❖ Standard 8: Develop explicit abundance and distribution goals for conservation targets/biodiversity elements.

[PLAN]

Rationale

A comprehensive conservation vision based on conservation targets depends on explicit conservation goals for the number and distribution of occurrences of an element/target that will be enough to ensure its long-term persistence. These goals, which are working hypotheses, also inform adaptive management and are the ultimate measure of our ability to secure biodiversity targets. Goals define the minimum abundance and distribution of target occurrences of sufficient viability and integrity to offer the probability for long-term persistence in an ecoregion. They should be sufficient to allow the target to persist, and to evolve within the ecoregion as conditions change over the coming decades. Progress towards meeting the goals in terms of effectively conserving targets needs to be tracked as the fundamental ecoregional measure over time. Progress towards abundance and distribution goals can be made through additional information (for example, surveys to identify more already conserved occurrences), range expansion, and restoration of currently non-viable occurrences. If appropriate, assessments could include alternative goals, as expressions of relative risk, to form the basis for creating multiple regional conservation scenarios. In addition, the concept of conservation goals should be adapted for relatively intact ecoregions, where multiple goal levels may be effectively combined with forecasts of future land/water uses to analyze levels and locations of acceptable change.

Recommended Products

- Minimum numerical abundance (number, percent or area) and distribution goals (spatial/ecological stratification) and justifications for these goals for every target/group of targets within the ecoregion.

INTRODUCTION

Conservation goals are the ecological criteria that we establish for the persistence and variability of conservation targets across an ecoregion. Thoughtful goal setting to define “how much is enough” is necessary for credibility of an ecoregional assessment (Soule and Sanjayan 1998, Noss 1996). While viability/integrity criteria are applied for each target occurrence (e.g., minimum size, landscape context), conservation goals define the abundance and spatial distribution of viable target occurrences necessary to adequately conserve those targets in an ecoregion for at least 100 years. Individual target goals contribute to development of a portfolio that depicts characteristic landscape settings that support all of the ecoregions biodiversity. Adequate conservation maintains self-perpetuating ecological and evolutionary processes. These processes include meta-population dynamics, non-equilibrium spatial and temporal processes that create and maintain heterogeneity, resilience to disturbance events, natural ranges of variation of biotic and abiotic characteristics, and the ability to withstand the impacts imposed by humans.

Developing conservation goals requires an understanding of:

- The importance of setting conservation goals
- The components of conservation goals
- How to set abundance and distribution goals
- Incorporating risk into goal setting
- Design goals

The importance of setting conservation goals

Conservation goals determine the vision for conservation success and are the basis for measuring progress in conserving and restoring biodiversity. In nearly all instances, goals are based upon our knowledge of historical abundances and distributions, and require that we understand and acknowledge effects of human activity over recent centuries. In most instances, our conservation vision should attempt to mitigate negative human effects on the regions biodiversity. Goals provide a benchmark is available to strive for when designing ecoregional portfolios. This benchmark influences the number and distribution of areas of biodiversity significance, and is therefore a necessary step to creating a portfolio. Goals define the overall design: how many components and where should they be placed. Once a portfolio has been designed, gaps in progress towards goals inform the adequacy of proposed areas of biodiversity significance and existing conservation areas in maintaining biodiversity targets. Those gaps also, inform inventory needs, and define restoration needs to regenerate viability and integrity of target occurrences.

Setting meaningful and realistic conservation goals for targets is challenging for a number of reasons. First, there is no scientific consensus on how much area or how many occurrences are necessary to conserve targets across their ranges. Second, there is little empirical or theoretical scientific research that addresses representation goals for most species, communities, and ecological systems. Finally, in some highly fragmented regions of the country, estimating historic conditions can be difficult, and setting goals based upon current conditions will almost certainly result in targets not persisting over the long term. Therefore, goals must be treated as working hypotheses. They need to be clearly stated, well documented and measurable. They should be treated in an adaptive approach where they are refined through time by monitoring and re-evaluating the status and trends of targets. Levels of uncertainty and risk should be a component of goal setting and documentation. (See Tear et al 2005)

The components of conservation goals

Conservation goals in ecoregional planning have several components. **Abundance** goals are the **number, or percent area** of occurrences necessary for a target to persist. These goals provide **redundancy**. **Distributional** goals define how the target occurrences should be arrayed spatially across an ecoregion. These goals capture **representation.** Conservation of multiple, viable examples of each target, located across its geographic and ecological range addresses the **ecological** and **genetic variability** of the target, and provides sufficient redundancy and representation for persistence in the face of environmental stochasticity and human perturbations.

Conservation goals are not only a numbers game. Ecoregional assessments have historically focused on abundance and distribution goals, but conservationists have realized that these goals alone do not ensure the conservation of some critical ecological processes, especially as they relate to long-distance connectivity. Conservation planners now also set **design** goals defining specific **contexts**. For instance, a planner may specify appropriate minimum distances between target occurrences in order to maintain source and sink ecological processes, or they might define specific terrestrial corridors for wide-ranging mammals, or connected stream systems to allow routes for migratory fishes and natural flows.

Goals	**Measurable Objectives**	**Conservation Strategy**	**Example**
Abundance	Numeric	Maximize the probability of target persistence through redundancy	25 viable examples of each G1 endemic species[1] 30% of estimated historical extent;
Distribution	Numeric/Unit	Maximize the probability of target persistence through capturing variability through representation	At least one viable example of each natural vegetation community type in each ecoregional subsection based on current and historic distribution[1]
Design	e.g. connectivity, spatial arrangements, linkages to critical ecological processes	Maximize the probability of target persistence through maintenance or enhancement of specific ecological processes.	At least one connected suite of aquatic systems (size 1-4) in each ecological drainage unit to support coarse-scale migratory fish species conservation target group[1]

Table 1. Framework of abundance, distribution and design goals.

How to set abundance, distribution and design goals.

Deciding on numeric values for goals can be challenging but there are some guiding principles that are useful to this process. Abundance and distributional goals should be based on the proportional historic range-wide characteristics of targets, and ecoregional

[1] Extracted from the High Allegheny Plateau Ecoregional Plan

goals should be placed within the context of broader range-wide goals. For example, if 50% of the known, historical range of a target falls within a given ecoregion, the goal for that ecoregion should reflect roughly 50% of a range-wide goal. In practical terms, we have sometimes used the target's distribution relative to the ecoregion as a guide to establish abundance goals (higher with endemic, to lower with peripheral). These categories can apply to all conservation targets.

Target Distribution Classes and suggested thresholds (Comer, 2005):
Endemic/restricted. . Target occurs primarily in one ecoregion.
>90% of global distribution in ecoregion,

Limited. Target distibution is centered in a few ecoregions
<90% of global distribution is with in the ecoregion, and distribution is limited to 2-4 ecoregions,

Disjunct. Target is a distinct occurrence in the ecoregion isolated from other occurrences in adjacent ecoregions. Distribution in ecoregion quite likely reflects significant genetic differentiation from main range due to historic isolation.
Roughly >2 ecoregions (or several hundred kilometers) separate this ecoregion from other more central parts of it's range.

Widespread . Target occurs across several to many ecoregions. Goals should be established across the range of the targets, if possible.
Global distribution >3 ecoregions.

Peripheral . Target has a small percentage of its distribution in the ecoregion.
<10% of global distribution in ecoregion.

<u>Abundance</u>
Abundance goals should take into account attributes of target scale and pattern. Targets can be grouped according to these attributes so planners do not need to set goals for each target individually. For instance, terrestrial communities and ecological systems are often grouped as Matrix, Large Patch and Small Patch and Linear types (see Targets unit, as well as Anderson et al. (1999) in tools/resources section of this unit for guidance on defining these categories). Freshwater ecological systems are grouped by different sizes, such as headwaters and small tributaries, small, medium and large rivers. Commonly, smaller communities and ecological systems, and locally occurring targets are given higher abundance goals because they historically had more numerous occurrences, and are more susceptible to disturbances than those that are larger and more widely distributed.

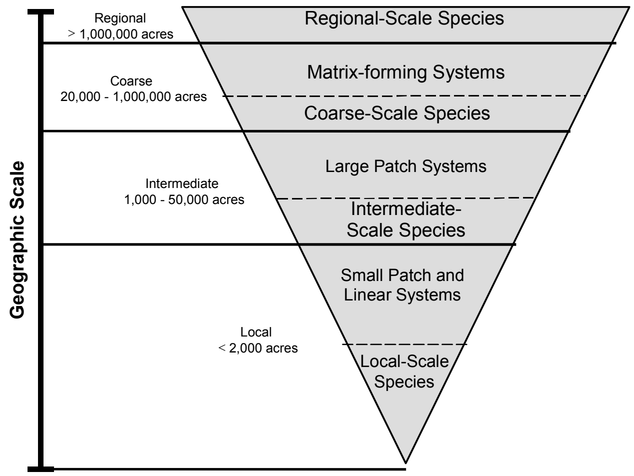

Figure 1: Categories representing geographic scale of conservation targets. Spatial ranges are approximate and overlapping (Poiani et al. 2000).

Target- specific goals have been defined using historic records and expert knowledge to avoid setting goals higher than the historic number of populations, as many targets are naturally rare. Additional information on setting target-specific goals is available in species Population Viability Analyses and recovery plans. Cox et al. (1994) suggest a minimum of ten secure populations would provide a >90% chance that at least one population would persist for >100 years. It should be noted, however, that these goals were set to prevent extinction, not necessarily to secure populations in numbers that could adapt and evolve over time. However, since many species historically never had ten populations, this guidance should be used as a rule of thumb, and modified when historical information suggests that fewer populations are sufficient. Default goals of all existing occurrences have also been used, but do not inform data gaps or restoration needs for targets.

Ecological systems are used as coarse filter targets. As such, they capture many common, untracked and unknown species as well as serving directly as large-scale conservation targets themselves. Many goals for ecological systems have been based on species diversity/area curves. These curves are conceptual models that provide an approximation of the proportion of species that might be lost given the reduction in habitat areas. These relationships grew from empirical observations of island biogeography (MacArthur and Wilson 1967), and have been shown to exist for habitat islands in terrestrial and aquatic landscapes. Dobson (1996) provides estimations of terrestrial species loss associated with the percent habitat remaining, and suggest that 30-40% of the historic area of a given community or ecological system would likely contain 80-90% of the species that occur in them (from Groves 2003). This model has not been tested, and regional analyses of species/area relationships would better inform goal setting using this as a framework.

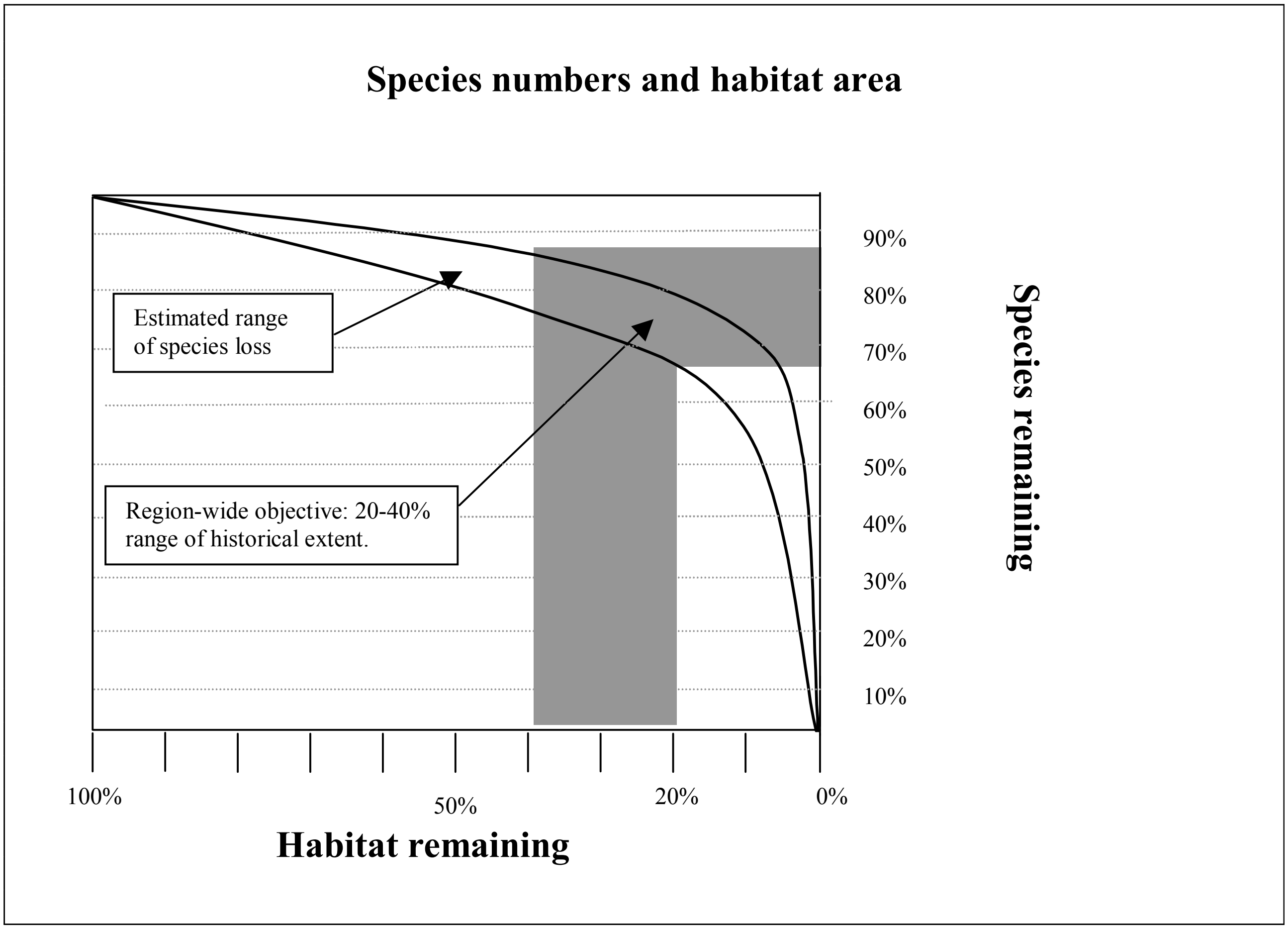

Figure 2. Estimated percentage of species loss with habitat loss over time, and potential effect of selecting goals between 10 and 40% of historical extent (grey shade). (Source: Tier et al. in press)This is a model and does not precisely represent species/area relationships. In addition, those relationships are expected to change regionally and across biological realms (e.g., freshwater, coastal marine).

An additional criterion that has been applied in setting abundance goals is the condition/viability ranks of occurrences. The rationale is that goals might be higher for low-ranked occurrences that are in relatively poor condition because they each have an innately lower chance for persistence than higher-ranked occurrences. This rationale would suggest that in fragmented landscapes with few high quality occurrences, goals would be set higher than in more intact landscapes where there is less human impact and more high quality occurrences. This approach requires detailed ranking information on target occurrences and is not applicable in most places.

Abundance goals have been set using both number of occurrences and percent area of targets. Number of occurrences is appropriate for species, community and small patch ecological system targets, where occurrences are represented as point locations. In addition, in fragmented landscapes where large patch and matrix forming ecological systems are distinct occurrences, applying these types of goals may be appropriate. Caution should be taken in making sure that occurrences are adequately ranked for their condition and viability, so that what may seem like small patch ecological system occurrences are not actually poor quality occurrences of historically large patch or matrix forming ecological systems.

Percent-area goals are often used for targets such as matrix forming, large patch and linear ecological systems which often occur as extensive mapped polygons on the landscape, and distinct, multiple occurrences are not common. It typically makes little sense to set goals based on number of occurrences, but instead on the percent area of the historic and extant area of the ecological system.

<u>Distribution</u>

Ecoregions are not homogeneous. They contain environmental gradients and non-random distributions of biodiversity. Ecoregions are stratified in a variety of ways to delineate broad patterns of environmental gradients. In the United States, ecoregional "Provinces" (which we often refer to as "ecoregions") are subdivided by Sections and Sub-sections. In other parts of the world, similar stratification has been developed using information on regional climate, elevation, geology and soils. Freshwater ecoregions are being stratified by Ecological Drainage Units (Higgins et al 2005). These units correspond to regional patterns of climate, geology and drainage network characteristics. Marine ecoregions can be subdivided by geographical sub-units. (*See standard 6: Develop assessments/ visions within ecologically meaningful areas adopted or adapted from existing ecoregional classifications* for guidance and case studies for stratifying ecoregions.)

All targets should be represented across major biophysical gradients in order to capture environmental representation, ecological variability and potential genetic variability of targets. Representation of targets across major biophysical gradients also helps to ensure that each regional scenario encompasses native ecological system diversity while providing a hedge against a changing climate. This can be accomplished in several ways. First, as mentioned earlier, targets could be represented in each of the ecoregional *sections/EDUs/geographical subdivisions* of their natural distribution. Second, for large patch, linear, and matrix forming systems (both terrestrial and freshwater), they can be represented in combination with biophysical land units and aquatic biophysical environments to help represent ecological variability and gradients. For example, scenario generation software can be programmed to apply percent objectives to terrestrial/biophysical environment and riverine system/biophysical environment combinations; ensuring that the major biophysical gradients of each system would be represented in proportion to their occurrence for the ecoregion as a whole. A common approach successfully used elsewhere is to apply a given percent area objective (e.g., 30% of historical extent) using one layer (e.g., the system map). Typically this is applied with a minimum size requirement for each polygon of the map (e.g., 1000 hectares for a given large patch type). At the same time, apply a 10% areal objective to each unique combination of the system layer and a finer-scale biophysical land unit map. The combination of these allows you to represent both a total area objective and ensure that much environmental variability within and across types is also represented. Minimum distributional goal guidance that has been often applied to ecological systems is a minimum of one occurrence per stratification unit. Current guidance for marine goals is 20%. The guidance in the discussion above and in the examples below is more informed and sophisticated, and should be applied where possible.

TARGET DISTRBUTION	ABUNDANCE GOAL/ECOREGION	DISTRIBUTION GOAL
Endemic	20	At least 3 per section
Limited	20	At least 3 per section
Disjunct	15	At least 3 per section
Widespread	10	At least 2 per section
Peripheral	5	At least 2 per section

Table 2. An example of abundance (# of occurrences) and distribution goals for terrestrial species from the Southern Rocky Mountains ecoregional plan.

	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	*	*	*

Table 3. An example of recommended preliminary number of occurrences for ecological communities (plant associations) for an ecoregion incorporating distribution and spatial scale characteristics. The same could be applied for ecological system targets. See the Northern Appalachians Ecoregional Plan. * = goals determined on case by case basis.

Global Rank	Distribution Relative to Aquatic Region	Stream/River Size Inhabited by Species Target	Number of Populations Required in Each EDU
G1-G2	Endemic (>90% of range in aquatic region)	Large Rivers	1
		Small Rivers	2
		Creeks, Headwaters	3
	Widespread	Large Rivers	1
		Small Rivers	2
		Creeks, Headwaters	3
G3-G5	Endemic (>90% of range in aquatic region)	Large Rivers	1
		Small Rivers	1
		Creeks, Headwaters	2
	Widespread	Large Rivers	1
		Small Rivers	1
		Creeks, Headwaters	2

Table 4. Example of defining general goals for freshwater species targets using two categories of global ranks, two categories of distribution, and ecological system size categories. More specific categories of distribution and the addition of spatial scale were used as well (see below) (From Smith et al 2002).

Table 5. Examples of specific species target goals from guidance for different categories of global ranks, spatial scales and distributional attributes. Details can be found in Smith et al. (2002)

Common Name	**Scientific Name**	**Target Category**	**Global Rank**	**Spatial Scale**	**Distribution**	**EDU Goal**
Paddlefish	*Polyodon spathula*	Fish	G5	Regional	Widespread	1
Spectaclecase	*Cumberlandia monodonta*	Mussel	G2G3	Intermediate	Widespread	2
Tennessee Dace	*Phoxinus tennesseensis*	Fish	G3	Local	Widespread	3
Mississippi Flatwoods Crayfish	*Procambarus cometes*	Crayfish	G1	Local	Limited	10
Flattened Musk Turtle	*Sternotherus depressus*	Reptile	G2	Intermediate	Limited	5

For wide-ranging species whose populations are distributed over more than one ecoregion, it will likely be inadequate to set ecoregional goals in isolation from goals of adjacent ecoregions. Examples include salmon species in the Pacific-Northwest, Colorado River endangered fishes, migratory birds, and wide-ranging mammals like grizzly bear, wolf, wolverine, etc. For these types of species, goals should first be set range-wide by working across ecoregional boundaries and then subsequently set for each ecoregion based on range-wide needs. Ideally, we should establish goals for all targets in this manner. In addition to thinking about adjoining terrestrial, freshwater or marine ecoregions, some species use multiple biomes, such as salmon, and goal setting should take into account the multiple biomes and ecoregions. Fortunately, conservation planning is often underway by government agencies and other conservation organizations for many species. Ecoregional assessments should build upon and complement existing conservation planning efforts.

In some instances, migratory species targets are addressed by defining components of their habitat, such as specific nesting habitat, over-wintering habitat, and critical connecting corridors, as the mechanism for representing the target, then establish goals for each of those habitat components. Some have also used dynamic simulation models to understand region-wide population movements of certain well-studied target species and highlight critical landscape linkages, and then feed that information back to refine portfolio design.

Incorporating risk into goal setting

Incorporating risk into goals can inform selection of a single set of goals, or provide a set of alternative outcomes. Alternative risk scenarios are informative for several reasons. While there is constant debate about which exact number is appropriate for a single goal, there is more agreement that having more occurrences presents lower risk. By having several risk scenarios, multiple numbers in a risk scenario context provide a framework and set of hypotheses to test through time. Additionally, partners involved in developing and implementing ecoregional assessments may not agree on ecological goals, but may agree to apply several goal levels. It is critical to define the relative risk of different goals, so that when we use high risk goals we also generate, lower risk goal scenarios to provide a vision for a portfolio that would better secure biodiversity in the long term. For instance, while the COP7 agreements are to put 10% of a country's lands and waters into protected areas, this level of protection is generally viewed as a high-risk scenario. Moderate and low risk scenarios would provide visions for expansion of protected area networks to better secure biodiversity over the longer term.

Comer (2005) provides an example of alternative risk scenarios for species and terrestrial ecological systems (below). The examples below should be structured within a distributional goal as well. See the case study "**A Tiered Approach to Goal Setting in the Utah High Plateaus Ecoregion**" **for details.**

Distribution	**"High Risk" Scenario**	**"Moderate Risk" Scenario**	**"Low Risk" Scenario**
	Number of High Quality Occurrences		

Endemic	21	42	80
Limited	10	21	42
Disjunct	5	10	21
Widespread	5	10	21
Peripheral	2	5	10

Table 6. Example of Initial Abundance Goals for Targeted Species and Species Assemblages, expressed as three levels for developing "High Risk," "Moderate Risk," and "Low Risk" conservation scenarios. Stratification is inherent to the goal. (source, Comer 2005). These goals should be considered to be specific to this ecoregion. The relative differences in numbers across distributional characteristics and different risk scenarios are the critical concept.

Distribution Relative to Ecoregion	**Spatial Pattern of Occurrence**					
	Matrix, Large Patch, and Linear s			**Small Patch s and All Rare Communities**		
	Area or Length, per Section **or Ecological Drainage Unit**			**Number of High Quality Occurrences**		
	"High Risk" Scenario	**"Moderate Risk" Scenario**	**"Low Risk" Scenario**	**"High Risk" Scenario**	**"Moderate Risk" Scenario**	**"Low Risk" Scenario**
Endemic	**20%**	**30%**	**40%**	21	40	80
Limited				10	21	40
Widespread/ Disjunct				5	10	21
Peripheral				2	5	10

Table 7. Example of Initial Abundance Goals for and Rare Community Targets, expressed as three levels for developing "High Risk" "Moderate Risk" and "Low Risk" conservation scenarios. (Source Comer 2005).

Design Goals

Design goals are a developing yet critical concept to improve the potential for the persistence of conservation targets in addition to the abundance and distribution goals. Design goals provide the contexts in which ecological processes will function to maintain the viability of the occurrences. Most design goals have focused on freshwater and freshwater/marine connectivity and migratory corridors for large mammals. Goals should be stated to define the length, width and land cover/ecological system types necessary for migratory corridors, and the length of contiguous stream and types of interconnected ecological systems for freshwater systems. There are tools in the Developing a Portfolio unit that provide computer algorithms to best meet design goals.

Key Steps:

- Characterize species, community and ecological system targets by their range-wide distribution patterns (endemic, limited, disjunct, widespread, peripheral).

- Characterize targets by their spatial scale: regional, coarse-scale, intermediate, and local-scale.

- Further group species by ecological or functional groups that share similar landscape needs for life history traits, such as migration, dispersal, multiple habitat needs, etc.

- Evaluate existing stratification units of ecoregions or develop stratification units to delineate major environmental gradients such as climate, geology and elevation to provide a spatial framework to set distributional goals.

- Set abundance and distribution goals for every target either on an individual basis or as groups of targets with similar characteristics. Consult experts and existing guidance, recovery plans and conservation plans for specific targets when available. Use number of species, community and ecological system (when feasible) occurrences, and use percent area of matrix and large ecological systems to set goals. Review adjacent ecoregional assessments and information on wide-ranging species to inform goals.

- Define design goals to the extent that are applicable and pragmatic.

- Document assumptions, data gaps and long term steps to monitor and re-evaluate goals.

- Once an ecoregional portfolio/vision has been developed, quantify its adequacy in terms of fulfilling the abundance and distribution goals for each target.

- Identify the potential for further data acquisition and/or surveys to document additional numbers of target occurrences to make progress in meeting goals by adding them to future iterations of ecoregional portfolios. Identify restoration needs and objectives to make progress in meeting goals where further data acquisition and/or surveys are not a great potential for further information.

OPPORTUNITIES FOR INNOVATION

Conservation goals set the hypothetical benchmark for how much is enough and drive the design and extent of ecoregional portfolios/visions. Goals need to be tested and addressed in an adaptive manner. The best way to do this is through empirical studies of the persistence of targets in ecoregions over time. An alternative is to take advantage of natural experiments by looking at ecoregions of varying degrees of alteration and target loss to better understand the relationship between the degrees of target loss and persistence of specific targets and the species which are maintained by coarse filter targets. We need to develop explicit design goals in order to quantitatively evaluate the adequacy of the existing portfolios and landscapes to potentially fulfill such goals. This method should move more from a qualitative to a quantitative set of goals.

CASE STUDIES

- **Goal Setting in the High Allegheny Plateau—An Illustration of the Eastern Regional Approach to Setting Numeric and Distributional Goals**. The goal setting process used in the Eastern Region in was developed between1997 and 1999 with a lot of dialog and debate among the state and regional scientists. The method was then employed for all ecoregions in the region including the High Allegheny Plateau. Explicit quantitative goals were set for both the number and distribution of occurrences of a target within an ecoregion

- **A Tiered Approach to Goal Setting in the Utah High Plateaus Ecoregion**. NatureServe and the Utah High Plateaus Ecoregional Assessment team developed a "goal-based" approach to building regional conservation scenarios. Developing three tiers of numeric goals for high, medium, and low risk scenarios promotes the examination of a range of conservation solutions.

- **Florida Game and Fresh Water Fish Commission's Goal for Florida's Wildlife.** As part of a gap analysis for the state of Florida, species distributions were determined for 44 focal species. This was followed by a population viability analysis to determine minimum requirements for adequate protection of a species. Out of this analysis a quantitative goal was set -- 10 populations, distributed broadly, with at least 200 individuals on publicly owned land or land under a public management agreement (e.g. conservation easements).

- **Aquatic and Terrestrial goal setting in the Edwards Plateau Ecoregion.** Overall and stratified goals were set for aquatic and terrestrial targets using distribution, scale and conservation status criteria. Targets were selected and their associated goals developed to be in alignment with ecoregions that share conservation targets.

TOOLS

Under development

RESOURCES

Publications

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