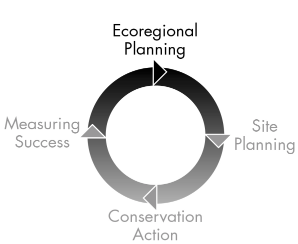
Designing *a* Geography *of* Hope

A Practitioner's Handbook to Ecoregional Conservation Planning



Volume I
Second Edition
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The Nature Conservancy®
Saving the Last Great Places

Designing a Geography of Hope:

A Practitioner's Handbook for Ecoregional Conservation Planning

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Table of Contents

Volume I – Practitioner's Handbook

Volume II – Appendices

Setting the Stage

by Greg Low, Deborah Jensen, and Alec Watson

As the field of ecology has advanced over the last several decades and the discipline of conservation biology has emerged, The Nature Conservancy has adapted and evolved its conservation goals and strategies accordingly. The 1996 publication *Conservation by Design: A Framework for Mission Success* succinctly states our organizational conservation goal:

The long term survival of all viable native species and community types through the design and conservation of portfolios of sites within ecoregions.

We recently articulated more near-term, tangible goals both domestically and internationally:

In 10 years, the Conservancy and its partners will conserve 2,500 sites identified by ecoregional plans in the United States—with special emphasis on 500 landscape-scale projects.

Over the next 10 years, the Conservancy and its partners will take direct action to conserve 100 landscape-scale projects in 35 countries, leveraging these investments to protect at least 500 additional sites in national portfolios.

The guidelines contained in this second edition of *Geography of Hope* provide methods for identifying the conservation sites where the Conservancy will need to take conservation action to achieve its goals, both near-term and long-term. To best appreciate these guidelines, it is helpful to place ecoregional planning in the context of the overall conservation process of The Nature Conservancy. That conservation process has four components, each of which is inextricably tied to the other. Ecoregional planning represents the initial building block of that process:

- **Ecoregional Conservation Planning—**Selecting and designing networks of conservation sites that will conserve the diversity of species, communities, and ecological systems in each ecoregion.
- **Site Conservation Planning—**Applying the 5-S approach (systems, stresses, sources, strategies, success) to priority conservation sites in ecoregional portfolios for the purpose of applying site-based strategies and actions.
- **Conservation Action—**Undertaking any number of different strategies to abate threats and conserve targets at conservation sites.
- **Measuring Success—**Using the Biodiversity Health and Threat Status and Abatement Measures to assess the efficacy of our conservation strategies and actions.

There are many important linkages among these four components. These guidelines and those contained in a parallel publication entitled *The Five-S Framework for Site Conservation: A Practitioner's Handbook for Site Conservation Planning and Measuring Conservation Success* note these ties, point out the similarities, and contrast the differences in the various components.

Why a second edition of *Geography of Hope*? Written with little experience, the guidelines contained in the first edition were intended as a starting point for staff undertaking ecoregional planning. With four years of experience in ecoregional planning, the second edition builds upon our experience as an organization, the experiences of other organizations doing similar work, and the continual advances in ecology and conservation biology. For example, this new edition details advances we have made identifying conservation targets at multiple scales, setting conservation goals for ecological communities and systems, conceptualizing functional conservation sites and landscapes, selecting conservation targets in freshwater and marine systems, and in the site selection or assembly process itself. Despite these advancements, ecoregional planning methods, like much of our conservation work, remain a "work in progress." Just as we must adaptively manage our conservation sites, we must similarly learn from our experiences and evolve our conservation planning methods. Better assessing viability of conservation targets, more adequately addressing the "how much is enough?" question for targets, providing a practical framework for deciding what is "feasibly restorable," and designing true networks of linked conservation sites remain some of our most significant challenges in ecoregional planning.

As we continue to complete conservation plans for all ecoregions in the lower 48 states, and selected ecoregions in Alaska and our international conservation programs, we will continue to evolve and advance our ecoregional planning methods. The methods detailed in this second edition of *Geography of Hope* will remain dynamic, and practitioners can expect regular updates as we continue to advance this important work. On the other hand, we also recognize the need for a certain level of accountability in producing quality ecoregional plans or national portfolios of sites. To that end, the eight standards outlined on page vi represent our expectations of the important processes that should be undertaken in an ecoregional planning project.

Like our work in site conservation planning, we view ecoregional plans as dynamic, living documents. What does that really mean? It means that these plans should not collect dust on shelves but instead be constantly referred to, revised, and improved upon. The corollary is that the first versions of these plans need not be perfect. Each project will face different constraints of time, money, expertise, and information. Although we expect teams to make good faith efforts to attain the standards outlined on the following page, there will always be information gaps and room for improvement. For example, it may not be possible in the first edition of an ecoregional plan to adequately assess the viability of all or even many occurrences of conservation targets. What would be expected, however, is that teams get started with assessing the viability ranks (size, condition, landscape context) of ecological systems and work towards updating the viability ranks for species targets in later editions. Just as we advocate that the Conservancy should be an organization that is continually learning and improving, we should have similar expectations for our conservation plans and planning processes.

The product of ecoregional planning, a portfolio of conservation sites, provides an important component that has long been missing in biodiversity conservation programs—a baseline for measuring progress towards mission success. These plans provide a vision of conservation success, not just for The Nature Conservancy, but for the entire conservation community. This point cannot be overstated—accomplishing the conservation outlined in our ecoregional plans will require a commitment to conservation by a multitude of public and private organizations and individuals. To achieve these lofty goals necessitates that we engage the entire conservation community at large as the audience of our ecoregional conservation work.

Standards for Nature Conservancy Ecoregional Plans

We have identified a set of eight standards for ecoregional plans that are intended to meet the need of producing quality plans to achieve the goal of *Conservation by Design* and, at the same time, strike the proper balance between planning and taking conservation action. All teams are expected to make good faith efforts to adhere to these standards. Written plans should articulate methods for addressing these standards, document assumptions behind efforts to meet the standards, and summarize results.

1. **Conservation Targets:** Conservation targets are selected at multiple spatial scales and levels of biological organization. Targets should include both aquatic and terrestrial types (and marine/estuarine where appropriate) and should represent the range in diversity of ecological systems found within an ecoregion. Information on the distribution and viability of conservation target occurrences is sought from a wide variety of information sources.

2. **Conservation Goals:** Conservation goals are set for all targets or groups of targets. Goals should have two components: the number of populations or occurrences of species, communities, and ecological systems, and how those populations/occurrences will be distributed or stratified across the ecoregion.

3. **Viability:** To the extent practical, the long-term viability (100 years) of populations and occurrences of conservation targets is assessed with the three criteria of size, condition, and landscape context. No site should be included in the portfolio of sites unless the coarsest-scale target at that site has been assessed as viable with these three criteria or can be feasibly restored to a viable status.

4. **Portfolio Assembly:** Coarse-scale targets (e.g., matrix communities), including those that are feasibly restorable, are the foundation of the portfolio. All targets should be represented in sites across the range of environmental conditions in which they occur in the ecoregion. A map delineating conservation sites or areas of biodiversity significance is the product of this standard. Tabular data on each site should accompany the map and include the following information: conservation targets at the site and general land ownership information (e.g., federal, state, private).

5. **Taking Conservation Action:** Action sites (10-year high priority sites for the Conservancy) are selected with the criteria of complementarity, conservation value, threats, feasibility, and leverage.

6. **Peer Review:** Peer review is sought from inside and outside the Conservancy on the methods used in the planning process and the targets and sites selected to achieve the goals of the plan.

7. **Information Management:** Data and information generated during the ecoregional planning process are maintained and periodically updated in a standardized format so that critical information can be synthesized across ecoregions and efficiently utilized in a dynamic, ecoregional planning process (see Chapter 4 for information management guidelines).

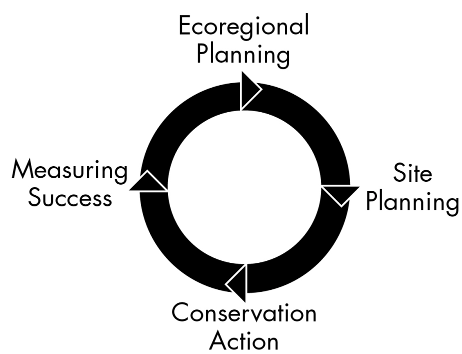
8. **Assessing the Performance of the Portfolio:** Compile summary statistics on the degree to which the portfolio of sites achieves the conservation goals for the following three categories of targets: species, communities and ecological systems. An automated tool is under development that will simplify this task. Teams are not accountable to this standard until this tool is available and operational.

Executive Summary

The second edition of *Designing a Geography of Hope*, The Nature Conservancy's handbook on ecoregional planning, builds upon the Conservancy's and other organizations' experiences in large-scale conservation planning over the last four years and improves upon the first edition in a number of significant ways. It details advances we have made in identifying conservation targets at multiple spatial scales and levels of biological organization, in setting goals for communities and ecological systems, in conceptualizing functional sites and landscapes, in selecting conservation targets in freshwater and marine systems, and in the site selection or assembly process itself.

The value of ecoregional plans is best understood when placed in the context of the Conservancy's overall conservation work. This work is best described through the four-part conservation process:

- **Ecoregional Planning—**Selecting and designing networks of conservation sites that will conserve the diversity of species, communities, and ecological systems in each ecoregion.
- **Site Planning—**Applying the Five-S Framework to priority conservation sites identified through ecoregional planning to develop strategies to abate threats to conservation targets
- **Taking Conservation Action—**Implementing any number of different strategies to abate threats and conserve targets at conservation sites
- **Measuring Success—**Using the Biodiversity Health and Threat Status Measures to assess the efficacy of conservation strategies and actions



The second edition of *Designing a Geography of Hope* is organized in two volumes. Volume I contains the standards and guidelines for developing an ecoregional plan. Volume II contains a set of technical appendices. The ten chapters of the second edition guide practitioners through the basic steps of preparing an ecoregional plan: selecting conservation targets, collecting and managing information, setting conservation goals, assessing viability of conservation targets, selecting and designing a portfolio of conservation sites, conducting a cursory threats assessment, selecting action sites, and completing the project. Throughout the document there are references and linkages to the Conservancy's parallel handbook on site conservation and measures of success—*The Five S Framework for Site Conservation.* A set of standards for the ecoregional planning process is provided in the preface of this second edition. Planning teams are encouraged to treat ecoregional plans as iterative, dynamic documents.

At the inception of an ecoregional planning project, practitioners should take a strategic "look" at the ecoregion and assess what goals they want to achieve through such a project. This is the right time to be thinking about who the stakeholders are, who potential partners are, who the audiences are for the plan, and what the land ownership and socioeconomic patterns are in the ecoregion. It is also the correct time to get the plan off to a good start from a project management perspective with a strong team and leadership, appropriate budget, timelines, and benchmarks. A detailed appendix on project management provides helpful information in this regard.

The Nature Conservancy continues to employ the coarse filter (communities and ecological systems)—fine filter (species) approach as a conservation strategy. Making that strategy operational involves identifying conservation targets—those species, communities, and ecological systems that are the focus of planning efforts in an ecoregion. These conservation targets are used to help identify conservation sites within ecoregions. In this second edition of *Designing a Geography of Hope*, we have placed a greater emphasis on the identification of the diversity of ecological systems occurring in an ecoregion as conservation targets, including those that may be significantly degraded or destroyed but are feasibly restorable. Although ecological communities (plant associations in the National Vegetation Classification) are also conservation targets, the most significant of these are those communities considered to be imperiled (ranked G1-G2 by the Natural Heritage Network/Association for Biodiversity Information) or those that occur as patch communities that would not otherwise be adequately encompassed as conservation targets by coarser-scale ecological systems. In addition to these community and system-level targets, we are also recommending that ecoregional planning teams target all imperiled species (G1-G2 ranks by Heritage), all federally listed threatened and endangered species, and a representative subset of species of special concern. There are several classes of species of special concern including declining species, endemic species, disjunct species, vulnerable species, and focal species (keystone and wide-ranging species). Finally, all ecoregional plans should identify both terrestrial and freshwater targets, as well as marine targets, where appropriate.

It is helpful to address the management of information and data from the onset of an ecoregional planning project. Ecoregional plans should utilize information on the status and distribution of conservation targets from a wide variety of sources, including but not limited to information from Natural Heritage Programs and Conservation Data Centers. Remote sensing data on communities and ecological systems (e.g., vegetation cover maps from Gap Analysis programs) and expert workshops have proved to be especially useful sources of information. Data from ecoregional plans should be archived and maintained in a Conservancy office, preferably in Excel, Access, and Arcview (GIS) files. Information managers should carefully document new data sets with appropriate metadata and identify important data gaps that will be addressed in future editions of an ecoregional plan. There are a few pieces of information that are necessary to synthesize nationally for rangewide scientific analyses of conservation targets; for reports to senior management and Board of Governors; and to use by government relations staff in the policy arena. All ecoregional planning teams are asked to collect and maintain this information in a standardized way (Appendix 11).

Following identification of conservation targets, practitioners should set goals for each target or group of targets. These goals should be quantitative and consist of two components: 1) the number of populations or occurrences of the target necessary to conserve it in the ecoregion, and 2) the distribution of the target across environmental gradients in which it occurs in the ecoregion. Goals should be set based upon the criteria of size, condition, and landscape context that will most likely result in the long-term (100 years) viability of the target within the ecoregion. In highly altered ecoregions, planners should exercise caution in using the current status of the target to establish goals.

Determining whether a particular occurrence of a conservation target may be viable or not over the long-term is a critical component of ecoregional planning. In the final analysis, doing a better job of assessing viability will help ensure that the conservation sites identified in ecoregional planning are functional. Functional conservation sites and functional landscapes maintain their conservation targets and the ecological processes which support them within their natural ranges of variability. To assess viability, three criteria are used: the size of the occurrence, its condition, and its landscape context. These are the same criteria as those used in the Biodiversity Health measure of success. The principal recommendation for this component of ecoregional planning is for teams to work with experts to apply the three criteria of size, condition, and landscape context to as many occurrences of conservation targets as possible. Special emphasis should be placed on developing specifications that will allow these criteria to be applied to ecological system targets. No site should be included in the final portfolio unless at least the coarsest-scale target occurring at that site has been assessed for its viability.

The principal product of any ecoregional planning effort is a portfolio of conservation sites that are intended to conserve the native species and ecological communities of an ecoregion (i.e., achieve the conservation goal of *Conservation by Design*). Strictly speaking, the areas identified during ecoregional planning are not conservation sites as articulated in site conservation planning. That is, the threats to the conservation targets and the strategies and areas necessary to conserve these targets have not been analyzed as rigorously as they will be during site conservation planning. Consequently, it is more appropriate to think of these places identified during ecoregional planning as areas of biodiversity significance.

Six criteria are used to identify these areas of biodiversity significance: coarse-scale focus, representativeness, efficiency, integration, functionality, and completeness. In the site selection process, teams should first select those sites that contain coarse-scale targets (e.g., ecological systems, matrix communities) and represent those targets across the environmental gradients (representativeness) in which they occur. Sections or subsections of ecoregions as well as GIS-constructed environmental data layers such as Ecological Land Units or Ecological Drainage Units are useful in "capturing" these targets across such environmental gradients. Wherever possible, planners should first select those sites that contain either both freshwater and terrestrial targets (integration) and/or targets at multiple spatial scales and levels of biological organization. Subsequently, the portfolio assembly process should focus on identifying conservation sites that contain finer-scale targets (e.g., local-scale species, patch communities). A final step in the portfolio assembly process is to ensure that all viable occurrences of conservation targets have been represented in conservation sites (completeness). In areas that contain substantial amounts of public or indigenous lands, planners are encouraged to map these lands, determine which conservation targets occur within them, and use them as starting points or "seeds" in the design of the portfolio. In ecoregions with relatively large numbers of targets and potential conservation sites, a computerized algorithm (SITES) has been developed specifically for Conservancy ecoregional planning teams as a tool or aid in portfolio design. Such programs allow users to examine alternative portfolios of sites (e.g., portfolios that emphasize private lands or public lands) and to design efficient portfolios—those that attempt to achieve the conservation goals for targets in the least amount of land.

All ecoregional plans will identify more potential conservation sites than The Nature Conservancy will be capable of conserving in the foreseeable future. Consequently, it is necessary to set site-based priorities. The final steps in ecoregional planning are to conduct a cursory threats assessment of each site in the portfolio; identify multi-site strategies (if applicable) to abate these threats; and apply the criteria of complementarity, conservation value, threat, feasibility, and leverage to each of these sites. The application of these criteria is best accomplished with an Excel program specifically designed for this purpose; the end result of applying these criteria is the selection of priority or action sites. Planning teams are also asked to identify a subset of action sites, referred to as landscape action sites. These sites are distinguished by their large spatial scale and need for a full-time project director.

To complete an ecoregional plan, each project is asked to participate in an Ecoregional Roundtable Meeting. The purpose of these meetings is twofold: to provide a forum for peer review by Conservancy colleagues of each ecoregional plan and to develop ideas and frameworks for addressing technical challenges within ecoregional planning (e.g., information management, restoration, setting conservation goals). Following these Roundtable meetings, participants are asked to prepare a final version of their plan for distribution. A last step is to ensure that copies of databases developed during the planning process have been adequately documented and archived for future uses.

Chapter 1 Introduction

In its nearly 50-year history as an organization, The Nature Conservancy's conservation strategies and methods have continually evolved. We can trace at least four different approaches that the Conservancy has used to identify places for taking conservation action. Through the 1950s and most of the 1960s we were primarily a volunteer organization and our choice of where to work was mostly opportunistic and strongly focused on natural areas that local members thought were important to protect. In the early 1970s, the Conservancy hired its first scientist—Dr. Robert Jenkins—who successfully created the first biological inventory programs, the Natural Heritage programs, to help guide our land acquisition work. The use of Heritage program information led to a second conservation approach in the 1970s and early 80s referred to as "identification, protection, and stewardship." By the mid to late 1980s, we recognized the important role that ecological processes play in sustaining biodiversity and greatly expanded our ideas on conservation in what has been dubbed "the bioreserve era." The need to work at increasingly larger scales and measure our progress against the mission led to our fourth and current conservation approach, outlined in *Conservation by Design*. This approach places emphasis on the conservation of all communities and ecosystems (not just the rare ones), emphasizes conservation at multiple spatial scales and levels of biological organization, and recognizes the value of comprehensive biodiversity planning on ecoregional rather than geopolitical lines.

In his 1998 book entitled *Ecoregions: the Ecosystem Geography of the Oceans and Continents,* Robert Bailey defined ecoregions in a hierarchical fashion as major ecosystems resulting from large-scale, predictable patterns of solar radiation and moisture, which in turn affect the kinds of local ecosystems and animals and plant found within. From a conservation planning perspective, Eric Dinerstein and colleagues at World Wildlife Fund (Dinerstein *et. al* 1995) have provided a more practical definition: "Ecoregions are relatively large areas of land and water that contain geographically distinct assemblages of natural communities. These communities (1) share a large majority of their species, dynamics, and environmental conditions, and (2) function together effectively as a conservation unit at global and continental scales." The switch to ecoregions as planning units for the Conservancy's conservation work is a formal recognition that the distribution of many species more closely parallels that of ecoregions than geopolitical lines. In addition, ecoregions are more effective units at capturing the ecological and genetic variability of conservation targets—the species, ecological communities, and ecological systems (Ricketts *et al.* 1999 for overview of U.S. ecoregions). As a result, we are using ecoregions as planning units for identifying the sites necessary to achieve lasting conservation of all native species and ecological communities. A map of these sites, along with pertinent information on the conservation targets contained within these sites, is the principal product of ecoregional plans.

The evolution of the Conservancy's conservation approach to the scale of ecoregions has had a considerable impact on how we go about our conservation work. Some of the most significant examples of ways in which our work has changed are:

- A focus on larger and presumably more functional conservation sites. For example, the roadless blocks of forested habitat in the Northern Appalachians ecoregion.

- A greater emphasis on representing all communities and ecological systems in a portfolio of conservation sites within ecoregions and a correspondingly lesser emphasis on rarity.
- More effective partnerships with public agencies. For example, the U.S. Fish and Wildlife Service and Department of Defense involvement in the Sonoran Desert ecoregional plan.
- Better setting of conservation priorities by focusing on those potential conservation sites that have the most significant biological values and are under the greatest threat.
- A vision of mission success for a large, growing, and increasingly decentralized conservation organization.

Geography of Hope—The Second Edition

In this second edition of *Designing a Geography of Hope*, we build upon the experience our organization has gained in ecoregional planning, the experiences of other organizations involved in similar conservation efforts, and the continued advances in ecology and conservation biology. Some of these changes have appeared during the last two years as updates to the first edition of *Geography of Hope*. These *Geography of Hope Updates*, covering such topics as aquatic conservation targets, ecological processes, and migratory birds as conservation targets, are referenced throughout the document and are available in their complete form on the Conservancy's web site.

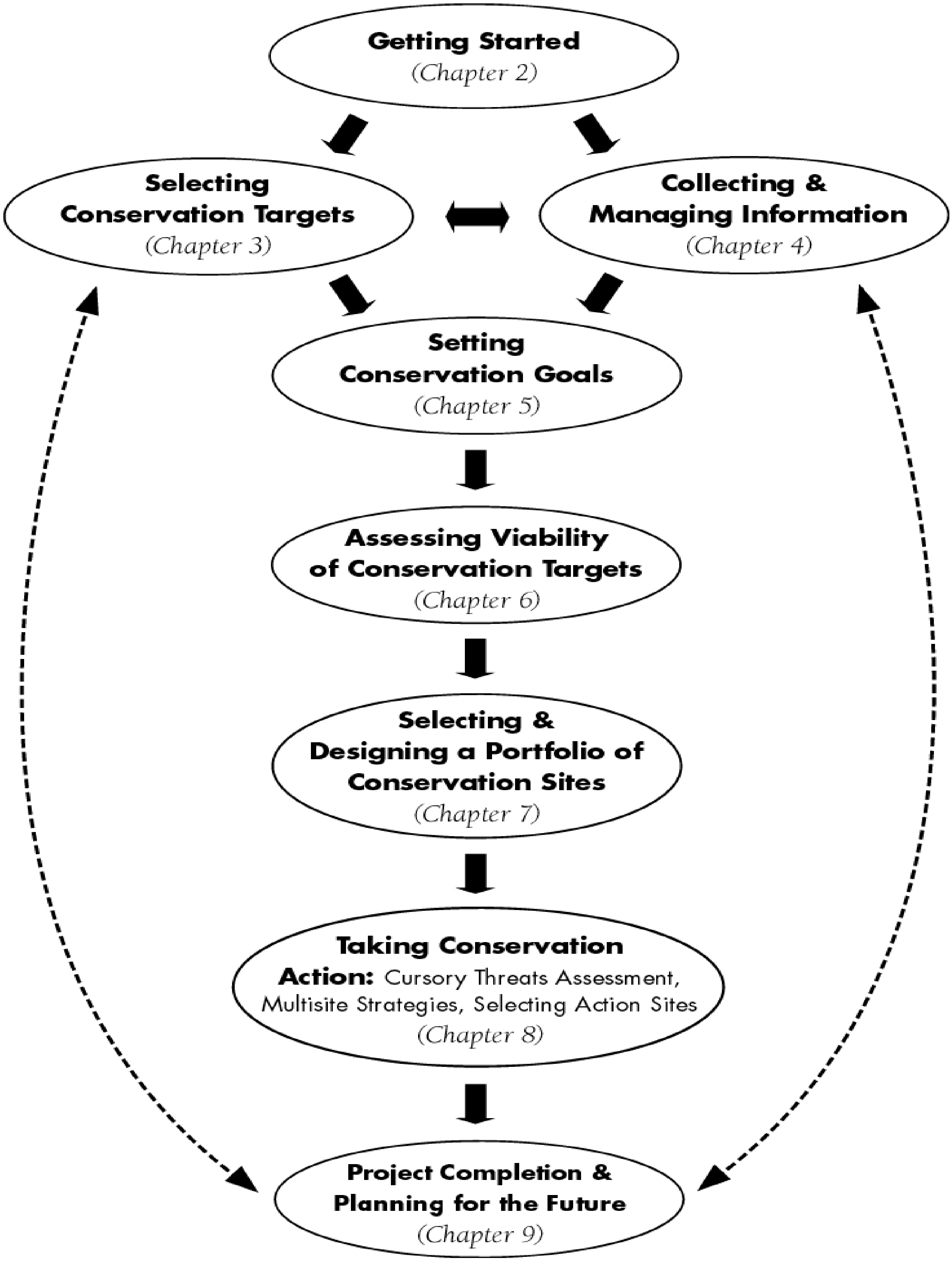
This second edition is organized in two volumes. The first volume consists of ten chapters that focus on the methods and major steps involved in completing an ecoregional plan (see Figure 1-1). Although the chapters and Figure 1-1 are organized in a linear fashion, practitioners should recognize that not all steps in the planning process are linear. Many of the major steps need to take place simultaneously. For example, although information management appears as Chapter 4 it clearly needs to be thought about from the inception of the project. The ten chapters in Volume I are as follows:

1. Introduction
2. Getting Started
3. Selecting Conservation Targets
4. Collecting and Managing Information
5. Setting Conservation Goals
6. Assessing Viability of Conservation Targets
7. Selecting & Designing a Portfolio of Conservation Sites
8. Taking Conservation Action
9. Project Completion, Planning for the Future
10. Future Challenges in Ecoregional Conservation

Each chapter follows a similar format:

- The **Objective—**what planners should accomplish if they follow the steps outlined in the chapter.

Figure 1-1. The Ecoregional Planning Process



- A small box at the beginning of each chapter recommends **Who** should be involved and the key **Products** from this stage of the process.
- A short list of **Key Questions** that planners need to consider to adequately address the topic adequately.
- The main body consisting of a brief **Background** section followed by a series of **Key Steps** that planners should follow.
- A few selected **Practical Tips** are provided as recommendations from teams who have completed ecoregional plans.
- A list of appropriate **Tools** for assistance in accomplishing the steps.
- A few selected references in **Recommended Reading** that readers can turn to for additional information.

Volume II—Appendices

A variety of useful materials are included in Volume II—Appendices. These materials range from details about steps in various chapters to maps, worksheets, illustrative examples, land management categorizations, and other important material. Please see the Table of Contents in this volume for a complete listing of appendix items. Four appendices merit special attention:

- Appendix 24 is a summary of marine considerations in conservation planning including a NOAA classification of marine habitats.
- Appendix 25 is a summary of all pertinent information on ecoregional planning available to Conservancy staff on the Intranet.
- Appendix 26 is a primer on principles and concepts of conservation biology that are relevant to ecoregional planning. Non-scientists who are involved in ecoregional planning should find this appendix especially useful.
- Appendix 27 is a glossary of most technical terms found in this 2nd edition of *Geography of Hope*.

Ecoregions

In the United States, the Conservancy has used the U.S. Forest Service ECOMAP or "Bailey" ecoregional map, with some modifications, as its base map for conservation planning. Efforts are underway to reconcile differences between the Conservancy's domestic ecoregional map and similar maps across the Canadian border. In the Latin America/Caribbean region, The Nature Conservancy and its partners are using an ecoregional map developed by World Wildlife Fund and the World Bank; we are also using ecoregions identified by WWF for Asia and the Indo-Malayan archipelago. See Appendices 1 and 28 for copies of these maps, marine ecoregional maps, and details on how these maps were produced. Appendix 2 provides a standard procedure that Nature Conservancy staff must use if they plan to make changes to ecoregional map boundaries.

Recommended Reading

Bailey, R. G. 1998. Ecoregions: the ecosystem geography of the oceans and continents. Springer-Verlag, New York.

Dinerstein, E., D. M. Olson, D. H. Graham, A. L. Webster, S. A. Primm, M. P. Bookbinder, and G. Ledec. 1995. A conservation assessment of the terrestrial ecoregions of Latin America and the Caribbean. World Wildlife Fund and the World Bank, Washington D.C.

Noss, R. F., M. A. O'Connell, and D. D. Murphy. 1997. The science of conservation planning: habitat conservation under the endangered species act. Island Press, Washington, D.C.

Ricketts, T. H., E. Dinerstein, D. M. Olson, C. J. Loucks, W. Eichbaum, D. DellaSala, K. Kavanaugh, P. Hedao, P. Hurley, K. Carney, R. Abell, and S. Walters. 1999. Terrestrial ecoregions of North America: a conservation assessment. Island Press, Washington D.C.

Objective:

To assess key partners, stakeholders, and audiences for the planning effort; determine how to best communicate about ecoregional planning with these different audiences; develop ideas concerning implementation of the plan; and establish a core planning team, budget, and timelines for the project.

GETTING STARTED

Who: Core team, sponsor, state directors, implementers

Products: Stakeholder-Partner Analysis, Communication Plan; Team Charter; Team Composition; Budget; Timelines

Background

The best time to explore the potential big-picture results of a planning effort is before the planning process begins. Planning teams should ask, "What do we want this planning effort to accomplish other than a portfolio of conservation sites?" For example, the ecoregional planning process may be an opportunity to fill data gaps, develop new or revitalize current partnerships, secure funding opportunities for implementation, or break traditional state or national working boundaries. Addressing these important issues before beginning the planning exercise will help identify how the planning process can be transformed into a conservation strategy.

Key Questions

- Who are the major stakeholders and potential partners in the ecoregion? Who are the major audiences for the eco-regional plan?
- What are the land ownership patterns and socioeconomic trends in the ecoregion?
- What level of investment (staff time and financial resources) is appropriate for this ecoregional plan? Over what time frame should the project be conducted? Can a strong team with a competent, respected leader be assembled?

Key Steps

▶ ***Step 1: Establish a core planning team, determine how decisions will be made, create a budget, and develop a project work plan with timelines***

Appendix 3 provides detailed information on how to accomplish this step, keep the project on track, and close out the project within time and budget. A flow diagram in this appendix gives a more detailed look at the steps, team composition, and products involved in the ecoregional planning process. Teams with no prior experience in ecoregional planning are encouraged to peruse a variety of completed plans and talk with staff who have ecoregional planning experience for information on lessons learned and comparative approaches.

▶ ***Step 2: Assess major landowners, partners, and stakeholders who will influence conservation plans and actions***

- What is the land ownership/management pattern in the ecoregion? How will land ownership affect the development of strategies? Will sites be comprised mostly of public or priavte lands?

- Are there dominant land uses (e.g., commercial timber, ranching, agriculture)?
- Who are the major stakeholders? (see)
- What partners will be needed to affect conservation action at sites in the portfolio?

▶ ***Step 3: Determine if, when, and how key partners should be integrated in the process***

- Should key partners be involved from the beginning? Is it sufficient to engage them at an expert's workshop (see chapter 4)? Where is the point of involvement?
- Do they have their own planning schedules or annual planning timeframes that should be considered? Is there a public agency planning exercise underway in the ecoregion?
- Are there other institutions or organizations interested enough in the plan to help pay for it? For example, in the Northern Great Plains Steppe Ecoregion, the U.S. Forest Service provided funding to help put the National Grasslands into an ecoregional perspective. The Sonoran ecoregion plan was funded by the Department of Defense and written primarily for the Department of Defense and other agency partners.

▶ ***Step 4: Identify the key audience for the plan (is it an internal or external audience)***

- Develop and implement a communication strategy early to identify key audiences (see Appendix 4).
- Can a plan be written for multiple audiences? The Central Tallgrass Prairie Team wrote the main body of their plan in easily understandable language, while the scientific documentation appears in the appendix of the plan.
- Have other organizations done an analysis for the ecoregion or significant parts of the ecoregion? For example, World Wildlife Fund and the Conservation Biology Institute have developed an ecoregional plan for the Klamath Mountains Ecoregion. In a number of places, Wildlands Projects are developing plans very similar to ecoregional plans.
- Are there organizations that would be interested in helping promote the planning effort? The Sonoran team contracted the Sonoran Institute at the beginning of their project to introduce the planning process at agency meetings. This approach generated interest, a commitment for agency staff to participate, buy-in to the planning process, and an expectation of a product.

▶ ***Step 5: Assess demographic and socioeconomic factors that could affect the planning process***

- Information on urban sprawl, second home development, ownership changes, and economic trends can influence the site selection process. It is useful to assess this early so sites can be selected to avoid potentially intractable conflicts.
- Knowing if there are changing land-use trends or economic forces at work in the ecoregion will assist in strategy development and identifying key partners. For example, in the Intermountain West, land ownership is changing from family-run cattle ranches to "second home" ranches for recreation, a trend that will influence conservation strategies.

▶ ***Step 6: Determine who will be in charge of developing and implementing conservation strategies***

- Assemble the implementation group or identify the individual staff who will implement protection strategies at the beginning. They can help with this analysis as well as communicate what is happening to important constituencies.
- Consider engaging staff (state, country, protection, and conservation program staff) who will be involved in implementing the plan at the point of portfolio assembly if not sooner. It may be useful to create a separate implementation team.
- Do not wait until the analysis is completed to start informing an implementation group and key partners about findings and potential opportunities.

▶ ***Step 7: Determine what level of investment of time and resources is appropriate for each ecoregional plan***

A number of factors are important to consider before deciding how much time and money to spend on an ecoregional planning effort. Some of the most important factors are:

- **Options:** What conservation options and opportunities remain in the ecoregion?
- **Data:** How much information on conservation targets is available?
- **Staff Capacity:** What can the respective Conservancy offices afford to spend on the project?
- **Existing Conservation:** To what extent are many of the conservation targets already conserved within existing managed areas or reserves?
- **Institutions**: What other organizations besides the Conservancy are capable of taking conservation action in the ecoregion?

Taking these and other factors into consideration, each team must decide what level of investment is appropriate for the ecoregion and at the same time consider what effort will be necessary to attain the standards for ecoregional plans outlined at the beginning of these guidelines.

Tools

▶ Stakeholder-partner analysis available on the Conservancy's Intranet site. Contact rmullen@tnc.org if you have questions.

Chapter 3 Selecting Conservation Targets

Objective:

To select conservation targets (species, ecological communities, ecological systems) at multiple spatial scales and multiple levels of biological organization. On-the-ground populations and occurrences of targets will serve as building blocks for designing a portfolio of conservation sites.

SELECTING TARGETS

Who: Core team, technical teams, expert reviewers

Products: List of conservation targets for the ecoregion

Key Questions

- What information is available on conservation targets within the ecoregion? Is there an existing classification of terrestrial or aquatic ecological communities and/or ecological systems?
- Who are the experts in the ecoregion who can review a list of conservation targets?
- Are there conservation targets no longer considered viable in the ecoregion but could be feasibly restored over time to viable levels?

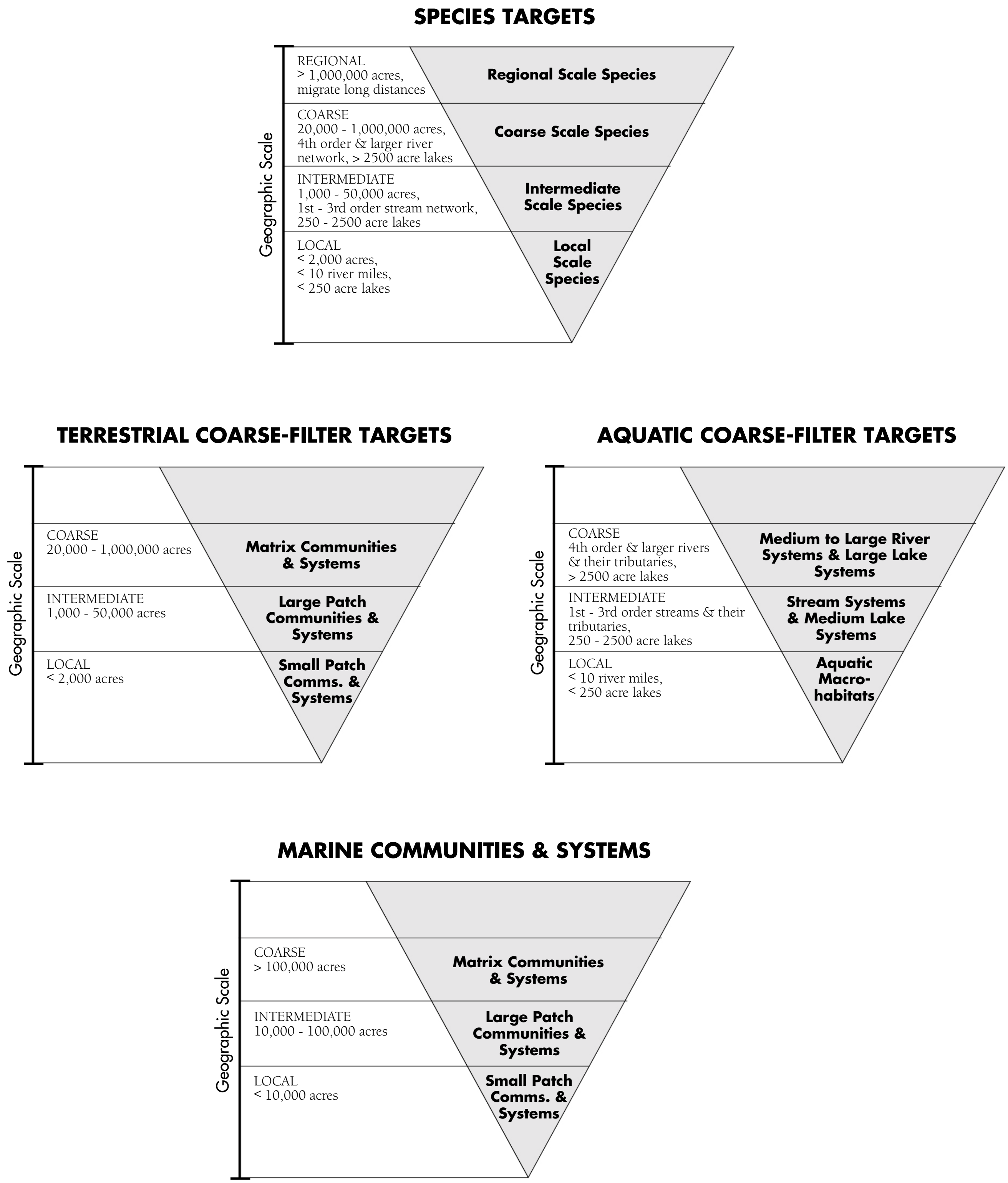
Background

The first critical step in ecoregional conservation planning is to identify conservation targets—the elements of biological diversity or surrogates that will be the focus of planning efforts. These conservation targets will be used to identify conservation sites across the ecoregion. In contrast, conservation targets at the site level help identify threats and develop strategies and actions to abate threats. Although conservation targets are used for different purposes at the ecoregional and site scales, the conservation process will be most efficient and effective if there is a high degree of concordance between ecoregional and site-level targets.

Because it is impractical to plan for all of the elements of biodiversity, even all of those that are known, we must select a subset of targets at different spatial scales and levels of biological organization that will best represent all biological diversity. In their paper on functional landscapes, Karen Poiani and Brian Richter have elucidated four spatial scales and three levels of biological organization at which targets can occur (Figure 3-1). The three levels of biological organization are: *species, communities*, and *ecological systems*. The four spatial scales are: *local, intermediate, coarse,* and *regional*—with each scale corresponding to a characteristic range in area or stream length (acreage and river miles/stream order are preliminary estimates and should be considered guidelines). Most ecoregional plans should have targets at all four spatial scales.

The long-term survival of these targets in ecoregions requires **functional conservation sites** with intact ecological patterns and processes. Functional conservation sites include a subset of these sites referred to as **functional landscapes**, concepts which will be explained in more detail in Chapter 7. Because staff throughout the Conservancy use and understand the terminology of conservation sites, we have elected to use it throughout these ecoregional planning guidelines. However, as we discuss in

Figure 3-1. Different spatial scales and levels of biological organization at which targets can occur. Adapted from Poiani and Richter (1999). Spatial or geographic scale refers to local, intermediate, coarse, and regional. Different levels of biological organization are inside the inverted pyramids.



Chapter 7 in more detail, the result of most ecoregional planning efforts is an identification of generalized **areas of biodiversity significance**, not conservation sites where the targets, threats, and strategies/ plans to abate threats have been analyzed with considerably more rigor than in ecoregional planning.

The goal of ecoregional planning is to identify areas of conservation importance that contain multiple, viable (or feasibly restorable) examples of all native plants, animals, and ecological communities and systems across important environmental gradients. To achieve this goal, we use the "coarse-fine filter strategy," a working hypothesis that assumes conservation of multiple, viable examples of all coarse-filter targets (communities and ecological systems) will also conserve the majority of species.[1] Thus, defining ecological communities and systems as ecoregional planning targets requires careful consideration of their level of resolution, spatial scale, ability to be mapped, and overall number. If ecological communities and systems are to work as coarse filters, they must be conserved as part of dynamic, intact landscapes, maintain some level of connectivity between examples, and be represented sufficiently in conservation sites across environmental gradients to account for ecological and genetic variability. Those species that the coarse filter cannot reliably conserve require individual attention through the fine-filter approach. Wide-ranging, very rare, extremely localized, narrowly endemic, or keystone species are all likely to need fine-filter strategies. The conceptual framework outlined in Figure 3-2 and the coarse filter/fine filter strategy strongly suggest that the most effective means to conserve biological diversity will be at many different spatial scales and biological levels of organization.

Key Steps

▶ ***Step 1: Identify terrestrial ecological communities and ecological systems***

All teams must identify ecological system targets that represent the entire range and variety of systems found within an ecoregion. Community-level targets should include only those communities that are either imperiled (ranked G1-G2 by Heritage Programs) or occur as patch communities and are not adequately encompassed by broader ecological systems.

Terrestrial ecological communities are plant community types of definite floristic composition, uniform habitat conditions, and uniform physiognomy. Terrestrial ecological communities are defined by the finest level of classification, the "plant association" level of the National Vegetation Classification (Grossman *et al.*1998; Maybury 1999)—a taxonomic, hierarchical, and geographically comprehensive classification developed by The Nature Conservancy and the Natural Heritage Network (Figure 3-2). Even though communities are classified based upon dominant vegetation, we assume that conservation of these communities includes both a biotic component and the abiotic or environmental structure and function that support the biota. Data on plant associations maintained by Natural Heritage programs is far from comprehensive and often focused on rare or imperiled communities. Ecologists in the Conservation Science Resource Centers can provide consultative help on the collection and use of Heritage community data. For any given ecoregion, the number of identified plant associations will usually be in the low hundreds. The selection of plant associations

[1] Note that coarse filter refers to targets at the community or system level of biological organization whereas coarse scale refers to spatial scale of, for example, terrestrial targets that roughly cover 20,000–1,000,000 acres.

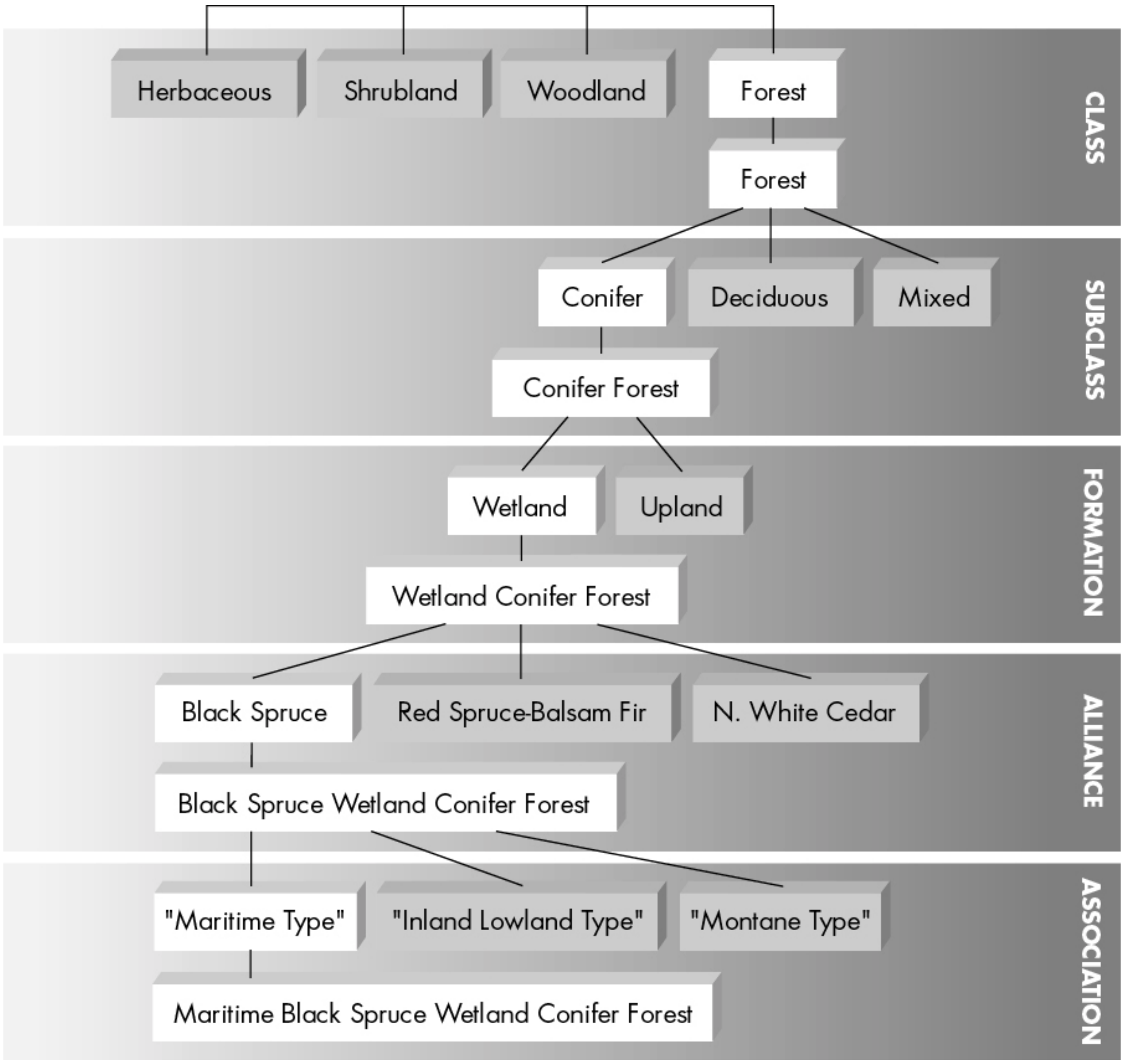
as targets should focus on those communities that are either imperiled (ranked G1-G2), or occur as rare patch-type communities (G3) and are not adequately encompassed by broader ecological systems.

Terrestrial ecological systems are dynamic spatial assemblages of ecological communities that 1) occur together on the landscape; 2) are tied together by similar ecological processes (e.g., fire, hydrology), underlying environmental features (e.g., soils, geology), or environmental gradients (e.g., elevation, hydrologically-related zones); and 3) form a robust, cohesive, and distinguishable unit on the ground. Ecological systems are characterized by both biotic and abiotic (environmental) components and can be terrestrial, aquatic, marine, or a combination of these. Examples include Mojave Desert saltbush scrub, high elevation spruce/fir forest, northern pine barrens, Great Lakes dune and swale complex, an estuary, or a salt marsh. Existing knowledge of characteristic spatial pattern, environmental setting, and driving processes for finer-scale ecological communities can often form the basis for defining ecological systems. In the United States, this knowledge is often documented in the descriptive text of each state Heritage community classification and with the association, alliance, and formation levels of the U.S. National Vegetation Classification (NVC) (Grossman *et al.* 1998). Classifications approximating the formation level of the NVC may be used in tropical regions with similar results. Occurrences of ecological systems may be identified with and evaluated using existing Heritage element occurrence information (EO) for plant associations (referred to as a bottom-up approach in the *Five S Handbook*, see ), remotely sensed data (e.g., state Gap Analysis vegetation maps), or from expert opinion (referred to as top-down approach in *Five S Handbook)*. Teams are encouraged to use classifications of vegetation or ecosystems that already exist in a state or region for identifying ecological systems. The number of systems for any given

Matrix and Patch Communities

Ecological communities vary greatly in size and the environmental conditions in which they occur. Typically, a few communities (defined as plant associations of the National Vegetation Classification) are dominant, forming extensive cover encompassing hundreds to millions of acres (sagebrush steppe in the Great Basin, salt marsh in Louisiana). These **matrix** communities exist under a broad range of environmental conditions, are driven by regional-scale ecological processes, and are important habitats for wide-ranging species. The term "matrix community" has been a source of some confusion. In some parts of the country, Conservancy ecologists define matrix communities as individual associations, while elsewhere these communities are thought of as "matrix-forming" associations that have embedded within them patch-like plant associations. For consistency, we have adop-ted this latter definition, which implies that nearly all matrix communities are, in fact, ecological systems, made up of co-occurring communities (plant associations) tied together by similar ecological processes and environmental conditions. Another confusing point about matrix communities is the tendency to view them synonymously with common communities. Matrix communities can be either rare or common, as well as secure or imperiled. The majority of communities nest within these matrix-forming types, and cover relatively smaller portions of land surface. These **patch** communities are maintained primarily by specific environmental features rather than disturbance processes. Some patch communities are large and may form extensive cover (aspen communities in the Rockies) while others are smaller and more restricted, requiring specific ecological conditions (e.g., bogs and fens, midshore rocky intertidal zone). The majority of biodiversity of an ecoregion, as measured by the number of species, tends to be concentrated in these patch communities.

Figure 3-2. An example of the use of the United States National Vegetation Classification (USNVC) from the Northern Appalachian/Boreal Forest ecoregion. From Anderson *et al.* (1999).



ecoregion should generally range between 15-50. For example, the Northern Great Plains Steppe Ecoregional Plan identified 34 ecological systems (referred to as ecological complexes in the plan) that encompassed some 323 plant associations (Appendix 5).

In Step 1 above we have placed a great deal of emphasis on the identification of ecological systems. There are a number of reasons for shifting the emphasis from targeting of ecological communities (associations) to ecological systems in ecoregional planning: 1) much of the country lacks comprehensive or any information about on-the-ground occurrences of plant associations and obtaining such information is financially impractical; 2) ecological systems are more comparable in scale to information available from remote sensing; 3) using ecological systems reduces the number of targets to a more practical number for conservation planning purposes; 4) the complexity and cost of cross-walking plant association-level data across different state community classifications cannot be borne by most ecoregional planning efforts; 5) most ecological processes do not operate at the scale of plant associations, but many do operate at the scale of ecological systems; and 6) ecological system targets provide a better linkage between site and ecoregional conservation targets.

Mark Anderson and a team of ecologists have provided detailed guidance on how to identify, set goals, and select on-the-ground occurrences for ecological communities and systems (Anderson *et al.* 1999). Biophysical or environmental analyses such as Ecological Land Units (ELUs) combined with land cover types and satellite imagery can be useful tools to predict locations of communities or ecological systems when such information is lacking, and to capture ecological variation in communities and systems based upon environmental factors. ELUs may be derived using readily available digital spatial data sets such as digital elevation models, surficial geology, and hydrography. Appendix 6 provides detailed information on and an example of the use of ELUs in the Central Appalachian ecoregion.

▶ *Step 2: Identify aquatic (freshwater) communities and ecological systems*

All teams must identify a set of aquatic community or system targets that represent the range of aquatic ecosystems in a given ecoregion. Conservancy aquatic ecologists have developed a hierarchical classification framework that describes both biotic and environmental components of aquatic ecosystems (See Table 3-1 and Appendix 28, Figure A28-1). The classification accounts for the environmental processes and features that are responsible for determining the types and distributions of assemblages of aquatic species. Because biological information is usually inadequate to utilize the biotic portion of the aquatic classification (alliances and associations), physical or environmental units like macrohabitats serve as surrogates for the biological units. **Macrohabitats** and **aquatic ecological systems** are the units that most ecoregional planning teams will use as conservation targets for representing aquatic ecosystems in portfolios of conservation sites. Ecological Drainage Units (EDUs) are used to spatially stratify ecoregions according to environmental variables that determine regional patterns of aquatic biodiversity and ecological system characteristics.

Aquatic ecological systems are dynamic spatial assemblages of ecological communities that 1)

Aquatic Targets and Geographic Scale

Aquatic systems and macrohabitats are described and mapped as discrete units, but we recognize that they are indeed dynamic and interconnected. The geographic size classes described here are not necessarily the most appropriate ecological boundaries, but they are a good starting point for thinking about multiple spatial scale patterns and processes. Coarse scale systems are 4th order larger rivers and their tributaries, and lakes greater than 2,500 acres. These systems are dominated by regional scale patterns and processes and are important for many wide-ranging and migratory species. Within these coarse-scale systems are intermediate and local scale systems and macrohabitats. Intermediate-scale systems and macrohabitats are 1st-3rd order streams and lakes from 250-2,500 acres, and are characterized by more specific environmental patterns and disturbances. Local-scale macrohabitats have very specific environmental features and processes. They are typified by lakes and ponds less than 250 acres in size and stream reaches less than 10 miles in length.

occur together in an aquatic landscape with similar geomorphological patterns; 2) are tied together by similar ecological processes (e.g., hydrologic and nutrient regimes, access to floodplains and other lateral environments) or environmental gradients (e.g., temperature, chemical, and habitat volume); and 3) form a robust, cohesive and distinguishable unit on a hydrography map. The first step in identifying aquatic ecological system targets is to determine the key environmental variables that shape aquatic diversity in the ecoregion. The second step is to assess the distribution of aquatic processes and biota throughout the ecological drainage units. The third step is to create a list of the aquatic ecological systems that describe patterns and processes of aquatic biodiversity. The final step of identifying examples of each system type can be done in two ways: consult experts to map specific examples of each system type, or comprehensively map all the ecological systems in the ecoregion using fine-scale information, including macrohabitats if they have been mapped previously. Examples of aquatic ecological systems include Colorado Rockies high elevation headwater systems; Central Tallgrass Prairie low gradient, large floodplain river systems; and Great Lakes ecoregion kettle lakes, streams, and wetland systems.

Table 3-1. Definitions of aquatic classification framework levels

Level	Description	Key Variables
Ecoregion	Large areas of similar climate and physiography that correspond to broad vegetation regions.	Climate Physiography General physiognomy of the vegetation
Ecological Drainage Units	Aggregates of watersheds that share ecological and biological characteristics. Ecological drainage units contain sets of aquatic systems with similar patterns of hydrologic regime, gradient, drainage density, & species distribution.	Physiography Zoogeography Watershed
Aquatic Ecological System	Hydrological subunits of ecological drainage units in the same physiographic setting, and within one of two size classes (see Figure 3-2), that represent dynamic, spatial assemblages of aquatic communities and macrohabitats.	Size, drainage network position, connectivity, hydrologic regime, geology
Macrohabitat Type	Types of small to medium-sized lakes or lake basins, and valley segment types of streams within ecological systems. *Note*: lentic, lotic, and nearshore ecosystems are treated separately.	Surficial geology Local physiography Size, shape, and network position
Habitat Unit Type	Distinct subunits of macrohabitats that capture the physical variability.	Depth and light penetration Velocity (lotic) Substrate
Alliance	Coarse level of biological community organization. Corresponds spatially to macrohabitats.	Taxa that are diagnostic of groups of associations
Association	Finest scale of biological classification. Corresponds spatially to either macrohabitats or habitat units.	Repeating, distinct species assemblages

Macrohabitats are the finest-scale biophysical classification unit used as conservation targets. Examples are lakes and stream/river segments that are delineated, mapped, and classified according to the local environmental factors that determine the types and distributions of aquatic assemblages.

Geography of Hope Update #6 on aquatic targets ( ) provides guidance on the development and selection of aquatic community targets. The aquatic ecology team of the Freshwater Initiative provides expert consultative assistance in selecting aquatic targets. Appendix 7 provides an example of aquatic ecological systems and macrohabitats in the Prairie-Forest Border ecoregion.

▶ *Step 3: Identify estuarine and coastal marine communities and ecological systems*[2]

A common marine system is an estuary, an assemblage of many communities whose dynamics are all tied to the changes in salinity (and other associated physical-chemical conditions) created by the interaction between freshwater drainage and tidal influx. Estuaries are dynamic, but they are also internally consistent in that many important ecological processes are regulated and controlled within the relatively well-defined borders of the bay and its watershed.

By convention, marine communities and systems are referred to as **habitats**. They are named according to the features that provide the underlying structural basis for the community (just as in terrestrial environments). Examples of marine habitats include salt marshes, seagrasses, mangroves, coral reefs, tidal flats, and oyster reefs. Not all marine habitats are defined by vegetation. Animals (e.g., coral and oyster reefs) form the structural basis for many marine communities. The principal biotic substrates (e.g., seagrasses) usually define the habitat, but abiotic features (e.g., salinity) can modify the definition. The classification of marine habitats is not as well developed as the classification of terrestrial communities. However, reasonable classifications of marine habitats by the National Wetlands Inventory at the U.S. national level and by many Heritage programs at the state level (e.g., Washington, Maine) are available on their internet site ( ).

▶ *Step 4: Identify species targets*

All planning teams should identify species targets, where information allows, in the groups indicated below.

Step 4A. *Select all viable imperiled, threatened, and endangered species as targets*

- **Imperiled species** have a global rank of G1-G2 by Natural Heritage Programs/Conservation Data Centers. Regularly reviewed and updated by experts, these ranks take into account number of occurrences, quality and condition of occurrences, population size, range of distribution, threats and protection status. Some ecoregional teams with sufficient resources and information may also include G3 species in this category. However, it will likely be impractical to select all G3 species as conservation targets; practitioners should select only the most threatened and declining species of this group as targets.
- For international programs, use the IUCN Red List as a guide, selecting species in the critically endangered, endangered, or vulnerable categories.

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[2] All steps for marine planning can be assumed to be the same as those for terrestrial planning unless otherwise noted.

- **Endangered and threatened species** are those federally listed or proposed for listing as Threatened or Endangered by the U.S. Fish and Wildlife Service under the Endangered Species Act (see the Federal Register in for the most current list).

Step 4B. *Select a representative subset (those not likely to be captured by system-level targets) of species of special concern as targets in each category below.* Projects with sufficient resources and data may elect to target all species known to fall in these categories. Species of special concern are classified as such due to declining trends, endemic status within the ecoregion, disjunct distribution, vulnerability, keystone status, and wide-ranging needs. For many of the species below, it may be necessary to target only one aspect of a species life history such as breeding range, wintering range, or a migratory location. Planners should note, where appropriate, what aspect of a species life history is the target of conservation efforts.

- **Declining species:** Declining species exhibit significant, long-term declines in habitat and/or numbers, are subject to a high degree of threat, or may have unique habitat or behavioral requirements that expose them to great risk. *Geography of Hope Update # 7* () provides detailed information on incorporating declining bird species as targets in ecoregional plans. Appendix 8 provides an example of targeting declining bird species in the East Gulf Coast Ecoregional Plan based on Partners in Flight information ().
- **Endemic species:** Endemic species are restricted to an ecoregion (or a small geographic area within an ecoregion), depend entirely on a single area for survival, and therefore are often more vulnerable.
- **Disjunct species:** Disjunct species have populations that are geographically isolated from those of other populations.
- **Vulnerable species:** Vulnerable species are usually abundant, may or may not be declining, but some aspect of their life history makes them especially vulnerable (e.g., migratory concentration or rare/endemic habitat). For example, sandhill cranes are a vulnerable species because a large percentage of the entire population aggregates during migration along a portion of the Platte River in Nebraska.
- **Focal species:** Focal species have spatial, compositional, and functional requirements that may encompass those of other species in the region and may help address the functionality of ecological systems. Focal species may not always be captured in the portfolio

Practical Tips for Selecting Conservation Targets

- Consult with adjacent ecoregional planning projects to ensure that conservation target lists are as consistent as possible.
- Use expert workshops to refine and finalize the target list as early as possible.
- Establish taxonomic teams at the beginning of the project and assign each team the task of developing target lists for that group.
- Make sure targets encompass multiple levels of biological organization and multiple spatial scales.
- In ecoregions with large numbers of targets, consider grouping finer-scale targets into coarse-scale ones to make the planning process simpler. Viability criteria for coarse-scale targets may explicitly account for habitat requirements of finer-scale targets.

through the coarse filter. Several types of focal species (Lambeck 1997 and Carroll *et al.* 2000) can be considered. The two most important categories for the Conservancy's purposes are:

- *Keystone species* whose impact on a community or ecological system is disproportionately large for their abundance (Simberloff 1996). They contribute to ecosystem function in a unique and significant manner through their activities. Their removal initiates changes in ecosystem structure and often a loss of diversity (e.g., beaver, bison, prairie dog, sea urchin).
- *Wide-ranging species* (i.e., regional) depend on vast areas. These species include top-level predators (e.g., wolves, grizzly bear, pike minnow, killer whale) as well as migratory mammals (e.g. caribou), anadromous fish, birds, bats, and insects. Wide-ranging species can be especially useful in examining necessary linkages among conservation sites in a true "network" of sites (see Chapter 7).

Step 4C. *Select species aggregations, species groups, and/or hot spots of richness.* These targets are unique, irreplaceable examples for the species that use them, or are critical to the conservation of a certain species or suite of species.

- Globally significant examples of species aggregations (i.e., critical migratory stopover sites that contain significant numbers of migratory individuals of many species). For example, significant migratory stopovers for shorebirds have been formally designated through the Western Hemisphere Shorebird Reserve Network.
- Major groups of species share common ecological processes and patterns, and/or have similar conservation requirements and threats (e.g., freshwater mussels, forest-interior birds). It is often more practical in ecoregional plans to target such groups as opposed to each individual species of concern.
- Biodiversity hotspots contain large numbers of endemic species and usually face significant threat (Mittermeir *et al.* 1998). This particular target category is largely applicable only to Conservancy and partner work in tropical forests in Latin America/Caribbean and Asia-Pacific Regions.

Summary of Ecoregional Planning Targets

- Terrestrial Ecological Systems and Communities
- Aquatic Ecological Systems and Communities
- Marine Habitats
- Species Targets
  - Imperiled Species (G1-G2 ranked species)
  - Federally listed Threatened and Endangered Species
  - IUCN Red List Species
  - Species of Special Concern
    - Declining Species
    - Endemic Species
    - Disjunct Species
    - Vulnerable Species
    - Focal Species–Keystone and Wide-ranging
  - Special Consideration
    - Species Aggregations
    - Species Groups
    - Biodiversity Hotspots

▶ *Step 5: List all conservation targets*

Include common and scientific name, global ranks, federal status, IUCN ranks, other status and criteria used to select targets, and confidence of data. Appendix 9 provides an Excel worksheet for tracking information on selected targets. An example of selecting community and system level targets for terrestrial, marine, and freshwater systems is provided in the box "Identifying National-Scale Conservation Targets in the Dominican Republic".

Identifying National-Scale Conservation Targets in the Dominican Republic.

by *Jeffrey Parrish,* The Nature Conservancy; *Francisco Nuñez,* Fundación Progressio, Dominican Republic; *Mila Plavsic, Pamela Boyle,* The Nature Conservancy

The Dominican Republic and the island of Hispaniola harbor some of the best representations of the marine biodiversity of the Central Caribbean marine ecoregion. A large percentage of the island's terrestrial flora and fauna are endemic. In addition, its 10,000' peaks form the headwaters for some of the most diverse and threatened watersheds and aquatic ecosystems in the insular Caribbean. Three categories of conservation targets—marine, terrestrial, and aquatic—have been the driving forces in the design of the national conservation site portfolio. Yet, portfolio design has been challenged by a near complete lack of fine-filter data on threatened species. Fortunately, high quality, coarse-filter target data had been developed by Dominican scientists.

The Departamento de Inventarios de Recursos Naturales produced a vegetation and land use map of the Dominican Republic (Tolentino and Peña 1998) at 1:500,000 scale combining 1992 and 1996 Landsat TM data. Vegetation types were mapped to the formation level, resulting in a national map of major habitat/formation types that served as terrestrial ecological systems. Marine targets were identified through the Central Caribbean Marine Ecoregional plan which developed subregions of the coastline of the Dominican Republic as conservation targets, and prioritized those subregions based on such measures as reef community and fisheries health. Although watershed function in the Dominican Republic historically weighed heavily in the establishment of protected areas in the mountainous headwaters regions, aquatic biodiversity in the country remains poorly understood. To ensure that aquatic conservation goals were included in national portfolio, Dominican experts in hydrology and water quality teamed with aquatic ecologists from The Nature Conservancy's Freshwater Initiative to derive aquatic ecological systems as coarse-filter freshwater targets. To stratify these system targets across the country, ecological drainage units were derived by grouping watersheds using expert opinion coupled with abiotic GIS data layers. This rapid procedure was based on the assumption that these abiotic factors for which data existed—including geology, precipitation patterns, elevation, gradient, and river systems—accounted for the poorly understood variation and hypothetical distribution of aquatic biological communities.

These three categories of conservation targets (marine, terrestrial, and aquatic) were mapped and overlaid with the five ecoregions of the Dominican Republic, resulting in a target x ecoregion subdivision. By following a goal of protecting multiple viable representations of conservation targets within each ecoregion in which the target occurred, we took further steps to ensure representation and protection of geographical diversity of the conservation targets within the Dominican Republic. A key challenge with which conservation planners in the Dominican Republic have struggled is the necessity of building a lasting national portfolio with only coarse-filter targets. Does such a strategy sufficiently capture the full range of biodiversity at finer scales, ensuring the long-term population viability of species and communities? To shed light on these assumptions, a separate hypothetical national portfolio is being derived via habitat/elevation distribution models for threatened and endemic bird species. A comparison of these independently derived site portfolios should provide insight as to how well a conservative coarse-filter approach will conserve a specific set of species targets.

▶ *Step 6: Peer review*

Circulate draft list of all targets for review by experts within and outside the Conservancy to:

- Review list for deletions and additions.
- Ensure that the targets regularly occur in all or part of the ecoregion in potentially conservable and viable (or restorable) numbers.
- Obtain information from experts on targets for which there is little published information.

Tools

- Anderson, M., P. Comer, D. Grossman, C. Groves, K. Poiani, M. Reid, R. Schneider, B. Vickery, and A. Weakley. 1999. Guidelines for representing ecological communities in ecoregional conservation plans. The Nature Conservancy, Arlington VA. Available at www.consci.org
- Federal Register. U.S. Fish and Wildlife Service's most current listing at www.endangered.fws.gove/endspp.html
- Five S Framework for Site Conservation Planning: A Practitioner's Handbook for Site Conservation Planning and Measuring Conservation Success. Available from Jeff Baumgartner at jbaumgartner@tnc. org
- Gap Analysis Web page address: www.gap.uidaho.edu
- Geography of Hope Update #6. Including Aquatic Targets in Ecoregional Portfolios: Guidance for Ecoregional Planning Teams. J. Higgins, M. Lammert, and M. Bryer. 1999. Available at www.consci.org
- Geography of Hope Update # 7. Incorporating Birds into the Ecoregional Planning Process. D. Mehlman and L. Hanners. 1999. Available at www.consci.org
- National Wetlands Inventory Web page address: www.nwi.fws.gov
- Partners in Flight (http://www.PartnersInFlight.org) physiographic areas and The Nature Conservancy's ecoregions (map) and bird list
- Western Hemisphere Shorebird Reserve Network at www.bsc-eoc.org/nabci.html

Recommended Reading

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Grossman, D.H., D. Faber-Langendoen, A.S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K.Goodin, S. Landaal, K. Metzler, K. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International classification of ecological communities: terrestrial vegetation of the United States. Volume I: The National Vegetation Classification Standard. The Nature Conservancy, Arlington, VA.

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Chapter 4 Collecting and Managing Infomation

Objective

Collect data from multiple sources, identify data gaps, and manage information in a consistent manner in tabular databases and geospatial (GIS) formats.

INFORMATION MANAGEMENT

Who: Core team, GIS/Data Manager

Products: Electronic Database Templates/Forms, Metadata Standards, Confidence Levels, Data Gaps

Key Questions

- Who will manage the data?
- What are the potential sources of data for targets, goals, viability assessments, and selection of sites? What are the significant data gaps that will affect the plan?
- How and when will information be collected, managed, and analyzed?
- Where will data be archived? What data should be archived?

Background

The best ecoregional plans utilize data and information from a wide variety of sources. Proper management and storage of ecoregional information will ensure it is available and useful for site conservation planning, measures of success, and future editions of ecoregional plans. Clear documentation of data used in an ecoregional plan is also critical, given loss of institutional memory due to staff turnover and high costs associated with developing subsequent versions. Information management functions include compiling information from multiple data sources at varying scales and levels of consistency, creating and maintaining good links between tabular and spatial databases, integrating new information in existing data sets, and coordinating data requests with planning teams. A complete ecoregional plan should identify data gaps and document the location, sources, confidence, and purposes of data sets to better facilitate future field work, site conservation planning efforts, and subsequent revisions to the plan.

Key Steps

▶ ***Step 1: Identify a lead information manager***

A Conservancy employee at either a Field Office or a Conservation Science Resource Center should be designated as the lead information manager. The lead information manager should be identified as early as possible to answer key information management questions and establish the data management structure for an ecoregion. This person should coordinate information management during the active planning and between editions of the plan. For some Field Offices that have limited staff capacity and whose Conservation Science Resource Center is unable to meet their data management needs, it may be useful to contract with a state Heritage Program or Conservation Data Center to manage ecoregional information. Similarly, a country program may elect to have a partner program take the lead in managing information for a national portfolio of sites.

▶ ***Step 2: Identify multiple sources of data, collect data from sources, and identify significant data gaps***

While Natural Heritage Programs have historically provided the bulk of information for the Conservancy's domestic planning efforts, ecoregional conservation requires collecting information on targets and related data from a wide variety of additional sources. Determine the availability of appropriate ecoregional planning data by querying information managers and scientists in multiple programs, organizations, and agencies in the ecoregion. Many agencies or organizations have already developed or compiled much of the data teams will need. Also ask planning team members in adjacent ecoregions about the data sets they used in their plans and determine whether similar information would be useful. Appendix 10 lists many sources of data that are useful in ecoregional planning and provides internet addresses for sources of publicly available information.

Information should be collected in an electronic format that is easily imported into the database. When collecting data, review and eliminate historic records of non-viable populations and occurrences. Also, update existing databases with information on new populations and occurrences and revised viability ranks. Timing is essential to meet interim planning benchmarks, improve efficiency, and lessen the burden on experts and agencies from which information is requested. If possible, make all anticipated data requests from each data source at one time; at a minimum, reduce the number of requests to data sources. The order in which data are collected and assessed may impact future steps in the planning process (e.g., have base map data layers assembled before spatially analyzing target occurrences). The time needed to request, collect, compile, format, and analyze multiple data sets also should be factored into ecoregional work plans.

At the start of the planning process teams also should identify significant data gaps that may affect plan methodology or intended products for all plan components. In most cases, ecoregional planning efforts will need to move forward despite identified data gaps. Many identified data gaps may be best addressed between planning iterations. Some significant data gaps, such as lack of known locations for particular targets, may be addressed during the planning process through Rapid Ecological Assessments (REAs) (Sayre *et al.* 2000) or expert workshops. The Central Shortgrass Ecoregional plan ( ) provides an excellent example of using REAs to identify remnant examples of prairie communities in addition to engaging experts in the ecoregional planning process—which has proven vital to successful plans. Experts provide valuable and often previously undocumented information on targets, sites, threats, and feasibility. Involvement of experts can be a strategic method of developing meaningful partnerships, receiving peer review, and gaining acceptance and credibility for the portfolio. Expert involvement can range from one-on-one interviews to large meetings depending on the needs and capacity of ecoregional planning teams. Workshops are organized around data collection and portfolio design as well as to address threats and to solicit peer review. (See box for more information on expert workshops.)

▶ ***Step 3: Develop a centralized ecoregional database***

Develop a centralized ecoregional database (or linked databases) that is managed by the lead information manager. Use the smallest number of software packages as possible in the ecoregional database to reduce confusion of data updates and modifications across multiple software platforms.

As feasible, import all tabular data into an Access database (Excel is less preferable) and link it to spatial data in ArcView attribute tables. The Biological Conservation Database may be used as necessary and should continue to maintain Heritage data. A comprehensive database shell for adaptation and use by ecoregional planning teams will available on the Conservancy's Intranet soon. In the meantime, some databases that have been used by other ecoregional planning teams are available on the Intranet for your use ( ).

Determine how data will be collected, managed, analyzed, and stored to develop a database that will meet planning needs. When compiling existing and new data into a centralized database, identify all standard fields that will be analyzed and all metadata that will be maintained. Include as standard data fields those fields of information that will be required of all planning teams for national roll-up purposes (Appendix 11). This information will be used in rangewide assessments of conservation targets, for summary reports to senior management and The Nature Conservancy's Board of Governors, for fundraising purposes, and for formulating policy in our government relations work with federal land management and regulatory agencies.

▶ ***Step 4: Analyze data***

Data compiled in the centralized database will be analyzed during target selection, goal setting,

Practical Tips on Expert Workshops

- Expert workshops usually last one or two days and involve from 20 to 100 experts representing local, state and federal agencies, universities, and Natural Heritage and Conservancy staff.
- Distribute an agenda and relevant reading materials to participants in advance. Do not overload information or structure, since the purpose is to foster new ideas and information.
- Use an expert facilitator to conduct the workshop.
- Articulate in advance the workshop's goals, expectations, and ground rules (how information will be collected, managed, compiled, shared and used).
- Aim for diversity among participants to capture input from a variety of backgrounds and disciplines.
- Collect data at the interview/meeting/workshop in a format that can be readily transcribed into ArcView. Forms for data collection during expert workshops are available on the intranet (Tools). Consider using GIS and map overlay products during the workshop—they are invaluable tools.
- Experts should supply coordinates or polygons for all new conservation target records.
- Include Natural Heritage program staff to ensure that new information gathered at the workshop is archived. If the Heritage program is not responsible for archiving the information make sure someone is assigned the task. It is up to individual Heritage Programs to decide what expert-identified information to incorporate into their databases.
- Build sufficient staff time into the overall ecoregional work plan, budget, and timeline to process and archive information and ideas generated at an Experts Workshop.
- Let attendees know what kind of follow-up they can expect (meeting notes, data, maps, reports), and then deliver!
- Conservation Science Resource Center staff have been involved with several expert workshops throughout the country and may be able to provide guidance and tools.

viability assessment, and portfolio design planning stages. While there are many ways to design a portfolio of sites, site selection is generally an iterative process with many stages of review and refinement. It will require significant time for analyzing and incorporating multiple spatial data layers at both fine and coarse scales (e.g., species locations, vegetation cover, roads, soils), digitizing new site boundaries, and generating reports (e.g., lists of targets found at each site). Computer algorithms and spreadsheets for selecting conservation sites and setting priorities among sites help streamline the portfolio assembly process (see Chapters 7 and 8).

The plan should explicitly document caveats about data gaps, inaccuracies, and confidence levels, as well as assumptions used in data analyses. Teams may assign data quality, or confidence ranks to a variety of fields including target goals, viability assessments, precision of target population/occurrence locations, and overall data quality for each portfolio site. Explicit evaluation of data quality will help teams highlight important data gaps and ensure that teams do not select priority sites for which there is little data confidence.

▶ ***Step 5: Document data sets and data gaps, and archive data***

After the portfolio of sites is identified, the lead information manager organizes the data and works with the planning team to document the planning process, methodological assumptions, important data gaps, and metadata. Metadata document the content, source, reliability, and other characteristics of final data products. Metadata are particularly important in ecoregional planning because this documentation will expedite the review of existing tabular and geospatial data sets when an ecoregional plan is revisited and will minimize the likelihood of "lost" data. For tabular data sets, descriptions should be provided for all data fields and relationships defined between tables. Teams using Access may use the data dictionary and other features to document tabular metadata. Teams using Excel must create explicit documentation. Creating a directory structure helps in identifying files. For geospatial datasets, we recommend that teams use the U.S. Geological Survey and United Nations Environment Program metadata tool, MetaLite, to document minimum data sets. MetaLite complies with Federal Geographic Data Committee (FGDC) metadata standards. To learn more about FGDC metadata, visit their website ( ). To download the MetaLite tool for free, visit their web site and follow the instructions.

Practical Tips in Information Management

- Think ahead about whether data sharing agreements will be needed with partners and include time to develop agreements as part of the overall work plan.
- Allow several weeks minimum to request, receive, and import data from existing data sources across an ecoregion. Also allow time to process new information and assimilate it with existing data. If the data are updated or new information is added, time is also required to resolve discrepancies between new and old data.
- When using geospatial data at multiple scales and from multiple sources, consider issues such as matching projections and the accuracy of data at coarse scales.
- As a rough estimate, allow at least 2 months of data management time to develop, assess, and refine portfolio sites.
- Create a table that shows a snapshot of available data sets. Fields may include the name of each data set, location, scale, intended use, and distribution comments/restrictions.

Table 4-1. What information should be archived?

Tabular Information	**Geospatial Information**	**Text Documentation**
Access databases	Source data layers	Ecoregional plan
Excel workbooks	Final data layers	Technical methods
BCD volumes	ArcView projects	Metadata
	Final map layouts	Models/algorithms

A final step is to archive copies of the completed ecoregional plan, an important safeguard against accidental loss of data. An archival copy of an ecoregional plan includes text information, tables and reports, final map products, source data sets, and modified data (i.e., data not easily recreated) (See Table 4-1). At a minimum, an electronic copy of each ecoregional plan (preferably CD-ROM) should be archived at 1) the same location as the lead data manager (master copy) and 2) the Conservation Planning Office in Boise, Idaho. In addition, plans may be archived on the Conservancy's intranet, the internet, or an FTP site (optional).

Tools

- Access database shell for use/adaptation by planning teams (TNC website in the near future). In the meantime, there are several examples of databases used by ecoregional planning teams available at www.consci.org
- Central Shortgrass Ecoregional Plan (REA example) on TNC intranet
- FGDC Web site: http://www.fgdc.gov/metadata/metadata.html
- MetaLite geospatial metadata information at Web site: http://edcnts11.cr.usgs.gov/metalite
- Worksheets and templates for expert input and reporting (TNC website in the near future)
- Conservation Science Resource Centers:
- Northeast–Information Manager, Shyama Khanna at 617-542-1908
- Midwest–Information Manager, Jon Haferman at 612-379-2207
- Southeast–Information Manager, Shannon Wolfe, 919-484-7857
- Western–GIS Manager, Dan Dorfman at 303-444-1060

Recommended Reading

Final Interim Guidelines for Ecoregional Information Management. April 2000. Ecoregional Information Management Team. Available from the Boise Conservation Planning Office—contact Renee Mullen at rmullen@tnc.org

Sayre, R., E. Roca, G. Sedaghatkish, B. Young, S. Keel, R. Roca, and S. Sheppard. 2000. Nature in focus—rapid ecological assessment. Island Press, Washington, D. C.

U.S. Geological Survey. 1999. Metadata in Plain Language. USGS Geologic Information Internet Site. http://geology.usgs.gov/tools/metadata/tools/doc/ctc/

Chapter 5 Setting Conservation Goals

SETTING GOALS

Who: Core team, technical teams, expert reviewers

Products: Quantitative goals for each target or group of targets and clear assumptions regarding how goals were set

Key Questions

- What information is available to help set goals for the targets?
- At what spatial patterns and scales do targets occur?
- What assumptions are behind the conservation goals?
- What are the historic and current global distribution and range of each conservation target?
- What percentage of the total rangewide distribution of the target is within the ecoregion?

Objective:

Set conservation goals for all conservation targets or groups of targets, accounting for both the spatial distribution of the target across the ecoregion and the number of populations or occurrences.

Background

The primary purpose of setting goals is to estimate the level of conservation effort necessary to sustain a target at viable numbers over a specified planning horizon (100 years). Setting such goals also enables planners to measure how successful a portfolio of conservation sites is at representing and conserving targets in an ecoregion. Thoughtful goal setting is important for establishing credibility of an ecoregional plan (Soule and Sanjayan 1998). Conservation goals in ecoregional planning define the number and spatial distribution of on-the-ground occurrences of targeted species, communities, and ecological systems that are needed to adequately conserve the target in an ecoregion. In contrast, site conservation goals focus on the intended status of individual target occurrences as measured by the criteria of size, condition, and landscape context. Although this assessment of quality is also a consideration in ecoregional planning (see Chapter 6 on viability), it is done to much greater depth in site conservation planning and is the basis of the Biodiversity Health measure of success (see *The Five-S Framework for Site Conservation*).

A conservation goal in ecoregional planning has two components: the **number** of populations or occurrences of a community or system needed to conserve a target in an ecoregion, and a **distributional** component noting how the target should be distributed or stratified across an ecoregion. Conservation of multiple, viable examples of each target, stratified across its geographic and ecological range, is necessary to capture the variability of the target and to provide sufficient replication to ensure persistence in the face of environmental stochasticity.

Setting meaningful and realistic conservation goals for targets is challenging for a number of reasons. First, in some highly fragmented regions of the country, setting goals based upon current conditions will almost certainly result in these targets not being viable over the long term, and estimating historic conditions can be difficult. Second, there is currently no scientific consensus on how much area or how many populations are necessary to conserve a species target across its range.

Practical Tips

- Goals should be set for all conservation targets by ecoregion. In high biodiversity regions where resources are limited, teams may need to group targets by function (e.g., native fish) or nest within coarse-filter targets.
- Teams should take into account historical vs. current distribution of targets in setting goals, and set goals based on historical distributions.
- Goals should be based on what will be necessary in terms of abundance and distribution to conserve a target and not necessarily on present-day status and distribution.
- Set goals that will conserve target population or occurrences across the environmental range of the target within the ecoregion. Check with adjacent ecoregions when setting goals.

Finally, there is little empirical or theoretical scientific research that addresses representation goals for communities and ecological systems. Therefore, goals must be tested and refined through time by monitoring and re-evaluating the status and trends of individual targets.

Key Steps

▶ ***Step 1: Setting goals for ecological communities and ecological systems (terrestrial, aquatic, and marine)***

Step 1A. *Assign attributes of scale/pattern and range/distribution to each targeted community or ecological system.* (See Anderson *et al.* 1999 in for details on setting conservation goals for communities and systems):

- *Geographic scale and spatial pattern* of the community and ecological system refer to how a community is distributed across a landscape. Group terrestrial communities and systems into one of three broad pattern types. Some ecoregions have found it useful to add a fourth pattern type, linear, to encompass riparian areas, especially in the arid portions of the western United States.
  - Matrix community or ecological system
  - Large-patch community or ecological system
  - Small patch community, aquatic macrohabitat, or ecological system
- *Rangewide distribution pattern*: Rangewide distribution of a community or ecological system relative to the ecoregion is an important consideration for setting goals. To gauge how many examples of each target to conserve and how intensively to stratify their distribution, group communities and systems into categories based on their relative endemism to the ecoregion.
  - Restricted/endemic: occurs primarily in one ecoregion
  - Limited: occurs in the ecoregion and a few other adjacent ecoregions
  - Widespread: widely distributed in several to many ecoregions
  - Disjunct: occurs in ecoregion as a disjunct from the core of its distribution
  - Peripheral: more commonly found in other ecoregions

Goals should be set relatively higher for communities and ecological systems that are restricted to one or a few ecoregions and therefore depend entirely on efforts within the ecoregion for long-term conservation. As distribution increases relative to the ecoregion, the number of occurrences or examples needed under conservation should decrease. Peripheral occurrences of communities and ecological systems may play a valuable role in persistence of communities under predicted changes in global warming (see Chapter 7 on Designing a Portfolio of Conservation Sites for practical tips on considering climate change effects in portfolio design).

Step 1B. *Stratify the ecoregion into subunits, usually ecoregional sections and/or subsections.*

Other physical units such as Ecological Land Units (Appendix 6) are also useful stratification units for communities and ecological systems. For aquatic targets, stratify ecological systems, macrohabitats, and species by Ecological Drainage Units (Appendix 7). Ecological drainage units are aggregations of eight-digit Hydrologic Catalog Units (as defined by the USGS) that have been grouped according to regional patterns of aquatic zoogeography, geology, landform, climate, hydrology, and drainage pattern. They are the aquatic analog of ecoregional sections and subsections. For marine targets, ecoregions can be subdivided by the geographic subunits (Appendix 24).

Step 1C. *Set quantitative conservation goals for each ecological community or system.*

- Establish standard table for each ecological system or community type with scale/pattern of distribution on one axis and global range on another axis. Table 5-1 provides preliminary guidance on such goals based on work with plant associations in the Northern Appalachians ecoregion. This table makes a number of assumptions. The most important assumptions are that patch communities are more ecologically variable than matrix communities, and because primarily of their smaller size, are subject to higher probabilities of attrition over time. Consequently, the conservation goals for these patch communities have been set higher than for matrix communities. This table will prove most useful for those ecoregions with detailed information on the distribution of plant associations, particularly ecoregions with communities similar to those of the Northern Appalachians. Planners should exercise caution in using Table 5-1 with plant associations that are ecologically quite different than those in the Northern Appalachians. See Anderson *et al.*

Table 5-1. Recommended preliminary number of occurrences for ecological communities (plant associations) for an ecoregion. See the Northern Appalachians Ecoregional Plan. * = goals determined on case by case basis.

	Matrix	Large Patch	Small Patch
Restricted/Endemic	10	18	25
Limited	5	9	13
Widespread	2/3	4/5	5/6
Disjunct	1*	2*	3*
Peripheral	*	*	*

(1999) and the Northern Appalachians Ecoregion Plan for details. As we move more towards adoption of ecological systems as conservation targets, Table 5-1 guidelines will be less relevant.

- For widespread ecological systems, we recommend using a default goal of one example or occurrence per ecoregional section or ecological drainage unit in which the system occurs when there is no information to establish a more informed goal. This is likely to be a minimum conservative goal. For example, in the western United States a typical terrestrial ecological system is pinyon-juniper woodlands. This system occurs across several ecoregions from the Columbia Plateau to Mexico, and in most sections of these ecoregions. With an average of five sections per ecoregion, the total number of occurrences of pinyon-juniper woodlands we would be seeking to represent in conservation sites is likely to be 40-50. Without knowing something about species turnover in this system and other systems across the environmental gradients in which they occur, it is difficult to know whether this number represents a sound conservation goal. Those teams with sufficient resources to develop Ecological Land Units and analyze the environmental variability and/or biological variability within ecological systems should be able to set more meaningful goals than the default goal we have suggested.

  For ecological systems with more limited distribution, goals will need to be set relatively higher. Because of the coarse-scale at which ecological systems occur, most of these targets will be classified as widespread with a few in the restricted or limited distributional categories.
- For most marine habitats, a starting goal should be to conserve 20% of the current distribution of a habitat type (a number frequently used in discussions among experts about the appropriate size of marine reserves).

Step 1D. *Seek expert input on conservation goals (expert workshop and/or interviews to help set or refine quantitative goals).*

▶ *Step 2: Setting (baseline) conservation goals for species*

Setting goals for species entails determining how many viable populations over what distribution need to be conserved in the ecoregion to ensure the long-term sustainability of species, taking into account the entire range of the species.

Step 2A. *Categorize species by rangewide distribution pattern for each target* (see categories under Step 1A above).

Step 2B. *Consult recovery plans and population viability analyses (PVA) where they exist for goals of selected species targets.* To the extent possible, tie goals to agency established standards (but see Tear *et al.* 1995).

Step 2C. *Develop baseline quantitative goals for each target species in terms of numbers of population* *and distribution.* A standard, default minimum goal is: two viable populations per ecoregional section in which the species occurs with a minimum of 10 viable populations rangewide. For vertebrate species, these populations should represent breeding populations of at least 200 individuals. For plant and invertebrate populations, what constitutes a viable population size should be determined on a case by case basis. This is a placeholder goal when no better information is available.[1] Threatened species that are endemic to an ecoregion or limited in distribution may need goals set relatively higher than for widespread species or than the standard default goal. Disjunct or peripheral populations of a species that are located in the northern part of a species range or at the upper end of a species elevational distribution are likely to be especially important as safeguards from potential global warming impacts.

Step 2D. *Set goals for wide-ranging species.* For some wide-ranging species whose populations are distributed over more than one ecoregion, setting ecoregional goals in isolation from goals of adjacent ecoregions will likely be inadequate. Examples include salmon species in the Northwest, Colorado River endangered fishes, and wide-ranging mammals like grizzly bear, wolf, wolverine, etc. For these types of species, goals should first be set rangewide by working across ecoregional lines and then subsequently set for each ecoregion based on rangewide needs. Ideally, we should establish goals for all targets in this manner. Realistically, it may only be possible to do so for species whose individual populations cover such large areas. Fortunately, conservation planning is often underway by state and federal agencies for the majority of these species. Conservancy ecoregional plans should build upon and complement existing conservation planning efforts.

▶ *Step 3: Document assumptions and future data needs*

Planners should state assumptions or rationale behind goals and identify data needs and analyses that will simplify such goal setting in the future. Appendix 12 provides an example from the Sonoran Desert Ecoregional Plan of the assumptions behind their conservation goals.

We recognize that one of the greatest needs and challenges in ecoregional planning is to set consistent, meaningful conservation goals for targets across their entire range of distribution. As an interim step, we have recommended default standard conservation goals when information is lacking to set more informed goals. During 2000, the Conservation Science Division will be working with agency and academic scientists to improve upon these goals. We hope to develop a range of conservation goals for species groups that share a similarity in life history characteristics.

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[1] This minimum standard is based upon the work of Cox *et al.* (1994) who conducted population viability analyses for 11 vertebrate species ranging from gopher tortoises and snowy plovers to Florida panthers and bald eagles. This standard refers to populations, not necessarily to occurrences in the Heritage program sense. The analyses of Cox *et al.* took into account demographic, environmental, and genetic stochastic factors facing most populations. Establishment of 10 relatively secure populations should provide a > 90% chance of at least one population persisting for > 100 years.

Setting Conservation Goals for Aquatic Ecological Systems and Macrohabitats

by *Jonathan Higgins* and *Mark Bryer*, The Freshwater Initiative

Aquatic ecological systems and macrohabitats occur over a large range of spatial scale, abundance, and distribution patterns across an ecoregion. The local-scale macrohabitats can either be common and widespread, or rare, depending on the ecological features and processes that determine their types and distributions. For instance, in Ecological Drainage Units (EDUs) dominated by lake plain geomorphology, there are low-gradient, warm, surface-runoff headwaters. These headwaters are common and widely distributed. There can also be isolated examples of spring-fed headwaters. These are less common, and not widely distributed. Medium and coarse-scale targets are larger, and have progressively fewer examples within each EDU.

The goals for the number of occurrences should be based on their distribution, relative abundance, size, condition, and susceptibility to threats and stochastic processes. To capture examples of ecological systems and macrohabitats across their ecological and geographic range, occurrences need to be identified within each EDU. Since coarse-scale targets are large, and there are generally only a few occurrences of each type within each EDU, an initial goal may be to conserve one example of each type within each EDU. For common, widely distributed targets, goals should be established on a percentage and rangewide basis, and the percentage should be determined by the regional experts who have an understanding of the effects of stochastic processes (e.g., flood and drought). For less common and rare targets, a higher proportion should be captured.

The actual selection of occurrences for aquatic ecological systems and macrohabitats is complex when considering the landscape perspective. Macrohabitats and aquatic ecological systems are often dependent upon being linked to other macrohabitats and systems. This does not necessarily mean that we need to select the entire watersheds for occurrences of these targets. Site conservation teams will decide what spatial area needs to be considered for conservation. However, targets that can be connected make better examples.

In the Middle Rockies-Blue Mountain ecoregion, the planning team developed aquatic targets using an abiotic classification. The team defined and mapped stream macrohabitat units by five attributes: stream order, elevation, lithology, down-stream connectivity, and upstream connectivity. The combinations of these attributes produced 207 targets throughout the ecoregion. A table was generated to characterize the abundance and conservation goal for the targets across the entire ecoregion. In this ecoregion, the total kilometers of each macrohabitat type was summed to give an impression of the abundance. Generally, the number of occurrences is a more accurate way of depicting abundance, and should be assessed in any future applications.

Total Length	Abundance	Conservation Goal	Number of Types
< 11 km	Rare	50%	47
11-100 km	Uncommon	20%	78
100-1000 km	Common	10%	47
> 1000 km	Very Common	5%	35

Examples of each of these targets were selected in each of the 12 EDUs in the ecoregion.

Tools

- Anderson, M., P. Comer, D. Grossman, C. Groves, K. Poiani, M. Reid, R. Schneider, B. Vickery, A. Weakley. 1999. Guidelines for representing ecological communities in ecoregional conservation plans. Conservation Science Division, The Nature Conservancy, Arlington, VA. Available on the Conservancy's Internet: http://consci.tnc.org/library/index.html
- Geography of Hope Update #6. Including Aquatic Targets in Ecoregional Portfolios: Guidance for Ecoregional Planning Teams. J. Higgins, M. Lammert, and M. Bryer. 1999. Available on the Conservancy's website at www.consci.org
- Geography of Hope Update # 7. Incorporating Birds into the Ecoregional Planning Process. D. Mehlman and L. Hanners. 1999. Available on the Conservancy's website at www.consci.org
- Northern Appalachian/Boreal Forest can be requested rom Mark Anderson (manderson @tnc.org)

Recommended Reading

Bailey, R. 1995. Description of the ecoregions of the United States. 2nd edition revised and expanded. USDA Forest Service Miscellaneous Publication 1391, Washington, DC. 108 pp.

Cox, J., R. Kautz, M. MacLaughlin, and T. Gilbert, 1994. Closing the gaps in Florida's wildlife habitat conservation system. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Soule, M. E. and M. A. Sanjayan. 1998. Conservation targets: do they help? Science 279:2060-2061.

Tear, T.H., J. M. Scott, P. H. Hayward, and B. Griffith. 1995. Recovery plans and the Endangered Species Act: are criticisms supported by data? Conservation Biology 9(1)182-195.

Chapter 6 Assessing Viability of Conservation Targets

Objective:

To identify viable populations and occurrences of conservation targets, to the greatest extent practical, using the criteria of size, condition, and landscape context (the same criteria as used in the Biodiversity Health measure of success).

ASSESSING VIABILITY

Who: Core team, technical teams, expert reviewers

Products: Viability assessment of target occurrences based on size, condition, and landscape context

Background

Embedded in the conservation goal of The Nature Conservancy is the notion of "viable native species and community types." Viability refers to the ability of a species to persist for many generations or a community/ ecological system to persist over some specified time period. Within a planning context, viability may refer to either the viability of a population or the viability of the species as a whole, or similarly to the viability of an entire community or ecological system versus individual examples of it. In this chapter, we focus on the viability of populations, and occurrences or examples of ecological communities and systems. In this second edition of *Geography of Hope,* we expect that practitioners and planners will place a greater emphasis on assessing the viability of conservation targets, thereby ensuring that sites in ecoregional portfolios are as functional as possible and that conservation targets contained in them have high likelihood of remaining extant.

Key Questions

- What types of information are available pertaining to the viability of conservation targets in the ecoregion? In addition to species-level data, what GIS and remote sensing data and tools may be useful in assessing the viability of communities and ecological systems?
- Who are the experts in the region that could provide additional viability information about individual conservation targets or collections of targets (e.g., cavity-nesting birds, stream systems, matrix or patch communities)?
- For North American planning projects, are standard data (element occurrence ranks) on the viability of populations and occurrences of communities available from Heritage Programs and Conservation Data Centers? Have these programs used the most recent criteria (size, condition, landscape context) for assessing viability?

This same assessment of the viability of conservation targets occurs as part of the Conservancy's efforts to measure conservation success (see Biodiversity Health measure in *The Five-S Framework for Site Conservation*). However, there are notable differences in these assessments of viability during ecoregional planning versus measures of success at sites. First, we anticipate that the viability assessment during ecoregional planning will be less rigorous than the site-based process. Second, viability is ideally assessed for occurrences of all conservation targets in ecoregional planning compared to a maximum of eight targets in the measures of success process. This broader but more cursory assessment in ecoregional planning is needed to identify which target occurrences should be included in the portfolio of sites. Finally, the target list for which this viability assessment occurs may be somewhat different at the site level because conservation targets are used for different purposes in site and ecoregional planning (see Targets chapter). Viability assessment in ecoregional planning has taken on greater importance as experience has shown us that including marginally viable occurrences of targets has resulted in marginally functional sites being included in the portfolio. Such sites can demand significant resources and may be difficult to back away from once implementation of ecoregional plans has begun. In essence, viability assessment in ecoregional planning represents a risk analysis for making an investment decision.

Ecological Communities/Systems. Three primary factors govern the viability of a community or ecological system: demography of component species populations; internal processes and structures among these component species; and landscape-level processes which sustain the community or system. These factors are roughly equivalent to and certainly incorporated by the criteria of size, condition, and landscape context. One of the most significant challenges in the application of these criteria is factoring in the large-scale change brought about to these communities and systems by anthropomorphic disturbance that has occurred over the last several hundred years.

Species. At the population level, chance events are the primary determinant of whether a population goes extinct or remains viable, especially when the population is small. Four types of chance events influence population viability:

- **Demographic uncertainty—**random events in the survival and reproduction of individuals
- **Environmental uncertainty—**unpredictable events related to weather and populations of predators and competitors
- **Natural catastrophes—**extreme events of environmental uncertainty such as hurricanes and wildfires
- **Genetic uncertainty—**chance events affecting the genetic makeup of populations through genetic drift

As a general rule, genetic and demographic uncertainty are important considerations only in very small populations, whereas environmental uncertainty and natural catastrophes can affect much larger populations.

In the steps outlined below, we recommend a number of alternative approaches for addressing the viability of populations, ecological communities, and systems. Our principal recommendation is for ecoregional planners to work with experts and apply the criteria of size, condition, and landscape context (see assessing viability box) to as many occurrences of conservation targets as is possible and practical. As a first priority, we strongly encourage planning teams to develop viability specifications for ecological systems and apply them to on-the-ground occurrences of those systems. Next in importance is for teams to assess the viability of finer-scale community and species targets. The applicable standard for this chapter is that no site should be included in a final portfolio unless at least the coarsest-scale target occurring at that site has been assessed as being viable or is feasibly restorable to a viable status. An important implication of this standard is that any site identified for the purpose of conserving a single species population must ensure that the population or occurrence has been assessed as viable with the criteria of size, condition, and landscape context. Sites not passing this viability standard for whatever reason (including lack of information) need not be eliminated from consideration in the future. These sites can be thought of as a "bench of sites," and

Assessing Viability with the Criteria of Size, Condition, and Landscape Context

Criteria 1–Size: At the population level, size is a measure of the area of occupancy by a species and/or its population abundance and density. All else being equal, larger populations are assumed to be more viable than smaller populations. For matrix-type communities and ecological systems, large-scale natural disturbances create a diverse shifting mosaic of successional stages and physical settings. The area needed to ensure survival or recolonization from such disturbances (e.g., disease, fire, insect outbreaks, hurricanes) has been called the minimum dynamic area. For a matrix type to persist over time it must be able to sustain, buffer, and absorb these disturbances and maintain these minimum dynamic areas. Size can be determined in two ways for ecological communities and systems. First, the home range of a species (usually a vertebrate) that is a typical occupant of that system and is at the higher end of the food chain can be used to estimate the size of the community or system (e.g., Flammulated Owl in ponderosa pine forests). Alternatively, there is a rule of thumb from the field of patch dynamics and disturbance ecology that suggests the size of a community or system needs to be the size of the largest natural disturbance to that community or system over a 500–1000 year time frame.

For aquatic communities and systems, large-scale natural disturbances like floods and droughts create a mosaic of habitat suitability. Aquatic organisms will often move to refugia during disturbance events and recolonize after habitat conditions become favorable again. A minimum dynamic area for aquatic systems must be large enough to ensure the linear connectivity of habitats at scales appropriate to the targets. As with populations, larger occurrences for communities and systems are generally preferable to smaller ones, especially for matrix types.

Criteria 2–Condition: Condition is an integrated measure of the quality of biotic and abiotic factors, structures, and processes that characterize targets. Criteria for measuring condition include success and regularity of reproduction, presence/absence of competitors/predators, degree of anthropogenic impacts, and presence of biological legacies:

- *Anthropogenic impacts*—fragmentation, presence of exotic species, alteration of natural disturbance regimes, pollution, and so on. Occurrences that contain relatively continuous cover of natural vegetation (i.e., less fragmentation) are more likely to have intact ecological processes and be free of invasive exotic species.
- *Biological legacies*—critical features of communities and systems that take generations or sometimes hundreds to thousands of years to develop. For example, in old-growth forests the presence of fallen logs and rotting wood, a well-developed herbaceous understory, and structural complexity in the canopy are examples of such biological legacies. As a general rule, the presence of a well-developed structure and species composition that include characteristic but also uncommon species implies good habitat quality and some historical continuity. Those communities and systems that are depauperate in species composition for any of a variety of reasons make poor "coarse filters."

Criteria 3–Landscape Context: For populations, landscape context is an integrated measure of two criteria: connectivity to other populations and intactness of surrounding ecological processes and environmental regimes. Although landscape context is important for all communities and systems, those patch and matrix types and aquatic communities and systems that depend on easily disrupted ecological processes occurring at a scale larger than the individual community are most at risk by what happens in the surrounding landscape (e.g., altered fire regime, altered flow regime, ground water pumping). A few patch communities such as those on raised bogs, perched wetlands, isolated lakes, and cliffs and rocky summits are more dependent upon atmospheric input of nutrients and water than the surrounding landscape. In general, communities and systems that are connected to or in proximity to other natural habitats are usually preferable to isolated examples.

can be inserted back into the lineup of the portfolio over time as practitioners are able to assess the viability of targets on them.

Key Steps

▶ *Step 1: Assess the viability of ecological communities and systems*

Step 1A: *Develop ranking specifications for ecological systems and use expert opinion to assign ranks for the three criteria of size, condition, and landscape context.* The Central Tallgrass Prairie Ecoregional Plan developed ranking specifications for ecological systems for each of the three criteria of size, condition, and landscape context (see viability specifications box). Subsequently, these ranking specifications can be used to assign ranks for each of the three criteria to target occurrences of communities and systems. Planners should use the worksheet in Appendix 13 for assigning these ranks (this is the same Excel worksheet used in the Biodiversity Health measures of success).

Step 1B. *Use Element Occurrence Ranks (EO Ranks) for community targets that are available from Natural Heritage Programs and Conservation Data Centers.* When ranks (A = Very Good, B= Good, C = Fair, D = Poor; see Appendix 13) that assess the viability of communities or systems are available from the Natural Heritage/Conservation Data Center network, conservation planners should make good use of them. Occurrences with a rating of Poor (D) should not be considered viable, and any Fair (C) ratings should be accepted with some caution. Such data will largely be available only for communities (i.e., plant associations, not ecological systems) and usually only for highly ranked (G1-G2) communities. If resources allow, expert opinion or site visits should be used to assess viability of community occurrences for which no information is available. Alternatively, GIS analyses as outlined in the step below may be used.

Step 1C: *Use a Pass/Fail grade for viability.* When information is extremely limited, it may be desirable to consult experts and assign P/F grades of viability to target occurrences. Passing grades indicate that communities or systems have a >50% chance of remaining extant for the next 100 years assuming that reasonable, practical conservation actions take place to safeguard these targets. In these situations, size is the most important of the three criteria to assess for matrix community and system viability, whereas quality is likely a better indicator for patch communities and systems.

Step 1D: *Use existing GIS data as a substitute or complement to the steps above.* There are a number of techniques for qualitatively and quantitatively assessing the potential viability of ecological community and system targets with GIS analyses, remote sensing information (satellite imagery and aerial photography), and other spatially-referenced data. Such analyses allow planners to assess:

- degree of habitat fragmentation of a community or system
- extent of conversion of natural habitats
- whether natural disturbance regimes are intact

Viability Specifications for a Mesic Tallgrass Prairie Ecological System, Central Tallgrass Prairie Ecoregion

CONDITION SPECIFICATIONS

A-rated condition: Typical native composition with indicator species present, as these relate to natural disturbances. Key disturbances, including human disturbances that mimic natural ones, include fire and grazing. Typical structure is dominated by graminoids and forbs. Few to no exotics present. Lack of negative human impacts, such as gravel roads.

B-rated condition: Lack of some typical native indicators, particularly as these relate to absence of some natural disturbances. Structure not always typical, with native forbs or graminoids overly dominant or shrub encroachment. Some exotics present. Some negative human impacts.

C-rated condition: Many native indicator species absent. Structure not typical with native forbs or graminoids excessively dominant, and shrubby encroachment high. Exotic may be extensive, but rarely dominate over native component. Extensive negative human impacts, including pesticide spraying, some dirt or gravel roads, or heavy cattle grazing.

D-rated condition: Most, if not all, native indicator species absent. Weedy native dominants are still present with many exotics. Structure is not typical. Exotic species dominate over native species component, as listed in C-rated condition. Extensive negative human impacts evident as listed in C-rated condition.

Justification for minimum A-rated criteria: Native species are being maintained by natural processes. Justification for C/D threshold: Native component is very difficult to restore once the exotic component has eliminated all but the most weedy native species.

LANDSCAPE SPECIFICATIONS

A-rated landscape context: Highly connected, the Element Occurrence (EO) is surrounded by intact natural vegetation, with species interactions and natural processes occurring between the EO and all adjacent communities. The area around the EO is >2000 ha (> 5000 ac) with at least 50% natural vegetation, and the rest some mix of permanent cultural grassland.

B-rated landscape context: Moderately connected, the EO is surrounded by moderately intact natural vegetation, with species interactions and natural processes occurring between the EO and most adjacent communities. The area around the EO is between >800 and 2000 ha (2000 and 5000 ac) with between 20 and 50% natural vegetation, and the rest some mix of permanent cultural grassland and tilled fields.

C-rated landscape context: Moderately fragmented, the EO is surrounded by a combination of cultural and natural vegetation, with barriers to species interactions and natural processes between the EO and many adjacent natural communities. Surrounding landscape area is undefined, but EO is surrounded by between 10 and 20 % natural vegetation

D-rated landscape context: Highly fragmented, the EO is entirely or almost entirely surrounded by cultural vegetation or other urban/suburban/rural land uses. Surrounding landscape area is undefined, but EO is surrounded by <10% natural vegetation.

SIZE SPECIFICATIONS

A-rated size: > 640 ac., *B-rated size:* 160-640 ac., *C-rated size:* 40-160 ac., *D-rated size:* < 40 ac.

Justification for minimum A-rated criteria: This matrix community should occupy extensive areas on the landscape to provide habitat for large fauna, including bison. The A-rated size should, ideally, be set at >10000 ac. However, tallgrass prairie has been reduced to less than 1% of its former extent throughout most its range, and few large examples remain. With this in mind, the A-rated size was originally set low to ensure that remaining EOs contained some spread in rank to assist in conservation planning. Justification for C/D threshold: Edge effects become increasingly problematic for EOs below the threshold, particularly in fragmented landscapes. Edge effects include dust and salts from roadsides, pesticide sprays, and presence of exotic-dominated communities.

Prior to and during early Euro-American settlement in this ecoregion, A-rated size specifications would have exceeded 10000 acres. Thus, the following size specifications may more accurately reflect viability criteria:

A-rated size: > 10000 ac., *B-rated size:* 2000-10000 ac., *C-rated size:* 400-2000 ac., *D-rated size:* < 400 ac.

- proximity of other conservation sites or managed areas to a potential conservation site for a community or system
- connectivity of community to other areas of natural habitat

Geography of Hope Update #5: Ecological Processes and Landscape Patterns ( ) provides a more detailed treatment of these analyses and data sets. Eric Dinerstein and colleagues from World Wildlife Fund (1995) provide similar recommendations for selecting high priority ecoregions in Latin America, but much of their guidance is also useful for selecting conservation sites for communities and ecological systems. Finally, GIS-based suitability indices (Appendix 14) in combination with a computer algorithm-based approach to site selection can be used in the portfolio assembly process to guide the selection of sites away from areas with high road density, high human population density, and high degrees of habitat conversion. Such indices are particularly useful in western U.S., Latin American, and Asia-Pacific landscapes where information on viability of individual target occurrences is limited. Suitability indices have been successfully used by the Columbia Plateau, Middle Rockies-Blue Mountains, and Sierra Nevada ecoregional teams to assess viability in an indirect manner.

▶ *Step 2: Assess the viability of species populations*

Step 2A. *Use Natural Heritage Element Occurrence rank information.* For North American conservation plans with access to Natural Heritage Program or Conservation Data Center information on target species, use Element Occurrence (EO) Ranks (A,B,C,D) to assess viability. In some cases, these ranks will already be available. In other cases, the ranks may have been assigned from now out-of-date criteria and must be updated before application to ecoregional plans. In most cases, the ranks will not be available and will need to be assigned. Ecoregional plans involving multiple states and provinces should strive to ensure that these ranks have been assigned consistently across geopolitical boundaries.

Step 2B. *For situations where no Element Occurrence rank information exists and time/resources are limited, planners should take the following steps:*

- Consult with experts or organize an experts workshop (see Chapter 4) to gain information on the viability of species' populations.

Practical Tips

- ▶ In areas with large numbers of Heritage EO's, planners should eliminate any occurrences for which there is insufficient information to assess viability.
- ▶ Existing EO records with last observed dates prior to 1980 should be eliminated and identified as data gaps; occurrences with ranks of "D" quality should also be eliminated.
- ▶ In many cases, EO's represent metapopulations and may be aggregated into fewer EOS for the purposes of assessing viability.
- ▶ For approximately 500 animal species in North America, specifications on assignment of ranks A-D based upon the criteria of size, condition, and landscape context have already been developed. Contact the Zoology Program, Heritage Operations (lmaster@tnc.org) for accessing these specifications.

- Use the worksheets in Appendix 13 for assigning values to each of the criteria of size, condition, and landscape context, and determine an overall viability rank for each population. In cases where information is extremely limited, use a Pass/Fail (P/F) criterion for whether a population is viable or not. Consider the three factors of size, condition, and landscape context. Work with experts to assign P/F grades to each population of concern. To receive a passing grade, populations must have estimated >50% probability of remaining extant for the next 100 years assuming that reasonable, practical conservation actions take place to safeguard the population.
- Practitioners working in an international setting may find it useful to consult IUCN Action Plans (available on IUCN web site http://www.iucn.org/themes/ssc/index.htm) for endangered, critically endangered, and vulnerable species in order to assess the viability of target species' populations. These plans typically include a Population and Habitat Viability Analyses (PHVAs), a tool developed by the IUCN Conservation Breeding Specialist Group, which focuses on specific factors affecting the status of the population and recommends conservation action.

Step 2C. *For all species targets in domestic planning projects, practitioners should consult, where available, Recovery Plans for those species designated as Threatened or Endangered under the Endangered Species Act by the U. S. Fish and Wildlife Service.* These plans ( ) or recovery team members are often a source of viability information related to population sizes, numbers of populations, and the distribution of those populations for the species to recover from its threatened status.

Step 2D. *Use Population Viability Analyses (PVAs) to assess viability of target species where such analyses already exist or the information, time, and resources of planners allow for PVAs to be performed as part of ecoregional planning.* PVAs are a set of quantitative tools for predicting the likely future status of a population or set of populations of conservation concern. *A Practical Handbook for Population Viability Analyses* ( ) provides the tools and methods necessary for conducting a PVA along with some excellent examples from actual Nature Conservancy conservation planning projects. In addition, Tim Tear of the Illinois Field Office has a computer program for assessing the viability of multiple populations that will also assist planners in determining the number of populations needed based on census data from one population (see).

▶ *Step 3: Assess the viability of aquatic communities and systems*

The considerations of size, condition and landscape context as discussed previously in this chapter all pertain to aquatic targets as well. The mobility of aquatic species merits additional consideration in any viability assessment of aquatic systems. Barriers to movement for biota, such as dams, poor water quality or poor physical habitat should be taken into consideration when evaluating regions for viability. Another distinction is that condition and landscape context are a function of the surrounding landscape and all upstream landscapes. Therefore, planning teams must consider how catchment condition affects species, community and system level target viability analyses.

Depending upon the type of aquatic species, community or system target, planners can utilize a variety of different approaches using expert workshops and GIS analyses for assessing viability in freshwater systems. For coarse-scale targets such as ecological systems, expert knowledge supplemented with information from land use/land cover maps, water quality sampling data, and maps showing hydrological alteration and stream channelization is likely the most practical approach. A number of GIS tools exist to evaluate the land cover/use of stream and lake buffers as well as the cumulative land cover /use of the upstream watershed.

For more detail on types of threats and data sources, see the Threats Guide document (DePhilip 1999). For assessment of finer-scale targets (macrohabitats), a variety of GIS data can be used to develop quality ranks or develop indices such as those of Biotic Integrity (Higgins et al. 1999). Some of the types of information available, depending upon location, for use in GIS analyses are: dam locations, location of levies, stream channelization, exotic species introductions to streams and lakes, biomonitoring indices, water quality measures, sediment loading, proximity to urban area, road density, percentage of converted lands. See Appendix 15 for an example of a viability assessment of aquatic targets.

▶ *Step 4: Document assumptions and future data needs*

With insufficient data to adequately address viability for many if not most target occurrences, planners will be making a number of assumptions. As a result, planners should document those assumptions and identify the most significant data gaps so that future planning efforts can improve upon any viability assessments.

Recommended Reading

Cox, J., R. Kautz, M. MacLaughlin, and T. Gilbert, 1994. Closing the gaps in Florida's wildlife habitat conservation system. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Dinerstein, E. D. M. Olson, D. J. Graham, A. L. Webster, S. A. Primm, M. P. Bookbinder, and G. Ledec. 1995. Appendix A: methods used for assessing the conservation status of terrestrial ecoregion *in* A conservation assessment of the terrestrial ecoregions of Latin America and the Caribbean. The World Bank, Washington, D. C.

The Nature Conservancy. 1999. Element occurrence data standard. Network of Natural Heritage Programs and Conservation Data Centers and The Nature Conservancy, Arlington VA.

Tools

- Anderson, M., P. Comer, D. Grossman, C. Groves, K. Poiani, M. Reid, R. Schneider, B. Vickery, and A. Weakley. 1999. Guidelines for representing ecological communities in ecoregional conservation plans. Conservation Science Division, The Nature Conservancy, Arlington VA. Available at www.consci.org
- Element Occurrence Ranks available in North America from Natural Heritage Programs and Conservation Data Centers (http://www.abi.org)
- DePhilip. M. 1999. (The Threats Guide) Guide to information for assessing quality and threats to biodiversity of freshwater systems. Freshwater Initiative, Conservation Science Division, The Nature Conservancy, Arlington VA. Available at www.consci.org and at http://www.freshwaters.org
- Geography of Hope Update #6. Including aquatic targets in ecoregional portfolios: guidance for ecoregional planning teams. J. Higgins, M. Lammert, and M. Bryer. 1999. Available on the Conservancy's Intranet: http://knowledge. tnc:86/pagewire/newstory/tcp/GoH.htm and at http://www.freshwaters.org (Aquatics and Ecoregional Planning)
- IUCN Species Survival Commission Action Plans (available on IUCN web site http://www.iucn.org/themes/ssc/index.htm)
- Morris, W., D. Doak, M Groom, P. Kareiva, J. Fieberg, L Gerber, P. Murphy, and D. Thomson. 1999. A practical handbook for population viability analysis. Conservation Science Division, The Nature Conservancy, Arlington VA. Available on the Conservancy's at www.consci.org
- Geography of Hope Update #5. Ecological processes and landscape patterns: considerations for ecoregional planning. K. Poiani, R. Myers, J. Randall, B. Richter, and A. Steuter. 1998. Available at www.consci.org
- Recovery Plans for federally listed Endangered Species—see http://fa.r9.fws.gov/r9fwrs/recplan.pdf for list of available recovery plans
- Software programs for Population Viability Analyses. See *A Practical Handbook for Population Viability Analyses* for information on available software programs for estimating viability from census counts over several years and for programs that use more detailed demographic data (RAMAS, ALEX, Vortex).
- Tim Tear (ttear@tnc.org), Illinois Field Office—computer program developed by University of Idaho (Dr. Oz Garton) for assessing the viability of multiple populations.

Chapter 7 Selecting and Designing a Portfolio of Conservation Sites

Objective:

Select and map a portfolio of conservation sites for an ecoregion using the criteria of coarse-scale focus, representativeness, efficiency, integration, functionality, and completeness (see below for definitions).

PORTFOLIO ASSEMBLY

Who: Core team, technical teams, GIS/Data Manager, key partners

Products: Portfolio of Sites, Map of Sites, Alternative Portfolios, Summary of Statistics of Targets Captured and Goals Met.

Background

A number of different criteria have been used in the past to select conservation sites ranging from naturalness, rarity of habitats and species, to diversity (number of species), presence of umbrella or flagship species, and representation. Representation has emerged as a global principle as conservationists strive to establish a representative set of reserves for the world's major ecosystems. This principle is captured in The Nature Conservancy's con-servation goal as articulated in *Conservation by Design*.

As we work to achieve the goals of *Conservation by Design*, our experience in ecoregional planning has enabled us to develop the following principles for assembling a portfolio of conservation sites:

- **Coarse-scale Focus:** The first step in site selection is to represent or "capture" all coarse-scale targets in the ecoregion (including those that are feasibly restorable) in conservation sites followed by targets at finer spatial scales.
- **Representativeness:** Capture multiple examples of all conservation targets across the diversity of environmental gradients appropriate to the ecoregion (e.g., ecoregional section or subsection, ecological land unit, or some other physical gradient).
- **Efficiency:** Give priority in the site selection process to occurrences of coarse-scale ecological systems that contain multiple targets at other scales. Accomplish this through identification of functional sites and landscapes (see box later in this chapter).

Key Questions ?

- How extensive are existing conservation sites and publicly managed lands within the ecoregion? The extent of these lands will influence the process for selecting sites.
- What methods can be used to determine where functional landscape sites remain in the ecoregion?
- What percentage of land within the ecoregion has been converted to a non-natural cover type? The extent of natural land cover will influence the opportunities for site selection and methods used to select conservation sites.
- What GIS capacity does that planning team have for developing, analyzing, and viewing alternative portfolios of conservation sites?
- Who should be involved in the selection of conservation sites?

- **Integration:** Give priority to sites that contain high-quality occurrences of both aquatic and terrestrial targets.
- **Functionality:** Ensure all sites in a portfolio are functional or feasibly restorable to a functional condition. Functional sites maintain the size, condition, and landscape context within the natural range of variability of the respective conservation targets.
- **Completeness:** Capture all targets within functional sites.

In the steps outlined below, we have incorporated these key principles into the guidelines on portfolio assembly. There is no single best way to design a portfolio of conservation sites. Conservation planners inside and outside of The Nature Conservancy are approaching this problem from a number of different angles based upon the data, time, and resources available. In the steps outlined below, we provide a number of recommendations for selecting conservation sites that are intended to be both robust and flexible. For additional guidance in selecting sites, we recommend consulting the following general references in Recommended Reading: Andelman et al. (2000), Noss and Cooperrider (1994), Noss et al. (1997), Pressey et al. (1993).

Two other points about selecting conservation sites need clarification. The first of these concerns what constitutes a **conservation site**[1]. Conservation sites are those areas that maintain the target species, communities, and ecological systems and their supporting ecological processes within their natural ranges of variability (see The Five-S Framework for Site Conservation and box example later in this chapter on functional conservation sites). More often than not, ecoregional plans are identifying **areas of biodiversity significance** and not conservation sites as defined in the site conservation planning process. These areas are being identified in a variety of ways. In some ecoregional plans they represent watershed units that are known to contain important targets. In others, standardized buffer areas have been added with GIS around known occurrences of conservation targets to create conservation sites. The main point is that site boundaries are not being drawn consistently or with the rigor that they would be in addressing threats to conservation targets and developing strategies to abate threats during site conservation planning. This identification of more generalized areas of importance for biodiversity during ecoregional planning is entirely appropriate. We simply need to recognize that "sites" selected during ecoregional planning are usually not the same conservation sites that we end up focusing conservation action on as a result of site conservation planning.

The second point concerns **portfolios of conservation sites** versus **networks of conservation sites**. To date, nearly all of our ecoregional planning efforts have resulted in a collection or portfolio of sites with little consideration about the need for linkages, connections, or juxtaposition among sites. With lands being increasingly fragmented, populations of many target species are also increasingly isolated. The spotted owl situation in the Pacific Northwest is a good example of such fragmentation and isolation. In such cases, flow among and dispersal from populations become inhibited and the normal demographics of populations are disrupted. In the steps below, we make some preliminary recommendations for paying greater attention to the design of true networks of conservation sites in the next generation of ecoregional plans.

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[1] The presumption throughout these Geography of Hope guidelines is that the term "conservation site" refers to "functional conservation sites" as discussed in detail by Poiani and Richter (1999).

Key Steps

▶ ***Step 1: Team assembly***

Assemble an appropriate team of staff and partners that will be involved in selecting conservation sites. This team should include land protection, site conservation planning, government relations, communication, program directors, and state director staff. Interested state chapter trustees, key partners, and some members of the core team responsible for getting the project to this stage may also want to participate.

▶ ***Step 2: Mapping target, ecoregional (section, subsection) information, and ancillary data***

Step 2A. *Map viable and restorable populations and occurrences of conservation targets (species, ecological communities, ecological systems), preferably with a Geographical Information System (GIS).* This step, along with a delineation of ecoregional section and subsection boundaries (and ecological drainage unit and land unit boundaries), should have already been underway or completed concurrently with selecting conservation targets, setting goals, and assessing viability.

Step 2B. *Obtain and map other information relevant to site selection—roads, stream networks (hydrography), topography (Digital Elevational Models), population density, land use data (% converted lands), vegetation maps, locations of existing conservation sites (see Step 3 on conservation lands).*[2] Such information is highly useful in assessing the viability of conservation sites, designing an efficient network of sites, and in stratifying targets and sites across environmental gradients within

Summary of Steps for Portfolio Assembly

Team Assembly
▼
Map Targets & Ecoregional Info and Map Ancillary Data
▼
Land Ownership Assessment
▼
Portfolio Assembly Considerations
▼
Site Selection Process
▼
Alternative Portfolio of Sites
▼
Design a Portfolio of Sites
▼
Evaluate the Portfolio

Practical Tips

- Do as much of the site selection with computers and GIS as possible.
- Spend time up-front getting all the appropriate data ready for a site selection meeting well ahead of time.
- Hold a preliminary meeting where the site selection process is outlined for appropriate staff.
- Have experts for various taxonomic groups meet individually to discuss priority sites before bringing all experts together for a comprehensive site selection meeting.
- Allow plenty of time for the site selection process—it is the most important component of ecoregional planning.

[2] Geography of Hope Updates #5 and #6 on ecological processes and aquatics provide detailed information on additional data layers that can be used in site selection.

Functional Conservation Sites, Landscapes, and Networks

Earlier in these guidelines (Chapter 3), we introduced the concept of biodiversity and conservation targets occurring at multiple spatial scales and multiple levels of biological organization. As a result of this distribution of biodiversity along these two continua, we can describe different types of functional conservation sites. Karen Poiani, Brian Richter, and colleagues have identified three types of functional conservation areas: **functional sites**, **functional landscapes**, and **functional networks**. All functional conservation areas maintain targets and their supporting ecological processes within their natural ranges of variability (amount of fluctuation expected in biodiversity patterns and ecological processes under minimal or no human-influenced activities). The differences among sites, landscapes, and networks are defined by the different conservation targets that each seeks to conserve (see Figure 2, Chapter 3).

A *functional conservation site* aims to conserve a small number of ecological systems, communities, or species at one or two scales below regional. Targets tend to be relatively few and often share similar ecological processes. Many Conservancy preserves were established to protect imperiled local-scale species or communities, and are good examples of functional conservation sites.

In contrast, f*unctional landscapes* seek to conserve a large number of ecological systems, communities, and species at all scales below regional. The conservation targets are intended to represent many other ecological systems, communities, and species (i.e., "all" biodiversity). The distinction between functional landscapes and sites is not always clear cut—the operational difference between the two is the degree to which the conservation targets are used to represent other biodiversity combined with their multi-scale nature.

A functional network is an integrated set of functional sites and landscapes designed to conserve regional species. Portfolios of sites in regions of the country that still support wide-ranging species like the grizzly bear should be based upon functional networks of sites.

Adapted from Poiani and Richter (1999)

ecoregions. See Appendix 14 for an example of a suitability index for selecting sites in the Columbia Plateau ecoregion—an index that employed a variety of ancillary data in innovative ways to indirectly assess the functionality of sites and viability of conservation targets. Similarly, Appendix 6 on Ecological Land Units also uses a number of ancillary digital data sets to help predict the occurrences of communities and stratify the representation across environmental gradients.

▶ *Step 3: Assessing public lands, existing conservation sites, and native American/indigenous lands*

Public lands, existing conservation sites, and indigenous lands play a major role in the conservation of biological diversity. In many ecoregions, these lands contain extensive natural cover and harbor imperiled species as well as many high quality examples of conservation targets. In those ecoregions with extensive holdings of these lands, planning teams should map these areas and determine which conservation targets occur on them. In ecoregions with substantial lands in public ownership and/or existing conservation sites, use these lands as the "seeds" or starting point for portfolio design. Such a design results in efficiencies related to acquisition and management costs of locating new sites adjacent to existing ones and often makes good sense for ecological reasons (e.g., linkages among sites). However, for ecoregions with relatively small proportions of natural cover and small existing numbers of conservation sites or managed areas, such mapping and analysis will likely be of limited value.

Practical Tips for Assessing Public/Indigenous Lands in Portfolio Assembly

1. *For ecoregions with substantial holdings of public lands, existing conservation sites, and/or indigenous lands*, meet with natural resource agency staff and representatives of indigenous communities, explain conservation planning process, and obtain appropriate information on conservation targets and sites. Natural Heritage Programs and Conservation Data Centers will often already have this information in place.

2. *Determine if a Gap Analysis project has been completed or is underway within the planning area.*[3] Usually these projects have already digitized the locations of all public lands within a state including existing conservation sites as well as information on many conservation targets that are contained within these conservation sites. Gap analysis projects are sources of valuable baseline data for ecoregional planning. In addition, the ranking of conservation sites (item 3 below) according to their degree of protection provides valuable information for selecting action sites (Chapter 8). See Appendix 16 for two applications of gap analysis, one domestic from the Columbia Plateau ecoregion and one international example from the Andean region of Colombia.

3. *Assign categories of protection to public lands, conservation sites, and indigenous lands if such rankings do not already exist.* The Gap Analysis Program and the World Conservation Union have devised schemes to rank conservation sites according to their degree of legal protection (Appendix 17).

4. *If a Gap Analysis project has not been conducted, then planners should consider conducting a cursory gap analysis.* This project would determine: a) which conservation targets are already adequately protected within existing conservation sites (focusing only on those conservation sites with the greatest degree of protection as determined in item 3 above), (b) which have some but inadequate levels of representation within existing conservation sites, and (c) which are not represented at all within the existing network of conservation sites. Such an analysis will greatly enhance planners' ability to set priorities and select "action sites" as one of the final steps in ecoregional planning (see Chapter 8).

5. *If extensive indigenous lands occur within the ecoregion, determine best tribal contact and develop effective strategies* for effectively approaching tribes for information on conservation targets and taking actions to conserve those targets (see Appendix 18 for advice and recommendations on working with native Americans).

▶ *Step 4: Portfolio assembly considerations*

Step 4A. *In ecoregions with significant amounts of public land and/or existing conservation sites,* build the portfolio or network from these "seeds," locating as many conservation sites as possible on public lands and as close as possible to existing conservation sites.

Step 4B. *Consider using computer algorithms as tools to assist the site selection process.* The process of selecting sites is a complex one, often involving several hundred conservation targets and potentially hundreds of conservation sites. Computer-algorithms for site selection simplify this process. One such algorithm—SITES (see box)—has been designed specifically for TNC ecoregional planning teams and is available on CDROM (with a detailed user manual) from the Boise Conservation Planning Office. Remember that such site selection algorithms are tools to aid

[3] See Scott et al. (1993) reference in Recommended Reading for more information on Gap Analysis and visit the Gap Analysis Web site at www.gap.uidaho.edu

SITES–A Practical Site Selection Computer Program for TNC Ecoregional Planners.

A number of different types of algorithms have been developed for selecting conservation sites. A limitation of many of these is their usefulness beyond the project for which they were initially designed. The Nature Conservancy contracted with the University of California, Santa Barbara, and the National Center for Ecological Analysis and Synthesis to develop a site selection program that would be sufficiently robust and flexible to the wide variation in quality and quantity of data of Nature Conservancy ecoregional plans. SITES is an optimization model that can be viewed as a cost function whereby:

Cost = Area + Species (i.e., target) Penalty + Boundary Length

Cost is the objective of the model and the model attempts to minimize the cost variable. In this case, cost is a portfolio of conservation sites. **Area** refers to the total area needed in conservation sites to capture the conservation targets at the specified representation goals. **Species penalty** refers to the fact that there is a penalty in the model for not meeting the specified representation goals. Without the species penalty factor, SITES weights all conservation targets equally. With the penalty factor, teams can place greater emphasis on meeting the goals for one set of targets over another set. **Boundary length** controls the spatial layout of the portfolio. By setting this factor either relatively low or high, planning teams can favor a highly dispersed set of conservation sites or a more aggregated set of sites.

SITES uses a mathematical technique called simulated annealing to select a portfolio of conservation sites. Possingham et al. (1999) provide more details on simulated annealing and contrast it with heuristic and linear programming models. Data are input to SITES via text files. As a result, any number of database or spreadsheet software packages can be used to input data into the model provided that the data are converted to text files. Outputs from the model are best viewed in ARCVIEW or ARCINFO. A proficient user of ARCVIEW who has also had some minimal experience with database management and spreadsheet software should have no problem using SITES. Both the Middle Rockies-Blue Mountains ecoregion and the Sierra-Nevada eco-region teams have used SITES as a tool in site selection.

If you are interested in using SITES in your planning process, contact The Nature Conservancy's Conservation Planning Office in Boise, Idaho, at lvalutis@tnc.org.

planners—they are not meant to replace the common sense and knowledge of seasoned conservation practitioners and scientists. Any results of site selection algorithms should be carefully reviewed and fine-tuned by the planning team that has on-the-ground knowledge of conservation targets and sites. In ecoregions with relatively small numbers of targets and limited conservation opportunities, the benefits of using computer-based tools for site selection will be reduced.

Step 4C. *Consider using a standardized unit such as a grid system, EPA hexagon, or watershed unit (HUCs) as a first approximation for identifying areas of biodiversity significance.* Such units make organization of data more efficient and consistent, and lend themselves well to GIS analyses such as identification of roadless blocks of habitat. Ecological Land Units as employed by the Central Appalachian ecoregional team and others can serve a similar purpose.

▶ *Step 5: Site selection process*

For planning projects not using a computerized algorithm as an aid, the following steps should be followed in selecting a portfolio of sites.

Step 5A. *For ecoregions with substantial amounts of public land and existing managed areas, first select functional conservation sites that occur on public lands and use existing managed areas as "seeds" from which to build the initial portfolio (see Step 6).*

Step 5B. *Next select those sites that contain viable coarse-scale conservation targets (e.g., matrix communities)*. Wherever possible, select sites that contain both aquatic and terrestrial targets and sites that contain targets at multiple spatial scales and levels of biological organization. Special guidance for designing portfolios that capture aquatic community and system targets is provided in *Geography of Hope Update # 7* ( ) and an illustrative example is given in Appendix 19.

Step 5C. *Capture these targets (from 5B) in multiple sites across environmental gradients in the ecoregion (until conservation goals are met) by using Ecological Land Units (ELUs), Ecological Drainage Units (EDUs), and/or ecoregional sections and subsections.*

Step 5D. *Select functional conservation sites containing intermediate-scale targets (patch communities and systems, intermediate-scale species) and capture these targets across environmental gradients.*

Step 5E. *Select sites containing local-scale targets that have not been captured in previous steps.*

Step 5F. *Re-examine portfolio to ensure that all viable occurrences of conservation targets have been represented in functional conservation sites to the greatest extent practical.*

▶ ***Step 6: Evaluate alternative portfolios of sites in planning areas where options for the locations of conservation sites still exist***

Such alternatives can be developed by placing greater or lesser emphasis in portfolio assembly on certain factors (e.g., locate conservation sites near existing conservation lands, or bias the portfolio towards private lands). Evaluating the tradeoffs between different portfolios will most efficiently be accomplished with GIS and computerized site selection algorithms. In ecoregions with limited lands remaining in a natural condition, this step may not be useful.

▶ ***Step 7: Design a network of conservation sites (optional)***

Step 7A. *Establish corridors among sites for conservation targets that require such areas for dispersal and movement. Utilize focal species to help design corridors and linkages (see Targets chapter).* See Beier and Noss (1998) and Soule and Terborgh (1999).

Step 7B. *Where options exist, locate new conservation sites as close as possible to existing conservation sites or to lands that remain in a natural (non-converted) condition.*

Step 7C. *Where options exist, bias the design of the network to include as many functional landscape sites as possible, especially those that contain a variety of targets at multiple spatial scales.*

Step 7D. *Consider the impact of global climate change on portfolio design (see box below).*

▶ *Step 8: Evaluate the portfolio*

Once the portfolio has been designed, planners should assess how well the conservation sites function in meeting the goals set forth for the targets at the beginning of the planning project. These analyses are best done separately for plants, vertebrates, invertebrates, and communities and ecological systems. Data should be portrayed as percentage of targets for which goals were met. Such analyses inform data gaps and indicate where the portfolio is weak. More importantly, these analyses should direct teams to undertake additional inventory for the most important data gaps and to give thoughtful consideration to which targets may be appropriate and feasible for restoration efforts in the ecoregion.

Global Climate Change and the Selection of Conservation Sites

- Select replicate conservation sites for each community or ecological system.
- Select sites with the greatest habitat diversity—sites should be as large as possible; have as much altitudinal and latitudinal variation as possible; and should maximize variation in climatic, edaphic, and hydrologic features.
- Transition areas between major vegetation types should be located at the core of sites.
- Coastal sites should be large enough to buffer against potential rising sea levels.
- Buffer zones should be established around all conservation sites to maximize management options.
- Connective corridor systems should be established between sites and sites should be located in close proximity to maximize dispersal.

Adapted from Halpin (1997)

Tools

- Gap Analysis National Program Web Page (www.gap.uidaho.edu) for information on what types of data are available for various state gap analysis projects.
- Geography of Hope Update # 5. Ecological processes and landscape patterns: considerations for ecoregional planning. K. Poiani, R. Myers, J. Randall, B. Richter, and A. Steuter. 1999. Available at www.consci.org
- Geography of Hope Update #6. Including aquatic targets in ecoregional portfolios: guidance for ecoregional planning teams. J. Higgins, M. Lammert, and M. Bryer. 1999. Available at www.consci.org
- SITES Site selection software developed by Sandy Andelman, Frank Davis, and Ian Ball at the National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara. Available from Director of Conservation Planning, Conservation Science Division, The Nature Conservancy Arlington VA. Available from the Boise Conservation Planning Office, contact Laura Valutis at lvalutis@tnc.org.

Recommended Reading

Andelman, S. J., W. Fagan, F. Davis, and R. L. Pressey. 2000. Tools for conservation planning in an uncertain world. BioScience: in press.

Beier, P. and R. F. Noss. 1998. Do habitat corridors provide connectivity? Conservation Biology 12:1241-1252.

Halpin, P. N. 1997. Global climate change and natural area protection: management responses and research direction. Ecological Applications 7:828-843.

Noss, R. F. and A. Y. Cooperrider. 1994. Chapters 4 and 5–Selecting reserves and designing reserves networks in Saving nature's legacy: protecting and restoring biodiversity. Island Press, Washington, D. C.

Noss, R. F., M. A. O'Connell, and D. D. Murphy. 1997. Chapter 6 a framework and guidelines for habitat conservation *in* The science of conservation planning: habitat conservation under the Endangered Species Act. Island Press, Washington D. C.

Poiani, K. and B. Richter. 1999. Functional landscapes and the conservation of biodiversity. Working Papers in Conservation Science No. 1, The Nature Conservancy, Arlington, VA.

Possingham, H., I. Ball, and S. Andelman. 1999. Mathematical methods for identifying representative reserve networks. Chapter 16 in S. Ferson and M.A. Burgman, editors. Quantitative Methods for Conservation Biology. Springer-Verlag, NY.

Pressey, R. L., C. J. Humphries, C. R. Margules, R. I. Vane-Wright, and P. H. Williams. 1993. Beyond opportunism: key principles for systematic reserve selection. Trends in Ecology and Evolution 8:

Scott, J. M., F. Davis, B. Csuti, R. Noss, B. Butterfield, C. Groves, J. Anderson, S. Caicco, F. D'Erhia, T.C. Edwards, J. Ulliman, and R. G. Wright. 1993. Gap analysis: a geographic approach to the protection of biodiversity. Wildlife Monographs 123:1-41.

Soule, M. E. and J. Terborgh. 1999. Continental conservation: scientific foundations of regional reserve networks. The Wildlands Project, Island Press, Washington, D. C.

Chapter 8 Taking Conservation Action

Objective:

To conduct a cursory threats assessment for targets at sites, to assess whether recurring threats across the ecoregion can be abated by any multi-site strategies, identify those strategies and how they can be implemented, and select 10-year "action" sites based on the criteria of complementarity, conservation value, threats, feasibility, and leverage. Action sites (platform sites in LACR national portfolios) are those sites in ecoregional portfolios where The Nature Conservancy will take conservation action.

SELECTING ACTION SITES

Who: Core team, sponsor, state directors, implementers

Products: Cursory Threats Assessment, List of Action Sites and Landscape-Scale Sites, Multiple Strategies

Key Questions

- What information is available to conduct a cursory threats assessment for targets on sites in an ecoregional plan?
- Which sites in the portfolio face the most urgent threats? Are there sites in the portfolio where abating threats is not feasible? Are there sites where taking conservation action may lead to other conservation opportunities?
- Are there threats to targets that repeat themselves across several or many sites in the ecoregion? Are there strategies that can be identified and implemented to abate these multi-site threats?
- Are there other agencies/organizations that could take the lead role at some of the sites identified in the portfolio?

Background

Experience to date suggests that many ecoregional portfolios will contain over 100 important conservation sites that may occupy up to as much as 40%-50% of the ecoregion. These daunting statistics help make two important points. First, The Nature Conservancy or its partners will only work at some percentage of these places. Consequently, it will be especially important, nationally and internationally, for the Conservancy to work with all sectors of the conservation community at large to achieve conservation at an ecoregional scale. Second, given the large number of important sites and limited conservation resources, it is imperative that we set priorities concerning which sites are the most important places to work first. In this chapter, we outline a qualitative procedure for setting priorities based upon the criteria of conservation value, complementarity, threats, feasibility, and leverage. Once these priorities have been established, more detailed site conservation plans for each site will critically analyze threats and develop strate-gies for abating these threats. The methods for site conservation planning are detailed in *The Five-S Framework for Site Conservation.*

An important component of setting priorities among sites in the portfolio is conducting a cursory threats assessment of threats to targets at each site in the portfolio. The operative word here is *cursory* as the more detailed assessment of threats is most appropriately conducted as part of the site conservation planning and measures of success component of the conservation process. As part of this threats assessment, ecoregional planning teams are urged to determine which threats recur to targets across the ecoregion and identify multi-site strategies that could abate these threats. Although identification of multi-site threats and strategies is an optional part of ecoregional planning (not a standard), many teams to date have found this to be a useful activity.

Key Steps

▶ ***Step 1: Assemble a team to conduct a threats assessment, identify potential multi-site threats and strategies, and select action sites in the ecoregional portfolio***

This team (often referred to as an implementation team) should consist of staff members who are knowledgeable of the sites, the threats to the sites, and potential capacity and strategies to conserve portfolio sites. Such staff might include state and country program directors, directors of conservation programs, land protection staff, government relations staff, directors of development, and representatives of the core planning team who created the portfolio of sites.

▶ ***Step 2: Conduct a cursory threats assessment for each site in the portfolio***

The primary purpose of a threats assessment at the ecoregional scale is to assist in setting priorities for action among all the potential conservation sites. In addition, a cursory threats assessment may eliminate a small number of sites from the portfolio where abatement of threats does not seem feasible and it will aid in identifying threats which recur at multiple sites. A more detailed threats assessment with a ranking of stresses, sources of stress, and identification of critical threats is conducted as part of the site conservation planning and the measures of success process.

Step 2A. *For each conservation site in the portfolio, rank the overall threat to the site as High, Medium, or Low.* The overall threat ranking is a *gestalt* ranking by the project team, taking into account the varied targets at the sites and the varied threats to the targets. Because some conservation sites will have many targets, teams are encouraged to select a representative subset of targets that occur at different spatial scales and levels of biological organization for the purposes of identifying critical threats. Threats to ecological systems and to globally imperiled targets should be given the greatest consideration in determining the overall threat ranking.

The overall threat ranking encompasses two factors:

- **Is the threat critical?** A critical threat is defined as one that is likely to destroy or seriously degrade conservation targets at many or most places within the conservation site where it occurs. Each threat is really a combination of a stress to a conservation target (the impairment or degradation of the size, condition, or landscape context) and the sources of that stress, that is the agent(s) causing the destruction or degradation of the target. For example, nutrient loading is a stress to many aquatic systems but it can have many sources (farm fertilizers, feed lots, septic systems, urban runoff). Appendix 20 provides illustrative lists of stresses and sources of stresses (these same illustrative lists are used in the site conservation/measures of success process). Each identified threat should be listed as a source of stress (e.g., incompatible residential development, incompatible grazing practices, exotic species invasion).

- **Is the threat urgent?** In ranking portfolio sites for Conservancy action, urgency is an important variable. All else being equal, if a critical threat is likely to affect the site within the near future, then the need for action is greater than if the threat is more distant in time.

Step 2B. *For any sites with a High threat rank, list the critical threats of high concern.*

Step 2C. *For each critical threat identified in the entire portfolio, prepare a summary table* or tables which details the sites affected by the threat, the total number of sites affected, and the percentage of sites in the portfolio affected by the threat. This analysis will enable the team to identify threats that recur across many sites in the ecoregion and to develop multi-site strategies for abating these threats (Step 3).

▶ *Step 3: Evaluate the portfolio of sites for strategic conservation action*

The purpose of this step is to look at the whole portfolio and identify what actions might contribute to making substantial progress towards (1) the long-term abatement of urgent threats and/or (2) the sustained maintenance or enhancement of biodiversity health at the greatest number of sites. This step precedes the setting of priorities and ensures that the team does not miss the opportunity to look across the entire portfolio to identify the high-leverage activities it might execute.

Step 3A. *Determine if there are similar threats to targets that recur at many sites across most or all of the ecoregion.* This threats information should be available from step 2 above. See Appendix 21 for a framework from the AZ-NM Mountains ecoregion for identifying multi-site threats.

Step 3B. *Consider and evaluate potential strategies that might abate threats at multiple sites.* Teams should first discuss potential strategies, and then evaluate them based on the following factors:

Benefits

- Potential for the strategy to impact many sites
- Degree to which the strategy is likely to reduce the critical threat

Probability of Success

- Availability of a lead individual, lead institution and/or potential partners for implementing the strategy
- Ease and lack of complexity in implementing the strategy
- Availability of financial resources

Cost

- Cost of implementing the strategy in terms of discretionary resources

Teams should look for strategies that produce high benefits, with reasonable probability of success, for a reasonable investment of discretionary resources.

Step 3C. *Assign responsibility for developing and implementing any viable multi-site strategies.*

- Consider at what scale the strategy should be implemented (state, ecoregional, regional, national)
- Determine lead responsibility. Further strategy planning and implementation responsibility should be vested in a designated lead individual and institution. That lead person/institution may or may not be a member of the ecoregional implementation team. The team itself may or may not play a continued role as a group in developing the strategy. If a lead individual and institution is not readily available to implement the strategy, the ecoregional plan sponsor should be assigned responsibility to explore the strategy further and determine potential for taking action.

Steps 4 and 5: Selecting Action Sites

The Conservancy's domestic goal is to conserve 2500 sites in the United States over the next 10 years, with a special emphasis on 500 landscape-scale projects. ***Landscape-scale projects*** (referred to as landscape action sites) include both *functional landscapes* (which conserve targets at all scale, including ecological systems) as well as *large functional sites* (which require a large spatial area to maintain the processes needed to conserve a target species or community). *On average*, each U.S. ecoregional planning team needs to select approximately 40 ten-year action sites, including approximately 8 landscape action sites, to meet the ten-year goal. In reality, the number of sites and new projects undertaken by field offices within each ecoregion will depend on staff capacity, fundraising capability, urgency of threats, and other factors.

Criteria to be considered during the "action site" selection are complementarity, conservation value, threats, feasibility, and leverage.

Complementarity—the principle of selecting action sites that complement or are "most different" from sites that are already conserved. We can define sites that are already conserved as those with targets that have high biodiversity health (as measured by size, condition, and landscape context) and low threat rankings.

Conservation Value—a criterion based upon the number, diversity (scale, aquatic/terrestrial), and health of conservation targets.

Threat—a criterion based on the presence/absence of critical threats.

Feasibility—the staff capacity of TNC and partners to abate threats, the probability of success, and the financial costs of implementation.

Leverage—ability to affect conservation at other sites by undertaking conservation action at one site.

Generally, complementarity and leverage are only considered at landscape action sites. Conservation value, threats and feasibility are relevant for evaluating all action sites. Therefore, a two-stage process is suggested for selecting action sites—using a set of two slightly different evaluation tools. First, a set of landscape action sites is selected; then the remaining sites are chosen. The most current and evolving Excel program with worksheets for conducting this analysis is available from the Boise Conservation Planning Office ( ).

▶ *Step 4: Evaluate Landscape Action Sites*

Landscape action sites are distinguished from other action sites by their large spatial scale and the need for a dedicated, full-time project director. These sites are geographically large—they are functional conservation sites (including, but not necessarily limited to functional landscapes) that have: 1) coarse-scale conservation targets, or 2) intermediate or local-scale targets with sustaining processes that operate at a coarse scale. The large geographic scale and the complex conservation situation that usually accompanies large size are what dictate the need for a full-time project director. These sites include all portfolio sites with ecological systems or other coarse-scale targets, as well as all sites where a large spatial scale is required to sustain processes for a smaller-scale target (e.g., watershed required to conserve rare mussels).

Step 4A. *Determine which sites, if any, are already conserved.* We define sites that are already conserved as those with targets that have **high biodiversity health** (as measured by size, condition, and landscape context) *and* have a **low threat** ranking. For example, a federal wilderness area might conserve one or more coarse-scale targets. Because of its strong conservation status, this site, in effect, would be "taken off the table" as a potential Conservancy action site. Like emergency room doctors, the Conservancy must practice triage—we will not focus on those sites that are in good health and have low threat, nor will we work at sites that are not viable. Instead we will focus our efforts on those sites where we have a chance to make a difference.

Step 4B. *Assign value of complementarity to each site not already conserved.* Use the coarsest-scale target (e.g., an ecological system, community, or wide-ranging species) as possible to make this assignment. For example, any site containing a target of a subalpine fir-spruce ecological system in the western U.S. would be assigned to Tier 3 because several examples of these systems are already conserved in national parks and wilderness areas.

- Tier 1 = No occurrence of a coarse-scale target is conserved or designated as a TNC action site with the ecoregional section or subsection
- Tier 2 = One occurrence of the coarse-scale target is currently conserved or has been designated as a TNC action site within the ecoregional section or subsection
- Tier 3 = Two or more occurrences of the coarse-scale target are currently conserved or have already been designated as a TNC action site within the ecoregional section or subsection

Note: Complementarity must be evaluated iteratively. As one site is selected as an action site, the Tier rank for other sites with similar targets in similar ecoregional sections will change. The Excel worksheet makes the iterative evaluation an easy task.

Step 4C. *Assign targets value to each site.*

- High = relatively large number of targets relative to other sites in the ecoregion, *and* both

terrestrial and aquatic targets, *and* targets at different spatial scales
- Medium = moderate number of targets relative to other sites in the ecoregion, *or* both terrestrial and aquatic targets *as well as* targets at different spatial scales
- Low = low number of targets relative to other sites in the ecoregion, *or* both terrestrial and aquatic targets, *or* targets at different spatial scales

Step 4D. *Assign biodiversity health value to each site.*
- High = Targets with very good biodiversity health based upon their size, condition, and landscape context
- Medium = Targets have good biodiversity
- Low = Targets have fair or poor biodiversity health

Step 4E. *Assign threat value to each site with threat rankings from Step 2A.*
- High = critical threat now exists or is likely to exist within 2-4 years
- Medium = critical threat likely to exist within 5-10 years
- Low = a critical threat not likely to exist within 10 years

Step 4F. *Assign feasibility value to each site.*
- High = Conservancy or partners have capacity to implement strategies to abate the critical threat, and there is reasonably high probability of success, and the strategies can be implemented at reasonable costs
- Medium = uncertain capacity, or medium probability of success, or high costs
- Low = capacity unlikely to exist in 10 years, or probability of success low, or very high costs

Step 4G. *Assign leverage value to each site.*
Most sites should be assigned the default value of Tier 3 unless there is good, persuasive information for assigning a higher ranking.
- Tier 1 = high, clearly specified, demonstrable leverage for building partnerships, tools or funding to conserve other sites with plans and capacity in place to capitalize on this leverage
- Tier 2 = potential leverage to build partnerships, tools, or funding to conserve other sites
- Tier 3 = no clearly specified, demonstrable leverage

To select landscape action sites, the team setting conservation priorities should address the following questions:
- Does a project director exist, or will it be possible to hire one?
- Will it be possible to assemble a multi-disciplinary project team?
- Does an experienced practitioner exist to mentor the project or is there a similar project from which lessons can be learned?
- Does adequate funding for operations and implementing strategies exist or can it be raised?

Step 4H. *Synthesize all criteria to determine action sites.*

▶ ***Step 5: Evaluate Other Action Sites***

These sites include all other portfolio sites not considered in Step 4. A similar evaluation process (but not including complementarity and leverage) is used.

Step 5A. *Determine which sites, if any, are already conserved.*

Step 5B. *Assign targets value to each site.*

- High = relatively large number targets relative to other sites in the ecoregion, *and* globally imperiled targets (G1 or G2)
- Medium = moderate number of targets relative to other sites in the ecoregion, *or* globally imperiled targets
- Low = low number of targets relative to other sites in the ecoregion; no globally imperiled targets

Step 5C. *Assign biodiversity health value to each site.*

Step 5D. *Assign threat value to each site.*

Step 5E. *Assign feasibility value to each site.*

Step 5F. *Synthesize all criteria to determine other action sites.*

▶ ***Step 6: Track the status of all sites in the ecoregional portfolio, initiate site conservation planning and strategic conservation actions at top priority action sites, implement multi-site strategies if applicable, and monitor progress of the ecoregional plan***

Step 6A. *Assign responsibility for tracking the status of each site in an ecoregional portfolio to an individual staff person in state field offices, country programs, or partner organizations.* Action site status will be assessed through the application of corporate Measures of Success (Biodiversity Health, Threat Abatement). For all other sites, these assignments should be made to staff at all levels in any program, thereby engaging as many staff as possible in our conservation work. Each non-action site should be checked at least annually in a cursory fashion to assess threats or change in status of conservation targets. In the future, the Conservation Planning Program of the CS Division will develop some simple standardized guidelines and forms for these annual check-ups of non-action sites in the portfolio.

Step 6B. *Initiate site conservation planning process on highest priority action sites.* Details for this process are provided in the companion document, *The Five-S Framework for Site Conservation.*

Step 6C. *Implement multi-site strategies, if applicable.*

Step 6D. *Establish a schedule for meeting to monitor progress of implementation of the ecoregional plan including progress on action sites, multi-site strategies, and tracking of status of all sites in the portfolio.* Incorporate these tasks into annual strategic plans of chapter and country programs and individual job objectives. Appendix 22 provides an example of steps being taken to implement the Central Shortgrass Prairie Ecoregional Plan.

Tools

- Excel worksheets and software program for selecting action sites. The most current and up-to-date version is available from the Boise Conservation Planning Office and on the Conservancy Intranet site by going to: Conservation Science, Departments, Conservation Planning, Resources, Tools.

Chapter 9 Project Completion, Planning for the Future

Objective:

Complete a draft ecoregional plan, obtain final peer review of plan by attending a Roundtable Discussion/ Peer Review meeting on ecoregional planning, document major data gaps, make revisions to plan as necessary, and make copies of the plan available via printed versions (CD-ROM optional) and posting on the Conservancy's website.

PROJECT COMPLETION

Who: Core team, sponsor, state directors, implementers

Products: Peer-reviewed Document, Identified Data Gaps & Research Needs, National & International Roll-up Information

Key Questions

- Did the plan adhere to the standards outlined at the beginning of these guidelines? If not, where did it fall short and why?
- What critical suggestions did peer reviewers make that should be addressed in revisions of a "final" version of the ecoregional plan?
- What are the major data gaps that should be filled over the next several years before undertaking an updating of the plan? What methodological improvements could be made in future versions of the plan?
- What project management and scientific lessons were learned from this planning project that will allow for future improvements in the plan and planning process?

Background

The most difficult aspect of most projects is simply bringing them to a close. The Conservancy has implemented a process to aid in bringing ecoregional planning projects to a close. Each ecoregional plan must be presented at a Roundtable Discussion/Peer Review meeting where it will be reviewed by Conservancy peers. Following these meetings, teams are expected to revise their plan and make a "final" version available to Conservancy colleagues and audiences outside the Conservancy as appropriate. The tentative use of the word *final* here signifies the dynamic, iterative nature of ecoregional plans. In one sense, no plan is ever final because there will always be new information and improved methods that will necessitate revising and updating the plan. On the other hand, these projects do need to come to a close so that staff can move on to other important work and have the satisfaction of a completed product. Our hope is that teams will take steps to ensure that the product of these planning efforts are completed versions but never finalized plans set in stone. The best plans will be adaptive tools that remain useful to conservation practitioners for years to come, not 2-inch thick documents destined to collect dust on shelves.

Key Steps

▶ ***Step 1: Attend a Roundtable Discussion/Peer Review meeting and make a presentation on the draft ecoregional plan***

Provide national or international roll-up information to the Conservation Planning Program office as requested in Appendix 11. International staff will be asked to attend similar Country Strategy Roundtable meetings.

▶ ***Step 2: Revise the draft ecoregional plan with peer review comments and prepare a "final" version of the plan for distribution to various audiences***

Consider making a CD-ROM version of the plan available to interested parties. Submit 10 copies of the plan to the Boise Conservation Planning Office and prepare a digital version of the plan suitable for posting on the Conservancy's intranet site. See Appendix 23 for guidance on preparing a plan for posting on the Conservancy web site.

▶ ***Step 3: Ensure that the most significant data gaps and methodological shortcomings have been identified and plans are underway to fill those gaps prior to any substantial revisions to the plan***

▶ ***Step 4: Archive and document data sets used in the planning process per recommendations in Chapter 4 of these guidelines***

▶ ***Step 5: Document the most significant project management and technical lessons learned during the planning process***

Chapter 10 The Road Ahead: Future Challenges in Ecoregional Conservation

There are two hurdles to successful conservation planning at large scales like ecoregions. The first is technical in nature, and some of the more important technical challenges that we will address in the second generation of ecoregional plans are articulated below. The second hurdle is organizational —how do we create credible plans that outline the path to mission success yet don't turn The Nature Conservancy into a *planning* instead of *doing* organization. In this second edition of *Designing a Geography of Hope*, we've done our best to strike that balance. The fact is, the Nature Conservancy has, since 1970, used a systematic approach to selecting conservation sites. As we have grown and the job of conserving biological diversity has grown more difficult and complex, so too has the task of conservation planning. We are now the world's largest and wealthiest conservation organization. As such, we are better positioned than ever to have a major impact and influence on the conservation of the world's biological diversity. To do so, however, we must spend resources wisely by ensuring that we and the conservation community at large are taking action in the right places. In that context, developing and implementing ecoregional plans with these guidelines is both smart and strategic.

How much is really enough?

One of the most significant nuts to crack in ecoregional planning is addressing the question of how much is enough. Answering this question inherently involves setting goals for targets and assessing the probabilities of long-term persistence for these targets. Determining how many populations are needed over what size of an area remains one of the greatest challenges in conservation planning, yet also one of the most important ones. Making these same determinations for ecological communities and systems is equally compelling and imperative.

Will there ever be enough information?

Biological inventories will never be complete for any part of the world. This void represents a particularly acute problem in the freshwater and marine systems. Consequently, we will always need to rely to greater or lesser extents on surrogates for species conservation. In the terrestrial realm, research that combines biological inventories with remote-sensing approaches is sorely needed to evaluate the relative efficacy of using ecological communities and ecological systems at different levels and scales as "coarse filters" to capture and represent species, both common and uncommon, known and unknown. In the aquatic world, we must further refine the classification of environmental or biophysical units and assess how well these units perform at capturing biological diversity.

Designing True Networks of Conservation Sites

Although a number of sophisticated and useful algorithms have been developed for selecting conservation sites, only minimal progress has been made in designing these sites into an actual network with appropriate levels of connectivity among conservation sites. Similarly, linking adjacent planning efforts through rangewide assessments of some of the more critical conservation targets will add to the credibility and power of these plans. A second generation of planning efforts should attempt to remedy the many inconsistencies in target selection and goal setting across ecoregional plans.

Managing Data and Information

Archiving, managing, and sharing data and information generated by regional planning efforts is an effort worthy of far more attention than has been given it in The Nature Conservancy's initial planning efforts. The cost of not doing so is an inevitable reinvention of the wheel as costly data sets are lost or poorly documented. Measuring our conservation success in attaining the conservation goals detailed in regional conservation plans will be nearly impossible without adequate management of the information that goes into these plans. In the age of the Internet and websites, we should be striving to make as much information as possible on targets, goals, and conservation sites available in a consistent and useable format to colleagues and partners who will put it to good use in achieving conservation. Given the formidable conservation challenges that conserving sites in these ecoregional portfolios represents, we have everything to gain by sharing data and results of our planning efforts in a compelling manner to the conservation community at large.

Building Consensus

John Prendergast, a conservation biologist who focuses on the theory and tools behind the selection and design of nature reserves, has wondered aloud as to why these tools and theory are put to such little use by conservation practitioners and managers. In the United States, the answer likely lies in the fact that there is little consensus among government agencies that an ecologically representative group of conservation sites is a necessary or sufficient strategy to conserve biological diversity. Without such consensus, tools and theory for achieving such a design, much less implementing a plan based on it, will be less useful than they otherwise could be. Although The Nature Conservancy will use the results of these planning efforts to the greatest extent possible, the conservation needs and demands of the 21st century extend far beyond the capacity of this organization. The challenge then, is to demonstrate and convince managers, politicians, policy makers, and other interested conservation organizations that conserving networks of conservation sites is both prudent and necessary.

Making Tough Decisions

Ecoregional conservation plans have revealed several important insights as to the magnitude of the challenge of conserving biological diversity. In regions where much of the landscape remains in a relatively natural state, up to 50% of the land will need to be under some type of conservation management to avoid future species losses. In regions where much of the landscape has been fragmented or converted, restoration will be a necessary strategy to conserve many of the native species and systems. What is "feasibly restorable" and what is not are critical questions to conservation success. In a number of cases, the conservation community must concede that it will not be possible to restore lost or highly endangered species or ecological systems everywhere. One of the most significant challenges will be making those concessions and decisions to spend precious conservation dollars where they will have the greatest impact.

Recommended Reading

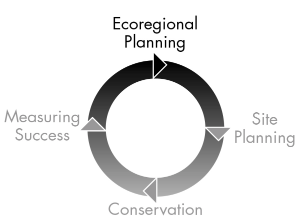
Prendergast, J. R., R. M. Quinn, and J. H. Lawton. 1999. The gaps between theory and practice in selecting nature reserves. Conservation Biology 13:484-492.




Designing *a* Geography *of* Hope




A Practitioner's Handbook to Ecoregional Conservation Planning



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The Nature Conservancy®
Saving the Last Great Places

Designing a Geography of Hope:

A Practitioner's Handbook for Ecoregional Conservation Planning

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Table of Contents

Volume I – Practitioner's Handbook

Volume II – Appendices

Appendix 1 Maps and Ecoregions

United States Map *(Figure A28-2 in Appendix 28)*

Because of its scientific consistency and hierarchy of spatial scales, The Nature Conservancy selected Robert Bailey's U.S. Forest Service ECOMAP framework as the base map for Conservancy ecoregional planning efforts across the United States.

The Bailey map continues to be modified for ecological and institutional reasons. First, based on information compiled by Conservancy scientists and the Natural Heritage/Conservation Data Center network, several ecoregional boundary lines were modified or added to make the ecoregional units more homogenous in terms of representative vegetation cover types, physiographic units and ecological processes. Second, some modifications in the size and boundaries of ecoregional units were made to better align these units with Conservancy institutional capabilities. Ecoregional teams developed preliminary names for the ecoregions based on ecological, geographic and cultural characteristics of the region (see Appendix 2).

The ecoregional map for Alaska continues to evolve. The boundaries of its ecoregions are being determined based on data gathered at an experts workshop held in the spring of 1999. The resulting map will be a combination of the ECOMAP and U.S. Geological Survey map and will align with Canadian ecoregions.

United States Coastal Marine Environment

Biogeographic boundaries for the nearshore waters of the United States have been most clearly delineated by NOAA (see Appendix 24). This system is used by most federal agencies involved in the marine environment (e.g., NOAA, EPA, USGS, and MMS). Because the biogeography of marine organisms is not constrained by terrestrial considerations, terrestrial and marine ecoregions are not necessarily aligned.

Latin America *(Figure A28-3 in Appendix 28)*

Conservation planning for the large number of ecoregions in Latin America presents serious challenges. In most cases, The Nature Conservancy and its partners use the ecoregional map developed by the World Wildlife Fund/World Bank (Dinerstein *et al.* 1995). However, these ecoregional boundaries are primarily being used within countries to develop national portfolios of conservation sites. Along the border with the United States, rectifying the boundaries of Bailey's U.S. map and the World Wildlife Fund map continues.

Coastal Ecoregions of Latin America and the Caribbean *(Figure A28-4)*

In 1997, The Nature Conservancy's Florida and Caribbean Marine Conservation Science Center at the University of Miami, led a project aimed at delineating and ranking coastal ecoregions in Latin America and the wider Caribbean. This framework and the subsequent exercise of setting priorities were developed with the contribution of 26 experts on marine science and fisheries. Nine Coastal Biogeographic Provinces were delineated based on climate, ocean circulation, coastal geology, and geomorphology along the Pacific, and Atlantic coasts of the study area. A second level of biogeographic division, the Coastal Biogeographic Region (or Marine Ecoregion) was conducted within each Province. It was based on smaller-scale physical attributes such as ocean gyres and eddies, upwelling occurrence, coastline features and shelf width, as well as the distribution of major biological populations (fish, coral, algae, mangrove, invertebrates). In some cases, the country boundaries were ultimately used for segregating marine ecoregions. For both the province and the ecoregion the 200-mile Exclusive Economic Zone was taken as the seaward limit, recognizing that this is the extent of the country jurisdiction upon marine resources.

Canada *(see Figure A28-2 with preliminary stitching efforts)*

Several ecoregional maps exist for Canada. They organize the nation according to potential vegetation, soils, climate and topography and other factors. The Nature Conservancy is working with its Canadian partners to align the Canadian map with the U.S. map ecoregion by ecoregion. The goal is to complete this work for the 10 currently defined ecoregions shared by the lower 48 states of the U.S. by 2001, as well as for ecoregions shared by Canada and Alaska.

Asia Pacific *(Figure A28-5 in Appendix 28)*

The Nature Conservancy has defined the Asia/Pacific Region as the vast expanse of land and water that spans 140 degrees of longitude from the foothills of the Himalayas to Easter Island in the southeastern Pacific Ocean. It comprises approximately one hundred ecoregions in Asia (World Wildlife Fund) and 20 in Oceania (World Bank).

For Asia and the Indo-Malayan archipelago (as far east as the Solomon Islands), ecoregions identified by World Wildlife Fund are used. We refer to Bailey's Domains and Divisions when considering ecoregional strategy at a coarser scale (e.g. Wallacea).

Appendix 2 Changing Ecoregional Map Boundaries

U.S. Ecoregion Boundaries

Changing map boundaries is strongly discouraged because it can impact adjacent ecoregions and slow the overall planning process. However, some ecoregional teams have found it necessary to change ecoregional boundaries. Because we recognize that the original ECOMAP is not infallible and ecoregional teams are currently working with U.S. Forest Service colleagues its improvement, a procedure for changing boundaries has been developed.

▶ *Process*

1. The Director of Conservation Planning will make final decisions regarding map changes.
2. It will be the responsibility of the ecoregional planning team to make a compelling case for changing the boundaries and to prepare adequate documentation based on the following rules:
   - Changes should be based on Bailey's criteria of climate, topography, vegetation and geology.
   - Any proposed changes should be along existing or new section or subsection lines. Proposed changes at a scale of resolution finer than the section or subsection lines will not be approved.
   - Changes will be approved only if those changes will make information management in an adjacent ecoregion more difficult. All ecoregional teams affected by a change must be in agreement before a boundary is changed.
3. Proposed changes should be submitted to the ecologists in the regional Conservation Science Resource Centers. They will provide their recommendations to the Director of Conservation Planning. The regional Conservation Science Resource Centers must maintain the documentation justifying the change.
4. Regional GIS staff will be responsible for preparing the approved digital changes to the map. They should be submitted to GIS Manager in the Western Resource Office, who is responsible for maintaining the national map.
5. Proposed boundary changes will be considered every six months, at the end of March and at the end of September.

▶ *Ecoregion Names*

Ecoregion names cannot be changed unless extremely unusual circumstances arise. Changing ecoregional names is discouraged because the Conservancy is creating a body of published information that requires that names remain the same. If a team feels it is imperative to change the name of the ecoregion, contact the Director of Conservation Planning.

International Ecoregion Boundaries

For changes in international ecoregional boundaries or ecoregional names, contact Roger Sayre, the Director of Conservation Science for the International Conservation Program at rsayre@tnc.org.

Appendix 3 Managing an Ecoregional Planning Project

Background

Project management is a process for effectively translating ideas into results. It is a means to an end—a way to solve problems and get from start to finish more effectively and successfully. Effective ecoregional planning projects are developed over time in an organized, consistent, and strategic way. A well-executed project typically has a solid beginning, middle, and end.

The benefits of managing an ecoregional planning project well are twofold: effectiveness and efficiency. The cost of unsuccessful projects—often the result of poor project management—is high. Although some projects succeed using the "fly by the seat of your pants" work style, this approach can be risky and ineffective. This is particularly true for large, complex, and time-critical projects like ecoregional planning. Well-planned and managed projects are not only much more likely to be completed on target, on schedule, and within budget, but will also provide project team members with a positive, satisfying, and motivating experience.

The step-by-step section below describes seven discrete phases of project management: (1) Defining the project, (2) Defining the team, (3) Understanding leadership, authority and the decision making process, (4) Planning the work, (5) Ensuring team communication, (6) Staying on track, and (7) Closing out the project.

Steps

▶ *Step 1: Defining the project*

The purpose of defining the project is to clarify from the very outset the specific objectives to be accomplished, the products that the planning team will produce, the variables that will affect the project's outcome, the manner in which activities will be conducted, and the timing of specific activities. Ideally, this process should include the project sponsor, project manager, the core planning team, and the key implementers of the plan (these roles are defined later in this chapter). The Practical Tips on the following page should be part of the project definition phase, which is conducted before work on the ecoregional planning project is even begun.

▶ *Step 2: Defining the team*

Step 2A. *Roles and responsibilities of ecoregional planning team members.*

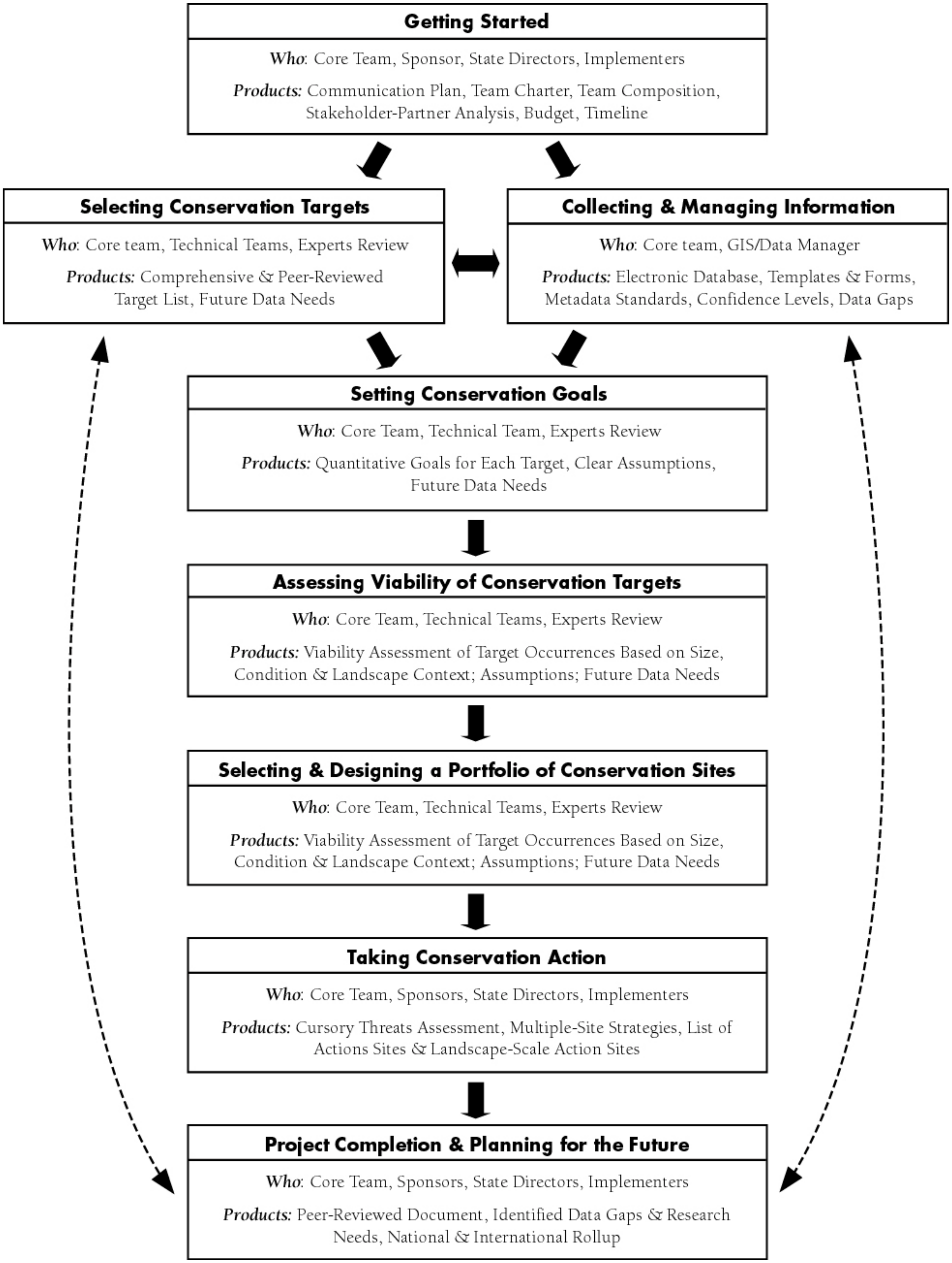
The following list describes the various groups that may participate and have a stake in the ecoregional planning process:

- **Customers:** The products and results of the ecoregional planning project need to meet this group's needs and requirements. Those who will implement the ecoregional plan should be considered as one set of customers of the plan.
- **Stakeholders:** This group has a vested interest in the project. It has the power to influence the acceptance and use of the products and results of the project.

Practical Tips

- Develop as specific a definition as possible of goals and objectives of the ecoregional planning project (See Figure A3-1 for ecoregional planning flow, products, and key personnel).
- Define the specific products that will be developed by the planning teams
- Define the project variables (or project constraints). These are Quality, Cost, Time, and Scope. This is a very important step because the team can only "fix" three of these variables. For example, if the quality, time, and scope of the project are pre-determined from the outset, then the cost cannot be fixed because it will be determined by the other three variables.
- Determine the key stakeholders who will be involved in project implementation. Consider which groups will be interested in and involved with the completed ecoregional plan, and strategically engage these groups in the project definition process.
- Organize the work by developing a work breakdown structure diagram or similar work planning tool. At a minimum, the work breakdown structure should define the major phases of the ecoregional planning project (See Figure A3-1 for phases), the estimated time to be spent on each of the major phases, the specific activities to be conducted within each of these phases, and a brief description of the products that will be produced during each phase.

- **Oversight/Advisory Groups:** These groups provide high-level input that typically directs and influences project scope, funding, schedule, products and sometimes staffing.
- **Partners:** This group provides direction and influence on project scope, products and results, and may contribute funding and resources to the project. Partners are often one of the project's customers. Partners may also include groups that manage the data needed for ecoregional plans, including state Heritage Programs and Conservation Data Centers.
- **Sponsor(s):** The sponsor(s) has high level responsibility for defining the project's scope and budget, overall accountability for ensuring the delivery of results and products, usually selects the project manager, and often has influence on the selection of project team members. In The Nature Conservancy, the sponsor role is usually filled by a state or country director.
- **Planning Team Leader:** Manages project planning, including the definition and update of project scope, budget, products, and results. The team leader participates in team selection, manages the work teams, chairs meetings, maintains project momentum, reviews and tracks progress and budgets, and is the person accountable for the delivery of products and results.
- **Planning Team(s):** The team members participate in project planning, updating, reviewing and tracking, and managing their portion of the project. The team members typically complete products and produce results. The make-up of the ecoregional planning team may change over the course of time as new expertise is needed to produce specific results in different phases of the project. For example, there may be three principal groups participating in the ecoregional planning project:
  - *Core team*—the group that is accountable for the completion of the ecoregional planning project. Ideally, this should be an interdisciplinary group.


Getting Started
Who: Core Team, Sponsor, State Directors, Implementers
Products: Communication Plan, Team Charter, Team Composition, Stakeholder-Partner Analysis, Budget, Timeline
Selecting Conservation Targets
Who: Core team, Technical Teams, Experts Review
Products: Comprehensive & Peer-Reviewed Target List, Future Data Needs
Collecting & Managing Information
Who: Core team, GIS/Data Manager
Products: Electronic Database, Templates & Forms, Metadata Standards, Confidence Levels, Data Gaps
Setting Conservation Goals
Who: Core Team, Technical Team, Experts Review
Products: Quantitative Goals for Each Target, Clear Assumptions, Future Data Needs
Assessing Viability of Conservation Targets
Who: Core Team, Technical Teams, Experts Review
Products: Viability Assessment of Target Occurrences Based on Size, Condition & Landscape Context; Assumptions; Future Data Needs
Selecting & Designing a Portfolio of Conservation Sites
Who: Core Team, Technical Teams, Experts Review
Products: Viability Assessment of Target Occurrences Based on Size, Condition & Landscape Context; Assumptions; Future Data Needs
Taking Conservation Action
Who: Core Team, Sponsors, State Directors, Implementers
Products: Cursory Threats Assessment, Multiple-Site Strategies, List of Actions Sites & Landscape-Scale Action Sites
Project Completion & Planning for the Future
Who: Core Team, Sponsors, State Directors, Implementers
Products: Peer-Reviewed Document, Identified Data Gaps & Research Needs, National & International Rollup

- *Working groups*—groups contributing content to the ecoregional plan as part of their job, but not working full time on the project. Working groups may change over time with the initiation of new phases of planning (for example, moving from collecting and organizing information to assembling the portfolio).
- *Advisors*—content specialists and experts who are consulted to obtain specific information related to the project. Advisor groups may also change as the phases of the project change.

Step 2B. *Team Organization and Structure.* At the outset of the project, the ecoregional planning team should be assembled to meet for the following purposes identified in practical tips:

Practical Tips

- Identify individual team member responsibilities and make appropriate assignments
- Clearly establish who is going to do what, and when it needs to get done
- Assemble and distribute a team "directory"
- Establish guidelines for the team

In addition, it should be recognized that the composition of the ecoregional planning team will change over time as the team takes on new tasks (e.g., moving into the portfolio assembly stage). As new members join the team, there will be a need to reestablish the processes described above in order to ensure that the team will operate with the maximum efficiency possible.

▶ *Step 3: Leadership, authority, and decision making*

How will decisions be made, by whom, and by what process? The sponsor of the ecoregional plan should work with the planning team to clarify and define from the beginning of the project what decision-making process will be used for setting expectations and for delivering products.

▶ *Step 4: Work planning*

At the outset, the team leader and planning team should meet in order to develop a Work Breakdown Structure that will serve to answer the following questions:

- What are the different stages of the project and what needs to be accomplished during each individual stage?
- What are the specific products that will come from each phase of the planning process and when do they need to be completed?
- Who is responsible for each of the stages of ecoregional planning?
- What is the team composition for each phase of the planning process?
- How much time and funding is needed to complete each product or task (use historical data from other planning projects for this)?

The team should document the assumptions used in determining the project variables (cost, quality, time and scope). If one of the variables changes, the team then will be able to make adjustments based on the assumptions used. The team should be realistic about estimating efficiency and the amount of time required to complete tasks—when possible, factor in for unknowns, unpredictability and interruptions.

▶ *Step 5: Ensuring team communication*

Step 5A. *Why have meetings—don't we have enough of them already?*
Much of the work involved in ecoregional planning needs to be conducted in a collaborative manner. This points out the need for meetings that result in definite outcomes to move the planning process forward. Effective and successful project team meetings are a key ingredient in a successful ecoregional planning process. All meetings should have a clear objective and well-defined expectations for meeting outcomes.

Practical Tips

- The team should consider ways to consolidate meetings so as to take advantage of team members being together, perhaps attending another scheduled meeting
- One alternative is to consider using regularly scheduled conference calls instead of face-to-face meetings

Step 5B. *How can the team best communicate with each other?*
It is important that the team identify roles, responsibilities, and expectations for communication within the team.

Practical Tips

- Communicate regularly and clearly
- Have a regular schedule and format for team communication
- Ensure that the minutes from every team meeting or conference call are distributed to all team members, and that the minutes clearly document the decisions and assignments made during the meeting

Step 5C. *Need for external communication*

- Develop an approach to conducting external communications. The team should determine if this will be a purely internal planning project or if the team will go public with the information. If the information will be made public, the team should determine what types of maps will be produced for external audiences, and how much information these the maps will contain. The external communications plan should also consider if the final product will be presented as an ecoregional planning analysis (as opposed to an ecoregional plan) to accommodate the planning interests of other groups that may like the "roadmap" but want to develop their own ideas about implementation.
- Identify who will communicate to external audiences, what will be communicated, and when it will be communicated

- See Appendix 4 for more information on developing a communications strategy

▶ *Step 6: Staying on track*

Step 6A. *Symptoms of troubled projects*

- Cost overruns/underruns
- Time overruns/underruns
- Technical problems
- Late or non-delivery of intermediate products
- Low morale/high turnover

Step 6B. *Causes of troubled projects*

- Earlier mistakes in planning, including inadequate or unrealistic planning, inadequate resource allocation, lack of leadership, and assignment of inexperienced personnel
- Poor communication between the team leader and the plan sponsor
- Changes in resource availability, including people, equipment, and materials
- Changes in the working environment including changes in priorities, changes in project politics, changes in work conditions
- Scope creep—the content of the project keeps expanding
- Lack of agreement on specific products and the timing of when products are expected to be delivered

Step 6C. *If things get off-track*

The team leader needs to determine what options are available and present them to the sponsor. The sponsor then needs to make a decision on how to proceed. Getting back on track involves making adjustments to the project variables of time, scope, cost, and quality. One tip to keep the project on track is to set interim milestones or benchmarks and communicate regularly with key project staff so the team can measure progress and identify potential problems sooner rather than later. The longer the group waits to identify potential problems, the fewer options will be available to resolve them, and the greater the impact or cost the problems will have on the project. Early problem identification allows for more options to be formulated to resolve the problem, usually at a lower cost.

▶ *Step 7: Close out of project planning*

When the project has been successfully completed, it is critical to CELEBRATE AND RECOGNIZE SUCCESS!!!

- The planning team should review what went well and what didn't go quite so well and share its lessons with other ecoregional planning teams, through ecoregional roundtable meetings or by writing *One Conservancy* articles or articles for the *ERP Newsletter* (contact Laura Valutis at lvalutis@tnc.org).
- Planning teams should ensure that the ecoregional plans undergo a peer-review. For

ecoregional plans that are led by The Nature Conservancy, it is important that each ecoregional plan be peer-reviewed through the ecoregional roundtable process (see Chapter 9).

- Ensure that the ecoregional plan is a dynamic plan—the ecoregional planning team needs to determine its role in helping with the transition from the planning team to the implementation team.

Tools

- The Nature Conservancy's Project Management training.
- The Nature Conservancy's Learn It On-Line module for training in the use of Microsoft Project
- Software scheduling tools (Microsoft Project, Excel, others)
- TNC Intranet site with job descriptions, work breakdown diagram, plan budgets, funding worksheets, meeting agendas can be found at http://knowledge.tnc:86/pagewire/newstory/tcp/ERPwheel1.htm.

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Appendix 4 Developing a Communication Strategy

Background

Twenty ecoregional plans are now complete and another 20 will be finished by December, 2000. The ownership pattern of sites identified in ecoregional plans is complex and the land use within those sites is diverse. Publicly owned or controlled sites (federal/state/local) range from 15% of the portfolio in the Central Shortgrass Prairie, to 81% in the California Central Coast. Seventeen countries share sovereignty of the 722,000 square kilometers of ocean surface in the Central Caribbean ecoregion.

Because of the relatively large amounts of land and water being identified as areas of biodiversity significance in ecoregional plans and the diverse ownership of these areas, the plans provide a strategic opportunity to increase conservation impact. However, to increase that impact the Conservancy must become more visible to a broad array of audiences. Maps produced by the plans are compelling and potentially controversial. Therefore, it is important to consider the following:

- The Conservancy cannot conserve all of the sites or areas of biodiversity significance identified in a portfolio of sites. Public and private sector partners will be essential for success. The Conservancy and ecoregional planning teams must develop compelling messages and useful communication products that will help get partners involved.
- It is advantageous for potential partners or stakeholders to be engaged by the planning team first. This provides the opportunity to control the messages and engage support.
- It is impossible and undesirable to keep this work a secret. Due to public funding, many of the plans may become public documents.
- The Conservancy's reputation as a science-driven organization gives these ecoregional plans credibility.
- The Conservancy's reputation as a "can-do", action-oriented organization is respected.

A communications strategy should be recognized as a critical component of implementation. It will position the Conservancy as the leader in on-the-ground habitat protection with a vision that others can embrace. It will identify key stakeholders and partners and the messages that will resonate with each of them. It will also identify potentially harmful detractors and the means to control our message rather than having to react to messages controlled by them.

Steps

▶ ***Step 1: Assemble the people who will be responsible for communicating this work*** (appropriate people from the planning team, implementers, communication staff and development). This ensures acceptance of the strategy by all those involved.

Many teams start the planning process by meeting with state directors and others who can define the project, finalize a budget, and determine who should participate. This initial meeting provides an opportunity to brainstorm and speculate as to what actions will lead to successful conservation of the portfolio. It also provides an opportunity to develop a preliminary communications strategy and identify the people responsible for executing the strategy. Because the information generated by the plan may lead to altered assumptions, the first stab at identifying communication strategies should be reevaluated at the end of the planning process. The first meeting should focus on who needs to be contacted early in the process in order to get "buy-in". It will also help identify the communication tools and the format of the plan, so it will not have to be reinvented later in the planning process.

▶ *Step 2: Think about conservation action*

Identify the top 3-5 conservation actions that are likely to emerge. Focus on what has to happen in order to ensure protection of the high priority sites. Align the top 3-5 communications strategies so that they support those conservation efforts.

For example, the Arizona-New Mexico ecoregion is largely public land. One conservation goal is to bring attention to the importance of these sites for biodiversity conservation to the U.S. Forest Service (USFS). The ecoregional planning team is collaborating with the USFS on a technical paper that describes the sites and the planning process in language familiar to the USFS. Technical papers are widely read by USFS land managers and therefore an efficient way to reach a broad audience.

▶ *Step 3: Identify the plan's stakeholders*

Prioritize the list. Put those who can help/hurt the conservation success the most, first.

Who is a stakeholder? Someone who: a) would benefit if the Conservancy achieved its project goals; b) would be hurt, or believe they could be hurt by the Conservancy's goals; c) could shape public opinion about the Conservancy's project even if it might not directly affect them; and d) has the authority to make decisions affecting the Conservancy's goals.

Practical Tips

Possible stakeholders:

- Immediate neighbors
- Resource-based industry (agriculture, timber, mining, fishing, etc)
- Elected officials
- Government agencies
- Anti-environmental groups
- Recreational user groups
- Major donors
- News media

▶ *Step 4: Refer back to conservation actions*

For each action, decide who the key stakeholders will be. These individuals or groups are the potential audiences with whom communication is crucial.

Many audiences will be familiar to the planning team. However, there may be great variation in how well the audience is understood, what the team wants from the audience, and what the audience wants from the planning team. There are many ways to quickly gain additional information about audiences. One resource is community-based staff; another might be a volunteer who serves on a

Practical Tips

Some proposed messages:

- Ecoregional planning is sound science
- The Conservancy has done its homework. Ecoregional planning brings efficiency and sharp focus to the habitat debate
- The Conservancy is non-confrontational
- Ecoregional planning offers high-leverage strategies
- Planning now saves tax dollars later
- The Conservancy encourages private incentives for good land stewardship
- By identifying a portfolio of conservation sites, the Conservancy will help prevent confrontation later

chapter or advisory board and who is active in community affairs. Newspaper archives are an excellent resource, because they chronicle most of the day-to-day discussion of issues at local, regional, state and national levels.

▶ *Step 5: Based on actions and audience, develop potential messages*

One aid at this step is to have access to polling data or survey research that gives insight about the attitudes of the audience. Polls are most helpful when teams know what they want to learn from them. A well-crafted poll can test preliminary solutions or approaches with an audience.

The Conservancy's Communication Department is testing and evaluating messages that work with some of the key audiences. This information will be available to the teams by mid 2000 (contact Renee Mullen at rmullen@tnc.org).

For example, a poll taken early at the Clinch River Valley project identified that women were most interested in the sustainable ideas proposed by the Conservancy. The staff changed its outreach and leadership development to frequently target women.

▶ *Step 6: Develop the strategy matrix*

This is the communication "game plan". It sets out the goal/audience/message line, along with

Goal	Audience	Message	Tool	Leader
Position TNC as the leader in ecoregional conservation	USFS Dist. Supervisor	Our ERP work backs you up	One-on-one briefings, maps, plan details	Dir. of Conservation Programs
	Elected county commissioners	Voters support this	Polling, editorials of support in local newspapers	State Director, Govt. relations staff
	News Media	Biodiversity is key to quality of life	Show them the places we're talking about	Communications staff
Inoculate against attacks from Wise Use	General public, media	Credible science, valid approach	Develop speaking points, media training	Communications team (State Dir., Conservation Programs, Communications Dir., et al)

the communication tools necessary to get the work done. Tasks can also be assigned to specific individuals/teams within the grid.

Summary

The communications plan—process and product—is driven by the conservation actions to achieve protection of the portfolio of sites. It assumes that for the Conservancy to get conservation done "on the ground," a number of different audiences will need to hear and be moved by the message to act. Communicating is more than just talking about the mission. It also involves listening to audiences and understanding what attributes the audience wants in any conservation group and agenda it will support. Finally, as with the ecoregional plan, communication plans should evolve and change as more information becomes available, as conservation actions shift and as awareness is altered in the conservation marketplace.

Appendix 5 Ecological Systems in the Northern Great Plains Steppe

from *Ecoregional Planning in the Northern Great Plains Steppe*, 1999

The Northern Great Plains Steppe (NGPS) ecoregional plan identified 323 ecological communities as occurring in the ecoregion and considered them all to be conservation targets. These terrestrial natural plant community types were taken from a natural vegetation classification system developed by the Conservancy and its Heritage/CDC partners. In response to the paucity of data for plant associations, the NGPS ecoregional planning team adopted a surrogate for these associations, referred to here as ecological complexes (the Conservancy now refers to these ecological complexes as ecological systems).

The NGPS plan defined ecological complexes largely from the National Vegetation Classification, and represented taxonomically-related associations and alliances, or easily identified ecological assemblages of natural communities (i.e. riparian types) that could be incorporated in landscape-based conservation action. For ease of organization, ecological complexes were placed in vegetation or geomorphic aggregations (i.e. forest/woodland, wetland; Table A5-1).

Table A5-1. Northern Great Plains Steppe—10 ecological complexes

Ecological Complex	Size
Wetland	
• Pothole	S
• Lake	M
• Alkali/Saline	M
• Fen	S
• Playa	S
Wooded Draw	
• Shrub	S
• Deciduous	S
• Deciduous-Coniferous	S
Riparian	
• Herbaceous	S
• Shrub	S
• Cottonwood	M
• Deciduous-Coniferous	S
Sandhills	M/L
Badlands	L
Forest/Woodland	
• Deciduous	S
• Low elevation coniferous	L
• High elevation coniferous	M

Ecological Complex	Size
Shrublands	
• Big sage	M
• Big sage	M
• Bird’s foot sage	S
• Black sage	M
• Mountain mahogany	M
• Nuttal’s saltbrush	M
• Greasewood	M
• Silverberry	S
• Creeping juniper	S
Tallgrass Prairie	M
Mixed-grass sod	
• Prairie sandreed	S
• Western wheatgrass	L
• Northern wheatgrass	L
• Neddlegrass	S/M
Mixed-grass bunch	
• Idaho fescue	M
• Rough fescue	L
• Bluebunch wheatgrass	M
• Little bluestem	S/M

Ecological complexes were assigned a characteristic size class (small, medium, and large) that is analogous to patch size developed for the Northern Appalachian and Boreal Forest ecoregional plan (small patch, large patch, matrix) and used extensively elsewhere (e.g. Northern Tallgrass Prairie). This helped the planning team better understand the spatial pattern and scale of each of the units, and how to determine appropriate size of sites required to sustain the ecological complexes.

Appendix 6 Ecological Land Units in the Central Appalachians Ecoregion (CAP)

by Mark Anderson, The Nature Conservancy

The development and use of abiotic units is based on the widely recognized premise that the natural distribution of species and communities is driven by environmental gradients (e.g., nutrient availability, moisture, and temperature). These gradients are determined by underlying abiotic features operating at multiple scales (e.g., local, landscape, and regional). For a particular area, the distribution and composition of the key abiotic features should act as appropriate approximations for the distribution and location of many species and communities.

The Central Appalacians ecoregions (CAP) team used widely available data to develop discrete, mappable topographic units with a particular geologic and elevation setting as predictors of species and communities. Most ecoregions have limited or spatially biased information on species or communities, and therefore will depend heavily on the use of many data layers for a comprehensive portfolio design. Even in ecoregions such as CAP with relatively extensive element occurrence (EO) data (> 3,000 EOs), locational infor-mation on common communities is generally lacking and planning teams are using multi-scale data to help identify sites that capture all features. The primary methods used in this study were developed for a planning project in the Connecticut River watershed.

Ecological Land Units

Ecological land units were developed by classifying and categorizing three abiotic data layers: elevation, bedrock geology, and topographic features. These elements were combined using a GIS into unique combinations (Figure A28-6 in Appendix 28).

Elevation: Elevation has important ecological implications. We determined three relevant elevation zones based on literature review, element occurrence analysis, and ecology planning team expertise. The zones included a high elevation zone above 3,500 feet. This boundary demarks the lower limit of red spruce. The mid elevation zone was from 3,500 feet to 1,500 feet. The lower limit of this zone generally corresponds with the upper limit for many low-elevation communities, such as floodplain forests. The low elevation zone included areas under 1,500 feet. Many common communities occur at both low and mid elevations. The area and percent for each elevation zone is shown in Table A6-I. We used the USGS 1:250,000 scale digital elevation model (DEM) to generate this data layer.

Bedrock Geology: The Central Appalachians have a rich and complex geologic history com-prised of over 350 mapped bedrock formations. We grouped the geolo-gic formations into 6 classes based

Table A6-1. Elevation zones in CAP

Elevation Zone	Area(ha)	% of CAP
Low (< 1500 ft.)	6,508, 035	51.3
Mid (1500-3500 ft.)	5,901,79	46.5
High (> 3500 ft.)	271,949	2.2

on their litho-geochemical properties. Soil chemistry was highly correlated with the dominant chemical properties of the parent bedrock. Weathering and erosion rates also corresponded with bedrock texture. We grouped bedrock geology types into six categories (see below). These groups were highly correlated with soil chemistry and structure, which in turn should be correlated with natural community distribution. The area and percent for each geologic class in the ecoregion are shown below (Table A6-2).

Topographic Features: At a finer scale, the distribution of species and communities tend to follow the distribution of topographic features in the landscape. The set of topographic features we defined reflected a combination of slope, relative land position, moisture, aspect, and the presence of water features. We derived 15 discrete topographic features (Figure A6-1) from the USGS 1:250,000 scale DEM and the USGS 1:100,000 scale hydrography data. The topographic features in this study varied in size on the landscape. For example, cliffs and steep slopes occurred as small patches in the landscape whereas; dry flats tended to occur over vast areas (Table A6-3).

Table A6-2. Geologic classes in CAP

Geologic Class	Area(ha)	% of CAP
Acidic Sedimentary	4,577,243	36.2
Acidic Shale	3,565,948	28.2
Acidic Granitic	866,305	6.9
Calcareous Sedimentary	2,084,357	16.5
Calcareous Shale	1,239,688	9.8
Mafic	272,465	2.2

Table A6-3. Topographic features in CAP

Topographic Features	Area(ha)	% of CAP
Cliff	6,078	0.1
Steep slope	115,034	0.9
Slope crest	102,488	0.8
Upper slope	470,047	3.7
Flat summit	430,911	3.4
NE facing sideslope	1,639,163	12.9
NE facing cove	713,747	5.6
SW facing sideslope	1,085,755	8.6
SW facing cove	477,635	3.8
Dry flat	5,691,926	44.9
Wet flat	807,305	6.4
Slope bottom flat	142,003	1.1
Stream	917,718	7.2
River	44,923	0.4
Lake/Pond	36,990	0.3

Combining Elevation, Geology, Topographic Features: Combining the three abiotic data layers into a comprehensive set of ELUs produced 270 potential unique combinations (3 elevation zones x 6 geologic classes x 15 topographic features=270 ELUs). Only 252 ELUs actually occurred. Of the 18 ELUs which do not occur in CAP, 17 are high elevation features with erosion prone bedrock such as calcareous and mafic cliffs. Examples of ELUs that occur are low-elevation acidic sedimentary flat summits, low-elevation mafic NE facing sideslopes, mid-elevation, calcareous shale slope bottom flats, and high elevation granitic steep slopes.

Selecting Matrix Community Targets: The resulting ELU's were used to sort out a whole set of intact landscapes or road bounded block containing matrix forming communities through 5 steps:

1) Develop the set of all potential matrix sites based on a GIS analysis of road-bounded areas

greater than 15,000 acres.

2) Determine which blocks qualify for inclusion by assessing the boundaries and condition of each potential blocks and removing those blocks which are apparently non-viable or otherwise unsuitable (e.g. have been repeatedly logged and sprayed, have dead aquatic features due to acid drainage, have killer threats or are otherwise in poor condition).

3) Assess the remaining blocks for ELU composition and aggregate the blocks into block-groups based on similarities in their ELU composition.

4) Prioritize and rank the blocks within each block-group based on their EO diversity, ELU diversity, condition, proximity to other features, and feasibility of protection work and threat.

5) Determine the minimum set of blocks needed to fully represent each matrix block group and select the highest priority blocks for inclusion in the first iteration matrix community sites.

Details on these five steps:

1) Matrix Blocks: road bounded blocks greater than 15,000 acres

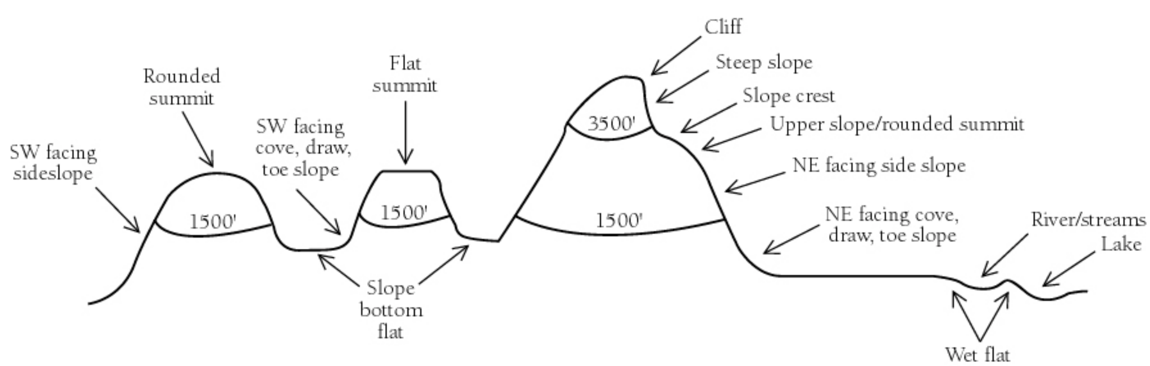
We used road-bounded “blocks” as the “site selection “ unit for both the actual portfolio and the automated selection analysis. Blocks are defined as areas or polygons that are bounded by roads (ranging from major highways to local roads), utility lines, railroads, and major water bodies. The advantage of using road-bounded blocks is that they are easily created through a process which is efficient, straightforward, uniformly applied across the entire ecoregion, and reproducible. Furthermore, the blocks represent preliminary “sites” because their boundaries are recognizable (roads, etc.) and often reflect ownership patterns (parks, preserves, private lands, etc.). The block coverage was created in GIS for CAP ecoregional planning purposes using techniques developed during the Northern Appalachian ecoregion planning process.

Initially, we selected a block for analysis if it was greater than 15,000 acres or if it was one of the largest 10 blocks in a subsection. Out of the initial 159,676 blocks possible in the Central Appalachians (even city “blocks” are analyzed as blocks), 213 met the criteria for consideration. We presented these 213 blocks as a starting point in matrix site selection.

2) Analysis of block condition:

The initial 213 blocks were assessed both quantitatively and qualitatively as to their current condition. First the attributes of total area, total core area, number and miles of dangling roads, per-

Figure A6-1. Topographic features profile for CAP



cent developed land, percent agriculture, percent natural cover, etc. were summarized in a report for each block. Next, we evaluated each block for logging/spraying/management history, other anthropogenic impacts, disturbance history, notable diversity and other features in a series of state by state expert interview sessions consisting of TNC state field office staff, state natural heritage ecologists, and various state and federal land managers. At each state meeting the boundaries of the blocks were also adjusted to reflect better information provided by the experts on the type and use of local roads. Every potential block was discussed and ranked on a 5 part scale, which ranged from #1 "yes the block qualifies" to #5 "no, the block does not qualify". Based on these meetings, the original 213 sites were reduced to 57 qualifying potential matrix blocks (e.g. blocks ranked #1 or #2).

3) Aggregating the blocks into block-groups

For each of the 57 qualifying block we tabulated the extent and type of all ELUs within the block boundaries. We used standard quantitative ordination, classification, and cluster analysis programs (DECORANA, TWINSPAN and CLUSTAN programs available in the PC-ORD for windows) to aggregate the blocks into groups within which the blocks were relatively inter-changeable as to their ELU features. From this analysis we distinguished 10 groups of 2–7 blocks each. We also identified 3 outlier blocks which were not readily interchangeable with any of the other potential matrix sites with respect to their ELU composition. The block groups often corresponded with the subsections boundaries. This was expected as the subsection boundaries were created based on areas with similar abiotic features. However, certain subsections lumped together (i.e. Northern and Southern High Allegheny Mts.) while several of the larger ones were split into finer groups (i.e. Appalachian Ridges). This analysis suggested that a minimum of 1 site from each of the groups would be necessary to fully represent the diversity of matrix forest sites across all bedrock, topography and elevation gradients within the ecoregion.

4,5) Prioritizing and selecting the final matrix blocks within each block group

Within each block group the individual blacks were assessed and compared as to their relative condition, EO representation and diversity, ELU representation and diversity, complementarity, feasibility for protection, threat and proximity to other features. This was done in small working groups at an extended core team meeting (details in CAP plan). Unavoidably, variation within the block-groups was not always identical, some groups being remarkably homogeneous and others having a fair amount of heterogeneity with respect to ELU composition. To account for differences in the internal variation, some block-groups required several blocks to fully represent their features while others needed only a single block. Only one block was actually eliminated from the set, all other blocks were assigned a Tier 1 or Tier 2 status. Tier 1 blocks formed the first iteration matrix community sites and were assumed to represent a minimum solution which maximized occurrence viability and representation of all major gradients and sources of variation. Tier 2 blocks were prioritized as reasonable alternatives to the Tier 1 sites in the event that protection of the latter would prove unfeasible or require supplementation by more sites from within the block group. The final set of Tier 1 sites consisted of 26 matrix blocks distributed across the ecoregion.

Appendix 7 Defining Biophysical Conservation Targets for Aquatic Communities & Systems in the Prairie Forest Border Ecoregion

by Mary Lammert, The Nature Conservancy's Freshwater Initiative

Identifying priority aquatic conservation sites necessitates a comprehensive picture of aquatic diversity. However, many ecoregions have limited or spatially-biased information about the distribution of aquatic species, and aquatic communities are not well sampled or described for most of the world. We do know that environmental gradients of climate, elevation, and geology shape aquatic ecosystems at several spatial scales, and the influence of physical habitat on the diversity of aquatic species and communities has been well documented. Based on these relationships, we have created a method to approximate a comprehensive picture of the environmental gradients that influence the patterns of aquatic ecological system and community diversity across an ecoregion. Similar to the process for defining Ecological Land Units (see Appendix 6), we use spatial data to describe and map discrete units of aquatic ecosystems in terms of the regional and local driving factors that influence community composition and distribution (see Color Figure A28-7 in Appendix 28). By comprehensively classifying an ecoregion, we can conduct quantitative and spatial analyses to support conservation planning. This approach has been used to classify streams and lakes in several ecoregions. We will discuss a recent application of the classification in the Prairie-Forest Border.

Ecological Drainage Units: One of the goals of ecoregional planning is to protect targets across the environmental gradients over which they occur. For each ecoregion, we create Ecological Drainage Units (EDUs) to spatially subdivide ecoregions according to large-scale environmental gradients and zoogeographic patterns that determine regional patterns of aquatic biodiversity. Aquatic biodiversity patterns are influenced by many of the same environmental patterns and processes that affect terrestrial biodiversity, but their distribution is often constrained by additional factors, such as watershed boundaries, and the spatial patterns of lakes and streams. EDUs are aggregations of 8-digit Hydrologic Catalog Units (as defined by the USGS) according to regional patterns of aquatic zoogeography, geology, landform, climate, hydrologic patterns, and watershed drainage density and pattern. Each ecoregion is subdivided into Ecological Drainage Units to stratify the occurrences of ecological systems, community alliances and macrohabitats, and species.

The Prairie-Forest Border includes parts of 17 EDUs that were delineated based on historic patterns of species distributions, major drainage basins, and physiography (geology and relief) (see Color Figure A28-8 in Appendix 28). For example, the set of watersheds that drain glacial outwash plains along the upper Mississippi River comprise one EDU and are distinguished from the Mississippi River watersheds downstream that occur in the driftless region, a maturely dissected, unglaciated landscape that has high relief, exposed bedrock, and a variable loess cap.

Aquatic Ecological Systems: Within each EDU there are a range in types of aquatic ecosystems. Aquatic ecological systems coarsely characterize this variability, describing hydrologically connected streams and lakes that occur in similar ecological settings defined by geology, elevation, and hydrologic pattern. If a Macrohabitat classification has been completed for the ecoregion, aquatic ecological systems summarize the range in macrohabitat types for sets of hydrologically-connected streams. Where only EDUs have been defined, visual assessment of the ecological settings using GIS tools as well as expert input on the main distinctions among the major tributaries and mainstems are used to create a list of the aquatic ecological systems. In both cases, quality information and expert review are employed to identify the best examples of each system type. In the Prairie-Forest Border, we identified 144 coarse and intermediate-scale systems representing 22 distinct types.

For example, in the Lower Wisconsin River EDU, we identified five examples of aquatic ecological systems comprising four distinct types (see Color Figure A28-9 in Appendix 28). The Wisconsin River mainstem (24) is a coarse-scale system, a large, low-gradient, surface flow dominated river. The two intermediate-scale systems, the Kickapoo River (26) and Baraboo River (25) are distinguished by the occurrence of higher groundwater inputs in the Kickapoo and the occurrence of glacial deposits in the Baraboo as well as greater influence of wetlands and lakes. The fourth system type, another intermediate-scale type, represented by the Pine River (27a) and the Blue River (27b), contain small to medium streams directly connected to a larger river, with moderate to high gradient and high inputs of groundwater.

Macrohabitats: Macrohabitats are discrete classification units of streams and lakes that are relatively homogeneous with respect to size, and thermal, chemical, and hydrological regimes. They describe the environmental variation in aquatic ecosystems with greater resolution than do ecological systems. Macrohabitats correspond to the spatial extent of potentially distinct biological communities. Stream and lake macrohabitats were mapped in the Prairie-Forest Border based on three primary spatial data sets: hydrography, geology and elevation (see Color Figure A28-10). For this example, we will focus only on the stream classification. Five stream variables were derived from these layers: stream size, connectivity (network position and connection to lakes, wetlands or other streams and rivers), surficial geology, gradient, and hydrologic regime. Lines representing stream reaches were attributed both automatically and manually in a GIS and grouped into macrohabitats based on these variables. This process is described in greater detail below.

Hydrography: We analyzed the map of streams and lakes to describe two important aspects of streams: size and connectivity. We defined four stream size classes based on link number, which is a count of the number of first order streams upstream of a point. The classes are: small (link 1 or 2); medium (link 3-50); large (link 51-700); very large (link >700). The distribution by size classes is described in Table A7-1. Stream connectivity has two aspects, position in the drainage

Table A7-1. Size classes.

Size class:	Percent of macrohabitats
Small	80.14
Medium	18.43
Large	1.31
Very Large	0.12

Table A7-2a. Connectivity—network position.

Connectivity class: Drainage position	Percent of macrohabitats
Small	28.42
Medium	57.01
Large	11.25
Very Large	3.37

Table A7-2b. Connectivity—lake & wetland influence.

Connectivity class: Lake or wetland	Percent of macrohabitats
Wetland	12.51
Lake	18.82
Both	4.32
None	76.86

network, which was measured as the link number of the down-stream reach, and connectivity to other aquatic habitats including lakes, wetlands, and coastal areas. The distribution of macrohabitat in each connectivity class is summarized in Table A7-2a&b.

Geology: We used the surficial geology texture and topography to infer the hydrologic regime of each stream macrohabitat in terms of relative inputs of ground and surface water. The surficial geology of the Prairie-Forest Border is highly variable. The percentage of each class is summarized in Table A7-3. Generally, in the glaciated region of the Prairie-Forest Border, the highest ground water inputs occur in coarse glacial deposits (outwash, ice contact, coarse till) in areas of relief. In the driftless zone, ground water inputs are found also in areas of considerable relief and karst. Table A7-4 summarizes the percent of macrohabitats falling into each category.

Topography: In the Prairie-Forest Border we measured only one topographic factor, gradient, the change in elevation of a stream reach over its length. Gradient is a useful single measure of channel morphology because it is correlated to sinuosity, pool-riffle pattern, confinement, substrate size, and water velocity. We calculated the gradient for each stream reach automatically from a digital elevation model (DEM) in the GIS, then averaged the gradient value for each macrohabitat. We classified macrohabitat gradients into three classes: low (<0.003), medium (>0.003 and <0.013) and high (>0.013) based on the recommendation of Lyons (personal communication). The distribution of the macrohabitats by gradient class is given in Table A7-5. We also used the DEM to infer the effect of stream confinement on the hydrologic regime.

Macrohabitat Types: Macrohabitat types were defined for the Prairie-Forest Border as unique combinations of the five classification variables described above. In the Prairie-Forest Border 213 unique macrohabitat types occurred out of a possible 432 combinations (4 size x 4

Table A7-3. Surficial geology of the prairie-forest border

Geology class:	Percent of ecoregion area
Peat	1.83
Bedrock	0.06
Fine glacial deposits	38.43
Sand	13.26
Coarse glacial deposits	44.04
Open water	2.39

Table A7-4. Hydrologic regimes.

Hydrologic regime: source	Percent of macrohabitats
Surface water dominated	56.16
Mixed with low groundwater	30.84
Mixed with high groundwater	13.00

Table A7-5. Gradient.

Gradient class:	Percent of macrohabitats
Low	55.23
Medium	36.24
High	8.52

network position x 3 lake/wetland x 3 hydrologic regime x 3 gradient). (As with ELUs, many of these types do not exist.) Maps and an interactive database were generated as tools for conducting quantitative and spatial analyses of the macrohabitats. The most common macrohabitats were small, surface flow dominated, low-medium gradient streams connected to medium streams.

Our goal for this ecoregion is to protect examples of macrohabitat types in each of the EDUs in which they occur. The product of the aquatic analysis will be a map and description of the best occurrence of species and community-level targets. This information will then be considered with information on terrestrial targets to identify portfolio sites.

Appendix 8 Selecting Bird Targets in the East Gulf Coastal Plain Ecoregion

by Dave Mehlman, Wings of the Americas Program, The Nature Conservancy

Bird conservation targets were selected in the East Gulf Coastal Plain ecoregion following the procedure outlined in *Geography of Hope Update # 7* (available on the Intranet). This ecoregion overlaps two Partners in Flight (PiF) physiographic areas, East Gulf Coastal Plain (#4) and South Atlantic Coastal Plain (#3). To assemble the draft target list, we first put together a list of all species that occurred in either of the two PiF areas that met one or more of the criteria listed in *Geography of Hope Update #7*, Target List Development section. This resulted in the list of species shown below, along with the appropriate information needed to place the species on the list.

The critical next step was to determine which species on this list were not valid ecoregional planning targets. This led to the deletion of several species from the list, for the following reasons:

- Florida Scrub-Jay, Bell's Vireo, and Cerulean Warbler since they do not occur in the ecoregion, despite occurring in one or more of the overlapping PiF physiographic areas;
- Black-throated Blue Warbler, Painted Bunting, and Dickcissel since this ecoregion is not one in which they occur in sufficient abundance to be conservation targets;
- Reddish Egret and Worm-eating Warbler since they are peripheral breeding species in the ecoregion;
- Gray Kingbird, Blue-winged Warbler, and Louisiana Waterthrush since they are not on the Partners in Flight WatchList, despite their relatively high global scores[1]; and
- Ivory-billed Woodpecker and Bachman's Warbler since they are effectively no longer conservation targets in the ecoregion.

This resulted in a draft list of 19 bird species to be used by the ecoregional planning team as targets, which would be supplemented by G1-G3, T1-T3 species data to be obtained from appropriate heritage programs.

As a final step in the bird target identification process, Swallow-tailed Kite and Black Rail were flagged as occurring mostly in small and/or localized populations. Therefore, the standard conservation goal guidelines may not apply to these species if they are vulnerable. It was also noted that Piping Plover, Henslow's Sparrow, and Saltmarsh Sharp-tailed Sparrow occur in the ecoregion only in the non-breeding season, which would affect the kinds of sites and/or occurrences to be part of the portfolio. For all other species, breeding season sites/occurrences pertain.

[1] However, teams may want to consider for target inclusion if species is declining.

Table A8-1. Example of draft bird species target list.

Species	Global PiF Score	PiF WatchList	AREA3		AREA4	
			Abundance	Trend	Abundance	Trend
Reddish Egret	22	Yes			3	3
Swallow-tailed Kite	21	Yes	2	2	2	3
Black Rail	24	Yes	4	3		
Snowy Plover	19	Yes	3	3		
Wilson's Plover	19	No	5	3	3	3
Piping Plover	24	No	3	3		
Willet	18	Yes	5	3	3	3
Chuck-will's-widow	19	Yes	5	2	5	5
Red-headed Woodpecker	18	Yes	3	2	3	2
Red-cockaded Woodpecker	28	No	5	2	3	3
Ivory-billed Woodpecker	30	No	5	3		
Gray Kingbird	19	No	2	3	2	3
Florida Scrub-Jay	30	No	2	3		
Brown-headed Nuthatch	21	Yes	5	5	2	3
Wood Thrush	20	Yes	4	5	4	2
Bell's Vireo	23	Yes			2	3
Bachman's Warbler	30	No	5	3	2	3
Blue-winged Warbler	19	No	2	3		
Black-throated Blue Warbler	20	Yes			2	3
Prairie Warbler	20	Yes	4	4	4	5
Cerulean Warbler	25	Yes	2	3	3	3
Prothonotary Warbler	21	Yes	5	1	3	5
Worm-eating Warbler	21	Yes	3	2	2	3
Swainson's Warbler	24	Yes	5	1	4	3
Louisiana Waterthrush	19	No	3	2	3	1
Kentucky Warbler	19	Yes	3	1	4	2
Painted Bunting	21	Yes	2	5	2	3
Dickcissel	20	Yes	2	3	2	2
Bachman's Sparrow	24	Yes	5	5	5	5
Henslow's Sparrow	24	Yes	3	3		
Saltmarsh Sharp-tailed Sparrow	25	Yes	2	3		
Seaside Sparrow	21	Yes	5	3	4	3

In the table, *Global PiF* score is the overall measure of conservation threat and concern developed by Partners in Flight (a higher number equals greater concern, with a maximum of 30); *Abundance* is a number from 1 to 5 indicating lesser or greater importance of that physiographic area within the overall distribution of abundance of the species; and *Trend* indicates the known population trend in the physiographic area, with 1 indicating a demonstrable increase, 3 no known change, and 5 a demonstrable decrease.

Appendix 9 Worksheet for Conservation Targets & Goals

In Chapter 4 of *Geography of Hope*, Second Edition, Volume I, we recommend that a comprehensive information management program be developed that will incorporate ecoregional and site planning data. Intentions are to have such a program available for Conservancy staff by Fall 2000. In the meantime, Table A9-1 can be used as a basic guide when developing an Access database or Excel spreadsheet for tracking conservation targets and goals. Until a comprehensive Conservancy-wide information management program is developed, you may want to contact your regional Conservation Science Resource Center—many of which have developed Access databases for ecoregional and site planning.

Column Descriptions for the Worksheet Follow:

Ecoregion

List the Ecoregion Number (e.g. in the continental U.S. they are numbered 1-64) or an Ecoregion Code

G Rank

A numeric assessment of a biological element's relative imperilment and conservation status across its range of distribution ranging from G1 (critically imperiled) to G5 (secure). Assigned by the Natural Heritage Network, global ranks for communities are determined primarily by the number of occurrences and total area of coverage by a community (associations in the USNVC), modified by other factors such as condition, historic trend in distribution or condition, vulnerability, and threats. Global ranks for species take into account number of occurrences, quality, and condition of occurrences, population size, range of distribution, threats, and protection status.

USESA (Endangered Species Act)–Federal Status

The taxonomic relationships between species and their intraspecific taxa may be important. Therefore, follow the USESA methodology for federal status. Current species federal status is available at the US Fish and Wildlife Service's web site at www.fws.gov. In addition they also list foreign listed species at www.endangered.fws.gov/fornspp.

E = Endangered
T = Threatened
P = Proposed for listing

IUCN Rank

C = Critically endangered
E = Endangered

V = Vulnerable

Type of Ecological Communities and Systems

1 = G1 or G2 ranked Terrestrial Community
2 = Patch Terrestrial Community
3 = Terrestrial Ecological System (including matrix community)
4 = Aquatic Ecological System
5 = Aquatic Macrohabitats
6 = Marine Habitat

Rationale for Species Targets (can select more than one)

1 = Imperiled or endangered species (includes all G1-G3 species, federally listed endangered or threatened species, and/or IUCN ranked species)
2 = Species of special concern due to declining population trends, endemic, disjunct or vulnerable or focal species in ecoregion
3 = special considerations— species aggregations, species groups, or biodiversity hotspots
4 = other—may be a target in an adjacent ecoregion

Conservation Target Inclusion

T = Conservation target used to drive planning process
U = Uncertain whether this species should be a conservation target; need to resolve this with other technical team members

Comments on selection of conservation targets:

Please add any pertinent information that justifies why you selected the target

Ecoregional Distribution (for conservation targets)

E = Endemic (primarily or only occurring in the ecoregion)
L = Limited (occurs in the ecoregion and within a few other adjacent ecoregions)
D = Disjunct (found a significant distance from its primary range)
W = Widespread (typically found in the ecoregion, but common in many others; bulk of distribution elsewhere)
P = Peripheral (rarely occurs in ecoregion and is more common in other ecoregions; bulk of distribution elsewhere)

Overall Conservation Goal

Fill in a number for the collective ecoregional goal for conservation target.

Conservation Goal by Sub-section

Stratify the overall numeric conservation goal by ecoregional section or sub-sections.

Rationale (for goal setting—can select more than one)

Please fill in numbers for goal setting rationale using following key:

1 = best guess based on my field experience and expertise with this species in the ecoregion

2 = best guess based on research conducted on this species (cite source)

3 = best guess based on historical extent/restoration potential of species

4 = based on a baseline or default goal

Comments (for goal setting)

State reasons for any discrepancies in your proposed stratification of goals.

Data Gaps (Inventory and Research Needs for Conservation Targets)

List geographical areas and/or taxonomic work that needs to be done for a given target to help direct future inventory and research.

Table A9-1.

												Conservation Goal by Section or Subsection					
Ecoregion	Common Name	Scientific Name	G Rank	Federal Status	IUCN Rank	Community Type	Spp Rationale	Target Inclusion	Comment	Ecoregional Distribution	Overall Conservation Goal	*sub1*	*sub2*	*sub3*	Rationale	Comments	Data Gaps
These fields to be filled in by data manager																	

Other Recommened Fields:

Heritage/CDC Element Code
Spatial Scale for Communities & Systems (Matrix, Large Patch, Small Patch, or Linear)
Level of Confidence (Confident, Probable, Questionable)
State or Provincial Distribution and Ranking
Experts/Sources for Target Information

Appendix 10 Sources of Data for Ecoregional Planning

This appendix includes both a **Table** and a **List** of digital information that may be pertinent for large-scale conservation management activities. The Table (Table A10-1) is organized according to the type of data that may be needed and the List (Table A10-2) is organized alphabetically by source with URL locations. This complementary information is only intended as a guide for large-scale ecoregional planning.

The information within the **Table** is organized according to the following major categories:

- Base Map Data
- Biological Data
- Physical Data
- Marine Data
- Remotely Sensed Data
- State Data
- International Data
- Technical Support and Data Clearinghouses

Included under each of these categories are suppliers of data and the scale at which various layers may be acquired. This is an incomplete list. Data coverage, accuracy and date will vary for the different layers. The scale at which the data have been mapped will be important to consider when envisioning the products of the ecoregional plan and the targets to be captured. For example, use of landcover data at a 1:250,000 scale may be less helpful in identifying a localized forest type than a 1:24,000 scale data layer. Although the scale of collection is important to note, also important is the accuracy at which the data layers have been mapped.

The information within the **List** is organized by the source with the URL location and a brief statement regarding the site and the type of data that may be acquired. Sites within the Table are cross-listed in the List.

These data may be applied at various stages in an ecoregional planning process. Particularly important is the consideration of the data layers during the groundwork phase and in the data collection process. In particular, initial constraints may include the cost of the data, the type of software required for use of certain data, and expertise available to both manage and analyze the data. Conservation Science Resource Center GIS and information managers, as well as information managers in adjacent ecoregions, may have already compiled many of these data sets and would be a great resource in assembling data layers.

Also important to consider is the availability of data and the conservation targets of an ecoregional plan. Depending on these targets, certain data layers may be more appropriate than others such that the targets will direct data acquisition. Continual communication among team members as to the focus of the ecoregional plans and the ability of the available data to represent the objectives of the plan should be continually evaluated.

Table A10-1: A selection of data that may Be valuable for ecoregional planning

The table is organized by the type of data and source. Coverage for these data will vary and should be examined for availability within a given area. Geographic Information System (GIS) managers may have data layers already compiled. Additional information regarding these sources and web sites for the data can be seen in Table A10-2.

Data	Sources & Scales
Base Data	
Transportation & Hydrography	Environmental Protection Agency (1:100,000) National Atlas of Canada Natural Resources Canada (1:7.5 mil- 1:30mil) Southern Appalachian Man and Biosphere (1:2mil & 1:100,000) U.S. Census (1:100,000) U.S. Fish and Wildlife Service (1:2mil & 1:250,000) U.S. Geological Survey (1:2 mil & 1:100,000)
Administrative Boundaries	Environmental Protection Agency (1:100,000) National Atlas of Canada Natural Resources Canada (1:7.5 mil- 1:30mil) Southern Appalachian Man and Biosphere (1:100,000) Remote Sensing Research Unit–Managed Areas Database (1:2 mil) U.S. Census (1:100,000) U.S. Fish and Wildlife Service (1:2mil & 1:250,000) U.S. Geological Survey (1:2 mil & 1:100,000) World Conservation Monitoring Center (wide variety of coverages) World Wildlife Fund (national maps)
Watersheds	Environmental Protection Agency (8-digit Hydrologic Units enhanced from U.S. Geological Survey units & Reach Files, version 1) National Atlas of Canada National Wetlands Inventory (1:250,000) U.S. Fish and Wildlife Service (1:2mil, 1:250,000) U.S. Geological Survey (Hydrologic units- 1:250,000 & 1:100,000)
Landuse / Landcover	Environmental Protection Agency (BASINS Data–1:250,000 data from 1970-1980 & 1:100,000; MRLC images from 1986–1994 for EPA Region 3) Southern Appalachian Man and Biosphere (1:100,000) U.S. Geological Survey (1:250,000 & 1:100,000 from 1980 imagery)
Soils	Natural Resources Conservation Service Soil Landscapes of Canada (1:1 mil) Soil Survey Geographic Data Base (1:12,000 to 1:63,360) Southern Appalachian Man and Biosphere (1:250,000) State Soil Geographic Data Base (1:250,000)
Vegetation / Land Units	Environmental Protection Agency Federal Geographic Data Committee Natural Resources Conservation Service Southern Appalachian Man and Biosphere (1:100,000) U.S. Forest Service (1:100,000 and other scales) World Conservation Monitoring Center (various coverages) World Wildlife Fund

Table A10-1 (continued)

Data	Sources & Scales
Terrain Data	Natural Resources Canada Natural Resources Conservation Service Southern Appalachian Man and Biosphere (7.5min 30m resolution, DMA 3 arc second, DMA 30 arc second, 1:24,000 topographic relief) U.S. Geological Survey (digital elevation models 1:250,000 & 7.5 minute 30m resolution) University Edinburgh (various scales)
Climate	National Oceanic and Atmospheric Administration Natural Resources Canada Southern Appalachian Man and Biosphere (1:2mil)
Geology	U.S. Geological Survey (Bedrock- 1:500,000 & Surficial- 1:750,000)
Biological Data	
Species	Association for Biodiversity Information National Biological Information Infrastructure Natural Heritage Network The Nature Conservancy World Conservation Monitoring Center
Biodiversity	National Biological Information Infrastructure Partners In Flight U.S. Geological Survey (NAWQA) World Conservation Monitoring Center
Vegetation	U.S. Forest Service Physical Data
Physical Data	
Monitoring	Environmental Protection Agency (BASINS data) NAWQA (part of USGS) U.S. Geological Survey
Planning	WildlandsProject
Climate	National Oceanic and Atmospheric Administration
Marine Data	
	Environmental Protection Agency (EMAP Project 1991-1994) Minerals Management Service National Wetland Inventory National Wetland Research Center National Oceanic and Atmospheric Administration (Special Projects Office; National Shellfish Register) Southeast Fisheries Science Center (part of National Biological Information Infrastructure)

(continued next page)

Table A10-1 (continued)

Data	Sources & Scales
Remotely Sensed Data	
	National Oceanic and Atmospheric Administration Natural Resources Canada & CCRS (Images for Canada) Natural Resources Conservation Service (Digital Orthophoto Quadrangles) U.S. Geological Survey (Digital Orthophoto Quadrangles, Multi-resolution Land Characteristics, Photos, Images)
State Data	
	Data Access and Support Center (base map layers for Kansas at various scales) National GAP Analysis Programs (1:100,00 to 1:500,000) U.S. Fish and Wildlife Service (1:12,000 & 1:500,000 base data) Visit University Sites and State Pages Contact GIS managers for your area
International Data	
	Asia Pacific Research Online AZTECA-The Mexico Datasystem Geoprocessing Technologies and Services in Latin America Latin American Network Information Center Natural Resources Canada (various base data for Canada) South-East Asia Information The World Conservation Union United Nations Educational, Scientific and Cultural Organization University of Edinburgh GIS Server World Wildlife Fund (Asia Pacific, Latin America, and Caribbean)
Technical Support & Clearinghouses	
	Bureau of Land Management & Metadata Environmental Systems Research Institute GNU Local Universities MapData National Biological Information Infrastructure Natural Resources Conservation Service (USDA Conservation Program) U.S. Geological Survey (EROS home page; Earth Sciences data on the Global Land Information System) University of Edinburgh GIS Server World Wide Web Mapping Home Page

Table A10-2: Sources and brief descriptions of various sites to obtain ecoregional data

These are examples and locations of data sources for ecoregional planning. Many other available sources are not included in this list. Website addresses accurate as of March, 2000.

Asia Pacific Research Online

http://www.ciolek.com/

Collection of information regarding maps, research, education and published materials about Asia.

Association for Biodiversity Information (ABI)

http://www.abi.org

Provides links to Natural Heritage Programs, Conservation Data Centers, and other partners that collect and disseminate biodiversity data.

AZTECA The Mexico 2.0 Datasystem

http://www.resourcescience.com/database/aztec.htm

Data compiled for Mexico such as topography, reference layers, and geology. Some free downloads available in ARC and other formats.

Bureau of Land Management (BLM)

http://www.blm.gov/gis/

Contains links to the NSDI metadata and WWW mapping sites (http://www.blm.gov/gis/nsdi.html). These sites contain a plethora of links to national, state, and international clearing-houses and GIS sites.

Canada Centre for Remote Sensing (CCRS)

http://www.ccrs.nrcan.gc.ca/

RADARSAT, SPOT, and Landsat images. Also includes AVHRR, SEASAT, and ERS images and other sources of information.

Data Access and Support Center, State of Kansas GIS Initiative's (DASC)

http://gisdasc.kgs.ukans.edu/dasc.html

Data for the state of Kansas with links to other GIS sites including regional sites, products, publications and GPS information.

Environmental Protection Agency (EPA)

http://www.epa.gov/nsdi

Coverage within the United States organized by EPA regions (10 regions within the US). Availability of coverage for the US may vary.

EPA (Better Assessment Science Integrating Point and Nonpoint Sources (BASINS))

http://www.aquaterra.com/basins.html

Coverage within the United States organized by EPA regions (10 regions within the US). Includes base data coverages such as transportation, boundary, and landcover information. Also provides gauge station point data and information related to water quality.

EPA (EMAP Project)

http://www.epa.gov/emap/

Biodiversity information for marine systems (benthic organisms, fishes, invertebrates) available for 1991-1994.

Environmental Systems Research Institute (ESRI)

http://www.esri.com

Dominant provider of GIS software. Site contains access to data, maps, programs, and scripts for use with various GIS packages.

Federal Geographic Data Committee (FGDC)

http://biology.usgs.gov/fgdc.veg/index.html

Terrestrial vegetation mapping project and classifications with links to various vegetation mapping projects.

National GAP Analysis Program (GAP)

http://www.gap.uidaho.edu/GAP/index.htm

State level projects coordinated by USGS. States work independently such that information will vary among the programs. These programs were developed for ecoregional assessments with data at 100,000-500,000 Scales. Most information is based on 1:100,000 scale USGS maps. States are generally working toward producing maps of landcover, species distributions, manage-ment areas and status of ownership maps.

Geoprocessing technologies and services in Latin America

http://www.david.stevens.net/geoproce.htm

Access to digital data and information regarding projects for Latin American countries. Also contains access to free GIS software for Latin America.

Global Land Information System (webglis)

http://edcwww.cr.usgs.gov/webglis

USGS site for downloading information organized by data type.

GNU

http://www.gnu.org

Provides free software and links to other software packages. Also helpful for downloading software and providing manuals on software packages. Provides general information including ftp and zipping files.

Latin America Network Information Center (LANIC)

http://lanic.utexas.edu/

Contains regional and country maps with links to informational sites.

Remote Sensing Research Unit- Managed Areas Database (MAD)

http://www.ncgia.ucsb.edu/sb/mad/mad.html

Large scale mapping of managed or public land information.

MapData

http://www.mapdata.net/info.html

Commercial provider of digital data.

Minerals Management Service

http://www.mms.gov

Provides information on offshore bottom sediment types.

Multi-Resolution Land Characteristics Interagency Consortium (MRLC)

http://www.epa.gov/docs/grd/mrlc/

Landcover data and land characteristics database for the US based on TM Landsat data from 1986-1994 with image coverage for EPA region 3. Some areas are covered by only one TM scene. [NOTE: This information is dated—the web site says 1996. This data can also be obtained directly from EPA and from a EROS ftp site: edcftp.cr.usgs.gov/pub/edcuser/vogel/states. There are about 30 states available.]

National Atlas of Canada

http://atlas.gc.ca/english/digital.html

Includes base map layers of Canada at various scales.

National Hydrographic Data Set

http://nhd.usgs.gov

Preliminary release of 1:100,000 hydrography for the United states except Alaska, Washington, Idaho, and Oregon.

National Wetlands Inventory

http://www.nwi.fws.gov/

Wetland locations and types organized according to USGS 7.5' quadrangles. Data on seagrass beds, wetland vegetation, and oyster beds.

National Wetland Research Center

http://www.nwrc.usgs.gov/sdms

Provides information on seagrass beds, wetland vegetation, and oyster beds.

National Water-Quality Assessment Program (NAWQA)

http://wwwrvares.er.usgs.gov/nawqa/index.html

Water quality assessments with data developed from 1:2mil hydrologic unit boundary coverages and some coverages at larger scales. Information collected in study units with 59 units encompassing major river basins and aquifers across the U.S.

Natural Heritage Network (NHN)

http://www.heritage.tnc.org/index.html

Electronic methods (http://www.heritage.tnc.org/dvic/emethods/)

The Natural Heritage Network web site contains information regarding conservation efforts and links to state sites. Contains information regarding species, communities, sites and managed areas.

National Biological Information Infrastructure (NBII)

http://www.nbii.gov/index.html

Biological data around the world and within the US maintained by various organizations and initiated by USGS.

National Oceanic and Atmospheric Administration (NOAA)

http://www.ngdc.noaa.gov/

http://www.nos.noaa.gov/

http://sposerver.nos.noaa.gov/

Provides links to the NOAA server with environmental data from databases within NOAA. The NOAA National Shellfish Register is also available as a CD-ROM (data on water quality for shellfish as well as information on bays, estuaries, and other water bodies). The home page for NOAA contains information on maps, news and events, publications, and education.

Natural Resources Canada (NRCan)

http://atlas.gc.ca/english/digital.html

Site includes digital data for topographic mapping at 1:50,000 and 1:250,000 scales, base maps, and aerial photography for Canada. Base maps at various scales including 1:2 mil, 1:7.5 mil and 1:30 mil scales. Includes mapping of waterways, boundaries, transportation places, and parks.

Natural Resources Conservation Service (NRCS)

http://www.nrcs.usda.gov/

USDA Conservation Program (http://www.nrcs.usda.gov/NRCSProg.html)

Formally known as the Soil Conservation Service. Contains a variety of technical data related to natural resources including DEM's, DOQ's, soils, climate, and plants. Also, various links to other sites including the USDA Conservation Program.

Partners in Flight

http://www.PartnersInFlight.org/

Main goal is to work with various organizations to provide protection for avifauna.

Soil Landscapes of Canada (SLC)

http://res.agr.ca/CANSIS/NSDB/SLC/_overview.html

Major soil characteristics for Canada at a 1:1 mil scale.

Soil Survey Geographic Data Base (SSURGO)

www.nrcs.usda.gov

County level soil maps.

South-East Asia Information

http://sunsite.nus.sg/asiasvc.html

Site with links to various areas in South-East Asia including country specific sites and university sites.

Southeast Fisheries Science Center

http://www.nbii.gov/nbiimetadata/

Biodiversity information (fishery catch).

Southern Appalachian Man And Biosphere (SAMAB)

http://sunsite.utk.edu/neighborhoods/SAMAB/samab/index.html

Limited coverage for states within the Southern Blue Ridge ecoregion including GA, AL, TN, NC, SC, VA, KY, WV. Some states will contain more information. In general a great deal of information compiled for these states contained within this assessment

State Soil Geographic Data Base (STATSGO)

www.nrcs.usda.gov

State level soil maps.

The Nature Conservancy (TNC)

http://www.tnc.org

Contains data regarding rare plants, animals and rare communities. Additional information may be obtained regarding sites and managed areas.

The World Conservation Union (IUCN)

http://www.iucn.org/

A union of organizations assisting conservation efforts.

United Nations Educational, Scientific and Cultural Organization (UNESCO)

http://mirror-us.unesco.org/science/environ.htm

Contains access to UNESCO's major Intergovernmental Scientific Programs with associations with international agencies providing data and information on environmental issues.

U.S. Census

http://www.census.gov

Data is organized by US counties and contains information on populations, administrative boundaries, transportation networks, and various other coverages including landmarks and juris-dictions

U.S. Fish and Wildlife Service (USFWS)

http://www.fws.gov/data/gishome.html

This site contains the Fish and Wildlife Service data organized by State and National categories and according to U.S. Fish and Wildlife Service Regions. This site also contains links to other GIS sites. Availability of coverage for the US may vary.

U.S. Forest Service (USFS)

http://www.fs.fed.us/
Forest Inventory Analysis (http://www.srsfia.usfs.msstate.edu/wo/wofia.htm)
Data organized by 9 National Forest System Regions. Contains data such as land classification and forest inventories as well as various sources of information regarding GIS applications.

United States Geological Society (USGS)

www.usgs.gov
http://edcwww.cr.usgs.gov/webglis
http://edcwww.cr.usgs.gov/eros-home.html
http://wwwrvares.er.usgs.gov/nawqa/digmap.html
Coverage within the United States and variable coverage of countries outside the US. Data organized by states, counties, and topographic quadrangles. Coverage will vary and availability for areas may be incomplete. Also includes remotely sensed data including Digital Orthophoto Quadrangles (DOQ) and aerial photographs form the National Aerial Photography Program (NAPP).

University of Edinburgh

http://www.geo.ed.ac.uk/home/gishome.html
This site has many links to digital data sites around the world.

World Conservation Monitoring Center (WCMC)

http://www.wcmc.org.uk/
World coverage organized by country. Information available in both map and table form.

WildlandsProject

http://www.wildlandsproject.org/
Goals of this organization centered on preserving much of the North American continent by creating core preserves, with buffer zones, and linking these areas with corridors. Corridors may allow for the interconnection of core areas and support the dispersal and migration of some species.

World Wildlife Fund (WWF)

http://www.worldwildlife.org
Data includes information regarding forest cover and protected areas with 80 National maps including countries in the Asia Pacific, Latin America, and the Caribbean. Digital maps produced in conjunction with the WCMC with more detailed coverage obtained from WCMW's site. Also on this site is an assessment of threatened and endangered forest within North America.

Appendix 11 Requested Roll-up Information for Completed Ecoregional Plans

The following is a list of roll-up information that team leaders will be asked to provide to the Conservation Planning Office in Boise, Idaho prior to peer-review at a Roundtable. This roll-up information will be used by Conservancy staff in presentations to federal agencies; Conservancy staff, trustees, and board member; academics; and other partners interested in learning more about ecoregional planning efforts.

Prior to a Roundtable, the Conservation Planning office will ask team leaders to provide the following information regarding their ecoregional plan:

- Who is on the core planning team (name, affiliation, role, phone number, and email)
- Where is the data generated from ecoregional planning efforts stored, in what format, and who is responsible for information management
- A list of conservation targets by species, terrestrial/aquatic community, marine habitat, or ecological system
- For each conservation target provide:
    - The percentage of all targets that met their conservation goals
    - The percentage of targets that met their conservation goals by species, communities (aquatic and terrestrial), and ecological system (aquatic and terrestrial)
    - The percentage of G1 and G2 species that met their conservation goals
    - The percentage of Federally listed threatened and endangered species that met their conservation goals
- List up to five critical threats (sources of stress) to targets that recur at many portfolio sites[1] across most or all of the ecoregion
- The number of portfolio sites in the ecoregion
- The number of portfolio sites in the ecoregion that are considered protected (High Biodiversity Health, Low Threat)
- The number of sites that contain aquatic communities/systems and species targets
- The number of action sites in the ecoregion
- The number of these action sites in the ecoregion that are landscape action sites
- An approximate estimate of the area of all the portfolio sites, all of the action sites, and all of the landscape-scale sites in the ecoregion. Note: areas of biodiversity significance or sites

[1] Portfolio sites are also known as areas of biodiversity significance.

may be assessed differently between plans (based upon the planning unit used or detail in site boundaries). Therefore, please check the one that is most applicable to your ecoregion:

Approximate % area of the ecoregion	**The entire portfolio of sites**	**All action sites**	**All landscape action sites**
0 - 10%			
11 - 20%			
21 - 30%			
31 - 40 %			
41 - 50%			
> 51%			

- Ownership percentage of the portfolio of sites broken down by:
  - Federal (National Park Service, US Forest Service, Bureau of Land Management, US Fish and Wildlife Service)
  - State
  - Private

  (e.g., number or percentage of sites within USFS ownership, number or precentage of sites with private ownership, etc.)

Appendix 12 Sonoran Desert Ecoregion: Basic Underlying Assumptions for Setting Goals

by Pat Comer and Rob Marshall, The Nature Conservancy

Conservation goals were established for species, grouped into several functional assemblages, and for ecological communities, as represented in the working ecoregional classification. Underlying assumptions for this initial set of conservation goals were documented in the ecoregional plan:

1. Occurrences of each conservation target described by experts as “medium” or “high” in viability are indeed potentially viable over the next 25-year period.
2. The four ecological subdivisions of the Sonoran Desert represent significant ecological variation for all conservation targets. Replicating each target within each of the subdivisions where they naturally occur therefore aids in conserving their natural range of variability within the ecoregion.
3. For conservation targets with natural ranges extending beyond the Sonoran Desert Ecoregion, similar conservation goals (in numbers and ecoregional scales for replication) should be applied in all other ecoregions to ensure that range wide variability is conserved.
4. Quinn and Hastings (1987) described a relationship between the number of populations protected and the probability of population persistence. They assumed that each population had a 30% probability of persistence and therefore the protection of 10 populations, rangewide, would give a >90% probability of at least one population persisting. We assume that this baseline number is too low or at least that it assumes more risk than is acceptable, given current knowledge.
5. The conservation status ranks (global ranks) applied to conservation targets, especially those indicating global imperilment and rarity (G1, G2, and G3) indeed reflect the potential for irrecoverable loss of a species or community type. Maintaining rangewide numbers of viable populations (if indeed enough exist) provides sufficient levels of conservation for monitoring over the next 25 years.
6. Sites protected and managed to meet the conservation goals will also serve to protect all G4-G5 species not specifically targeted.

Additional underlying assumptions specific to ecological communities and systems goals include:

7. The typical spatial pattern of the community type also provides an indication of how viable occurrences should be identified in the portfolio. For example, matrix types should be captured in extensive roadless areas, small patch types should be captured within context of

surrounding apparently functional landscapes, linear (riparian and coastal) types often occur as complex vegetation mosaics directly influenced by processes at many scales (e.g. upstream water diversion, long-shore coastal processes). These attributes were assessed for each occurrence when chosen for a conservation site.

8. Some concepts of population viability analysis may apply to ecological communities. Estimates of rangewide numbers of occurrences, when applied to selected characteristic species may inform community goals. However, profound differences between the potential recovery of species and "restorability" of ecological communities suggest, if anything, the application of higher numbers for communities than for species.

9. Matrix-forming communities lend themselves to expressing conservation goals as a percentage of historic extent. As opposed to expressing conservation goals as numbers of occurrences, area measures provide for greater emphasis on capturing ecological gradients in large conservation networks. The time period chosen as a benchmark is, therefore, also significant. We used the time period immediately prior to widespread European-American settlement (1600-1800). This time period is immediately before the most extensive and rapid human/technology-driven changes to ecosystems and is recent enough in the Americas to reflect ecological distributions under modern climatic conditions. To the degree that reasonable approximations of historic extent could be derived from various sources, they were utilized.

10. The hypothesized percentage of historic extent that would be adequate for conservation should relate to dynamic processes and typical pattern of the community and consider the influence of changing climate on vegetation distribution. The concepts of minimum dynamic area and shifting mosaic are useful for determining the area needed for maintaining the internal dynamics of the system. For an occurrence to persist over long time frames, it must be large enough to sustain, absorb, and buffer these disturbances. In the Sonoran Desert "matrix," dominated by creosote-bursage or palo verde-mixed cacti scrub, highly dynamic processes are likely limited to those driven by wind, and secondarily, flash flood events. However, we assumed that conserving characteristic ecological gradients, from mesa top to lower *bajada* are of central importance to the life histories of component species. An analysis of ecological gradients integrating coarse vegetation pattern with elevation, aspect, and slope provided insight into ecological representativeness and overall area requirements and of matrix-forming communities. Redundancy of typical ecological gradients in conservation sites was addressed through assessment of the relative extent, patch size, and adjacency relationships of major vegetation types within each ecological subdivision. Further research is required to adequately understand and represent all significant ecological gradients into Sonoran Desert conservation sites.

Recommended Reading

Quinn J. F. and A. Hastings. 1987. Extinction in subdivided habitats. Conservation Biology 1:198-208.

Appendix 13 Viability: Worksheet on Size, Condition, and Lanscape Context

Three factors—***size***, ***condition***, and ***landscape context***—should be considered in characterizing viable occurrences of the conservation targets (See Chapter 6 for more a more detailed description of these three factors).

- **Size** is a measure of the area or abundance of the conservation target's occurrence. For ecological systems and communities, size is simply a measure of the occurrence's patch size or geographic coverage. For animal and plant species, size takes into account the area of occupancy and number of individuals in a population. Minimum dynamic area, or the area needed to ensure survival or re-establishment of a target after natural disturbance, is another aspect of size.
- **Condition** is an integrated measure of quality of biotic and abiotic factors, structures and processes that characterize targets. This included factors such as reproduction, competitors/ predators, anthropogenic impacts, and biological legacies.
- **Landscape** context for populations, is an integrated measure of two criteria: connectivity to other populations and intactness of surrounding ecological processes and environmental regimes. For communities and systems, those patch and matrix types and aquatic communities and systems that depend on easily disrupted ecological processes occurring at a scale larger than the individual community are most at risk by what happens in the surrounding landscape.

Step 1. Assess the Viability of the Conservation Targets. Rank each target for *size*, *condition*, and *landscape context*, (Table A13-1) using the following scale:

- "Very Good" or 4.0
- "Good" or 3.5
- "Fair" or 2.5
- "Poor" or 1.

Step 2. Determine the overall viability rank for a target by computing the average value of the numeric scores for size, condition, and landscape context. Round the numeric average to the nearest 0.5 (e.g., 3.3 would round up to 3.5), and determine the viability rank using table 1 below.

4.0	Very Good
3.0, 3.5	Good
2.0, 2.5	Fair
<= 1.5	Poor

Table A13-1. Characterizing viable occurrences of the conservation targets

Conservation Target Occurrence	Size of Population	Size Viability Rank	Condition Rank	Condition Viability Rank	Landscape Context	Landscape Context Rank	Overall Viability Rank	Comments/ Justifications

This table is available on the Conservancy's Intranet site. Go to Conservation Science, Departments, Conservation Planning, Resources, Tools to find this worksheet. Contact Dan Peerless at dpeerless@tnc.org if you have difficulty finding this table on the Intranet.

Step 3. Target viability is then assigned to one of four viability classes, as follows:

“Very Good” = Excellent estimated viability

“Good” = Good estimated viability

“Fair” = Fair estimated viability

“Poor” = Poor estimated viability; or, not viable

Appendix 14 Use of a Suitability Index to Guide Selection of Conservation Sites in the Columbia Plateau Ecoregion

A large regional assessment of the entire Columbia River Basin by federal natural resources agencies was conducted prior to the Columbia Plateau ecoregional planning effort. This assessment provided a number of useful GIS coverages and databases for the ecoregional planning effort. The entire basin was classified into a hierarchical system of watersheds known as Hydrological Unit Codes (HUCs) by the U.S. Geological Survey. These 6th HUC subwatersheds were used as the selection unit by the Columbia Plateau team for potential conservation sites. For each 6th HUC unit an index of conservation suitability was calculated. This index was based upon the following factors: distance to existing conservation sites, human population density, road density, percent of land converted to human uses, aquatic integrity, and percent of land in private ownership. In essence, the suitability index is a mechanism for integrating biological, programmatic, economic, and socio-political factors in the portfolio design process. It is also a mechanism for indirectly assessing the viability of conservation targets when on-the-ground information on size, condition, and landscape context is not available. Each of the factors described above can be given different weights within the index in order to evaluate alternative portfolios of sites. For example, placing greater weight on the distance to existing conservation sites has the effect of clustering conservation sites near existing sites. The suitability index was used as part of a computerized site selection model known as BMAS—Biodiversity Management Area Selection. This model selects sites to meet the goals for the conservation targets while balancing the dual objectives of efficiency (greatest amount of targets in least amount of land) an suitability. The suitability index is used in the model to help select among sites that contain the same conservation targets. For more detailed information on the suitability index and sources of information for factors in the index, see Stoms *et al.* 1997. Preserve selection modeling in the Columbia Plateau. Final report to The Nature Conservancy of Washington. Available on the Web site: www.biogeog.ucsb.edu. Suitability indices are also being used in the Sierra-Nevada and Middle Rockies-Blue Mountains ecoregional plans.

Appendix 15 Assessing the Viability and Threats to Aquatic Targets

by Mary Lammert, Jonathan Higgins, and Mark Bryer,
The Nature Conservancy's Freshwater Initiative

The leading national threats to aquatic biota include hydrologic alteration, non-point source pollution and exotic species, although there are several less widespread threats that are still significant (Richter et al. 1997). The determination of the quality and viability of aquatic biodiversity targets and ecosystems is a critical step in the design of an ecoregional portfolio. From an assessment of the condition of the aquatic targets, planners can identify the best conservation opportunities as well as priorities for restoration. This example provides a brief summary of strategies to assess the quality and viability of aquatic targets and ecosystems.

The first step in assessing viability of aquatic targets is to identify and evaluate existing data for their availability, spatial extent, and accuracy. Many types of data can be readily used in a GIS to gain insight about potential quality and threats at scales ranging from landscapes to specific sites. These data include land use, sedimentation rates, dam/irrigation withdrawal location and amount, presence/abundance of exotic species, percentage of historic species present, location of point sources, stream flow gauge station data, and biomonitoring/chemical samples. In addition, expert knowledge can provide additional key information on the location and condition of high quality areas.

The second step is to determine the appropriate unit of evaluation given the resolution of the data and the size of the aquatic target. In many cases, assigning a quality rank to small watersheds (12 or 14-digit Hydrologic Unit Code [HUCs] as determined by USGS) will provide a good measure for aquatic targets that do not integrate large areas (e.g., small streams or rare species that use small to moderate-sized stream habitat). On the other hand, for targets such as large rivers or migratory fishes, assessing the condition of watersheds large enough to encompass processes that affect the target (e.g., 6 or 8-digit HUC) would be more appropriate. Analysis of large watersheds will provide good information to evaluate intact landscapes and identify larger-scale sites that protect many communities. However, data for these watersheds average the quality over extensive areas and, therefore, may not necessarily reflect the values of individual streams and lakes within them.

Individual stream segments and lakes can also be assessed by evaluating land use and land cover within buffers or individual catchments and with point data such as biomonitoring information. This higher resolution approach allows for a comprehensive assessment of the targets, giving information specific to each individual target. Such a scale of quality will allow specific conservation goals to be set for aquatic targets and improve our ability to identify the best sites for their protection.

The third step is to synthesize available data into a viability ranking scale and apply that scale to each unit of evaluation. Multiple criteria should be used when assessing degree of threats and quality, and the classes used to define ranks should be broad and address data gaps. Depending upon the data, you may wish to weigh all factors equally or give higher weight to certain criteria. Below are examples of quality ranking applied at the watershed and target scale.

▶ ***Example 1. Quality analysis at the watershed scale***

In the Middle Rockies-Blue Mountain ecoregion, six equally weighted factors were evaluated for 12-digit HUCs in a GIS to create an overall index of poorest viability to highest viability. This index is being used to select high quality examples of each aquatic target. In this ecoregion, extensive spatial data sets were available across a large portion of the ecoregion, including dams, exotic species distributions, pollution point sources, degraded waterbodies (303d listed), and critical salmonid areas. Expert opinion will be used to verify the viability of and threats to selected watersheds.

▶ ***Example 2. Quality analysis at the target level***

In contrast to example 2, in the Great Lakes ecoregion, each macrohabitat was evaluated for viability using a combination of expert opinion and GIS analysis. Overriding factors of expert opinion and state water quality data were first used to select preliminary "best occurrences" for each macrohabitat target. Secondarily, the presence of dams or channelization, as apparent from GIS data, was used to eliminate a macrohabitat occurrence from inclusion in the preliminary portfolio. Finally, land use was assessed in a buffer adjacent to the macrohabitat (buffer width was scaled to stream size) to rank the viability of all other macrohabitat occurrences. The result from this analysis was a viability rank of A, B, C, or D (best, good, fair, or poor, respectively) assigned to every stream and lake in the ecoregion. The A and B ranked occurrences were the first to be considered during preliminary site selection.

The appropriate level of effort and scale of analysis will differ for each ecoregional planning team depending upon on the process that is being used to identify targets, data availability, and capacity of the team. At a minimum, we recommend that the viability analysis be done at the 11-digit catalog unit scale and include factors that evaluate indirect impacts to aquatic targets (e.g., land use/land cover data), direct impacts (dams, point source pollution), and the presence of exotic species. Viability analysis of these watersheds will be useful for ecoregion planning that used either the ecological system or macrohabitat approach to identifying aquatic targets. Where data and resources allow, we also recommend that teams assess the viability of individual macrohabitats. Further guidance for assessing the quality and threats to targets is available from the Freshwater Initiative Aquatic Ecologists.

For more information, see the Freshwater Initiatives web site at http://www.freshwaters.org

Recommended Reading

Richter, B. D., D. P. Braun, M. A. Mendelson, and L. L. Master. 1997. Threats to imperiled freshwater fauna. Conservation Biology 11(5):1081-1093.

Appendix 16 GAP Analysis Examples

A GAP analysis of vegetation communities in conservation sites and public lands of the Columbia Plateau ecoregion.

Land cover was mapped independently for each of the states in the Columbia Plateau from a combination of Landsat Thematic Mapper imagery, field inventories, and existing vegetation maps. Inconsistencies in state Gap Analysis vegetation maps were reconciled by reclassifying satellite data with NOAA Advanced Very High Resolution Radiometer (AVHRR) imagery and assigning cover types at the alliance level of the National Vegetation Classification. Digital maps of land ownership and land management were compiled from the individual state Gap programs and each tract of land was assigned a Gap status of 1,2,3, or 4 to denote the relative degree of maintenance of biodiversity for each tract (1 = greatest degree of protection, 4 = lowest degree). The intersection or overlay of land management-ownership maps with vegetation cover types maps provided information on the percentages of different vegetation types found within lands of different management status. Forty-eight cover classes were mapped for the ecoregion. The total amount of land under conservation management in the ecoregion (e.g., in a research natural area, wilderness area, national park, Nature Conservancy preserve) is < 4%. Most cover types that are characteristic of the ecoregion have < 10% of their area under protection or conservation. Twenty of the 48 cover types were found to be particularly vulnerable to loss or degradation because of low levels of representation with biodiversity management areas and the impact of expected land-use activities. Gap analyses of these types have several limitations including unreliable representation of communities that typically occur as patches less than the minimum mapping unit, limited field verification of maps in some states, and limited information on the current condition or quality of vegetation on-the-ground. Despite these limitations, Gap analysis data and findings provide a considerable amount of useful information for the ecoregional planning process including target selection, goal setting, and site selection. For more information, see Stoms et al. (1998).

A GAP analysis of the protected areas of Colombia's Andean region.

Colombia's leading biodiversity research organization, the Alexander von Humboldt Institute, is conducting a project entitled "Conservation and Sustainable Use of Biodiversity in the Andes." The goal of this project, financed by the World Bank via the Global Environmental Facility, is to support implementation of Colombia's National Biodiversity Plan and assist in the application of the Plan's key strategies (sustainable and equitable use, conservation, and improved knowledge of biological resources) in the Andean region of Colombia (approximately one-fourth of the country).

One of the specific objectives of this project is to design a procedure for identification of priority biodiversity conservation areas in Colombia's Andean region. This includes designing a process for establishing a Protected Areas Master Plan. The project involves analysis of existing and proposed protected areas and their potential for contribution to biodiversity conservation, as well as an analysis of current policies and procedures for establishing protected areas.

This analysis includes four major steps:

1. Review the current protection situation in the Colombian Andean region:
   - Review and evaluation of current knowledge about biodiversity in the region
   - Review of current protection status for all categories of protected areas in the Colombian Andes, including national parks, regional parks, municipal parks, and private reserves
   - Review of the conservation goals of government and private organizations
   - Assessment of the current effectiveness of biodiversity conservation in the region
   - Assessment of the current level of financial resources available for biodiversity conservation

2. Design a procedure for identification of priority biodiversity areas in the region:
   - Evaluation of current methodologies for identifying priority biodiversity areas, including The Nature Conservancy's *Designing a Geography of Hope*
   - Adaptation of these methodologies to the Andean region
   - Identification of information requirements under the proposed methodology

3. Design a survey of the current status of biodiversity in the Andes with two objectives: (a) to guide identification of priority areas for biodiversity conservation, and (b) to serve as a baseline for a long-term monitoring program:
   - Review and evaluation of existing methodologies to survey biodiversity
   - Proposal of a methodology to generate a biodiversity baseline for the Andes
   - Implementation of the proposed methodology in a pilot region and evaluation of the methodology's viability
   - Identification of priority biodiversity areas for the pilot region
   - Identification of preliminary biodiversity conservation areas for the Andean region

4. Define a methodology for design of a protected areas system, including biological, cultural, social, and economic information:
   - Review and evaluation of existing categories of protected areas, in Colombia and in neighboring regions
   - Review of worldwide approaches for design and implementation of management plans for protected areas
   - Review of existing management plans for protected areas in the Andean region
   - Proposal of a methodology for development and implementation of management plans in the Andean region
   - Review of methodologies used for the design of protected areas systems
   - Definition of a methodology for the design of a protected areas system, composed of at least:
     - legally protected area making up the nuclei of the system
     - buffer zones around the nuclei intended for restricted use and promoted through conservation incentives and legal mechanisms
     - corridors connecting the nuclei also intended for restricted use and promoted through conservation incentives and legal mechanisms

Recommended Reading

Stoms, D. M., F. W. Davis, K. L. Driese, K. M. Cassidy, and M. P. Pressey. 1998. Gap analysis of the vegetation of the Intermountain semi-desert ecoregion. Great Basin Naturalist. 58:199-216.

Appendix 17 GAP and IUCN Ranking Categories

Biodiversity Management Status Categories of the GAP Analysis Program	
Category	**Description**
Status 1	An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.
Status 2	An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.
Status 3	An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense typen (e.g., mining). It also confers protection to federally listed endangered and threatened species throughout the area.
Status 4	There are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.

For additional info on the GAP Analysis Program go to http://www.gap.uidaho.edu/gap.

Categories & Management Objectives of Protected Areas as Defined by IUCN	
Category	**Description**
I	*Scientific reserve/ Strict Nature Reserve:* to protect nature and maintain natural processes in an undisturbed state in order to have ecologically representative examples of the natural environment available for scientific study, environmental monitoring, education, and for the maintenance of genetic resources in a dynamic and evolutionary state
II	*National Park:* to protect natural and scenic areas of national or international significance for scientific, educational and recreational use.
III	*Natural Monument/Natural Landmark:* to protect and preserve nationally significant natural features because of their special interest or unique characteristics.
IV	*Managed Nature Reserve/Wildlife Sanctuary:* to assure the natural conditions necessary to protect nationally significant species, groups of species, biotic communities, or physical features of the environment where these require specific human manipulation for their perpetuation.
V	*Protected Landscape or Seascape:* to maintain nationally significant natural landscapes which are characteristic of the harmonious interaction of man and land while providing opportunities for public enjoyment through recreation and tourism within the normal life style and economic activity of these areas.

For additional information on the IUCN and guidelines for protected area management categories go to http://www.iucn.org/theme/wpca/index.html.

Appendix 18 Recommendations and Contacts for Conservation Planning on Native American Lands

There are 100 million acres of Native American lands in the U.S. The Bureau of Indian Affairs is a trustee for 55 million acres of these tribally-owned lands while 44 million acres are owned by native corporations in Alaska. There are 570 tribes and 300 reservations in the U.S. It is inevitable that some ecoregional planning efforts will identify conservation targets and possibly areas of biodiversity significance on Native American lands. These lands and their owners require special considerations and strategies if partnerships are to occur. Listed below are suggested perspectives and strategies for forming partnerships with Native American tribes.

Background

- Native American land tenure is complex. It is essential to understand the land ownership/ management roles of tribal councils, tribal agencies, the Bureau of Indian Affairs (trustlands), individual Native American and non-native land ownership (allotments), native corporation owner (Alaska), etc. on the lands of interest.
- Native American politics is equally complex. Elected tribal chairs and council members hold official power, as do the tribal agency officials who report to them. But land use decisions may be strongly influenced by other factors and determined by traditional elders.
- With some notable exceptions, Native American peoples are experiencing high degrees of poverty and unemployment.

Strategies

- When communicating with tribal members clearly acknowledge overall goals and objectives for the meeting, the tribes potential involvement in the project, and the tribe's potential benefits from participating in the project (e.g., improved management of a listed species).
- The Conservancy's community-based conservation skills that were developed for traditional landowner groups (ranchers and farmers) may be applicable. Understanding the tribe's value and relationship with the landscape will be extremely useful.
- Lessons learned by the Conservancy's International Program staff in building partnerships may be useful tools when dealing with sovereign nations.
- Consider using the Conservancy's fund-raising and land acquisition strengths to help tribes consolidate land ownership within portfolio sites. Regaining land ownership, often lost through past allotment policies, is a high priority for some tribes. The Conservancy is not going to own and manage tribal sites, so success will depend on building the partnerships

that result in tribes managing their land for shared conservation objectives along with other compatible uses.

- An important and first-step strategy recommended by tribal contacts is to fund knowledgeable tribal members to work on their reservations at tasks related to the conservation of portfolio sites. Internships, or other programs, that employee recent college graduates on the reservation might be particularly effective.

Contacts

- Native American Fish and Wildlife Society, Patrick Durham, Technical Services Director, 303-466-1725. NAFWS staff are familiar with The Nature Conservancy's ecoregional conservation approach. Patrick can provide contact information and insights for tribes throughout the nation.
- Michele "Shelley" Silbert, No. AZ Ofc., TNC, (520) 774-8892. Shelley serves on the AZ/NM Mtns. and CO. Plateau ER teams and is developing strategies to involve several tribes (who control large portions of portfolio sites) in conservation activities.
- John Humke, TNC Government Relations, Boulder, CO., (303) 541-0357. John is the principal contact with NAFWS staff, has had some direct experience with conservation activities on tribal lands, and can direct you to other TNC offices with tribal land experience.

Appendix 19 New Tools for Identifying Aquatic Conservation Sites

by Mark Bryer, The Nature Conservancy's Freshwater Initiative

The Middle Rockies–Blue Mountains Ecoregion contains a vast diversity of aquatic communities, ranging from cold, salmonid-filled streams in northeast Oregon to the "vanishing rivers" in central Idaho to highly-productive carbonate streams that form the headwaters of the Missouri River in western Montana. When faced with the challenge of representing this diversity in a portfolio on a short timeline, the ecoregional planning team responded by using innovative tools in a Geographic Information System (GIS) to help them both identify this diversity and select sites that capture it.

Because aquatic communities were not previously defined in the ecoregion, the team relied on an approach created by the Freshwater Initiative's aquatic ecologists to understand their variety by understanding the physical habitats upon which they depend. Meeting with aquatic ecology experts across the ecoregion and using key GIS data created by the Interior Columbia Basin Ecosystem Management Project (a consortium of federal agencies created to better manage public lands in the region), the team built a list of stream and river habitat types that formed the targets for aquatic community conservation. Once defined, occurrences of each target were mapped across the ecoregion automatically in the GIS. A conservation goal for each target was set by assessing its distribution and abundance in the ecoregion, and comparing with other targets.

The team began the portfolio assembly process by using a second tool called SITES (see Chapter 7 for details on SITES), which references GIS data on targets and their occurrences to design reserves that most efficiently meet defined conservation goals. For the first time in a U.S. ecoregion, the Middle Rockies–Blue Mountains team applied SITES and integrated all targets—species and communities, both aquatic and terrestrial—to develop a preliminary portfolio of sites. Existing protected areas (such as TNC preserves and USFS Wilderness lands) were "locked in" to the portfolio, and additional planning units (defined in the ecoregion as small watersheds) were added on the basis of which targets they contained. "Suitability" indices were incorporated into SITES to weight planning units and cause more intact areas to be preferentially selected during portfolio assembly. A specific aquatic index was applied to all stream segments to favor sites that had fewer dams and exotic species, and better water quality.

Results from SITES proved supremely good for a first attempt, although many target goals were over-met, suggesting the solution wasn't as efficient as it could be. Some areas known to be heavily impacted were also selected, perhaps because of the presence of a single occurrence of a rare target. An essential step in the use of SITES was critical review and refinement of the program's output by the team. Using their knowledge of the landscape, the team removed some areas chosen by SITES and included others not selected. For aquatic community targets, intact watersheds (as opposed to individual stream segments) were the focus of site selection to increase ecological connectivity and improve conservation efficiency. The team delineated and prioritized preliminary conservation sites, and listed the key targets to be protected within each of these sites. Aquatic community targets in selected sites were identified as the physical habitat types and were further attributed with all biological information available.

The revised portfolio created by the team was fed back into SITES to re-evaluate how well overall goals were met. A number of targets whose goals were not completely met in the portfolio were identified for improved planning in the future. In summary, the team's use of new technologies combined with on-the-ground knowledge resulted in a portfolio for the Middle Rockies–Blue Mountains Ecoregion that represents and prioritizes sites that conserve much of the ecoregional diversity of aquatic communities.

Appendix 20 — Illustrative List of Stresses and Sources of Stress

Illustrative List of Stresses

Habitat destruction or conversion
Habitat fragmentation
Habitat disturbance
Alteration of natural fire regimes
Nutrient loading
Sedimentation
Toxins/contaminants
Extraordinary predation/parasitism/disease
Modification of water levels; changes in natural flow patterns
Thermal alteration
Salinity alteration
Groundwater depletion
Resource depletion
Extraordinary competition for resources
Excessive herbivory
Altered composition/structure

Illustrative List of Sources of Stress

Agricultural and Forestry
- Incompatible crop production practices
- Incompatible livestock production practices
- Incompatible grazing practices
- Incompatible forestry practices

Land Development
- Incompatible primary home development
- Incompatible second home / resort development
- Incompatible commercial / industrial development
- Incompatible development of roads or utilities
- Conversion to agriculture or silviculture

Water Management
- Dam construction
- Construction of ditches, dikes, drainage or diversion systems
- Channelization of rivers or streams
- Incompatible operation of dams or reservoirs
- Incompatible operation of drainage or diversion systems
- Excessive groundwater withdrawal
- Shoreline stabilization

Point Source Pollution
- Industrial discharge
- Livestock feedlot
- Incompatible wastewater treatment
- Marina development
- Landfill construction or operation

Resource Extraction
- Incompatible mining practices
- Incompatible oil or gas drilling
- Overfishing or overhunting
- Poaching or commercial collecting

Recreation
- Incompatible recreational use
- Recreational vehicles

Land/Resource Management
- Fire suppression
- Incompatible management of/for certain species

Biological
- Parasites/pathogens
- Invasive/alien species

Appendix 21 — Evaluating Multi-Site Strategies: an Example from the New Mexico Mountains Ecoregional Plan

Multi-Site Threat: Altered Fire Regime

Context:

- Public attitudes run predominantly against prescribed fire and wildfire
- Economic interests fear loss of timber revenue
- Attitude and perception toward prescribed fire and wildfire is slowly changing within agencies and the general public
- Agencies lack sufficient funding and staff to implement changes in fire management
- NEPA and ESA present obstacles to some agency-conducted prescribed burns
- Altered fire regime and inappropriate grazing are inextricably linked
- Population is growing and land is becoming fragmented at the urban/wildland interface
- The current level of prescribed burning and "prescribed natural fire" is far too low
- The landscape of the Arizona-New Mexico Mountains ecoregion has been deeply altered by more than 100 years of fire suppression and inappropriate livestock grazing

(see table on page A21-2)

Proposed Strategies	Strategy Feasibility						
	Cost	Impact	Probability of Success	Scale	Urgency	TNC Action?	Partners
Educate the public about need for restoration of fire regimes within the ecoregion.	H	H	M	Site, St, E, N	M	?	State and federal forestry agencies
Create sufficient resources within agencies to enable good fire management.	L/M	H	H	N	M/H	Y	US Dept of Interior, US DA
Focus agency fire management activities on portfolio sites.	L	H	H	E	H	Y	State and federal forestry agencies
Promote economic incentives for fire management, incl. *Reduction* of fuel loads in ponderosa pine and *increase* in fine fuels in wood/grasslands.	H	H	L	St, E	H	N	Many effective groups already involved
Encourage interagency communication and information exchange by convening one or several interagency fire teams.* Accomplish the following through these forums: • Establish incentives w/in agencies for well-planned ecological burning • Educate agencies re larger biodiversity, T/E species, & exotics issues • Liberate decision-makers from liability concerns • Hold workshop with agency fire managers to brainstorm identity of and solution to the bottleneck.	M	H	H	E, N	H	Y	State and federal forestry agencies

* Doing so would allow TNC to address several problems at once, and would perhaps open the unidentified bottleneck preventing state and federal forestry staff from conducting ecological burns and fire research.

Cost: Cost to TNC with respect to staff and funding; does not consider cost to partners. L = low, M = medium, H = high.

Impact: Degree of ecological risk reduction and breadth of geographic influence (i.e. number of portfolio sites).

Scale: Scale(s) at which strategy must be implemented. Site=site, St=state, E=ecoregion, N=nation.

TNC Action: Whether or not (Y/N) it is appropriate that TNC carry out this strategy.

Probability of Success and *Urgency:* Self-explanatory.

Appendix 22 Translating a Plan into Conservation in the Central Shortgrass Prairie

by Mark Burget, State Director of the Colorado Field Office for The Nature Conservancy

Approximately one year after the completion of the Central Shortgrass Prairie Ecoregional plan the Colorado Field Office (the lead state for the plan) organized the first annual implementation meeting. The state directors and conservation program staff from each state in the ecoregion attended. The goal was to monitor progress towards conservation and continue to collaborate on topics that affect all the states.

Site-based Strategies

The Central Shortgrass Prairie plan has generated considerable interest in many new sites. In addition, conservation activities will involve traditional and creative approaches including fee acquisition (KS, CO); easement acquisition (WY, CO); participation in the development of a Habitat Conservation Plan to address four short-grass prairie species that are proposed for listing under the Endangered Species Act (WY); outreach efforts to improve relationships with significant stakeholders such as ranchers (OK); evaluation of strategies designed to use TNC owned bison to assist other private landowners (CO); and the facilitation of a sample grazing demonstration compatible with conservation objectives (NE).

Cross-site Strategies

The Great Plains share many common social and environmental attributes that influence conservation. In particular, the group discussed how the proposed listing of the black-tailed prairie dog and mountain plover under the Endangered Species Act will present both challenges and opportunities to conservation. The listings are a very volatile issue where TNC may be able to help by working with other private landowners to develop conservation strategies that may enhance conservation of the target species and reduce the need for listing. The group agreed to develop cross-site partnerships and programs that will proactively conserve the target species. They all agreed to meet with their respective state cattlemen's association to discuss these strategies. In addition, the Colorado program agreed to meet with the Western Governors Association to draft a white paper presenting how conservation of these species in the Great Plains may work. On a related topic the group agreed to continue to develop better communication with private ranchers.

Filling Information Gaps

Ecoregional plans will continuously be refined and improved as new information becomes available. Betsy Neely of the COFO presented a proposal to use a newly formed and funded Central Shortgrass Prairie Task Force to fill those gaps. The proposal will be reviewed by the group for future action. She also emphasized the need to do Site Conservation Planning for the action or stage one sites.

Collaborative Funding

The meeting provided an opportunity for the state programs that share sites to discuss collaboration at those sites, potential funding for large-scale activities and the Great Plains component of the Capital Campaign.

Final Assessment

It was generally agreed that the meeting was a useful next step in implementing conservation strategies. Participants agreed it was an opportunity to note progress, or lack of progress in conserving the sites. A more formal structure was requested for the next meeting, in order to provide information about conservation at each site and to evaluate the effectiveness of cross-site activities.

Appendix 23 Publishing Ecoregional Plans on the Intranet for Conservancy Staff

The web is the perfect place for completed ecoregional plans, which are significant resources and excellent guides for others involved in the planning process, as well as for those implementing the plans. In addition, it appears from the experiences of team leaders of finished plans, that the plans are very much in demand. It will be far less expensive and time consuming to refer those inquiries to the internet, where the plans can be found, downloaded, and printed.

At this time the conservation science division is undergoing some changes and the process of submitting plans is rapidly changing. Below are some general guidelines but please contact Dan Peerless (dpeerless@tnc.org, 703-841-8784) of the Science Division at the Home Office to determine the best methods for submitting your plan.

General guidelines for submitting plans:

1. **Few Files:** Whenever possible, include images, tables and other supporting materials in the body of the text instead of as separate attachments. They will be automatically incorporated into the body of the document instead of needing to be manually added afterwards.
2. **Chapters:** It is acceptable, though not at all necessary, to provide the plan in multiple text blocks, divided into reasonable units such as chapters. One requirement for divided plans is that a separate table of contents be provided as well.
3. **File Formats:** Most common file types are acceptable. Microsoft Word, WordPerfect, and Pagemaker files are easily converted into web-compatible files. When sending maps and graphics, send eps or tiff files whenever possible.

DON'T:

Send Photocopies: All portions of a web-page must be in electronic format. If something from another source, such as a map, has simply been copied and inserted into the document, it cannot be used. Scanning images and maps is the recommended method.

Appendix 24 — Marine Considerations in Ecoregional Planning

by Mike Beck, The Nature Conservancy

The term marine refers to any coastal environment with salt water, which includes estuaries.

The guidelines for selecting marine targets, goals, sites, and portfolios in coastal environments generally are similar to those in terrestrial environments. This appendix highlights some additional points that should be considered in marine environments.

There are two ways to plan for conservation in marine ecoregions: (i) marine ecoregions can be considered as entities in their own right and developed as a full plan similarly to a terrestrial ecoregion or (ii) marine ecoregions can be considered as extensions of coastal terrestrial ecoregions and marine targets can be included within terrestrial plans in a manner similar to freshwater targets.

The former method has two advantages: (1) Marine ecoregions are already broadly recognized as distinct entities by government agencies and academia. (2) It may be difficult to give due consideration to marine biodiversity within the data constraints of a terrestrial ecoregional plan. Information on marine targets is often available, but not often in formats and sources (e.g., ABI databases) familiar to Conservancy ecoregional teams.

In places where there is significant overlap in terrestrial and marine ecoregions and due consideration can be given to marine targets, it should be possible to include marine targets within terrestrial ecoregional plans. This integration will provide a better understanding of the inherent connectivity of terrestrial, aquatic, and marine systems.

Identifying Conservation Targets

▶ ***Community and System Targets.*** For marine systems, as for terrestrial systems, it is best to examine community and system targets first and at the finest scale possible. Most marine conservation and management at the community or system level is directed at the habitat, which provides the underlying basis for the community. The classification of marine habitats is not as well developed as the classification of terrestrial communities, but there are some good marine habitat classification schemes that have been developed in specific regions (e.g., by the Washington State Department of Natural Resources).

▶ ***Species Targets.*** Marine species should be considered as conservation targets if (i) they are imperiled and conservation of their habitats will be insufficient for their conservation, (ii) they are declining faster than their habitats or (iii) their decline is likely to have strong effects on many other species. For example, the loss of top predators or keystone species may have important effects on trophic and community structure. In general, global rankings (G ranks) are not generally available for marine species because they tend to be more mobile and wide-ranging than terrestrial species and few will occur consistently at specific "point locations" or "occurrences."

Identifying Marine Targets in the Northern Gulf of Mexico

In the northern Gulf of Mexico, we can best conserve biological diversity by identifying nearshore conservation targets that create habitat, control process that affect water clarity and quality, and are good indicators of declines in water quality or clarity. Excellent examples of such targets include seagrasses, oyster reefs, and marsh (salt, brackish, and tidal fresh) communities.

Seagrasses provide a vital link in the maintenance of species diversity and secondary production throughout the Gulf of Mexico. Seagrasses are critically important for many reasons, because they:

- Provide food and refuge for many species
- Help to remove suspended sediments from the water column
- Add oxygen to the water and sediments
- May serve as nursery areas for juveniles of many species that migrate to the open Gulf as adults

Oysters are also a critical species in the northern Gulf of Mexico. Oysters provide food and refuge for many animals. In addition, they are vital regulators of water quality and clarity because they filter substantial quantities of water. The northern Gulf of Mexico provides more than half of the oysters harvested in the nation according to a 1997 NOAA report.

Seagrasses and oysters also can serve as good indicators of detrimental human impacts on estuarine environments, because their biology is well known, and the factors that strongly impact their distribution and abundance can be clearly identified. Seagrasses are sensitive to any factor that changes light availability, particularly, nutrient enrichment, eutrophication, and sedimentation. Oysters respond most strongly to factors that change salinity. Oysters also provide a handy measure of water quality, because they filter large quantities of water and bioaccumulate contaminants and pollutants.

Coastal salt, brackish, and tidal fresh marshes are extremely important to the productivity of coastal waters throughout the US and elsewhere. They are particularly abundant in the northern Gulf of Mexico and may support much of the fisheries production in this region. They also stabilize shorelines and provide structure to shelter many small fishes and invertebrates.

There are some species for whom preserving habitat is not enough in the northern Gulf of Mexico. Examples of these additional target species include the fringed pipefish, blackfin goby, longsnout seahorse, dwarf seahorse, opossum pipefish, Texas pipefish, manatee, Kemp's Ridley turtle, and Gulf sturgeon. The biology and ecology is well known for some of these species (e.g., manatees), but much less so for other species (e.g., pipefishes and seahorses).

Setting Goals

Many of the considerations for setting goals for marine targets are similar to those for terrestrial targets, but there are some additional points that should be considered.

▶ ***For Community/Habitat Targets.*** Conservation action must be more proactive in marine habitats than in terrestrial habitats before they are severely diminished because:

- Rates and processes are often different in marine vs. terrestrial environments. The spread of most threats in marine environments is faster and occurs over wider areas.
- The restoration of marine species and habitats has proven far more difficult than the restoration of terrestrial habitats and species.

A default goal should be to protect approximately 20% of the current distribution of each marine habitat type unless current distributions of the habitat are less than half of historical distributions. In cases of drastic decline, a greater goal should be set. A goal of 20% is generally used as the starting point for discussions about the ideal size for a system of marine protected areas.

▶ ***For species targets.*** The patterns of distribution, abundance, and rarity are very different for marine vs. terrestrial species. Some examples:

- Plants and animals usually have much wider distributions in marine vs. terrestrial systems
- There are approximately twice as many phyla of animals in marine systems as compared to terrestrial systems
- In general, there are fewer rare species per se in marine habitats than in terrestrial habitats, but most reproduction of marine species requires large populations.
- Marine species may be far less likely than terrestrial species to recover from significant reductions in population size. This problem has been demonstrated recently for abalone, urchins, groupers, and snappers.

▶ ***For both species and community targets.*** Just as for terrestrial systems, consideration must be given to representing the variability in species and habitats within an ecoregion. The present system of ecoregional boundaries developed by NOAA already includes reasonable subdivisions within ecoregions (Table A24-1).

Viability

▶ ***Marine Community/Habitat Considerations.*** The criteria of size, condition, and land/seascape context are valid for the consideration of the viability of marine communities and habitats.

- *Size:* In general, larger marine habitats are likely to be more viable than smaller ones within any habitat type.
- *Condition:* In marine communities, some of the factors that alter condition are invasive species, degraded water clarity (which kills macrophytic plants such as seagrasses and kelps), degraded water quality (e.g., nutrification, pollution), and overfishing (which can change community structure by removing top predators or forage fish).
- *Land/seascape context:* Factors that change the connectivity between habitats must be addressed. Connectivity between marine habitats is particularly affected by the flow of water. Water flow can be changed by alterations in inflow (riverine and runoff), the hardening of shorelines (e.g., seawalls), and other man-made structures (e.g., docks). Connectivity is also affected by dredging (which changes water flow and circulation) and channelization (e.g., when passes are cut across barrier islands altering flows and salinity). To date, there has been little direct consideration of the connectivity among marine habitats. For example, most marine reserves are specifically designed to encompass one type of system or habitat, usually a coral reef, with little consideration of the importance of nearby mangrove or seagrass habitats.

Designing a Network of Conservation Sites

The bay or estuary is the most appropriate and clearly defined natural unit for conservation in many nearshore marine environments. A portfolio can be assembled by ranking the conservation priority of the bays and estuaries within each subdivision of the ecoregion (e.g., using Sites). Within these larger bay and estuarine systems there may need to be smaller sites identified which more closely capture the target species. For instance if a key conservation target is a seagrass community, the bay in which this community occurs may be chosen but a smaller site may encompass the seagrass beds.

In tropical water, it necessary to consider coral reef tracts as systems in addition to bays and estuaries. On open coasts, which do not have clearly defined bays or other natural units, it may be necessary to define sites using grid-based geographic system.

The degree of prior/existing protection of sites is not likely to be an important consideration in developing portfolios in most marine ecoregions. While some marine habitats in the United States and elsewhere may fall within the bounds of nominal sanctuaries or aquatic parks, the protection from and restriction on threatening activities are slim to nonexistent. In addition, most other U.S. agencies that have identified high priority bays and estuaries are working on restoration projects not conservation projects. The Nature Conservancy should focus first on protecting intact marine systems.

Table A24-1. Biogeographic classification scheme of the NOAA National Estuarine Research Reserve System

The National Estuarine Research Reserve System was established to provide a nation-wide network of protected areas dedicated to research and education. In order to be sure all regions and habitat types are represented by this network when it is complete, a biogeographic classification scheme and typology of national estuarine areas have been developed.

The coastlines of the United States and its territories have been divided into the following areas based on their biologic and geographic characteristics:

Acadian

1. Northern Gulf of Mexico (Eastport to Sheepscot River)
2. Southern Gulf of Maine (Sheepscot River to Cape Cod)

Virginian

3. Southern New England (Cape Cod to Sandy Hook)
4. Middle Atlantic (Sandy Hook to Cape Hatteras)
5. Chesapeake Bay

Carolinian

6. Northern Carolinas (Cape Hatteras to Santee River)
7. South Atlantic (Santee River to St. Johns River)
8. East Florida (St. Johns River to Cape Canaveral)

West Indian

9. Caribbean (Cape Canaveral to Ft. Jefferson and south)
10. West Florida (Ft. Jefferson to Cedar Key)

Louisianian

11. Panhandle Coast (Cedar Key to Mobile Bay)
12. Mississippi Delta (Mobile Bay to Galveston)
13. Western Gulf (Galveston to Mexican Border)

Californian

14. Southern California (Mexican border to Pt. Conception)
15. Central California (Pt. Conception to Cape Mendocino)
16. San Francisco Bay

Columbian

17. Middle Pacific (Cape Mendocino to Columbia River)
18. Washington Coast (Columbia Rover to Vancouver Island)
19. Puget Sound

Great Lakes

20. Lake Superior, including St. Marys River
21. Lake Michigan and Huron, including Straits of Mackinac, St. Clair River, and Lake St. Clair
22. Lake Erie, including Detroit River and Niagara Falls
23. Lake Ontario, including St. Lawrence River

Fjord

24. Southern Alaska (Prince of Wales Island to Cook Inlet)
25. Aleutian Islands (Cook Inlet to Bristol Bay)

Sub-Arctic

26. Northern Alaska (Bristol Bay to Demarcation Point)

Insular

27. Hawaiian Islands
28. Western Pacific Islands
29. Eastern Pacific Islands

see http://www.nos.noaa.gov

Appendix 25 Ecoregional Planning Information Available on the Internet

The ConSci Forum is a website dedicated to providing information to Conservancy staff. One page is dedicated to providing information on ecoregional planning. To get to this page, go to www.consci.org and click on "Conservation Planning." From here there are several links to various ecoregional planning information. This ecoregional planning site will be updated to reflect evolving methods and thinking on ecoregional planning. For more information, contact Dan Peerless (dpeerless@tnc.org) or Renee Mullen (rmullen@tnc.org).

Guidelines

- *Geography of Hope*, Second Edition
- *Geography of Hope* Updates
  - Update #1: Contents of an ecoregional plan
  - Update #2: Results from a roundtable discussion
  - Update #3: Getting an ecoregional plan started
  - Update #4: Engaging experts
  - Update #5: Ecological processes and landscape patterns: considerations for ecoregional planning
  - Update #6: Including Aquatic Targets in Ecoregional Portfolios: Guidance for Ecoregional Planning Teams
  - Update #7: Incorporating birds into the ecoregional planning process

In the News

- *One Conservancy* articles

Plans and Maps

- The Map of US ecoregions
- Some completed plans, we are working to have all completed plans located here
- Status map of completed ecoregional plans

Tools and Templates (examples from completed Conservancy ecoregional plans)

- Groundwork
  - Job Descriptions
  - Budgets
  - Team Charters

- Gathering the Pieces
  - Expert Workshops
  - Information gathering (requests for data)
- Portfolio Assembly and Design
  - Site selection and assembly
  - Portfolio design
  - Threats and feasibility assessment
  - Setting priorities
  - Multisite Strategies
- From Planning to Practice
  - Fact sheet for policy makers

Learning and Teaching

- LACD Ecoregional Planning Training
- Presentations
  - New Employee Workshop Conservation Process Presentation
  - Ecoregional Planning Powerpoint presentation
- Other Ecoregional Conservation Sites
  - Ecoregional atlas at the EPA
  - US Forest Service ecoregions
- Canadian ecozones
  - Southwest Ecoregion Planning Group
  - Fish and Wildlife Service Report on the "Ecosystem Approach"

Schedule and Analysis of Plans

- Schedule organized by ecoregion, by lead state, and by lead division
- Roll-up information

Appendix 26 Principles & Concepts in Conservation Biology Related to Ecoregional Planning

Introduction

Conservation biology, while practiced for centuries, is a relatively new science—derived from various other fields including population biology, genetics, forest and wildlife management, ecology, economics, anthropology, and philosophy. The field of conservation biology focuses on the protection of biological diversity at all levels, including genes, populations, species, habitats, ecosystems, and landscapes, as well as the maintenance of ecological processes, such as natural selection, natural disturbance, and hydrologic flow. Current thinking within conservation biology differs from traditional resource conservation in that it is driven not by utilitarian, single-species issues, but by the desire to conserve the biological components and ecological processes within entire ecosystems. What has emerged from this field is a complex set of terminology (see glossary) and concepts.

Ecoregional planning (or reserve selection), a subset of the conservation biology field, involves working at large geographic scales to systematically determine areas of biodiversity significance and thus conservation importance. In contrast, site planning (or reserve design) focuses on the best methods to achieve conservation success at a particular site or area.

In this section, we highlight a subset of the principles and concepts within conservation biology as they relate to ecoregional planning. This certainly is not meant to be an inclusive list of concepts, but rather a highlight of some concepts that are relevant to ecoregional planning efforts.

Principles and Concepts

▶ *Biodiversity, Species Richness*

Biodiversity is a key concept in conservation biology and one that is often overused and poorly defined. In essence, biodiversity is the variety of living organisms including their genetic diversity and the types of ecological communities which they comprise. Biodiversity not only refers to species diversity, but to multiple levels of organization at spatial and temporal scales.

Two relatively simple ways to measure biodiversity are species richness and species diversity. Species richness measures the number of species found in an area. Species diversity also measures numbers of species, but weights individual species according to their abundance, productivity, or size. Species richness is usually used because available data often come in the form of species lists. Species diversity, however, is a useful measure to compare ecological communities and to assess the adverse effects of an environmental disturbance. Typically, a community that has experienced an ecological stress will have a reduced species richness and dominance of a few species. While these are straightforward and relatively easy measures of biodiversity (compared to other measures such as genetic diversity), they do not capture the genetic variability or abundance of a population and therefore, have limitations as a true measure of biodiversity.

▶ *Connectivity: Corridors and 'Nodes, Networks, and MUMs'*

A sad reality for biodiversity conservation is that in almost every ecoregion, fragmentation is a factor that must be addressed—especially for large-scale planning efforts such as ecoregional planning. One way to address fragmentation issues is to look at ways to connect habitat and landscapes. Corridors, strips of habitat that connect isolated habitat patches, may accomplish this connectivity of fragmented habitats. There are three types of corridors—based upon the scale of the areas to be connected: fencerow scale which connect small patches; mosaic landscape scale which are broader and longer in order to connect larger landscapes; and regional scale corridors which connect several large reserves in a network. Typically, the larger the scale to be connected, the wider and longer the corridor must be to prevent edge effects and to provide the habitat for larger, wide-ranging species. The success of corridors remains largely untested, therefore it is important to consider the function that a corridor may potentially play in the long-term viability of a reserve.

Another approach to reserve selection and design was developed by Reed and Noss in 1986 called "Nodes, Networks, and MUMs." A node is a relatively small area that may change in space and time but that contain high species diversity, high endemism, and/or critical resources. These nodes may then be connected in a network of reserves using corridors. Multiple-use Modules (MUMs) are protected areas surrounded by a series of buffer zones. Each zone allows more human use and management the further they are from the core protected area.

▶ *Edge effects, Fragmentation, and Exotic species, and Predators*

Fragmentation results in two very important consequences to natural systems: direct loss of habitat (including both total loss and decreased size of patches) and increased isolation of habitats. Direct loss of habitat is by far the most serious threat associated with fragmentation. However, as the theory of island biogeography predicts, decreased size also leads to increased extinction and increased isolation leads to decreased immigration rates. Therefore, a small, isolated habitat patch is expected to have a small population and is less likely to experience dispersal from surrounding populations. Metapopulation theory indicates that an unoccupied patch of suitable habitat is less likely to be colonized by a species if it is isolated. A metapopulation can become threatened if too many suitable habitat patches are isolated by fragmentation. This can lead to extinction of local populations and threaten the survival of a species.

In addition to individual species, fragmentation also affects communities, ecosystems, and landscapes. Problems include biotic and abiotic edge effects, increased human access and disturbance of sensitive habitats and species, and disruption of natural disturbance regimes, hydrology, and other processes. Fragmentation often leads to a reduction in native species and an increase in exotic species or weeds. Again, different species are affected by fragmentation in different ways, and it is important to determine the thresholds below which specific species experience negative ramifications.

Influences and fluxes from outside a reserve occur at reserve boundaries and are known as 'edge effects.' Common edge effects include increased invasion by exotic species, increased predation, and changes in microclimatic conditions, including increased temperature, decreased moisture, and increased wind. Successful reserve design relies on knowledge of how a habitat mosaic is affected by movement of organisms, materials, and other influences from outside the reserve, or even from outside the greater region. These fluxes between systems can occur even when boundaries appear to exist. In addition, human influences may have initiated, stopped, or changed important fluxes in the landscape. Changes in these fluxes as well as other influences may alter population, community, or ecosystem processes within a conservation site so that they no longer occur naturally. Reserve design and management may have to compensate for these changes.

▶ *Focal species: keystone, umbrella, flagship, indicator, wide-ranging*

Focal species are sometimes used as a surrogate method in reserve selection when data is lacking for other targets. This is because their requirements for viability may represent factors important to maintaining the ecological integrity for other species. Focal species, however, have their limitations. In many instances, unjustified assumptions have been made of the species-habitat relationship and selection criteria have been biased towards particular species. As with any surrogate, assumptions must be clearly stated and defined.

Various focal species have been used in conservation and reserve selection including:

- *Keystone species* may make an unusually strong contribution to a community structure and may enrich ecological functions with the ecosystem. Their contribution is typically unproportional to their abundance (e.g. beaver or prairie dogs)
- *Umbrella species* are typically wide-ranging species that require large blocks of relatively natural or unaltered habitat. The assumption here is that if you protect enough habitat to assure the viability of these species, more restrictive species may benefit (e.g. grizzly bear)
- *Flagship species* or charismatic species are typically used in public relations and educational campaigns to draw attention to an issue or to build support for reserve selection. These species typically have a wide appeal to general audiences (e.g. giant panda).
- *Indicator species* are the 'canary-in-the coal-mine' and are typically sensitive to ecological changes and are found in a highly specific niche. Therefore, they may useful for monitoring habitat quality and to act as a surrogate for ecological integrity (e.g. river otters for river systems) .
- *Wide-ranging species* (i.e. regional) utilize vast areas. Examples include top-level predators (e.g., wolves, grizzly bear, pike minnow, killer whale) as well as migratory mammals (e.g. caribou), anadromous fish, birds, bats and insects. These species can be especially useful in examining necessary linkages among conservation sites in a true "network" of sites.

▶ *Habitat Change and Natural Disturbance*

Nearly all habitat mosaics are dynamic. Habitat mosaics undergo change in two ways: 1) individual patches may appear, change size or shape, or disappear and 2) the structure, function, or composition within individual patches may change. These changes within individual patches and in the distribution of habitat patches across space and throughout time are referred to as 'patch dynamics.' The overall changing landscape pattern is referred to as a 'space-time mosaic' or 'shifting mosaic.' Current reserve design considerations emphasize patch dynamics within a habitat mosaic rather than the successional sequence of community change that occurs within a spatially-fixed single habitat type.

Habitat mosaics and their characteristic patch dynamics are primarily controlled by the nature of the underlying environment and myriad of multi-scale natural processes, including disturbances. Natural disturbance regimes are particularly important because they can influence population dynamics, including local extinction. No matter the scale or type of disturbance, each has important attributes, including size, timing, frequency, magnitude, intensity, and spatial location and extent. For example, a forest may experience treefall on a relatively frequent basis at a small spatial scale, whereas hurricanes and tropical storms may occur less frequently but at a much larger spatial scale. The variation in these attributes creates the temporal and spatial patterns that define habitat mosaics and their resulting patch dynamics.

▶ *Habitat Pattern*

Habitat pattern is the spatial and temporal distribution of different kinds of 'patches' across the landscape. The total assemblage of critical habitat patches (and the inter-patch areas) is often called a 'mosaic.' Habitat patches comprising a mosaic can be defined in various ways, depending on the species and communities of conservation concern. Different species perceive and utilize an area in different ways, both in terms of preferred patches as well as the spatial and temporal scale at which they interact with the patches. For example, a single habitat patch for a grizzly bear, a species with a very large home range, may constitute an entire landscape for a butterfly, which interacts with the landscape at a much finer scale. Thus, patches are determined according to the biodiversity we are trying to conserve. Habitat patches are often defined by different coarse-level land cover types (e.g., forest, shrubland, grassland, water), but can also consist of finer designations (e.g., deciduous forest, mixed forest, conifer forest), depending on the requirements of the focal species or communities and available information.

Specific aspects of habitat pattern to consider in reserve selection and design include the number and type of patches, the amount of different types of patches, the size of patches, and the distance between patches. In addition, the inter-patch area or 'matrix' is an important component of the overall habitat mosaic that determines the connectivity of the area and the ability of organisms to disperse and migrate among the more desirable patches. All these factors have a large effect on population survival and viability

▶ *Metapopulations*

For any species, a habitat mosaic is composed of patches that vary in quality. Suitable patches for a particular species are sometimes isolated areas surrounded by a matrix of less-suitable or completely unsuitable habitat. This has a strong influence on population dynamics in a landscape. Because suitable habitat for a particular species varies spatially, many species are distributed as metapopulations, or groups of sub-populations linked together by dispersal. Metapopulations are often characterized by sources and sinks. Sources are comprised of suitable habitat and generally produce excess individuals, whereas sinks are comprised of unsuitable habitat and result in reductions in population size.

A metapopulation can be threatened if dispersal between suitable habitat patches becomes difficult or impossible due to loss of connectivity. Again, the target species chosen will determine the degree of connectivity between patches. Barriers to one species are not necessarily barriers to another, and conversely connectors for one species are not necessarily connectors for another, so it is important to determine the life history characteristics of the target species (e.g., dispersal behavior), as well as the spatial and temporal characteristics of the habitat mosaic.

▶ *Minimum Dynamic Area*

Patch dynamics and the importance of disturbance regimes has led to definition and consideration of 'minimum dynamic area.' Minimum dynamic area has been defined as the smallest area that is needed to maintain a natural habitat, community, or population based on natural disturbance regimes and the ability of the biota to recolonize or restabilize component species. In this context, identification of a minimum dynamic area for a particular conservation target is based on the size of patches created by various disturbances, the frequency of those disturbances, the longevity of the resulting patches, and the ability of the component species to disperse through the greater mosaic. More recent work in landscape ecology has expanded this definition to include not only issues related to species viability, but also the maintenance of the disturbance regime itself. In many cases, however, even the largest available conservation sites are too small or too fragmented to fully rely on natural processes to maintain minimum dynamic areas or shifting mosaics. In these situations it may be necessary to consider the minimum size area that can be managed to simulate natural disturbance regimes through ecological management.

▶ *Nonequilibrium Paradigm*

An early and dominant theory in ecology, known as the equilibrium paradigm, stated that ecological systems had a climax state that was structurally and functionally maintained—a "balance of nature." This concept assumed that if a system were left alone, without human intervention, it would return to a climax stage.

Only recently has this concept been challenged. Today, conservation biologists focus on a non-equilibrium paradigm in which it is assumed there is no endpoint for an ecological system. Instead, it is recognized that systems are continuously changing due to disturbances in the system. Implications of the nonequilibrium paradigm to ecoregional planning are vast: reserves will and should change from natural disturbances; reserves will not (and should not) maintain themselves in a climax for extended periods of time; and a reserve should not be isolated from its surrounding ecological processes and functions. Ecoregional planning should incorporate the dynamics of ecological change and disturbance—this may be easier to do in larger reserves than in smaller ones where a disturbance may decrease biodiversity and viability.

▶ *Vulnerability*

Within the Conservancy's ecoregional planning process, vulnerable species are considered target species. The Conservancy has defined a *vulnerable species* as typically abundant, may or may not be declining, but some aspect of their life history makes them especially vulnerable (e.g., migratory concentration or rare/endemic habitat). For example, sandhill cranes are a vulnerable species because a large percentage of the entire population aggregates during migration along the Platte River in Nebraska.

This definition varies somewhat from the general definition of vulnerable within the field of conservation biology where vulnerable species are further refined and categorized in three ways: rare, long-lived, and/or keystone dependent species. A *rare species* is one that is not common and does not dominate the biota. This is defined by the distribution pattern of the species. So, a species may be said to be rare if it has a highly restricted geographic range, high habitat specificity, or small local population size—or a combination of these criteria. Long-lived species are vulnerable to extinction because they can not adapt to rapid ecological disturbances. These species typically have delayed maturation, low fecundity, and high juvenile survival rates. They are dependent on the stability of their habitat and do not adapt well to degradation of their habitat. *Long-lived species* are also vulnerable to extinction because their decline may occur over an extended period of time and therefore may be difficult to monitor. In contrast, a *keystone dependent species* is one whose survival is dependent upon another species (or group of species) that makes an usually strong contribution to a community or ecological process. If this keystone species is extirpated, the dependent species may display rapid population decline (e.g. keystone pollinator species).

Appendix 27 Glossary

action sites—The subset of sites from the full portfolio of ecoregional conservation sites where the Conservancy is committed to achieving conservation over the next ten years. Criteria considered during the "action site" selection process are complementarity, conservation value, threats, feasibility, and leverage. Domestic ecoregional planning project will select approximately 40 action sites to meet the Conservancy's overall conservation goal of 2500 sites conserved in the next 10 years. In reality, the number of sites and new projects undertaken by a field office will depend on staff capacity, fundraising capability, urgency of threats, and other factors.

alliance—A coarse level of biological community organization in the US National Vegetation Classification, defined as a group of plant associations sharing one or more diagnostic species (dominant, differential, indicator, or character), which, as a rule, are found in the uppermost strata of the vegetation. Aquatic alliances correspond spatially to macrohabitats.

areas of biodiversity significance—Although the term conservation site is often used to describe areas chosen through the process of ecoregional planning, in actuality these are areas of biodiversity significance and different from sites as defined in site conservation planning. Although ecoregional plans may delineate rough or preliminary site boundaries or use other systematic units such as watersheds or hexagons as site selection units, the boundaries and the target occurrences contained within these areas are first approximations that will be dealt with in more specificity and accuracy in the site conservation planning process.

assembly—A step in the Conservancy's ecoregional planning process wherein "sites" or areas of biodiversity significance are selected for inclusion in the portfolio of sites. Computer algorithms (such as SITES) and spreadsheets are available to speed this process.

association—The finest level of biological community organization in the US National Vegetation Classification, defined as a plant community with a definite floristic composition, uniform habitat conditions, and uniform physiognomy. With the exception of a few associations that are restricted to specific and unusual environmental conditions, associations generally repeat across the landscape. They also occur at variable spatial scales depending on the steepness of environmental gradients and the patterns of distribution.

aquatic ecological system—Dynamic spatial assemblages of ecological communities that 1) occur together in an aquatic landscape with similar geomorphological patterns; 2) are tied together by similar ecological processes (e.g., hydrologic and nutrient regimes, access to floodplains and other lateral environments) or environmental gradients (e.g., temperature, chemical and habitat volume); and 3) form a robust, cohesive and distinguishable unit on a hydrography map.

biological diversity—The variety of living organisms considered at all levels of organization including the genetic, species, and higher taxonomic levels. Biological diversity also includes the variety of habitats, ecosystems, and natural processes occurring therein.

biodiversity hot spot—Typically, a geographic location under a high degree of threat and characterized by unusually high species richness and large numbers of endemic species.

bioreserve—A landscape, large in size with naturally functioning ecological processes and containing outstanding examples of ecosystems (ecological systems), communities, and species which are endangered or inadequately protected.

coarse filter-fine filter approach—A working hypothesis that assumes that conservation of multiple, viable examples of all coarse-filter targets (communities and ecological systems) will also conserve the majority of species (fine-filter targets). The term coarse filter refers to targets at the community or system level of biological organization whereas coarse-scale refers to spatial scale of, for example, terrestrial targets that roughly cover 20,000–1,000,000 acres.

coarse-scale approach—Ecological systems or matrix communities are spatially large terrestrial targets referred to as coarse-scale. The coarse-scale approach is the first step in the portfolio assembly process where all coarse-scale targets are represented or "captured" in the ecoregion (including those that are feasibly restorable).

community—Terrestrial or plant communities are community types of definite floristic composition, uniform habitat conditions, and uniform physiognomy. Terrestrial communities are defined by the finest level of classification, the "plant association" level of the National Vegetation Classification. Like ecological systems, terrestrial communities are characterized by both a biotic and abiotic component. Even though they are classified based upon dominant vegetation, we use them as inclusive conservation units that include all component species (plant and animal) and the ecological processes that support them.

complementarity—The principle of selecting action sites that complement or are "most different" from sites that are already conserved. We can define sites that are already conserved as those with targets that have high biodiversity health (as measured by size, condition, and landscape context) and low threat rankings.

completeness—In portfolio assembly, the attempt to capture all targets within functional sites.

connectivity—Conservation sites or reserves have permeable boundaries and thus are subject to inflows and outflows from the surrounding landscapes. Connectivity in the selection and design of nature reserves relates to the ability of species to move across the landscape to meet basic habitat requirements. Natural connecting features within the ecoregion may include river channels, riparian corridors, ridge-lines, or migratory pathways.

conservation focus—Those targets that are being protected and the scale at which they are protected (local scale species and small patch communities; intermediate scale species and large patch communities; coarse scale species and matrix communities; and regional scale species).

conservation goal—In ecoregional planning, the number and spatial distribution of on-the-ground occurrences of targeted species, communities, and ecological systems that are needed to adequately conserve the target in an ecoregion.

conservation status—Usually refers to the category assigned to a conservation target such as threatened, endangered, imperiled, vulnerable, and so on.

conservation target (see target)

conservation value—A criterion in the action site selection process that is based upon the number, diversity (scale, aquatic/terrestrial), and health of conservation targets.

corridor—A route that allows movement of individuals or taxa from one region or place to another. In ecoregional planning, it is important to establish corridors among sites for conservation targets that require such areas for dispersal and movement Focal species may help designing corridors and linkages.

decline/declining—For conservation targets, the historical or recent decline through all of part or its range. Declining species exhibit significant, long-term declines in habitat/and or numbers, are subject to a high degree of threat, or may have unique habitat or behavioral requirements that expose them to great risk.

disjunct—Disjunct species have populations that are geographically isolated from that of other populations.

distribution pattern—The overall pattern of occurrence for a particular conservation target. In ecoregional conservation projects, often referred to as the relative proportion of the target's natural range occurring within a given ecoregion (i.e.; endemic, widespread, limited, disjunct, peripheral).

ecological backdrop—Large areas of intact natural vegetation that occur in portions of an ecoregion but outside of conservation sites and are recognized as having critical importance in connectivity, ecological context, and function of natural processes. Ecological backdrops are differentiated from conservation sites by the anticipated lower level of on-the-ground conservation and strategies that may focus on large scale policy issues, such as multi-site threat abatement.

ecological communities (see community)

ecological complex—In some ecoregional planning efforts, such as the Northern Great Plains Steppe Ecoregional Plan, ecological systems are referred to as ecological complexes.

ecological drainage units (EDU)—Aggregates of watersheds that share ecological and biological characteristics. Ecological drainage units contain sets of aquatic systems with similar patterns of hydrologic regime, gradient, drainage density, & species distribution. Used to spatially stratify ecoregions according to environmental variables that determine regional patterns of aquatic biodiversity and ecological system characteristics.

ecological integrity—The probability of an ecological community or ecological system to persist at a given site is partially a function of its integrity. The ecological integrity or viability of a community is governed primarily by three factors: demography of component species populations; internal processes and structures among these components; and intactness of landscape-level processes which sustain the community or system.

ecological land units (ELU)—Biophysical or environmental analyses such as (ELUs) combined with land cover types and satellite imagery can be useful tools for predicting locations of communities or ecological systems when such information is lacking, and capturing ecological variation based upon environmental factors. ELUs are derived using readily available digital spatial data sets such as digital elevation models, surficial geology, and hydrography and are defined as combinations of several environmental variables.

ecological system (see terrestrial ecological systems or aquatic ecological system).

ecoregion—A relatively large area of land and water that contains geographically distinct assemblages of natural communities. These communities (1) share a large majority of their species, dynamics, and environmental conditions, and (2) function together effectively as a conservation unit at global and continental scales." Ecoregions were defined by Robert Bailey as major ecosystems resulting from large-scale predictable patterns of solar radiation and moisture, which in turn affect the kinds of local ecosystems and animals and plant found within.

edge effect—The influence of a habitat edge on interior conditions of a habitat or on species that use interior habitat. Greater amounts of edge habitat can often lead to deleterious effects on "interior" target species.

efficiency—In portfolio design, a principle in which occurrences of coarse-scale ecological systems that contain multiple targets at other scales are given priority. This is accomplished through identification of functional sites and landscapes. In more academic literature, efficiency refers to conserving the greatest amount of biological diversity in the least amount of land area.

element—A term originating from the methodology of the Natural Heritage Network that refers to species, communities, and other entities (e.g., migratory bird stopovers) of biodiversity that serve as both conservation targets and as units for organizing and tracking information.

element occurrence (EO)—A term originating from methodology of the Natural Heritage Network that refers to a unit of land or water on which a population of a species or example of an ecological community occurs. For communities, these EOs represent a defined area that contains a characteristic species composition and structure.

endangered species—A species that is federally listed or proposed for listing as Endangered by the U.S. Fish and Wildlife Service under the Endangered Species Act.

endemic—Species that are restricted to an ecoregion (or a small geographic area within an ecoregion), depend entirely on a single area for survival, and are therefore often more vulnerable.

feasibility—A principle used in ecoregional planning to select Action Sites by evaluating the staff capacity of TNC and partners to abate threats, the probability of success, and the financial costs of implementation.

fine filter—To ensure that the coarse-fine filter strategy adequately captures all viable, native species and ecological communities, ecoregional planning teams also target species that cannot be reliably conserved through the coarse-filter approach and may require individual attention through the fine filter approach. Wide-ranging, very rare, extremely localized, narrowly endemic, or keystone species are all likely to need fine-filter strategies.

focal species—Focal species have spatial, compositional and functional requirements that may encompass those of other species in the region and may help address the functionality of ecological systems. Focal species may not always be captured in the portfolio through the coarse filter. In the Conservancy's ecoregional planning efforts wide-ranging and keystone are examples of focal species.

fragmentation—Process by which habitats are increasingly subdivided into smaller units, resulting in their increased insularity as well as losses of total habitat area. Fragmentation may be caused by humans (such as development of a road) or by natural processes (such as a tornado).

functional conservation site—A site which maintains targets and their supporting ecological processes within their natural ranges of variability. A functional conservation site will conserve a small number of ecological systems, communities, or species at one or two scales below regional and targets tend to be relatively few, often sharing similar ecological processes.

functional landscape—Sites where we seek to conserve a large number of ecological systems, communities, and species at all scales below regional. The conservation targets are intended to represent many other ecological systems, communities, and species (i.e., "all" biodiversity). The distinction between functional landscapes and sites is not always clear cut—the operational difference between the two is the degree to which the conservation targets are used to represent other biodiversity combined with their multi-scale nature.

functional network—An integrated set of functional sites and landscapes designed to conserve regional species. Portfolios of sites in regions of the country that still support wide-ranging species like the grizzly bear should be based upon functional networks of sites.

functionality—In portfolio assembly, a principle where we ensure all sites in a portfolio are functional or feasibly restorable to a functional condition. Functional sites maintain the size, condition, and landscape context within the natural range of variability of the respective conservation targets.

GAP (National Gap Analysis Program)—Gap analysis is a scientific method for identifying the degree to which native animal species and natural communities are represented in our present-day mix of conservation lands. Those species and communities not adequately represented in the existing network of conservation lands constitute conservation "gaps." The purpose of the Gap Analysis Program (GAP) is to provide broad geographic information on the status of ordinary species (those not threatened with extinction or naturally rare) and their habitats in order to provide land managers, planners, scientists, and policy makers with the information they need to make better-informed decisions.

GIS (Geographic Information System)—A computerized system of organizing and analyzing any spatial array of data and information.

global rank—A numeric assessment of a biological element's relative imperilment and conservation status across its range of distribution ranging from G1 (critically imperiled) to G5 (secure). Assigned by the Natural Heritage Network, global ranks for species and communities are determined primarily by the number of occurrences or total area of coverage (communities only), modified by other factors such as condition, historic trend in distribution or condition, vulnerability, and threats.

habitat—The place or type of site where species and species assemblages are typically found and/or successfully reproducing. In addition, marine communities and systems are referred to as habitats. They are named according to the features that provide the underlying structural basis for the community.

Heritage—A term used loosely to describe the Network of Natural Heritage Programs and Conservation Data Centers or to describe the standardized methodologies used by these programs.

imperiled species—Species which have a global rank of G1-G2 by Natural Heritage Programs/Conservation Data Centers. Regularly reviewed and updated by experts, these ranks take into account number of occurrences, quality and condition of occurrences, population size, range of distribution, threats and protection status.

imperilment—A term from Natural Heritage methodology referring to the degree to which an element of biodiversity (e.g., species or community) is considered at risk of extinction or elimination. Three factors can be considered part of the term: 1) evidence of current or historic decline; 2) threat, or likelihood, that human action will result in future decline; and 3) rarity.

indicator species—A species used as a gauge for the condition of a particular habitat, community, or ecosystem. A characteristic or surrogate species for a community or ecosystem.

indigenous—A species that is naturally occurring in a given area and elsewhere.

irreplaceable—The single most outstanding example of a target species, community, or system, or a population that is critical to a species remaining extant and not going extinct.

integration—A portfolio assembly principle where sites that contain high-quality occurrences of both aquatic and terrestrial targets are given priority.

keystone species—A species whose impacts on its community or ecosystem are large; much larger than would be expected from its abundance.

landscape—A heterogeneous land area composed of a cluster of interacting ecosystems that are repeated in similar form throughout.

landscape action site—Landscape action sites are distinguished from other action sites by their large spatial scale and the need for a dedicated, full-time project director. These sites are geographically large—they are functional conservation sites that have 1) coarse-scale conservation targets, or 2) intermediate or local-scale targets with sustaining processes that operate at a coarse scale. The large geographic scale and the complex conservation situation that usually accompanies large size are what dictate the need for a full-time project director.

large patch—Communities that form large areas of interrupted cover. Individual occurrences of this community patch type typically range in size from 50 to 2,000 hectares. Large patch communities are associated with environmental conditions that are more specific than those of matrix communities, and that are less common or less extensive in the landscape. Like matrix communities, large-patch communities are also influenced by large-scale processes, but these tend to be modified by specific site features that influence the community.

leverage—Used in ecoregional planning to select Action Sites by evaluating if conservation at a site will influence conservation elsewhere, if the site provides an opportunity to test a strategy, or if staff or a mechanism exists to help export conservation experience from one site to others.

linear communities—Communities that occur as linear strips are often, but not always, ecotonal between terrestrial and aquatic systems. Examples include coastal beach strands, bedrock lakeshores, and narrow riparian communities. Similar to small patch communities, linear communities occur in very specific ecological settings, and the aggregate of all linear communities covers, or historically covered, only a small percentage of the natural vegetation of a ecoregion. They also tend to support a specific and restricted set of associated flora and fauna. Linear communities differ from small patch communities in that both local-scale processes and large-scale processes strongly influence community structure and function.

macrohabitats—Macrohabitats are the finest-scale biophysical classification unit used as conservation targets. Examples are lakes and stream/river segments that are delineated, mapped, and classified according to the environmental factors that determine the types and distributions of aquatic species assemblages.

matrix-forming or matrix communities—Communities that form extensive and contiguous cover may be categorized as matrix (or matrix-forming) community types. Matrix communities occur on the most extensive landforms and typically have wide ecological tolerances. They may be characterized by a complex mosaic of successional stages resulting from characteristic disturbance processes (e.g. New England northern hardwood-conifer forests). Individual occurrences of the matrix type typically range in size from 2000 to 500,000 hectares. In a typical ecoregion, the aggregate of all matrix communities covers, or historically covered, as much as 75-80% of the natural vegetation of the ecoregion. Matrix community types are often influenced by large-scale processes (e.g. climate patterns, fire) and are important habitat for wide-ranging or large area-dependent fauna, such as large herbivores or birds.

metadata—Metadata documents the content, source, reliability, and other characteristics of data. Metadata are particularly important in the iterative ecoregional planning process because this documentation will expedite the review of existing tabular and geospatial data sets when an ecoregional plan is revisited and will minimize the likelihood of "lost" data.

metapopulation—A network of semi-isolated populations with some level of regular or intermittent migration and gene flow among them, in which individual populations may go extinct but can then be recolonized from other source populations (this is referred to as rescue effect).

minimum dynamic area—The area needed to insure survival or re-colonization of a site following disturbance that removes most or all individuals. This is determined by the ability of some number of individuals or patches to survive, and the size and severity of stochastic events.

mosaic—An interconnected patchwork of distinct vegetation types.

MUM—Multiple-use module, a term coined by Reed Noss to define a type of nature reserve design where the intensity of human use increases outward from the core and intensity of protection increases inward.

native—Those species and communities that were not introduced accidentally or purposefully by people but that are found naturally in an area. Native communities are those characterized by native species and maintained by natural processes. Native includes both endemic and indigenous species.

network of conservation sites—A reserve system connecting multiple nodes and corridors into a landscape that allows material and energy to flow among the various components.

nonequilibrium paradigm—An early and formerly dominant theory in ecology was the equilibrium paradigm, which stated that ecological systems had a climax state that was structurally and functionally maintained—a "balance of nature". This concept assumed that if a system were left alone, without human intervention, it would return to a climax stage. Today, conservation biologists focus on a nonequilibrium paradigm where it is assumed that there is no endpoint for an ecological system. Instead, it is recognized that systems are continuously changing due to disturbances in the system.

occurrence—Spatially referenced examples of species, communities, or ecological systems. May be equivalent to Heritage Element Occurrences, or may be more loosely defined locations delineated through 1) the definition and mapping of other spatial data or 2) the identification of areas by experts.

partnership—Collaborative relationship with a diverse array of public and private organizations, agencies, and individuals that work with TNC to conserve biodiversity.

patch community—Communities nested within matrix communities and maintained primarily by specific environmental features rather than disturbance processes.

phase 1 site—The eight to ten "no-regret" conservation sites selected for each ecoregion prior to the completion of an ecoregional plan. This exercise was conducted in 1997 by TNC staff and completed in March 1998 to begin the process of thinking and working within ecoregional boundaries. All Capital Campaign sites should be Phase I sites. Phase I sites become irrelevant once the full ecoregional portfolio is assembled and the "action sites" or first places for TNC action are identified.

platform site—Those sites in LACR national portfolios where The Nature Conservancy will take conservation action and measure success. Similar to action sites in domestic ecoregional planning. (see action site)

portfolio of sites—In ecoregional plans, these sites are the suite of conservation sites within an ecoregion that would collectively conserve the native species and communities of the ecoregion.

population viability analysis (PVA)—A collection of quantitative tools and methods for predicting the likely future status (e.g., likelihood of extinction or persistence) of a population or collection of populations of conservation concern.

rangewide—Referring to the entire distribution of a species, community, or ecological system.

rapid ecological assessment (REA)—Technique for using remote sensing information combined with on-the-ground selected biological surveys to relatively quickly assess the presence and quality of conservation targets, especially at the community and ecosystem level.

representation—A principle of reserve selection and design referring to the capture the full spectrum of biological and environmental variation within a network of reserves or conservation sites, including all genotypes, species, communities, ecosystems, habitats, and landscapes.

representativeness—Captures multiple examples of all conservation targets across the diversity of environmental gradients appropriate to the ecoregion (e.g., ecoregional section or subsection, ecological land unit (ELU), or some other physical gradient).

section—Areas of similar physiography within an ecoregional province; a hierarchical level with the U.S. Forest Service ECOMAP framework for mapping and classifying ecosystems at multiple geographic scales.

shifting mosaic—An interconnected patchwork of distinct vegetation types that may shift across the land surface as a result of dynamic ecosystem processes, such as periodic wildfire or flooding.

site (or conservation site)—Areas that are defined by the presence of conservation targets, are the focus of conservation action, and are the locus for measuring conservation success. Ecoregional planning identifies and selects conservation targets and locates occurrences of these targets. Based on geographic proximity, these target occurrences are grouped together into sites.

SITES—Software consisting of computerized algorithms designed specifically for TNC users in ecoregional planning to aid in selecting conservation sites.

small patch—Communities that form small, discrete areas of vegetation cover. Individual occurrences of this community type typically range in size from 1 to 50 hectares. Small patch communities occur in very specific ecological settings, such as on specialized landform types or in unusual microhabitats. The specialized conditions of small patch communities, however, are often dependent on the maintenance of ecological processes in the surrounding matrix and large patch communities. In many ecoregions, small patch communities contain a disproportionately large percentage of the total flora, and also support a specific and restricted set of associated fauna (e.g. invertebrates or herptofauna) dependent on specialized conditions.

source (of stress)—An extraneous factor, either human (i.e. activities, policies, land uses) or biological (e.g. non-native species), that infringes upon a conservation target in a way that results in stress.

spatial pattern—Within an ecoregion, natural terrestrial communities may be categorized into four functional groups on the basis of their current or historical patterns of occurrence, as correlated with the distribution and extent of landscape features and ecological processes. These groups are identified as matrix communities, large-patch communities, small-patch communities, and linear communities.

sponsor—The person who is ultimately accountable for the completion of the ecoregional plan. Usually a state director or individual of equal standing and power.

stakeholder—In a particular project or area, someone who: a) would benefit if TNC achieved its project goals, b) would be hurt, or believe they could be hurt by TNC's goals, c) could shape public opinion about TNC's project even if it might not directly affect them, and d) has the authority to make decisions affecting TNC's goals.

stratification—A hierarchical division of an ecoregion into nested, progressively smaller geographic units. Spatial stratification is used to represent each conservation target across its range of variation (in internal composition and landscape setting) within the ecoregion, to ensure long-term viability of the type by buffering against degradation in one portion of its range, and to allow for possible geographic variation.

stress—Something which impairs or degrades the size, condition, or landscape context of a conservation target, resulting in reduced viability.

surrogate—In conservation planning, surrogates are generally referred to as any conservation target being used to capture or represent targets or elements of biological diversity (both known and unknown) that occur at finer scales of spatial resolution or finer levels of biological organization. For example, communities and ecological systems are often labeled as surrogate measures of biodiversity which are intended to represent the many species that occur within these types of targets.

target—Also called conservation target. An element of biodiversity selected as a focus for conservation planning or action. The three principle types of targets in Nature Conservancy planning projects are species, ecological communities, and ecological systems.

terrestrial ecological community—Plant community types of definite floristic composition, uniform habitat conditions, and uniform physiognomy. Terrestrial ecological communities are defined by the finest level of classification, the "plant association" level of the National Vegetation Classification.

terrestrial ecological systems—dynamic spatial assemblages of ecological communities that 1) occur together on the landscape; 2) are tied together by similar ecological processes (e.g., fire, hydrology), underlying environmental features (e.g., soils, geology) or environmental gradients (e.g., elevation, hydrologically-related zones); and 3) form a robust, cohesive, and distinguishable unit on the ground. Ecological systems are characterized by both biotic and abiotic (environmental) components and can be terrestrial, aquatic, marine, or a combination of these.

threat—The combined concept of ecological stresses to a target and the sources of that stress to the target.

threatened species—Species federally listed or proposed for listing as Threatened by the U.S. Fish and Wildlife Service under the Endangered Species Act.

umbrella species—Typically wide-ranging species that require large blocks of relatively natural or unaltered habitat to maintain viable populations. Protection of the habitats of these species may protect the habitat and populations of many other more restricted or less wide ranging species.

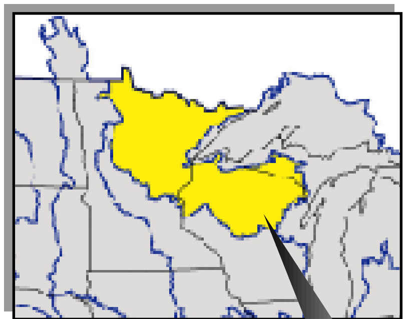
urgency—A qualitative measure referring to the immediacy of severe threats—taking into account how severe the threat is and how likely it is to destroy or seriously degrade the targets.

viable/viability—The ability of a species to persist for many generations or an ecological community or system to persist over some time period. An assessment of viability will often focus on the minimum area and number of occurrences necessary for persistence. However, conservation goals should not be restricted to the minimum but rather should extend to the size, distribution, and number of occurrences necessary for a community to support its full complement of native species.

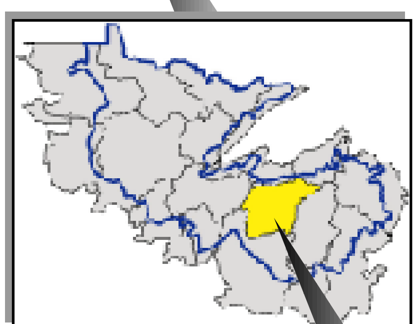
vulnerable—Vulnerable species are usually abundant, may or may not be declining, but some aspect of their life history makes them especially vulnerable (e.g., migratory concentration or rare/endemic habitat). For example, sandhill cranes are a vulnerable species because a large percentage of the entire population aggregates during migration along a portion of the Platte River in Nebraska.

Appendix 28. Color Figures

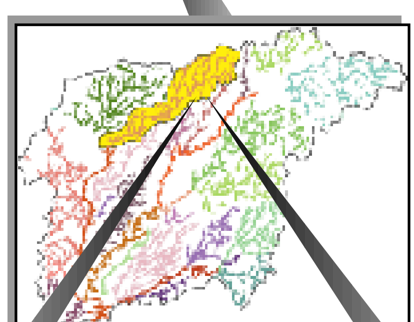
Figure A28-1. Aquatic classification framework showing the relationships among the levels



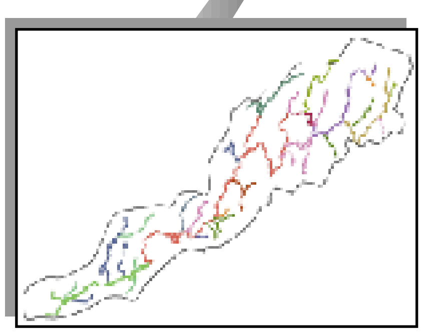
a. North central United States, one ecoregion highlighted



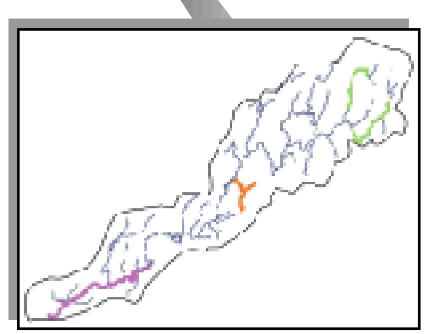
b. Ecoregion with Ecological Drainage Unit (EDU) boundaries, one EDU highlighted



c. EDU with systems indicated, one system highlighted



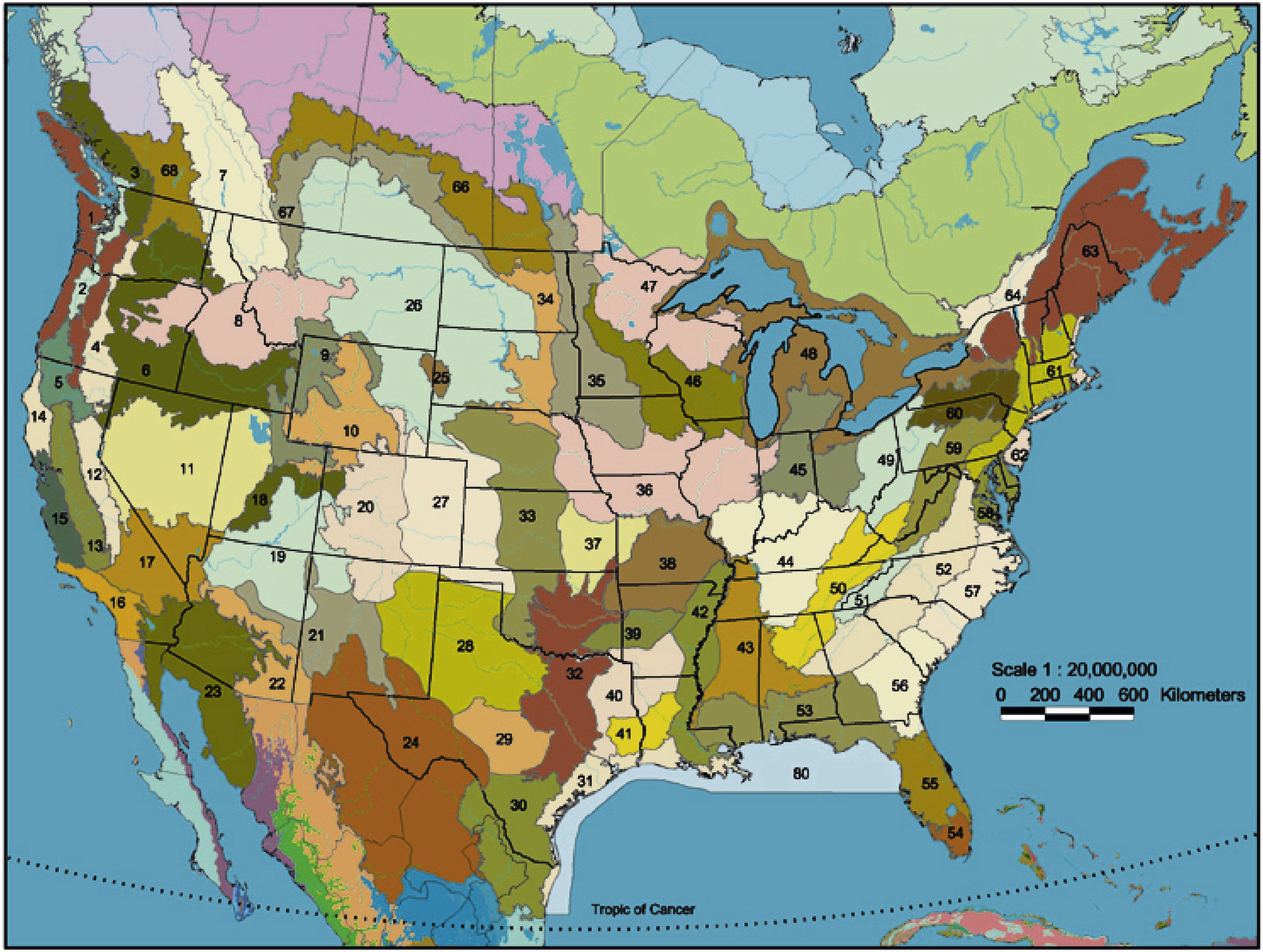
d1. System with macrohabitats indicated



d2. System with alliance occurrences indicated

Figure A28-2. Ecoregions of the United States

#	Ecoregion Name
1	West Cascades and Coastal Forests
2	Puget Trough and Willamette Valley
3	North Cascades
4	Modoc Plateau and East Cascades
5	Klamath Mountains
6	Columbia Plateau
7	Canadian Rocky Mountains
8	Middle Rocky Mountain- Blue Mountain
9	Utah-Wyoming Rocky Mountains
10	Wyoming Basins
11	Great Basin
12	Sierra Nevada
13	Great Central Valley
14	California North Coast
15	California Central Coast
16	California South Coast
17	Mojave Desert
18	Utah High Plateaus
19	Colorado Plateau
20	Colorado Rocky Mountains
21	Arizona-New Mexico Mountains
22	Apache Highlands
23	Sonoran Desert
24	Chihuahuan Desert
25	Black Hills
26	Northern Great Plains Steppe
27	Central Shortgrass Prairie
28	Southern Shortgrass Prairie
29	Edwards Plateau
30	Tamaulipan Thorn Scrub
31	Gulf Coast Prairies and Marshes
32	Crosstimbers and Southern Tallgrass Prairie
33	Central Mixed-Grass Prairie
34	Northern Mixed-Grass Prairie
35	Northern Tallgrass Prairie
36	Central Tallgrass Prairie
37	Osage Plains/Flint Hills Prairie
38	Ozarks
39	Ouachita Mountains
40	Upper West Gulf Coastal Plain
41	West Gulf Coastal Plain
42	Mississippi River Alluvial Plain
43	Upper East Gulf Coastal Plain
44	Interior Low Plateau
45	North Central Tillplain
46	Prairie-Forest Border
47	Superior Mixed Forest
48	Great Lakes
49	Western Allegheny Plateau
50	Cumberlands and Southern Ridge and Valley
51	Southern Blue Ridge
52	Piedmont
53	East Gulf Coastal Plain
54	Tropical Florida
55	Florida Peninsula
56	South Atlantic Coastal Plain
57	Mid-Atlantic Coastal Plain
58	Chesapeake Bay Lowlands
59	Central Appalachian Forest
60	High Allegheny Plateau
61	Lower New England/Northern Piedmont
62	North Atlantic Coast
63	Northern Appalachian-Boreal Forest
64	St. Lawrence-Champlain Valley
65	Hawaiian High Islands
66	Aspen Parkland
67	Fescue-Mixed Grass Prairie
68	Okanagan
69	Alaskan Coastal Forest and Mountains
70	Gulf of Alaska Mountains and Fjordlands
71	Cook Inlet Basin
72	Alaska Peninsula
73	Bering Sea and Aleutian Islands
74	Bristol Bay Basin
75	Beringian Tundra
76	Alaska Range
77	Interior Alaska Taiga
78	Yukon Plateau and Flats
79	Brooks Range Tundra Coastal Plain
80	Northern Gulf Coast


Scale 1 : 20,000,000
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Tropic of Cancer
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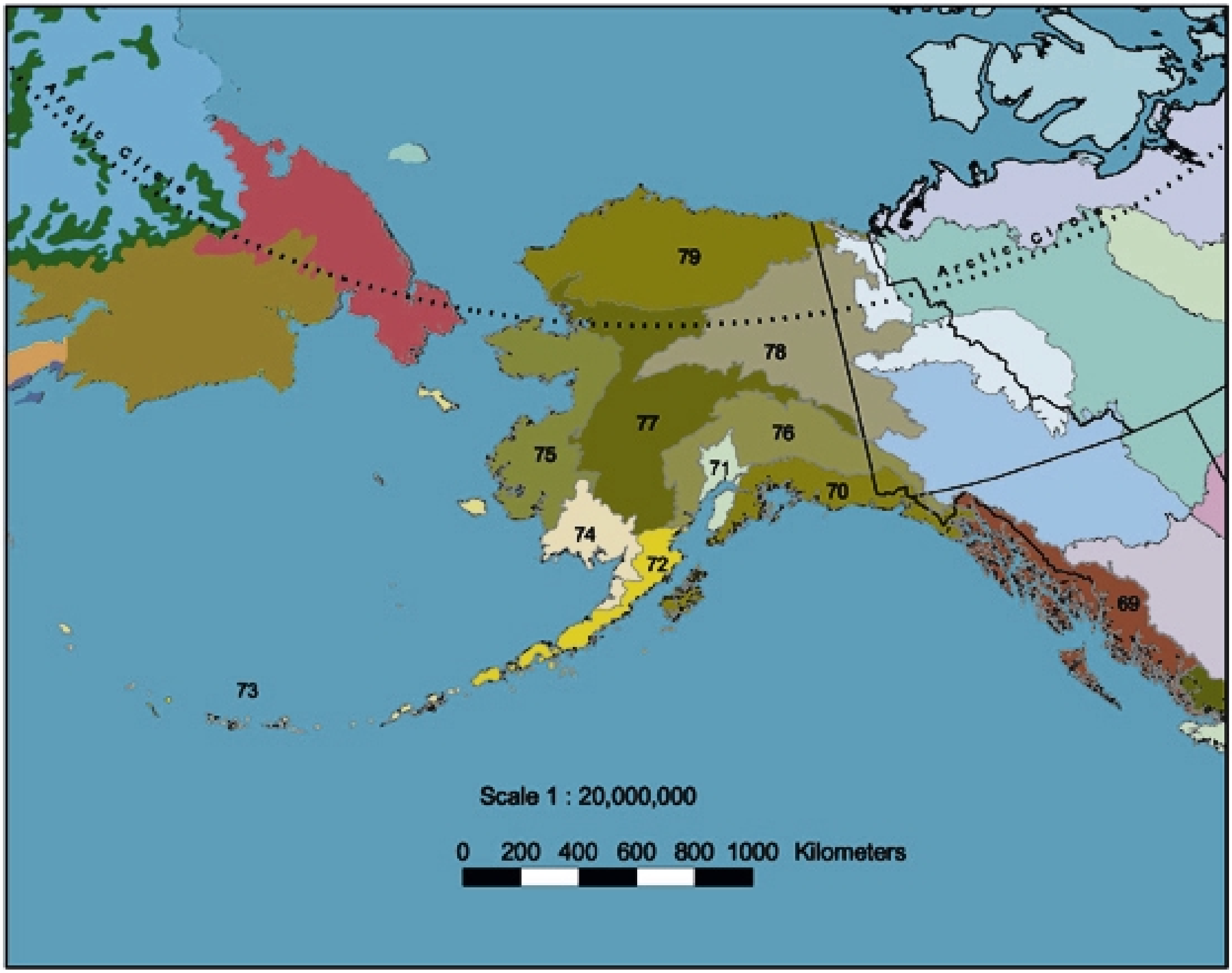
Arctic Circle
Arctic Circle
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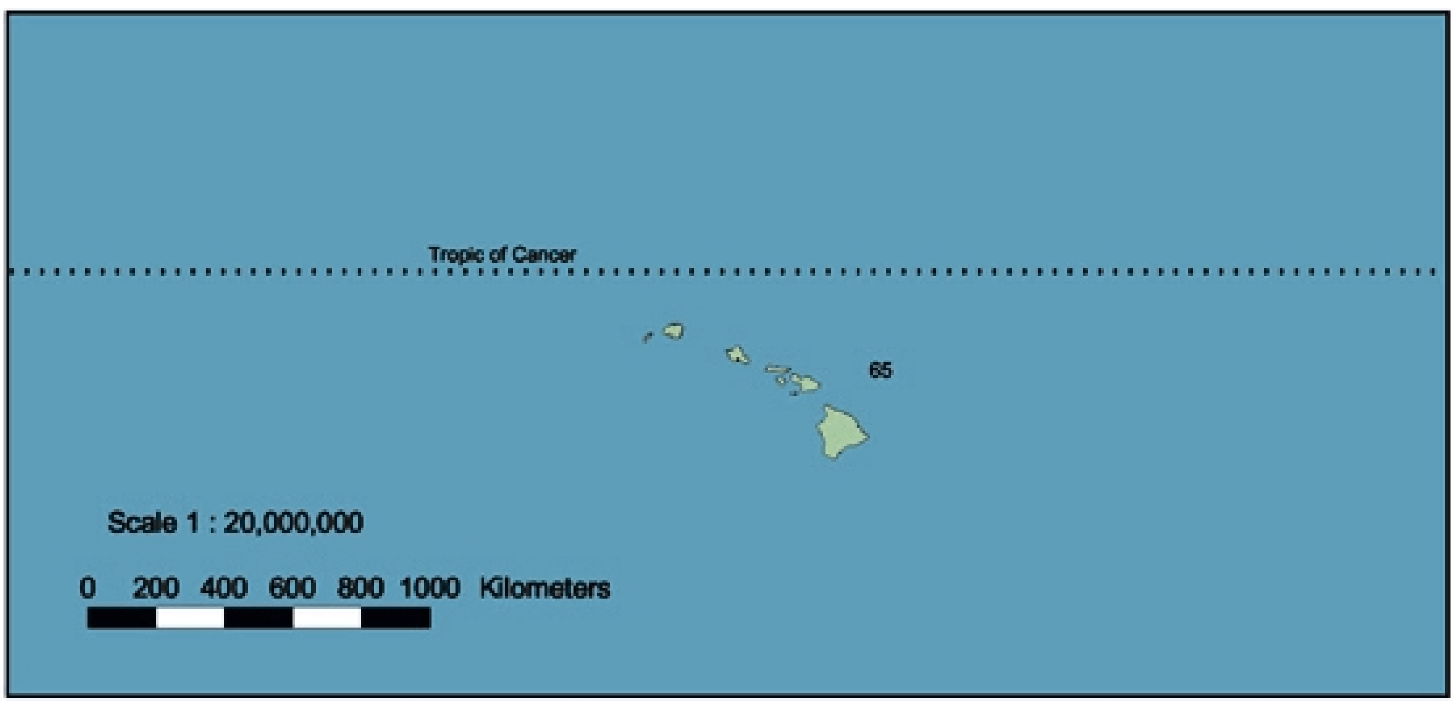
Tropic of Cancer
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Scale 1 : 20,000,000
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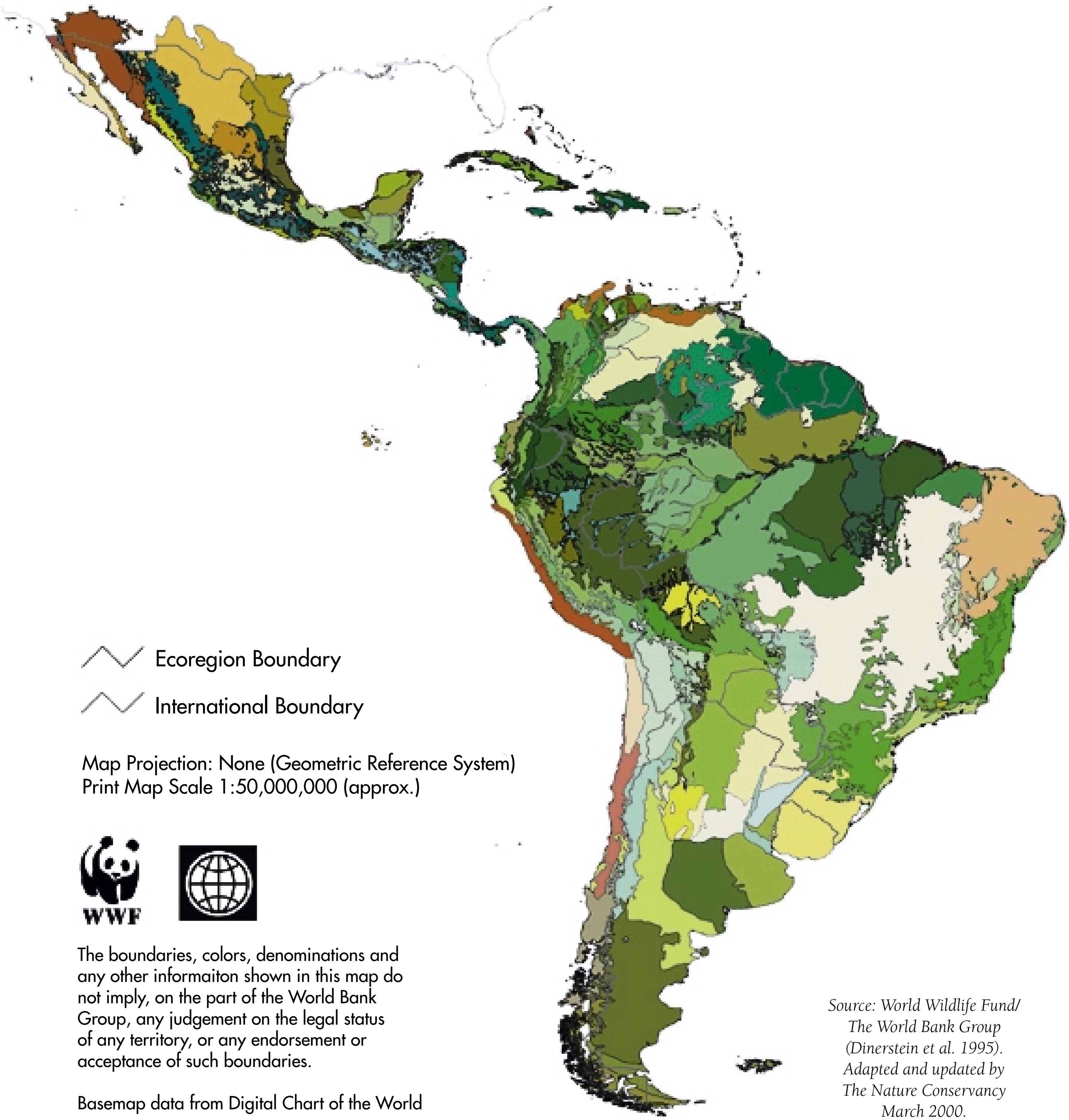
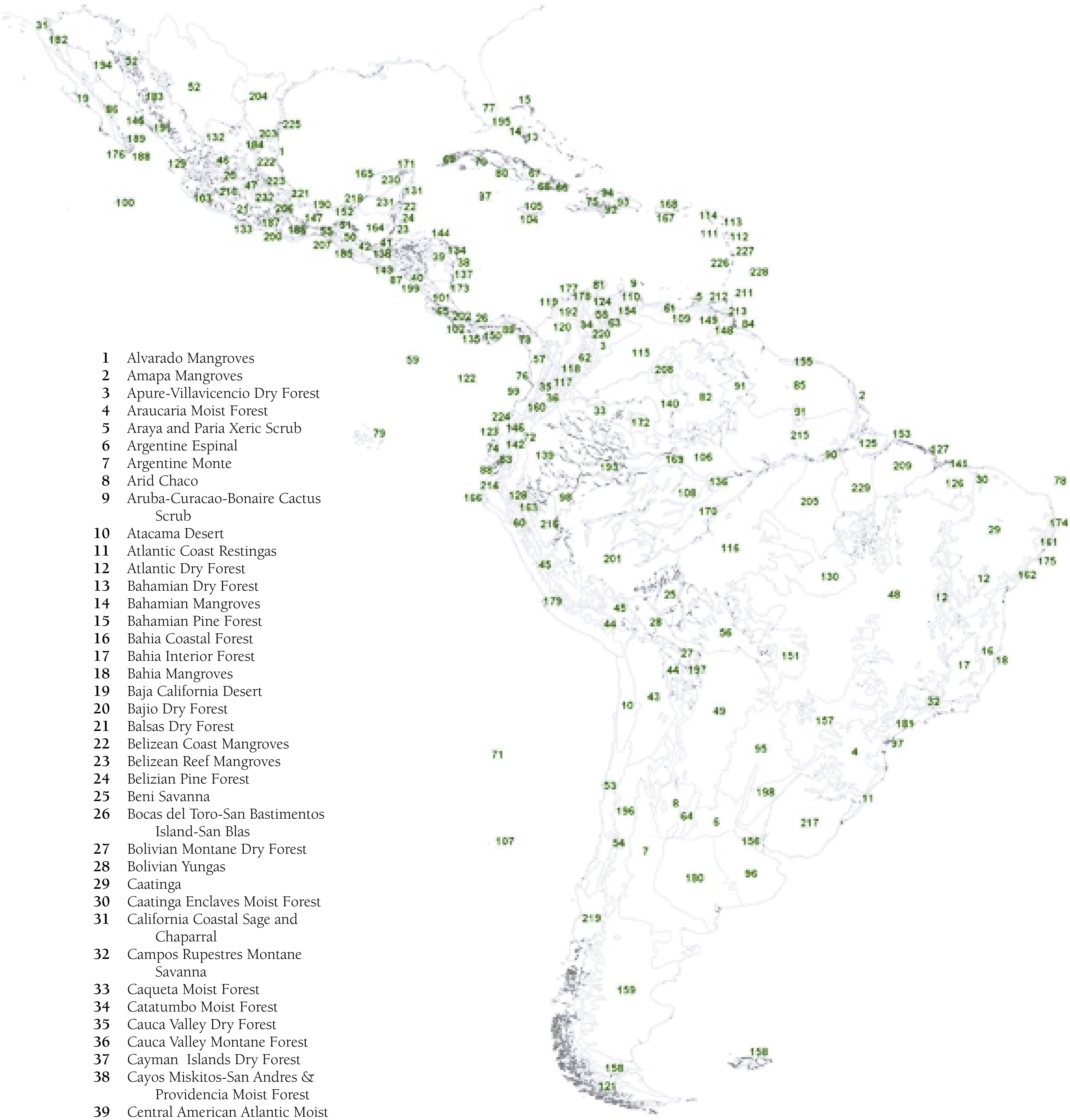
Figure A28-3. Latin America and Caribbean ecoregions



The boundaries, colors, denominations and any other informaiton shown in this map do not imply, on the part of the World Bank Group, any judgement on the legal status of any territory, or any endorsement or acceptance of such boundaries.

Basemap data from Digital Chart of the World

Source: World Wildlife Fund/ The World Bank Group (Dinerstein et al. 1995). Adapted and updated by The Nature Conservancy March 2000.



1 Alvarado Mangroves
2 Amapa Mangroves
3 Apure-Villavicencio Dry Forest
4 Araucaria Moist Forest
5 Araya and Paria Xeric Scrub
6 Argentine Espinal
7 Argentine Monte
8 Arid Chaco
9 Aruba-Curacao-Bonaire Cactus Scrub
10 Atacama Desert
11 Atlantic Coast Restingas
12 Atlantic Dry Forest
13 Bahamian Dry Forest
14 Bahamian Mangroves
15 Bahamian Pine Forest
16 Bahia Coastal Forest
17 Bahia Interior Forest
18 Bahia Mangroves
19 Baja California Desert
20 Bajio Dry Forest
21 Balsas Dry Forest
22 Belizean Coast Mangroves
23 Belizean Reef Mangroves
24 Belizian Pine Forest
25 Beni Savanna
26 Bocas del Toro-San Bastimentos Island-San Blas
27 Bolivian Montane Dry Forest
28 Bolivian Yungas
29 Caatinga
30 Caatinga Enclaves Moist Forest
31 California Coastal Sage and Chaparral
32 Campos Rupestres Montane Savanna
33 Caqueta Moist Forest
34 Catatumbo Moist Forest
35 Cauca Valley Dry Forest
36 Cauca Valley Montane Forest
37 Cayman Islands Dry Forest
38 Cayos Miskitos-San Andres & Providencia Moist Forest
39 Central American Atlantic Moist Forest
40 Central American Dry Forest
41 Central American Montane Forest
42 Central American Pine-Oak Forest
43 Central Andean Dry Puna
44 Central Andean Puna
45 Central Andean Wet Puna
46 Central Mexican Matorral
47 Central Mexican Wetland
48 Cerrado
49 Chaco
99 Isla Gorgona Moist Forest
100 Islas Revillagigedo Dry Forest
101 Isthmian-Atlantic Moist Forest
102 Isthmian-Pacific Moist Forest
103 Jalisco Dry Forest
104 Jamaican Dry Forest
105 Jamaican Moist Forest
106 Japura-Solimoes-Negro Moist Forest
107 Juan Fernandez Temperate Forest
108 Jurua-Purus Moist Forest
109 La Costa Xeric Shrubland
110 Lara-Falcon Dry Forest
111 Leeward Islands Dry Forest

112 Leeward Islands Moist Forest
113 Leeward Islands Xeric Scrub
114 Lesser Antilles Mangroves
115 Llanos
116 Madeira-Tapajos Moist Forest
117 Magdalena Valley Dry Forest
118 Magdalena Valley Montane Forest
119 Magdalena-Santa Marta Mangroves
120 Magdalena-Uraba Moist Forest
121 Magellanic Subpolar Forest
122 Malpelo Island Xeric Scrub
123 Manabi Mangroves
124 Maracaibo Dry Forest
125 Marajo Varzea Forest
126 Maranhao Babaçu Forest
127 Maranhao Mangroves
128 Maranon Dry Forest
129 Marismas Nacionales-San Blas Mangroves
130 Mato Grosso Tropical Dry Forest
131 Mayan Corridor Mangroves
132 Meseta Central Matorral
133 Mexican South Pacific Coast Mangroves
134 Miskito Pine Forest
135 Moist Pacific Coast Mangroves
136 Monte Alegre Varzea
137 Mosquita-Nicaraguan Caribbean Coast Mangroves
138 Motagua Valley Thornscrub
139 Napo Moist Forest
140 Negro-Branco Moist Forest
141 Northeastern Brazil Restingas
142 Northern Andean Paramo
143 Northern Dry Pacific Coast Mangroves
144 Northern Honduras Mangroves
145 Northwest Mexican Coast Mangroves
146 Northwestern Andean Montane Forest
147 Oaxacan Montane Forest
148 Orinoco Delta Swamp Forest
149 Orinoco Wetland
201 Southwest Amazon Moist Forest
202 Talamancan Montane Forest
203 Tamaulipan Matorral
204 Tamaulipan Mezquital
205 Tapajos-Xingu Moist Forest
206 Tehuacan Valley Matorral
207 Tehuantepec-El Manchon Mangroves
208 Tepuis
209 Tocantins-Araguaia-Maranhao Moist Forest
210 Trans-Mexican Volcanic Belt Pine-Oak Forest
211 Trinidad Mangroves
212 Trinidad and Tobago Dry Forest
213 Trinidad and Tobago Moist Forest
214 Tumbes-Piura Dry Forest
215 Uatuma-Trombetas Moist Forest
216 Ucayali Moist Forest
217 Uruguayan Savanna
218 Usumacinta Mangroves
219 Valdivian Temperate Forest
220 Venezuelan Andes Montane Forest
221 Veracruz Dry Forest
222 Veracruz Moist Forest
223 Veracruz Montane Forest
224 Western Ecuador Moist Forest
225 Western Gulf Coastal Grassland
226 Windward Islands Dry Forest
227 Windward Islands Moist Forest
228 Windward Islands Xeric Scrub
229 Xingu-Tocantins-Araguaia Moist Forest
230 Yucatan Dry Forest
231 Yucatan Moist Forest
232 Zacatonal
50 Chiapas Depression Dry Forest
51 Chiapas Montane Forest
52 Chihuahuan Desert
53 Chilean Matorral
54 Chilean Winter-Rain Forest
55 Chimalapas Montane Forest
56 Chiquitano Dry Forest
57 Choco-Darien Moist Forest
58 Coastal Venezuelan Mangroves
59 Cocos Island Moist Forest
60 Cordillera Central Paramo
61 Cordillera La Costa Montane Forest
62 Cordillera Oriental Montane Forest
63 Cordillera de Merida Paramo
64 Cordoba Montane Savanna
65 Costa Rican Seasonal Moist Forest
66 Cuban Cactus Scrub
67 Cuban Dry Forest
68 Cuban Moist Forest
69 Cuban Pine Forest
70 Cuban Wetland
71 Des Venturadas Temperate Forest
72 Eastern Cordillera Real Montane Forest
73 Eastern Panamanian Montane Forest
74 Ecuadorian Dry Forest
75 Enriquillo Wetland
76 Esmeraldes-Pacific Colombia Mangroves
77 Everglades
78 Fernanda de Noronha Moist Forest
79 Galapagos Islands Xeric Scrub
80 Greater Antilles Mangroves
81 Guajira-Barranquilla Xeric Scrub
82 Guayanan Highlands Moist Forest
83 Guayaquil Flooded Grassland
84 Guianan Mangroves
85 Guianan Moist Forest
86 Gulf of California Xeric Scrub
87 Gulf of Fonseca Mangroves
88 Gulf of Guayaquil-Tombes Mangroves
89 Gulf of Panama Mangroves
90 Gurupa Varzea
91 Guyanan Savanna
92 Hispaniolan Dry Forest
93 Hispaniolan Moist Forest
94 Hispaniolan Pine Forest
95 Humid Chaco
96 Humid Pampas
97 Ilha Grande Mangroves
98 Iquitos Varzea
150 Panamanian Dry Forest
151 Pantanal
152 Pantanos de Centla
153 Para Mangroves
154 Paraguana Xeric Scrub
155 Paramaribo Swamp Forest
156 Parana Flooded Savanna
157 Parana-Paraiba Interior Forest
158 Patagonian Grassland
159 Patagonian Steppe
160 Patia Valley Dry Forest
161 Pernambuco Coastal Forest
162 Pernambuco Interior Forest
163 Peruvian Yungas
164 Peten-Veracruz Moist Forest
165 Petenes Mangroves
166 Piura Mangroves
167 Puerto Rican Dry Forest
168 Puerto Rican Moist Forest
169 Purus Varzea
170 Purus-Madeira Moist Forest
171 Rio Lagartos Mangroves
172 Rio Negro Campinarana
173 Rio Negro-Rio San Sun Mangroves
174 Rio Piranhas Mangroves
175 Rio Sao Francisco Mangroves
176 San Lucan Xeric Scrub
177 Santa Marta Montane Forest
178 Santa Marta Paramo
179 Sechura Desert
180 Semi-Arid Pampas
181 Serra do Mar Coastal Forest
182 Sierra Juarez & San Pedro Martir Pine-Oak Forest
183 Sierra Madre Occidental Pine-Oak Forest
184 Sierra Madre Oriental Pine-Oak Forest
185 Sierra Madre de Chiapas Moist Forest
186 Sierra Madre de Oaxaca Pine-Oak Forest
187 Sierra Madre del Sur Pine-Oak Forest
188 Sierra de la Laguna Dry Forest
189 Sierra de la Laguna Pine-Oak Forest
190 Sierra de los Tuxtlas
191 Sinaloan Dry Forest
192 Sinu Valley Dry Forest
193 Solimoes-Japura Moist Forest
194 Sonoran Desert
195 South Florida Rocklands
196 Southern Andean Steppe
197 Southern Andean Yungas
198 Southern Cone Mesopotamian Savanna
199 Southern Dry Pacific Coast Mangroves
200 Southern Pacific Dry Forest

Figure A28-5. Asia-Pacific ecoregions

Natural Vegetation Cover

- Forest Dry/Deciduous
- Forest Moist Semi-evergreen
- Forest Subtropical
- Forest Lowland Moist
- Forest Tropical/Rain
- Forest Broadleaf
- Forest Temperate
- Forest Coniferous
- Forest Pine
- Forest Montane
- Forest Subalpine
- Desert
- Grasslands/Heath
- Savanna
- Steppe
- Upland
- Forest Scrub
- Shrub Thornscrub
- Woodland
- Meadows
- Taiga
- Tundra
- Tundra/Meadow/Grasslands
- Swamps
- Mangroves
- High Islands
- Water
- Snow/Ice/Glacier/Rock

Current Terrestrial Sites
1. NW Yunnan, China
2. Lore Lindu, Indonesia
3. Pohnpei, F.S. Micronesia

Terrestrial Site Feasibility Studies
4. Riau, Indonesia
5. Josephstaal, PNG
6. Arnavons, Solomon Islands
7. Babeldaob, Palau

Coastal/Marine Sites
6. Arnavons, Solomon Islands
7. Palau
8. Kimbe Bay, PNG
9. Komodo, Indonesia

Biogeographic Realm Boundary

Figure A28-6. Ecological land unit components

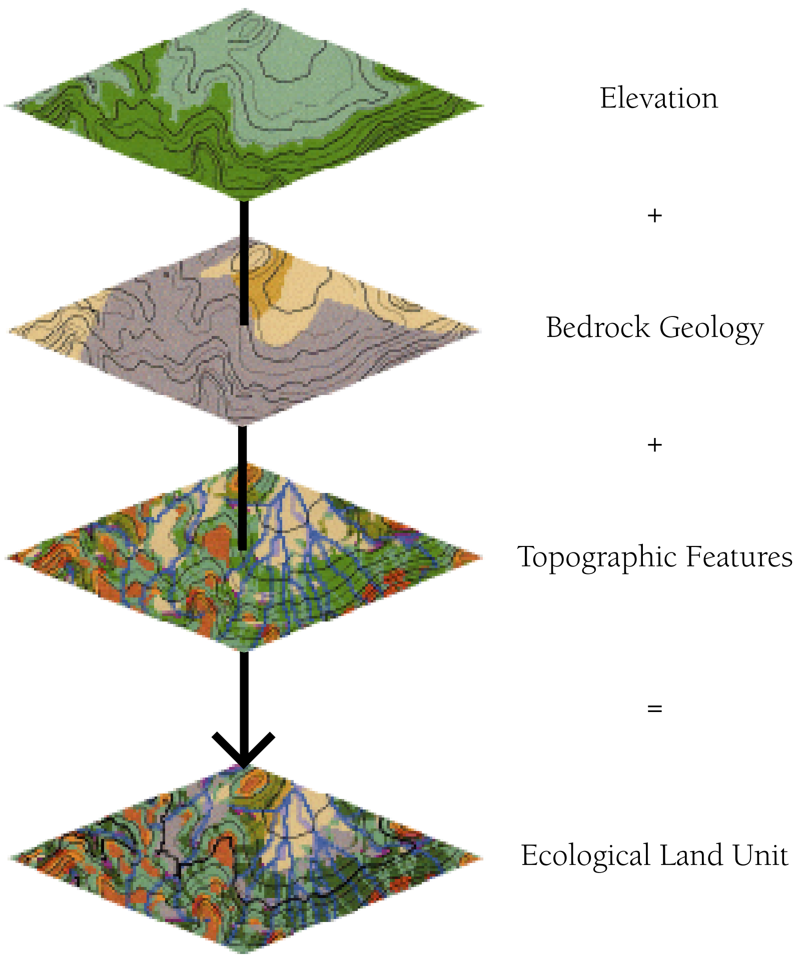


Figure A28-7. Model for aquatic ecological classification at two levels of resolution—ecological systems and macrohabitats

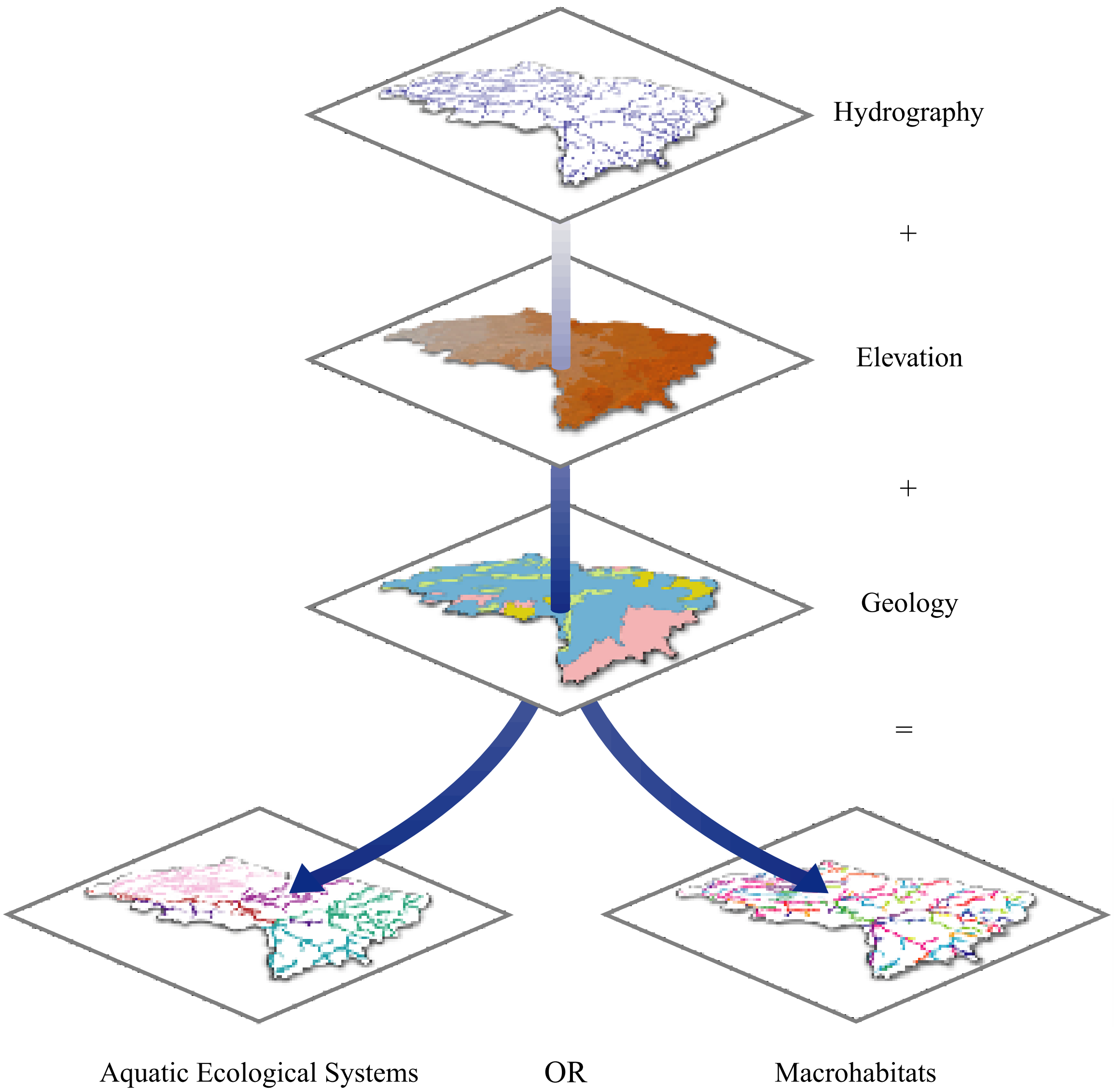


Figure A28-8. An example of ecological drainage unit delineation in two midwestern ecoregions

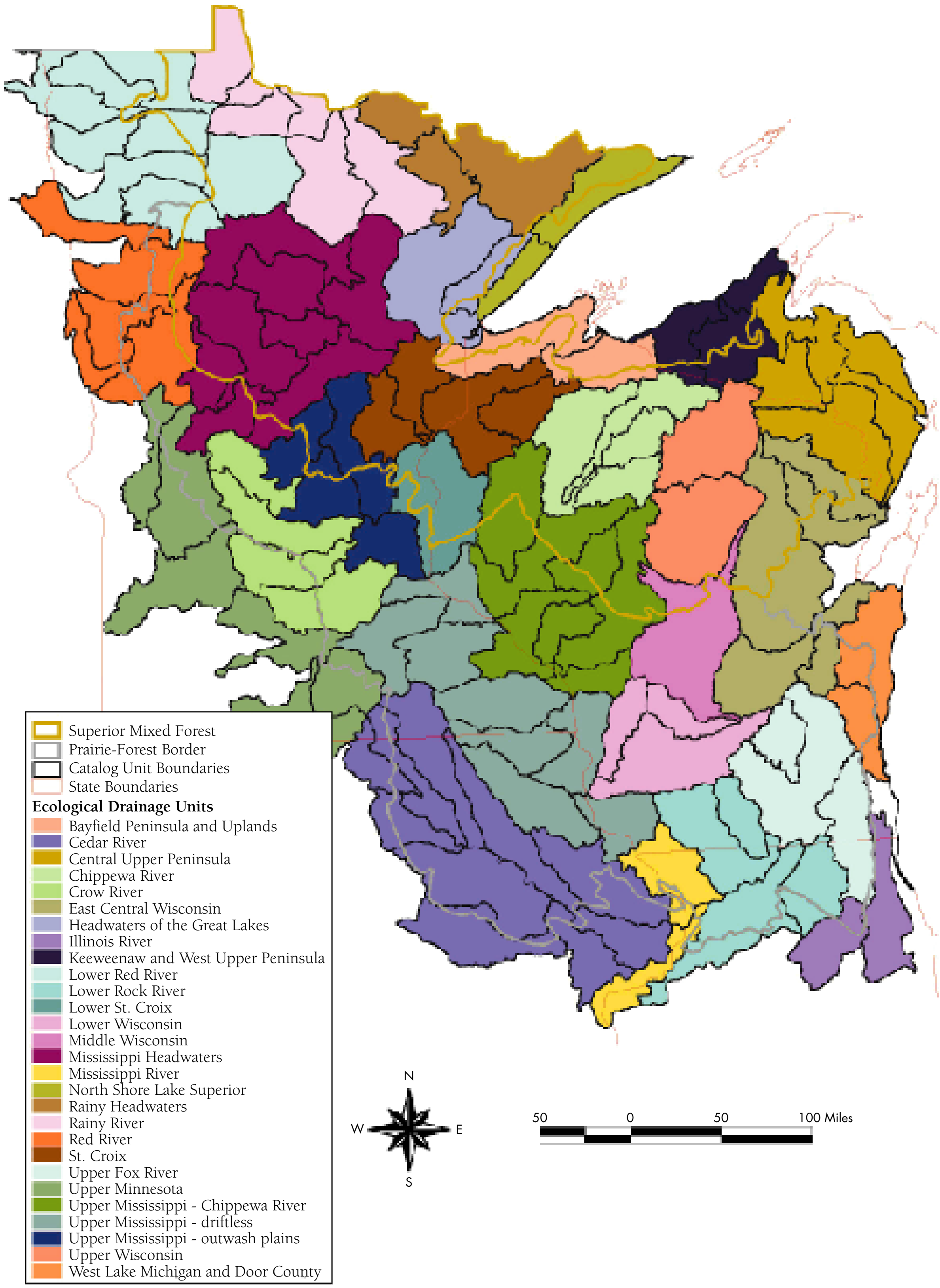


Figure A28-9. Systems in the lower Wisconsin ecological drainage unit

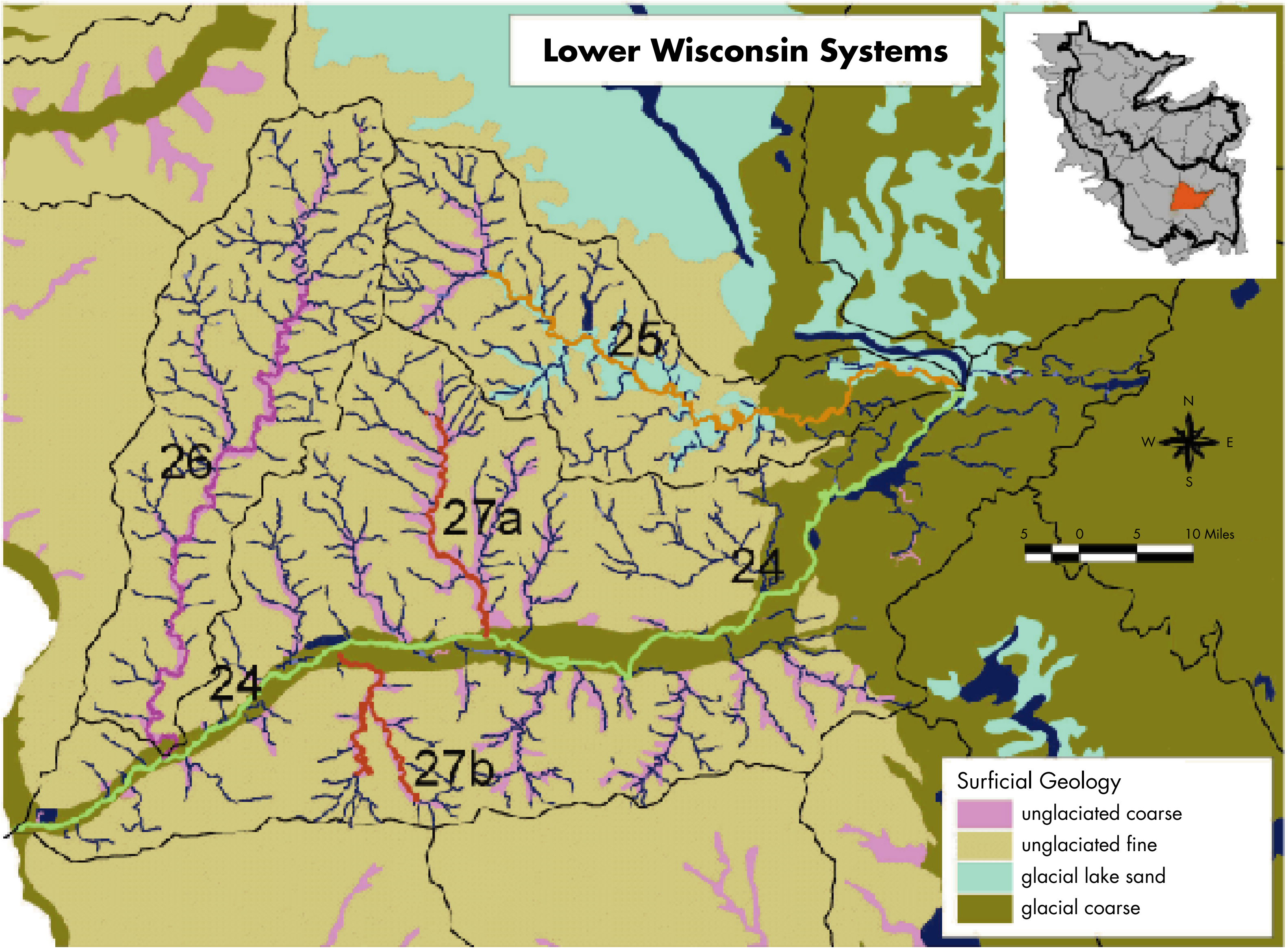


Figure A28-10. An example of macrohabitat classification within one ecological drainage unit