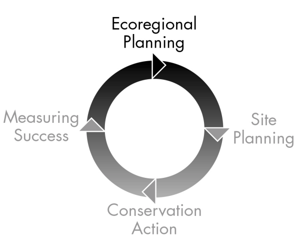
Designing *a* Geography *of* Hope

A Practitioner's Handbook to Ecoregional Conservation Planning



Volume I
Second Edition
April 2000

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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Acknowledgements: Members of the Freshwater Initiative Team (Jonathan Higgins, Mary Lammert, Mark Bryer) did writing, editing, and reviewing for the steps and examples related to aquatic communities and systems in all chapters. Mike Beck was responsible for steps and examples related to marine considerations in all chapters. Jon Haferman, Terry Cook, and Frank Biasi made significant contributions to the chapter on information management. Kathy Bisko provided substantial help in the appendix on project management. Special thanks are due to Greg Low, Karen Poiani, Jeff Baumgartner, and Tim Tear for extensive comments and editing help with this second edition. The following individuals provided critical reviews of draft versions of these guidelines and/or contributed by writing illustrative examples or portions of chapters: Mark Anderson, Susan Anderson, Henry Barbour, Josh Basofin, Gary Bell, Kathy Bisko, Mark Burget, Georgina Bustamante, Steve Buttrick, Steve Chaplin, Brooke Cholvin, Pat Comer, Terry Cook, Scott Davis, Dan Dorfman, Clifton Eakes, Audrey Goddell, Denny Grossman, Jenny Hall, Alyson Heyrend, Alan Holt, Phil Hoose, Gabe Horner, John Humke, Malcolm Hunter, Fran James, Jeff Jaros-Su, Deborah Jensen, Peter Kareiva, Shyama Khanna, Sally Landaal, Amy Lester, Rob Marshall, Dave Mehlman, Maureen Mislivets, Rick Moore, Bob Moseley, Brad Northrup, David Olson, Wayne Ostlie, Jeff Parrish, Dan Peerless, Earl Saxon, Roger Sayre, Mike Scott, Jan Slaats, Rob Sutter, Helen Taylor, Tim Tear, Joel Tuhy, Alan Weakley, Leni Wilsmann, Chris Wilson.

Front cover photographs (from left to right): Harold E. Malde, PhotoDisc, PhotoDisc, and Greg Miller/ TNC

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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).

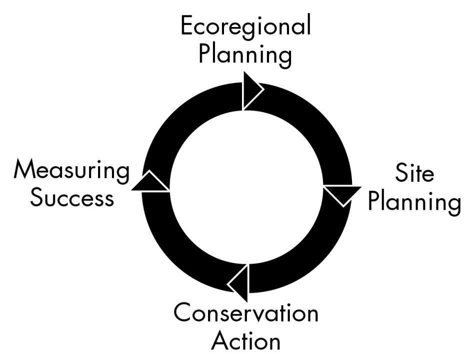
8. **Assessing the Performance of the Portfolio:** Compile summary statistics on the degree to which the portfolio of sites achieves the conservation goals for the following three categories of targets: species, communities and ecological systems. An automated tool is under development that will simplify 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.

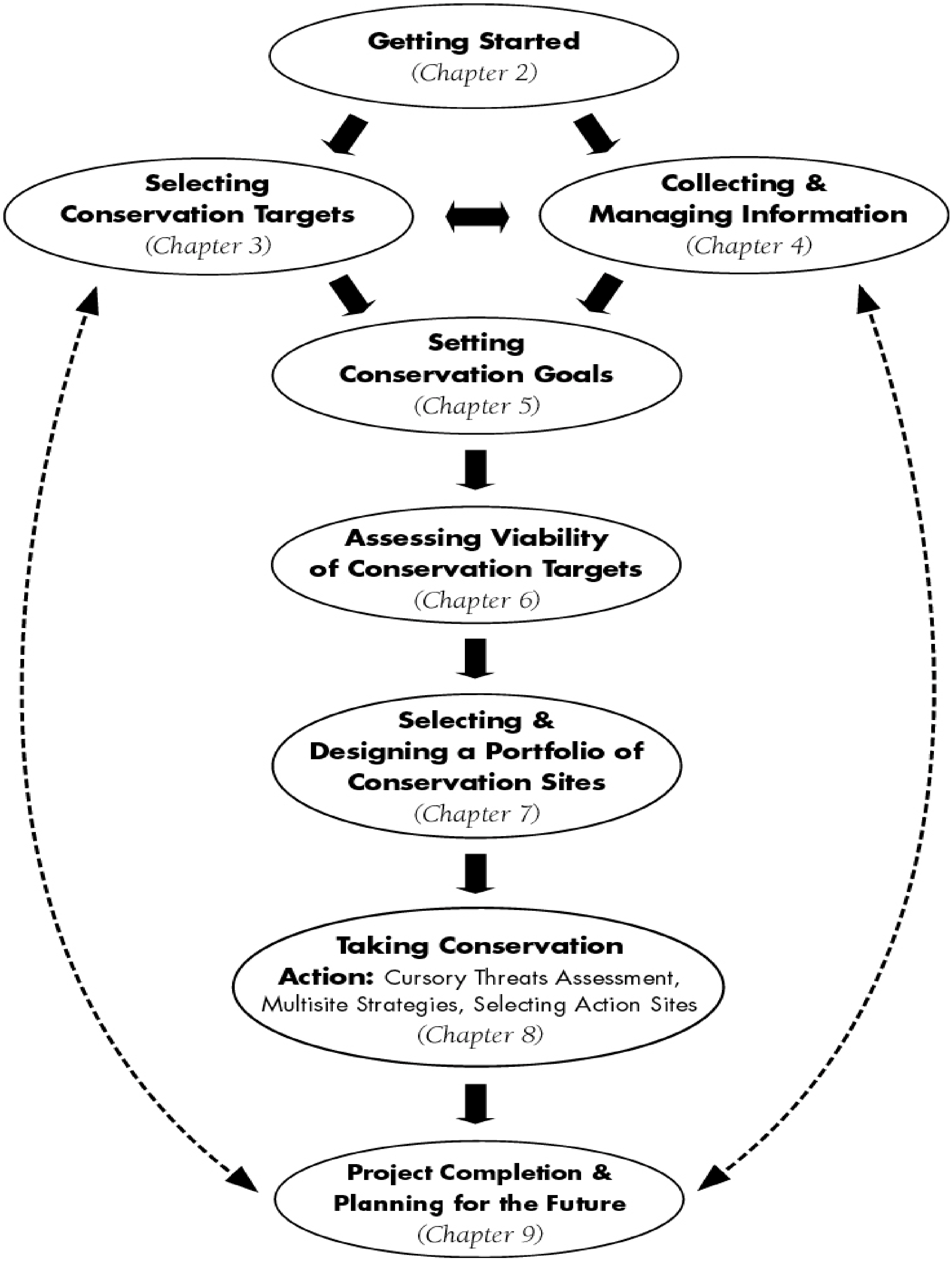
This second edition is organized in two volumes. The first volume consists of ten chapters that focus on the methods and major steps involved in completing an ecoregional plan (see Figure 1-1). Although the chapters and Figure 1-1 are organized in a linear fashion, practitioners should recognize that 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.

Chapter 2 Getting Started

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?

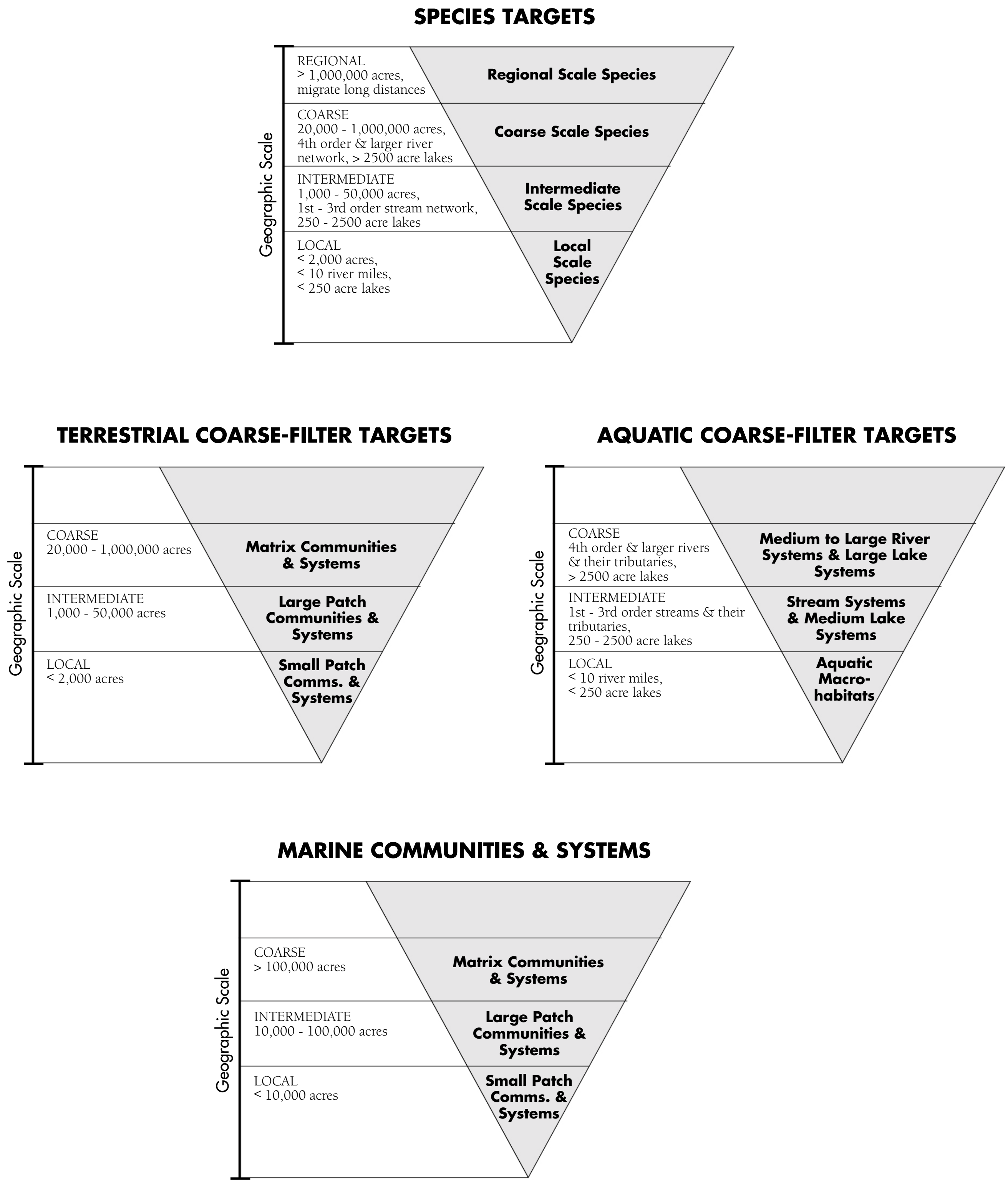
Background

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.

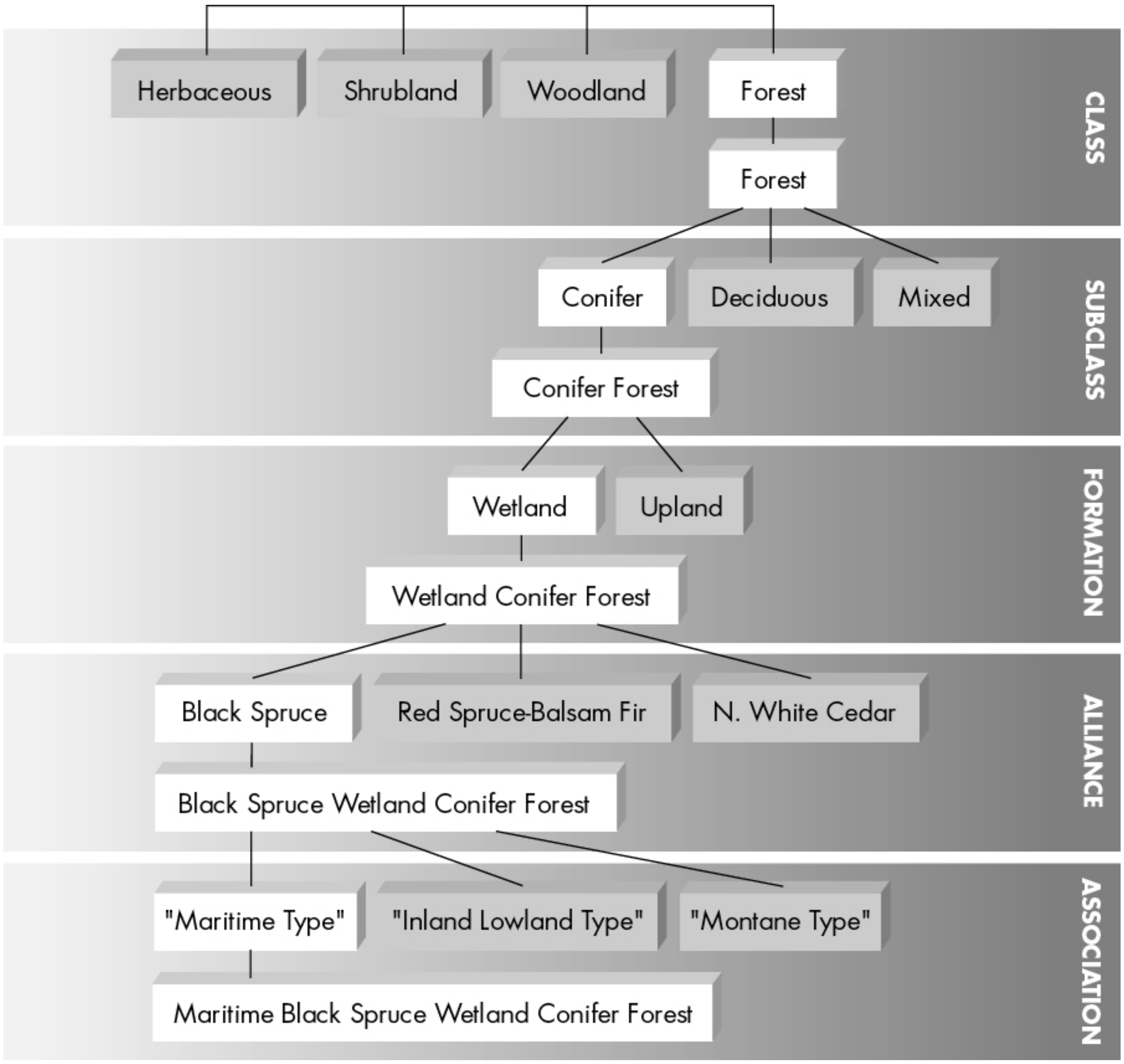
as targets should focus on those communities that are either imperiled (ranked G1-G2), or occur as rare patch-type communities (G3) and are not adequately encompassed by broader ecological systems.

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 4^{th} 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 1^{st}-3^{rd} 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

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 Questions

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- 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?

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/

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.

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?

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.

[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

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[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 Assesment, 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.