexico. Three separate and distinct subspecies were identified, including *R. l. yumanensis*, based on plumage and wing configurations and distribution patterns (Banks and Tomlinson 1974).

Distribution and Abundance

The Yuma clapper rail is an uncommon to fairly common summer resident and breeder between February and September, north to Topock Marsh. It is more secretive and, possibly, less numerous in winter (Rosenberg, et al. 1991). Until recently, most of the population was thought to retreat to Mexico during the winter. Telemetry studies, however, indicate that over 70% of the breeding population winters along the LCR (Eddleman 1989).

Breeding population centers are Mittry Lake, West Pond Imperial NWR, Bill Williams River Delta, Topock Gorge and Topock Marsh (Rosenberg et al. 1991). These centers reflect the distribution of relatively large marshes. Smaller populations occur where moderately extensive emergent vegetation is persistent, including backwaters. Elsewhere in the interior Southwest, breeding populations occur at the Salton Sea and along the Gila and Salt Rivers east to Picacho Reservoir and Phoenix in central Arizona.

According to Rosenberg et al. (1991), early naturalists on the Colorado River, many of whom were familiar with clapper rails, did not record them north of the Gila-Colorado confluence and noted that "marshes were few and of small size" (Grinnell 1914). The type specimens of Yuma clapper rail were taken in 1921 on the Colorado River, in the vicinity of Laguna Dam, north of Yuma, Arizona, by Huey and Canfield (Dickey 1923). However, an earlier specimen, since lost, and presumably of this subspecies, was collected "at Yuma" in 1902 (Swarth 1914 *in* Rosenberg, et al. 1991). Laguna Dam was completed in 1909 and marsh vegetation became established along canals near the dam about ten years later (Rosenberg et al. 1991).

Several researchers believe that this species has expanded its range to the north from brackish water marshes of the Colorado River delta after extensive damming of the LCR in the early 1900's (Conway 1990, Rosenberg, et al. 1991). According to these researchers, the dams have created marshlands with relatively stable water conditions ideal for rails. Todd (1987) contends that extensive marshes existed historically throughout the river valley; however, the existence of many large, long-standing marshes north of the Gila-Colorado confluence before 1920 is not supported by any detailed description of the region from that period according to Ohmart et al. (1977 *in* Rosenberg, et al. 1991). Similarly, the California black rail, (*Laterallus jamaicensis coturniculus*), a related marsh species, was first reported in the marshes around Imperial Dam in 1969 and now numbers about 200 birds (Repking and Ohmart 1977).

Yuma clapper rails appeared north of Laguna Dam a few years after the completion of Parker, Imperial, and Headgate Rock dams in 1938, 1939, and 1942, respectively (Rosenberg et al. 1991). The species was not collected at Topock Marsh until 1966. Today this is the most northern population center. The northernmost record is from Laughlin Bay, in 1986, on the Nevada side of the river. Rosenberg et al. (1991) cite Ohmart and Smith (1973) and Monson and Phillips (1981) as evidence that the population was localized in the Yuma area before 1940 and since has become more widespread. They point to expansions into the newly formed Salton Sea in California by the 1940's and Picacho Reservoir in central Arizona by the 1970's as supporting this view.

Home ranges of individuals or pairs may encompass up to 43 ha (106 ac) and may extensively overlap with home ranges of other birds. Year-round home ranges averaged 7.5 ha (18.5 ac) (Rosenberg, et al. 1991).

Habitat Use

The Yuma clapper rail is the only subspecies of clapper rail known to regularly inhabit freshwater marshes; in Mexico it also inhabits brackish marshes. Clapper rails are associated primarily with dense marsh vegetation, but high densities also occur in some moderately dense cattail/bulrush marshes. They may also occur in dense reed and even sparse cattail/bulrush, but in reduced numbers. Habitat edges between marshes and terrestrial vegetation are important, but the main factors determining habitat use are the annual range of water depth and the existence of residual mats of marsh vegetation (Eddleman 1989). Most individuals remaining through winter are found in tall, dense cattail/bulrush stands; however, some occur in flooded saltcedar and willow stands.

The most productive clapper rail areas consist of a mosaic of uneven-aged marsh vegetation interspersed with open water of variable depths (Conway et al. 1993). Habitat requirements of the Yuma clapper rail include freshwater or brackish stream sides and marshlands associated with heavy riparian and wetland vegetation (Grinnell and Miller 1944). Openings within the wetland, especially channels with flowing water are also important (Todd 1971, Tomlinson and Todd 1973, Cornelius 1972). A variety of water level conditions are encountered by Yuma clapper rails on the Colorado River, ranging from nominally stable levels in unconnected backwaters to unpredictably unstable levels in wetlands connected to the river. Rosenberg et al. (1991) believe that artificial marshes behind backwater levees compare favorably with natural marshes as habitat.

Life History

Nesting. Nesting behavior commences by February; nesting begins in mid-March and runs through early July, with most eggs hatching during the first week of June. There is no evidence of more than one brood per season, despite the long breeding period (Eddleman 1989). Both adults care for the eggs and young. Clutch size is usually six to eight eggs. Young are precocial and follow the adults through the marsh within 48 hours of hatching. Adults lead the young to productive feeding areas where they quickly learn to feed on their own. Young clapper rails experience high mortality from predators, usually within their first month of life. Surviving clapper rails of other subspecies fledge in 63-70 days. Nest bowls are built in three major microhabitats, the base of living clumps of cattail or bulrush, under wind thrown bulrush, or on the top of dead cattails remaining from the previous year's growth. Mature cattail/bulrush stands provide materials for nest building and cover for their nests. Sometimes they weave nests in the forks of small shrubs that lie just above moist soil or above water that is up to two feet deep (Thelander 1994).

Food Habits. The preferred prey of the Yuma clapper rail is the crayfish, predominantly *Procambarus clarki* (Todd 1986), which is not native to Arizona. Crayfish comprises up to 95% of the rail's diet by volume (Ohmart and Tomlinson 1977). The rails will also take isopods, aquatic and terrestrial beetles, damselfly and dragonfly nymphs, earwigs, grasshoppers, spiders, freshwater shrimp, freshwater clams, leeches, plant seeds and small fish. Using data from Ohmart and Tomlinson (1977), Rosenberg et al. (1991) state that crayfish, like the rails themselves, are apparently recent invaders (since 1900) to the northern portions of the LCR Valley. Crayfish were introduced for use as a fish bait about 1934 and may be a limiting factor determining rail occurrence today.

Population Estimates

In 1987, the Yuma clapper rail population size in the LCR Valley was estimated to be between 400 and 750 individuals in the United States, with 450-970 in Mexico (Eddleman 1989). In 1994, the last year a full river-wide survey was taken, the population on the Colorado River in the United States was estimated to be 1,145 individuals. This figure is based on call-counts taken between late April and mid-June, the period of peak responses to taped calls (Todd 1986, Bennett and Ohmart 1978, Montgomery 1987). The percentage of breeding birds responding to taped vocalizations has been estimated at 70-80% for paired birds and 90-95% for unpaired rails (Smith 1975, Bennett and Ohmart 1978). These estimates are based on knowing the locations of all vocalizing birds from repeated visits to study marshes, then determining the percentage of the birds that responded during call-count surveys, but see Eddleman (1989). **Table 8** shows the total number of responses to taped calls from 1990 to 1995. Based on the annual call count survey taken on the LCR, the Yuma clapper rail population appears to be stable. Overall associated habitat trends have been downward, however.

Rangewide Present Status

Population numbers of the Yuma clapper rail appear to be stable. However, the habitat throughout the species' range is not secure. Due to daily and seasonal fluctuations in river flow, breeding habitat for the Yuma clapper rail cannot establish permanently along the main channel. Many of the backwaters have also undergone successional changes or were adversely impacted by siltation or channel degradation due to the high flows of 1983 and 1984. These backwaters no longer provide habitat for the rail. However, the Yuma clapper rail appears to expand into desired habitat when it becomes available. This is evidenced by the colonization of the California Department of Fish and Game Finne-Ramer habitat management unit in Southern California. This unit was modified to provide marsh habitat specifically for Yuma clapper rail. A substantial resident population exists there.

Table 8. Yuma clapper rail census results.

Location	1990	1991	1992	1993	1994	1995
Mohave Division	0	0	0	0	0	0
Havasu NWR						
Topock Marsh	59	52	66	30	14	-
Topock Gorge	111	98	122	97	-	-
Havasu Division	6	3	3	8	6	-
Bill Williams NWR	6	15	16	18	10	7
Parker Division	0	9	9	2	4	-
Palo Verde Division	4	0	4		0	-
Cibola Division						
Oxbow Lake	0	0	0	-	-	-
Old River Channel	11	14	21	27	28	-
Cibola NWR	52	39	29	34	109	-
Imperial Division	64	69	91	107	72	86
Imperial NWR	38	24	-	127	113	50
Laguna Division						
South of Imperial Dam	-	-	7	16	32	
West Pond	-	3	2	1	7	17
Mittry Lake	21	18	16	16	27	
Teal Alley	44	50	38	20	18	38
YPG Slough	43	70	88	65	38	31
Yuma Division	17	14	10	4	0	3
Limitrophe Division	2	7	27	13	3	4
TOTAL	478	485	549	585	481	236*

*NOTE: The 1995 data were based on selected permanently established transects and not upon a complete survey of the habitat areas as in previous years.

A substantial population of Yuma clapper rail also exists in the delta area of the Colorado River in Mexico. Eddleman (1989) estimated a total of 450 to 970 Yuma clapper rails were present in the delta area in 1987. These were located in the Cienega, Sonora, Mexico (210-420 birds), along a dike road on the delta proper (35-140 birds), and at the confluence of the Rio Hardy and Colorado River (205-

410 birds). Based on this census and Todd (1986), it is believed approximately one quarter to one half of the total population resides in Mexico.

According to the BA, about 5,657 acres of marsh type 1 (nearly 100% cattail/bulrush) is found along the LCR in the United States. An additional 10,600+ acres of this habitat exists in Mexico in the Cienega and other areas in the Colorado River delta. This type of habitat is preferred by rails. However, under certain conditions other types of marsh habitat may be used by rails (Eddleman 1989).

Proposed species/critical habitat:

Flat-tailed Horned Lizard

Listing History

On November 29, 1993, the Service published a rule in the Federal Register proposing the flat-tailed horned lizard as a threatened species (USFWS 1993b). The Service proposed the flat-tailed horned lizard as a threatened species because of documented and anticipated population declines and loss of habitat, associated with widespread habitat
fragmentation, and degradation due to human activities such as agricultural and urban development, off-highway vehicle use, energy developments, construction of roads and canals, and military activities. The Service did not propose critical habitat as it was undeterminable. The Service is currently working with a number of State, Federal, and local agencies, including Reclamation, to develop a Rangewide Management Plan and conservation agreement for the flat-tailed horned lizard.

Species Description

The flat-tailed horned lizard is a small, cryptically colored, phrynosomatid lizard restricted to flats and valleys in the western Sonoran Desert, including the Coachella, Borrego, and Imperial valleys in California, the Yuma Desert in extreme southwestern Yuma County, Arizona, and adjacent portions of Baja California Norte and Sonora, Mexico (Johnson and Spicer 1985).

Life History

In Arizona, the range of this species is approximately bounded by the Gila River on the north, urban and agricultural development along the Colorado River on the west, and by bajadas and relatively coarse, alluvial, granitic soils immediately west of the Gila and Butler mountains to the east (Rorabaugh et al. 1987, Hodges 1995). Hodges (1995) estimated 550 km^2 (212 mi^2) of suitable habitat remains in Arizona. In this area, most records for the species are from areas of fine, often windblown, silica sand dominated by sparse stands of white bursage (*Ambrosia dumosa*), creosote (*Larrea tridentata*), and big galleta grass (*Hilaria rigida*) (Rorabaugh et al. 1987, Hodges 1995). The species shows a preference for and may be more abundant on sandy substrates as compared to desert pavement or hardpan surfaces (Muth and Fisher 1992, Rorabaugh et al. 1987), and in Arizona is most often found in areas of silica sand, rather than granitic sands and gravels (Hodges 1995).

The diet of the flat-tailed horned lizard consists primarily of ants, particularly from May to July (Parker and Pianka 1975; Turner and Medica 1982; Mark Fisher, Deep Canyon Desert Research Center, Palm Desert, California, pers. comm. 1992). The lizards are active primarily from mid-

February to mid-November (Muth and Fisher 1992, Mayhew 1965). Some evidence indicates a late summer and fall period of dormancy in adults (Howard 1974), while juveniles may be active on warm days throughout the winter (Muth and Fisher 1992). Mean home range of telemetered flat-tailed horned lizards in Imperial County, California, was 4.7 acres (Muth and Fisher 1992). Females produce one or two clutches of eggs that hatch in July and August-September (Turner and Medica 1982, Muth and Fisher 1992, Howard 1974). Flat-tailed horned lizards construct burrows in which they hibernate in winter and escape high temperatures in summer (Muth and Fisher 1992, Rorabaugh 1994). Mean cloacal temperature of active flat-tailed horned lizards in California was 37.7° C (Mayhew 1965). Maximum and minimum voluntary body temperatures are 41.0° and 29.3° C, respectively (Brattstrom 1965). Individuals become stressed when cloacal temperatures reach 45° C or more (Mayhew 1965). Further information on the range, biology, and ecology of the flat-tailed horned lizard can be found in Muth and Fisher (1992), Turner et al. (1980), Turner and Medica (1982), Rorabaugh et al. (1987), Rorabaugh (1994), Norris (1949), Hodges (1995), and Mayhew (1965).

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all Federal, State, and private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

In most formal section 7 consultations, the proposed action has not been initiated. This situation is different. Reclamation's operations and maintenance of its facilities in the action area represent ongoing projects, some of which have been in place for more than 50 years. The combined actions of numerous parties in addition to Reclamation over the last century and a half have already created a controlled, altered and much used river that bears only a limited resemblance to pre-development conditions. In order to completely assess the effects of the continuation of Reclamation's activities, it is necessary to examine the history of development along the Colorado River and the changes to aquatic, wetland and riparian habitats that resulted.

Listed species/critical habitat:

Bonytail Chub and Razorback Sucker

Historic Habitat Conditions on the Colorado River

Although the Spanish explorers and missionaries entered the region in the 1600-1700's, the history of significant human-induced change on the Colorado River can be said to have begun in 1823, the year the first fur trappers began to move into what would become Arizona. By 1824-26, trappers looking for beaver had reached the confluence of the Gila and Colorado Rivers (Davis 1973), and the serious exploitation of the river valleys had begun. Using information from the journals of early explorers and examining observable geography of the river, an approximation of the physical and habitat characteristics of the pre-development Colorado River can be made. While there are many historic sources of information describing the character of the project area, most do not provide details on physical conditions nor on the flora and fauna that would enable a mile-by-mile or year-by-year specific analysis of the river. The following discussions are based on anecdotal information from these historic sources (Davis 1973, Ohmart 1979), and on background information drawn from hydrology and fluvial geomorphology, to describe the historical system that likely existed (Simons et al. 1975). This discussion is not intended to be an exhaustive analysis of the formation and morphology of the Colorado River, but is intended as a starting point to assess the effects of river development activities.

For purposes of this discussion, the Colorado River in the action area was divided into two sections based on the different geographic features of each. The upper portion begins at Pierce Ferry and extends to the mouth of the Black Canyon. The lower portion begins at the mouth of the Black Canyon and extends to the SIB. The landforms and history of development in the two areas differ enough that the division is a logical one.

Upper portion of the project area

The upper portion extends approximately 90 miles south from Pierce Ferry to the mouth of the Black Canyon. The escarpment that marked the lower end of the Grand Canyon, the Grand Wash Cliffs, are immediately upstream of Pierce Ferry, and changes in gradient and landform became apparent downstream from this point. Through the Grand Canyon, the river dropped at approximately eight feet per mile. Through the upper section of the project area, as the river began to level out, the river drop reduced to about three feet per mile (USBR 1946). The Colorado River cut through an area of alternating valley fills and mountains in this reach. Narrow canyons resulted from the mountains reaching the river channel. Rapids were largely restricted to these narrow canyon reaches. The open benches of the valleys provided a wider floodplain with some seasonally inundated bottomlands. Only one significant tributary, the Virgin River, entered the Colorado River in this portion of the action area. There were numerous desert washes that flowed during storm events and these had debris fans at their mouths. Probably the largest of these washes was Las Vegas Wash.

Physical characteristics of the narrow channel and wider floodplain areas were shaped by flow patterns. Water flowing out of the narrow Grand Canyon was contained in a wider and less steep channel through the valley fills and tributary basins of the upper portion of the action area. At high flows, water covered a wider area and was deeper and faster in the main channel area with shallower, quiet waters on the margins of the floodplain. Erosion and deposition of silts, sands and gravels by the flows affected bottomland topography and created or destroyed shoreline or mid-channel bars, islands, and other features. At lower flows, the river was flanked by these beaches and bars, existing in low-flow channels. It is possible that some meandering may have occurred throughout these reaches, especially in areas of available bottomlands or floodplain. If the sediment loads were high enough that deposition was actively occurring, sediment from easily eroded banks entered the system, and if the gradient was high enough, braided stream condition may have occurred. Braided conditions were likely limited by the availability of a wide channel area with floodplains throughout the reach. This availability also could have limited formation of backwaters and marshes, although there likely were side channels and eddies to function as quiet water habitats.

The narrow canyons separating the valley reaches were steeper and narrower, with rapids and higher water velocities. High flows presumably affected beach and channel bar topography in these reaches. Low flows were likely conveyed in the low flow channels. Depending upon the type of landform at the flood line through the reach (for example, a sheer cliff or talus slope), there could have been beaches or bars along the shorelines and possibly mid-channel bars if the river channel was wide enough. If the gradient and flow were sufficient, rapids could be found here also. Quiet water habitats were found in eddies and behind debris fans or associated with bars or deep pools.

There were two primary zones of riparian vegetation along the channels and floodplains. As is true today, substrates of silt, sand, gravel, cobble and rock, and stabilized talus were available for plants. The two zones can be briefly described as that above the normal flood line and that below the normal flood line. Plants characteristic above the flood line zone included catclaw acacia (*Acacia greggii*), western honey mesquite (*Prosopis glandulosa* var. *torreyana*), and netleaf hackberry (*Celtis reticulata*) (Turner and Karpiscak 1980). In the occasionally inundated area immediately below the normal flood line, these same plants might become established if floods did not reach them, but permanent colonization was not likely. The above the flood line zone was well represented in the canyon areas of the upper portion where there were talus slopes or other areas above the normal flood line; and its vegetation community would likely be found on the benches above the active floodplain.

Plants characteristic of the below flood line zone include Fremont cottonwood (*Populus fremontii*), several species of willows (*Salix* spp.), arrowweed (*Pluchea sericea*) and, where conditions allowed, cattail and reed (*Phragmites communis*) (Turner and Karpiscak 1980). The plant communities in this zone were subject to frequent inundation and washout during high flows. However, reestablishment was generally rapid where suitable substrates existed (Rosenberg et al. 1991).

Flows over the course of the year varied tremendously (USBR 1946, Carlson and Muth 1989). Highest flows were in April to June, coinciding with the spring runoff from the Upper Basin tributaries. Rising flows during this period flooded the bottom lands along the river channe The spring-summer flows passed through the narrow canyons at high velocities and significantly higher stages than flows at other times of the year. Flows decreased over the summer, with some higher flows possible due to local rainfall events in the watershed areas of the Grand Canyon tributaries or the Virgin River. Lowest flows were seen from October to March, at which time the river generally remained within low flow channels. Winter rainfall events resulted in shorter duration higher flows that could be quite significant. While the pattern of flows remained the same each year, the actual flow levels would vary based on rainfall, snowpack, and other factors. Daily variations were observed and could be traced to local rainfall events but were generally not large or consistent in occurrence (Turner and Karpiscak 1980).

Sediment loads in the river were highest during the May-June and August-September periods, with the latter period having the higher levels (Turner and Karpiscak 1980). Sediment was deposited in areas of lower velocity, building banks, beaches and bars; but sediment was removed from areas subject to higher velocities or erosive forces. Higher flow levels or velocities would erode some deposition areas and create or augment others. The inflow into this part of the river provided a source of new sediments coming from upstream sources. The addition of these materials to the system allowed for the maintenance of beaches, banks and bars as sediments were carried downstream out of the area.

The combinations of flows and geology in this portion of the river created a mosaic of habitat options for fish. In the main channel, the interaction of flows and bed composition created a variety of stream bed configurations. Significant differences in depth and current velocity over short distances could occur (Simons et al. 1975, Leopold 1969) and could change with flow rate. Ripples, dunes, antidunes and chutes and pools were features of the river bed that resulted from the interaction of flow and riverbed composition (Simons et al. 1975). Although the flow velocity could be quite high in the main channel, the stream bed configurations allowed for some areas with a reduced current velocity. Examples of these areas would be those immediately downstream of underwater dunes. Creation of islands or mid channel bars also could reduce velocities and create a lower velocity retreat in the side channel, chute, eddy, backwater or slough areas located between the island and the shore. There is considerable variation in current velocity depending upon where along a bar or island the measurement is taken. The riffle-pool sequence provided for deep pools separated by shallow crossings, or alternate bars with the pools located against the concave bank of bends (Simons et al. 1975). Eddies also formed at the detritus fans of the washes and in the lower reaches of tributaries. The watered tributaries also provided some different habitats, being generally smaller and carrying lower flows than the main river. In wider areas, high flows caused inundation of floodplain and bottomland areas, creating slower moving, shallow, water areas that, while ephemeral, were extremely important habitats for refuge and food for native fish species.

Although the load of sediment in the river varied, and thus to an extent light transmission varied, there was little in the way of planktonic plants or animals or rooted aquatic vegetation in the main channel. The shifting instability of the substrate further precluded rooted plants, and was not conducive to aquatic invertebrates. Chironomids and oliochaetes likely were the dominant invertebrates (Carlson and Muth 1989). The slower water areas, where the river was clearer and silts formed the substrate, likely supported a more varied invertebrate fauna, possibly with planktonic plants and animals being more numerous (as they are today in similar habitats) (Minckley 1979, Ohmart et al. 1988). Depending upon age and structure of the area, rooted plants might have been present, but there is little information to suggest this was common in the upper portion of the river.

The riparian areas along the river provided much of the organic input needed to support the aquatic resources. This contribution came in two forms, the first from invertebrate production that entered the river as drift, and the second from leaves and woody material that decomposed in the shallow waters and provided food and substrate for invertebrates and algae. Additional woody or other plant debris was brought into the mainstem from the tributary washes or the Virgin River. Backwaters and marshes or slow-moving areas concentrated organic materials, but there was no barrier to downstream transport of organic compounds.

Given the unstable nature of the river channel throughout this upper portion of the project area, substantial areas of riparian vegetation would not, at first, be expected to occur. However, this was not the case. A large population of beavers was found in the early 1800's in this area along the river (Davis 1973). It is known that in 1853, trees cut by beavers ended up as driftwood used by the Aubry party to construct rafts for crossing the Colorado River near the site of Hoover Dam. In his diary, Aubry noted that by next morning, the rafts had been destroyed by the beavers chewing on the lashings. Both cottonwood and willow then, as now, grew rapidly and were adapted to periodic inundation and elimination through erosion. The constantly renewed stands were sufficient to support sizeable beaver populations. Beaver did not have to cut all the trees they needed, because erosion of upstream riparian areas brought trees to them. The width and flows of the Colorado River in this area likely precluded development of many beaver dams, although side channels and sloughs might have been temporarily blocked off by beaver dams. These beaver-created backwaters augmented the uncommon backwaters and marshes created by the river itself.

Water quality was as important a component of the available habitat as the physical structure. Sediment (as already mentioned) was a major component of both habitat and physical structure. Water temperatures varied both daily and seasonally during any year, with wide fluctuations possible, especially in shallow waters (Minckley 1979, Carlson and Muth 1989). Total dissolved solids concentrations and components were also variable; evaporation losses may have concentrated these ions in some backwater shallows possibly causing some overall downstream increases. Oxygen depletion was not likely a problem in this upper portion of the project area due to the relative lack of deep, isolated backwaters with large amounts of organic material and the prevalence of flowing water conditions that provided for oxygenation of the water.

Lower portion of the project area

The lower portion of the project area is approximately 300 miles long. Unlike the upper portion of the project area, the lower portion was moderately well recorded by explorers, scientists and settlers prior to and during early development. Downstream of Black Canyon, the Colorado River flowed through broad alluvial valleys created by river action (Rosenberg et al. 1991). The only constraints on the river's movement were periodic bedrock areas; these bedrock areas created minor canyons, separating the basins (Hely 1969). Three such areas were the area above the present site of Imperial Dam, the canyon where Parker Dam would be built, and Topock Gorge. These canyon areas constrained river flow and in form and function resembled canyons found further upriver. At certain flows, currents could be quite high with whitewater rapids. Two major tributaries, the Bill Williams and the Gila Rivers, enter the lower portion of this part of the project area. In addition, there were many desert washes and associated debris fans.

The alluvial materials of the valley floors allowed the Colorado River to meander through the floodplain and bottomlands. The cycle of erosion and deposition created, and eventually destroyed, a series of terraces along the banks of the river (Grinnell 1914). These terraces were prone to varying degrees of inundation, depending upon the runoff level of the particular year and height of terraces above the river channel. Deposition of sediments in the channel itself created islands and bars, and the river could take on a braided configuration. Bars and islands were similar in form and function to the same forms upstream. The erodibility of the materials in the terraces and the force of the river flows created cut banks several feet high in some areas (Ohmart 1979). Flow dynamics led to the creation of oxbow lakes when meanders were cut off from the main channel. These lakes were not permanent, and their life span depended upon the availability of water which might reaceeper backwater lakes with good water connections to the river or the river water table yet outside the area of frequent inundation might have lasted longer. In the 1800's, some of these larger backwaters were permanent enough features that they had been named by settlers (Ohmart et al. 1975). Most backwater lakes were not large, and changed rather quickly to marshes, then to terraces or were completely filled in by single flood events. While in a geologic sense, these backwater lakes were transitory, their life spans could be 50 to 70 years (Ohmart et al. 1975). Such life spans were not inconsequential and allowed for the development of habitat features to support fish and other aquatic life. The large numbers of beaver found along the river, with their small dams, also created backwaters. These dams would likely be washed out by the yearly high water events. Another type of backwater was even more ephemeral and may have been much more common along the river. The lowest terraces of the river were flooded during late spring and early summer. For native fish, these flooded bottomlands provided feeding and refuge areas from the high flows in the main channel. The presence and extent of these temporary lakes (sloughs) were noted by explorers and Native Americans, who fished these areas with nets and traps (Ohmart 1979).

The presence of abundant riparian vegetation in many places along the river was reported by many diarists. Riparian tree and shrub communities were established on the terraces, bars and beaches along the river and could extend several miles back from the active channel. The specific type of vegetation present depended upon how high above the normal flood line the terrace or beach was located (Grinnell 1914, Rosenberg et al. 1991). The highest terraces if not inundated, supported thickets of western honey mesquite with an understory of various shrubs. On the lower terraces, arrowweed was found in drier locations, with willows dominating the inundated areas.

Many historscribe the presence of marsh vegetation and give the impression that considerable marshland existed. This may have been true in some specific areas, such as at the confluence with the Gila River and at times with the Bill Williams River. Marsh development along the rest of the river in the lower portion of the project area was limited. Shallow marshes would fill in quickly during floods, and were susceptible to drying out as the river shifted away from them. Several accounts mention the presence of marsh vegetation (reeds or "tules") away from the tributary confluences but not with any sense of real abundance (Davis 1973, Ohmart 1979). Marshes could develop at the lowest terrace where flood waters persisted over long periods or where the water table was at the surface. Marsh vegetation such as cattail, bulrushes (*Scirpus* spp.) and reed were found in these areas. Reeds were so abundant in some areas that they could in some instances stabilize the sediments along the banks of the active channel (Ohmart 1979).

As discussed earlier, cottonwoods and willows are fast growing species of trees adapted to the frequently flooded bottomlands (Rosenberg et al. 1991). These communities were subject to erosion of substrate, prolonged inundation that could kill trees, or relocations of the channel that isolated these vegetative communities from the water needed for proper growth and maintenance. Such communities were "short-lived" because of these factors. While some areas, especially those in the canyons or other river reaches lacking significant floodplain, did not support extensive riparian vegetation, many other places did. Early diarists noted the presence of everything at various times and places along the river from a scarcity of any trees at all, to dense willow and cottonwood thickets, to gallery forests (Davis 1973, Ohmart 1979). There was sufficient wood in the cottonwood, willow and mesquite areas to support steamboats, ranching, mining, domestic use and other activities along the river for many years. Also noted was the rapid regeneration of the cottonwood-willow forest after cutting or other disturbance (Davis 1973, Grinnell 1914, Ohmart 1979).

Flow patterns through the lower portion of the project area were not significantly different from those in the upper portion, although the times of peak flows might be shifted to slightly later in the year. Highest flows were in the late spring to early summer, with decreasing flows from summer to spring. Rainfall events on the Bill Williams watershed might provide a brief inflow peak during the summer or winter rainy seasons. Flows from the Gila River were substantial and could be a significant part of the flow to the Sea of Cortes that maintained the marsh and riparian habitats below the SIB. Both drought and high flood years could be devastating to the backwater, marsh and riparian communities along the river.

Especially during the high flow months (late spring to early summer), when significant erosion of the terraces was taking place, the sediment loads carried by the river were extremely high. This sediment built bars and islands in the channel and in the inundation areas, and raised the heights of the terraces after each event. It also filled in marshes and backwaters during flood events. The amount of sediment coming into the system each year, combined with the relocation of existing sediments, caused aggradation in some areas, while active erosion occurred in others (Minckley 1979). During periods of lower flows and in areas of quiet water, the water became significantly clearer.

As in the upper portion of the project area, the riparian vegetation communities provided a significant amount of organic material to support the system. The river channel itself, with its shifting sand/silt bottom supported a limited invertebrate fauna. Plankton growth in the more turbid main channel was depressed by turbidity. Invertebrate drift in the main channel was largely dependent upon the terrestrial insects from the riparian communities. In backwater areas, the deposited sediment formed a soft substion and clearer water, and provided increased invertebrate, plankton and algal populations. Aquatic plants could also root and grow in these areas. The inundated bottom lands provided an important source of organic material to the system. As with the upper portion of the project area, there were no barriers to downstream transport of organic compounds.

Water quality was an important issue in aquatic habitats in the lower portion of the project area. Salinities and total dissolved solids in the water were increased by high evaporation rates. Isolated waters could quickly become uninhabitable for most aquatic organisms. Several diarists mentioned seeing white salts or other material on the ground surface of some dry banks or sloughs. Air temperatures were very high in the summer, and water temperatures, especially in shallow areas with little inflow, could reach 30° C (Carlson and Muth 1989). Oxygen depletion in backwaters and marshes was very possible during the hot summer months.

There were a variety of habitats available to fish in the lower portion of the project area. Main channel pools and runs, side channels, eddies, oxbows, bars and islands were located throughout the reach. There were limited amounts of canyon type habitats, but a greater abundance of sloughs, lagoons, other inundation areas and backwaters than in the upper portion of the project area. Even more so than the upper portion, habitats in this lower portion were very physiologically demanding. Tolerance for high temperatures, high salinities, and low oxygen was needed to get through the difficult periods. High flow events reshaped the floodplain and available habitats in ways that canyon bound reaches did not usually experience.

Native aquatic species

Of the ten native fish species in the Colorado River in the area of interest, only two are involved in this consultation. The bonytail chub and razorback sucker were common to abundant in the Colorado River prior to 1823, and some information documenting their decline in the years leading up to the present day is available. There are two areas of interest; the first is related to abundance, the second to habitat use and availability.

Early estimates of fish abundance are very unspecific. The diarist period spans several decades and normal population cycles and seasonal abundance in a particular area combined with drought and flood effects compound errors in any estimates. Variously, diarists described "few" or "many" fish of several types (Davis 1973, Ohmart 1979) present in a variety of locations along the river. In some cases, we can determine which native fish were discussed. For example, when diarists referred to "salmon," they probably meant Colorado squawfish. References to suckers could have been razorback suckers or flannelmouth suckers (*Catostomus latipinnis*). Similarly, "trout" could have been bonytail or roundtail chubs or something else.

Fish were common in the diet of Colorado River tribes (Miller 1955, Davis 1973, Ohmart 1979). Capture methods recorded in historic accounts included traps, nets, and hook and line using cactus spine hooks (Palmer 1878). In the 1700's, catch rates for setting nets and traps in lagoons near what is now Yuma was estimated at 37 pounds of fish an hour (Eixarch 1977 in Ohmart 1979). That was at the start of the lagoon fishing season in February. Records up to 1911 reveal Colorado squawfish, razorback suckers and bonytail chubs ran up into irrigation canals near Yuma in such numbers that they clogged the outlets and had to be pitchforked out and used for fertilizer (Miller 1961, Minckley 1965). Observations of fish in the highly turbid waters of the mainstem were unlikely, and attempts to capture fish under these conditions had li. In 1914, Grinnell captured razorback suckers and bonytail chub in a backwater in the spring and observed Colorado squawfish moving upstream but stopped below Laguna Dam in April. Not many people recorded abundance of fish in the river during the pre-development and early development periods. Fish might have been more or less abundant than the records show and may have been only easily noticeable at certain times and places. The general conclusion reached by various researchers is that the razorback sucker and Colorado squawfish were abundant in the pre-development period and the bonytail chub was at least common (Dill 1944, Miller 1961, Minckley 1979).

The available information is not sufficient to determine how these native fish species might have been seasonally distributed in the available habitats of the action area. More recent information is available from the Upper Basin on the habitat use of these fish. Although conditions are not entirely the same between the two Basins, it is reasonable to use the life history information summarized elsewhere in this document and provided in other sources to gain an understanding of how these native fish seasonally used the habitats available to them in the pre-development baseline of the LCR. Minckley (1979) provided a discussion of habitat use in his work that is herein incorporated in summary.

The bonytail chub became rare long before scientists were able to fully assess its habitat requirements. In the Upper Basin, it is assumed to be a mainstem species, utilizing pools and eddies (Minckley 1973, Vanicek 1967) rather than fast flowing areas. The physical adaptations seen in body form are thought to address the problems of moving around in a fast flowing system in order to reach slower water areas and to deal with floods (Minckley 1973). These types of slow-water habitats were widely available through the project area. Grinnell (1914) captured bonytail chubs with razorback suckers in a backwater in early spring; therefore these habitats were used to some extent by native fish. The ability of bonytail chubs to successfully survive in small hatchery ponds and large reservoirs may be related to use of and adaptations to backwaters in the wild. We know very little about spawning behavior or spawning habitat in rivers, although from the reservoir data (Jonez and Sumner 1954, Wagner 1955) it is surmised that gravel and similar hard substrates were used. Spawning in bonytail chub is in late spring to early summer, later than that for the razorback sucker. There is no information on any type of bonytail chub spawning migrations, although they were taken in irrigation canals. Habitat needs for juvenile fish are not known. Young bonytail chubs feed on invertebrates taken from the substrate. Sub-adults and adults also utilize floating food items, particularly terrestrial insects. The extensive riparian areas along the Colorado River would have provided a source of insects to the river. Water quality issues in the backwaters and sloughs presumably affected seasonal use of these habitats.

Based on present information from the Upper Basin, habitats for the razorback sucker are generally slower moving portions of the mainstem, and, when available, inundated bottomlands and sloughs. Spawning takes place in the spring, starting (in Lake Mohave) in January or February and running until April, with staging beginning as early as November (Minckley et al. 1991). There are records suggesting that spawning migrations occurred (Minckley et al. 1991). Some fish may not have migrated at all but used the nearest gravel fan available. These migrations may have been the cause for entrainment in irrigation canals. Spawning areas required a harder substrate than the shifting sand of the river bed. Gravel bars and debris fans at the mouths of desert washes provided the necessary features and these were not uncommon along the river (Loudermilk 1985). In the Upper Basin, spawning behaviors have been observed in mainstem reaches with flat water, backwaters and creek mouths usually with gravel to cobble substrates. Similar habitats were available in the project area. The spawning period took place just before and at the start of spring floods. The newly inundated bottomlands would then be available for the young of the year fish as feeding and refuge areas. Young of the year razorback suckers were found not only in inundated bottomlands but also in backwaters and tributary mouths (Smith 1959 and Taba et al. 1965 *In* Minckley et al. 1991). Young razorback suckers apparently moved downstream after hatching (Minckley et al. 1991) but the optimal distance between spawning areas and rearing areas is not known. The lower portion of the project area was well supplied with the inundated bottomlands n other places of quiet water (Minckley et al. 1991). Inundated bottomlands were used until water levels dropped enough to dry them up. In the absence of backwater type habitats, razorback suckers used deep pools, areas behind obstructions, slow-moving side channels, runs, and the areas of lower velocity behind underwater dunes (Minckley et al. 1991). All of these habitat types were available in the project area. Although razorback suckers do not generally reside in fast-water canyon areas, these areas did not necessarily constitute a barrier to passage, and individuals ranged through the entire reach. Research from the Upper Basin indicates that some, but not all, razorback suckers have significant non-spawning movements.

Water quality in backwaters and inundated bottomlands may have been a problem for young and adult razorback suckers using these areas. Movement to the main channel quiet water habitats may have occurred as conditions deteriorated. Grinnell noted numerous carp (*Cyprinus carpio*) and catfish (*Ictalurus punctatus*) in clear water lagoons and sloughs but did not mention observing any native fish there. However, both razorback and bonytail were captured in a backwater where there were both carp and catfish (Grinnell 1914). Both of these non-natives are potential predators on native fish.

Human Uses of the Colorado River

Early uses: pre-1823

Early uses of the Colorado River in the action area had effects more on the local than regional scale. Clearing and use of inundated bottomlands for subsistence agriculture by Native American peoples did reduce riparian vegetation in localized areas. Use of cottonwood, willow and mesquite for domestic purposes also reduced the amount of riparian vegetation on a local scale. Maintaining agricultural fields prevented the regrowth of riparian vegetation, but where possible, both cottonwood and willow regenerated very rapidly along the river. The mesquite portion of the riparian forests, although slow growing, was an important source of food for the Native American people. It is not likely that activities they undertook significantly reduced the acreage of this vegetation community.

Effects to the river channel from Native American activities were limited. There were no significant diversions made from the river and floodwaters provided much of the irrigation needed. Protective stands of riparian vegetation were removed for agricultural terracing or other uses and thus were susceptible to erosion during high flows; but the amount of erosion is difficult to estimate. No levees or bank stabilization or training structures were in place. River functions were controlled by natural forces. There were no barriers to fish movement through the Colorado River, up the Gila River or down to the Colorado River delta except those resulting from natural river dynamics.

During the period of Spanish exploration and mission development, the LCR was used as a travel corridor. Cattle and burros were introduced to the region sometime in this period and likely grazed along the river, affecting riparian and emergent aquatic vegetation.

Populations of the razorback sucker, bonytail chub and Colorado squawfish were exploited for food by the Native Americans. These fish were actively sought and may have been seasonally more susceptible to capture (Ohmart 1979). One diarist in 1776 noted that catches of 37f fish per hour were made using traps and nets in lagoons (Ohmart 1979). The sizes of the fish populations varied due to environmental factors, with no evidence overharvesting. During this period, no non-native fish or invertebrate species were introduced into the LCR.

Initial development: 1823-1909

Early activities by the trappers and explorers had limited effects on the river environment. Removal of beavers may have had effects on the numbers of small backwaters, but the extent of this is not known, and beaver populations rebounded after trapping declined in the 1830's. Permanent settlements emerged adjacent to military posts, ferry points, mines, and farming/ranching areas.

The need for ferry service across the Colorado River to allow passage to California, the development of mines near the river, and the need for a way to deliver supplies to military posts and other settlements along the river and the interior of Arizona led to the development of navigation companies. Steamboats would collect cargo from sailing ships or steamships at the ports down in the delta and transport the materials up the Colorado River as far as Callville (submerged by Lake Mead after 1935) (Leavitt 1943). At the height of the period, about 35 trips per year upriver from Yuma were made by the steamboats (Leavitt 1943).

By far the major effect of the river steamboats was the harvest of cottonwood, willow and mesquite for fuel. Fuel stations were set up along the river and most of the suitable trees were used up by 1877 when railroads largely replaced steamboats for carrying cargo. Regeneration of the forests occurred naturally, although we do not know if the extent of cutting and the type of trees taken had any significant effect on the mosaic of riparian community age structure along the river as a whole. These uses might have set succession back over a large area and possibly affected erosion of lower terraces.

Docking facilities likely had little to no effect on the river itself and such structures likely had to be replaced following high flows. The river steamboats had a very shallow draft and could operate in a few feet of water. When they did go aground, there was local disturbance to the immediate areas during efforts to refloat the boats. These effects were transitory. Between 1869 anix surveys evaluated the potential for channel improvements to improve navigability. Only two, one in 1884 for channel work between Mohave and El Dorado Canyon, and another in 1892 for a levee along the Gila River, actually determined channel improvement projects were feasible (Leavitt 1943). The channel improvements in 1884 likely had little to no lasting effect to the river. However, the construction of the Gila River levee was tied to a larger pattern of effects from settlements along the banks of the river.

In 1877, Thomas Blythe made the first application for diversion of water from the LCR to the Palo Verde Valley in California. Other diversions for irrigation in the Yuma and Gila Valleys in Arizona and the Palo Verde and Imperial Valleys in California followed. Some of this new agricultural land was located along the terraces of the river and replaced the mesquite and cottonwood-willow forests. However, significant amounts of agricultural development were in fertile valleys away from the river itself.

The beginnings of significant agricultural development along the river affected the extent and location of the riparian forests and their ability to regenerate. Riverside lands converted to agriculture were lost to riparian vegetation as well as to potential marshes and backwaters. There might have been changes to local erosion and deposition patterns due to the cleared terraces, but the extent and meaning of these are not known. Construction of diversion structures did not create large, permanent barriers to movements of fish or water, and did not result in reservoir formation. Their barrier effect was greatest during periods of drought or seasonal low water. During high flows, these diversion barriers would often be destroyed.

Efforts to protect agricultural fields from flooding resulted in the first of the levees along the river. The first levees were placed near Yuma in 1902 (COE 1982). With the strength of the high flows of the river, the success of these structures was dubious at best.

The amount of total Colorado River flow diverted during this period increased as the irrigated acreage increased. The actual diversion depended upon the river flow at the time. During high flows, the percent diverted may not have been significant. Diversions during moderate periods may have been locally more significant, but the degree of effects to overall aquatic habitats is not known. At low flows, if the diversion was capable of taking a majority of the water, it could partially dewater the downstream segment of the river. The extent of this dewatering may not have been widespread.

Perhaps the most significant effect of human activities and development in the watershed of the LCR between 1823 and 1909 was the sequence of events that led to the inadvertent diversion of the Colorado River to the Salton Sink in November 1905. Overflows of the river to the sink were nords exist for such flows in 1840, 1842, 1852, 1859, 1862, 1867, and 1891 (Ohmart 1979). The 1905 overflow was different, and resulted from a series of natural causes overlying significant changes to the watershed, a discussion of which follows.

The Gila River was the largest tributary to the Colorado River in the project area. Reports from the early diarists indicated that the river was perennial with large marsh and riparian areas associated with it (Davis 1973, Ohmart 1979, Rea 1983). By the middle of the 1800's, the number of livestock grazing on the Gila River watershed began to increase dramatically. The drought cycle that began in the 1860's did not reverse that trend, and overgrazing of the range became more and more significant. By the time of the drought of 1891-1893 (Hastings and Turner 1965), adverse effects to both upland and riparian vegetation, loss of surface flow and the initiation of arroyo cutting had occurred along at least the middle reaches of the Gila River. By the end of the 1800's, the channel and riparian floodplain had been adversely affected to the extent that flood events were more erosive and moved faster through the system. In November, 1905, a very large winter rain-caused flood event went down the Gila River and joined the Colorado River's similarly high flow. A few miles below the confluence, the combined rivers broke through a cut and flowed west down the Alamo Canal, north along the Alamo river, and into the Salton Sink. Unlike previous overflows, the entire capacity of the Colorado River was diverted. This situation continued until November 1906 when the river was diverted back into its channel. About that same time, another winter rain flood came down the Gila River and may have contributed to the failure of the repairs and the flow returned to the Salton Sea. The Colorado River was not finally returned to its channel again until February 1907.

At the end of this period of development, there were some changes to the river in terms of age structure and extent of the riparian forests, in both the cottonwood-willow and mesquite. There may have been some losses to backwaters and marshes from conversion of those lands to agriculture, but use of the very low lying lands for agriculture was not practicable given the periodic flooding. There were some changes in flows due to diversions, and these had some effects that are difficult to quantify and may not have been regionally significant. There were no man-made barriers to movement within the system. The Gila River had been significantly affected by watershed conditions and dry cycles and may have lost much of its native fish value, and use of the Gila Basin by fish in the Colorado may have been compromised. The inadvertent diversion of the entire flow of the Colorado and Gila Rivers to the Salton Sea was both a natural and human development related event, and it created a large lake, something that had not been recently present in the system. That inadvertent diversion also had some effects on physical habitats of the Colorado River below the diversion and to the delta and the biotic resources there. These effects would be related to the reduction in flows through the areas and changes in salinity patterns where there was a tidal effect from the Sea of Cortez.

In addition to looking at the physical effects to the river, the presence of carp after 1885 and channel catfish after 1892 complicate the analysis. The information available on the status and distribution of non-native fish populations in the late 1800's is almost entirely anecdotal.

The development of the floodplain terraces for agriculture eliminated their value as riparian, marsh and backwater areas for fish habitats. With the placement of levees, floodwaters could no longer reach these important habitats, thus even seasonally inundated areas could be lost. Changes in erosion patterns due to lack of vegetative cover and the placement of levees may have had effects on erosion and deposition on downstream habitats. The placement of diversions may have been a temporary barrier to movement, but it is likely that most significant migrations took place during high water periods when functions of such barriers were inconsequential. The effect of actual water diversions varied greatly, largely dependent upon local water conditions. Where water levels were already low, removal of some portion of the water could result in a fish kill if the habitat dried up or water quality declined due to evaporation. At some point, the loss of fish could have been significant. Losses to young fish, perhaps even whole cohorts, could occur. The removal of water for irrigation would be of special concern during drought years when water levels were already low.

Overall, water quality in general did not change much. There may have been some increase in total dissolved solids and salinity from increased irrigation returns, but the proportion of these returns was still small. Continued evaporation of water during low water periods and droughts likely had more effect on water quality.

The presence of carp and channel catfish in the Colorado River in the late 1800's is documented, but the extent of their presence and the size of their populations is not fully understood. We do know they were observed in clearer water areas such as backwaters (Grinnell 1914), but their use of the main channel habitats is unknown. Both species use main channel habitats in other rivers, and physical conditions in the Colorado River were not preclude this possibility. Drought and low water conditions put stress on these introduced fishes as well as on the native species. Both carp and channel catfish are resilient species, capable of surviving in difficult environments. Whether the largely unmodified habitats of the Colorado River were fully usable by these species is unknown.

At the end of this period, 1823-1909, populations of all three native fish remained abundant or at least common in the Colorado River in the project area despite a fish kill late in the 1800's caused by "alkali" water from the Gila River (Sykes 1937 in Minckley 1979). Significant numbers of razorback suckers and bonytail were recorded in the Salton Sea as well (Miller 1961, Minckley 1983). Despite drought and flood, no noteworthy declines in the populations were observed, although we do not have any information on the age structure of the populations at the end of the period.

Dam construction: 1909-1954

This period marked the first significant regional changes to the LCR from water development activities. By 1913, as additional lands were converted to agriculture, both along the river and in the more remote valleys, irrigated acreage from the Virgin River to the boundary with Mexico totaled 367,000 acres, 53,000 of which were along the river itself. By 1927, 95,000 acres of irrigated land were found along the river. The water supply of the Colorado River was estimated and divided for human uses among the Basin States and Mexico, thus setting the parameters for development (USBR 1946).

In 1909, Laguna Dam was completed and provided a diversion point for water to off-river lands in Arizona and California. Silt was trapped behind the dam and water was backed up for several miles, inundating and drowning riparian vegetation (Grinnell 1914) and creating a large, slack-water habitat in certain seasons. It also acted as a barrier to fish passage at least at some seasons. Grinnell (1914) recorded that Colorado squawfish were staged below the dam in April. Laguna Dam was built strictly as an agricultural diversion and did not create a significant reservoir pool to store water or control the floods of the Colorado River.

The decision to construct Hoover Dam was driven by the need to control the floods that damaged agricultural lands and facilities. The number and extent of levees along the banks of the river were not sufficient to control the river and required expensive maintenance and strengthening (USBR 1946). The closure of Hoover Dam in 1935 definitely had the most significant physical effects to the river in the project area of any action before or since.

Hoover Dam significantly altered the natural hydrograph of the river. High spring and summer flows were captured and stored and the water released later in the year in a controlled manner to provide sufficient water for irrigation needs and to meet other downstream obligations. The early 1930's were drought years, with flows in 1931 and 1933-37 all below average (USBR 1946, Hely 1969). The worst year was 1934 with an annual flow of only 6,573,000 acre-feet (COE 1982), less than half of long term average flows. Flows at Yuma in August, 1934 reached a low of 18 cubic feet per second (Dill 1944), and the adverse effects to aquatic and riparian habitats and fish populations must have been tremendous. After this difficult period, a normal hydrograph was not resumed in the LCR. Starting in 1935, flows below Hoover Dam were controlled by releases made to provide flood control, water storage for irrigation and power needs. Flows to provide for the natural river hydrograph were not considered in the development of Law of the River documents.

These changes to the natural river flows significantly altered the fish habitats available. Without high spring and early summer flows, there was a reduction in inundated bottomlands and flows through backwaters and marshes. Erosion and deposition altered fish migration or spawning cues based on rising water levels and did not follow previous patterns. Access from the lower reaches of the river to the upper reaches and the Grand Canyon was completely prevented by Hoover Dam, severing migration routes and isolating portions of each of the fish populations from each other. Lower water levels may have left some spawning and nursery backwater sites dry. The river's ability to meander and to create or destroy backwaters and marshes was reduced with the reduction in flows. Water availability to higher terraces was minimized. Without the threat of floods, additional terrace lands containing riparian vegetation could be converted to agriculture. Levees could be constructed to more easily contain the water remaining in the river.

The closure of Hoover Dam also created a large reservoir, Lake Mead, on the mainstem of the river, inundating miles of river, riparian areas and the associated habitats with hundreds of feet of water. Reservoir shorelines had little chance to develop riparian areas due to the fluctuations in water levels caused by the operation plans. Lake Mead became a sediment trap. Sediment laden waters coming out of the Grand Canyon slowed when they reached portions of the river affected by reservoir elevation and thus sediments were deposited (Hamblin and Hardy 1969, Turner and Karpiscak 1980). Raising and lowering the reservoir level alternatively eroded and deposited these materials within the reservoir and its area of influence upriver. Such river dynamics created areas where riparian vegetation could develop, but these water fluctuations also could retard the development of these areas.

Because the sediment was trapped in Lake Mead, water released from Hoover Dam was clear. ters picked up sediment from the river bed below the dam and carried it downstream, causing a net movement of sediment out of the system because the input of fine material into the system was now limited to desert washes and this input did not balance the output. The clear water and progressively armored substrates extended further down the Black Canyon each year (Moffett 1942). Once Lake Mead filled, the water released was also significantly colder than at the inflow from the Grand Canyon and water temperature varied little over the year, maintaining a range of 22° to 16° C (Moffett 1942, Dill 1944, Allan and Roden 1978).

Before 1940, two additional dams had been added to the river. Parker Dam formed another complete upstream barrier to fish, further inundated riparian vegetation and riverine aquatic habitats, created a large reservoir, regulated water flows, and allowed for a large, and fairly constant diversion from the Colorado River by the Metropolitan Water District of Southern California. Just as with the upper end of Lake Mead, a delta began to form at the head of Lake Havasu as sediment was deposited. A large marsh area was created; yet large areas of riparian vegetation were also destroyed to create Topock Marsh. As Lake Havasu does not fluctuate to the extent Lake Mead does, there were more opportunities for new riparian and marsh habitats to develop in its delta area. Water released from Parker Dam was clear and erosive, carrying deposited sediments upstream, but it was not a cold tailrace. The much smaller Imperial Dam was much less of a barrier, but did trap sediment behind it and significantly increased the size of the ponded area resulting from Laguna Dam. Additional areas of riparian vegetation were lost, but the larger slack-water area provided for backwater-type habitats. Water diversions for California and Arizona were made from Imperial Dam, replacing diversions from Laguna Dam.

The last large dam, Davis Dam, was completed in 1950 and finally closed in 1954. This created Lake Mohave, which drowned out another large valley and miles of riverine habitats and backed up the Black Canyon to the tailrace of Hoover Dam. Davis Dam has a cold tailrace; sediment transport below the dam created another clear, armored channel. Davis Dam was also a complete upstream barrier to fish movement. Between the effects of the three large dams, the Colorado River was no longer a connected series of habitats, reachable from any part of the system. Much of the upper portion of the action area had been converted to reservoirs. The northern area of the lower portion had also been converted to reservoirs, but the southern portion was still riverine, although flows were almost completely controlled by releases from the dams.

During this period, several other projects for irrigation diversion came on line. Headgate Rock Dam was completed in 1946 to provide irrigation water to the Colorado River Indian Tribes. Morelos Dam was completed in 1950 to provide irrigation water to portions of Mexico. The Gila Gravity Main Canal (1939), All-American Canal (1940), Siphon Drop (1941) and Coachella Canal (1948) transported Colorado River water to farms in Arizona and California. These actions contributed to the additional fragmentation of habitats and alteration of flows.

The small reservoir behind Imperial Dam in no way compared in size or depth with Lake Havasu behind Parker Dam, Lake Mohave behind Davis Dam, or the enormous Lake Mead behind Hoover Dam. But Imperial Reservoir was probably the largest "backwater" ever known along the Colorado River. Like the ponded area behind Laguna Dam, water backed up more or less permanently onto the lower terraces, drowning out cottonwoods, willows and some mesquite. Miles of river, bottomlands, terraces and uplands were inundated by Havasu, Mohave, and Mead. New habitat was created, a lake-like reservoir, that had not been present on the mainstem before.

In addition to being sediment traps, the large reservoirs also trapped organic material and dissolved nutrients. Waters released from the dams did not contain the same level of organic material that would provide for primary productivity in the downstream backwaters. The reduction of riparian vegetation inundated by reservoir pools and due to agricultural development further diminished the amount of organic input to the system. Irrigation returns contained higher levels of dissolved solids, organics from fertilizers, pesticide and herbicide residuals and caused an overall reduction in the quality of the water remaining in the river.

As noted previously, at the heads of Lakes Mead and Havasu, the slowing of river flows deposited sediment loads and created depositional deltas. Riparian vegetation could establish on portions of these sites, but its persistence was variable and linked to management of reservoir levels. At what is now Topock Marsh at the head of Lake Havasu, deposition of sediment raised water levels and drowned out mesquite bosques on the upper terraces. Marshes also formed at the confluence of the Colorado River and Bill Williams, now in Lake Havasu. The total area of new marshes may have been larger than that previously known on the river. The creation of these new habitats resulted in the deliberate introduction of additional non-native fish species. Largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), and black crappie (*Pomoxis nigromaculatus*) were introduced into Lake Mead to provide a sport fishery. Rainbow trout (*Oncorhynchus mykiss*) were stocked into the tailrace of Hoover Dam for the same purpose. Additional stockings of these species were made in other locations on the river. Red shiners (*Notropis lutrensis*) were also introduced as forage fish. Populations of these new species, along with the carp, channel catfish and other non-native species accidentally introduced, expanded throughout the radically altered system. Dill (1944) reported that the spread and increase in size of non-native fish populations did not occur until after the completion of Hoover Dam.

Populations of native fish underwent significant declines early in this period. Razorback suckers were thought to be holding their own in reservoirs (Miller 1961), and populations in Lake Mead were larger than those in the newly completed Lake Mohave (Wallis 1951). In the Colorado River below the big reservoirs, razorback suckers became rare (Minckley and Deacon 1968, Minckley 1973). Bonytail chub were reported as at least common in the early 1940's in Lake Mead (Moffett 1943 in Wallis 1951), but were much less common in the 1950's (Wallis 1951, Jonez and Sumner 1954). In Lake Mohave, the bonytail was observed more often (Jonez and Sumner 1954, Allan and Roden 1978), but it was still considered rare. There is limited information on the river below the dams, but locals told Dill (1944) that the once common bonytail chub was now rarely seen. The Colorado squawfish populations in the project area were essentially gone by the 1950's. Significant declines were noted in the 1930-1935 period (Miller 1961) with a few caught in the system until the late 1940's (Moffett 1942, Dill 1944, Wallis 1951, Jonez and Sumner 1954, Allan and Roden 1978, USFWS 1980).

Rather than focussing on one or another of the changes (physical or biological) to the river as the definitive cause for the declines in native fish populations, it is more likely that a combination of circumstances was responsible. While specific data on abundance and age structure are lacking, available anecdotal information does not indicate any precipitous increases or decreases in observed native fish population levels prior to the 1930's. From a habitat perspective, there had been some changes due to diversions, development of agricultural lands, and other effects to the watersheds prior to this period. Changes in water quality and the beginnings of nutrient retention in reservoirs could also be a factor. As far as flows in the river, overall, in the period 1897-1930, average discharge of the Colorado River was 15,297 acre-feet at Lees Ferry (USBR 1946), which is higher than the long term average of 14,400 acre-feet. Years with sufficient flows at the right time to have successful spawning and recruitment must have occurred within that period, allowing for maintenance of varied age structures in the populations. We do not accurately know the extent or expansion of non-native fish species and their status at the start of the period.

After the construction of Hoover Dam, the resultant changes to the Colorado River in the project area dramatically altered physical conditions. Those altered conditions came after another short drought cycle, with the river never returning to its pre-1930 condition. Non-native fish populations increased (Dill 1944), including additional species introduced to the river. While all fish species, native and non-native, were stressed by the drought situation, once that stress was relieved, the physical conditions that were restored were not the historic ones. Despite being adapted to a widely fluctuating, physically demanding aquatic habitat, the native Colorado River fish were specialized to function within those conditions.

For example, the rise of the river in the late spring and early summer may have been a cue to initiate spawning activity for Colorado squawfish (USFWS 1991). Without that cue, because of the storage of high flows behind Hoover Dam, maturation and spawning might have been impaired. The precise locations of spawning areas for the three native species prior to dam construction are not known. Closure of the dams isolated portions of the populations from each other, and from essential habitats, presumably including historic spawning locations. Essential habitats might also have been inundated during reservoir formation. For the Colorado squawfish and perhaps razorback sucker, migratory routes to spawning areas might have been blocked by Hoover Dam. Passage for larvae downstream to rearing areas in the few remaining inundated bottomlands was similarly hampered. Expansion of non-native fish populations into the remaining backwaters, the main channel and the reservoirs increased the level of predators, something the native fish had not had to cope with before. Ordinarily, predators have a pattern of behaviors that prey species develop defenses against. Prey species faced with new predators using different patterns generally do not fare well unless they can quickly adapt.

The declines in the populations of razorback suckers and bonytail during the period 1909-1954 were not as dramatic as those of the Colorado squawfish, but they were significant and largely occurred for the same reasons. As with Colorado squawfish, large numbers of adult fish were lost in irrigation canals and never returned to the river but were carted off to be used as fertilizer (Miller 1961). Both species persisted in reservoirs at the end of the period but the riverine populations were depleted.

It is significant to note that razorback suckers did manage to have several years of recruitment to the population trapped in Lake Mohave. Reports after the dam had closed indicated the population was not as large as that in Lake Mead (Wallis 1951). Data from captured fish from Lake Mohave in the next period showed there had been recruitment to the population at least from 1937 to about 1957 with a "peak" in the late 1940's to early 1950's (McCarthy and Minckley 1987). Recruitment after the mid-1950's for both the bonytail chub and the razorback sucker has been virtually non-existent. Recent reports of the presence of spawning razorback suckers in Lake Mead has raised questions as to the source and age of these fish.

Channel modification: 1954-1996

The large dams on the Colorado River provided for controlled releases of water when needed and prevented large floods. The dams did not, however, exert the same measure of control over what effect the released water had in the river channels. Meanders and braided channels continued to be formed. Sediment loads were carried downriver and deposited at the head of Lake Havasu and behind Imperial Dam.

The Colorado River Front Work and Levee System provided Reclamation with the responsibility for managing the Colorado River and its floodplain. This responsibility dates back to 1925, but the most significant law was that of 1946 which authorized funding to Reclamation to manage the river. This included operating the Front Work and Levee System, constructing and improving protective structures and drainage systems, improving and straightening the river channel and conducting investigations and studies pertaining thereto. The purposes of these activities fall into three main categories. The purposes for physical conditions were flood control, sediment control, water savings, navigational improvement, and river regulation. The economic purposes were salinity control, improvement of drainage on adjacent agricultural lands, enhanced land values, and recreation and recreational development. Environmental goals were protection of the environment and fish and wildlife preservation (USACOE 1982).

Starting in 1902, levees were constructed along the river to protect agricultural developments

(USACOE and BR 1982), but until the threat of high floods was addressed, control of the river was not practicable. With the construction of the large dams along the river, it became more feasible to address additional control of the river.

Reclamation's BA addresses the placement of levees and bank stabilization structures, as well as the amount of dredging necessary to maintain channels and settling basins from Davis Dam to the SIB. Minckley (1979) includes information on the amount of channelization per r A description of the existing (1996) works under this program is included in the BA and will not be repeated here.

Bankline stabilization and dredging programs were intermittently undertaken by Reclamation from 1951 onward. The physical control of the river was achieved by bankline stabilization, training structures, channel realignment and levee construction. Dredging operations were important to channel realignment, sediment control, and environmental enhancement and mitigation. By 1996, 167.46 miles of bankline stabilization and 113.8 miles of levees lined the river from Davis Dam to the SIB.

Depending upon placement, the effects of levees can be minimal or significant. If placed at the outer edge of the floodplain, there is likely to be little to no effect except in the instance of a flood for which portions of the floodplain are beyond the levee. Since levees tend to reclaim lands from the floodplain for development purposes, their placement can narrow or otherwise restrict the floodplain. Assuming that levees remain in place during high water, flows through the narrowed floodplain are likely to be deeper and faster than if the channel were wider. Erosion and deposition patterns are likely to be different and may significantly alter the channel morphology. Depending upon the degree to which the channel has been narrowed, there may be increased deposition of materials at the lower end of the levee if water is allowed to spread out into a wider channel past that point. Marsh and riparian vegetation may establish here, and at low flows water may pond up on the upstream side. Marshes and backwaters nearest to the active channel are always more at risk of being adversely affected by high flows because they are subjected to more frequent high flows. The areas affected may be altered due to the inability of the river to spread out over a wider area. There is opportunity for new marsh and backwaters to form, but they may be subject to shorter life expectancies since they may be affectective floods more often. The marshes, backwaters and riparian forests behind the levee are almost entirely lost. Any remaining areas would lose accessibility to the river. With reductions to backwaters, marshes, and riparian areas, there is less organic material input to the system and fewer places to retain it. There are also fewer places for young and adult fish to find slow water areas except perhaps at downstream deltas.

Bank stabilization and placement of training structures have significant effects on flow patterns and create a new, straighter, channel for the river. Transport of water is made more efficient by decreasing the distance needed to travel, reducing turbulence due to shoreline heterogeneity and increasing velocity of the water (Minckley 1979). Currents may be almost uniformly swift with the straight channel configuration. Rock rip-rap and training structures prevent movement of the active channel and reduce the available sediment load from "unprotected" banks.

Once channelized, the river may cut a deeper channel due to the action of water on the bottom sediments (Minckley 1979, Ohmart et al. 1988); the same effect may be created mechanically by dredging. In either case, the result is a dropping of the water table which dries up marshes and backwaters and eliminates riparian vegetation if the water goes deeper than the roots can reach (Minckley 1979, Ohmart et al. 1988). In the interest of water conservation, additional riparian trees were removed (Ohmart et al. 1988), and the remaining backwaters were reduced in size or eliminated using dredge spoil to decrease the water surface area (Minckley 1979). In the new stabilized channel, there is considerable shifting of the bottom sediments under the new velocity regime, with subsequent adverse effects to navigation as sandbars move around. With limited input of fine materials, the silt and sand is eliminated and gravel/cobble/rock substrates may dominate as they do below the large dams. Diversity of main channel habitats is reduced considerably.

As part of river control projects, backwaters and marshes immediately adjacent to the river channel are often closed off from the river by a stabilized bank or dike. Water percolating through the bank provides some freshening for these areas, but it may not be sufficient to offset high evaporation rates that reduce water quality. Backwaters and marshes that have only percolation inlets are isolated and thus not available as habitat for fish and other aquatic organisms in the main channel and do not contribute much in the way of organic materials to the system. Backwaters and marshes with more open inlet structures are available as habitat and can provide organic material to the system.

Bankline stabilization has effects to fish habitats along shorelines as well. Rip-rapped shores reduce heterogeneity of bank and near-shore habitats available for fish (Minckley 1979). Uncut banks with riparian vegetation provide sheltering habitats in rootwads (Moffett 1942, Ohmart et al. 1988) and, if vegetated with emergent vegetation, are also diverse habitats (Minckley 1979).

The combination of controlled discharges from the dams, bank stabilization and dredging of the channel, and diversion of water from the system does not allow for the natural formation of new backwaters and marshes by the action of the river. Backwaters and marshes that survived the channel work are slowly aging out of existence (Ohmart et al. 1975). There has been an increase in backwater and marsh acreage behind Imperial Dam and Parker Dam at the Bill Williams delta and Topock Marsh. Yet, these areas are subject to normal aging and effects of the river. As an example, several areas above Imperial Dam have been lost as backwaters over the last few years in part due to high flows of the early 1980's transporting large amounts of silt into them.

As part of the mitigation for the various river control projects, Reclamation has undertaken to improve and enhance backwater and marsh areas. These are to offset losses to wildlife habitats lost from Reclamation’s operations and have been designed to provide fish and wildlife habitats. Dredging, dike construction and other mechanical techniques are used to create these areas. Studies on main channel (Minckley 1979) and backwater habitats (Tash 1975, Kennedy 1979) have been done in concert with these mitigation activities.

Water levels in controlled situations fluctuate on a daily, weekly and seasonal basis. Fluctuations are largest below the large dams and attenuate as the water moves downstream. Shallow backwaters and marshes may be dewatered or replenished by the fluctuations. If insufficient water reaches these areas, water quality problems may limit their usefulness to fish.

Reductions in organic input from the floodplain riparian areas coupled with entrapment of organic materials in the l affect productivity. Reduction in shallow areas in the channel and of marshes and backwaters also reduces the amount of quiet water areas where primary production can occur. These areas have higher concentrations of plankton (Marsh and Minckley 1985) and benthic invertebrates (Minckley 1979) than does the shifting sand of the main channel. Where main channel substrates are composed of larger materials, benthic invertebrate populations rise and there is considerable growth of algae on the substrate. These types of areas, with their generally clearer water, are new habitats to the river.

There may be some changes to historic water temperature patterns as a result of river control activities. Seasonal and diurnal fluctuations were the historic norm. Fluctuating water levels and partial isolation of backwaters from the mainstem may allow some backwater areas to become warmer or cooler than they would have under historic circumstances. Especially below Davis Dam, the channelization of the river and the fluctuating nature of the releases influence the distance downstream that cold water effects are felt.

Other water quality parameters are affected more by actions on the river other than river control structures. Large increases in salinity resulting from water use and re-use may have greater effects in backwaters with insufficient fresh water exchange. Combined with high evaporation rates and fluctuating water levels, the situation exists for less than optimal conditions for fish survival.

In summary, the efforts to control the Colorado River have resulted in losses to floodplain riparian areas, and alterations in the way backwaters and marshes develop and age. Dam construction may have increased the total acreage of marshes along the river, thus offsetting some marsh losses. As for backwaters, maintenance of the existing ones relies on human intervention; natural formation of backwaters is improbable. What backwaters are still extant may be isolated from the mainstem and thus not available to fishes in the main river. Others are in the process of aging out of existence. While some remediation and conservation efforts have resulted in retaining or creating backwaters and marshes, channelized reaches of the mainstem are less diverse habitats for fish (Beland 1953, Minckley 1979). Many of the remediation and conservation efforts are described in **Table 9**.

As for introductions of non-native fish to the system, there are now 44 species of fish recorded from the LCR. Of that number, nine are native species, and 33 are non-native. Of the non-natives, 13 are "hypothetical," which leaves 20 species of non-native fish known from all or part of the lower portion of the action area (Minckley 1979). There may be additional species in Lake Mead not included in these records.

For the native fish species, most of the river control activities came well after declines in their populations were observed. Yet, river control efforts do appear to have played a part in creating a habitat more conducive to non-native species than native ones. Information in Minckley (1979) and summarized by Ohmart (1988) on fish habitats and habitat use showed that while different species might be selective, the multi-species, non-native fish fauna occupied virtually every available habitat along the river. This includes what remained of the types of habitats historically used by the native fish, as well as the newly created habitats such as rip-rapped banks. This is not surprising given the range of species present and their habitat flexibility. There are few relicts of the historic Colorado River left in the managed water delivery system the river has become.

[[[[insert table 9 landscape, pp. 1

[[table 9, p. 2]]

Other activities: 1823-1996

Especially in the last 40 or 50 years, other activities and events have had effects on the Colorado River and its floodplain. These include residential, urban and recreational facilities development, introduction and spread of salt cedar, changes to the fire cycle, and changes to runoff and nutrient loading through irrigation returns and wastewater treatment plant effluent. This is not an inclusive list, but it is clear that the LCR is at the center of a complex and interwoven set of Federal, State, tribal, local and private programs, needs and requisites. Additional mention of these activities is included in the section of this opinion that addresses socioeconomic and related factors in the environmental baseline, as well as in the species-by-species discussions of direct, interrelated/interdependent, indirect, and cumulative effects, below. The following discussion addresses key conservation activities in the action area for the bonytail chub and razorback sucker that various agencies have cooperatively undertaken in recent years.

The bonytail chub still occurs in Lakes Mohave and Havasu. Total numbers in each population are unknown, but are believed to be very small, less than 2,000 fish. In 1981, sex products were taken from ten wild fish taken from Lake Mohave. From that year class, part of the resultant year class were returned to Lake Mohave as fingerlings and the rest were retained for future brood fish. Since 1981, some 217,000 fingerling bonytail chubs have been reintroduced into Lake Mohave. Aged fish captured since introductions were initiated indicate some survival of these fish or successful recruitment from the small residual population that occurs in Lake Mohave. Because of some apparent success from these reintroductions, the Service, via a biological opinion, committed to producing 25,000 10-12 inch bonytail chub annually for five years for reintroduction into Lake Mohave. The goal of these reintroductions is to establish an adult population of approximately 25,000 adult bonytail in Lake Mohave. Through cooperative efforts by Reclamation, State conservation agencies, and other affected parties, a similar reintroduction program is being implemented in Lake Havasu. The goal of this effort is also 25,000 adult bonytail in Lake Havasu. If reintroduction efforts are successful, present commitments are expected to supplement small populations in Lakes Havasu and Mohave thereby establishing an adult population of 25,000 bonytails in each reservoir. The projected total population would be 50,000 adult fish by 2002. If reintroduction efforts fail, a small total population of perhaps 500 to 1,000 bonytail chubs may remain in the wild in the year 2002, with the species by then headed rapidly toward extinction in the wild.

The razorback sucker still occurs sporadically in the upper and lower basin of the Colorado mainstem. By far, the largest of the remaining populations occur in Lake Mohave. The current population in Lake Mohave is estimated to be some 20,000 fish, less than 50% of the estimated population a decade ago. Lack of recruitment from swimup fry to adult has been identified as the major threat to this species' existence in the wild. In 1989, a multi-agency group of State and Federal agencies agreed to a concerted effort to replace the aged and decreasing population of razorback suckers in Lake Mohave. Initial efforts were to place adults in lake-side rearing ponds to promote natural production in an environment protected from non-native fish predators. Young fish would be allowed to grow to a minimum of 12 inches before reintroduction into Lake Mohave. Through trial and error, the effort has grown to removing naturally spawned fry from Lake Mohave and rearing them in hatcheries to fingerlings prior to their reintroduction into Lake Mohave as 12 inch fish. In 1996 some 60,000 fry were collected and approximately 40,000 fingerlings are ready for transfer to grow-out ponds before being released into Lake Mohave during late 1997. To date, some 5,000 advanced razorback sucker fingerlings have been reintroduced into Lake Mohave. Reintroduced fish are joining spawning aggregations as they return to known spawning areas. Similar reintroductions, on a smaller scale, are being made at Lake Havasu.

Through a biological opinion, the Service committed to assist cooperating State and Federal agencies in providing 10,000 12-inch razorback suckers annually for reintroduction into Lake Mohave. If efforts specified in the biological opinion are met and successful, the projected population of razorback suckers in the action area will be 25,000 to 50,000 young adults by 2002. If reintroduction efforts fail, the projected population would be perhaps 20,000 adult fish in 2002 with the species headed rapidly toward extinction in the wild. Against this backdrop of causative actions and activities, one can examine the present status of these native fish species in the LCR.

Status of the Species Within the Action Area

<u>Listed species/critical habitat</u>:

Bonytail Chub

Historic range of the bonytail chub is estimated at 2,300 miles (USFWS 1993a). Occupied habitat as of 1993 is approximately 344 miles (15% of the historic range). The designation of critical habitat included all occupied habitat. Thirty two percent of the critical habitat is within the action area. The bonytail chub has small populations in Lake Mohave and Lake Havasu made up primarily of old fish nearing senescence (Minckley 1973). The Lake Mohave population of bonytail chubs in 1996 consists of few young adults from repatriated stocks and very few old adults are captured. The fish in the Lake Mohave population provided the founders for the Lower Basin broodstock currently being used to provide young fish to augment the reservoir populations in Lakes Mohave and Havasu. There have been 174,000 fingerling and 28,000 larvae bonytail chubs repatriated to Lake Mohave since 1980. Their fate is uncertain, but a large majority have likely perished.

The discussion of historic habitats in the project area and the changes to those habitats has already documented the effects of past actions on these species. Both the amount and the quality of habitat have been compromised by physical and biological changes driven by water, power, agricultural and recreational development. Little of the action area is untouched by these changes. Conservation efforts undertaken to date have concentrated on preventing extinction.

Razorback Sucker

Historic range of the razorback sucker is estimated at 3,500 miles (USFWS 1993a). Occupied habitat as of 1993 is approximately 1,824 miles, of which 336 miles is reintroduction habitats, (52% of historic range). The designation of critical habitat included most but not all of the occupied habitat. Fourteen percent of the designated critical habitat is within the action area, with 17% of the total occupied habitat accounted for there. Large adult razorback suckers were last widespread in the 1970's, being captured in Lakes Mead, Mohave and Havasu as well as the river below Parker Dam (Minckley 1985). Small populations persist in Lakes Mead and Havasu and below Parker Dam. The largest remaining population of razorback sucker is in Lake Mohave and is declining due to old age mortality. The Lake Mohave population has provided the broodstock for all Lower Basin recovery efforts and contains significant amounts of genetic variance. Razorback sucker augmentation efforts are ongoing in Lakes Mohave and Havasu and below Parker Dam. To date, over 8,000 razorback suckers have been released into Lake Mohave by the Native Fish Work Group.

The discussion of historic habitats in the project area and the changes to those habitats has already documented the effects of past actions on these species. Both the amount and the quality of habitat have been compromised by physical and biological changes driven by water, power, agricultural and recreational development. Little of the action area is untouched by these changes. Conservation efforts undertaken to date have concentrated on preventing extinction.

Critical Habitat of Bonytail Chub and Razorback Sucker

The constituent elements involved with the designation of critical habitat for the bonytail chub and razorback sucker include water, physical habitat, and the biological environment. For the razorback sucker, additional criteria were used: areas with known or suspected wild spawning populations; areas where juveniles have been collected; present or historically occupied areas considered necessary for recovery; areas required to maintain rangewide fish distribution and diversity under a variety of conditions; and areas needing special management including those areas that once met the habitat needs of the species and could be recoverable with additional protection and management. The preceding discussion has addressed the physical and biological changes to the Colorado River that have affected the constituent elements.

Southwestern Willow Flycatcher

The review of historic and current data on the distribution and abundance of the southwestern willow flycatcher, as well as data on productivity throughout this subspecies' range, presented above under Status of the Species (rangewide) provides part of the baseline necessary to evaluate the effects of the proposed action. Other components of the baseline include the anthropogenic activities affecting the species and its habitat, the overall pattern and trend of habitat gains and losses, the effects of Federal actions that have undergone formal section 7 consultation, and the State, local, tribal, and private actions that are contemporaneous with the proposed action.

The development of limited and sparsely-distributed water resources in the Southwest has resulted in large-scale changes to aquatic and riparian systems. Those changes include losses of perennial aquatic ecosystems due to dams, diversions, and groundwater pumping; conversion of alluvial-influenced riparian areas to lacustrine-influenced reservoirs; loss and fragmentation of riparian and aquatic habitats due to residential, commercial, and agricultural development, overgrazing in riparian areas and in watersheds; modifications to stream systems from bank stabilization efforts and channelization; and invasion of remaining riparian areas by exotic species such as saltcedar. These activities and impacts are common among major stream systems in the Southwest.

The rangewide reduction in the southwestern willow flycatcher population reflects the widespread, continual loss and fragmentation of riparian habitats into smaller and more isolated remnants. Declines in willow flycatchers, however, have not been restricted to the subspecies *E.t. extimus*. Breeding Bird Survey data for 1965 through 1979 combined the willow and alder flycatchers into the "Traill's flycatcher" because of taxonomic uncertainty during the 15-year reporting period. These data showed fairly stable numbers in central and eastern North America, but sharp declines in the West, the region in which the alder flycatcher is absent and where *E.t. brewsteri, E.t. extimus,* and *E.t. adastus* occur (Robbins *et al.* 1986).

The timing and transformation of the LCR from a natural, dynamic aquatic and riparian system prone to scouring, deposition, and meandering channels that leave floodplain forests in their wake, to one where human modifications have greatly reduced or eliminated these factors is described under the Environmental Baseline section for the bonytail chub and razorback sucker, above. Where the water table was relatively close to the surface, cottonwood-willow forests formerly extended away from the LCR for up to several miles (USBR 1996). Most of this habitat no longer exists (Ohmart 1979, USBR 1996). Ohmart *et al.* (1988) documented an 80% decrease between 1938 and 1960 in the areal extent of cottonwood-willow habitat in the Parker II Division. In that case, the loss amounted to more than 4,000 ha (9,880 ac) of cottonwood-willow. Figure 24 of the BA provides a comparison of the current-day vegetation composition and extent near Blythe, California, with a reconstruction of habitat types and areal extent in the same area for 1879. That figure, in combination with historic photos compiled by Ohmart (1979) demonstrates the magnitude of loss of not only cottonwood-willow, but also of mesquite habitat. Figure 24 also shows the extent to which native riparian habitats on the LCR have been converted to saltcedar. In addition to invasion by saltcedar, much of the native habitat loss resulted from agricultural expansion in floodplain terraces (Ohmart *et al.* 1988).

The BA indicates that recent vegetation sampling documented a total of 43,623 ha (119,527 ac) of riparian, marsh, and desert vegetation between the United States - Mexico border and Davis Dam. Of that total, 18,155 ha (42%) (44,843 ac) was saltcedar and 1,376 ha (3%) (3,398 ac) was cottonwood-willow. The total for cottonwood-willow does not include the 465 ha (1148 ac) currently at the inflow to Lake Mead. Adding the habitat at Lake Mead, the total area of cottonwood-willow, or predominantly native broadleaf forested riparian habitat, over the 663 km (412 miles) reach of the action area is approximately 1,841 ha (4,547 ac). That averages to approximately 2.8 ha (7.7 ac) of cottonwood-willow per km of river, including both sides of the river's floodplain. However, considering 25% of that habitat occurs in a four-km (2.5 mi) stretch at the inflow to Lake Mead, the actual amount of habitat downstream of the Lake Mead inflow is approximately 2.1 ha/km (10 ac/mile). When compared to historical data on the distribution and extent of cottonwood-willow habitat, these figures demonstrate the magnitude of habitat loss and fragmentation in the action area. The actual amount of suitable habitat for the southwestern willow flycatcher is likely far less than the 1,841 hectares (4,547 acres) of cottonwood-willow currently available, because the presence of surface water, plant physiognomy, and size of willow stands are important habitat components not characterized by Reclamation's current habitat classification system.

Of the total saltcedar acreage, 89% was classified as structural types IV and V, which are characterized by low stature, low vertical foliage diversity (i.e., most foliage and structure is in the lowest stratum), and generally poorer quality habitat for birds than structural types with several strata and high vertical foliage diversity. Despite the extensive channelization and large expanse of reservoirs on the LCR, native cottonwood-willow habitat still develops in certain reaches in response to flooding events. The BA documents approximately 931 ha (2299 ac) of cottonwood-willow regeneration that developed in response to large flood events occurring in the mid-1980s. That habitat, however, was lost due to desiccation and competition from saltcedar.

Reclamation continues to sponsor a riparian restoration program along the river, including native plant nurseries and demonstration projects. Although the BA does not document how past restoration projects have contributed to the total acreage of native riparian habitat, it does specify that several areas are currently under restoration and will contribute approximately 89 ha (220 ac). Several other projects are in the planning stage, including an 8 ha (22 ac) wetland restoration project at the lower end of Las Vegas Wash and a 30-year cost-share project to restore 1,200 ha (2,964 ac) of native riparian habitat along a 15 km (9.3 mi) stretch through the Imperial Division. The potential for these projects to successfully establish habitat suitable for the southwestern willow flycatcher is not known. However, because plantings are comprised mostly of cottonwood, are typically spaced in an open plantation style, and are relatively small (i.e., 10 ha [24.7 ac] or less), the probability that these areas will develop into suitable flycatcher habitat in the near future is low.
To date, southwestern willow flycatchers have not been documented at locations where previous or on-going planting efforts have occurred. Other factors such as habitat extent and the presence of water must be considered when evaluating the probability that a planting effort will be successful for the southwestern willow flycatcher. Areas well away from river channels that have no standing or flowing water during the flycatcher's breeding season have a low probability of attracting nesting

flycatchers. Similarly, plantings done in narrow strips only a few trees wide also have a low probability of attracting flycatchers.

Approximately 465 ha (1,148 acres) of Goodding's willow occurs in the continuous patch spanning four km (2.5 mi) at the boundary of Grand Canyon National Park and Lake Mead National Recreation Area. Except for the South Fork Wildlife Area in Kern County, California, no other continuous patch of native willow habitat of this size is known to exist in the Southwest. The Lake Mead Delta willows have had their root crowns inundated for more than 16 consecutive months. Treefall resulting from inundation and loss of structural support provided by roots was responsible for the loss of at least three flycatcher nests in 1996 (R. McKernan, Riverside County Museum, pers. comm.). The mean depth of standing water at flycatcher nest trees during 1996 was 68.8 ± 5.8 cm.

Despite the numerous Federal agencies and actions involved, to date, no formal consultations have been initiated for the flycatcher on the LCR, except for Reclamation's current consultation. The broad scope of interrelated and interdependent actions, or those that would not be possible but for the management of water on the LCR, has also had a significant and widespread impact on the flycatcher's baseline. For example, the availability of irrigation water spawned wide scale agricultural development on private lands in the Colorado River valley. More than 75% of Mohave, Parker, Palo Verde, and Yuma valleys has been converted to agriculture (USFWS 1986). These areas formerly contained the vast riparian forests nsts and captured in early photographs of the area that probably comprised the most important riparian corridor in the Southwest and provided significant stands of habitat suitable for the southwestern willow flycatcher. The effect of these losses on the flycatcher has also been great; today, nowhere on the Colorado River could an individual ply a two mile stretch and find 34 flycatcher nests as was done by Herbert Brown in June of 1902.

Water management operations on the LCR exacerbate potential effects to flycatcher reproduction by concentrating naturally occurring selenium. During 1996 monitoring efforts in southwestern Colorado, a southwestern willow flycatcher fledgling was found with a crossed bill, a symptom of selenium poisoning in birds (Beyer et al. 1996, Heinz et al. 1989, Heinz et al. 1987, Ohlendorf et al. 1986a). The deformity prevented this bird from normal foraging. This flycatcher was reared in the Escalante State Wildlife Area, which drains agricultural lands where high levels of selenium have been detected in past monitoring (M. Sogge pers. comm.). Portions of the LCR are known to have high levels of selenium.

Status of the Species Within the Action Area

The status of the southwestern willow flycatcher on the LCR is not fully known, in part because all potential habitat has not been surveyed. Reclamation contracted for surveys and monitoring to be conducted throughout the LCR during the 1996 breeding season. That data was not presented in the BA; however, additional preliminary data have been made available to the Service by Reclamation (see Consultation History, above).

Combining surveys conducted through Arizona Partners In Flight since 1993 (including confluence areas at the Bill Williams and Gila rivers) and Reclamation's data collected in 1996, approximately 60 sites have been surveyed on the LCR for southwestern willow flycatchers (Muizneiks *et al.* 1994, Sferra *et al.* 1995, Spencer *et al.* 1996). Results from those surveys reveal a pattern of widely-separated, small breeding groups as found throughout the subspecies' range.

Migrant willow flycatchers, probably including *E.t. extimus*, were documented at eight sites along the LCR: Hunter's Hole (Yuma Co.), Gadsden Bend (Yuma Co.), Gadsden Pond (Yuma Co.), Martinez

Lake (Yuma Co.), Imperial National Wildlife Refuge (Yuma Co.), and Havasu National Wildlife Refuge (Mohave Co.). Several locations in Yuma County (e.g., Hunter's Hole, Gadsden Bend) have had small, but relatively constant, numbers of flycatchers remaining on site early in the season for up to several weeks, but then disappear around mid-June (Muizneiks *et al.* 1994, Sferra *et al.* 1995, Spencer *et al.* 1996). The persistence and territorial behavior of these birds suggests they may have been attempting to attract mates and breed. However, neither breeding nor confirmed pairs have been documented at these sites. Sogge and Tibbitts (1992), Sogge *et al.* (1993), Sogge and Tibbitts (1994), and Sogge *et al.* (1995), also documented widespread use of the Colorado River through Grand Canyon National Park by migrant willow flycatchers. Records from Grand Canyon and the LCR downstream from the Grand Canyon combined with historical records demonstrate that this system is an important migratory corridor for this species.

The first breeding confirmed on or near the LCR during this survey period was at the Bill Williams National Wildlife Refuge. One pair of flycatchers was observed feeding a brown-headed cowbird nestling in 1994 (Sferra *et al.* 1995).

Expanded efforts initiated by Reclamation in 1996 included survey and monitoring at 27 sites distributed in Yuma, La Paz, Mohave, Imperial, and San Bernardino counties. In total, southwestern willow flycatchers were found at 15 widely-distributed sites along the LCR. Twelve (80%) of the sites where flycatchers were found were comprised of single pairs; one site (6%) contained two pairs; an additional site contained an estimated five pairs; and the largest concentration was found at the inflow of the Colorado River to Lake Mead where ten territories (eight confirmed pairs) were documented in a random sample of plots within a 445 ha (1219 ac) area dominated by Goodding's willow. An additional 15 to 20 territories were suspected in unsurveyed portions of the Lake Mead inflow and another eight to twelve territories were suspected in adjacent habitat in Grand Canyon National Park (R. McKernan pers. comm.).

Nesting was confirmed at two locations in 1996, Topock Marsh and Lake Mead inflow. One nest was found at Topock Marsh. Seven nests were found at the Lake Mead inflow. Complete data on nest contents and nest success is not yet available. R. McKernan (pers. comm.) reported that none of the seven flycatcher nests at Lake Mead inflow was parasitized by cowbirds or depredated. However, as indicated previously, three flycatcher nests at the inflow were lost due to treefall resulting from willows that were saturated from prolonged inundation of root crowns (R. McKernan pers. comm.). All nests at Lake Mead inflow were placed in Goodding's willow. The mean nest height was 2.3 ± 0.15 m, and the mean height of nest trees was 6.9 ± 0.19 m. As indicated previously, the mean depth of standing water at nest trees (i.e., the depth at which nest trees were inundated above root crowns) was 68.8 ± 5.8 cm. The single nest found at Topock Marsh was 2.3 m up in a 7.6 m saltcedar that was inundated 2 cm above the root crown.

No data on the size of occupied sites was provided for areas outside of Lake Mead. However, aerial inspection of occupied sites revealed that, downstream from Lake Mead, flycatchers were found in very small riparian patches ranging between about 0.8 to 4 ha (2 to 10 ac).

Vegetation composition data was psites surveyed on the LCR in 1996. Of the 21 sites sampled, seven (33.3%) were dominated by either Goodding's or coyote willow; eleven (52.4%) were dominated by saltcedar; and three (14.3%) were comprised of nearly equal mixtures of willow and saltcedar. Each of the sites dominated by saltcedar had at least some willow component. For example, the flycatcher nest at Topock Marsh was placed in a saltcedar located beneath one of the few large and widely-scattered Goodding's willows at that site. Other plant species, such as cottonwood, arrowweed, and cattail occurred to a much lesser degree at each of the sites.

Yuma Clapper Rail

Present-day marshes along the LCR are of two kinds. The first kind includes backwater marshes, which are defined as marsh areas adjacent to the river and which are either directly connected to the river or are connected by seepage. The second kind, which is more extensive, includes those marshes formed by impoundments such as the marshes in Mittry Lake, Imperial Reservoir, Lake Havasu, Topock Marsh, and other similar impounded areas. (For additional historical background on the development of the LCR, see the Environmental Baseline section for the bonytail chub and razorback sucker, above.)

The construction of river control features, such as training structures, along the LCR has resulted in the formation of more permanent and expansive backwater marshes. There are over 400 backwater marshes along the LCR today from Davis Dam to Laguna Dam. Some of these marshes were created and are maintained specifically for mitigation for channel improvement projects. Reclamation actively pursues maintenance and restoration of backwater marshes not tied to mitigation on a cost-share basis. These backwater marsh habitats are subject to successional factors as were the historical marshes along the river. Under normal operating conditions, this succession is greatly slowed because current river conditions and operating criteria result in less scouring and associated sediment movement. Bankline stabilization has reduced erosion and associated sediment accrual to the river. When exceptional conditions are encountered, such as the high flow releases which occurred in 1983-1985, channel scouring occurs with associated sediment deposition in those backwater areas. These exceptional conditions would be expected to promote accelerated succession to upland conditions which are dominated by saltcedar.

The majority of the banklines of the flowing river have been stabilized. This does not allow for natural marsh formation resulting from the river channel moving laterally, which would occur during high flows. Additionally, current river operating criteria reduce the opportunity for high flows (floods) which would also reduce natural marsh formation during those type of flows. A portion of the backwater marshes, which exist along the river today, are isolated from the main river channel, reducing the opportunity for flushing flows through them. However, it was observed during the high flows experienced on the river during 1983 through 1985, the isolated backwater marshes did not fill in with deposited sediment. Impacts which occurred to those isolated backwater marshes were a result of the main river channel scouring and the resulting drop in water table.

In 1986, the LCR floodplain supported over 12,000 acres of marsh associated habitat. Younker and Anderson (1986) classified the marsh communities into different types based primarily on the percentage of cattail, bulrush, common cane and open water. Of the total of more than 12,000 acres of marsh habitat found, nearly 50% (5,657 acres) was classified as type 1 which met the criteria of being nearly 100% cattail/bulrush with small amounts of common cane and open water. (For descriptions concerning the remaining amounts and type of marsh habitat observed by Younker and Anders, see Table 7 in the BA.)

Status of the Species Within the Action Area

The status of the Yuma clapper rail on the LCR is fairly well known because of an annual call count survey taken by all of the resource agencies with management responsibilities on the river. Most of the potential habitat on the river has been surveyed over the last few years. The largest populations of Yuma clapper rails on the river are found on the National Wildlife Refuges (NWR) and wildlife management areas operated by the State Game and Fish agencies. Small isolated populations are found in fragmented habitat areas throughout the action area. Also, approximately one half of the total population (Eddleman 1989) is found in the Colorado River delta area in Mexico.

According to Rosenberg et al. (1991), this species is limited by, and has come under threat of reduction from, river management activities such as dredging, channelization, and stabilization of banks by riprapping, all of which are detrimental to marsh habitat formation. They state that recent flooding has resulted in more pressure on water management agencies to increase channelization and bank stabilization activities, which will result in a large reduction of available marsh habitat.

Recent contaminant studies on the Colorado River have indicated high levels of selenium (a trace metalloid) in tissues of the Yuma clapper rail. Selenium concentrations were determined from the livers of five adult birds and from two sets of eggs. The concentrations found in the livers equaled or surpassed those found in ducks at Kesterson NWR in California, an area of extreme selenium contamination (Ohlendorf et al. 1986b, Radtke et al. 1988, Kepner unpubl. data *in* Rosenberg et al. 1991). Rail eggs contained concentrations that were found, at Kesterson NWR, to result in a 20% chance of death or deformation in American coot embryos (Olendorf et al. 1986a, Kepner unpubl. data). Crayfish, a major rail food item, also had selenium concentrations that could cause toxic effects to their predators (Lemly and Smith 1987, Kepner unpubl. datals in Yuma clapper rail tissues could result in hatching defects and reduced reproductive output (Rusk 1991). Selenium can cause extensive metabolic problems in birds and may affect reproductive success.

The source of selenium in the LCR is unknown at this time, but it appears to be from upstream sources and may be from natural weathering of seleniferous shales, combustion of high selenium coal at electrical generation stations, extraction of uranium and coal ore, or upstream irrigation-based agriculture (Radtke et al. 1988). Agricultural activities in the LCR valley proper do not appear to be contributing (Radtke et al. 1988).

Living in the dynamic, highly variable wetland habitats of the Colorado River, the Yuma clapper rail can likely tolerate a wide range of physical conditions. Some changes that have resulted from human development along the river have altered overall habitat quality. In recent years, the use of boats and personal watercraft has increased along the LCR. This has led to speculation that the disturbance caused by water recreation activities may have a negative impact on species of marsh dwelling birds.

The Yuma clapper rail is dependent upon wetland habitat that is both created and lost as a result of modifications and operations of the Colorado River. While clapper rails and the marsh plant species they use for nesting and foraging substrate have the ability to fairly rapidly colonize newly created habitat, this habitat continues to be negatively affected by water diversions, bank stabilization and other channel modifications, flood releases, and development in the floodplain. These actions have resulted in the loss of important wetland habitat used by the Yuma clapper rail and the resultant loss of the rails that inhabit it. However, the positive effects of backwater marsh management in combination with this species' ability to recolonize new habitat, apparently offset these negative effects, since the population continues to remain stable and is possibly expanding.

<u>Proposed species/critical habitat:</u>

Flat-tailed Horned Lizard

Project Location and General Vegetation Communities

The 5-mile zone is located in the Yuma Desert southeast of Yuma, Arizona and west of the Barry M.

Goldwater Range. The vegetation community in which the project would be operated and maintained is classified as the lower Colorado River Valley subdivision of Sonoran desert scrub (Turner 1982). It is the largest and most arid subdivision of Sonoran desert scrub. Dominant perennial plant species in the more xeric examples of this vegetation community, such as at the project site, include creosote, white bursage, and galleta grass (Turner 1982, Rorabaugh, et al 1987).

Threats to Flat-tailed Horned Lizards and Their Habitat Specific to the Action Area

A general listing of threats that have contributed to the declining status of the flat-tailed horned lizard and that ultimately triggered the proposed listing of the species as threatened is presented in the section entitled "Status of the Species". These threats are primarily human-caused factors.

For the most part, areas used in maintenance of this project are highly disturbed by the presence and use of existing dirt roads. Other nearby uses and disturbances have adversely affected vegetation communities and wildlife habitat. Paved portions of County 23rd and Avenue B link San Luis with the Marine Corps Air Station (Yuma) and the eastern portion of the city of Yuma. The Arizona State Medium Security Prison lies immediately south of County 23rd and east of Avenue B. The County of Yuma Auxiliary 4 Airport, an old military airstrip located approximately five miles northeast of San Luis, is presently used primarily for "touch and go" landing exercises. There are no facilities at the airstrip, and on-the-ground activities are restricted primarily to repair of paved areas on the airstrip. City of Yuma Landfill operations, located along County 23rd immediately east of the Prison, include normal landfill operations, with the associated vehicular traffic to and from the landfill. Hillander C Irrigation District, located approximately three to six miles east of San Luis, is a privately owned irrigation district within the 5-mile zone. Farming activities are conducted within the confines of the district, with associated vehicular traffic to and from the area. The U.S./Mexico Cattle Crossing and Holding Facility straddles the U.S./Mexico border adjacent to Hillander C and functions as a quarantine holding facility for cattle being shipped to and from Mexico. The Sonora Substation and associated transmission lines are owned by Arizona Public Service Company and undergo periodic maintenance and inspection. The Arizona State Minimum Security Prison is operated by the State of Arizona and activities are primarily conducted within the facility confines. Security patrols may occur around the perimeter of the property. The U.S. Immigration and Naturalization Service patrols the 5-mile zone and adjacent areas to prevent illegal entry into the United States.

Approximately 23 to 27% of the historic flat-tailed horned lizard habitat in Arizona has been lost due to human uses, primarily urban and agricultural development (Service 1993b). Pesticide drift from croplands into adjacent flat-tailed horned lizard habitat may have reduced ant populations, the primary prey of the flat-tailed horned lizard (Service 1993b, Bolster and Nicol 1989). A variety of activities conducted by the Marine Corps on the western portion of the Barry M. Goldwater Range affect horned lizards and their habitat, although the extent of adverse effects is limited. Military activities that adversely affect the species are relatively few and small in areal extent. Marine Corps activities were addressed in a previous conference opinion (2-21-96-F-114) in which the Service found that ongoing and proposed activities would not likely jeopardize the continued existence of the flat-tailed horned lizard (Service 1996). In the Yuma Desert west and north of the Barry M. Goldwater Range, numerous proposed or ongoing activities threaten the habitat of the flat-tailed horned lizard. Recent Federal actions include proposed development of a Yuma County Administrative Center and rights-of-way for other roads and utilities. The Yuma Metropolitan Planning Organization has proposed a highway (the "Area Service Highway") from San Luis to Interstate 8 that would traverse County 23rd through parts of the project area. The Federal Highways Administration is lead Federal agency for the project. Several small disturbed areas and small trash piles are located near roadways and access routes adjacent to and through the 5-mile zone. Off-highway vehicle use is evident at scattered sites, particularly near San Luis and on the edge of the Yuma Mesa. Non-Federal activities are described in the Cumulative Effects section, below.

Reclamation maintains a sludge disposal facility for the Yuma Desalting Plant, a feature of its Colorado River Salinity Control Project, approximately one mile north of the intersection of County 23rd and Avenue B. The City of Yuma has a waste water sludge disposal facility in T11S, R23W, SE1/4 section 5, immediately north of County 23rd. The waste water site was apparently graded at some time in the past, but the vegetation is recovering. The above listed facilities and projects tend to increase the presence of predators mentioned in the section entitled Status of the Species Rangewide. Other activities such as on-and-off highway vehicle traffic cause flat-tailed horned lizard mortality. Mortality rate may be the most important factor affecting flat-tailed horned lizard population viability (Flat-tailed Horned Lizard Conservation Team, 1996).

Status of the Proposed Species Within the Action Area

About 6% of the total land area within the range of the species occurs in Arizona, 29% in Mexico, and the 65% in California. Much of the area in California, such as the Salton Sea and agricultural lands, is unsuitable habitat for the flat-tailed horned lizard. Among the most important habitat remaining for lizard conservation in the United States, about 39%, or 550 km^2 (212 mi^2), occurs in Arizona (draft Flat Tailed Horned Lizard Rangewide Management Strategy 1996).

Flat-tailed horned lizard relative abundance has been estimated using standardized transects in which observers count flat-tailed horned lizards and their scat. Numbers of scat and lizards observed per hour is used as an index to the species' relative abundance. Criteria developed from Bureau of Land Management (1990) follows:

High relative abundance = >9 scat/hr or at least 1 *P. mcallii* observed

Medium relative abundance = 5 to <9 scat/hr

Low relative abundance = 1 to <5 scat/hr

Poor relative abundance or unoccupied habitat = <1 scat/hr

The Flat-tailed Horned Lizard Interagency Technical Advisory Team (ITAC), comprised of biologists and land managers from a variety of State and Federal agencies, met in April, 1993, to discuss research findings and the validity of this survey method. The ITAC concluded that scat counts may not provide a reliable index to the relative abundance of the flat-tailed horned lizard and should be used with great caution. The assumption of a correlation between scat counts and lizard density has never been tested. There appears to be more reliability when scat count data are used in combination with lizard observations and habitat characteristics to determine the importance of an area for this species (Rorabaugh 1994). A recently developed interim survey protocol authored by the Flat-tailed Horned Lizard Conservation Team (a committee assisting in preparation of the Rangewide Plan) uses both lizard and scat counts to determine presence or apparent absence of this species in a given area.

The Service is aware of approximately 40 records for flat-tailed horned lizard within the 5-mile zone; these include two 3.6 hectare flat-tailed horned lizard study plots monitored by Rorabaugh (1994) and three four hectare plots monitored by Hodges (1995).

In 1985, one-hour "section searches" were conducted within many sections (one square mile units) of the 5-mile zone (Rorabaugh et al. 1987). Section searches consisted of one-hour walks along a triangular route through a section in which observers counted all horned lizards and horned lizard scat. Data from the study plots are presented in **Table 10**. **Table 10** depicts lizards and scat observed per hour for section searches and for study plots on each section listed.

Data in **Table 10** combined with nearly 40 additional locality records from 1985 to the present (most since 1990) indicate the species occurs throughout the project area. As noted previously, using scat counts from section searches and the study plots to estimate flat-tailed horned lizard abundance is problematic. However, these data show relatively high scat counts in 13 sections within the 5-mile zone. Scat counts in these sections were well above the mean (13.2 scat/hr) documented by Rorabaugh et al. (1987) for the Yuma Desert. These areas are also comparatively undisturbed and the substrate appears more sandy or windblown in these eastern sections. Flat-tailed horned lizards are associated with and may be more abundant in areas with moderate amounts of windblown sand (Muth and Fisher 1992, Rorabaugh et al. 1987).

The participating agencies to the draft Rangewide Management Plan will likely agree to manage several areas for viable flat-tailed horned lizard populations, including the Yuma Desert Management Area, which will likely include about 16,000 acres within the 5-mile zone and additional acreage in adjacent portions of the Barry M. Goldwater Range. In the 5-mile zone, the majority of the Yuma Desert Management Area will likely lie east of Hillander C Irrigation District and south of the County 23rd road. If implementation of the conservation strategy removes a significant number of the threats to the species, listing of the flat-tailed horned lizard as a threatened species may not be necessary.

Table 10: Results of section searches and monitoring of study plots in the 5-mile zone.

Section	Section Search[1] #lizards/hr	Section Search[1] #scat/hr	Study Plots[2] mean lizards/hr	Study Plots[2] mean #scat/hr (May-June)
T10S R23W S30	1	4		
T10S R23W S31	0	4		
T10S R23W S32	0	0		
T10S R23W S33	1	9		
T10S R24W S25	0	5		
T10S R24W S26	0	5		
T10S R24W S27	0	1		
T10S R24W S33	0	2		
T10S R24W S34	1	1		
T10S R24W S35	0	1		
T11S R23W S1	0	0		
T11S R23W S2	0	31		
T11S R23W S3	0	43	0	30
T11S R23W S4	0	40		
T11S R23W S5	0	3		
T11S R23W S6	0	4	0.13	11
T11S R23W S7	0	4		
T11S R23W S8	0	3		
T11S R23W S9	0	26		
T11S R23W S10	0	21	0.03	42
T11S R23W S11	0	15	0	15
T11S R23W S12	0	15		
T11S R23W S13	0	18		
T11S R23W S14	0	5		
T11S R23W S15	0	22		
T11S R23W S17	1	5		
T11S R23W S18	0	0		
T11S R23W S19	0	1		
T11S R23W S20	0	0		
T11S R23W S21	0	4		
T11S R23W S22	0	12		
T11S R23W S23	0	43		
T11S R23W S24	0	57		
T11S R23W S25	0	50		
T11S R23W S27	0	7		

T11S R23W S28	0

Additional Socioeconomic and Related Factors Affecting the Environmental Baseline

As stated previously, the environmental baseline includes past and present impacts of all Federal, State, and private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the effect of State and private actions which are contemporaneous with the consultation process. The various categories of non-Federal activities are summarized in **Table 11**, while the diversion and use of State waters by principal entitlement holders for 1993 are summarized in **Table 12**. It is anticipated that these contemporaneous non-Federal actions will continue during the next five years, and the potential effects of such actions, where they affect the action area, are discussed for the species consulted on here under Cumulative Effects. Additionally, these actions are expected to be addressed in the MSCP for the LCR.

The socioeconomic context in which the proposed action fits, and other key factors pertinent to this BO likely to impact the action area in the next five years, are summarized under five topic areas below. They are: 1) human population, 2) economic development, 3) visitation/recreation, 4) environmental contaminants, and 5) wildfire frequency. Information on some aspects of these topics is limited.

Table 11. Non-Federal activities that may affect the resources of the Lower Colorado River area.

Affecting the mainstem river and its reservoirs	• diversion of state entitlement waters • potential decrease in water quality by: - municipal effluent discharge - storm water runoff - agricultural drainage - recreational waste - other non-point discharges • trash accumulation • increased recreational use: - fishing - hunting - boating - swimming
Affecting the river's adjacent floodplain	• agricultural development: - land conversion - pesticide/herbicide applications - soil erosion/minimum tillage - cropping patterns benefitting certain species - land fallowing • municipal and industrial development: - land conversion - air pollution (dust, automotive and industrial emissions) - natural area management - solid waste disposal (landfills) • trash accumulation • increased wildfire frequency - reduced native riparian habitat/saltcedar expansion •increased recreational use: - hunting - camping - hiking - off-road vehicles
Affecting areas away from the lower Colorado River and its floodplain	• agricultural development: - land conversion - pesticide/herbicide applications - water pollution (of ground or surface waters) - soil erosion/minimum tillage - land fallowing - air pollution (dust and smoke from burning field residues) - cropping patterns benefitting some species - water conservation and reuse • municipal and industrial development: - land conversion - air pollution (automotive and industrial emissions) - water pollution (of ground or surface waters) - solid waste disposal (landfills) - water conservation and reuse • increased recreational use: - resource impacts (off-road vehicles, trampling, etc.) - management plans - developed recreational sites

SOURCE: Bureau of Reclamation Biological Assessment.
[[[insert Table 12]]]]

1. Human Population Impacting the Action Area.

Much of the action area is adjacent to rapidly expanding human populations. The Las Vegas/Henderson area in Nevada is the fastest growing metropolitan area in the United States. Riverside County, California, and Mohave County, Arizona, are two of the fastest growing counties in the country. **Table 13** provides various available population numbers and projections for areas associated with or adjacent to the LCR from 1995 through the year 2000. Projected growth rates for various human population centers range from 10.8% to 114.3%.

2. Economic Development Impacting the Action Area.

Tied with the rapidly growing human population has come rapid land and water development. The major types of development associated with the LCR area are: urban, suburban, and vacation residential areas and supporting infrastructure; commercial developments, including some manufacturing, but with an emphasis on retail establishments; water-oriented recreational developments such as marinas, docks, and boat ramps; and casinos and gaming-oriented hotels and resorts in the Nevada portions and associated with the Indian reservations along the LCR. Extensive agricultural development of the Mohave, Parker, Palo Verde, Imperial, and Yuma Valleys has occurred as irrigation water has been made available, occupying about three-quarters of the floodplain below Davis Dam as of 1986 (USFWS 1986).

Permits are administered along the LCR by the COE for developments that affect the water and shoreline (USACOE 1996). Examination of the 151 activities permitted from Jan. 1, 1994, through Nov. 12, 1996, indicates the types of development that have occurred recently or are ongoing (these are listed in order of their frequency; several permits involve more than one category of activity):

- dock construction (single and multiple) - 56 projects
- boat ramps - 24 projects
- minor developments (e.g., water/sewer lines, revegetation) - 22 projects
- bulkhead or riprap placement or maintenance - 19 projects
- dredging - 14 projects
- major developments (e.g., subdivisions, RV parks, power line) - 12 projects
- marina construction - 3 projects
- mining - 1 project

These developments often involve alteration to the river bank such as excavating for dock pilings, dredging to construct and maintain marinas, and grading and filling to create boat ramps and bulkheads. Conversion of floodplain or bankside lands has in many cases destroyed riparian vegetation and eliminated opportunities to restore historic wetlands and floodplain habitats (USFWS 1993a).

Table 13. Population projections for selected locations along the Lower Colorado River.

Location	Population 1995	Population Projection for Year 2000	Projected Population Increase	Percent Population Increase
Mohave Co., AZ	126,350	154,325	27,975	22.1%
La Paz Co., AZ	16,525	18,600	2,075	12.6%
Yuma Co., AZ	123,050	139,975	16,925	13.8%
Yuma City, AZ	61,466	68,445	6,979	11.4%
Blythe, CA	21,500	24,000	2,500	11.6%
Needles, CA	5,700	6,931	1,231	21.5%
Clark Co., NV	1,039,000 (est.)	1,151,460	112,460	10.8%
Boulder City, NV	14,090	16,467	2,377	16.9%
Henderson, NV	117,933	66,900	48,967	41.5%
Laughlin, NV	7,000 (est.)	15,000	8,000	114.3%

Note: Figures are from various State and local information packets; comparable projections are not available for other locations. The Clark Co. estimates includes Las Vegas.

3. Visitation/recreation Impacting the Action Area

Tourism drives much of the economy of the area, with gambling attracting the majority of the tourists to the Nevada portion of the LCR and warm winter weather as a major attraction in southwestern Arizona and southeastern California. Local tourism-oriented agencies aggressively market opportunities for fishing, boating, water and jet skiing, windsurfing, swimming, hunting, wildlife observation, and water project visitation, in particular, the Hoover Dam. The increasing tourism along the river, together with the increasing resident population, are driving a steady increase in recreational use of the LCR.

Las Vegas attracts more than 28 million visitors per year and the visitation continues to increase. The Bullhead City/Laughlin area attracts more than six million visitors per year. Lake Havasu City draws almost one million visitors per year. Estimates are lacking for other urban areas, but clearly many hundreds of thousands of people per year altogether visit the other towns along the river, such as Yuma, Arizona. The Bureau of Land Management oversees two heavily-used recreational districts on the river. In FY 1996, the Parker Strip area had more than 1.5 million visitors, and the Havasu North area had more than 750,000 visitors. Additional recreational use of the river and adjacent shorelines is ascertainable from visitation statistics for national recreational areas and wildlife refuges on the LCR (**Table 14**). Changes in monthly visitation rates from 1995 to 1996 range from a 0.4% decrease to a 219% increase, with four of the five areas registering an increase.

4. Environmental Contaminants Impacting the Action Area.

Recent research has revealed the impact of organochlorine (pesticides and industrial compounds) and other synthetic contaminants on carp in Las Vegas Wash and Las Vegas Bay in Lake Mead (Bevans et al. 1996). The sex-steroid hormone responsible for male spermatogenesis was present at significantly lower levels in male carp collected in these areas than in male carp from an uncontaminated reference area. Further, tissue changes found in carp livers and kidneys from Las Vegas Wash and Bay were consistent with long-term chronic exposure to a toxicant or combination of toxicants. These carp abnormalities were documented in parts of Lake Mead known to be razorback sucker spawning areas (Bevans et al. 1996).

In a study of contaminants in fish caught in backwater lakes on the Cibola, Havasu, and Imperial National Wildlife Refuges on the LCR, high, near-toxic, concentrations of selenium were found (King et al. 1993). Elevated levels of arsenic, cadmium, copper, lead, and zinc were also found in some fish samples.

In a separate study, contaminants found in wildlife carcasses from various sites in the southern LCR area were elevated above background levels, but did not exceed thresholds associated with poisoning or reproductive problems; these include DDE, aluminum, arsenic, chromium, cadmium, copper, and selenium (King and Andrews 1996). However, selenium was present in one killdeer liver at potentially toxic levels.

5. Wildfire Frequency in the Action Area.

Lightning and human-induced burning of southwestern floodplain environments appear to have increased markedly as native willow/cottonwood vegetation has been replaced by saltcedar - a fire-adapted non-native species - and other shrubs (Busch 1995). From 1981 through 1992, 183 fires burned 16,300 hectares (approximately 37%) of riparian vegetation along the LCR (below Davis Dam) and the Bill Williams River. Plant cover data suggest that saltcedar and arrowweed have dominated other types of vegetation after these fires (Busch 1995).

Table 14. Visitation to selected areas along the Lower Colorado River.

Notes: Abbreviations are: LMNRA - Lake Mead National Recreation Area (which includes Lake Mohave); BWNWR - Bill Williams National Wildlife Refuge; CNWR - Cibola National Wildlife Refuge; HNWR - Havasu National Wildlife Refuge. The averages presented are based on data provided by the administrators of the areas involved, which is incomplete in some cases.

Location	1995 Monthly Avg.	1996 Monthly Avg.	Change 1995-1996
LMNRA	849,628	846,300	- 0.4%
BWNWR	580	1,855	219%
CNWR	3,343	3,688	10.3%
HNWR	46,910	48,212	2.8%
INWR	8,988	9,992	11.2%

Previous and Ongoing Section 7 Consultations

1. Lower Colorado River Mainstem

Since 1973, Reclamation has informally and formally consulted under section 7 of the ESA for various projects that potentially may have had direct or indirect effects on threatened and endangered species and critical habitat along the LCR (**Table 15**). Although the projects have varied substantially, as have the effects, the Service has concluded that the projects consulted on would not jeopardize the continued existence of any species or its critical habitat. In some consultations, incidental take was addressed by reasonable and prudent measures (RPMs). These consultations are considered part of the environmental baseline.

[[[insert Table 15. p.1

[Table 15, p. 2

Table 15, p. 3]]]]

2. Other Baseline Projects

In addition to Reclamation activities that were evaluated for direct or indirect effects on the mainstream of the Colorado River, section 7 consultation and National Environmental Policy Act compliance have been completed or are in the process of being completed for authorized projects that provide facilities for the States to divert and distribute State waters confirmed by previously discussed court decrees. The Central Arizona Project (CAP) and Robert B. Griffith Water Project (southern Nevada) are summarized below as part of the environmental baseline.

a. Central Arizona Project Havasu Diversion

The CAP was constructed to provide a long-term, non-groundwater, water source for municipal, industrial, and non-Indian and Indian agricultural users in Arizona. The CAP was authorized for construction under the Colorado River Basin Project Act, Public Law 90-537 (82 Stat. 885), approved Sep. 30, 1968. An approximately 330-mile long series of open canals, inverted siphons, pumping plants and tunnels convey water diverted from Lake Havasu east through Phoenix and then south to the southern boundary of the San Xavier Indian Reservation southwest of Tucson. Under normally expected water supply conditions, project diversions from the Colorado River are expected to be about 1.5 maf per year of Arizona's basic annual entitlement of 2.8 maf.

Reclamation has consulted formally and informally on over 50 CAP-associated projects. In April of 1994, after three years of intensive formal consultation with Reclamation , the Service issued a final BO on the Transportation and Delivery of Central Arizona Water to the Gila River Basin (Hassayampa, Aqua Fria, Salt, Verde, San Pedro, middle and upper Gila Rivers, and associated tributaries) in Arizona and New Mexico. The opinion found that deliveries of CAP water would jeopardize the continued existence of the spikedace (*Meda fulgida*), loach minnow (*Tiaroga cobitis*), Gila topminnow (*Poeciliopsis occidentalis*), and razorback sucker and would adversely modify the critical habitat of the spikedace, loach minnow, and razorback sucker. Reclamation is now in the process of implementing the reasonable and prudent alternatives (RPAs) presented in the opinion. Reclamation's Phoenix Area Office is also preparing a biological assessment on the delivery of water into the Santa Cruz River Basin.

The CAP begins at the Havasu Intake and Pumping Plant, located at the lower end of Lake Havasu downstream of the Bill Williams River Delta and within the Havasu National Wildlife Refuge. The Havasu Pumping Plant has the capacity to lift 2.2 maf per year of Colorado River water 800 vertical feet to the Hayden-Rhodes Aqueduct. Each of the six pump units has a capacity of 500 cfs. Trash racks with openings 6 x 16 inches cover the pump intakes, and estimated water velocity in front of the trash racks is 1.1 feet per second.

Reclamation's Havasu Intake environmental impact statement (EIS) (Jan. 1973) addressed native, rare, and endangered species, concluding that "...very few fish in comparison to the overall fish population on Lake Havasu will move through the intake channel and be adversely affected by pumping operations. These fish would be types oriented to open water movement and feeding, such as threadfin shad and striped bass." The EIS stated that there would be a monitoring program to assess losses of fish and other aquatic biota in Havasu and "...data obtained in this initial phase and subsequent phases will be evaluated to determine whether protective measures are required." The emphasis at that time was clearly on sport fishes. The Fish and Wildlife Coordination Act (FWCA) Report from the Service, dated June 30, 1976, also recommended studies to determine the extent of any fishery losses. At the time of the EIS and the FWCA report neither the bonytail nor the razorback sucker were on the endangered species list.

In 1989, the Service, Arizona Game and Fish Department, and Reclamation cooperatively submitted a report on the Lake Havasu Fishery Study. Sampling was conducted on either side of a half-mile long dike that forms an embayment leading to a cement-lined channel and the pumping plant. Seasonal sampling was conducted from the spring of 1984 to December 1985. No razorback suckers were found during this study. However, adult razorback suckers were observed in the CAP canal in 1986 (Mueller 1989).

b. Southern Nevada Water System (Robert B. Griffith Water Project)

An environmental assessment was prepared in 1992 to obtain a contract for the uncontracted remainder of Nevada's 300,000 acre-feet per year consumptive use apportionment. Section 7 compliance was concluded through informal consultation. By memorandum dated Feb. 21, 1992, the Service concurred with Reclamation's determination that the proposed action was not likely to adversely affect the threatened desert tortoise.

Improvements to the Southern Nevada Water System (SNWS) were identified in the 1994 Final Environmental Assessment of the Colorado River Commission's Proposed SNWS Facilities Improvement Project. The improvements are associated with existing facilities. As part of the environmental compliance, Reclamation entered into formal section 7 consultation with the Service on Aug. 31, 1994, for the Mojave desert tortoise, a federally listed threatened species. On Dec. 6, 1994, the Service rendered its BO that the SNWS Improvement Project is not likely to jeopardize the continued existence of the threatened Mojave population of the desert tortoise and no proposed critical habitat will be destroyed or adversely modified. An Incidental Take Statement was issued with RPMs to minimize take.

A draft EIS for the proposed Southern Nevada Water Authority Treatment and Transmission Facility (SNWA-TTF) was provided for public review and comment in November 1995. A final EIS is expected soon. Reclamation initiated formal consultation on the desert tortoise on Aug. 15, 1995, and received a draft BO on Dec. 18, 1995. Because of a number of project refinements, Reclamation requested a number of extensions to incorporate these changes into the final BO. The additional information and comments were provided to the Service on June 26, 1996, and a final BO was completed on September 16, 1996.

The BO found that the proposed project is not likely to jeopardize the continued existence of the threatened Mojave desert tortoise population and no critical habitat will be destroyed or adversely modified. An Incidental Take Statement was issued with RPMs to minimize take.

3. Salton Sea and the Endangered Desert Pupfish

A summary of past ESA consultations on the endangered desert pupfish in the Salton Sea area is provided below. Following listing of the desert pupfish as an endangered species in 1986, a BO was issued by the Service (June 18) on the effects of agricultural drain maintenance on this species. The opinion found that both agricultural drain maintenance activities and the introduction of sterile grass carp would not jeopardize the continued existence of desert pupfish. The opinion allowed for unlimited incidental take of the species during drain maintenance.

When the desert pupfish was listed as an endangered species (March 31, 1986), critical habitat was designated for the species along San Felipe Creek/San Sebastian Marsh, an intermittent stream and marsh complex on the west side of the Salton Sea. Reclamation purchased all of the private land holdings within the critical habitat area for $300,000 and turned this land over to the California Fish and Game Department under a quitclaim deed in 1990.

In June 1992, a second BO was issued regarding drain maintenance and its affect on desert pupfish. The consultation involved the Salton Sea National Wildlife Refuge drains maintained by Imperial Irrigation District. The opinion again found that the drain maintenance would not jeopardize the desert pupfish; however only a limited incidental take was allowed due to recent observations of increased pupfish populations in the drains. This opinion also covered effects on Yuma clapper rails and California brown pelicans. Similar to the desert pupfish, the Service was of the opinion that drain maintenance would not jeopardize the continued existence of either species.

4. Operation of Glen Canyon Dam

The operation of Glen Canyon dam by Reclamation affects the timing and amounts of water and sediment flows to Lake Mead, at the upstream end of the action area currently under analysis. A BO was prepared by the Fish and Wildlife Service, on the proposed action to operate the dam according to operating and other criteria of the Modified Low Fluctuating Flow Alternative. This alternative was described as the Preferred Alternative in the Final EIS on the operation of Glen Canyon Dam issued in March, 1995, and was selected for implementation in the Secretary of Interior's Record of Decision dated Oct. 9, 1996. The BO (dated Jan. 7 , 1995) found that the dam operations were likely to jeopardize the continued existence of the humpback chub and the razorback sucker and were likely to destroy or adversely modify designated critical habitat for the two species. The BO noted the connection between the Glen Canyon dam operations and the potential for razorback sucker recovery downstream, including Lake Mead (in the action area currently under analysis), with primary adverse effects due to altered temperatures, flow regimes, and, possibly, sediment load. A reasonable and prudent alternative was developed to limit jeopardy to the endangered fish. The impacts of the operation of Glen Canyon Dam on the southwestern willow flycatcher are to be addressed in a later consultation.

5. Spring 1996 Beach/Habitat-Building Flow, Glen Canyon Dam

The BO by the Fish and Wildlife Service, dated Feb. 16, 1996, addressed the potential effects of flood-mimicking flows from Lake Powell through the Glen Canyon Dam designed to build beaches and improve wildlife habitat downstream. The final opinion found no jeopardy or adverse modification of critical habitat. RPMs for addressing incidental take were imposed for the southwestern willow flycatcher. The measure called for specific surveys and monitoring, and the initiation of formal consultation by February, 1997.

6. Fish and Wildlife Service Intra-Service Formal Consultation on Division of Federal Aid Transfer of Funds to Arizona Game and Fish Department for Stocking of Sportfish

The BO, dated Oct. 31, 1995, was on the Service's Federal Aid funding of Arizona Game and Fish Department's non-native fish stocking in 90 locations across the state, including the LCR, for the period 1995-1999. Following further informal consultation, the Division of Federal Aid submitted only the stocking sites and fish species for which it found no effect or not likely to adversely affect. The Service's Division of Ecological Services concurred with those findings.

7. Lake Havasu Fisheries Improvement Partnership Program Formal Consultation

This BO, dated February 18, 1993 addressed the Bureau of Land Management and cooperating agencies and entities' plan to: (1) improve fishing facilities; (2) place fish habitat structures; and, (3) augment existing bonytail chub and razorback sucker populations in Lake Havasu over a five to ten year period. Cooperators included Reclamation and the Service. The augmentation program for native fish would put 30,000 young bonytail chub and 30,000 young razorback suckers into the reservoir. The Service found that the proposed action, including the augmentation program, was not likely to jeopardize the continued existence of either species or adversely modify designated critical habitat for the bonytail chub. RPMs to minimize incidental take, especially from anglers, were included in the incidental take statement.

8. Fish and Wildlife Service Intra-Service Formal Consultation on Division of Fisheries and Federal Assistance on Stocking of Rainbow Trout and Channel Catfish

The Service proposed to stock catchable size rainbow trout and channel catfish into selected area of the LCR from below Hoover Dam to the international border to enhance recreational fishing. According to the BO issued July 1, 1994, the proposal would neither jeopardize the razorback sucker or bonytail chub nor would it adversely modify their critical habitat. An RPM was imposed to minimize the opportunity for contact between the trout and the endangered fish. Terms and conditions to implement the RPM included the introduction of 10,000 advanced fingerling razorback suckers a year to Lake Mohave for five years (1995-1999) and 25,000 advanced fingerling bonytail chub a year to Lake Mohave for four years (1996-1999) to augment declining populations of these species in the reservoir.

EFFECTS OF THE ACTION

This section addresses the proposed action's effects on the species under consultation. It also considers cumulative effects on these species in the action area, which include the effects of future State, local, tribal, and private actions that are reasonably certain to occur in the next five years. Future Federal actions that are unrelated to the proposed action are not considered here because they would require separate consultation pursuant to section 7 of the ESA.

Listed species/critical habitat:

Bonytail Chub and Razorback Sucker with Critical Habitat

The effects analysis is driven by the description of the proposed action. Reclamation defines the action in the BA as including only those activities for which Reclamation has discretion. Unlike most section 7 consultations where the proposed action has not been implemented, significant adverse effects to native fish species and habitats began to occur as much as 100 years ago due to the actions of Reclamation, other Federal agencies, and a variety of non-Federal parties with rights or interests on the river. The operation and maintenance program of the proposed action largely maintains the existing conditions of the LCR.

The analysis will be done in two stages. The first will examine the effects of activities included in the environmental baseline. The second will examine the proposed action for five years into the future, looking at direct (including effects of interrelated and interdependent actions), indirect, and cumulative effects. Unless the proposed management would result in a change to an effect arising from the baseline, all effects from the first stage analysis are presumed to carry forward into the second stage, in other words, they are additive. The analyses of effects for both the environmental baseline and the five-year period for the bonytail chub, the razorback sucker, and their designated critical habitats are nearly identical. These analyses have been combined into one to reduce duplication.

Effects of the Environmental Baseline

As described in the environmental baseline and the BA, the LCR is a managed river with three large dams (Hoover, Davis and Parker) and five small dams (Headgate Rock, Palo Verde, Imperial, Laguna and Morelos) that provide diversions for agricultural and municipal uses serving three states and the Republic of Mexico. All but one (Morelos) were built by or are operated by Reclamation. Hydropower produced by the system is partially used within the project area, but most is exported. Channelization and levee construction has allowed much of the floodplain to be developed for agricultural, recreational, residential and commercial uses. In addition to physical changes, non-native fish, invertebrates (crayfish and Asiatic clams), and trees (*Tamarix sp.*) have become established to the detriment of many native species of plants and animals.

Construction and operation of Hoover, Davis, and Parker dams had effects to the river both upstream and downstream of the dams themselves. The specific operation of these dams and their associated reservoirs differs between facilities. These large dams are barriers to fish migration and produce fragmented habitats and populations. Dams may not be complete downstream barriers, but are complete upstream barriers to fish migration. The severity of this effect depends on the location of the fish populations relative to the barrier and essential habitats. For example, leaving a few fish on one side and many on the other exposes the smaller population fragment to larger risks of extirpation. Spawning and nursery habitats may not be equally available on either side of the barrier, further stressing both populations. The construction of the three large dams on the LCR isolated populations of bonytail chub and razorback sucker, prevented most upstream movements (the exception being from Lake Mead into the Grand Canyon), and reduced access to essential habitats especially in the floodplains. These effects resulted in degradation to constituent elements of the physical environment for the bonytail chub and razorback sucker.

The large dams provided a means to control flood events and provide for water on demand for agricultural and municipal purposes. Disruption of the natural hydrograph modified natural flows and created large reservoirs; thus, interrupting the biological behavior for native fish, while enhancing habitat conditions for non-native fish. The new release schedules largely eliminated the spring-early summer floods and provided higher than normal releases through the late summer to late fall to accommodate agricultural and other needs. Without the high spring to summer flows, bottomlands important for adult razorback suckers as feeding areas and nursery areas for the young of the year either remained impounded behind dams or were not flooded, thereby interfering with the ability of adult fish to recruit successfully to replenish existing populations. Floods were also the dominant force in creation, refreshment and destruction of marshes, backwaters, and riparian vegetation on the terraces. Without high flows, this cycle of habitat succession became impaired (Carlson and Muth 1989). Cues for migration and reproduction based on rising or falling water levels also have been lost. Retention of higher flows for longer periods in the summer may have improved water quality in the shallow backwaters and channels by allowing for more water circulation, but more extreme short-term water level fluctuations may have negated all improvements of habitat for native fish. The pattern of releases also became regular, varying in a set pattern on a daily, weekly and monthly basis, although the actual amount of fluctuation was less downstream as peaks were attenuated. Daily variations could be extreme depending upon the water release schedule power production and other needs. Below dams, over a 24-hour period, changing water depths and velocities could strand fish in adjacent shallows or drain backwaters and marshes, and alter the form of the river channel itself through changes in sediment transport and channel modification. These effects degraded the critical habitat constituent elements provided by water and the physical environment.

Water released from large dams is clear and picks up sediment from below the dam and transports it further downstream. This transport is uneven due to the changing flows created by dams. These flows eventually lead to armoring of the river bottom in the tailrace (Moffett 1942, Dill 1944, Carlson and Muth 1989) and deposition of sediments downstream. Clear water and hard substrate in the armored tailrace provides sites for aquatic plants, especially filamentous algae, to become established. A variety of aquatic insects colonize plant beds. Before the dams, the main channel was not very productive due to turbidity and unstable substrates. With sediment and the organic materials carried with it being trapped in reservoirs, the river lost its capacity to transport nutrients downstream to backwater and ponded areas. Thus, the amount of sediment transported or available to be transported to downriver nursery areas is now greatly reduced.

Hoover and Davis dams release cold water from the hypolimnion located in reservoirs immediately upstream. Water temperatures are relatively constant at the base of each dam and do not reflect seasonal changes that occurred historically. Although water temperatures increase gradually as flows continue downstream, temperatures may vary from seasonal changes that occurred historically. Water temperature-related cues to trigger spawning behavior may be impaired throughout much of the lower river. The new water temperatures of 12-16°C (below Hoover) are within the range of temperatures normally experienced by bonytail chub and razorback sucker in the Colorado River (5-30°C or higher) (Carlson and Muth 1989). However, the modified flows do not reach water temperature levels necessary for bonytail chub reproduction, as this fish spawns at no less than 18°C (USFWS 1990). Razorback suckers however, spawn at water temperatures of 10°C to 20°C (Bestgen 1990), well within the temperature range of water coming from Lake Mead. Additionally, adult razorback suckers have been found within the area of influence of the cold water releases below Hoover Dam during the spawning season. After hatching, larval razorback suckers prefer warmer water, 21-24°C (Sigler and Miller 1963), found in flooded bottomlands, backwaters, and shallow water margins of the channel. Temperatures such as these are not normally attainable in the tailraces, however depending upon the extent of larval drift (itself influenced by the changing flow conditions), such temperatures could be present downstream. Bonytail chub have occasionally been found in the colder water areas, but with their very low population size, more definitive information on use of these coldwater areas is not available. These changes to water temperature have degraded this constituent element.

Downstream effects caused by large dams adversely impacted the bonytail chub and razorback sucker populations in the river. However, at the same time, more aquatic habitat was provided by the new flow regimes, more warm water temperatures were available in reservoirs, and local increases in productivity and decreases in turbidity may not have eliminated the constituent elements needed by native fish to survive through time. These native fish species had demonstrated their ability to thrive in the great extremes in physical conditions characteristic of the LCR historically. However, these changes also improved and greatly increased habitat for non-native fish species that were either already present or soon to be introduced into newly created reservoirs and thus adversely modified the biological environment constituent element for native fish.

As changes occurred to the water and physical environments, non-native fish and invertebrates prospered. Introduced fish species generally compete with or prey on native fish, especially, eggs, larvae and juveniles. Other introductions, such as threadfin shad (*Dorosoma petense*) and the Asiatic clam, were likely competitors and added to populations of non-native predators by providing an additional forage base. Thus, introduction, establishment, and maintenance of non-native competitors and predators further impaired the opportunity of native fish to adapt and survive in a river system where physical environments and water constituents are altered.

Carp have been identified as significant predators on razorback sucker eggs. Carp were introduced to the LCR before the large dams were constructed. While carp live successfully in turbid waters (LaRivers 1962, Lee et al. 1980), early observations noted these species in clearer backwater areas (Grinnell 1914). Whether carp could survive and expand in sizable numbers in the high sediment loads of the LCR mainstem is not clear. In the Upper Basin, larger populations of carp are found near backwaters (Joseph et al. 1977). Growth rates for carp in riverine areas in general are lower than in reservoirs (Carlander 1969). Water temperatures in the cold tailraces are generally too low to provide spawning habitat for carp, but are well within their survival range (Carlander 1969). Although sediment loads increased downstream from the dam, they settled out again at the next downstream reservoir, backwater or ponded area, thereby enhancing carp habitat. Dam construction and subsequent impoundment has increased the aquatic habitat in the Colorado Basin from some 15 maf of riverine habitat to 60 maf of reservoir and riverine habitat; under these conditions, carp populations have expanded dramatically.

Channel catfish prey on small fish and were present in the LCR by the 1900's. Within their native range, channel catfish are found in a wide variety of habitats, although there may be a preference for clear water rivers of various sizes (Miller 1966, Allan and Roden 1978, Minckley 1979, Lee et al. 1980). Habitat data from a number of locations indicates that sediment load is not a major factor in defining channel catfish habitat (Dill 1944, Miller 1966). Channel catfish utilize mainstem-type habitats such as deep pools or riffles, depending upon size and age of individual fish (Miller 1966). Water temperatures in the cold tailraces are not an impediment to channel catfish occupancy (Dill 1944), but are too cold for spawning. However, ample opportunities for successful catfish spawning elsewhere in the modified river are available. The increased productivity of filamentous green algae and aquatic invertebrates provided additional feeding opportunities for this species.

Upstream of the large dams, riverine, backwater, marsh, and riparian vegetation in the floodplain was lost to inundation as water backed up behind the dams, adversely affecting the physical habitat. These habitats were replaced by large reservoirs (Lakes Mead, Mohave, and Havasu). Water levels in all three reservoirs now fluctuate over the year in patterns resulting from flood control requirements, consumptive use of water downstream, and hydropower generation. Fluctuations in water levels can strand eggs or larvae and force young fish out of cover provided by vegetation and shallow water; thus increasing the risk of predation. Razorback suckers spawn in late winter and early spring, but young-of-the-year are subject to predation when levels begin to recede. The voluntary reduction of fluctuations to protect growout coves for razorback suckers in Lake Mohave has provided opportunities to implement short-term recovery actions for this species. At the same time, stabilized water levels also benefit later spawning non-native fish, which put additional pressures on bonytail chub and razorback sucker eggs and fry not in "protected" coves. Reservoir water level management has effects to the constituent elements of water, and the physical and biological environments.

Because of water level fluctuations, stands of riparian vegetation around reservoir shorelines are limited. Lake Havasu, because of the less severe annual fluctuations, has the most extensive marsh area of any of the three large reservoirs. Backwaters in reservoirs are of two types; the first are shallow coves fully connected to the reservoir proper, the second are small waters cut off from the reservoir except perhaps during times of very high water. Both types of backwaters are adversely affected by falling water levels in reservoirs and thus the value of these shallow waters can be diminished depending upon specific operations at each dam. Generally, falling water levels that expose fish eggs and protective cover for young fish, or that reduce the size of isolated nursery areas during the difficult summer months, have a negative impact on native fish.

Historically, the LCR mainstem was not extremely productive for aquatic plants and animals. However, adjacent backwater areas were extremely productive. Low productivity of the mainstem was due in large part to high turbidity and unstable substrates. As noted previously, large dams allowed for greater productivity in the main channel due to armoring of substrates and increased water clarity. Available nutrients carried downstream from the modified channel area deposit either in remaining riverine stretches or in reservoirs. Some of the organic material remains suspended in the water, but some becomes trapped in the sediments deep in the reservoirs and thus becomes unavailable to aquatic organisms or for further transport downstream to backwater areas. Overall, reservoir productivity is generally not high, with LCR reservoir averages generally in the mesotrophic range (Paulson et al. rman 1984). Since historically much of the productivity of the LCR was provided from off-site sources and carried downstream through the system, this interruption of nutrient flow (most of which has settled out in upstream reservoirs) has affected productivity in Lower Basin reservoirs and remaining backwater areas. Elimination of riparian, marsh and backwater conditions by creation of reservoir pools may have contributed to declines in productivity also. As with other large reservoirs, productivity in the LCR reservoirs has decreased over time, but in the years immediately after high water levels inundated shoreline areas in Lake Mead, higher production of fish was noted (Jonez and Sumner 1954, Allan and Roden 1978).

Bonytail chub and razorback sucker adults utilize reservoir habitats with considerable success, as has been shown by the persistence of adult populations in Lakes Mead, Mohave, and Havasu. But, reservoirs also produce carp, channel catfish, and a host of other species introduced to and maintained in reservoirs for sport fishing. Populations of largemouth bass, bluegill, rainbow trout, threadfin shad and striped bass are in the LCR in considerable numbers because of large reservoirs. Largemouth bass prefer non-flowing water habitats such as ponds, lakes, and backwaters with clear water and some type of aquatic vegetation (Emig 1966, Carlander 1969). Bluegill prefer similar habitats (Carlander 1969), while green sunfish are habitat generalists (McKechnie and Tharratt 1966, Lee et al. 1980). Declining water levels increase the risk of non-native predation on young native fish if they are forced out of cover (Carlander 1969, Allan and Roden 1978). After high water years, largemouth bass populations increased due to inundation of usually dry lands at Lake Mead (Jonez and Sumner 1954, Allan and Roden 1978).

The five smaller dams do not have the magnitude of effects that larger dams do; but, the same types of effects exist. Flows downstream of the smaller dams do not fully mimic the natural hydrograph, and are often smaller than the flows reaching the dam due to withdrawals via diversion dams and associated canals. Water temperatures do not change due to stratification because there is no hypolimnion in the reservoir. If water storage occurs, it is limited and resembles a pond or small lake habitat rather than that of a large reservoir. Water behind the dam is ponded, and the ponding effect offsets some of the fluctuations resulting from varying releases upstream. Aquatic plants grow well in impounded waters; emergent plants such as cattails and rushes also do well near reservoir shorelines. The largest of these areas is behind Imperial Dam and contains several backwaters, as well as the ponded area of the channel. Conditions in these areas are probably suitable for bonytail chub and razorback sucker, but they also support large populations of non-native fish species including carp, channel catfish, largemouth bass, green sunfish and bluegill that are more competitive and flourish in reservoir environments. Minckley (1979), after surveys of the Colorado River downstream of Davis Dam, determined that the non-native fish fauna preferentially occupied the more lentic portions of the river, including ponded areas. Thus, small dams also have an adverse effect on the three primary constituent elements of water, physical environment and biological environment.

Movement of sediments through the system had always been a concern for water users. With dam construction, sediment deposition behind small dams and at the heads of large reservoirs became a management issue. This concern was first apparent at Laguna Dam, which silted in within a year following its completion.

The first project to address deposited sediments took place at the head of Lake Havasu. As water velocities dropped due to the effects of lake elevation, the slowing water deposited sediments at the head of Lake Havasu. These depositional areas supported riparian and marsh vegetation and a meandering river channel with associated backwaters (Beland 1953). Water continued to back up above the depositional area and, as described in the BA, measures to protect the town of Needles were undertaken. The effect of these measures was to re-route the Colorado River to a new, straight channel and eliminate the old, meandering channel with its associated backwaters, marshes, and riparian areas (Beland 1953). The new channel was completed in 1951 and cut off the old river channel and its associated aquatic and riparian habitats. Elimination of most of the marsh area removed a source of non-native fish to other parts of the river, but it also eliminated preferred habitats for native species. The constituent element for physical environment was adversely affected. The higher water velocity in the new channel generally kept suspended sediments from being deposited before they reached Lake Havasu. Some down-cutting of the channel occurred also, further stressing water levels in the remaining marshes on the other side of the levee separating the two (Minckley 1979). Protection of the remaining marsh required a dike and headgate system to retain water levels and flows. The smaller marsh area provided suitable habitat for non-native fish species adapted to still, clear water situations. All native fish utilizing the same area were subjected to predation and competition stresses, thereby resulting in adverse effects to the biological environment element.

Virtually all the riverine reaches remaining after the construction of the large and small dams were channelized or stabilized to some degree. In areas such as upstream from Lake Havasu, as well as near Palo Verde and Cibola, new river channels were cut in the former floodplain to divert almost the entire flow from the old, meandering channel to the new straight one. Other projects straightened, dredged and stabilized banks within the existing channel. The intent of these activities was to provide faster, more efficient transport of water to downstream users, with flood control and safety issues also playing a role. In so doing, backwaters and marshes were isolated and sometimes dried up, as flows could no longer reach them, and thus the heterogeneity of the main channel habitats was lost (Minckley 1979). Generally, such reaches lack mid-channel bars and are almost uniformly deep and swift, with little seasonal variation over the year (Beland 1953, Ohmart et al. 1988). Areas containing aquatic plants are rare in these reaches too, and invertebrate populations are depauperate (Minckley 1979).

While main channel habitats were utilized extensively by bonytail chub and razorback sucker, backwater areas were also very important. The main channel was used extensively when moving from backwater to backwater, when moving to spawning, rearing, and nursery areas, and as refuges during periods of low flows when backwaters were either not suitable or available. With new flow regimes from the dams, there were changes to the main channel. Thus, the constituent elements of water and physical habitat were significantly affected by channelization and stabilization programs.

For non-native fish, reductions in flood events may have had a positive effect, as did clearing of the water and changes in sediment transport. Although all non-natives seemed to prosper, channel catfish and perhaps carp prospered disproportionately, as abundance of both species became more apparent after 1930. Channelization activities did not improve habitats for non-native fish. The most modified areas of the channel (deep water with linear currents and shifting fine-grained substrates) were the least occupied by all fish (Minckley 1979); examples of these types of areas are in the Mohave Valley, Topock Gorge, Parker, Palo Verde, Cibola, and Imperial Divisions of the LCR. Only in the Topock Gorge Division can these conditions be tied to natural features of the river. There was some use of channelized reaches by several species including carp, channel catfish, largemouth bass and green sunfish (Minckley 1979), but use was less than in less modified habitats or lentic environments. Lentic habitats such as backwaters and low-current portions of the channel were preferred by most non-native fish species (Minckley 1979). The deleterious habitat overlap between non-native and native fish species was shown in this joint preference for backwater-type habitats.

There is little specific information on habitat quality of backwaters prior to development of facilities on the LCR. Historically, backwaters could be completely isolated, partially isolated or connected to the main channel of the river. Flooding might temporarily have re-connected isolated or partially isolated backwaters to the river, thereby providing for water exchange and fish movement into and out of the backwater areas. Flooding might also have created, enhanced or obliterated backwaters. Seasonal changes in water levels in the main channel also influenced water levels in backwaters. Naturally low flows in the hot summer months increased water quality problems, water temperatures, influenced productivity by exposing aquatic plant beds and substrates supporting invertebrate populations, and dried up backwaters permanently or temporarily. Fish in isolated backwaters had no escape if conditions became too harsh, but fish in connected backwaters could move from backwaters into the main channel. Because of the natural historical flooding regime, the physical state of backwaters was constantly being adjusted or altered. The habitats were very dynamic and were extensively used by bonytail chub and razorback sucker.

Today, many backwaters are isolated behind dikes or levees, and water flow is through permeable dikes. Some backwaters may have simple inlet-outlet structures, while others retain an opening to the river. The magnitude of the connection has a significant influence on how quickly or to what extent water levels in the backwater fluctuate. Backwaters connected to the river are most affected by fluctuations, since the connections allow them to fill and drain rapidly as water levels rise and fall (Kennedy 1979). Water levels in isolated or partially isolated backwaters may not be as affected by daily fluctuations due to reduced water exchange capacities with the river, but are affected by weekly and monthly changes in flow levels. Water quality problems such as high salinity and high temperatures in these backwaters are exacerbated by limited inflows and lack of seasonal refreshing floods. Fluctuations in water levels affect the potential for stranding fish or eggs, affect benthic productivity (invertebrates and plants), influence water quality and temperatures, and may increase predation of fish forced out of shallow water cover into deeper, more open situations (Kennedy 1979). While the longer term effects observed are largely the same as in the historic period, the patterns of daily and monthly fluctuations in the main channel have been altered significantly. These alterations have increased short-term (daily) changes, maintained higher levels for longer into the summer, and eliminated spring-summer peak flows. Attenuation of fluctuations downstream of dams or diversions, serves to reduce the daily changes, although diversion of water also reduces the total flow available. Thus, the further downstream a backwater is, the less water flows past, and the less potential there is for flushing to improve water quality, for rebuilding of stream morphology, or for providing access to the main river's habitats.

Operations on the river today influence the aging of backwaters, the gradual infilling that reduces areal size and depth over time. In the absence of flooding, maintenance of existing backwaters is through human intervention. "New" or enhanced natural backwaters are created by dredging at the site of old backwaters, perpetuating existing patterns of habitat. Many of these new or enhanced backwaters were created as mitigation for channelization projects on the river that possibly had destroyed other natural backwaters along the meandering channel. Mitigation under the National Environmental Policy Act and the Fish and Wildlife Coordination Act for these channelization projects was directed towards creating fish and wildlife habitats to offset losses. The program has been very successful at providing secure, physically diverse habitats along the river. However, non-native fish have inadvertently been the primary benefactors from mitigation projects. It is not a question of habitat appropriateness, because both bonytail chub and razorback sucker use backwaters extensively, rather it relates to the clear overlap in habitat preference by the two groups for backwaters, and a fisheries management regime that favors recreational fishing supported by non-native species. As long as habitat conditions improve for non-native fish, efforts to provide for recruitment of native fish are largely unproductive. Projects in which portions of created backwaters are blocked off for native fish refugia can be beneficial to short-term efforts where native fish are raised for release and thus replacement/maintenance of existing populations; such projects may not be effective in a long-term conservation strategy. Overall, past mitigation for channelization projects on the LCR has not provided overall benefits for the bonytail chub or razorback sucker. While backwaters are clearly part of the water and physical environment constituent elements of the habitat, the creation of stable and permanent backwaters that provide long-term habitat for non-native fish degrades the biological environment constituent element of native fish habitat. In other words, the habitat values of backwaters to native fish are negated to a large degree by the subsequent invasion of non-native fish.

With less and less water available to the lower river divisions (Laguna, Yuma and Limitrophe), there is a significant reduction in the amount and diversity of aquatic habitats available. The Limitrophe Division is now essentially dry, whereas historically there was much aquatic habitat. Extensive bank stabilization in the Yuma Division effectively prevents flows from meandering or forming backwaters or marshes even if the flow was sufficient. Water quality in these lowest divisions can be poor because of low inflows, high salinity irrigation returns, and high evaporation rates. Both the water and physical environment constituent elements have been adversely affected.

Water quality has also changed due to use and reuse of river water as it travels downstream. Agricultural return flows contain various residuals from fertilizers and pesticides as well as salts leached from the soils. Salinity in the river has increased measurably as a result of water usage and evaporation (Minckley 1979). Levels are not to the point where they pose a risk to fish health; however, increased salinity causes levels to be higher in areas of significant evaporation such as isolated and partially isolated backwaters. Without the types of flushing flows historically experienced by these areas, water quality remains less than optimal. The increase in salinity is to some extent degrading the physical environment constituent element. Other types of pollutants in the system have similar effects.

Reclamation includes several activities under endangered species conservation as part of the proposed action. Since all these projects are ongoing, they have a place in the environmental baseline. The implementation of these and other projects has improved the baseline condition of the bonytail chub and razorback sucker in the LCR.

Through the Native Fish Work Group, Reclamation began the first significant efforts to restore razorback suckers to Lake Mohave. Reclamation's Boulder City Golf Course Native Fict also supports this program. These projects continue to be extremely important to the survival over the short-term of this species. Reclamation states that the goal of the NFWG is to put 25,000 bonytail chub and 50,000 razorback suckers into Lake Mohave by 2005 and 2000 respectively. In the BA, Reclamation also includes a provision for augmenting the Lake Havasu bonytail chub and razorback sucker populations with the release of 25,000 young fish of each species over the next ten years as part of its conservation actions. Also in the BA, Reclamation commits to providing the resources necessary to achieve at least half, if not more, of the quantified augmentation goals for the two reservoirs.

For the most part, these efforts on the part of Reclamation qualify as conservation actions under section 7(a)(1) of the ESA since these are voluntary efforts using existing authorities. The only portion that would not qualify would be whatever stake, as an official cooperator, Reclamation originally had in the Lake Havasu program being led by the Bureau of Land Management (BLM). However, what are conservation actions as far as Reclamation is concerned, are not actually conservation actions when all factors are examined. Reclamation's conservation actions have become interlinked with other projects that have undergone formal section 7 consultation, that include the production of bonytail chub and razorback sucker for Lakes Havasu and Mohave. These projects are the Lake Havasu Fishery Improvement Partnership Program led by BLM and the Service's rainbow trout stocking on the LCR (see Previous Section 7 Consultations section under Environmental Baseline, above.). The BLM and its cooperators and the Service are committed to the production of young native fish; indeed, if they are not produced as stated in the project description or the terms and conditions, then reinitiation of formal consultation would be required under the reinitiation standards included in regulations for section 7. Production of native fish is an integral part of these two actions and was a significant factor in the final analysis of the effeions. Reclamation, by voluntarily increasing its involvement in the Lake Havasu program and assisting the Service in the retrofit of Willow Beach National Fish Hatchery and other tasks, so these fish production goals can be met, has undertaken conservation actions in the current proposed action that would benefit the fish, but Reclamation is not providing any more fish to the river than are already committed to by BLM and the Service under these two projects. Presumably these goals could be met without Reclamation's conservation actions; it is to Reclamation's credit that it has chosen to contribute resources to assist. The situation involving these same fish is further complicated with the additional funding to accelerate production that Reclamation and the Service provided as part of the first year interim conservation measures for the MSCP (see Appendix G of the BA). These additional resources may assist in meeting the goals of the Lake Havasu and Lake Mohave augmentation programs, but do not provide for any increase beyond attainment of these goals.

Non-Federal parties have had significant effects to the river and the floodplain through development of agricultural lands within the old floodplain, actual diversion of water from the river, and construction of homes, recreation areas, and businesses along the shorelines and adjacent lands, as well as maintenance of sport fisheries, and other types of developments that rely on the river in some form for success.

The actual diversions and associated canals that are located within the action area, but are not part of the proposed action, provide some aquatic habitats for fish. Although both native and non-native fish utilize canals for habitat, management of the canal system may provide opportunities for successful recruitment of razorback suckers. Young razorback suckers were found in the Colorado River Indian Tribe's (CRIT) canal system when that system was dewatered for maintenance. It may be that populations of non-native fish are suppressed by this canal management enough for the young razorback suckers to grow beyond the size of greatest risk from predation. Considerably more information is needed to understand why razorback sucker fry survived and grew to subadults in these canals.

The introduction of some fish species, such as rainbow trout and striped bass (*Morone saxatilis*), would not have occurred without the habitat changes provided by the construction of the large water storage dams. Largemouth bass, bluegill, green sunfish, black crappie, or threadfin shad may be similar, since their introductions were tied to sport fishing opportunities provided by the creation of reservoirs. Carp and channel catfish also spread successfully in the project area, partially due to alterations in aquatic habitats. Without the physical changes to the habitat resulting from the dams and other facilities, other development along the river would not have occurred to the extent that it has. Thus, there would have been fewer people and less reason for agencies to develop, maintain, and enhance recreational fisheries for an expanding human populace.

The introduction of the Asiatic clam and crayfish to the system are tied to the overall development of the river and its resources. The Asiatic clam provides an abundant food supply, especially for carp (Minckley 1979) that may be supporting populations of this species at a higher level than otherwise possible. Carp are a serious predator on razorback sucker eggs. Crayfish may provide an important resource of food for the Yuma clapper rail, but crayfish are also predators on small fish and are themselves prey for larger fish.

Information from the less modified habitats of the Upper Basin provides some insight. Aquatic habitats have been significantly affected by grazing, mining, dams and diversions, channelization and other actions similar to those in the Lower Basin. There are, however, several areas that have been less impacted by these actions in which nat exist. Self-sustaining populations of the Colorado squawfish and humpback chub are known (USFWS 1993a), and recent evidence of recruitment of razorback suckers exists (USGS 1996). Such populations are found primarily in riverine sections of the drainage where influence of reservoirs is less.

Even with the real and significant gains accomplished as part of conservation actions and other commitments in the environmental baseline, the status of bonytail chub and razorback sucker in the project area is far from secure. Just as no one agency or group can be held solely responsible for the present conditions on the LCR, no one action can be held solely responsible for the declines in the native fish populations. The changes to water, the physical environment and the biological environment that have resulted from the activities of Federal, State, local, tribal, and private parties have had significant adverse effects to bonytail chub, razorback sucker and the constituent elements of their critical habitats.

Effects of the Action

This analysis addresses the programs and activities proposed by Reclamation for the next five years. Because there are no fundamental changes to management proposed, the effects will be the same as the ones that have created the 1996 baseline. The same suite of Federal and non-Federal parties whose activities contributed to the development of the 1996 environmental baseline are expected to be involved in activities over the next five years.

Reclamation asserts that it has significant discretionary control over the front work and levee system maintenance. No new areas are proposed for treatment in the five year period, so additional effects to shorelines are not anticipated. Repairs to existing projects are not expected to result in net change in conditions existing at the time of the 1996 environmental baseline. Other discretion exists in maintenance methods for facilities, but no changes are expected in the proposed action. Any new dredging projects proposed for the next five year period may require additional consultation.

Another area of significant discretion is in voluntary conservation measures for threatened and endangered species. As described previously, Reclamation has provided considerable resources in funds, equipment and manpower for these activities.

The BA identifies two areas of effect to bonytail chub and razorback sucker that may result in take. Water level fluctuations in the reservoirs over the five-year period are not likely to cause the stranding of eggs or larvae, or reduce levels to the extent that a loss of cover for young fish would be a significant issue. In the riverine sections, seasonal and daily fluctuations are large enough that spawning and nursery areas for both species could be exposed, perhaps on a daily basis. For bonytail chub, the riverine area of interest is upstream from Lake Havasu, and for razorback suckers the riverine areas are those below Davis Dam and Parker Dam. Fluctuations below Hoover Dam are absorbed into Lake Mohave before any spawning or nursery habitat can be compromised.

The second area of effect is entrainment into canals via diversion facilities in the action area and passage of fish through dam powerplants and other operational water releases. While passage through dams may not be automatically fatal, as is clear from the way various non-native fish species have spread in the system, there is a mortality component. In addition, while the receiving water's population may be augmented by the survivors, there is a corresponding loss to the originating population. There is no information on the likelihood of passage through the dams, so the magnitude of this effect is difficult to assess. The risk could be higher with more fish in the population, as is projected to occur over the five-year period.

Entrainment into canals is the most likely effect of the proposed action to occur. Information already exists on razorback suckers being found in the Central Arizona Project (CAP) canal and in some of the irrigation canals on the CRIT agricultural areas. Historically, we know that both species moved up canals and were lost to the population. Fish can move between certain types of canals (for example, those on the CRIT) and the river, and may not be lost to the population. Most of the large irrigation canal systems may fall under this category. The big diversions for the CAP and Metropolitan Water District of Southern California are very different because of the method of diversion and ultimate destination of the water. Once fish are in these systems, their return is unlikely. Again, as bonytail chub and razorback sucker populations increase over the five year period, the potential for fish to enter any of these types of canal systems increases.

Inter-related and inter-dependent actions and their effects are those tied somehow to the proposed action. Within the confines of the river and floodplain, these are somewhat limited. With Reclamation maintaining the existing facilities and programs over the next five years, additional urban development will proceed along existing lines. No significant changes in types of development or water diversion would be expected.

Indirect effects are those effects likely to occur in the future as a result of the proposed action. Because there is no significant change in management proposed, no new indirect effects are likely to occur in the five year period and existing ones would continue.

Several programs are controlled by other Federal or non-Federal agencies and Reclamation asserts limited discretion over them. In the case of the other party being a Federal agency, section 7 consultation with that agency would be needed to address the effects of those actions. There are two main areas involved.

Flood control is the joint responsibility of Reclamation and the Army Corps of Engineers in various forms at points along the river. Changes to the existing flood control operations are not anticipated during the five year period, so there are no changes to the effects described in the environmental baseline analysis.

Hydropower production and distribution from the dams is the responsibility of Reclamation and the Western Area Power Administration, with all power contract holders indirectly involved. Information on the power program is not adequate to determine if there would be changes in the five year period, especially as regards new power contracts. Changes to the effects cannot be quantified. Effects in this analysis assume no changes will occur to the hydropower program during the five year period covered by this consultation.

Storage and delivery of entitlement waters involves Reclamation, the three Lower Basin states, other Federal agencies, the Republic of Mexico and all other entitlement holders. In the next five years, there may be adjustments made in the amount of water taken by an entitlement holder or in the point of diversion. For Federal agencies, section 7 consultation may be needed to address the effects. For non-Federal parties, development of a habitat conservation plan under section 10 of the ESA, as is envisioned under the MSCP, would address the effects of those actions to listed species. Changes to these effects over the next five years largely will involve changes in amount of water diverted and perhaps the specific location of the diversion, although the latter is outside the scope of this proposed action and may require separate section 7 compliance. Adjustments made to the water storage program via Reclamations Annual Operating Plan are unknown and cannot be analyzed in this BO.

Over the next five years, there will be additional demands on the remaining resources of the LCR. Losses of shoreline habitat due to development of recreational, residential or commercial facilities will occur but be only partially considered under the Federal review of the Clean Water Act. Specific users and amounts of water used will change and these changes may affect portions of the action area through either higher or lower flows. There is insufficient information to quantify this. Further effects to the bonytail chub and razorback sucker are discussed under Cumulative Effects, below.

Cumulative Effects: Bonytail Chub and Razorback Sucker

a. Cumulative effects of human population growth

Growth is projected to generally be between 10% and 20% in the next five years in urban areas along the LCR, with some areas experiencing more explosive growth, such as Henderson (41.5%) and Laughlin (114.3%) (**Table 13**, above). This dynamic growth will drive the other factors discussed below that may affect the bonytail chub and razorback sucker, that is, it will lead to increased development, increased visitation/recreation (including fishing, boating, and other water-related activities), increased contamination, and could lead to increased non-Federally supported stocking of non-native fish, such as "bait bucket" releases not authorized by State fish and wildlife agencies.

b. Cumulative effects of economic development

Future alterations to the river bank in the next five years, such as excavating for dock pilings, dredging to construct and maintain marinas, and filling to create boat ramps and seawalls, will be subject to Federal section 7 review of COE section 404 permits; therefore these future alterations are not considered here for their potential cumulative effects on bonytail chub, razorback suckers, and their critical habitats.

Further economic development of the private upland areas near, but not directly affecting the river, will generally be free from Federal permitting. This development should act in combination with continuing population growth to lead to more public use of the river and shoreline areas. Also, further conversion of floodplain and nearshore lands should continue to eliminate opportunities to restore historic wetlands and floodplains for fish habitat.

c. Cumulative effects of future visitation/recreation

Visitation and recreation along LCR have steadily increased in the past; this trend likely will continue in the next five years. Future increases in mechanized uses of the river will result in increased spills of petroleum products and other contaminants, as well as in discharge of both treated and untreated sewage effluent (USFWS 1993a). These should adversely affect water quality. Increased visitation and recreation also should cause increased disturbance of the fish and their spawning areas.

d. Cumulative effects of environmental contaminants

Organochlorines and industrial contaminants are known to have adversely affected the reproductive organs of male carp in razorback sucker spawning areas in parts of Lake Mead (Bevans et al. 1996). Reproduction, and thereby long-term viability, of the razorback sucker may be adversely affected in these areas, but further research is needed to assess actual effects, if any. Further downstream, in backwater lakes on the national wildlife refuges, high selenium concentrations in fish may continue to pose a risk to razorback suckers (King et al. 1993). Continued irrigation water returns to the LCR will contain higher levels of organics from fertilizers and pesticide and herbicide residuals than the water contains when it is diverted.

e. Cumulative effects of non-Federally supported stocking of non-native fish

Private entities likely will continue to introduce non-native fish and other organisms into the LCR for various reasons, including sport fishing, insect and weed control, and dumping of unwanted aquarium and aquaculture fish. Accidental introductions through the use of live bait fish may occur. Private individuals may continue to make unauthorized stockings of fish, possibly in habitats that were previously free of non-native fish and that are appropriate for razorback sucker and bonytail chub restoration. These types of augmentation of non-native fish populations could exert increased competitive and predatory pressure on the razorback sucker and bonytail chub.

Southwestern Willow Flycatcher

For the purposes of this consultation, activities outside the 100-year floodplain that are enabled by Reclamation's operations on the LCR (e.g., urban expansion) are considered as they relate to the status of the southwestern willow flycatcher rangewide. Reclamation's operations will continue to enable and maintain, or increase, the scope and magnitude of those activities. Combined with the effects of interrelated and interdependent actions and the cumulative effects of State, tribal, and private actions, the Service anticipates that the flycatcher's low status outside the action area will further decline. Within the action area, discretionary and non-discretionary actions by Reclamation, and the cumulative effects of State, tribal, and private actions, are also anticipated to further depress the flycatcher's status and result in take of flycatchers and loss of habitat to a degree that compromises the survival and recovery of the flycatcher, resulting in effects both within the action area and rangewide.

Direct take of flycatchers due to water management occurred at the Lake Mead Delta in June of 1996 when Goodding's willows subjected to prolonged inundation of root crowns lost the structural support of their root systems and fell into Lake Mead. At least three southwestern willow flycatcher nests were lost to this phenomenon. The average depth of inundation of willow root crowns at the time of nesting was 68.8 cm (27 inches). Reclamation data indicate that willows throughout the inflow area have been inundated above root crowns since at least September, 1995 (see below), and Reclamation anticipates willows will remain inundated over the five year consultation period. A site visit during September, 1996, revealed that treefall is widespread throughout the delta (R. Marshall, pers. obs.). Thus, if trees survive into the 1997 breeding season and flycatchers return to breed at the site, additional take in the form of nest loss due to treefall is likely. Because the inflow backs up into Grand Canyon National Park, take is also anticipated to occur for flycatchers nesting in the portions of Grand Canyon National Park that have been flooded continually.

Mortality of willow trees at Lake Mead or habitat modification that results from prolonged inundation (e.g., reduced foliage volume) is also likely to result in take of flycatchers. Available data on willow tolerance to inundation and Reclamation's projections for lake elevations at Mead during the consultation period indicate there is a high probability that, without specific measures to manage for willow survival, trees will begin to die off during the 1997 growing season. Shrader (1995,nd that willow communities established along the Rio Grande in New Mexico and the LCR persisted under a regime of intermittent flooding, but experienced complete mortality when root crowns were inundated for more than 24 months. Similarly, Knighton (1981) demonstrated experimentally that three willow species (*Salix gracilis, S. discolor, S. bebbiana*) inundated for two consecutive growing seasons with just 15 cm (6 in.) of water suffered nearly complete mortality. In a review of the tolerance of woody species to flooding, Gill (1970) concluded that

> "...even the most flood-tolerant species generally need to be unflooded for at least 55-60% of the growing season... Year-round root inundation can be tolerated in isolated years."

Finally, Hunter et al. (1987) documented the loss of a 120 ha (296 ac) stand of cottonwood-willow near the confluence of the Bill Williams River and the Colorado River in 1981 after 24 months of continual inundation of root crowns.

Based on data provided by Reclamation in the BA and after completion of the BA, the average base elevation of willow trees in the vicinity of flycatcher nests at Lake Mead is between 360 m (1180 ft.) and 361 m (1184 ft.). The mean depth of inundation of root crowns measured at 27 locations throughout the inflow area on October 4, 1996 was 1.9 ± 1.2 m (range = 0.4 m to 3.7 m) (mean = 6.3 ± 3.9 ft.; range = 1.2 ft. to 12.3 ft.). These data indicate that despite significant variation in the topography of the inflow, none of the root crowns was exposed. Since 1990, the year Reclamation estimates willows were established at the inflow, the month's-end elevation of Lake Mead has exceeded 361 m during two periods: (1) for 15 consecutive months from February 1993 to April 1994 (encompassing one growing season), and; (2) for 16 consecutive months from September 1995 through December 1996 (encompassing one growing season). Furthermore, lake levels have exceeded or been within 0.5 m of 360 m (1180 ft.) since January of 1995. Thus, at the 360 m elevation, most, if not all, root crowns of willows used by flycatchers have been inundated for 24 months. Reclamation anticipates that lake levels will continue to inundate willow root crowns at the inflow during the consultation period and that willow mortality will be observed during the 1997 growing season. In the BA, Reclamation projected that during the consultation period (and for the next 15 years) water levels at Lake Mead will exceed 361 m (1184 ft.) at least 75% of the time, and will exceed 360 m (1180 ft.) 86% of the time (Figure E27 in BA). Based on the above analyses, the Service believes that, under current operations, the 465 ha (1,148 ac) of willow-dominated habitat currently occupied by southwestern willow flycatchers at Lake Mead will experience significant, if not complete, mortality sometime between the 1997 and 1998 growing seasons.

The Service believes that a loss of this magnitude, both in the amount of habitat involved and the potential rapid rate of loss, is catastrophic when the status of the flycatcher and riparian habitat on the LCR and in the southwestern U.S. are considered. Mearns (1907) estimated that the LCR contained more than 161,943 ha (400,000 ac) of riparian habitat at the onset of the 20th Century. Thus, the 1,841 ha (4,547 ac) that remain today represent a tiny remnant of the habitat potential on the LCR. The small amount of native riparian habitat on the LCR, the paucity of relatively large, contiguous tracts of native riparian habitat throughout the flycatcher's current range, the flycatcher's isolated distribution, and the predominance of small breeding groups are all factors that compromise the survival and recovery of this species. These factors also point to the critical need to protect breeding flycatchers and their habitat at Lake Mead. Reversing the trend of habitat loss and population fragmentation on the LCR is critical to improving the probability of survival of this species.

Indirect take of flycatchers may result from degradation of willow nesting habitat, either through structural modification (e.g., reduced foliage volume) or outright willow mortality. This would reduce habitat suitability and may cause flycatchers to abandon the Lake Mead breeding site. Some southwestern willow flycatcher breeding groups exhibit site fidelity, even when conditions appear unsuitable (e.g., near-completely inundated habitat and newly burned habitat). Flycatchers that establish territories at Lake Mead in adjacent, marginal habitat are not likely to attract mates, but are likely to eventually disperse outside the area (Hubbard 1987, Paxton et al. 1996). Given that Lake Mead contains one of the largest and most significant native riparian tracts in the Southwest, there is a high probability that dispersing flycatchers would settle into smaller, more isolated, habitat patches. Emigration to isolated habitat patches combined with the delay that dispersal entails reduces the probability that flycatchers would obtain mates and breed successfully, and may reduce adult and juvenile survivorship.

The Service recognizes that variation in individual fitness of flycatchers probably translates to variation in responses to habitat loss/degradation and subsequent survivorship and reproductive success. Thus, not all flycatchers are likely to perish as a result of displacement and not all flycatchers are likely to fail to attract mates and breed. The more likely result would be a regional phenomenon of "loss-disperse-decrease" whereby: (1) large habitat patches occupied by the larger breeding groups are lost either by stochastic (e.g., fire) or deterministic processes (e.g., permitted Federal action); (2) surviving birds are forced to disperse elsewhere, most likely into smaller habitat patches; and (3) this dispersal causes decreases in the probabilities of survival, of obtaining mates, and of reproducing successfully. This conclusion is based on the assumption that there is a negative correlation between habitat fragmentation/isolation and flycatcher survival and reproduction. This phenomenon could actually lead to a short-term increase in the number of sites occupied regionally while masking an overall, long-term decrease in population size and fecundity. The combined effect of small breeding group sizes, the survival costs of dispersal in a highly fragmented system, the reduction in fecundity and survivorship of young caused by delays in breeding, and the role of stochastic demographic, environmental, and genetic events on small populations are probably the ultimate factors governing southwestern willow flycatcher populations in the short-term.

In the remainder of the action area, Reclamation anticipates further habitat loss and degradation during the consultation period due to desiccation, fire, encroachment by saltcedar, agricultural development, and recreation, according to the BA; however, those losses are anticipated to be minimal. That assessment is based, in part, on the presumptions that riparian resources are ephemeral and that native revegetation efforts will balance out losses. With the large losses of cottonwood-willow that have occurred on the LCR, the significance of even small losses to fire, desiccation, or other causes increases dramatically, because they continue the trend of habitat loss and fragmentation in a river system for which no comprehensive plan exists to enable recruitment and regeneration of large, contiguous tracts of native cottonwood-willow.

Although Reclamation's BA acknowledges that fire has played a role in riparian habitat loss, it does not factor in fire in projections of habitat loss during the next five years. Reclamation's projected declines in cottonwood-willow habitat during the next five years appear to be based on demographic patterns of extant vegetation patches (i.e., age of trees and successional patterns). Busch and Smith (1993) and Busch (1995) documented 166 individual fires that burned more than 11,800 ha (29,146 ac) between 1981 and 1990. Busch and Smith (1993) argue that fire was a relatively infrequent phenomenon in native riparian habitats and that the advent of saltcedar brought about episodic burning events which create favorable conditions for recolonization by saltcedar. Since the remaining cottonwood-willow habitat on the LCR is virtually surrounded by saltcedar, the potential for fires started in saltcedar to affect cottonwood-willow habitat remains very high. Without modifications to the extent of recreation activities (e.g., restrictions on camp fires and access to Reclamation service roads), fire frequency is not likely to decrease. Combined with the extent and distribution of saltcedar, recreational activities are a major threat to the frequency and distribution of fire events on the LCR. Thus, the Service believes that both fire and recreational activities remain a major threat to both occupied and unoccupied southwestern willow flycatcher habitat on the LCR.

The ultimate factor affecting southwestern willow flycatchers and their riparian habitat below Lake Mead is that Reclamation's continuing operations and maintenance preclude the development and persistence of large, contiguous tracts of cottonwood-willow habitat in the large floodplain areas that historically contained such habitat. Reclamation operates and maintains the dams, hydropower facilities, diversions, banklines, and levees that take up space on the river that otherwise would be occupied by aquatic and riparian floodplain habitats and that largely preclude the overbank flooding that creates and sustains riparian habitats. For example, Reclamation maintains 452 km (281 mi) of bank lines and levees that "train" the river and eliminate or significantly restrict floodplain development. Some of the bank line actually reinforces levees, so the actual river mileage from which floodplain development is precluded is slightly less.

Water diversions and flood control promote agricultural development within the 100-year floodplain which also results in habitat loss. The BA acknowledges that the loss of 121,457 ha (300,000 ac) of riparian habitat along the LCR to agricultural development is one of the key reasons why the southwestern willow flycatcher is endangered. That area encompasses more than 75% of Mohave, Parker, Palo Verde, and Yuma valleys which historically contained vast floodplain habitat. However, the effects of agricultural development of floodplains are not limited to habitat loss. Agricultural developments attract brown-headed cowbirds. The extent of cowbird parasitism on the LCR is not well documented for the flycatcher, but significant levels of parasitism for other riparian nesting species on the LCR have been documented (Averill 1996). Nevertheless, cowbird parasitism is having a significant effect on flycatcher reproduction throughout the Southwest and it is likely occurring, possibly at high levels, on the LCR. The first recent evidence of flycatchers breeding on the LCR was the observation of an adult willow flycatcher feeding a brown-headed cowbird fledgling near the confluence with the Bill Williams River. Brown (1988), Sogge and Tibbitts (1992), Sogge et al. (1993), and Sogge and Tibbitts (1995) documented high, sustained levels of cowbird parasitism on flycatchers breeding upstream of the action area in Grand Canyon National Park. Conversely, McKernan (unpubl. data) documented no parasitism for the nests monitored in the relatively large (465 ha), contiguous patch of willows at the inflow to Lake Mead, well away from agriculture and most recreational disturbances, during 1996.

Agriculture along the LCR relies on pesticide use, which may have effects to flycatcher reproduction and endocrine systems. Additionally, during 1996 monitoring efforts in southwestern Colorado, a southwestern willow flycatcher fledgling was found with a crossed bill, a classic symptom of selenium poisoning in birds. The deformity prevented this bird from foraging. This flycatcher was reared in the Escalante State Wildlife Area, which drains agricultural lands and for which high levels of selenium have been detected in past monitoring (M. Sogge pers. comm.). Reservoir and channel maintenance, including dredging, as well as irrigation runoff, tend to concentrate selenium and expose it to the biotic environment.

The development and continued operation and maintenance of LCR water resources and related facilities as set forth in Reclamation's proposed action, primarily for flood control, power generation, and urban and agricultural development, precludes the system from sustaining riparian resources of the magnitude (i.e., areal extent, distribution, and species composition) found prior to the advent of major water development projects. The results of past and current water developments and operations are loss of a natural river dynamic and riparian habitat modification and fragmentation on a scale unprecedented in the arid Southwest. This loss, which continues today, has contributed significantly to the extremely precarious status of the sow flycatcher, both within the action area and rangewide. Without significant changes in land-use patterns and the apportionment of water, the river's potential to sustain its natural dynamic is minimal, and the maintenance of even limited native riparian habitat will require continual restoration projects that are expensive, limited in scope, and may not adequately mimic the habitat they are to replace. Current operations subject to this consultation, which include bankline and levee repair, controlled flows, diversions, and so on, continue to limit development of native riparian habitats, and thus contribute to the maintenance of a highly-fragmented riparian system vulnerable to fire, encroachment by exotics, desiccation, lack of recruitment of native cottonwood-willow communities, and tree mortality due to prolonged inundation. This vulnerability is far greater than the system's current capacity to develop and sustain large tracts of riparian habitats by natural or simulated processes.

Reclamation's proposed action would contribute to depressing the already low population status of the flycatcher; this presents the Service, as well as other Federal and State agencies, with a significant challenge to ensure the survival and recovery of this species. Habitat loss of the magnitude anticipated at Lake Mead is catastrophic and rapidly negates gains in riparian flycatcher habitat made elsewhere.

Haig et al. (1993) observed for the red-cockaded woodpecker, an endangered bird that still numbers from only one thousand to several thousand pairs, that,

> "...species with such small populations are easily 'nickel and dimed' to extinction. That is, loss of a few small populations does not cause concern, but the cumulative effects of these losses could be dramatic. Therefore, a first step to species' recovery will be to stop these local extinctions."

Losses of flycatcher habitat have been widespread, significant, and continue today. Recent comparisons of field data and computer simulation models shed further light on the dilemma small populations face in an increasingly fragmented landscape. Hanksi et al. (1996) compared estimates of minimum viable metapopulation sizes derived from population models with a long-term data set on the persistence of the Glanville fritillary (*Melitaea cinxia*), a butterfly that inhabits remnant grasslands in Finland. Based on the pattern and trend of habitat loss and population response documented for the fritillary, they concluded that extinction was likely because continued losses of habitat would result in a network of habitat patches smaller than the minimum area of suitable habitat needed for the fritillary. They predicted, however, that extinction would take

> "...tens or even hundreds of years. The inevitable decline to extinction may be temporarily halted for long periods, with the number of occupied patches fluctuating without any obvious trend. The final decline to extinction is slow because the last populations to go are typically the largest ones with the smallest risk of extinction. The delay would be smaller if the dynamics were greatly affected by regional stochasticity."

However, for the southwestern willow flycatcher, both stochastic and deterministic events are affecting some of the largest breeding groups rangewide, increasing the potential rate of decline and probability of extinction. Those losses include areas with the largest breeding groups, such as Roosevelt Lake and the San Pedro River in Arizona, as well as areas with significant native riparian habitat, such as Lake Isabella in California. Weins (1996) noted that habitat loss is probably the most important factor governing population dynamics when the landscape still contains a high proportion of suitable habitat, but "at a certain threshold of habitat loss, patch isolation may quickly come to dominate population dynamics."

The primary effect of Reclamation's activities, despite ongoing riparian restoration efforts, will continue to be habitat loss and prevention of new habitat development and protection on a large scale. The southwestern willow flycatcher evolved in a system that was highly dynamic and best characterized as one where local losses of "ephemeral" riparian habitat were buffered by a regional abundance of habitat and a scale of habitat continuity that is difficult to imagine in today's highly fragmented landscape. Renewal and regeneration was as much a part of that dynamic as was destruction and loss. However, natural flood events that renew and sustain significant areas of riparian forest are not incorporated into the proposed management of the river.

This continuing habitat loss without significant renewal has occurred throughout the southwestern willoange on private, tribal, State, and Federal lands. Although changes in land management practices have lead to some recent gains in riparian habitat (e.g., San Pedro National Riparian Conservation Area), most gains are small in extent and often quickly negated by catastrophic events, such as fires, inundation, and unauthorized agricultural expansion in floodplains that have eliminated flycatcher breeding areas during the last several years (Paxton et al. 1996; USFWS, unpubl. data). Continual isolation of breeding groups and fragmentation of habitat has left flycatcher populations extremely vulnerable to extirpation from random demographic, environmental, and genetic events. Extinction of the southwestern willow flycatcher is foreseeable. This low status rangewide, as well as in the action area, indicates a critical need to aggressively protect existing populations and to expand and enhance native riparian habitat and the suite of environmental conditions that promote such habitat. Additional habitat loss and forced emigration/population fragmentation is inconsistent with the need to ensure the survival and recovery of the southwestern willow flycatcher.

Cumulative Effects: Southwestern Willow Flycatcher

a. Cumulative effects of human population growth

As with the fishes discussed above, the rapid human population growth in the LCR area will drive the other factors, below, that may affect the southwestern willow flycatcher.

b. Cumulative effects of economic development

Localized impacts on southwestern willow flycatchers and their habitats from further clearing, human disturbance, and predatory pets, especially domestic cats, likely will continue. Also, cowbird parasitism of southwestern willow flycatcher nests is expected to increase with habitat fragmentation. Some of the following could have Federal actions related to them that would draw them away from the cumulative effects section, although presently the cases and degree to which this may be so is unknown, hence their inclusion here. A number of water transactions that would result in Colorado River flow depletions are being considered by States, tribes, and private organizations. A number of these transactions could have water diverted at Lake Havasu instead of at the lower river near Yuma. This could diminish the flows in the river for over 140 river miles, possibly negatively affecting the riparian vegetation.

c. Cumulative effects of future visitation/recreation

As visitation and recreational use increase, more disturbance of southwestern willow flycatchers will result. A number of tribes and private groups are proposing to build large casinos and recreation facilities on the river. This will increase the number of people fishing, swimming, skiing, hunting, and boating on the river. This will impact many of the habitat areas used by the southwestern willow flycatcher.

d. Cumulative effects of environmental contaminants

As indicated, a southwestern willow flycatcher fledgling in southwestern Colorado was found with a crossed bill, a classic symptom of selenium poisoning in birds. The flycatcher was reared in the Escalante State Wildlife Area, which drains agricultural lands and for which high levels of selenium have been detected in past monitoring (M. Sogge pers. comm.). Selenium and other contaminants have been found in elevated levels in other birds within the LCR (King and Andrews 1996). Continuing exposure to selenium and other contaminants may threaten southwestern willow flycatchers in the LCR.

e. Cumulative effects of wildfires

As indicated, as human activity in riparian zones along the LCR increases, fire frequency is also likely to increase (Busch 1995). As fire frequency increases, and as saltcedar and arrowweed continue to dominate post-fire recovery, more disturbance of southwestern willow flycatchers and adverse effects to their habitats likely will occur.

Yuma Clapper Rail

Almost the entire population of Yuma clapper rails on the Colorado River in the United States, and approximately one half of the total population of this species, occurs within the action area. Most of the entire remaining half resides downstream on the Colorado River and its delta in Mexico. Therefore, the proposed action has the potential to significantly affect almost the entire range of the species.

The operation and maintenance of the LCR is an ongoing action occurring on a daily and hourly basis and it includes the five year period covered by the project description. The direct effects of the action include water releases that affect daily and seasonal surface elevations. These fluctuations affect river flows, depths, and water surface elevations which can result in the loss of nest and wetland habitat needed for the survival of the Yuma clapper rail in the action area. These losses can also occur from flood control releases that result in sediment deposition and scouring. Also, the releasing of water on a demand basis results in decreased flows in the lower sections of the river resulting in less habitat areas for use by the rail.

The routine maintenance of banklines, levees, river control structures and bankline roads can result in the loss of riparian and wetland vegetation. This maintenance can also increase the sediment load in the river. These actions can result in the loss or degradation of habitat used by the Yuma clapper rail.

Proposed dredging operations include an on-going program (see **Table 15**, above) aimed at maintaining backwaters for wildlife purposes. This work is planned and directed by the various resource agencies on the river, with an active role by Reclamation. Marshes tend to evolve, through natural succession, into terrestrial types of plant communities. Without the maintenance of hydric conditions these areas lose their attractiveness to birds such as the rail. Rosenberg et al. (1991) emphasize that without such management, increased channelization of the river will result in a decrease in marsh habitats because more concentrated, swifter flows deepen the flow channel, lower the water table, and prevent the growth of emergent plants.

The operation of the Yuma Desalting Plant would result in a decrease in water flows to the Cienega de Santa Clara, a marsh complex located in Sonora, Mexico near the Sea of Cortez, that provides habitat to a large population of Yuma clapper rails. No other interrelated or interdependent actions are expected to affect the Yuma clapper rail.

Cumulative Effects: Yuma Clapper Rail

a. Cumulative effects of human population growth

As with the fish discussed above, the rapid human population growth will drive the other factors, below, that may affect the Yuma clapper rail.

b. Cumulative effects of economic development

Localized impacts on Yuma clapper rails and their habitats from further clearing, human disturbance, and predatory pets, likely will continue. Some of the following could have Federal actions related to them that would draw them away from the cumulative effects section, although presently the cases and degree to which this may be so is unknown, hence their inclusion here. A number of water transactions that would result in Colorado River flow depletions are being considered by States, tribes, and private organizations. A number of these transactions could have water diverted at Lake Havasu instead of at the lower river near Yuma. This could diminish the flows in the river for over 140 river miles, possibly negatively affecting the riparian vegetation.

c. Cumulative effects of future visitation/recreation

As visitation and recreational use increase, more disturbance of Yuma clapper rails will result. A number of tribes and private groups are proposing to build large casinos and recreation facilities on the river. This will increase the number of people fishing, swimming, skiing, hunting, boating on the river. This will impact many of the habitat areas used by the Yuma clapper rail. This increase in use could also result in a decrease in water quality, diminishing rail prey to some degree.

d. Cumulative effects of environmental contaminants

As discussed under Status of the Species in the Action Area, above, selenium and other contaminants have been found in potentially harmful elevated levels in Yuma clapper rails in the LCR (Ohlendorf et al. 1986b, Radtke et al. 1988, Kepner unpubl. data in Rosenberg et al. 1991, see also King and Andrews 1996).

e. Cumulative effects of wildfires

As human activity in riparian zones along the LCR increases, fire frequency is also likely to increase (Busch 1995). As fire frequency increases, and as saltcedar and arrowweed continue to dominate post-fire recovery, more disturbance of Yuma clapper rails, and adverse effects to their habitats, likely will occur.

Proposed species/critical habitat:

Flat-tailed Horned Lizard

Mortality and Injury of Flat-tailed Horned Lizards

During Operation, and Maintenance of the Roads and Ancillary Facilities

Flat-tailed horned lizards occur in the action area and would be subject to mortality or injury during operations and maintenance activities. Animals could be crushed by vehicles or equipment while in their underground, shallow burrows, or while on the surface. When approached, flat-tailed horned lizards often stop and freeze, rather than flee. Thus, they are especially susceptible to crushing by moving vehicles and other equipment.

Vehicle use in and between Reclamation-maintained sites in the 5-mile zone is expected to result in ongoing mortality and injury to lizards. For instance, of twelve flat-tailed horned lizards observed on paved portions of County 23rd and Avenue B, all but two had been crushed by vehicles. Fifteen of the approximately 40 locality records discussed in the Status of the Proposed Species in the Action Area section, above, were of dead horned lizards on dirt or paved roads within the 5-mile zone (USFWS, unpubl. data).

Roads can act as mortality sinks for small animals (Boarman et al. 1992, Klemens 1989, Rosen and Lowe 1994). During a four-year study of snake mortality along a 27.4-mile section of Route 85 in southern Arizona, Rosen and Lowe (1994) recorded snake mortality estimated at equivalent to the estimated snake population normally found in a 1.93 mi^2 area. They also estimated mortality to be equivalent to eliminating all snakes within 213 feet of the road. Effects on flat-tailed horned lizards from similar activity may be similar, as both snakes and these lizards cross roads, use roads for thermoregulatory purposes, and have limited ability to flee oncoming traffic. Desert tortoise populations are depleted up to a mile or more on either side of roads where average daily traffic is greater than 180 vehicles (Nicholson 1978a & 1978b). The tortoise and this lizard are similarly unlikely to escape oncoming vehicles. These two studies on snake and desert tortoise mortalities are all that is available on reptile mortality in this area; thus, the following discussion of take effects is derived from them as models.

Recent analysis suggests that flat-tailed horned lizard population viability is particularly sensitive to mortality (Flat-tailed Horned Lizard Conservation Team 1996). The mortality of flat-tailed horned lizards expected from maintenance activities in the 5-mile zone could affect populations for significant distances away from the roadways and the "footprints" of project sites. Periodic maintenance of the roadways could also result in occasional mortality or injury of horned lizards. Regrading of road shoulders could result in crushing of animals in burrows or on the surface. The amount of use of these sites by Reclamation averages a few monthly visits or less (J. Romero, pers. comm.), far less than the 180 vehicles/day in the desert tortoise example, cited above, by at least two orders of magnitude.

If scat and lizard counts provide a reasonable index to abundance, then relative abundance can be estimated for each Reclamation project feature in the 5-mile zone following the criteria from the BLM (1990):

Site	Horned Lizard Relative Abundance
Sludge disposal	low
242 well field	low-high
Powerline	medium-high
Drainage Channel	low-medium
Routes to the above	low-high

Hodges (1995) estimated that between 212 and 222 mi^2 (135,680-142,080 acres) of flat-tailed horned lizard habitat occurs in Arizona. Limited information exists to quantify densities of flat-tailed horned lizards; however, estimates have ranged from .06 to 1.5 per acre (Turner et al. 1978, Muth and Fisher 1992, Rorabaugh 1994, Wone and Beauchamp 1995). The lizards within the immediate vicinity of the project sites could be subject to death or injury proportionate to the acreage impacted and the density range indicated above. Lizards could be depleted within roughly 200 feet on each side of a road or other facility in a hypothetical "maximum case" scenario with a high degree of traffic (Rosen and Lowe 1994). The total habitat directly affected by the above aspects of the proposed action, including its interrelated and interdependent effects and indirect effects, in the hypothetical "maximum case" represents less than 1% of available habitat in Arizona. Approximately 1,295 acres reduced in horned lizard density to some degree suggests take of 78 to 1,360 lizards. As vehicle use is much less than that which would create the hypothetical "maximum case" scenario, take figures of two orders of magnitude less are more likely, perhaps in the range of (0.8 to 13.6) 1 to 14 lizards taken annually.

The approximately 16,000 acre (25 mi^2) portion of the 5-mile zone to be managed as part of the Yuma Desert Management Area would protect 11.8% of Arizona's flat-tailed horned lizard habitat to a great degree. The result would be to limit many deleterious uses.

Cumulative Effects: Flat-tailed Horned Lizard

Because much of the flat-tailed horned lizard habitat in the vicinity of the action area is managed by Reclamation, the Department of Defense, or BLM, many of the activities likely to occur in this area will be Federal actions subject to section 7 of the ESA. However, considerable private and State lands supporting flat-tailed horned lizards occur within a few miles or even adjacent to the action area. Continued development of non-Federal lands for residential, industrial, and agricultural purposes is expected. Several square miles of habitat could be lost in the foreseeable future. Pesticide drift from croplands will likely continue. If the flat-tailed horned lizard is subsequently listed, the effects of non-Federal actions, including residential and other development, will be addressed through the section 10(a)(1)(B) permit process. The effects of economic and development expansion will continue in flat-tailed horned lizard habitat in Mexico, particularly on the east end of San Luis, Sonora, as well as in the adjacent United States.

SUMMARY

Listed species/critical habitat:

Bonytail Chub and Razorback Sucker

Projects and actions in the environmental baseline have significantly changed the yearly flows, temperatures, habitat availability and diversity, and fish fauna of the LCR. These harmful effects on the bonytail chub and razorback sucker will be continued during the five year period of the proposed action. Neither significant increases in these pre-existing effects nor new types of effects are considered likely to occur in the five-year period. Similarly, pre-existing harmful effects to critical habitat constituent elements will be continued.

Reductions in harmful effects in the action area are unlikely. Indeed, cumulative effects of actions by parties other than Reclamation that affect the action area, especially those actions driven by human population growth and economic development, are likely to increase. Population augmentation projects for the bonytail chub and razorback sucker will provide benefits over the short term in preventing extirpation of existing populations.

Southwestern Willow Flycatcher

The environmental baseline encompasses an overwhelming change in the historical availability and extent of native riparian habitat on the LCR, which resulted in a decline in the southwestern willow flycatcher population. Remaining native habitats are a slight remnant of historic potential. Large tracts of cottonwood-willow that have developed after flooding remain threatened by dessication, prolonged inundation, fire, recreation, and development. A catastrophic loss of approximately 465 ha (1,148 ac) of willow habitat at the inflow to Lake Mead is anticipated during the consultation period as a result of Reclamation's operations. Downstream from Lake Mead, declines in native riparian habitat observed during the last 20 years probably will continue. The magnitude of the expected loss is uncertain because fire and saltcedar invasion are the predominant threats. Given the small remaining amount of habitat, however, small losses could be significant. Maintenance of dams, diversions, banklines, and levees will continue to impede the development and maintenance of large, continuous tracts of native riparian habitat on the LCR. The overall effect to the southwestern willow flycatcher will be continued declines in numbers and reproductive success resulting directly from cowbird parasitism, predation, and nest loss, and indirectly from dispersal away from habitat rendered unsuitable by Reclamation's operations.

Yuma Clapper Rail

Adverse effects of the proposed action are relatively minor in terms of anticipated take within the five year consultation period. Positive effects include Reclamation's on-going rail habitat maintenance program and their proposal to avoid rail habitat during their other maintenance activities. Cumulative effects will not be major over the five year consultation period.

<u>Proposed species/proposed critical habitat:</u>

Flat-tailed Horned Lizard

Adverse effects of the proposed action are relatively minor in terms of take and the portion of the species' range affected. No new land disturbance is proposed. Positive effects include Reclamation's proposed management of a large portion of the 5-mile zone as part of the Yuma Desert Management Area, including a host of beneficial actions. Cumulative effects will not be major over the five year period. If the Yuma Desert Management Plan is approved and implemented, the overall effect will be an improved environmental baseline for the species.

CONCLUSION

<u>Listed species/critical habitat:</u>

Bonytail Chub and Razorback Sucker with Critical Habitat

After reviewing the current status of the bonytail chub and razorback sucker in the action area and throughout the remaining range of these species, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that Reclamation's proposed action for operation and maintenance of facilities on the LCR is likely to jeopardize the continued existence of the bonytail chub and razorback sucker, and is likely to destroy or adversely modify designated critical habitat for both species.

Basis for the Analyses

The Service must utilize all information about the status of a species throughout its range when making the determination of jeopardy or destruction/adverse modification of critical habitat. This holds regardless of who or what is responsible for the actions that have adversely affected the status of the species. The analysis must consider conservation and recovery actions as well as those actions found to have adverse effects. The sum of the positive and negative factors is the status of the species. The analysis must also look at both the survival and recovery of the species as affected by the proposed action and all other relevant factors.

Regulations implementing section 7 of the ESA define "jeopardize the continued existence of" as:

> "...to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers or distribution of that species."

Under this standard, survival of an endangered species is jeopardized when an action, along with relevant factors above, appreciably reduces or compromises a species' ability to reach threatened status. Recovery is jeopardized when an action impairs or precludes an essential conservation effort, such as those identified in an approved recovery plan for the species.

Regulations implementing section 7 of the ESA define "destruction or adverse modification" as:

> "...a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical."

Under this standard, survival of a species is compromised when the critical habitat unit cannot achieve its assigned conservation goal due to an appreciably diminished capability of the constituent elements. Survival in this case is a long-term consideration. Recovery is compromised when the action appreciably diminishes or precludes beneficial management of a constituent element.

Bonytail Chub

Effects to the bonytail chub from water-based activities in the entire Colorado River Basin have already exceeded the jeopardy threshold. The species has been eliminated from at least 85% of its historic range and populations in the remaining 15% are very small (USFWS 1993a). Recruitment is virtually non-existent in the remaining wild populations. Actions called for in the recovery plan (USFWS 1990) are focused on preventing extinction in the wild as the primary, or most immediate, goal.

The LCR in the action area was once an important habitat for the bonytail chub and the species was at least common. Actions that are part of the environmental baseline have been directly and indirectly responsible for the collapse of the bonytail chub population, from being common in the river to only a few wild-born individuals surviving in two reservoirs. This collapse can be attributed to the combined factors of habitat alteration and introduction of non-native fish species that have precluded successful recruitment by the wild population. The continuation of these adverse physical and biological conditions impairs and precludes conservation efforts that would lead to the recovery of the species.

The small size of the extant bonytail chub population in the action area limits the extent to which the activities undertaken by Reclamation can have effects. Commitments by other agencies and Reclamation discussed in the proposed action will put 25,000 young fish into Lake Havasu and Mohave. This will not create adult populations of those levels due to mortality of individuals from various causes. What are likely small losses of individuals into canals or aqueducts or through powerplants may increase as population augmentation continues. This source of mortality is additive to natural losses that will reduce the population over time. Nonetheless, the increase in population size resulting from the proposed action does reduce the imminent threat of extinction in the wild and provides a respite in which to address issues affecting survival. The augmentation itself may, in the future, create an additional concern since the young fish will mostly be within ten years of age of each other and thus reach senescence at about the same time.

Without providing for recruitment to existing or re-established populations, recovery cannot occur. The maintenance of the bonytail chub in the wild by continual stocking provides for the survival of the species but not the recovery. Further, given that the number of wild-born adults available for the broodstock is very small, maintenance of what genetic variation remains for the species is critical.

Very exacting procedures are needed in a hatchery setting to ensure that inbreeding and loss of genetic diversity do not occur. It is far simpler and success is more likely to occur in a free-breeding, recruiting, population. The proposed action does not change the existing situation for recruitment; thus, essential conservation efforts continue to be impaired or precluded.

Razorback Sucker

Effects to the razorback sucker from water-based activities in the entire Colorado River Basin have already exceeded the jeopardy threshold. Less than one-third of the historic range contains natural populations (USFWS 1993a) and all but one of these are very small. Recruitment to all remaining populations, if it occurs at all, is not sufficient to maintain the populations. There is no final recovery plan, however, actions currently being implemented for the species focus on preventing extinction in the wild.

The LCR in the action area was once an important habitat for razorback suckers and the species was recorded as abundant. Actions that are part of the environmental baseline have been directly and indirectly responsible for the collapse of the razorback sucker population, from being abundant to less than 25,000 old adults in Lake Mohave and a few wild-born individuals in the reservoirs and riverine sections. This collapse can be attributed to the combined factors of habitat alteration and introduction of non-native fish species that have precluded successful recruitment by the wild population. The continuation of these adverse physical and biological conditions impairs and precludes conservation efforts that would lead to the recovery of the species.

Augmentation efforts have added young wild- or captive-born, cove-reared razorback suckers to the populations, but have not reached a replacement level. Commitments by other agencies and Reclamation discussed in the proposed action will put 25,000 young fish into Lake Havasu and 50,000 into Lake Mohave. This will not create adult populations at those levels due to mortality of individuals from various causes. What are likely small losses of individuals into canals or aqueducts or through powerplants may increase as population augmentation continues. This source of mortality is additive to natural losses that will reduce the population over time. Nonetheless, the increase in population size resulting from the proposed action does reduce the imminent threat of extinction in the wild and provides a respite in which to address issues affecting survival. The augmentation itself may, in the future, create an additional concern, since the young fish will mostly be within ten years of age of each other and thus reach senescence at about the same time.

Without providing for recruitment to existing or re-established populations, recovery cannot occur. The maintenance of the razorback sucker in the wild by continual stocking provides for the survival of the species but not the recovery. Using wild-born fish in the Lake Mohave efforts reduces the risk of genetic problems in the hatchery, but there is a chance of not capturing the range of characters in the population if the full breeding period and all spawning locations are not included in the effort. Having a free-breeding, recruiting, population reduces the risk further. There is some evidence to suggest that at least limited recruitment occurred recently in or above Lake Mead and below Parker Dam. We do not know the specific circumstances that allowed for this recruitment. Unusual events likely were involved. The proposed action does not change the existing situation for recruitment, thus essential conservation efforts continue to be impaired or precluded.

Critical Habitat

Critical habitat for the bonytail chub in the action area consists of Lakes Havasu and Mohave. Critical habitat for the razorback sucker consists of Lakes Mead and Mohave, and the river between Parker and Imperial Dams. Designation of an area as critical habitat is not precluded if a constituent element has been compromised by past activities. The ESA acknowledges such cases likely would exist by identifying areas requiring special management or protection in order to provide all constituent elements and contribute to survival and recovery. The Service, in designating critical habitat for the bonytail chub and razorback sucker, recognized that natural features of the river habitat had been significantly altered. However, the persistence of these species was determined to be important enough to override the deficiencies then existing.

The importance of Lake Mohave to the survival and recovery of the bonytail chub lies first with the presence of the extant population and second with providing lacustrine and cool water habitats. Lake Havasu has the added advantage of possessing areas of marsh, tributary inflow and riverine habitats largely lacking in Lake Mohave. The largest remaining population of razorback suckers is in Lake Mohave and the importance of that population is extremely high. The reservoir habitats can support a large population of adult fish. The Lake Mead population can access the Grand Canyon and habitats located in that portion of the river outside of the action area. The Parker-Imperial reach of critical habitat contains habitats that are closest to the historic conditions in the action area. The presence of these different habitats may assist in future studies on habitat needs and competition and predation related to non-native fish.

The Service recognizes that adult bonytail chub and razorback sucker can successfully live in the existing habitats. Both fish reproduce, but there is virtually no recruitment to the population. Under Reclamation's proposed operations and maintenance, few options to manage the river differently in order to correct deficiencies in the constituent elements are available. The ability to beneficially manage for constituent elements and contribute to recovery is diminished or precluded.

Southwestern Willow Flycatcher

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed operations and maintenance program along the LCR from Lake Mead to the SIB and the cumulative effects, it is the Service's biological opinion that the operations and maintenance program along the LCR from Lake Mead to the SIB, as proposed, are likely to jeopardize the continued existence of the southwestern willow flycatcher. The proposed action continues the depressed distribution, numbers, and reproduction of the species in the action area, which is already beyond the jeopardy threshold, and significant levels of take are likely. No critical habitat has been proposed or designated for this species in the action area, therefore, none will be affected.

Yuma Clapper Rail

After reviewing the current status of the Yuma clapper rail, the environmental baseline for the action area, the effects of the proposed operations and maintenance of the Colorado River, and the cumulative effects, it is the Service's biological opinion that the action as proposed is not likely to jeopardize the continued existence of the Yuma clapper rail. No critical habitat has been designated for this species, therefore, none will be affected.

Our conclusion is based on the following rationale: The numbers of this species are stable on the LCR and are increasing in some areas of California where new habitat has been created. Stable population levels for this species have persisted in the presence of long-term water project operations and several researchers believe that this species has actually expanded its range northward as a direct result of dam construction which created new marsh habitat with relatively stable water levels (Conway 1990, Rosenberg et al. 1991, Thelander and Crabtree 1994), although Todd (1986) disagrees.

A stable population of rails, perhaps moving toward recovery, occurs in the presence of the on-going operations and maintenance program on the LCR. Consultations on past individual projects of this program have not resulted in any jeopardy opinions. Only a relatively small amount of disturbance is likely in the form of occasional harassment of birds from recreation and from operations and maintenance activities and from the possibility of nest inundation due to water operations. No large construction projects are proposed during the five year period. Additionally, Reclamation proposes to avoid wetland areas during maintenance actions and to continue to maintain rail habitat.

Proposed species/proposed critical habitat:

Flat-tailed Horned Lizard

After reviewing the current status of the flat-tailed horned lizard, the environmental baseline for the action area, the effects of the proposed operations and maintenance program along the LCR from Lake Mead to the SIB and the cumulative effects, it is the Service's conference opinion that the operations and maintenance program along the LCR from Lake Mead to the SIB, as proposed, is not likely to jeopardize the continued existence of the flat-tailed horned lizard. No critical habitat has been proposed for this species, therefore, none will be affected. Our conclusion is based on the following rationale:

1) The proposed action would affect a relatively minor portion of the species' range.
2) A very small amount of take is likely.
3) During the five year period, no new disturbance will occur in the 5-mile zone.
4) Reclamation proposes to include approximately 16,000 acres of the 5-mile zone as part of the Yuma Desert Management Area for the flat-tailed horned lizard.

REASONABLE AND PRUDENT ALTERNATIVE

Regulations (50 CFR §402.02) implementing section 7 define reasonable and prudent alternatives (RPAs) as alternative actions, identified during formal consultation, that (1) can be implemented in a manner consistent with the intended purpose of the action, (2) can be implemented in a manner consistent with the scope of the action agency's legal authority and jurisdiction, (3) are economically and technologically feasible, and (4) would, the Service believes, avoid the likelihood of jeopardizing the continued existence of listed species or resulting in destruction or adverse modification of critical habitat.

Development of an RPA for the proposed action is a complex undertaking. The existing jeopardy and adverse modification of critical habitat for the endangered fish species and the southwestern willow flycatcher have not occurred solely due to the actions of Reclamation either now or in the past. Many Federal laws, regulations, treaties, court decisions and other policies have shaped the LCR environmental baseline. The needs of the States and local governments, quasi-governmental agencies, tribes, businesses and private individuals have contributed to the creation of the Federal structure governing the LCR.

The Service expects that the short and long-term provisions in the RPA will improve the baseline so that the status of the bonytail chub, razorback sucker, and southwestern willow flycatcher will improve to a point below the jeopardy threshold in the long-term, within the time frame of the MSCP. Reclamation’s current conservation activities and the activities required under the RPA herein comprise a portion of the activities involved in the MSCP (depicted generally in **Fig. 12**), but Reclamation cannot accomplish these activities alone. On August 2, 1995, Reclamation and other MSCP parties agreed to a long-range program designed to conserve habitat, work toward recovery of listed plant and animal species that occur along the LCR, and accommodate current water diversions and power production to the extent consistent with law. During the next five years, this long-range MSCP will be developed and it is anticipated that the MSCP will be initiated by the time this short-term interim consultation period concludes. The long-term requirements of this RPA are expected to be a part of the suite of actions implemented under the MSCP.

This RPA has been developed to address the jeopardy and destruction/adverse modification of critical habitat for the endangered bonytail chub and razorback sucker and their critical habitats in Lakes Mead, Mohave and Havasu and the mainstem of the LCR between Parker Dam and Imperial Dam, and to address the jeopardy for the endangered southwestern willow flycatcher along the mainstem LCR from Lake Mead to the SIB with Mexico.

[[insert **Fig. 12. How Reclamation's conservation activities for the bonytail chub, razorback sucker, and southwestern willow flycatcher fit into long-term LCR MSCP. landscape]]**

<u>Bonytail chub, razorback sucker, and southwestern willow flycatcher:</u> The RPA provisions for the bonytail chub, razorback sucker, and southwestern willow flycatcher consist of the following short-term and long-term provisions, all of which must be implemented by Reclamation:

a. Short-term Provisions:

BONYTAIL CHUB AND RAZORBACK SUCKER

1. **<u>Augmentation.</u> Reclamation will provide resources to expand grow-out facilities in the Lower Basin sufficient to augment the razorback sucker population below Parker Dam. The intent is to provide at least 50,000 fish over a five year period. These fish need not come from wild fry dipped from Lake Mohave. Once approval for bonytail chub reintroduction to the lower river has been obtained, these facilities will be maintained for production of the required number of fish for that effort.**

   Efforts elsewhere on the river are utilizing all available juvenile rearing pond space, preventing the augmentation of this population in designated critical habitat. This component will also provide fish to be used in radio/sonic tracking studies looking at habitat use, predation/competition, and other research efforts.

2. **<u>Review and evaluation.</u> In cooperation with the Service and with appropriate State fish and wildlife agencies, Reclamation will review and evaluate all of its fish and wildlife programs involving backwaters, maintenance dredging projects and wetland/riparian restoration projects to ensure that efforts to maximize the conservation of bonytail chub and razorback sucker are achieved.**

   No additional backwaters will be designed for sport fishing. The review and evaluation shall be completed within six months of the date of completion of this BO.

3. **<u>Impoundments.</u> As proposed in the Service's draft Lower Colorado River Basin Management Plan (LCRBMP), Reclamation will identify sites, and design and build at least three impoundments for native fish habitats totaling approximately 600 acres in the old floodplain of the river (a lesser area may be accepted by the Service if Reclamation establishes that a 600 acre total area is not feasible, but in no case shall fewer than 300 acres be accepted). These impoundments are to be prototypes for expansion to other sites (but are not the endpoints for recovery needs); their configurations, depths, locations, etc., are to be designed in the most efficient manner possible for construction. These habitats can be on refuge lands, or any other lands Reclamation can find, provided these lands are not compromised by toxic loads of salts, pesticides or herbicides resulting from agricultural activity.**

   These correspond to projects that stabilize population size and structure and re-establish native fish stocks, as proposed in the draft LCRBMP. These projects may use existing flatwater areas provided that: a) the existing backwater area is at least 100 surface acres, and b) the existing backwater can be effectively isolated from recreationists, thus minimizing the opportunity for non-native fish to be introduced.

4. **<u>Research funding.</u> Reclamation will provide funds for research into habitat use and habitat preferences of native and non-native fish in the river with the goal of managing to reduce conflicts detrimental to native fish caused by the**

presence of non-native fish. The amount of funding will be negotiated between the Service and Reclamation and shall begin within one year of the date of the final BO.

This includes habitat preferences, habitat management opportunities, and exploration of options for competitor/predator management in the river. Portions of this will require input and approval by the State game and fish agencies and other appropriate entities.

SOUTHWESTERN WILLOW FLYCATCHER

5. **Immediate habitat protection/restoration. Reclamation shall immediately initiate a program to protect approximately 1,400 ac (565 ha) of currently unprotected riparian habitat that is currently used by southwestern willow flycatchers, preferably in the LCR area, but if insufficient land is available, then elsewhere within the southwestern willow flycatcher's range. If insufficient seasonally occupied habitat can be identified to be in need of protection, then unoccupied, but high potential, habitat may be protected instead. All the required protections for at least 500 ac (202 ha) must be in place by January 1, 1999, and any necessary ecological restoration of the newly protected sites, including, but not limited to, cottonwood/willow reforestation, must be initiated by that date; all the required protections for the remaining areas necessary to comprise 1,400 ac total must be in place by January 1, 2001, and any necessary ecological restoration of the additional newly protected sites must be initiated by that date.**

   Protection can occur through acquisition, easements, partnerships, ecological restoration, etc., that result in long-term preservation of the habitat from destruction and from alteration in ways that would decrease its value as flycatcher habitat. The order of priority shall be: 1) occupied habitat on the LCR, 2) occupied habitat elsewhere in the flycatcher's range, 3) unoccupied, potential habitat on the LCR, and 4) unoccupied, potential habitat elsewhere in the flycatcher's range. Reclamation shall immediately initiate a rangewide evaluation to identify suitable lands requiring protection for the recovery of the southwestern willow flycatcher (to be done in conjunction with the plan called for in the long-term flycatcher alternative compensation habitat provision, number 11, below). (Part of the lands protected may, if suitable, overlap with lands protected in the bonytail chub and razorback sucker impoundment projects under short term provision number 3, above.)

6. **Review and evaluation. In cooperation with the Service, Reclamation shall review and evaluate all fish and wildlife mitigation or enhancement programs involving riparian restoration in the action area to determine how the programs may be modified to maximize the conservation of the southwestern willow flycatcher.**

   The review and evaluation shall be completed for use in the next breeding season following the date of completion of this BO.

7. **Protective management. Reclamation shall implement protective management for existing flycatcher breeding groups and suitable habitat on the LCR .**

   Reclamation shall by March 15 of each year complete the following: (1) for each site occupied during previous years, evaluate and document existing and potential threats (inundation, desiccation, livestock, fire, recreation, habitat quality, parasitism, predation, etc.); (2) assess the potential to resolve the threats at each site; (3) with emphasis on larger breeding groups and larger habitat patches, develop management strategies including agreements, cowbird management programs, fire prevention, public education, fencing, etc.; and (4) implement the management strategies (see related Southwestern Willow Flycatcher Reasonable and Prudent Measure Number 1, below, on Habitat Protection).

8. <u>Study funding.</u> **Reclamation shall fund a five-year survey, monitoring, and research program for the southwestern willow flycatcher along the LCR and confluent drainages in adjacent states.**

   This program will include surveys and monitoring, dispersal/recolonization studies, monitoring productivity and survivorship, monitoring predation and parasitism, determining flycatcher habitat relationships, determining ecological conditions that promote habitat on the LCR, GIS-integrated studies, and any additional appropriate elements Reclamation determines to be important for conservation efforts for the flycatcher. (Reclamation will discuss other research details with the Service.)

b. Long-term Provisions:

Full achievement of the RPA requirement of eliminating the jeopardy and the adverse critical habitat modification caused by the proposed action to the bonytail chub and the razorback sucker, as well as the jeopardy to the southwestern willow flycatcher, will relate directly to how the short-term requirements of this RPA complement the anticipated development and implementation of the 50-year MSCP. In order to comply with the long-term component of this RPA, Reclamation must, either independently or as part of a cooperative effort such as the MSCP, actually be involved in initiating implementation of each of these provisions by May 15, 2001, which is one-year before the projected end of the consultation period. Alternative approaches that are developed through the MSCP, that will achieve the same goals, will satisfy these provisions. The long-term requirements of this RPA are:

BONYTAIL CHUB AND RAZORBACK SUCKER

9. <u>Reintroduction.</u> **Reclamation will support reintroduction of protected populations of bonytail chub to the lower river and Lake Mead.**

   Reintroduction of additional populations of bonytail chub is in the LCRBMP. All populations of bonytail chub reintroduced under this item will be protected populations. In order for these populations to contribute to the recovery goals for the species, they must be protected under sections 7 and 9 of the ESA.

10. <u>Recruitment.</u> **Reclamation will determine what conditions in Lake Mead or the Grand Canyon allowed for the successful recruitment of razorback suckers to that population. Based on this research, Reclamation will present a plan, in cooperation with appropriate State fish and wildlife agencies, to the Service by which it will attempt to duplicate those conditions, if feasible and within Reclamation's discretion. Then, Reclamation will initiate implementation of the plan, by May 15, 2001. Reclamation also will explore ways to manage Lake Mohave water levels to provide the same type of conditions that allowed for successful recruitment of razorback suckers in the 1950's.**

    It is very important to understand how razorback sucker recruitment occurred in Lake Mead because, at least in one season, predators did not get all the eggs and larvae. On Lake Mohave, reservoir management may provide some opportunities to maintain the newly augmented populations in those areas. Water management requirements need special examination to assess flexibility.

SOUTHWESTERN WILLOW FLYCATCHER

11. **<u>Alternative compensation habitat.</u> Reclamation shall take part in a long-term program of on- and off-site compensation for historical southwestern willow flycatcher habitat that is lost and is not restorable on the LCR because of the effects of Reclamation's continuing operations and maintenance activities. This shall be coordinated with the rangewide evaluation called for in flycatcher short-term provision number 5, above, and with the Southwestern Willow Flycatcher Recovery Plan (in progress) and other efforts of the Southwestern Willow Flycatcher Recovery Team. The on-site compensation is additive to the requirements of provision number 5, above, and may be done in conjunction with provision number 14, below, on ecological restoration. The off-site compensation habitat, if not already used by southwestern willow flycatchers, will be managed to eliminate or sufficiently reduce the factors limiting to the species. By January 1, 1999, Reclamation shall present a plan to the MSCP for funding and implementation of the long-term program, e.g., through acquisition, easements, partnerships, ecological restoration, etc., with the goal of initiating implementation by May 15, 2001. Alternative off-site compensation approaches that may be developed through the MSCP, that are aimed at achieving the same goals, could satisfy this provision.**

    This compensation represents the amount of historical southwestern willow flycatcher habitat lost or precluded from developing into suitable flycatcher habitat due to inundation, lack of flooding, widely fluctuating water levels, exotic species encroachment, water quality, soil salinity, or permanent structures because of the continuing effects of Reclamation's facilities and operations. Criteria for suitable or potential flycatcher habitat are found in the Status of the Species--Habitat Use section of this BO. Reclamation, in conjunction with flycatcher short-term provision number 5, above, on immediate habitat protection, shall immediately initiate a rangewide evaluation to identify suitable lands requiring protection for the recovery of the flycatcher; this shall be coordinated with other flycatcher recovery efforts undertaken in the future by the Service, as well as with any flycatcher conservation efforts undertaken through the MSCP. As in provision number 5, protection can occur through acquisition, easements, partnerships, ecological restoration, etc., that result in long-term preservation of the habitat from destruction and from alteration in ways that would decrease its value as flycatcher habitat.

PROVISIONS THAT APPLY TO BONYTAIL CHUB, RAZORBACK SUCKER, AND SOUTHWESTERN WILLOW FLYCATCHER

The following provisions apply to the bonytail chub, razorback sucker, and southwestern willow flycatcher, and include a mix of short and long-term elements:

12. **<u>MSCP participation.</u> Reclamation will continue to be an active participant in the MSCP process and will encourage involvement from all Federal and non-Federal parties involved in the operation of the LCR to achieve the stated conservation goal of the MSCP.**

    This is intended to encourage the continuation of the MSCP process and the inclusion of as many parties as possible so the solutions can be as complete as possible.

13. **<u>Discretion.</u> Reclamation will provide the Service:**

    a) A detailed account of the type and extent of the discretionary action flexibility

available to it for all elements of the proposed action, under existing legal and contractual obligations, further clarifying any limits on such flexibility that were outlined in Table 1 in the Proposed Action section, above. This shall include, but not be limited to, all aspects of managing the water levels of all portions of the LCR. This account will be provided as soon as possible but no later than 120 days after the date of completion of the final BO.

b) Reclamation will identify any opportunities to increase that discretionary action flexibility in cooperation with the other parties. The specific parties will be named in each case. This account will be provided within 18 months after the date of completion of the final BO.

This component is intended to determine the legal, regulatory, and contractual limits on Reclamation's ability to manage the river. It will also assist in identifying other parties with action flexibility, determining the need for section 7 or section 10 discussions with those parties, and determining their involvement in the MSCP Steering Committee. Reclamation will then present a public forum for discussion of the limits on its discretion and on how additional water may be found for fish and wildlife; this may be done in conjunction with the annual public meetings called for in provision number 16, below, on progress evaluation.

14. **<u>Ecological restoration.</u> Reclamation shall collect, review, and synthesize available information on channelization modification or removal projects undertaken or planned for other comparable river systems. This information will be used to evaluate the potential modification or removal of channelization works from certain areas of the LCR, that is, on modifying channel configuration and stabilization, relocating levees to restore the old floodplain (acquiring land if necessary), and letting the river meander within the floodplain, with the goal of restoring large expanses of diverse habitat for self-sustaining populations of the bonytail chub, razorback sucker, and southwestern willow flycatcher. This study shall include information on the hydrological and ecological conditions necessary to maintain significant, continuous stands of native riparian habitat, e.g., stands > 500 ha (1,235 ac), with adequate surface water and other necessary conditions. This information shall be synthesized in a report by January 1, 1999.**

The study may include examining LCR areas currently without channelization and areas with channelization, and comparing the two. This study will assess the potential to restore natural-functioning cottonwood-willow areas and native fish habitat, to let the river meander within the floodplain, and to create "floods" to foster natural processes; it will also include analysis of the necessary management to sustain restored habitats and any related legal constraints that need addressing. This study shall be followed by an adequate number of demonstration or pilot projects to evaluate effectiveness of the techniques, to be completed by May 15, 2001. Also, Reclamation shall take advantage on an opportunistic basis of any natural flood events that may provide the conditions necessary to accomplish ecological restoration, and shall incorporate the findings from analysis of any such events into the evaluation called for under this provision.

Reclamation shall then determine which techniques are the most effective for restoration of native cottonwood-willow riparian habitat and more natural floodplains and aquatic habitats for razorback sucker and bonytail chub habitat on certain portions of the LCR; this shall include analysis of the expected response of the river to use of the techniques, as far as impacts on

existing habitats. Reclamation shall then present to the MSCP, no later than September 15, 2001, the results of the efforts called for under this provision and a plan for funding and implementation of a long-term, large-scale, ecological restoration program for the LCR. Alternative ecological restoration approaches that may be developed through the MSCP, that are aimed at achieving the same goals, could satisfy this provision.

In order to restore habitats to reflect historical rather than present conditions, information on restoration techniques available is an important component. Management to reduce conflicts detrimental to native fish caused by the presence of non-native fish, and to support southwestern willow flycatchers, will also require information on habitat restoration. Reclamation may use un-modified areas of the river as part of a pilot project, provided such areas are scientifically suitable for a comparative evaluation and are not restricted to one end of the river. The requirement to take advantage of natural flood events for ecological restoration purposes represents a form of adaptive management. Information regarding compliance with this provision shall be made available to the Service's Upper Colorado River Basin Floodplain Restoration Program Coordinator and to the parties to the MSCP, and demonstration and pilot projects carried out shall be coordinated to the extent feasible with those programs.

15. <u>**Agreements.**</u> **Reclamation shall use the full scope of its discretion to develop agreements with all MSCP parties and others, as necessary, including, but not limited to, acquiring property and other resources, to enable implementation of all of these RPA provisions.**

Again, participation by the MSCP parties is vital to achieving the requirements set forth in this BO.

16. <u>**Progress evaluation.**</u> **Reclamation shall meet on an annual basis during the consultation period with the Service, other agencies, and the public to review and evaluate progress on the RPA.**

This review, to evaluate progress and effectiveness of the RPA, shall include a written progress report and public presentations on: data collected; preliminary results of studies, demonstration and pilot projects underway; and implementation of each of the RPA provisions, as well as implementation of the Reasonable and Prudent Measures and Terms and Conditions, below.

17. <u>**If implementation failure occurs:**</u> **If Reclamation has not fully implemented the RPA requirements, or the MSCP process fails, then Reclamation must reinitiate formal section 7 consultation (see Reinitiation - Closing Statement, below).**

Because all LCR interrelated and interdependent actions would have to be part of the re-initiated consultation, any changes in such actions would be part of the proposed action and not handled separately. The complete action, over a meaningful time frame, must be the subject of a future consultation, in the absence of the MSCP. Implementation of the MSCP is very important to the present consultation.

Because this BO has found jeopardy and destruction or adverse modification of critical habitat, Reclamation is required to notify the Service of its final decision on the implementation of the RPA.

INCIDENTAL TAKE STATEMENT

The Service has developed the following incidental take statement based on the premise that the RPA herein will be implemented. Sections 4(d) and 9 of ESA, as amended, prohibit taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species of fish or wildlife without a special exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns, which include, but are not limited to, breeding, feeding or sheltering. Incidental take is any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or the applicant. Under the terms of ESA sections 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

For the bonytail chub, razorback sucker, southwestern willow flycatcher and Yuma clapper rail; and in the event the flat-tailed horned lizard is subsequently listed as threatened or endangered, the measures described below are non-discretionary, and must be implemented by the agency so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. Reclamation has a continuing duty to regulate the activity covered by this incidental take statement. If Reclamation (1) fails to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

AMOUNT OR EXTENT OF TAKE

Listed species:

Bonytail Chub and Razorback Sucker

The Service anticipates that incidental take of bonytail chub and razorback sucker will be difficult to detect. There are two classes of take occurring as a result of the proposed action: (1) take related to maintaining conditions that preclude successful recruitment to bonytail chub and razorback sucker populations; and, (2) take that directly impacts individual fish through mortality.

(1) Take that precludes recruitment. This take occurs in any area containing populations of either bonytail chub or razorback sucker. The lack of sufficient recruitment by bonytail chub and razorback sucker to allow maintenance and expansion of their populations is a measurement of take.
(2) Take that relates to individual bonytail chub or razorback sucker mortality. Determination of the level of responsibility for this category of incidental take attributable to Reclamation is a complex undertaking. The actual probability of detecting individuals of either species that have been stranded (as eggs, larvae or adults), have passed through one of the dams, or have become entrained passing into a canal is unlikely. In addition, both species have small population sizes which contribute to the probability that take of individual fish through mortality will be limited. As augmentations continue, population sizes will increase and the possibility of detecting occurrences and the occurrences themselves may increase. Because currently the probabilities of both detecting occurrences and the actual occurrences of take for bonytail chub and razorback sucker are low, a surrogate measure to estimate the extent of take must be defined. Other fish species are affected by stranding, passage through dams, and entrainment to canals in the LCR. Using a measure of numbers from other species, one could begin to assess the probability of similar occurrences that could take place proportionately in bonytail chub and razorback sucker populations. Take of bonytail chub and razorback suckers presently occurs at sease as implementation of the proposed action and other ongoing actions are carried out; but the amount of increase is unknown.

In order to determine when the level of incidental take has been exceeded, the Service applies the following standards:

(a) **Stranding.** For take due to stranding in riverine sections, the incidental take would be considered to be exceeded if Reclamation does not implement the reasonable and prudent measures and terms and conditions for the bonytail chub and razorback sucker, herein.

(b) **Dams.** For take due to passage through dams, there does not appear to be an adequate direct measure, since fish that "pass through" a turbine are no longer detectable. Reclamation shall determine an indirect way to assess the potential for fish passage through any particular LCR dam, that is, a "risk factor". Reclamation shall make this determination through modeling of the potential for fish to pass through the turbines of the hydroelectric dams (large and small), and through other appropriate risk analyses. That determined potential will then be compared with documented fish passage figures for other similar dams. Incidental take would be considered exceeded if the potential numbers of fish impacted are greater than the average of documented fish passage figures at the other similar dams, at a point in time one year after completion of the risk determination called for under the terms and conditions related to the bonytail chub and razorback sucker (numbers 1 and 2 under "To implement RPM 2 (Dams)", below). However, incidental take would not be considered exceeded if the Service concurs in a possible future determination by Reclamation that the management alternatives necessary to sufficiently reduce the risk of fish passage are not economically, technologically, and environmentally feasible, (the determination called for under term and condition number 2 under "To implement RPM 2 (Dams)", below).

(c) **Entrainment.** For take that involves canals, a direct measure of the live and dead fish taken can be used. Because population numbers of bonytail chub in Lake Havasu and razorback sucker in Lake Havasu and below Parker Dam are, at present, extremely low, and the likelihood of finding dead individuals is not high, it is prudent to use a low number of fish found dead to determine when incidental take would be exceeded. The actual number of dead fish will certainly be higher than the number of dead fish found, because many will go undetected. However, the RPA short-term provision number 1, above, requires Reclamation to significantly augment the fish populations. After the first two years of the proposed action, the implementation of this provision should result in a greater number of fish entrained than would otherwise be the case. The incidental take will be considered exceeded if a total of two (2) or more bonytail chub and razorback sucker (in any combination of the two species) are found dead, over the first two years of the five year period covered by this incidental take statement. For years three through five, if the augmentation programs that are part of the proposed action and the RPA herein are implemented at the appropriate rate over the five year period for the specific receiving water (Mohave, Havasu, Parker-Imperial), then the level of take that can occur before incidental take is considered exceeded will be increased proportionally to the increase in the fish populations each year. This increase will be one (1) fish added to the level of incidental take for each 1,000 fish stocked into the specific receiving water. This increase would be added to the base of two (2) fish from the first two years. Depending on the number of either bonytail chub or razorback suckers stocked overall, the level at which incidental take would be exceeded may not be the same for both species. Fish that are found alive in the canals will not be counted as take under this provision. Live fish found will be handled according to a Service-developed protocol to be developed.

Southwestern Willow Flycatcher

With full implementation of the RPA, the Service still anticipates that incidental take of southwestern willow flycatchers will occur due to project-related activities in the form of riparian habitat degradation and loss, reduced productivity of adults, and reduced survivorship of adults and young. Nest loss/abandonment is anticipated to result from treefall, fire, cowbird parasitism, and recreational activities. Habitat loss and degradation caused by fire, desiccation, encroachment by saltcedar, and the operation of dams, diversions, levees, and banklines is anticipated to result in displacement of adults, reduced productivity, and reduced survivorship of adults and young.

Throughout the LCR, the rate of nest loss due to predation is anticipated to be up to 50% (i.e., up to 50% of all nesting attempts may fail as a result of depredation of nests). The rate of cowbird parasitism is also anticipated to be up to 50% (i.e., up to 50% of all nests will have at least one cowbird egg in them). Inadequate information is available to quantify actual take in the form of nest loss and habitat loss that results from fire, desiccation, encroachment by saltcedar, recreational activities, and the operations of dams, diversions, levees and banklines. However, when habitat is destroyed or habitat regeneration is impeded, population maintenance and expansion are precluded. Thus, young and adults that return to breed in areas that have been lost or degraded are less likely to find suitable habitat or find mates. For the unquantifiable take, incidental take will be considered exceeded if the following reasonable and prudent measures and terms and conditions are not implemented.

Yuma Clapper Rail

The Service anticipates some incidental take of the Yuma clapper rail will occur due to project-related activities in the form of habitat loss and disturbance, disturbance and possible injury to adults and occasional inundation of active nests. Incidental take will be difficult to estimate or detect and quantify. Observing flushed birds or finding a dead or impaired specimen or an inundated nest is unlikely due to the dense habitat used by this secretive species. Therefore, although we are unable to quantify it, we are assuming some incidental take will occur and that it will be minimized or avoided by implementing the following reasonable and prudent measures and terms and conditions.

Proposed species:

Flat-tailed Horned Lizard

This conference opinion anticipates that eight (8) flat-tailed horned lizards per year could be taken as a result of animals moving onto travel routes or project sites from adjacent habitats and being crushed or injured by moving vehicles or equipment that would not be present but for the proposed action.

If this conference opinion is adopted as a biological opinion, the Service will only authorize forms of take of listed species that are incidental to operation, and maintenance of the existing 242 well field, Yuma Desalting Plant sludge disposal site, and ancillary facilities. Incidental take will be authorized only if such activities are consistent with the terms and conditions of this conference opinion.

EFFECT OF THE TAKE

Listed species:

Bonytail Chub and Razorback Sucker

In the accompanying BO, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat when the RPA is fully implemented.

Southwestern Willow Flycatcher

In the accompanying BO, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of proposed critical habitat when the RPA is fully implemented.

Yuma Clapper Rail

In the accompanying BO, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species.

<u>Proposed species:</u>

Flat-tailed Horned Lizard

In the accompanying conference opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the flat-tailed horned lizard.

REASONABLE AND PRUDENT MEASURES

The definition of an RPM is an action consistent with a proposed action's basic design, location, scope, duration, and timing. An RPM cannot cause more than a minor change to the project. Determining appropriate RPMs for this incidental take statement are complicated by the limits of Reclamation's discretion on the LCR activities. Many of the activities on the river that cause take are controlled by parties other than Reclamation. As a result, it is difficult to define RPMs that can actually be accomplished by Reclamation alone. Reclamation is strongly encouraged to seek the help of MSCP parties in implementing the terms and conditions of these RPMs.

<u>Listed species:</u>

Bonytail Chub and Razorback Sucker

The Service believes the following RPMs are necessary and appropriate to minimize take of bonytail chub and razorback sucker:

1. Reclamation will assess and reduce the potential stranding of eggs, larvae or individual fish; if needed, Reclamation will seek agreements from necessary parties to implement this measure.

2. Reclamation will assess and reduce the potential of bonytail chub and razorback suckers passing through the hydroelectric dams.

3. Reclamation will assess and reduce the potential of bonytail chub and razorback suckers being lost to the system because of entrainment.

Southwestern Willow Flycatcher

The Service believes the following RPMs are necessary and appropriate to minimize take of southwestern willow flycatchers:

1. Reclamation will protect southwestern willow flycatcher habitat on the LCR.

2. Reclamation will conduct additional surveying and monitoring of southwestern willow flycatcher habitat on the LCR.

Yuma Clapper Rail

The Service believes the following RPMs are necessary and appropriate to minimize take of the

Yuma clapper rail:

1. Operations and maintenance actions by Reclamation must result in no net loss of Yuma clapper rail habitat, otherwise rails will be taken due to loss of nesting habitat. Disturbance of rails and rail habitat must be minimized. If areas are affected, they must be restored or replaced.

2. Subject to the limitations of the RPA for the bonytail chub, razorback sucker, and the southwestern willow flycatcher (which take precedence over this provision), dredging to maintain wetland and backwaters to offset succession and to benefit clapper rails must be continued (see **Table 15**, above) as part of Reclamation's annual maintenance program on the Colorado River.

<u>Proposed species:</u>

The prohibitions against taking a species found in section 9 of ESA do not apply until the species is listed. However, the Service advises Reclamation to consider implementing the following reasonable and prudent measures. If this conference opinion is adopted as a biological opinion following a listing or designation, these measures, with their implementing terms and conditions, will be nondiscretionary.

Flat-tailed Horned Lizard

The Service believes that the following RPMs are necessary and appropriate to minimize the incidental taking authorized by this conference opinion. If the species is listed, then the incidental take statement in this opinion, including its protection against a section 9 violation, will apply <u>only</u> to the proposed action.

1. Worker education programs and procedures shall be implemented to avoid or minimize the take of flat-tailed horned lizards resulting from operation and maintenance of the project facilities.

2. Reclamation shall monitor incidental take resulting from the proposed action and report to the Service the findings of that monitoring.

TERMS AND CONDITIONS

<u>Listed species:</u>

Bonytail Chub and Razorback Sucker

In order to be exempt from the prohibitions of section 9 of the ESA, Reclamation must comply with the following terms and conditions, which implement the RPMs described above. These terms and conditions are non-discretionary.

To implement RPM 1 (Stranding):

1. Reclamation will evaluate the amount of spawning and nursery habitat that would be exposed by water level fluctuations in riverine areas in the January through May period. The amount of such habitat available to fish depends upon the actual total amount of water released <u>and</u> the daily fluctuations in the release. The amount of potential spawning and nursery habitat (i.e., habitat that would be under water at the highest daily flow), will vary over the five month period and the Service and Reclamation will have to evaluate this variance. Once the

evaluation is completed, the possibilities to reduce such exposures will be examined. The evaluation, based over the first January through May period following issuance of the final BO, must include, at a minimum, a delineation of affected areas, an estimate of population size for the endangered fish species in affected areas, the extent of discretion in water releases available to each area, and the potential benefits to non-native fish species from either maintaining or altering the current system.

2. The evaluation in term number 1, above, will be completed by October 1 following the first January to May evaluation period after the date of the final BO and shall be provided to the Service and the MSCP Steering Committee. Reclamation will have until the next January to put in place alternatives that are reasonable, prudent, and environmentally feasible that will minimize effects to bonytail chub and razorback suckers; if needed, Reclamation will seek agreements from necessary parties to implement this term.

To implement RPM 2 (Dams):

1. Reclamation will determine, using surrogate measures or species, modeling, and other appropriate risk analyses, the current potential for bonytail chub and razorback sucker to pass through turbines at each of the LCR hydroelectric generating dams. Once the risk determination is complete, Reclamation will evaluate potential changes to existing management that would reduce passage of fish through each dam's turbines. The assessment will be completed within one year of the date of the final BO and the evaluation of management alternatives will be completed within another 120 days. These assessments and evaluations will be discussed with interested parties involved in the MSCP process, and both the assessments and evaluations will be provided to the MSCP Steering Committee and the Service.

2. Reclamation will implement those alternatives, if any, that reduce the risk of fish passage and are economically, technologically, and environmentally feasible, within one year of the date of the completed risk determination.

3. Reclamation will provide reports documenting determinations and decisions made in terms number 1 and 2, above, to the Service and the MSCP Steering Committee.

4. In the event that incidental take is exceeded, within seven (7) days Reclamation will provide the Service with a report on where, why and how this excess occurred. At the time of the report, Reclamation and the Service will convene a meeting to address a method(s) for avoiding further take expected to occur during the remaining period covered by this consultation. Such determination(s) shall be implemented as appropriate. Should an individual of either species be found showing signs of having passed through a dam, Reclamation will contact the Service within 48 hours.

To implement RPM 3 (Entrainment):

1. Reclamation will evaluate all diversions (to canals or pipelines) for their potential to remove fish from the system. Diversions that allow for access into and out of the system will be evaluated for the potential of such movements of fish. This will be completed and a report provided to the Service within one year of the date of the final BO.

2. Management programs for all accessible canals will be examined by Reclamation in consultation with the affected water rights or contract holders to determine if present management encourages or discourages fish residency in the canal system. Reclamation will work with canal owners to develop monitoring programs to locate listed fish. This task will be completed and a report provided to the Service within 18 months of the date of the final BO.

3. Reclamation will work with appropriate Federal and non-Federal parties to research appropriate technologies to prevent fish entrainment into canals or pipelines from which return to the system is unlikely. If economically, technologically, and environmentally sound methods exist to reduce the potential for fish to access these canals or pipelines, Reclamation will work with the owners of the facilities to incorporate such methods into each facility within five years of the date of the final BO. A report detailing each decision herein will be provided to the Service and the MSCP Steering Committee before the end of the five year consultation period.

Because of the need for Reclamation to obtain cooperation and assistance from outside parties who own or operate facilities or have water or power contracts on the LCR (and therefore additional discretion) in meeting the terms and conditions of these RPMs, the Service believes that there is no guarantee that the level of incidental take will be reduced in the short-term as a result of these terms and conditions. However, Reclamation is required to use all of its appropriate discretionary authority alone if cooperation is not forthcoming. Cooperation with Reclamation by water and power users could address a portion of the take of these species that can be attributed to those users. Cooperation with Reclamation on the terms and conditions in this incidental take statement does not address the entire issue for these parties, but could provide some assurances as far as incidental take by them. In order to document the progress of these terms and conditions and cooperative or non-cooperative activities of outside parties, the Service will require Reclamation to provide informal briefings to the Service at least twice annually during the five year period covered by this consultation.

Southwestern Willow Flycatcher

In order to be exempt from the prohibitions of section 9 of the ESA, Reclamation must comply with the following terms and conditions, which implement the RPMs described above. These terms and conditions are non-discretionary. Implementation of the following terms and conditions may reveal additional information that will help to better define the extent of take and additional measures to reduce it. If that occurs, Reclamation may need to request a modification of this BO from the Service to address this new information.

To implement RPM 1 (Habitat Protection):

1. Reclamation will protect occupied flycatcher habitat regardless of plant species composition, and unoccupied, but potential flycatcher habitat, including stands of willow, cottonwood-willow, and mixtures of saltcedar and cottonwood-willow in all portions of the LCR under Reclamation management; provided that this term shall not be interpreted to require protection of saltcedar when its removal would actually result in improved flycatcher habitat, but saltcedar removal should not occur in an extant or recently-extant flycatcher location. Protection actions will include but not be limited to cowbird trapping in and near occupied habitat, fire breaks, and measures such as levee road closures to limit recreational disturbance of occupied sites.

2. In areas not under Reclamation management:

    a. Reclamation will immediately develop agreements with appropriate land management agencies along the LCR to implement a cowbird trapping program in the specific area(s) where cowbird parasitism rates have been monitored for one year from the date of the final BO and parasitism rates exceed 10% at any LCR site. Reclamation will continue trapping at the specific area(s) during the five year consultation period or until alternative means of reducing take have been negotiated with the Service.

    b. Reclamation will develop agreements with appropriate land management agencies along the LCR to put in and maintain fire breaks to protect occupied or potential southwestern willow flycatcher habitat from wildfire within one year of the date of the final BO.

c. Reclamation will develop agreements with appropriate land management agencies along the LCR to close levee roads and put in place and enforce other public closures necessary to minimize impacts to southwestern willow flycatcher habitat from fire and disturbance within one year of the date of the final BO.

3. Reclamation will initiate a public information program within one year of the date of the final BO to alert resource users about the dangers of wildfire to riparian habitat.

To implement RPM 2 (Surveys and Monitoring):

1. Reclamation will conduct additional status surveys of all occupied and potential southwestern willow flycatcher habitat on the LCR over the next five years and a representative sample each year after that, or until alternative means of reducing take have been negotiated with the Service to determine the number of flycatcher territories, the number of breeding pairs, the breeding status of pairs, cowbird parasitism rates, predation rates, nest success, biotic and abiotic habitat relationships of occupied sites, and the genetic relationships of flycatchers throughout the LCR for comparison with genetic data obtained from flycatchers breeding at Roosevelt Lake and the San Pedro River, Arizona. Reclamation will deliver a report of the findings to the Service annually, by December 1.

2. Reclamation will determine the effectiveness of the fire break and recreational access measures by monitoring location, size, and timing of fires on the LCR. Such monitoring will include acquisition of both ground and aerial color transparencies of all occupied or potential southwestern willow flycatcher habitat areas that are burned, partially or completely by fire. A yearly report, due September 30 each year, will be provided to the Service and will include photographs described above, a summary of the fire activity over that period, the amount of southwestern willow flycatcher habitat affected, effectiveness of closures and fire breaks, and recommendations for the coming year that can be transmitted to other agencies..

Yuma Clapper Rail

In order to be exempt from the prohibitions of section 9 of the ESA, Reclamation must comply with the following terms and conditions, which implement the RPMs described above. These terms and conditions are non-discretionary.

To implement RPM 1 (Habitat Protection):

1. All clapper rail habitat areas destroyed or degraded due to future project activities shall be restored by the action agency.

2. This restoration shall be implemented as part of the scheduled project activity and completed within one year of the action.

3. Reclamation will develop/update and begin to implement rail management plans for areas under its management that currently or potentially support Yuma clapper rails within one year of the date of the final BO. These plans shall include management protocol for operations and maintenance activities that need to occur within or near rail habitat. These activities can be expanded in future years as part of the MSCP.

4. Where there is discretion regarding the scheduling of activities (such as non-emergency work or activities that are not constrained seasonally) in or near rail habitat, the clapper rail nesting season (March 15-July 10) will be avoided.

To implement RPM 2 (Dredging):

1. Subject to the limitations outlined in the RPA for the bonytail chub, razorback sucker, and the southwestern willow flycatcher, Reclamation will continue to maintain all mitigation backwaters and will work with all resource agencies on a cost share basis to maintain other backwaters. These backwaters will contain areas suitable for Yuma clapper rail habitat.

Proposed species:

Flat-tailed Horned Lizard

The following terms and conditions are established to implement the RPMs described above. If the species is listed, implementation of these terms and conditions will be mandatory.

To implement RPM 1 (Worker Education):

1. All personnel who implement the proposed action shall be briefed on the biology and status of the flat-tailed horned lizard, protection measures designed to reduce potential impacts to this species, and reporting procedures to be used if flat-tailed horned lizards are encountered in the field. Personnel shall be advised that handling of flat-tailed horned lizards by anyone is prohibited by State law without a permit.

2. Reclamation shall implement standard mitigation measures for the flat-tailed horned lizard detailed in the *Flat-tailed Horned Lizard Rangewide Management Strategy* for work in flat-tailed horned lizard habitat.

3. No ground-disturbing maintenance activities shall occur within the context of this conference. Any ground-disturbing activities are outside the project description herein and will require additional site-specific section 7 compliance.

To implement RPM 2 (Monitoring):

1. At the end of each calendar year, Reclamation will submit a monitoring report to the Arizona Ecological Services Field Office. The report shall include numbers and locations of flat-tailed horned lizards encountered; and numbers of flat-tailed horned lizards killed, injured, moved, or otherwise taken as a result of activities authorized by this conference opinion. The report will also make recommendations for modifying or refining the terms and conditions stipulated herein to enhance flat-tailed horned lizard protection or to reduce needless hardship on Reclamation.

2. Reclamation will work with the Marine Corps Air Station - Yuma, the Bureau of Land Management, Arizona Game and Fish Department and other entities to support research necessary to: 1) improve our knowledge of the ecology and life history of the flat-tailed horned lizard, particularly in regards to demographic parameters needed to better understand population dynamics and viability; and, 2) determine the relationship between scat/lizard counts and lizard densities.

Review requirement: The RPMs, with their implementing terms and conditions, are designed to **minimize** incidental take that might otherwise result from the proposed action. With implementation of these measures, the Service believes that:

1) Because of the difficulty in detectability or measurement, a minimized level of take for bonytail chub and razorback sucker cannot be identified. If the RPMs are implemented, no more than the numbers identified, or the surrogate measures, determined to represent the level of incidental take under provisions (2)(a)-Stranding, (2)(b)-Dams, and (2)(c)-Entrainment, of the Amount or Extent

of Take section for bonytail chub and razorback sucker, will be incidentally taken.

2) Because of the difficulty in detectability or measurement, a minimized level of take for the southwestern willow flycatcher cannot now be completely identified. The survey and monitoring requirements identified in the RPA, the RPMs, and the terms and conditions will enable monitoring of take throughout the LCR. If the RPMs are implemented, take of flycatchers due to nest predation is not to exceed 50%. Incidental take will have been exceeded if more than 50% of flycatcher nests are depredated during any one breeding season. Additionally, take of flycatchers due to cowbird parasitism is not to exceed 25%. Incidental take will have been exceeded if more than 25% of flycatcher nests contain one or more cowbird eggs during any one breeding season.

3) An unknown, but minimized, number of Yuma clapper rails will be incidentally taken and the Service will consider that the incidental take level has not been exceeded if the Yuma clapper rail RPMs are implemented.

4) No more than **four (4)** flat-tailed horned lizards per year will be incidentally taken resulting from direct mortality due to crushing of lizards on roadways, routes, or project sites.

If, during the course of the action, these minimized levels of incidental take are exceeded, such incidental take would represent new information requiring reinitiation of consultation. Reclamation must immediately provide an explanation of the causes of the taking(s) and review with the Service the need for possible modification of the RPMs along with the reinitiation request.

DISPOSITION OF DEAD, INJURED, OR SICK INDIVIDUALS OF A LISTED SPECIES

If a dead, injured, or sick individual of a listed species is found in the action area, initial notification must be made to Service Law Enforcement, Federal Building, Room 105, 26 North McDonald, Mesa, Arizona, 85201 (Telephone: 602/261-6443) within three working days of its finding. Written notification must be made within five calendar days and include the date, time, and location of the finding, a photograph of the animal, and any other pertinent information. The notification shall be sent to Law Enforcement with a copy to the Arizona Ecological Services Field Office. Care must be taken in handling sick or injured animals to ensure effective treatment and care, and in handling dead specimens to preserve biological material in the best possible state. If possible, the remains shall be placed with educational or research institutions holding appropriate State and Federal permits. If such institutions are not available, the information noted above shall be obtained and the carcass left in place. Arrangements regarding proper disposition of potential museum specimens shall be made with the institution prior to implementation of the action. Injured animals should be transported to a qualified veterinarian by an authorized biologist. Should any treated animals survive, the Service shall be contacted regarding the final disposition of the animals. Although not required, Reclamation should implement these disposition measures for the flat-tailed horned lizard, as well as the listed species addressed herein.

Notice: To the extent that this incidental take statement concludes that take of any threatened or endangered species of migratory bird will result from the agency action for which consultation is being made, the Service will not refer the incidental take of any such migratory bird for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 USC sec.s 703-712) or the Bald Eagle Protection Act of 1940, as amended (16 USC sec.s 668-668d), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein.

CONCURRENCES

Bald Eagle

The Service concurs with Reclamation's finding that the Lower Colorado River Operations and Maintenance Program may affect, but is not likely to adversely affect, the bald eagle. Our rationale for this concurrence follows. As stated in the BA, Reclamation's ongoing native riparian plant restoration program has the potential to increase the available tree nesting and perching habitat for eagles along the river beyond the five year time frame. Current river operations may preclude establishment of newly regenerated cottonwood and willow stands that could provide future nesting and perching substrate for bald eagles. However, the likelihood that regeneration-inducing events would be precluded over the five year time frame is so low as to be discountable. The limited number of nesting attempts in this area indicates that competition for nesting and perching sites would not be increased by precluding the trees from developing over the next five years, and it is also a discountable effect. Because the above effects are either insignificant, discountable, or beneficial over the short, five year time frame, no adverse effect is likely.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

<u>Listed species/critical habitat:</u>

Bonytail Chub and Razorback Sucker

The Service recognizes the ongoing conservation efforts of Reclamation in helping to stabilize and prevent additional loss of bonytail chub and razorback sucker populations in the LCR. Because the Service is aware of Reclamation's continuing dedication to the survival and recovery of these species, additional conservation recommendations are not necessary at this time. The Service urges Reclamation to continue its efforts and to work in cooperation with other interested parties in long-term planning efforts to recover bonytail chub and razorback suckers in the LCR.

Southwestern Willow Flycatcher

Because of its expertise, authorities, and the amount of habitat it can affect, Reclamation should become a key player in helping develop and facilitate implementation of the recovery plan for this species.

Yuma Clapper Rail

Reclamation should continue to support recovery actions including, but not limited to, those detailed in the 1983 Recovery Plan for this species, such as annual surveys, effects of contaminants, habitat creation and maintenance, investigations of relationships between rail populations in the United States and Mexico, and investigations of the relationship between river water levels, flow rates and rail habitat and nesting success. Reclamation should join the Service in pursuing agreements with appropriate land management agencies and the Republic of Mexico to protect rail habitat.

<u>Proposed species:</u>

Flat-tailed Horned Lizard

Reclamation should manage undeveloped parts of the 5-mile zone north and west of the proposed area service highway route with the same management prescriptions as the Yuma Desert Management Area for the flat-tailed horned lizard. This area could be managed as a unit of the Management Area until construction of the area service highway is initiated. Reclamation should work with Yuma County, the BLM, and the Border Patrol to close and rehabilitate unneeded roads along section lines within the proposed Yuma Desert Management Area.

In future planning decisions regarding sludge disposal sites, well fields, or other activities, Reclamation should consider locating such facilities outside of the Yuma Desert Management Area and west of Avenue B. In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation and conference on the actions outlined in Reclamation's request. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

The Service expects that above conditions (2) and (3) for reinitiation may be met if the Lower Colorado River Multi-Species Conservation Program does not materialize as described in the description of the proposed action.

In instances where the amount or extent of incidental take (see Amount or Extent of Take section, above) is exceeded, any operations causing such take must cease pending reinitiation. To avoid this, Reclamation is encouraged to provide the Service with early notice if excess take is anticipated to occur in order to provide an explanation of the causes of the anticipated take and review with the Service the need for possible modification of the RPMs.

Proposed species/critical habitat:

Reclamation may ask the Service to adopt the conference opinion incorporated in this consultation as a biological opinion issued through formal consultation if the flat-tailed horned lizard is listed. The request must be in writing. If the Service reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, the Service will adopt the conference opinion as the biological opinion on the proposed action and no further section 7 consultation will be necessary.

After listing of the flat-tailed horned lizard as threatened or endangered and any subsequent adoption of this conference opinion, Reclamation shall request reinitiation of consultation if: (1) the amount or extent of incidental take is exceeded (see Amount or Extent of Take section, above); (2) new information reveals effects of the agency action that may affect the species or critical habitat in a manner or to an extent not considered in this conference opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the species or critical habitat that was not considered in this conference opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

The incidental take statement provided with this conference opinion does not become effective until the species is listed and the conference opinion is adopted as the biological opinion issued through formal consultation. At that time, the project will be reviewed to determine whether any take of the flat-tailed horned lizard has occurred. Modifications of the opinion and incidental take statement may be appropriate to reflect that take. No take of the flat-tailed horned lizard may occur between the listing of the species and the adoption of the conference opinion through formal consultation, or the completion of a subsequent formal consultation.

Because this BO has found jeopardy and destruction or adverse modification of critical habitat, Reclamation is required to notify the Service of its final decision on the implementation of the RPA.

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