Geography of Hope Update

When & Where to Consider Restoration in Ecoregional Planning

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Executive Summary

The first five years of the Nature Conservancy's ecoregional planning process clearly demonstrated that substantial conservation effort will be necessary to achieve success. Of particular concern is the fact that no ecoregional portfolio has identified enough conservation areas to meet 100% of the numeric conservation goals needed for each target. In some cases, we simply will not meet these conservation goals without restoring the viability/ecological integrity of certain conservation targets. While ecological restoration has been practiced for many years, there is some debate and confusion surrounding its role in the ecoregional planning process. The purpose of this *Geography of Hope* Update is to understand when restoration should be considered in ecoregional planning and provide suggestions for where those areas might be considered. In addition to this update, an accompanying document titled *Theoretical Constructs for Large-scale Restoration* provides the context to understand the ecological, social, political, and economic principles and issues surrounding large-scale restoration and is available on conserveonline.org.

Ecoregional planning is the first step in the Conservancy's conservation approach and sets priorities for where conservation efforts need to be focused to conserve the full range of biodiversity of an ecoregion. If the conservation goals set forth in a plan are not met in the portfolio, then decisions are necessary to balance the role of further inventory and restoration efforts to meet these goals. Consequently, ecoregional planning should clarify **when** and **where** the potential exists for additional inventory and/or restoration of target occurrences. This differs from the role of ecological restoration in conservation area planning, which identifies the conservation strategies for **how** restoration will occur at any particular area.

Guidance and examples are presented in this update to aid ecoregional planners on when to include restoration areas in a portfolio and where those areas should be. The two major reasons for considering restoration in ecoregional planning are: 1) to meet numeric conservation target goals and 2) to address portfolio design issues. Numeric conservation goals are the number and distribution of each ecoregional conservation target set by the planning team as necessary to achieve viability within the ecoregion. These numeric and design goals are set before the portfolio selection process. Portfolio design issues encompass conservation challenges that affect the relationship among conservation areas and the "functionality" of the network of conservation areas that make up the portfolio such as connectivity, global climate change, abiotic disturbance patterns, and multi-area threats.

Planning teams are cautioned that ecological restoration can be an expensive and uncertain undertaking, and should be considered a last resort for meeting conservation goals. If restoration is to be undertaken, strategies and subsequent management actions should be specific to target occurrences. For species-level conservation targets, it is possible to improve the viability of the occurrence, or establish new target occurrences through reintroduction. However, the primary goal of restoration for natural community and system-level targets should be to improve the ecological integrity of existing occurrences, and not in creating "new" occurrences. While it is possible that new occurrences may some day result from restoration activities, this should be considered a secondary benefit. Examples to demonstrate the application of these concepts are presented in this update, including an illustrative hypothetical example.

To help clarify the role of restoration in ecoregional planning efforts The Nature Conservancy should:

1) adopt the peer-reviewed definition of ecological restoration developed by the Society for Ecological Restoration, and
2) incorporate a standard for ecoregional planning teams to identify potential conservation areas when numeric and portfolio design goals have not been met.

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NOTE: We would like your input. The authors intend for this update to be a working document that will be improved and revised over time. We also intend to synthesize the concepts and framework proposed in this Geography of Hope Update into a manuscript that will be submitted to a peer-reviewed journal such as *Restoration Ecology* or *Conservation Biology*. To ensure the concepts presented in this update are robust and logical we would appreciate your comments, thoughts, concerns, and/or examples, which we can then incorporate into the manuscript and future revisions. Please send your input to Laura Landon at llandon@tnc.org. Thanks!

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> ***"In the coming years, true heroism will be found in those who tackle the challenge of putting landscapes back together, of helping nature heal, of connecting the places we've left alone with those we may have been too eager to modify."* – Steve McCormick (2001)**

BACKGROUND & OBJECTIVES OF THE UPDATE

Science and stewardship staff of The Nature Conservancy have practiced restoration at conservation areas for many years. Because of their pioneering work with high-diversity plantings, improved hydrologic regimes, prescribed burns, and other innovative restoration techniques, today the Conservancy is closer to mission success. Their efforts contribute to a larger body of knowledge that continues to improve on the theoretical concepts and practical application of ecological restoration at multiple spatial and temporal scales. This document is aimed at building upon this expanding information base to clearly define the role of restoration in large scale ecoregional planning.

Despite the many restoration successes within and outside the Conservancy, the topic of restoration is a contentious issue in conservation. Proponents argue that without restoration the Conservancy will not be able to achieve conservation success. For example, in some regions such as in the Midwestern United States, entire matrix ecosystems will be lost without landscape-scale restoration. Critics counter that limited financial and staff resources first demand protection of viable conservation areas before restoration of marginal target occurrences[1]is even considered.

Ecoregional planning experience has demonstrated that both arguments have merit. Restoration must be used to meet the challenges of our conservation mission and our conservation goals. To date, no ecoregional portfolio has identified enough conservation areas to meet all the numeric goals for all of the conservation targets. In some cases, we simply will not meet these conservation goals without improving the viability/integrity[1] of these conservation targets through restoration.

Despite these shortcomings, restoration should not be undertaken without careful consideration. In many cases, shortfalls in attaining ecoregional goals are due to a lack of sufficient inventory of the conservation targets. There is a pressing need in most ecoregions for additional and improved conservation target occurrence viability data as well as better inventory tools and resources. In a review of Conservancy ecoregional plans most (75%) called for additional inventory to meet goals. This strategy will be a lower cost alternative to meet conservation goals than restoration. However, in some cases, even additional inventory will not be enough to meet conservation goals, and restoration options will need to be considered.

The science of restoration ecology is in its infancy, and outcomes of restoration efforts are often uncertain (Rapport and Whitford 1999, Sauer 1998, Whisenant 1999). Successful examples of meaningful ecological restoration, especially at landscape and larger scales, are few (see *Theoretical Constructs for Large-Scale Restoration*[2]). In addition, ecological restoration is expensive, costing an estimated 2-5 times more than conserving intact and viable examples of natural communities (TNC 2000b). Reluctance to address restoration in large scale planning efforts is further exacerbated by disagreement and confusion over defining the very term itself. Researchers and practitioners employ varied definitions of restoration, and often confuse its use with related practices such as rehabilitation, revegetation, successional revitalization, mitigation, habitat creation and even land management. This *Geography of Hope* Update is intended to clarify the role of restoration in ecoregional planning and provide guidelines for application in order to

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[1] While the term *viability* has been a standard term in assessing TNC target occurrences, the term has come under increasing scrutiny in its application to ecological communities and systems. While *viability* is an apt term for species level targets, *ecological integrity* is a more widely accepted standard to describe natural communities and ecological systems. The Conservancy's Ecosystem Research Program has made formal recommendations regarding the use of the terms 'viability' and 'ecological integrity' that are available on conserveonline.org.

[2] This accompanying document provides the context to understand the ecological, social, political, and economic principles and issues surrounding large-scale restoration and is available on conserveonline.org.

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facilitate its use in large scale planning efforts. The need for such guidance stems from the realization that to achieve mission success, the Conservancy will rely upon restoration as a conservation tool at many scales.

This Update is targeted for scientists and planners within the Conservancy and is structured into four major sections:

- **Section 1 – Defining Restoration and its Role in Planning**. Restoration is defined and the role of restoration in ecoregional planning is described in contrast to its role in conservation area planning (a.k.a. site conservation planning).
- **Section 2 – Restoration Considerations to Meet Numeric Goals**. Specific steps and guidelines for *when* and *where* to consider restoration in ecoregional planning to help meet numeric conservation goals are provided along with examples from ecoregional planning efforts.
- **Section 3 – Restoration Considerations to Meet Portfolio Design Goals**. Guidance and several examples are provided to help planning teams to consider restoration to meet portfolio design goals such as connectivity, natural ranges of variation, and adaptability to climate change.
- **Section 4 – Tools & Resources**. Provides suggested tools & readings, glossary of terms, and literature cited section.

For additional information related to large-scale restoration, please see the accompaniment document titled "Theoretical Constructs for Large-Scale Restoration[3]" which provides a context to understand the ecological, social, political, and economic principles and issues surrounding large-scale restoration upon which this Update is based.

SECTION 1 - DEFINING RESTORATION

Many definitions in the restoration literature are problematic for practitioners. Restoration is often used narrowly to describe returning to pre-disturbance condition (e.g., NRC 1992). This has posed problems both scientifically (e.g., difficulty in defining the pre-disturbance condition, difficulty in overcoming ecological thresholds, etc.) and socially (e.g., difficulty in overcoming biases against 'moving backward'). We propose that the Nature Conservancy adopt the definition developed by the Society for Ecological Restoration (SER 2002):

> **Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed** (SER 2002)

This peer-reviewed definition is consistent with the principles of *Conservation By Design*, *Designing a Geography of Hope,* and *The 5-S Framework for Site Conservation*. It is compatible with current concepts that advance the 5-S process such as identifying and influencing the key ecological factors that support the integrity of species, natural communities, and ecosystems[4].. The SER definition also allows for a view of ecological restoration along a series of continuums, consistent with the conceptual view of restoration supported by this work. For example, Hobbs and Norton (1996) suggested that, "restoration occurs along a continuum and that different activities are simply different forms of restoration." From their view, restoration includes restoring highly degraded but localized sites such as mine sites (a.k.a. reclamation), improving productive capability in degraded production lands, enhancing conservation values in protected landscapes,

[3] Available on conserveonline.org
[4] See conserveonline for more information in the document *A Step-By-Step Approach to Ecological Integrity Assessment in The Nature Conservancy's Five-S Framework*

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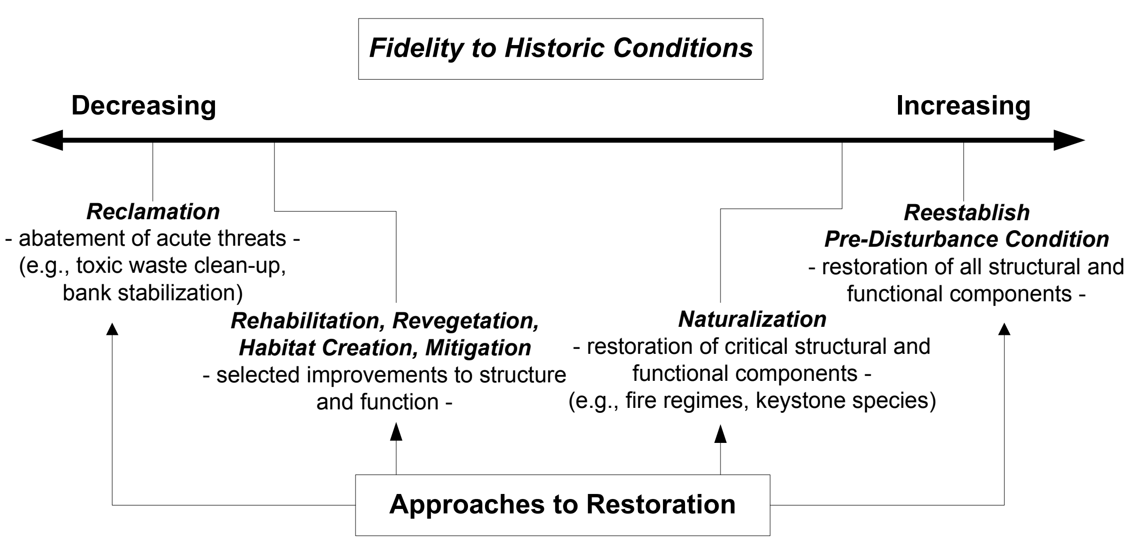
and enhancing conservation values in productive landscapes. The many definitions of restoration may be placed on a continuum from decreasing to increasing fidelity to historic conditions (Fig. 1).

Figure 1. Continuum of approaches to ecological restoration



Although this inclusive way of thinking about restoration could be viewed as a distraction from the goals of conservation biology, Hobbs and Norton (1996) contend that the extent of degradation to natural systems necessitates restoring some lands to a state that is compatible with ecosystem values, rather than to a state of pre-disturbance conditions. According to Hobbs and Norton (1996), including productive lands along with conservation lands is fundamental in thinking about restoration at the landscape level, and that if approached in this manner, restoration is "likely to be a key tool for ensuring integrated land management for production and conservation."

The concept of 'naturalization' is also a useful working concept (Sparks et al. 1998). One of the key components of naturalization is that people determine the target of restoration, and this societal decision is recognized as a legitimate goal given real limitations imposed on the landscape. Naturalization focuses on returning key natural functions and structures (e.g., critical disturbance regimes; keystone or umbrella species; matrix, endemic, or limited plant communities) to ecosystems rather than measuring success as a strict return of all characteristics of the reference condition (e.g., exact soil nitrogen levels; complex species composition relationships). These reference conditions may be secondary to the ecological integrity of the natural system in a particular instance as changes in climate, for example, may preclude returning to reference conditions. Therefore, reference conditions should be used as a guide to a range of potential conditions, rather than focusing on a particular point in the restoration continuum that may be unattainable.

Restoration may also be viewed along a continuum of land use decisions and associated management actions. In this view, land use and management impact the ecological integrity of any area or site as either degrading or improving its status (Fig. 2).

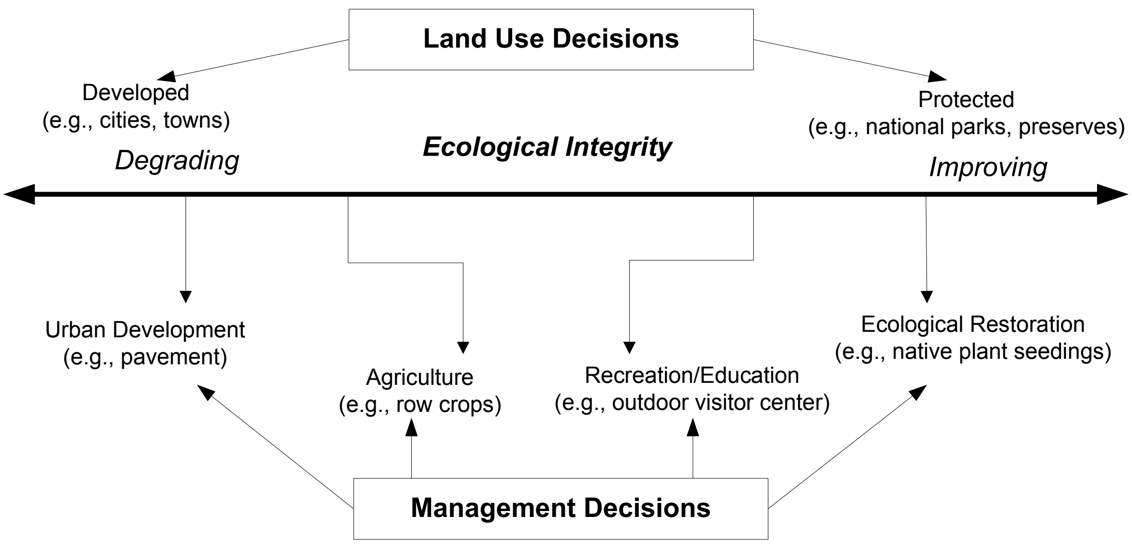


Figure 2. Conceptual relationships of various land use and management decisions and ecological condition. In this framework, ecological restoration is one of many possible management decisions, positioned at one extreme on the continuum between degrading and improving ecological condition.

RESTORATION IN ECOREGIONAL PLANNING

The primary objective of ecoregional planning is to set priorities that focus conservation efforts on where to work in order to conserve the full array of biological diversity in the ecoregion. This is accomplished by selecting a set of conservation targets that represent all biodiversity within an ecoregion. The quantitative vision of what is needed to achieve success is stated via the numeric goals set for the conservation targets. For this reason, the Conservancy has identified quantitative goal setting for each target or groups of targets as a standard for all ecoregional plans. These quantitative goals must address how much is needed (either stated as the number or areal extent) and the distribution stratified in some manner across the ecoregion. Planners at the ecoregional level should also explicitly address the relationship among conservation areas and design a "functional network[5]" that incorporates conservation issues at multiple spatial scales. Ecoregional planning should also establish and implement guidelines for occurrence viability/integrity and determine the current status of all known target occurrences. This process clarifies what is currently known about target distributions and can help prioritize future inventory effort.

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If the target occurrences identified through ecoregional planning are insufficient to meet conservation goals, and if the potential for identifying additional occurrences through further inventory is insufficient to meet conservation goals, planners should consider ecological restoration of low quality occurrences that currently do not count toward meeting goals. Ecoregional planning should clarify **when** restoration of target occurrences becomes an important conservation strategy, and help to develop scale appropriate strategies for implementation.

Restoration as a strategy for achieving conservation goals should become an integral part of the ecoregional planning process. When it is necessary to consider restoration, the portfolio of conservation areas should include a subset of *potential* restoration areas that if restored, would be carried out specifically to enhance the portfolio and further progress toward meeting goals. The planning team needs to identify the

[5] See Poani et al. 2000 for more discussion of functional networks of sites.

potential location of these restoration areas, and describe the rationale used for selection that articulates specifically which components of the portfolio are enhanced through this design.

In general, potential restoration areas are intended to increase the size or improve the condition or landscape context of target occurrences selected in the ecoregional planning process. While ecoregional planning should identify areas **where** restoration could improve target viability, it does not address **how** restoration will occur at any particular area. Instead, once ecoregional planning identifies a potential restoration area, that area becomes the object of more intensive conservation area planning efforts to determine the feasibility of restoration at a given site. An effective feasibility study should involve more detailed, area-specific information than is usually available to ecoregional planning teams. This approach assumes that some restoration areas may not be considered feasible after closer scrutiny and planning teams are urged to choose sites accordingly.

Restoration in Conservation Area Planning

Restoration in the context of conservation area planning focuses on **how** to improve the viability/integrity of target occurrences at a conservation area. Planning and implementation of ecological restoration at the conservation area level has occurred for many years in the Conservancy, and significant progress has been achieved in improving the size, condition, and landscape context of target occurrences at some conservation areas (See Kankakee Sands example below).

Once a potential restoration area has been identified through ecoregional planning, conservation area planners should determine the feasibility of restoration and devise an implementation plan through a formal process, employing the 5-S strategy. At this point, the potential restoration area identified through ecoregional planning becomes a potential conservation area. Conceptually the focus shifts from where to carry out restoration efforts that will enhance the ecoregional portfolio to how to improve the viability/integrity of target occurrences contained within this new conservation area.

Integrating Ecoregional and Conservation Area Restoration

Integrating restoration efforts at the ecoregional and conservation area planning levels is critical to improving the integrity of conservation targets across spatial scales in many, if not most, of the places the Conservancy works. An ecoregional framework can ensure that conservation area projects address regional restoration needs, reduce the occurrence of incompatible activities, reduce the risk of creating "ecological museum pieces" at great expense, and create economies of scale (Simberloff et al. 1999).

Table 1. A comparison of restoration at the ecoregional planning level and the conservation area planning level

	Ecoregional Planning	**Conservation Area Planning**
When to consider restoration?	When existing[6] high quality occurrences do not meet conservation goals.	When ecoregional planning identifies a potential restoration area or conservation area planners determine restoration is necessary to sustain or improve the integrity of conservation targets
Purpose	Identify potential restoration areas to help meet numeric goals. Identify multi-area management strategies to improve functionality of portfolio.	Using 5-S Framework, define explicit strategies and actions to improve size, condition, and/or landscape context of target occurrences at a conservation area.
Result	An ecoregional plan that identifies potential restoration areas and/or multi-area strategies to improve target viability/ integrity.	A conservation area plan that assesses feasibility of restoration, and if merited describes restoration strategies, and develops an action plan.

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[6] As described in Fig. 5, an analysis of inventory gaps should always occur before considering restoration to meet conservation goals to ensure there are no uncounted existing high quality occurrences.

In summary, ecoregional planning will select potential restoration areas and suggest large-scale strategies; conservation area planning will determine the feasibility of restoration activities, and if feasible, detail the strategies and specific management actions necessary to carry out the restoration effort. Therefore, once a potential restoration area is selected through the ecoregional planning process, more work is necessary at an area-specific level to develop appropriate methodologies and actions.

Kankakee Sands Macrosite, an integrated example

The Kankakee Sands Macrosite, straddling the border between Indiana and Illinois, comprises a mosaic of prairie and savanna communities in the Central Tallgrass Prairie Ecoregion. The Kankakee project encompasses a 35,000-acre (14,164-ha) area that includes agricultural lands of low ecological quality along with fair to high quality remnants of wet sand prairie/sedge meadow [1,800 acres (728 ha)] and oak barrens [15,000 acres (6,073 ha)] natural communities.

Although planning for the Kankakee Macrosite predated ecoregional planning for the Central Tallgrass Prairie, the project addressed design issues well-suited to ecoregional planning. While the restoration and management strategies the Conservancy is implementing at Kankakee Sands are area-based, the *design* of the Macrosite is an excellent example to illustrates the conceptual relationship of potential restoration area identified through ecoregional planning and developing strategies and actions in conservation area planning. Before the advent of the Kankakee Sands Macrosite, there were numerous disjunct ecological remnants that were themselves conservation targets occurrences. While these remnants supported most of the conservation targets historically present in the region, the Kankakee planning team recognized that target viability/integrity was affected by fragmentation. They designed the project to re-connect these fragmented remnants (TNC 2001) by "healing the intervening landscape." The goal of this large-scale restoration project is to create a landscape in which "imperiled species and ecological processes flow and ebb. What was once farmland will be transformed over time into a mosaic of prairie, savanna, and wetland, altering the landscape dynamics of the Kankakee Sands Macrosite into a viable system that achieves the Conservancy's mission." The result is a large-scale restoration effort that focuses on enhancing the ecological integrity of existing high quality savanna and sand prairie remnants by recreating the prairie matrix that once connected these occurrences. In addition, many of the sand savannas themselves are biased towards later successional stages, the result of past fire suppression. The savannas are being "succesionally revitalized" through mechanical removal of woody vegetation and prescribed fire.

Conceptually, once the Kankakee planning team designed the Macrosite, the project moved from the realm of large-scale restoration planning to area-specific planning and implementation. In designing the Macrosite, the team identified potential restoration areas to improve the landscape context of existing ecological remnants. This large-scale planning then set the stage for area-based strategies to restore ecological processes (e.g., hydrologic and fire regimes) and structure (e.g. vegetative communities). While the Indiana Chapter aims to restore the highest quality connecting prairie landscape as possible, they are not undertaking the restoration efforts for the purpose of creating new element occurrences (J. Shuey, pers. comm.). Restoration efforts at Kankakee Sands are on-going.

When the Central Tallgrass Prairie ecoregional planning team completed their plan in January, 2000, they included the Kankakee Sands Macrosite as one of five landscape restoration areas with specific conservation targets that counted towards achieving the numeric goals of the plan. The team also included other potential restoration areas in the Central Tallgrass Prairie ecoregion that, if restored, would help meet conservation goals and address some of the portfolio design issues for the ecoregion (TNC 2000a).

A NOTE ABOUT AQUATIC SYSTEMS

The principles outlined in this Update apply to freshwater and marine systems as well as terrestrial systems. In many cases freshwater and marine systems may be more easily restored at large scales For example, restoring critical ecological processes to their natural ranges of variability will sometimes sufficient to return freshwater systems to a more natural state. Where the hydrologic regime is the fundamental key factor, restoring natural flows can lead to improved habitat condition, recolonization by native species, and reduction in threat from invasives. Connectivity may be more easily addressed in freshwater than terrestrial systems because of the known human-induced “point-source” stresses such as diversions, dams, reservoirs, levees and other structural alterations. For a detailed freshwater example, see the Illinois River Restoration section below.

Coastal and marine ecosystems are dynamic, and many experience high levels of natural disturbance from hurricanes, tropical storms, and seasonal or directional weather events. Frequently disturbed systems must be resilient, having evolved the capacity to naturally rebuild both physically and biologically. In addition, many marine organisms are highly vagile and relatively fecund, enabling rapid recolonization and population increases given the chance (S. Antenen pers. comm.). In short, freshwater and marine systems have a high restorative potential.

SECTION 2 - MEETING NUMERIC CONSERVATION GOALS

This section addresses restoration in the context of ecoregional portfolios that have not met all numeric conservation goals. This is an important issue because a review of 28 final and draft U.S. ecoregional plans revealed that none of the portfolios met conservation goals for all of the conservation targets. Of the 23 plans with quantifiable results, the portfolios captured a median of 31% of the total number of occurrences needed to meet all goals for species and vegetation communities (Fig. 3). In general, the plans with a high percentage of goals met on a target by target basis were from ecoregions with more intact landscapes that were less impacted by human alteration. The Middle Rockies–Blue Mountains Ecoregional Plan, for example, which has the greatest area of intact landscape and designated wilderness in the in the contiguous United States, captured 90% of the conservation goals the highest percentage of the 23 plans evaluated. Plans with a low percentage of goals met in general occurred in ecoregions with a low percent of the total ecoregion area in protected status, and a high degree of human alteration.

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Figure 3. Categorical distribution of ecoregional plans based on the percent of the cumulative number of occurrences needed to meet all conservation goals (n=23).

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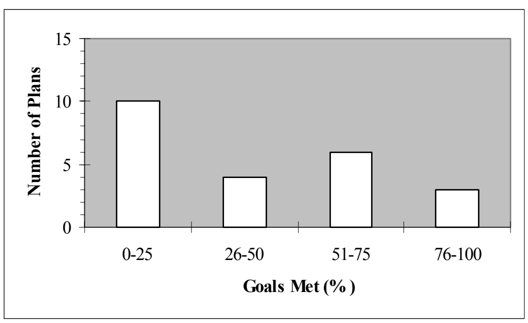
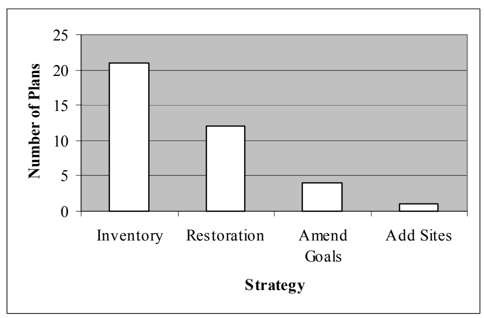


Figure 4. Strategies identified in ecoregional plans for reaching unmet conservation goals. Note that some planning reams identified more than one strategy.



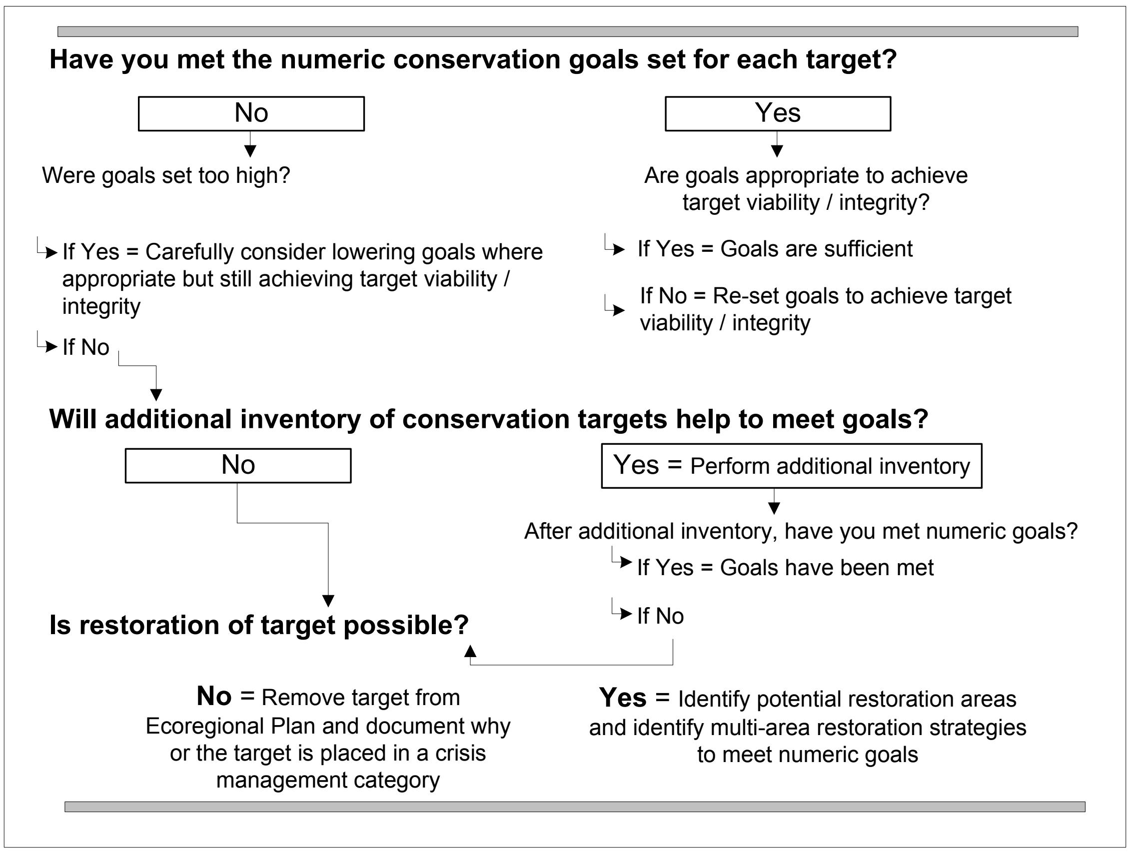
Most plans identified reasons for not meeting conservation goals and ways to address shortfalls in future iterations (Fig. 4). Planners in 75% (21) of the 28 ecoregions reviewed called for additional inventory of conservation targets, reasoning that further inventory would yield additional occurrences and a higher percentage of goals met. Ecological restoration of occurrences was considered as a means of meeting conservation goals in 43% (12) of the plans, and in all but one of these additional inventory was also considered. Other suggestions included amending the goals and adding more conservation areas to the portfolio.

If Conservation Goals are not met, WHEN to Consider Restoration?

The decision tree below provides a step-by-step guide for when to consider restoration in ecoregional planning (Fig. 5). Each step in the decision tree should be addressed before moving on to the next step. The steps outlined should be applied individually to each conservation target that has not met its conservation goals through the initial portfolio design process.

Because of the expense and uncertainty associated with ecological restoration, it should be a "last resort" strategy for increasing the number or quality of conservation target occurrences. Ecoregional planners should always consider additional inventory of targets before considering restoration. Following this procedure will help ensure that alternative solutions are exhausted before undertaking restoration. Each ecoregional planning team is expected to choose which approach, or set of approaches, is appropriate for a particular target that has not met conservation goals.

Figure 5. A decision tree for determining ***when*** restoration should be considered to meet numeric conservation goals in ecoregional planning.



An explanation of the steps in Figure 5

Step 1 emphasizes the need for a thoughtful consideration of the numeric goals set forth in the planning process. If the portfolio designed in a given ecoregional plan meets all the conservation goals, it is worthwhile to re-examine the goals using the guidance in *Designing a Geography of Hope* (Groves et al. 2000) to ensure they are sufficient to maintain viable target occurrences. Conversely, if the portfolio does not meet all the goals, the planning team should consider whether or not the unmet goals are appropriate for each corresponding conservation target. For a rare target or a target at the edge of its distribution, the target may never have existed in the ecoregion at levels high enough to meet the conservation goals. Again, planners should use the *Geography of Hope* guidance in assessing numeric goals warrant change.

Step 2 addresses if a conservation goal has not been met and it is inappropriate to lower the goal. This step considers additional resource inventory as a feasible and where possible, a preferable alternative to restoration. A full consideration of inventory gaps and their potential for meeting numeric goals should take place before restoration planning occurs. If viable target occurrences are identified through additional inventory, the planning team should consider adding conservation areas to the portfolio to capture the targets of concern.

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Step 3 addresses instances in which the goals for a conservation target cannot be met through additional inventory, and illustrates that planners should next determine whether or not there is a reasonable possibility of restoration to viable levels. If a target is virtually extinct, crisis management actions may be necessary to sustain the target. The planning team needs to determine if such actions are warranted, or if there is no hope of recovery, and restoration efforts are considered too risky, ineffective and/or costly. Responsibility for such a decision lies with the planning team. If the target cannot be restored, the planning team may consider removing it from the list of ecoregional targets. Any decisions to do so should be carefully documented and well justified.

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If Restoration is an Option To meet Goals, <u>Where</u> should the Potential Conservation areas be in the Portfolio?

Following the decision tree, if the planning team determines that successful restoration is necessary, potential restoration areas should be identified. To select potential restoration areas for the portfolio, the team must document the rationale and approaches used to identify where restoration efforts should be located. This can be a complex issue, and there are many possible solutions. Potential steps and considerations include:

- Categorize restoration targets as coarse-filter and fine-filter[7]. To improve efficiency, design potential restoration areas around coarse-filter targets (e.g., maximum number, greatest diversity, and highest quality), and test their effectiveness at benefiting fine-filter targets.
- Focus the location of potential restoration areas on targets that are fundamental to the character or distinctiveness of the ecoregion. Examples include coarse-filter targets such as matrix, limited, and endemic plant communities or keystone animal species.
- Prioritize restoration areas around targets whose ecology is well understood or for which previous restoration efforts have been successful.
- Perform a cursory threats assessment for potential restoration areas and prioritize areas with the lowest threats. Potential restoration areas with a low degree of threat may be easier to restore, and thus of

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[7] The coarse-filter/fine filter strategy is 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. See Chapter 3 of *Designing a Geography of Hope* (Groves et al. 2000) for further guidelines regarding conservation targets.

higher priority for restoration, than those with a high degree of threat. (Note that this concept contrasts with the priority ranking of standard conservation areas in which areas with a higher degree of threat may receive higher priority.)

- Prioritize potential restoration areas according to their proximity to existing portfolio sites. This will improve the landscape context and connectivity of existing conservation areas.

- Assess the viability/integrity of targets at potential restoration areas and select areas that have the easiest potential for contributing toward numeric goals. For example, it is likely to be easier (e.g., less time, resources, uncertainty)to improve the viability/integrity of higher quality target occurrences (e.g., C-ranked communities) than lower quality occurrences (e.g., D-ranked communities).

- Select potential restoration areas for the maximum density of restorable targets to emphasize habitat diversity and nested ecological system processes.

- Select a single conservation target or small set of targets to restore because of rarity, cultural significance, or importance to ecological processes (e.g., bison in prairie systems). Restoration needs and objectives will vary significantly among species, communities, and ecological system targets.

- Select a set of objectives from the list above, and develop a prioritization process. For example, use distinctiveness, proximity, and density to select priority areas.

- To help document the assumptions, methods & approaches, and the intended goals & objectives used to identify potential restoration areas, planning teams may consider constructing a flow chart (Table 2). This will document the rationale for selection of potential restoration areas, which in turn will help to inform peer-reviews and future iterations.

ADDITIONAL CONSIDERATIONS:

The level of biological organization matters. Conservation targets occur at three levels of biological organization (species, natural communities, and ecosystems) and the goal of restoration in an ecoregional context is to enhance the viability/integrity of lower quality targets so that they contribute to meeting the numeric and network design goals of the ecoregional plan. But restoration goals and subsequent actions must be specific to target occurrences if they are to be effective. These goals may vary depending on the target's level of biological organization.

For species-level conservation targets, it is possible to establish new target occurrences through reintroduction at the population level. Successful reintroduction efforts are often long-term, expensive, and risky, especially for large animals. Notable examples include the Arabian oryx (*Oryx leucoryx*; Tear and Forester 1992, Tear and Ables 2000), the golden lion tamarin (*Leontopithecus rosalia*; Kleiman et al. 1986), and the gray wolf (*Canis lupus*; USFWS 2001). The Conservancy has considered reintroduction strategies in ecoregional plans such as the Southern Rocky Mountain plan. In that ecoregion two wide-ranging mammals (the gray wolf and the grizzly bear) are currently extirpated and conservation areas were not selected for them in the portfolio. The viability of grizzly bears in the Southern Rocky Mountains under existing or perceived future conditions is poor at best. Consequently, the team concluded that this species is unlikely to exist in the area in the foreseeable future. However, the gray wolf was recently reintroduced just north of this ecoregion into the Yellowstone area. This reintroduction appears to be highly successful (http://ecos.fws.gov/servlet/SpeciesProfile?spcode=A00D). While, the ecoregional planning team did not select specific conservation areas for the gray wolf, they believe because of preliminary viability analyses and the broad ecological tolerances of wolves that the existing portfolio would support at least one viable population should the citizens of Wyoming, Colorado, and or New Mexico decide to support the reintroductions.

The concept of creating or reintroducing "new" occurrences for species is more controversial with natural communities or ecosystems. While restoration efforts for natural communities and ecosystems may vary in intensity, we propose that the primary goal should not be to create "new" conservation target occurrences. Instead, area-specific restoration actions should be designed to achieve clearly defined goals aimed at improving the size, condition, and/or landscape context of *existing* target occurrences. Some intensive restoration efforts (e.g., highly diverse prairie restoration efforts) may eventually result in new, high-quality communities (C. Helzer, pers. comm.). This is a possible, long-term benefit of undertaking such an effort. However, we propose this should not be the primary reason for initiating action. This suggestion is based on the understanding that even if a new community occurrence were created, it is difficult at best, and perhaps impossible to reliably predict when or if this will occur. As the formation of a new, high-quality community occurrence could take hundreds of years, and ecoregional plans have a shorter time frame for implementation, we propose focusing on the enhancement of existing natural community or ecosystem element occurrences over the creation of new ones.

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Time Frame

An important consideration for planning teams is the potential time lag between steps in the decision tree. Some planning teams (e.g., Central Shortgrass Prairie) performed rapid ecological assessments during the planning process, which resulted in identifying new target occurrences, and served to help prioritize the need and location of future inventory efforts. Another approach was to interview Heritage biologists and quantify the likelihood that new occurrences could be found, and where such places might be located (e.g., Central Tallgrass Prairie). While it is true that many years of effort will likely be necessary for inventory work to substantially alter progress toward meeting goals, planning teams can make decisions based on existing knowledge and plan to implement a strategy that will provide information in the future to revise decisions and adaptively manage the ecoregional planning process.

Similarly, the information needed to carry out an effective feasibility study in a potential restoration area is likely to take significant time and effort. For example, habitat models are useful and necessary tools to guide habitat restoration efforts. In addition, gathering site-specific information to assess actual target viability can be a lengthy process. The ecoregional planning process should not be put on hold to wait for this information. The team must make informed decisions, and rely on adaptive management as part of the planning process to improve conservation efforts over time.

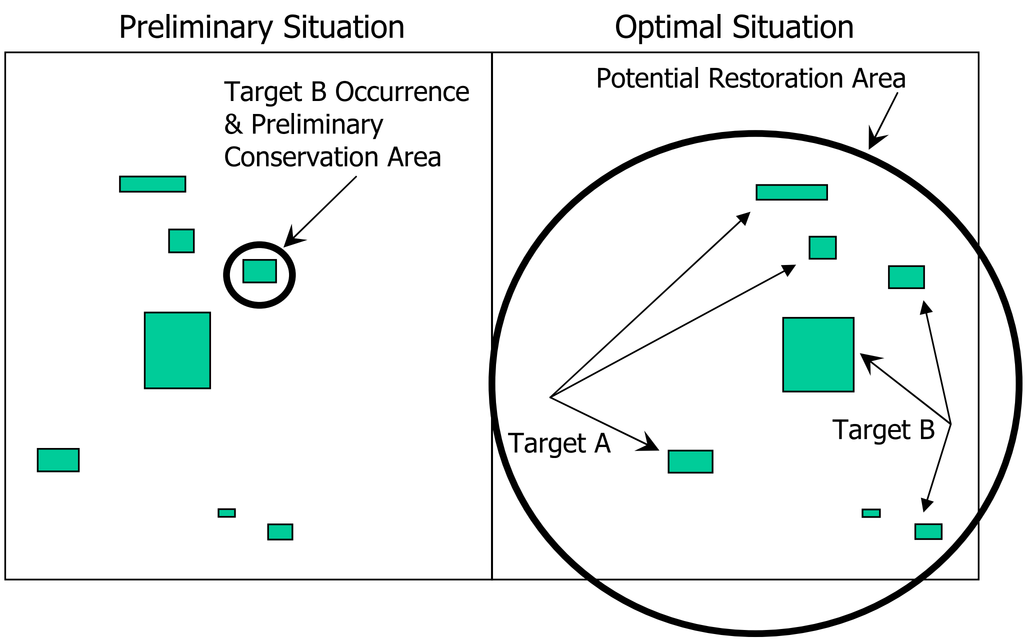
Clearly such decisions are complex and challenging, require significant judgements to be made in the face of limited information, and yet are critical to the planning process. Planning teams should consult with outside expertise to help weigh the benefits and costs of various approaches. Various resources available include members of the planning teams from the three example ecoregional plans that follow, internal TNC networks, working groups and expertise identified in Table 4, or various academic researchers that work on related issues as described in the appendix.

Finally, it is important to note that once an ecoregional planning team has selected an approach and identified a potential restoration area, the next step is to complete a conservation area plan. At this point, an area-specific approach is necessary to determine the feasibility of restoration by evaluating the specific management strategies necessary and possible to improve the target's status enough to meet numeric conservation goals.

Table 2. Restoration Approaches. The table below illustrates various options for conducting ecological restoration to meet numeric conservation goals. The approaches provided are strictly illustrative and not exhaustive.

Strategy	**Restoration**		
Approach	1) Geographic	2) Functional	3) Area-Specific
Goal	Improve viability / integrity of low-quality occurrences through improved connectivity (e.g., remove a decommissioned diversion dam to enhance aquatic species distribution, revegetate agricultural lands with low diversity native plantings between existing conservation areas to increase landscape context and connectivity).	Improve viability / integrity of occurrences by restoring natural processes necessary to target survival (e.g., alter water releases from a reservoir to simulate natural flow regime and return seasonal flooding, establish prescribed burning plan to result in large, expansive, seasonal fires).	Improve viability / integrity of targets occurrences at existing conservation areas by improving size, condition, or landscape context (e.g., remove invasive, exotic plants or animals)
Objective(s)	Identify potential restoration areas that cluster a high density of low-quality occurrences or join them with existing portfolio areas (**Figure 6**).	Identify potential restoration areas of sufficient size to support natural disturbance processes and management strategies to ensure their return.	Complete a Conservation Area Plan.
Next Step	Complete a Conservation Area Plan	Complete a Conservation Area Plan	Implement Conservation Area Plan

Figure 6. A geographic approach to improving the viability/integrity of low-quality occurrences by improving connectivity. This is accomplished by identifying potential restoration areas that cluster a high density of low-quality occurrences or join them with existing portfolio areas (see Table 2).



A Hypothetical Example

The following hypothetical example describes how an ecoregional planning team might use the decision tree in Figure 3 when conservation goals have not been met. For simplicity, we have used Heritage nomenclature (A-ranked, B-ranked, etc.) for viability/integrity rankings of the fictitious targets. Alternative ranking systems may be used to assess and categorize viability/integrity of target occurrences. Note that the viability/integrity of each target occurrence should be ranked for size, condition, and landscape context separately to arrive at the overall quality ranking. Please refer to *Designing a Geography of Hope* (Groves et al. 2000) for full guidelines on assessing viability/integrity.

The ecoregional planning team from the Purple Mountains Majesty Ecoregion has just completed their portfolio and found they did not meet their conservation goals for conservation targets A, B, C, D, E, and F. They decide to consider the possibility of restoration to help make up the shortfall in meeting the numeric conservation goals for these six targets. When they apply the decision tree from Figure 5 to Targets A, B, C, D, E, and F, they find that their conservation goals are appropriate for each target except Target A.

Target A is a federally listed endemic rare plant found only in alpine seeps on steep slopes with a northwest aspect. There are only three known populations of this plant, all in the only alpine ecosystem in the ecoregion, located in a designated wilderness area. The federal Fish and Wildlife Service has done extensive survey work and drafted a recovery plan for Target A. The Service concluded that the three known plant populations represent the historic range for the species and that, if preserved, the three populations are sufficient to maintain viability of the species.

The conservation goal for Target A was originally five populations of 100 individuals. After determining that this target probably never occurred in such abundance due to lack of suitable natural habitat and that there is a very low probability of expanding the range of the plant, the team concludes that the existing portfolio will protect the three known populations and that restoration is not feasible. They decide to lower the conservation goal for the target to three populations of 100 individuals.

Following the decision tree in Figure 5, the team then considers the inventory status for each of the remaining targets (B, C, D, E, and F). They find that there are no data gaps for Targets C, D, E, and F. However, after consulting with experts and overlaying Target B's habitat needs with land use maps, the team concludes that there are several areas with potentially suitable habitat for Target B that have not been adequately inventoried. They decide that rather than consider restoration of Target B at this time, they will contract with their state Heritage Program to find additional viable occurrences of Target B in the areas they have identified as having a high survey potential. If Heritage finds viable occurrences outside of existing portfolio areas, the team will consider adding additional portfolio areas to meet the goals for Target B.

The planning team is very concerned about Target C, a small patch prairie community with only two occurrences, both D-ranked, in the ecoregion. These occurrences are located at two city parks in downtown Metropolis, the main urban center of the ecoregion. The lands surrounding the Target C remnants are highly developed – a concrete jungle. After a thorough review of the habitat needs of Target C, the team determines that due to the highly specialized soil requirements of this plant community, there are no other suitable areas for restoration outside the current remnants. The team is split. One small group believes that that there is no reasonable hope of restoring the ecological integrity of Target C and suggests removing it from the list of targets. The other group believes that the D-ranked occurrences have a strong, local following committed to improving the "health" of these targets. They are currently raising $500,000 to "rescue" a doomed patch of this prairie community from an adjacent ecoregion that is scheduled to be destroyed by a parking lot development, and move it to this area. The team decides to place this community type in a crisis management category, retain the target on the ecoregional list, notes the reason behind their decision, and agrees that the Conservancy will not invest resources in these heroic efforts.

The team believes that it may be possible to help meet the conservation goals for Targets D, E, and F through restoration. Target D, the purple pine-mountain fir (*Pinus purpurus*-*Abies montanus*) community, is a matrix community for which the portfolio has captured three viable occurrences. The conservation goal is five viable occurrences. As a coarse-filter target that is essential to the character of the ecoregion, Target D is a high priority for restoration. In addition to the three viable occurrences captured in the existing portfolio, the team has identified an additional high quality (B-ranked) occurrence that does not meet the size criterion for ecological integrity and a cluster of four small, lower-quality (C-ranked) occurrences.

Based on their analysis of the minimum dynamic area needed to ensure ecological integrity of Target D (25,000 ha [61,175 acres]), the team decides to create two potential restoration areas that, if successfully restored, would meet their numeric goals for Target D. The B-ranked occurrence comprises about 15,000 ha (37,065 acres), and there is an adjacent 10,000-ha (24,710-acre) patch where Target D historically occurred but that was logged 20 years ago. The planning team identifies the B-ranked occurrence and the adjacent patch as a potential restoration area totaling 25,000 ha (61,175) acres in area. In order to become viable, and help toward meeting numeric goals for Target D, the condition of the adjacent area must be improved through conservation area planning. Additionally, the team clusters the four smaller C-ranked occurrences into another potential restoration area that totals 30,000 ha (74,130 acres) in size. In order to become viable as an occurrence for Target D, the clustered sites must be connected and the condition improved through subsequent conservation area planning.

Target E, the majestic squirrel (*Sciurus majesticus)*, is a species that spends its entire life in purple pine-mountain fir forests of the ecoregion. The three viable populations of Target E occur in the three viable purple pine-mountain fir conservation areas. It is expected that this fine-filter target will also be restored to viability, and meet its conservation goal of five viable populations, through recolonization of the restored Target D communities.

Target F is a small patch plant community heavily dependent on fire. Numerous low quality remnants have been identified within conservation areas already captured by the portfolio. The planning team believes that this plant community can be restored to a condition that meets standards for ecological integrity by managing for a more natural fire regime at existing conservation areas. They recommend in the ecoregional plan that the conservation area planning teams at the corresponding portfolio sites consider restoration of Target F to meet numeric goals through appropriate fire management.

Table 3. Summary of outcomes for hypothetical targets.

Target	Type	Strategy for Target	Reason for Strategy
A	Species	Re-set goals	Historic abundance less than original goal.
B	Species	Additional Inventory	Inventory gaps in areas of existing habitat.
C	Small-patch Community	Placed on Crisis Management list	Restoration not possible. Existing occurrences not viable. Heroic restoration efforts being initiated by another conservation group.
D	Matrix Community	Restoration (Geographic Approach)	Inventory adequate and restoration deemed feasible. Coarse-filter target necessary for Target E.
E	Species	Restoration (Geographic Approach)	Inventory adequate and restoration deemed feasible. Fine-filter target dependent on Target D.
F	Small-patch Community	Restoration (Functional Approach)	Inventory adequate and restoration deemed feasible.

SECTION 3 - ADDRESSING PORTFOLIO DESIGN ISSUES

As we gain more experience with ecoregional planning, it has become apparent that planning teams need to consider more than meeting quantifiable goals for individual conservation targets. Ecoregional planning teams should also address broad regional and inter-regional conservation issues necessary to establish functional networks of conservation areas (Poiani et al. 2000, Poiani and Richter 1999). Portfolio design issues include the need to:

- focus on connectivity of conservation areas for specific wide-ranging species
- promote natural disturbance dynamics,
- develop methods to reduce the potential impacts of global climate change
- develop strategies to abate multi-area threats

Most first iteration ecoregional plans have focused on meeting numeric conservation goals. Although meeting numeric conservation goals is critical and should incorporate target redundancy and distribution to promote persistence, these two factors alone may not be sufficient to meet the challenges that face most ecoregions. It is imperative for teams still working on first iterations and for those contemplating future iterations to begin addressing network design issues with more specificity, and make explicit links to key factors influencing viability and integrity of specific conservation targets.

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When and Where to Consider Potential Restoration Areas to Meet Portfolio Design Goals

A framework for considering the issues, objectives, and actions that might be considered in addressing portfolio design more thoroughly is presented in Table 4. A variety of portfolio design issues are outlined, some of which may have different objectives but overlapping actions. It is the responsibility of the planning team to assess which network design issues will be addressed in the ecoregional portfolio. Restoration activities may or may not play a role in achieving design objectives, as there may be other appropriate management actions separate from or in addition to restoration. This framework presents an illustrative set of examples, but is not intended to represent an exhaustive list. In addition, this framework is not intended to provide specific guidance in meeting these design challenges. Many scientists and planners within the Conservancy are working on such guidance, to be provided as additional *Geography of Hope* Updates.

Leading By Example

The previous sections have provided theoretical guidelines for restoration considerations. The following practical examples of ecoregion-specific applications of restoration offer transferable lessons for other ecoregional planning efforts. In particular, planning teams from the Central Tallgrass Prairie, the Osage Plains / Flint Hills Prairie, and the Mississippi River Alluvial Plain have provided leadership in thinking about the role of restoration in ecoregional planning. Each of these teams used restoration as a tool in meeting numeric conservation goals and in addressing portfolio design issues in their plans.

Central Tallgrass Prairie

Meeting Conservation Goals

In creating *Conservation in a Highly Fragmented Landscape: The Central Tallgrass Prairie Ecoregional Conservation Plan* (TNC 2000a), the planning team recognized early on that designing a portfolio of conservation areas that only captured viable target occurrences would fall far short of meeting their conservation goals. Even with additional inventory to fill data gaps, they knew that conservation goals would still not be met.

The Central Tallgrass Prairie (CTP) team began by identifying Natural Community Concentration Areas defined as "areas containing relatively high densities of multiple matrix and large-patch remnant communities." This exercise resulted in adding two new conservation areas to the portfolio, and was later expanded into a larger effort that identified additional "landscape restoration areas." The CTP team chose these landscape restoration areas to improve functionality by linking concentrations of remnant communities through restoration of disturbed, low-quality connecting lands.

Eventually, the team selected five landscape restoration areas comprising less than 5% of the areas in the plan and encompassing 9% of the acreage identified for conservation. These landscape restoration areas captured 11% of A- and B-ranked community types and 5% of target species occurrences in the plan, clearly capturing existing targets that contributed to meeting conservation goals, with the intention of improving their status and that of lower quality occurrences had yet to contribute. Even with the landscape restoration areas, they realized that the contribution of restoration would have to be increased to make a substantial impact on reaching their conservation goals.

Table 4. A matrix of issues, objectives, and actions necessary for improving the design of an ecoregional portfolio of conservation areas.

<table>
<tr><th>Issues</th><th colspan="3">Connectivity</th><th colspan="2">Global Climate Change</th><th colspan="2">Abiotic Disturbances</th><th colspan="4">Multi-Area Threats and Strategies</th></tr>
<tr><td>Objectives</td><td>Migratory Patterns</td><td>Genetic Exchange</td><td>Social Systems</td><td>Adapt-ability</td><td>Refuges</td><td>Minimum Dynamic Area</td><td>Natural Range of Variability</td><td>Invasive Species</td><td>Impaired Air and Water Quality</td><td>Develop-ment</td><td>Extractive Natural Resource Industries</td></tr>
<tr><td>Actions</td><td colspan="3">Define targets, goals, and occurrence viability

Identify or restore corridors, surrounding matrix, or stepping stone areas

Reduce barriers (e.g., dams) to meet specific target objectives</td><td colspan="2">Represent environmental gradients using ELUs[1] and macrohabitats

Provide for northern range extensions

Maximize topographic diversity

Enhance connectivity among areas

Buffer refuges</td><td colspan="2">Expand landscape context to allow natural disturbance patterns

Control or manipulate fire and hydrologic regimes</td><td colspan="4">Select areas least impacted by current or projected development, pollution, invasive species, and natural resource industries (e.g., grazing, logging, mining)

Identify multi-area strategies to alleviate these threats</td></tr>
<tr><td>TNC Resources</td><td colspan="3">Freshwater Initiative
Northeast/East Connectivity Working Group
Setting Priorities Group
Migratory Bird Program</td><td colspan="2">Climate Change Program</td><td colspan="2">Ecological Systems Working Group
Freshwater Initiative
Natural Heritage
Setting Priorities</td><td colspan="4">Aridlands Grazing Network
Freshwater Initiative
Government Relations Program
Invasive Initiative
Developing Strategies Program
Setting Priorities</td></tr>
</table>

[1]ELU – Ecological land unit. See glossary for definition.

Further assessment focused specifically on the features that captured the "character" or "distinctiveness" of the Central Tallgrass Prairie; that is, the matrix, endemic, and limited plant communities that were historically dominant and distinctive in this ecoregion. By comparing a map that identified clusters of these communities with land use and land cover maps, they identified 12 potential restoration areas. These areas were of poorer ecological quality than the areas already in the portfolio and comprised about 1.2% of the ecoregion. If restored, they would benefit 16 imperiled and distinctive community types in the ecoregion. Successful restoration of these areas would also increase the conservation goals met for matrix communities from 60% to 90% and for endemic and limited communities from 30% to 40%.

The CTP team made an important contribution to restoration in ecoregional planning by explicitly recognizing the need for restoration to achieve the Conservancy's mission and by taking steps to prioritize and select areas for restoration. Perhaps as important, they quantified the contribution of the restoration areas to meeting their conservation goals. Now the challenge is to determine which of these potential restoration areas can result in a feasible restoration project, and become a priority action within the ecoregion.

Illinois River Restoration
Ecoregional and Conservation Area Planning, Action, and Measures of Success

The Illinois Chapter of The Nature Conservancy promotes actions to help maintain and improve the ecological integrity of the Illinois River. The Illinois River watershed captures 44% of Illinois, parts of Indiana and Wisconsin, and is one of region's most substantial natural features. The effective use of ecoregional and conservation area planning have helped focus conservation efforts in this large and diverse set of ecological systems, identify critical conservation targets and keystone ecological processes, and establish quantifiable measures to justify efforts and track progress towards success.

The Illinois River has a long history of anthropogenic alterations that have not only directly affected the conservation targets of concern today, but the very ecological processes that supported this expansive and dynamic system. These alterations began in the early to mid 1800's with the destruction of wetlands, grasslands and prairies and development of sub-surface tile drainage for agriculture across the basin. Perhaps the most remarkable engineering feat of the early 20th century was reversing the flow of the Chicago River in 1900 from Lake Michigan to the Illinois River in order to divert Chicago's sewage from contaminating the city's drinking water in Lake Michigan. A prolonged levee construction period from the 1920s to 1940s followed, isolating the river from roughly half of its original floodplain. Construction of a series of locks and dams in conjunction with dredging of the river channel to support the Heartland's agriculturally based barge industry further impacted the ecological integrity of this highly managed river. Combined with the nearly complete conversion of the uplands from the historic tallgrass prairie to tile-drained, row crop agriculture, the consequences to water quality and hydrologic processes were profound.

However, it was acknowledged as early as 1911 that efforts to restore this river were needed. Decades later, enforcement of the Clean Water Act led to substantial improvement in the river's water quality. Numerous organizations including state and federal agencies, private conservation groups, and concerned citizens continue to work on a variety of projects aimed at restoring the Illinois River. Of particular note, the National Research Council identified the Illinois River as one of only three large-floodplain rivers in the continental U.S. that retains sufficient ecological integrity to warrant fluvial restoration (NRC 1992). Large floods in 1993 and 1995 illustrated that some of the fundamental natural processes are still at work, a critical consideration for effective recovery.

Currently, the Illinois River suffers from systemic problems such as elevated sedimentation and nutrient loading common to most rivers in the Midwest. However, because it is a working river, the dams don't prevent the movement of water from maintaining the critical natural hydrologic characteristics of seasonal variability. High spring flows are followed by a summer low-flow period and a fall flow pulse. Of greatest concern are the altered low flow levels during the summer period, which do not get low enough because of augmented flow from the Chicago River, and confinement of the river from levees that create a "perched" river channel. In addition, there are hourly, daily and weekly variations in water levels in stretches associated with lock and dam operations and recreational reservoir operations in tributaries. These fluctuations impact the germination and survival of floodplain vegetation.

The Central Tallgrass Prairie (CTP) Ecoregional Plan (TNC 2000a) identified several sections of the Illinois River and its tributaries as priority aquatic conservation areas, some associated with adjacent terrestrial landscape-scale sites. For example, the LaGrange Reach is the longest stretch of the river chosen as an aquatic site (approximately 80 miles), bordered by its terrestrial counterpart, the Illinois River Floodplain Complex. While it has long been recognized as an important area for conservation work, illustrated by the high concentration of state and federal protected areas, the CTP plan was the first to quantify the importance of this area at a regional level. Conservation of this single wetland complex accounts for 32% of the ecoregion's numeric goals for four community types (6 examples out of a cumulative goal of 19), including the only high quality occurrences in the ecoregion of two community types. Previously the regional importance of this area had been expressed primarily on its contribution to migratory waterfowl and other bird species. In addition, the importance of floodplain reconnection and natural flow regime are recognized as critical to creating overwintering habitat and access to that habitat for ancient river fishes, one of the primary sets of freshwater targets in this conservation area.

Following an extensive conservation area planning process involving numerous local, state, and federal partners, the Conservancy identified four key areas to focus its efforts. In each priority area, projects were developed with separate strategies designed to address critical site-specific threats, and capitalize on local and regional opportunities. In the LaGrange Reach, reconnecting the river to its floodplain clearly emerged as a critical strategy, along with restoring the hydrology of this managed river to more closely resemble the seasonal variability of the historic natural flow regime.

The Conservancy has made substantial progress on both strategies. Of particular importance are two significant purchases of approximately 8,000 acres of historic floodplain. Although currently agricultural land isolated from the mainstem by levees, the plan is to reconnect these former floodplain wetlands with the river's mainstem. With this strategy, the Conservancy will begin to restore critical floodplain habitat and return the natural processes needed for effective recovery of this complex riverine system. Re-flooding of the Spunky Bottoms Preserve in 2000 produced lush, natural wetland vegetation that was surviving in the seed bank. Structural features in the levees are being constructed to allow passage of native fishes from the main channel while controlling water volume and sediment loading. A similar approach is being developed for the 7,000-acre Emiquon Preserve, perhaps the most significant former floodplain lake complex in the Upper Mississippi River system. These floodplain restoration projects will affect not only the habitats on their properties, but the ecological and hydrological processes in the mainstem as well.

Having set specific, quantifiable restoration goals for the percent of floodplain necessary to connect with the river's mainstem, it is now possible to measure the importance of these preserves. Once reconnected, they will account for 40% of the short-term (5 years) and 8% of the long-term (25 year) goals for reconnection estimated as necessary for the recovery of the entire Illinois River system. These floodplain restoration and reconnection projects will serve as models for restoration throughout the Midwest. They will demonstrate multi-site strategies that will affect floodplain conservation targets and ecosystem integrity at an ecoregional scale.

In addition, the Conservancy is supporting research to optimize the operation of locks and dams during the critical low-flow season. If successful, altered management of the river's flow will benefit many of the mainstem, riverbank, side channel, and backwater habitats of the Illinois River including those along the LaGrange Reach. Supported by a strong planning process, with carefully designed strategies and measurable indicators of progress, the Illinois Chapter has moved the Conservancy into the forefront of large-scale restoration of the Illinois River. When combined with other efforts across the watershed by the Conservancy and other organizations to restore wetlands and uplands and promote programs to improve agricultural practices that will benefit aquatic resources, the future looks bright for restoring the Illinois River as a fully-functioning, large-floodplain river.

Osage Plains / Flint Hills Prairie
Matrix Community Remnants

The Osage Plains / Flint Hills Prairie (OPFHP) team also incorporated restoration into their ecoregional plan, expanding on the work done in the Central Tallgrass Prairie. The OPFHP team used two major strategies in identifying areas for restoration. They first used Heritage Program data and expert knowledge to identify concentrations of matrix community remnants in areas where these communities had been largely destroyed. The team then used Thematic Mapper satellite imagery to identify large-sized matrix remnants associated with relatively intact untilled landscape areas (TNC 2000b) - need to reference this plan here).

This work resulted in the identification of seven Landscape Restoration Areas (LRAs) where restoration efforts will focus on improving the functionality of isolated matrix community remnants by linking them through restoration of connecting lands. These seven LRAs accounted for 13% of the terrestrial portfolio areas and comprised 17% of the total area identified for conservation. The LRAs captured 36% of the A- and B-ranked community occurrences and 50% of the target species occurrences selected for the portfolio.

Not only did the OPFHP effort use restoration to help meet numeric conservation goals for the ecoregion, but it also addressed major portfolio design issues. Before identifying Landscape Restoration Areas, the team determined the minimum dynamic area necessary for the continuation of historic natural processes and to maintain a mosaic of habitat in all structure classes for the full array of species in the ecoregion. Through this assessment, they determined that 250,000 acres (101,173 ha) was the preferred minimum area to support these processes and habitats (except for migratory bison and gray wolves), but that 70,000-acre (28,329-ha) areas were probably sufficient to retain a moderately high level of system functionality. The findings from this assessment then informed the selection of their Landscape Restoration Areas, with each of the LRAs exceeding the 70,000-acre (28,329-ha) benchmark.

The OPFHP team made significant strides in the Conservancy's use of restoration in ecoregional planning by using restoration to simultaneously help meet numeric conservation goals and address portfolio design issues.

Mississippi River Alluvial Plain
Migratory Birds

The Mississippi Alluvial Plain (MSRAP) planning team took a somewhat different approach to restoration planning than the CTP and OPFHP teams in that they used the habitat needs of three guilds of migratory birds to drive restoration area selection (TNC 1999). They noted that migratory birds had experienced precipitous declines in the ecoregion. Through their site selection process, they identified 101 Migratory Bird Areas (MBAs) for potentially restorable metapopulations. The MBAs were characterized by a nucleus of relatively large, contiguous habitat and by high potential for restoration based on flooding regimes and knowledge of landowner intent.

The MSRAP team then further refined restoration priorities through the use of GIS data layers that incorporated landscape features influencing avian population viability. Landscape features included were 1) distance from existing forest cover; 2) distance from forest core habitat; 3) proportion of landscape occupied by forest cover; and 4) mean forest patch size within the landscape. Based on these landscape features, they used raster-based digital data to assess reforestation priority of each hectare within the MSRAP.

In addition to meeting the needs of the targeted migratory bird species, the team used data from their restoration model to identify restorable habitat blocks for black bear, *Ursus americanus luteolus* and *Ursus americanus americanus*. They determined that habitat blocks of at least 40,000 hectares were necessary to support denning, establishment of home range, dispersal, and foraging for the black bear. The areas identified for restoration are believed sufficient to support disturbance events typical of the ecoregion including tornadoes, wind storms, and hurricanes as well as other ecological processes such as tree fall gap dynamics.

Wisconsin Pine Barrens
Considering Abiotic Disturbances

Land managers in the 450,000-ha Pine Barrens of northwest Wisconsin found that conservation of sharp-tailed grouse (*Tympanuchus phasianellus*) was limited by altered fire regimes in a landscape historically shaped by fire (Radeloff et al. 2000). From 1948 to 1978, six restoration areas comprising a total of 13,910 ha (34,372 acres) were created in the Pine Barrens. Each area was actively managed as open prairie with prescribed burning used in 5-10 year rotations. Current restoration efforts have been successful in maintaining large patches of open habitat and in managing for sharp-tailed grouse that rely on such patches. However, the pre-settlement Pine Barrens was a dynamic landscape (Radeloff et al. 2000) in which, "fires created a shifting mosaic where large openings were frequent but not fixed in space." The current configuration of restoration was too small to mimic the large-scale disturbance pattern that would better restore landscape-level ecosystem structure and function.

Because of the ownership patterns in the Pine Barrens, outright protection and restoration of sufficient land area was deemed infeasible. As an alternative, land managers have proposed coordinated management of private, local, state, and federal Pine Barrens lands to mimic the pre-settlement disturbance pattern. The Wisconsin Department of Natural Resources is working with stakeholders to develop coordinated management of the Pine Barrens that includes landscape-scale planning for a combination of timed clear cuts, prescribed burns, and natural regeneration to recreate the shifting mosaic of open-habitat patches (Radeloff et al. 2000).

Although this example is not from TNC ecoregional planning efforts, it demonstrates the need for effective portfolio design and strategic planning that incorporates restoration both within and outside conservation area boundaries. Although planners protected conservation areas and undertook restoration measures to improve condition at the area level, the "portfolio" had not adequately addressed the design objectives of providing a minimum dynamic area and effectively managing a disturbance regime historically governed by fire. By expanding the landscape context to include unprotected lands and by mimicking historic conditions through timed cuts and prescribed burns, land managers hope to address the design issue of providing a critical aspect of ecosystem function, that is, the shifting mosaic pattern of the historic fire regime.

SECTION 4 – SUMMARY & RESOURCES

SUMMARY

As ecoregional plans continue to demonstrate that conservation efforts have a long way to go to achieve success, in many cases large-scale restoration efforts are being considered as a potentially viable, and necessary, conservation strategy. Given the long-term nature of such restoration efforts, combined with their high-risk and high cost, the rationale for embarking on such efforts must be sound and guided by current, relevant information from science and management. This Update is intended to encourage ecoregional planning teams to actively consider the role of restoration in developing new plans or revisions, and . provide some support and guidance to meet this challenge. The following points summarize the major findings of this effort:

- a promotion for the organization to adopt the Society of Ecological Restoration's definition of restoration
- conceptual models that link restoration to ecological integrity, land use decisions, and management decisions
- a proposal to use a decision tree explicitly linked to meeting ecoregional goals to guide planning teams on where and when to consider restoration in the ecoregional planning process
- conceptual and practical examples of using restoration in ecoregional planning
- supporting documentation that describes the theoretical background to support these concepts in *Theoretical Constructs for Large-scale Restoration* available on conserveonline.org.

Successful restoration efforts are time-consuming, costly, and the long-term outcomes may be uncertain. However, it is imperative that planning teams consider the role of restoration in ecoregional planning. The information and guidance provided in this Update is intended to help planning teams make the difficult decisions that surround the use of ecological restoration. We promote a vision for restoration as a valuable tool in the ecoregional planning process not only to meet numeric goals, but also to address the design challenges necessary to successfully establish a functional network of sites.

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GLOSSARY OF TERMS

Deleted: I DIDN'T REALLY REVIEW THIS CLOSELY, BUT NOTICED A COUPLE THINGS..

condition – An integrated measure of the quality of biotic and abiotic factors, structures, and processes that characterize targets. For communities, this often includes degree of invasion by exotic species, presence of the full range of species diversity, etc. For populations, this often is measured through reproduction, age structure, resilience to disease, etc.

conservation goals – In ecoregional planning, the number, spatial distribution and design of on-the-ground occurrences of targeted species, communities, and ecosystems that are needed to adequately conserve biological diversity in an ecoregion.

conservation target – An element of biodiversity selected as a focus for conservation planning or action. The three principle types of targets in Nature Conservancy planning projects are species, ecological communities, and ecological systems. 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/integrity of conservation target occurrences is sought from a wide variety of sources.

ecological land unit (ELU) – Biophysical or environmental analyses such as ELUs combined with land cover types and satellite imagery can be useful tools for predicting locations of communities or ecological systems when such information is lacking and for capturing ecological variation based upon environmental factors. ELUs are derived using readily available digital spatial data sets such as digital elevation models, surficial geology, and hydrography and are defined as combinations of several environmental variables.

ecosystem function – The flow of energy, materials, water, and species among the various parts of the landscape (from Whisenant 1999). Ecosystem function includes abiotic processes such as fire, flooding, and storm events.

ecosystem structure – The distribution (not the movement) of energy, materials, and species in relation to the sizes, shapes, numbers, kinds, and configurations of ecosystem elements (from Whisenant 1999). Ecosystem structure includes species composition of the ecosystem.

landscape context – For populations, an integrated measure of two criteria: connectivity to other populations and intactness of surrounding ecological processes and environmental regimes. For communities and systems, those patch and matrix types and aquatic communities and systems that depend on easily disrupted ecological processes occurring at a scale larger than the individual community are most at risk by what happens in the surrounding landscape.

network of conservation areas – A reserve system connecting multiple nodes and corridors into a landscape that allows material and energy to flow among the various components.

occurrence – Spatially referenced examples of species, communities, or ecological systems. May be equivalent to Heritage Element Occurrences, or may be more loosely defined locations delineated through 1) the definition and mapping of other spatial data or 2) the identification of areas by experts.

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

viability/integrity – The probability that a species (viability) or a natural community/ecological system (integrity) to persist over some specified time period. The long-term viability/integrity (e.g., 100 years) of populations and occurrences of conservation targets is assessed based on the three criteria of size, condition, and landscape context. No area should be included in the portfolio unless the coarsest-scale target at that area has been assessed as viable with these three criteria *or can feasibly be restored to a viable status*.