IV. Systems

Site conservation begins with understanding the conservation targets, including the natural processes that maintain them, that will be the focus for site conservation planning and measuring conservation success. Identification of focal conservation targets is the basis for all subsequent steps in site planning, including identifying threats, developing strategies, measuring success, and delineating the site boundary—a different set of targets is likely to result in different threats, strategies, measures of success, and site boundaries.

Ecoregional plans identify portfolios of sites within ecoregions. Each priority site in a portfolio has one or more *prima facie* reasons it has been selected for conservation—occurrences of important species, ecological communities, and ecological systems. These species, ecological communities, and ecological systems are referred to as conservation targets. Once engaged at a site, you will often identify or find it necessary to define other important species, communities, or ecological systems in addition to those identified through ecoregional planning. Ultimately, you must select or define a subset of all possible targets that will be the focus of the site planning process.

This chapter describes four steps for identifying focal conservation targets, characterizing the viability of these targets, and determining Biodiversity Health of the site:

1. Identify the focal conservation targets for site planning and measuring success
2. Determine the characteristics of viable conservation targets
3. Rank the focal conservation targets for viability
4. Determine “Biodiversity Health” of the site.

The first two steps are prerequisites for moving on to the next “S”—stresses (Chapter V)—and for measuring biodiversity health of the site. The third and fourth steps are specific to measuring biodiversity health.

Background

As outlined in Geography of Hope and subsequent publications, conservation targets may include the following:

- ***Ecological communities.*** Ecological com-munities are groupings of co-occurring species, as defined at the finest operational level of a community classification hierarchy, e.g., the “association” level of the Conservancy’s U.S. National Vegetation Classification and the “alliance” level of the Conservancy’s Aquatic Community Classification.

- ***Spatial assemblages of ecological communities, or “ecological systems”.*** Ecological communities may be aggregated into dynamic assemblages or complexes that (1) occur together on the landscape; (2) are linked by ecological processes, underlying environmental features (e.g., soils, geology, topography), or environmental gradients (e.g., elevation, precipitation, temperature); and (3) form a robust, cohesive, and distinguishable unit on the ground. Ecological systems can be terrestrial, freshwater aquatic, marine, or some combination. See Appendix B for examples.

- ***Species.*** Types of species targets include:
  - **Imperiled and endangered native species**, including species ranked G1-G3 by Natural Heritage programs, federally listed or proposed for listing as Threatened or Endangered (U.S.), and on the IUCN Red List (international).
  - **Species of special concern** due to vulner-ability, declining trends, disjunct distributions, or endemic status within the ecoregion.
  - **Focal species**, including keystone spe-cies, wide-ranging (regional) species, and umbrella species.
  - **Major groupings of species** that share common natural processes or have similar conservation requirements (e.g., freshwater mussels, forest-interior birds).
  - **Globally significant examples of species aggregations**. An example is a migratory shorebird aggregation.

The purpose of conservation targets differs between ecoregional planning and site conservation planning. In ecoregional planning, the primary purpose of conservation targets is to guide site selection—ensure all biodiversity in the ecoregion is adequately represented in the ecoregional portfolio of conservation sites. In one sense, this is an accounting exercise, and the conservation targets are the currency. The tendency is to develop a comprehensive list of conservation targets known to occur within an ecoregion, and then select sites to adequately represent high quality or restorable occurrences of the targets. Also, to encourage consistency among sites and ecoregions, typically the targets are defined in the context of formal taxonomic and community classifications.

In contrast, the primary purpose of conservation targets in site planning is to guide conservation strategies at individual sites—what critical threats and persistent stresses must be abated in order to maintain or enhance the viability of the conservation target occurrences? The list of focal conservation targets for site planning need not be long and comprehensive; rather, it should be short and indicative of threats to and viability of the biodiversity of interest at a site. The conservation targets that occur at a site, as identified through ecoregional planning or otherwise, may be too numerous to individually assess during site conservation planning. Practical experience suggests that there should be no more than eight focal targets for any given site. It is important that these focal targets represent and capture all ecoregional conservation targets at the site, as well as all relevant levels of biodiversity organization and spatial scales. At functional land-scapes, the focal conservation targets are expected to subsume "all" biodiversity at the site. Focal conservation targets for site planning are often defined ad hoc by the site team rather than from formal classification systems, and thus may be idiosyncratic to the site.

A. *Identify the Focal Conservation Targets for Site Planning and Measures*

The first key question to address is

> ***What conservation targets will be the focus for site planning?*** ?

When identifying focal conservation targets for site conservation planning, the list of conservation targets developed through ecoregional planning is a good starting point. However, this list must be translated into no more than eight focal targets that adequately represent levels of biodiversity organization, spatial scale, and ecoregional planning targets. This is an extremely challenging task, especially for functional landscapes—it may be the most difficult step in the site conservation planning process.

Also, you and your site planning team must decide whether or not the site is or should be considered a functional landscape. Irrespective of how comprehensive or cursory the ecoregional targets, does the potential exist to conserve "all" biodiversity at the site, i.e., species, communities, and ecological systems at multiple spatial scales? The answer to this question will influence how you apply the next step.

There are four steps in identifying focal conservation targets:

STEP 1. Define the ecological systems and species groups (coarse, intermediate, and local scale, as appropriate) that occur at the site.

Ecological systems and species groups provide the broadest ecological context within which to conserve ecological communities and species. Some ecological systems and species groups that occur at the site may already have been identified during ecoregional planning; others may have to be defined *de novo* by you and your site planning team. The ecological systems and species groups identified in this step may be considered focal conservation targets.

There are two fundamental approaches to defining the ecological systems and species groups at a site. The *top-down* approach begins with a holistic ecological vision of the site, and breaks the whole into its component ecological systems. This approach is especially useful for functional landscapes, i.e., when the implicit conservation target is "all" biodiversity at multiple spatial scales and biological levels. The *bottom-up* approach builds the ecological systems and species groups by grouping ecologically related communities and species. The top-down and bottom-up approaches are not mutually exclusive, and may be most effective when utilized together.

1a. Identify all ecological systems that characterize the terrestrial, aquatic, and marine components of the site, as appropriate (i.e., top-down approach). Using the major components as an organizing framework, iden-tify all the major ecological systems occurring at the site. It is important to identify ecological systems at all appropriate spatial scales—local, intermediate, and coarse (see examples in Appendix B). In particular, coarse-scale ecolo-gical systems should be recognized because they provide the broadest ecological context within which to conserve intermediate- and local-scale communities and species.

Examples:

- The Laguna Madre landscape in Texas might be divided into six major ecological systems—coastal Texas sand plain, Tamaulipan thornscrub, freshwater wetlands and potholes, hypersaline lagoon system, barrier island com-plex, and nearshore marine system.
- The Canaan Valley/Dolly Sods site in West Virginia might be divided into six major systems—coarse-scale sub-alpine conifer matrix forest and northern hardwood matrix forest; intermediate-scale acidic wetlands and large, low-gradient, high elevation river system; and local-scale grass balds/heath barrens and circumneutral wetlands.

1b. Consolidate individual species and ecological communities into major groupings and ecological systems, respectively (i.e., bottom-up approach). At sites where numerous species and ecological communities have been identified either through ecoregional planning or subsequently by the site team, combine ecological communities or species that share a common set of sustaining ecological processes or conservation requirements into an ecological system or species group. It is important to define ecological systems and species groups at appropriate spatial scales—fine, intermediate, and coarse. These ecological systems and species groups may be considered focal conservation targets.

Examples:

- An intermediate-scale "freshwater mussels" grouping might be defined on the basis of common habitat requirements and fish hosts for a set of mussel species.
- At a riverine site in the Southeastern U.S., the stream (aquatic) system and the dynamic mosaic of floodplain plant community types, all created and maintained by the same fluvial processes, might be combined into a "ground-water-fed, blackwater stream–bottomland hard-wood forest" complex.
- A "shrub-steppe matrix" ecological sys-tem might consist of an assemblage of big sagebrush and bunchgrass communities, including the associated rare and common species that are dependent on this habitat.
- "Northern mesic conifer-hardwood forest," a composite of numerous forested communities that are (or were) widespread in the upper Midwest of the United States, might be identified as a conservation target at sites in that region.

STEP 2. Identify specific ecological communities, species, or species groups that occur at the site and have ecological attributes or conservation requirements not adequately captured within the previously defined ecological systems.

Types of ecological communities, species, and species groups to consider include:

2a. Individual species or species groups that disperse, travel, or otherwise use resources across different ecological systems. Such species help ensure attention to linkages, connectivity, ecotones, and environmental gradients.

Examples:

- In the Laguna Madre landscape in Texas, the ocelot is a focal target because it utilizes a suite of terrestrial-estuarine-barrier island-marine systems.

- A salamander species that moves from ponds for feeding to uplands for breeding and nesting might be recognized as a focal target.

2b. Important attributes of regional-scale species (or species groups) that should be conserved at this site. Individual conservation sites make important and often unique contributions to the functional network of sites that supports a population of a regional-scale species. The particular life stage(s) of the regional-scale species that is fulfilled at the site may be considered a focal conservation target.

Examples:

- Neotropical migratory bird species might be consolidated into a "Migrating Neotropical birds" grouping based on their common use of autumn staging habitat at a site along the Atlantic flyway. The focal target is the migratory life stage of the birds as they utilize the site.
- A functional landscape in the Pacific Northwest may contain the very best spawning streams in the ecoregion for a population of salmon. The reproductive life-stage of the salmon population could be considered a focal conservation target at this site.

2c. Individual species and ecological communities that have special conservation or management requirements. Individual ecological communities and species that require particular conditions that are different from the conditions required by broader species groups and ecological communities, or ecological systems, and that will not be adequately represented and captured by the focal targets identified in the previous steps, may be considered focal conservation targets. Some species need special attention not because they have special require-ments, per se, but because they are rare or imperiled.

Examples:

- A rare mussel species with a unique fish host or specialized habitat might be split out from the freshwater mussels grouping.
- A rare warbler with specialized staging habitat might be split out from the neotropical migrants grouping.
- Seagrass beds may need to be explicitly distinguished within the Laguna Madre hypersaline lagoon system because of their critical role in supporting the entire estuarine food web and their sensitivity to changes in water quality.

STEP 3. Of the conservation targets identified through the first two steps, identify the eight that best meet the following three criteria:

- ***Reflect ecoregion conservation goals.*** Focal targets that are grounded in the reasons for the site's inclusion in the ecoregional portfolio are more desirable. (If the ecoregional plan has not been completed, or if the first iteration of the ecoregional plan did not set goals for an important group of targets, e.g., aquatics, then the ecoregional importance of the target should be considered in light of the best available information).
- ***Represent the biodiversity at the site.*** The focal targets should represent or capture the array of ecological systems, communities and species at the site, and the multiple spatial

scales (coarse, intermediate, and local) at which they occur. A target that complements other focal targets in this respect is more desirable. This is especially important at functional landscapes, but also true at other functional sites.

- ***Are highly threatened.*** All else being equal, focusing on highly threatened targets will help ensure that critical threats are identified and addressed through conservation action.

STEP 4. Check the list of focal conservation targets to ensure that all conservation targets identified through ecoregional planning are adequately represented, and revise the site list as necessary.

Each conservation target identified through ecoregional planning should be explicitly attributed to one or more of the focal conservation targets for site conservation planning. These relationships should be documented (tables for documenting these relationships are provided in the *Site Conservation/Measures of Conservation Success* Excel workbook and in Appendix B). Any gaps, in this regard, should be acknowledged and addressed if possible. Any additions, deletions, or other revisions made to the ecoregional target list during site planning must be communicated back to the ecoregional planning team. New conservation targets and occurrences then can be considered during the next iteration of ecoregional planning.

Eglin Air Force Base and surrounding public and private lands—a functional landscape in the Florida panhandle where the Conservancy works with the Department of Defense and other partners—provides a good example of selecting focal conservation targets to reflect ecoregional goals, the array of communities and species at the site, and the linkages among ecological systems. As a functional landscape, the implicit conservation target is the set of "all" species, communities, and ecological systems within the Greater Eglin landscape. Four ecological systems and four species were selected as focal conservation targets: longleaf pine sandhill forest and longleaf pine-mixed hardwood forest (the two dominant, coarse-scale matrix forest types); seepage stream/slope forest complex (including seven ecological communities and 35 G1-G3 plants and animals); pitcher plant bogs-sandhill ponds; red-cockaded woodpecker; flatwoods salamander; Florida black bear; and Florida bog frog. All of these targets contribute to the conservation goals of the East Gulf Coastal Plain Ecoregion. Collectively, these focal targets cover coarse to local scales (see Appendix B), and are thought to represent the array of terrestrial and aquatic systems, communities, and species within the landscape, as well as the patterns and processes necessary to sustain them.

In some cases, the assessment of systems, stresses, sources, and strategies at a functional landscape may lead a site planning team to subdivide the large site into multiple, smaller sites for planning, implementation, and measuring success.

Returning to the Greater Eglin Air Force Base example, after further consideration of targets, threats, and potential conservation strategies, the planning team divided the single functional land-scape into three spatially-distinct, but adjacent functional landscapes: East Eglin, West Eglin, and Blackwater River State Forest (including associated private lands). Although the conservation targets were similar at these sites, the viability of the target occurrences, the types and degree of threats, and the conservation strategies were quite different. In this case, developing and implementing strategies and measuring success made more sense for the three individual sites than for the one composite site.

▶ The primary reason for subsuming individual species and communities into ecological systems or for identifying them individually apart from ecological systems is related to the identification of threats and strategies and the assessment of viability. If assessing two targets individually will lead to the identification of different threats and/or conservation strategies, or if the two targets are so different ecologically that they cannot (or should not) be combined for purposes of assessing viability, then it makes sense to distinguish them as separate targets. On the other hand, if the conservation requirements (i.e., threats, strategies) for one target subsume those of another target, it makes sense to combine the two.

▶ The viability of the focal conservation targets is the basis for the Biodiversity Health measure of success (see Step 2, below). Therefore the viability of each focal target must be measurable, either directly or via a set of indicators.

▶ **The identification or selection of focal conservation targets is an iterative process.** You will continue to re-evaluate and revise the focal conservation targets over the short term as you proceed through the site planning process (i.e., stresses, sources, strategies), and over the long term as you learn more about the ecological patterns and processes at the site and what threatens them. In addition, the focal conservation targets may change over time as strategies are implemented and threats are abated, or if the conservation situation changes significantly.

Appendix B illustrates the different levels of biodiversity organization and spatial scale, and provides illustrative examples of the focal conservation targets for several conservation sites.

For additional information about the treatment of conservation targets, see the following publications:

▶ *Designing a Geography of Hope,* 2nd Edition.

▶ *Setting Conservation Goals for Ecological Communities*, available upon request from the Conservation Planning program of the Conservation Science Division (contact Craig Groves, cgroves@tnc.org).

▶ Biodiversity conservation at multiple scales, by Karen Poiani, Brian Richter, Mark Anderson, and Holly Richter. 2000. Bioscience 50 (2). 133-146.

B. *DETERMINE THE CHARACTERISTICS OF VIABLE CONSERVATION TARGETS*

The continued existence of the focal conservation targets at the site will depend upon maintaining the natural processes that allowed them to establish and thrive in the past.

What factors, including key ecological processes, must be maintained to ensure the long-term viability of theconservation targets?

Three factors—***size***, ***condition***, and ***landscape context***—should be considered in characterizing viable occurrences of the focal conservation targets.

▶ ***Size*** is a measure of the area or abundance of the conservation target's occurrence. For ecological systems and communities, size may simply be a measure of the occurrence's patch size or geographic coverage. For animal and plant species, size takes into account the area of occupancy and number of individuals. Minimum dynamic area, or the area needed to ensure survival or re-establishment of a target after natural disturbance, is another aspect of size.

▶ ***Condition*** is an integrated measure of the composition, structure, and biotic interactions that characterize the occurrence. This includes factors such as *reproduction*, *age structure*, *biological composition* (e.g., presence of native versus exotic species; presence of characteristic patch types for ecological systems), *physical and spatial structure* (e.g., canopy, understory, and groundcover in a forested community; spatial distribution and juxtaposition of patch types or seral stages in an ecological system), and *biotic interactions that directly involve the target* (e.g., competition, predation, and disease).

- ***Landscape context*** is an integrated measure of two factors: the dominant environmental regimes and processes that establish and maintain the target occurrence, and connectivity. *Dominant environmental regimes and processes* include hydrologic and water chemistry regimes (surface and groundwater), geomorphic processes, climatic regimes (temperature and precipitation), fire regimes, and many kinds of natural disturbance. *Connectivity* includes such factors as species targets having access to habitats and resources needed for life cycle completion, fragmentation of ecological communities and systems, and the ability of any target to respond to environmental change through dispersal, migration, or re-colonization.

Characterizing the size, condition, and landscape context of a viable occurrence provides the basis for assessing stresses—the destruction, degradation, or impairment—that afflict the priority targets, as described in the next chapter. It also aids in the development of conservation goals (see next toolbox) and restoration strategies.

Two tools, conservation goals and conceptual ecological models, may provide clarity and focus in characterizing the viability of focal conservation targets.

- ***Conservation Goals*** are explicit descriptions of the *intended* viability status of a target—a goal specifies the characteristics for a viable occurrence. Goals ought to address size, condition, and landscape context. They may be broadly stated in terms of intended EO rank (i.e., an "A," "B," or "C") or Biodiversity Health category (i.e., "Very Good," "Good," or "Fair"), or may be stated more precisely in terms of specific size, condition, and landscape context characteristics. A more detailed discussion of conservation goals is provided in the *Supplemental SCP Volume*.
- ***Ecological Models*** describe our understanding of the relationships between and among the patterns of biodiversity (i.e., where conservation targets occur on the landscape) and the natural processes that create and maintain the patterns. Models are especially useful for summarizing the patterns and processes that characterize a target; identifying the viability of, and stresses to, the target; and identifying species and system components to monitor (i.e., attributes that reflect size, condition, and landscape context). A more detailed presentation on ecological models, including some examples, is provided in the *Supplemental SCP Volume*.

A note on boundaries related to conservation targets: The **pattern** of conservation target occurrences on the landscape and the natural **processes** that sustain the targets can be mapped. Boundaries depicting the patterns and sustaining processes of the conservation targets fall in to the category of ecological boundaries. Collectively, the relevant ecological boundaries delineate the *functional conservation site*. Additional information on site-based boundaries can be found in the *Supplemental SCP Volume*.

Note: Completing these first two steps for systems is a prerequisite for assessing stresses (Chapter V) and for measuring the biodiversity health of a site. The final two steps are specific to assessing biodiversity health (Steps C and D, below). We strongly recommend that you complete Steps 3 and 4 before assessing stresses.

C. *RANK THE FOCAL CONSERVATION TARGETS FOR VIABILITY*

The viability of a focal conservation target is a function of the size, condition, and landscape context of the target occurrence, as described above. Based upon the best available knowledge and judgement, rank the size, the condition, and the landscape context of each focal target. Each of the three factors should be ranked as "Very Good", "Good", "Fair", or "Poor". The ranking procedure follows the Natural Heritage Network's principles for ranking element occurrences (summarized in Chapter IX [*Measures of Conservation Success*]).

Target viability is ranked as "Very Good", "Good", "Fair", or "Poor" based on the explicit assessment and ranking of size, condition, and landscape context (see the *Site Conservation/Measures of Conservation Success* Excel workbook, and Appendix A for step-by-step instructions). The rationale for the viability ranks is as follows:

- ***Very Good.*** Excellent estimated viability. Generally, "Very Good" viability reflects at least two "Very Good" and no "Fair" or "Poor" ranks for size, condition, and landscape context.
- ***Good.*** Good estimated viability. Various combinations of "Very Good" to "Poor" size, condition, and landscape context can result in "Good" viability. In general, "Good" viability reflects at least two "Good", or one "Very Good", and no "Poor" ranks among the three viability factors.
- ***Fair.*** Fair estimated viability. Like "Good" viability, various combinations of "Very Good" to "Poor" size, condition, and landscape context can result in "Fair" viability. However, in general, "Fair" viability reflects at least two "Fair", or one "Poor", and no "Very Good" ranks among the three viability factors.
- ***Poor.*** Poor estimated viability; or not viable. Generally, "Poor" viability reflects at least two "Poor" and no "Good" or "Very Good" ranks for size, condition, and landscape context.

Given the fundamental role of assessing and ranking size, condition, and landscape context in ranking viability, it is essential to document the thinking behind the size, condition, and landscape context ranks assigned to each focal conservation target. You should cite global EO rank specifications when they exist; with some thought, the letter-grade global EO ranks can be translated into site-specific categorical viability ranks. Whether or not global EO rank specifications exist and are the basis for the site-specific viability assessment, you must document the size, condition, and landscape context attributes and ranks that justify the assigned, site-specific viability rank. This documentation should include the changes in these attributes that would cause size, condition, or landscape context to be up-ranked or down-ranked by one class.

As indicated in the heritage methodology, ranks should be assigned strictly within the four classes. A four level ("Very Good", "Good", "Fair", "Poor") scale should be sufficient for ranking the size, condition, landscape context, and viability of focal conservation targets; a scale having finer distinctions cannot be justified given the variability of nature, incomplete knowledge, and limitations inherent in our ability to accurately measure viability.

- Consider global EO rank specifications when they exist (e.g. specifications will be published in 2000 for 500 animal species). The global EO letter-grade ranks can be translated into the site-specific categorical viability ranks for Biodiversity Health.
- While EO rank specifications have not yet been developed for most ecological communities, the *EO Data Standards* document provides guidance on community EO ranking (see Chapter 5, section 5.6.2). Currently, there is little guidance available for ranking ecological systems and groupings of species.
- When EO rank specifications do not exist, site-specific viability rank specifications will have to be developed. Under these circumstances, there is likely to be less precision in ranking the occurrences than ranking occurrences of species and ecological community targets for which global EO rank specifications exist. There is also likely to be greater inconsistency in the rankings across sites.
- To help address the challenge of developing site-specific ranking criteria for conservation targets, you can consult with ecoregional planning ecologists and other scientists who are knowledgeable about the target, and use informed judgements and available information to assess the size, condition, and landscape context of the conservation target at the site.
- In some cases, TNC and partner scientists participating at sites may be sufficiently knowledgeable to develop EO rank specifications for a conservation target. Templates and examples are provided in Chapter 5 of *EO Data Standards*.
- The viability rank of a focal conservation target should be based strictly on its *current* size, condition, and landscape context. A target should not be down-ranked because a threat looms on the horizon. The potential threat could be abated. The threats at the site will be assessed as a separate measurement.

D. *ASSIGN "BIODIVERSITY HEALTH" FOR THE SITE*

Each of the viability ranks has a numerical score assigned to it:

"Very Good"=4.0

"Good"=3.5

"Fair"=2.5

"Poor"=1.0

This scale is a crude approximation of the underlying continuous viability scale. The non-linear numeric relationship among the viability classes reflects the diminishing return of moving up one class as one moves up the scale. For example, the viability score increases by 1.5 in moving from "Poor" to "Fair," but only increases by 0.5 in moving from "Good" to "Very Good."

The average viability score across the focal conservation targets at the site is calculated, and Biodiversity Health for a site is assigned as "Very Good", "Good", "Fair", or "Poor" according to the following grading scale:

>= 3.75	Very Good
3.0 – 3.74	Good
1.75 - 2.99	Fair
< 1.75	Poor

You and your planning/implementation team will need to develop appropriately detailed, cost-effective monitoring procedures to assess the viability (i.e., size, condition, landscape context) of the focal conservation targets. For each focal target, this will require the identification of the attributes that (1) reflect size, condition, and landscape context, (2) are sensitive to change, and (3) are amenable to being monitored. In addition to being the basis of the summary Biodiversity Health measure, this target-specific information can be used for more detailed, site-based decision-making, e.g., the response of individual targets to specific strategies. See the last section of Chapter VIII (*Measures of Conservation Success*) for more information on developing a site-based monitoring program.

The Microsoft Excel workbook entitled *Site Conservation/Measures of Conservation Success Workbook* contains a computer-automated *Systems Viability Worksheet* template that automatically ranks the viability of each selected conservation target, based on an assessment and ranking of size, condition, and landscape context, and assigns Biodiversity Health for the site. Moreover, the worksheet will allow a graphic presentation of the current viability rank of each conservation target.

A "manual" *Systems Viability Worksheet* is provided in Appendix A. This worksheet is analogous to the *Systems Viability Worksheet* in the Excel workbook, and can be copied and filled out manually to compute viability ranks for focal conservation targets and Biodiversity Health for a site.

The Excel workbook also contains a *Related Conservation Targets and Monitoring* worksheet that allows elements of biodiversity subsumed by each focal conservation target to be identified, and the indicators and monitoring parameters for size, condition, and landscape context to be documented. An analogous "manual" worksheet is provided in Appendix B.

The Excel workbook is included on the diskette that accompanied this handbook, or is available upon request from the Site Conservation program of the Conservation Science Division (site_conservation@tnc.org).

V. Stresses

We need to understand the *stresses* affecting the focal conservation targets—as distinct from *sources* of stress—in order to ensure that we develop effective conservation strategies.

At first glance, the distinction between stresses and sources may appear overly complicated or unnecessarily confusing, but it is actually designed to make a complex task easier to understand. More importantly, it is designed to help lead to effective strategies for addressing critical threats. This is well described in *Beyond the Ark*:

> The Nature Conservancy originally called the second step in its [site conservation] planning discipline "threats analysis". Project teams understandably adopted "threat" as the unit of analysis. The Conservancy concluded after a time, however, that its project teams would be better positioned to develop good strategies if they considered threats in two more narrowly defined steps. Team members are now advised to ask first what the ecological stresses to a system are—independent of the source of those stresses—before separately tracing those stresses to their sources. If we do not consciously alter our natural mode of expression, we will, for example, call a proposed road a threat in an estuarine system. We are then immediately inclined to the conclusion that we must stop construction of the road. Threat: road. Solution: stop road. However, if we separate the threat into stress and source, the stress isn't the road. The stress is, for example, loss of tidal flow. That formulation of stress inclines us to think, instead, of ways to keep tidal waters flowing through the pathway that is the proposed location of the road. Culverts may be the answer. (*Beyond the Ark*, by Bill Weeks, p. 46)

In essence, stress is the impairment or degradation of the size, condition, and landscape context of a conservation target, and results in reduced viability of the target. A source of stress is an extraneous factor, either human (e.g., policies, land uses) or biological (e.g., non-native species), that infringes upon a conservation target in a way that results in stress.

What types of destruction, degradation, or impairment are significantly reducing the viability of each focal conservation target at the site? **?**

This chapter presents two steps for answering this key question:

1. Identify major stresses to the focal conservation targets
2. Rank the stresses

It is necessary to complete both of these steps before proceeding to an assessment of sources of stress (Chapter VI).

1. Identify Major Stresses to the Conservation Targets

Every natural system is subjected to various disturbances. For our planning purposes, however, only the destruction, degradation or impairment of focal conservation targets resulting directly or indirectly from human causes should be considered a stress. Many or most stresses are caused directly by incompatible human uses of land, water, and natural resources; sometimes, incompatible human uses indirectly cause stress by exacerbating natural phenomena.

The stresses to consider should be happening now, or have high potential to occur within the next ten years. Do not consider past stresses that no longer affect the viability of the target, or those that are possible but have low potential to occur. The damage may be either a direct impact to the conservation target (i.e., degraded size or condi-tion), or an indirect impact via impairment or exacerbation of an important natural process (i.e., degraded landscape context).

The stresses afflicting *each* focal conservation target need to be identified. It is important to be as precise as possible in identifying the stresses; this will help focus the subsequent identification of sources of stress, and minimize double counting of stresses.

Review the size, condition, and landscape context ranks for each focal conservation target. These rankings should help you identify the existing stresses to the target. For example, if size, condition, or landscape context of the target was not ranked "Very Good", what sort of degradation or impairment was the basis for down-ranking the factor?

To identify stresses that have high potential to occur within the next ten years, you must have some sense of the human activities that are likely to become important sources of stress within the ten-year timeframe. For example, a river system may now be undammed, but a dam has been approved and construction scheduled to occur within the next ten years. Operation of the dam is expected to alter the magnitude and timing of peak flood flows that sustain the downstream riparian forest. In this case, altered flood flows should be identified as a stress to the riparian forest (and dam operation would be identified as the source of the stress).

- Conceptual ecological models (see toolbox on page IV-8, and *Supplemental SCP Volume*) may be helpful tools for identifying stresses to conservation targets and sustaining processes.
- An illustrative checklist of stresses is provided in Appendix C and as a drop-down menu in the Excel workbook to aid in the identification of stresses. Use this list as an aid, but consider other stresses that may be relevant and significant. Appendix C also provides some illustrative examples of the identification and ranking of stresses and sources.

A note on mapping stresses: The geographic component of a stress corresponds to the boundary of the conservation target occurrence or natural process afflicted by the stress. Mapping stresses can aid in identifying and locating conservation targets occurrences and sustaining processes that need restoration and ecological management. Additional information on site-based boundaries can be found in the *Supplemental SCP Volume*.

2. Rank the Stresses

The relative seriousness of a stress is a function of the following two factors:

- ***Severity of damage.*** What level of damage to the conservation target over at least some portion of the target occurrence can reasonably be expected within 10 years under current circumstances? Total destruction, serious or moderate degradation, or slight impairment?
- ***Scope of damage.*** What is the geographic scope of impact to the conservation target expected within 10 years under current circumstances? Is the stress pervasive throughout the target occurrences, or localized?

Based upon the best available knowledge and judgments, for each stress to each priority conservation target that you've identified, rank the severity and scope as "Very High", "High", "Medium", or "Low". The stress is then ranked, using the same four classes, based on the assessment of severity and scope (see the Microsoft Excel *Site Conservation/Measures of Conservation Success Workbook,* and Appendix A). The guidelines for ranking severity and scope, and the rules for combining severity and scope into a stress rank are presented in Appendix A. You want your conservation strategies to reduce or eliminate those stresses that have high severity combined with wide scope. You should not be as concerned about a stress with very severe impacts to only a small area, or stresses that are widespread but with low severity.

This method of characterizing and assessing stresses is, in part, the basis for making the Threat Status and Abatement measure of conservation success at sites.

Some stresses, while not seemingly widespread or severe, may actually be at or near a threshold of irreversibility. That is, the severity and/or scope of the stress may remain relatively small over the next ten years but in the future will increase inexorably and be impossible to reverse if the source of stress is not abated within the next ten years. Stresses caused by non-native invasive species often fall into this category.

For example, consider a grassland system with a few, small infestations of a non-native invasive weed; these infestations alter the composition and structure of the grassland. At face value, the scope of the stress (altered composition/structure) is "Low"; combined with "Very High" severity, the overall stress rank is "*Low*". However, the invasive species can be eliminated or prevented from spreading only if caught at this time when small in number and extent. Once the distribution of the invader, and thus the scope of the stress, reaches a threshold size (which may be small relative to the size of the whole grassland occurrence), it becomes, for all intents and purposes, impossible to eliminate—it will eventually spread unabated throughout the occurrence. In this case, if the invasive weed and corresponding altered grassland structure and composition are expected to reach this threshold within ten years under current circumstances, then a more appropriate stress rank would be "*Very High*". Under circumstances such as these, you should override the stress rank suggested by the scoring tables and use the more appropriate higher rank.

Note: if overriding the ranking suggested by the scoring tables is necessary, it is extremely important to document your rationale for doing so.

The previously referenced Microsoft Excel workbook entitled *Site Conservation/Measures of Conservation Success Workbook* contains computer-automated *Stresses/Sources Worksheet* templates that automatically rank the identified stresses to each target based on an assessment of severity and scope. The Excel workbook is included on the diskette that accompanied this handbook, and is available upon request from the Site Conservation program of the Conservation Science Division (site_conservation@tnc.org). A set of "manual" *Stresses/Sources Worksheets* is provided in Appendix A. These worksheets are analogous to those in the Excel workbook, and can be copied and filled out manually to determine the stress ranks.