The Nature Conservancy

SAVING THE LAST GREAT PLACES ON EARTH

Draft Guidelines for Implementing Ecoregional Status Measures

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Boxes

Introduction

Ecoregional status measures comprise a set of data about the viability, threat and conservation status of biodiversity within an ecoregion. Derived primarily from data generated by ecoregional assessments, these measures provide a snapshot of the status of biodiversity conservation, as well as a measure of trends in this status over time.

Ecoregional status measures are an integral component of *Conservation by Design*, TNC's flagship conservation approach, at two levels. Within an ecoregion, these measures are the primary vehicle for adaptive management – they enable TNC state and country staff to revise geographic and programmatic priorities and to re-evaluate strategies based on the shifting landscape of conservation and threats within an ecoregion. The measures can be tracked at more frequent intervals than a full ecoregional assessment, and can thus serve as an intermediary update that can more easily keep apace with the rapidly changing status of biodiversity.

Across ecoregions, these measures are also an integral component of *Conservation by Design* writ large. Ecoregional status measures are the currency by which TNC will measure progress toward its 2015 goal of ensuring the effective conservation of places that represent 10% of every major habitat type on earth. By defining the degree of "effective conservation" within an ecoregion – defined as areas with viable biodiversity, low threat and adequate conservation status – the ecoregional status measures can enable the organization to refine its global geographic and programmatic goals and to set achievable milestones toward its goal.

This model is based on the 'state-pressure-response' model[1] advocated by many conservation organizations (e.g., CI, 2004; OECD, 1993). The ecoregional measures define 'state' as biodiversity status, including the viability and persistence goals of biodiversity targets, 'pressure' as the degree of current and future threat facing biodiversity targets, and 'response' as the conservation status of biodiversity targets, including legal protection, stewardship management and enabling environment.

By enabling the status of the effective conservation of biodiversity within ecoregions to be routinely assessed, the ecoregional status measures provide a transparent and quantifiable benchmark for holding TNC accountable to its mission of protecting the diversity of life on earth.

[1] Variously called 'state-pressure-response' and 'pressure-state-response' model (see discussion in Conservation International, 2004)

Biodiversity Status

Despite the conservation community's widespread interest in the assessment of biodiversity status, there is no common framework for measuring the status of the species, natural communities and ecological systems that comprise biodiversity (Balmford et al., 2003.). This section outlines a proposal for measuring the biodiversity status of an ecoregion by measuring the viability of the targets within that ecoregion, as well as the extent to which those targets have enough well-distributed occurrences to meet numeric and abundance (persist) goals.

Selection of conservation targets for measuring ecoregional status

There is widespread agreement among most major conservation organizations that planning for the conservation of biodiversity at an ecoregional scale entails the selection of conservation targets – a set of biodiversity features that form the basis of conservation planning and actions (Redford et al., 1993). These targets include both fine filter targets (species) and coarse filter targets (ecological communities and systems) (Groves, 2003).

TNC ecoregional assessment guidelines recommend selecting all ecological system (including terrestrial, freshwater and, where applicable, marine systems), as well as a set of fine filter targets to comprehensively represent the biodiversity of an ecoregion (TNC, 2005). In reporting on ecoregional status measures, however, ecoregional teams should include all system targets, but only a smaller subset of focal species targets. Box 1 shows examples of the types of system targets that would typically be included in ecoregional status measures reporting.

Ecological systems are defined as a distinct assemblage of ecological communities (typically defined by vegetation type) that a) occur together on the landscape; b) share common ecological processes (e.g., fire, hydrological regimes) and underlying geological or topological features; and c) form a discreet unit on the ground. (Groves, 2003; TNC, 2000a). These system targets may include individual ecosystems, matrix systems that include mixed groupings of ecological associations that form the predominant matrix across the ecoregion[2], as well as groupings of community types (TNC, 2000a).

[2] See Anderson et al., 1999 and Groves, 2003 for a detailed discussion on how to aggregate groupings of ecological associations.

Box 1: Examples of system targets and focal species

BIOME	FOREST	DESERT	GRASSLAND	FRESHWATER	MARINE
MAJOR HABITAT TYPE	Temperate coniferous forest	Desert and xeric shrubland	Temperate grassland, savannah and shrubland	Large temperate river	Estuaries and bays
ECOREGION	Canadian Rocky Mountains	Sonoran Desert	Central Tallgrass Prairie	Upper Mississippi River Basin	Northern Gulf of Mexico
SAMPLE OF SYSTEM TARGETS	Lodgepole pine forests and shrublands, Montane dry grasslands, Rough fescue prairie, Subalpine larch forests	Desert riparian woodland, Palo Verde-mixed cacti, Brittlebush-ironwood group, Torchwood-limberbush desert scrub	Midwestern mesic hardwood forests, Great Plains oak savannas & woodlands, Midwestern loam prairies, Midwestern dry oak forests	Headwater creeks, Small rivers, Medium rivers, Large Rivers *(these systems are further delineated by underlying geological features)*	Sea grass beds, Oyster reefs, Salt marshes, Sponges & corals, Tidal flats
SAMPLE OF FOCAL SPECIES TARGETS	Lewis's woodpecker, Western toad, North American wolverine	Bighorn sheep, Suite of native fish, Southwestern willow flycatcher	Bald eagle, Lake sturgeon, Peregrine falcon	Blue sucker, Ebony shell mussel, Blanding's turtle	Florida manatee, Gulf sturgeon, Kemp's Ridley turtle
SOURCE	Rumsey et al., 2003	Marshall et al., 2000	TNC, 2000b	Weitzell et al., 2003	Beck and Odaya, 2001

In addition to using all system targets, each ecoregion should choose from among their existing fine filter conservation targets a small subset of focal species[3]. The selection of a smaller subset of focal species within ecoregions does not supplant the need for a more comprehensive list during the initial assessment phase, it simply provides a more nimble set of targets whose viability, threat and conservation status can be more routinely and easily measured.

These focal species should be selected for at least one of the following reasons:

1) they represent species that would not typically be well captured by individual system targets alone, either within or across ecoregion (e.g., wide-ranging species; species that require several different ecological systems);
2) they are closely linked to conservation strategies that TNC employs, either within the ecoregion or regionally, because a) they are vulnerable (e.g., threatened, endangered, at-risk); b) they depend on key ecological processes (e.g., fire dependent, flood dependent); and/or c) they are charismatic and emblematic species capable of catalyzing partner conservation actions[4]; and
3) they reflect a broader, synthetic summary of the status of ecological structures, processes and human activities within an ecoregion (e.g., umbrella, landscape and/or keystone species)[5]

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[3] The number of fine filter species will depend on the biodiversity richness, data availability and resources of an ecoregion, but would typically range in number from roughly 6 to 24.
[4] The first two criteria are directly from guidance to ecoregional assessment team on choosing fine filter targets, and are included here to reinforce the need to have a purposive selection process.
[5] See also Groves, 2003 and Noss (1996) for a more comprehensive discussion of choosing focal species.

The selection of focal species should be based on a) the availability of target occurrence data; b) the ease of accurately tracking their viability, threat and conservation status, either directly or indirectly through monitoring partnerships[6]; and c) the ability of their occurrences to be mapped spatially. Because the ecoregional status measures involve spatial overlays of multiple biodiversity, threat and conservation data layers, targets must be able to be mapped spatially, through ecological modeling, remote sensing, vegetation maps or other methods.

Because many focal species may span multiple ecoregions, and because their status may have widespread implications for more than one ecoregion, TNC regional science offices should help coordinate the selection of these targets.

Reporting on the viability of conservation targets

The viability of a conservation target is the degree to which a target occurrence has the potential to persist, and hence contribute towards ecoregional goals for target representation, redundancy and resilience. The viability of a target occurrence is determined by a combination of its size, condition and landscape context, and is generally ranked as 'very high, high, fair or poor,' or as simply 'viable or nonviable.' The size ranking should generally be driven by ecological thresholds such as minimum dynamic area for system targets, and minimum viable populations/ecologically viable populations for species targets (Groves, 2003; Tear et al., *in press*). Target condition is generally determined by the degree to which the structures, functions, composition and ecological processes are typical of highly intact examples or reference conditions of those systems or species populations. Landscape context refers to the relevant ecological processes and structures between and around target occurrences (e.g., connectivity, ground water withdrawal) (Groves, 2003).

There is no uniformly recognized scheme for defining and classifying ecological systems (Groves, 2003), and therefore the delineation of system targets has varied widely among conservation organizations, including within The Nature Conservancy. In some cases (e.g., ecoregional assessments throughout the Northeastern U.S.), the process used for defining system targets has entailed fine-resolution data, while in other cases (e.g., terrestrial ecological systems mapped throughout South America) the process TNC process has used much coarser-resolution data. In general, the finer the data resolution in developing system targets, the more utility and precision the ecoregional status measures will have in enabling adaptive management within an ecoregion and in defining effective conservation across ecoregions.

[6] In many cases, birds can be excellent focal species targets. Monitoring data on their population sizes is extensively available, their critical habitat is often delineated in "important bird areas," many utilize a wide range of system targets, and they are likely to catalyze many partners. See www.birdlife.net and www.partnersinflight.org for more information about bird monitoring efforts.

The viability of a target occurrence may be limited by structure and processes that are largely immutable. The viability ranking of a bog, for example, may always be limited to 'fair' because it is limited by its size, which is in turn limited by underlying geological features. In other cases, the viability ranking may be limited by structures and processes that may be improved through human intervention or through natural restorative processes, or decreased through continued human actions. The size of a forest block occurrence may increase through the removal of roads, the condition may improve through management practices that accelerate old-growth conditions, and the landscape context may improve through natural forest regeneration in buffer and corridor areas.

Restoration feasibility is defined as the degree to which a nonviable target (i.e., poor or fair) can be restored to a viable target (i.e., good or very good). The restoration feasibility of a target occurrence affects the degree to which target goals can be met, and can be an important component in developing strategies within an ecoregion. Therefore, ecoregional teams should provide restoration feasibility scores for each non-viable target occurrence, based on the degree to which that target occurrence can be restored from non-viable to viable (Box 2). The rationale and process for determining restoration feasibility scores should also be captured as metadata in any ecoregional data system.

Box 2: Ranking the restoration feasibility of target occurrences

Very high restoration feasibility	The conversion of the target occurrence from nonviable to viable is likely to occur either through natural restorative processes, or with a minimum of management intervention and/or investments within the next ten years.
High restoration feasibility	The conversion of the target occurrence from nonviable to viable could potentially occur with moderate levels of management intervention and/or investment within the next ten years.
Moderate restoration feasibility	The conversion of the target occurrence from nonviable to viable is unlikely to occur without substantial management intervention and/or investments within the next ten years.
Low restoration feasibility	The conversion of the target occurrence from nonviable to viable is unlikely to occur even with substantial investments and intensive management interventions within the next ten years.

Ecoregional teams determine viability rankings in many ways, ranging from in-depth ecological integrity assessments to remote sensing and modeling with little ground-truthed data. In order to capture these differences and to measure improvements in knowledge about target viability, ecoregional teams should record a measure of confidence in the ranking of each target occurrence (Box 3).

Box 3: Measuring the confidence of viability rankings

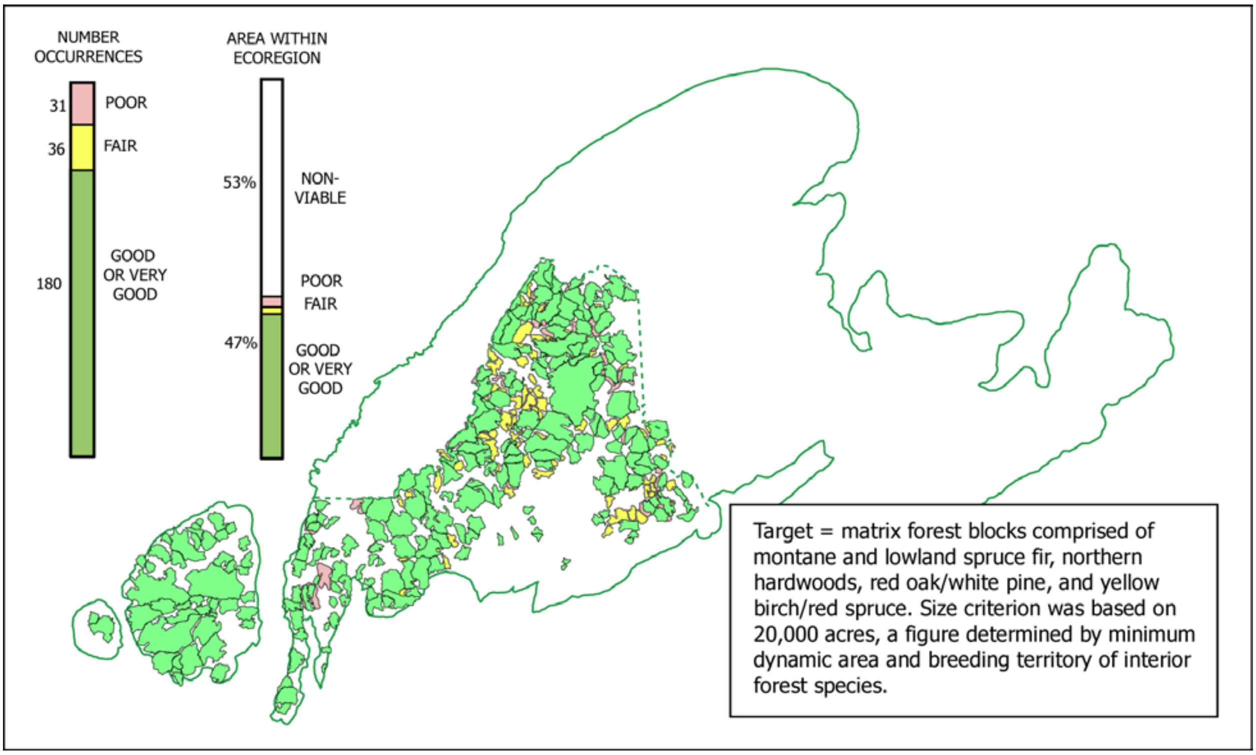
Very high reliability	Viability ranking is assigned and confirmed by rigorous, site-level data on ecological integrity of target occurrence
High reliability	Viability ranking is assigned through remote sensing (e.g., satellite imagery or aerial photography) of direct attributes, with some levels of ground-truthed data; or through first hand knowledge of the size, condition and landscape context of the target occurrence
Moderate reliability	Viability ranking is inferred through modeling or remote sensing of surrogate data (e.g., species viability inferred from remote sensing of potential habitat)
Low reliability	Viability ranking is assigned only through qualitative data of little or no reliability (e.g., with no first hand knowledge), and with little or no ground-truthed data
Occurrence Data Only	Data are not used to assign viability rankings; only presence/absence data

The basic recommendations for reporting target viability within an ecoregion are as follows:

1) the total number, distribution and area of all "measures targets"[7] within the ecoregion
2) the viability ranking of all measures targets (e.g., poor, fair, good or very good; or simply viable and non-viable);
3) a ranking of the restoration feasibility for non-viable target occurrences that are necessary to satisfy numeric and distribution goals;
4) a confidence measure in the viability ranking of each target occurrence (see Box 3).

[7] "Measures targets" refers to the subset of ecoregional targets that are included for the purposes of reporting on measures.

Box 4: Spatial example of viability of system target occurrences in the Northern Appalachians



Box 5: Tabular example of reporting data on status of target viability

TARGET	TOTAL AREA	Viability	Restorability	Confidence
Desert Riparian Woodland				
Occurrence 1	2,525 ha	good	n/a	mod
Occurrence 2	3,561 ha	v. good	n/a	mod
Occurrence 3	9,256 ha	fair	high	mod
Occurrence 4	4,569 ha	poor	n/a	high
etc.				
Palo Verde-Mixed Cacti				
Occurrence 1	22,145 ha	v.good	n/a	mod
Occurrence 2	13,465 ha	fair	high	mod
Occurrence 3	11, 872 ha	poor	low	mod
etc.				

Reporting on progress toward numeric and distribution goals

Ecoregional goals, also called 'persistence goals,' define the number and distribution of viable target occurrences necessary for ensuring adequate representation, resiliency and redundancy of the target diversity across an ecoregion. In short, ecoregional goals answer the question of where and how much of a target must be effectively conserved in order to ensure the long-term persistence of a target (Groves, 2003; TNC, 2000a; Tear et al., in press). Numeric goals define how much of a target, or how many target occurrences, are desirable; distribution goals define how those occurrences should be distributed across a stratified ecoregion (e.g., by ecoregional subsection, ecological land unit, hydrological unit or other stratification system)[8]. Additional design goals can provide guidance on choosing among different occurrences to maximize connectivity.

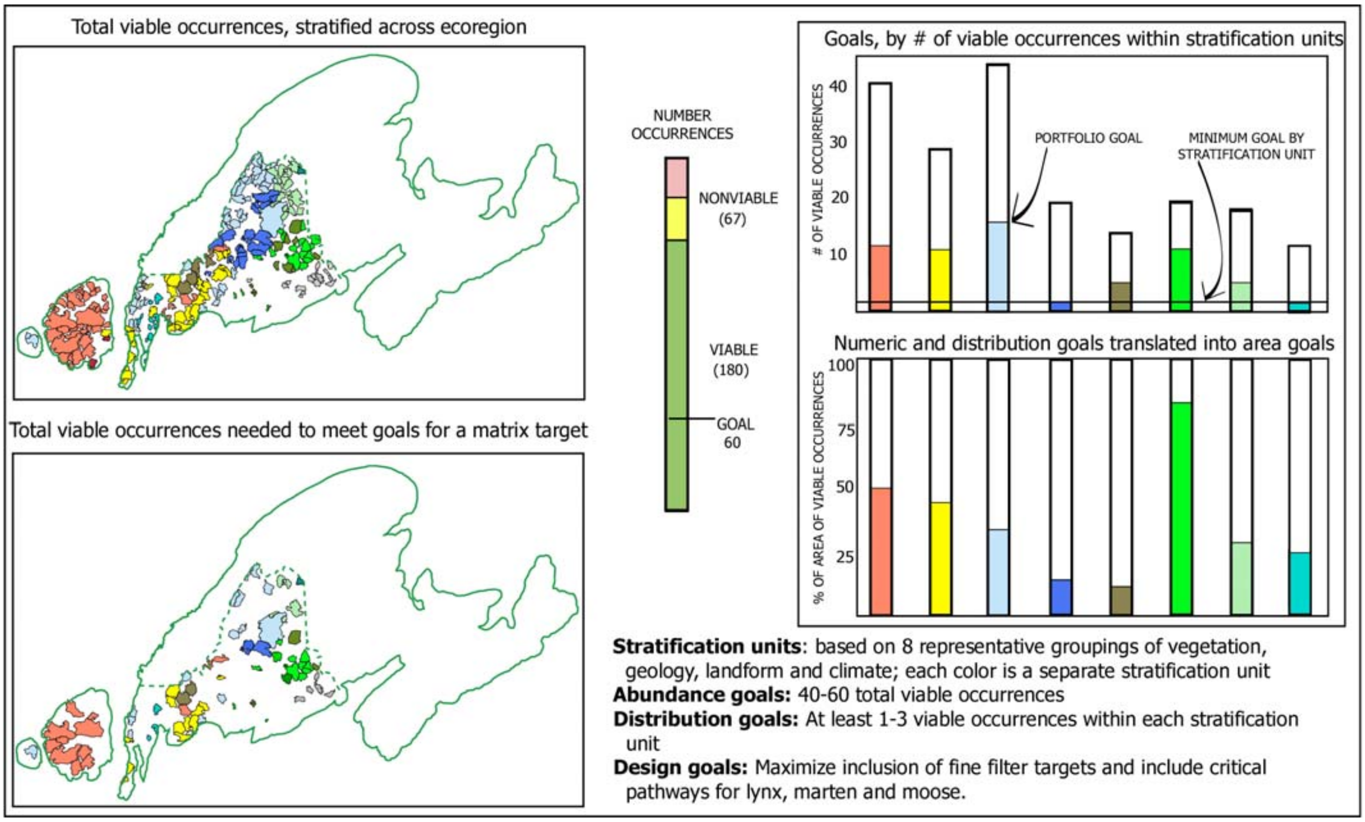
In some cases, the data are adequately clear and compelling for establishing rigorous, science-based numeric and distribution goals; in many other cases they are not. In the absence of sound science, many ecoregional teams have developed numeric and distribution goals in a variety of different ways. These have included goals set by convention (e.g., a set percentage, such as 10%); by convenience (e.g., a percentage of all remaining habitat); or by conservation objective (e.g., a set amount based on divergence from a target's historical range of variability). All of these examples can be used for measuring progress toward ecoregional goals, but teams should strive to improve the scientific basis of their goals over time. The basis for setting goals should be clearly articulated as part of the guidelines for ecoregional assessments and measures (TNC, 2005), and should be recorded as metadata for any ecoregional data systems.

The basic recommendations for reporting progress toward numeric and abundance goals within an ecoregion are as follows:

1) for each target, the numeric goals for viable target occurrences within each stratification unit;
2) the total number, distribution and area of all viable target occurrences within each stratification unit;
3) the total area of the stratification unit used for each measures target.

[8] The scientific principles for setting numeric and distribution goals are clearly laid out in Groves, 2003 and Tear et al., *in press*.

Box 6: Spatial example of reporting the status of persistence goals in the U.S. portion of the Northern Appalachian Ecoregion



Box 7: Tabular example of reporting the status of persistence goals

TARGET	STRATIFICATION UNIT #1				STRATIFICATION UNIT #2			
	Total # viable occurrences	Total area viable occurrences	Numeric goal for stratification unit	Translation into area goal	Total # viable occurrences	Total area viable occurrences	Numeric goal for stratification unit	Translation into area goal
Lodgepole pine forests and shrublands	57	219,354 ha	5	35,234 ha	22	43,469 ha	4	15,439 ha
Montane dry grassland	24	63,219 ha	3	12,364 ha	12	32,498 ha	3	8,793 ha
Rough fescue prairie	82	43,597 ha	12	35,978 ha	31	12,329 ha	13	4,385 ha
Subalpine larch forests	19	19,872 ha	8	9,872 ha	5	39,825 ha	2	17,439 ha
etc.								

Threat Status

Threat status is the degree to which biodiversity targets are threatened, both now and in the future. This section outlines a minimum set of threats that should be included in all ecoregional measures and describes a system for ranking and aggregating multiple threats within and across target occurrences.

Ecoregional threat assessments

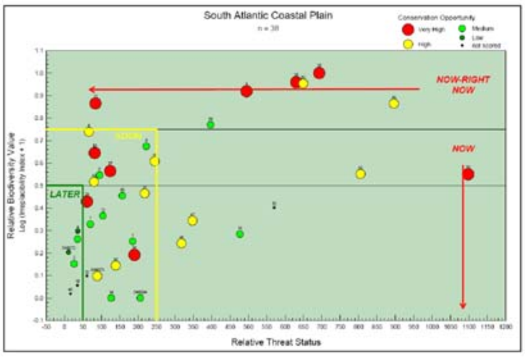
Assessing threats to biodiversity is widely recognized as a critical step in conservation planning (Margules & Pressey, 2000; Groves, 2003), and is considered an important step in ecoregional assessments (TNC, 2005). A threat, generally regarded as any human activity that directly or indirectly impairs the integrity and viability of biodiversity elements, occurs at multiple scales ranging from site to global. Approaches to assessing threats, therefore, can vary considerably, depending on the scale and objectives of the assessment.

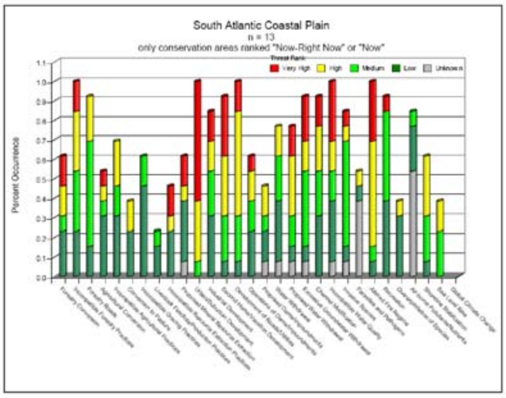
At a site or project level, TNC measures a threat relative to the degree to which it affects the key ecological attributes of a small suite of conservation targets (8 or fewer) within the site. In the context of ecoregion-wide threat assessments, an ecoregional threat is defined as any human activity that impairs the integrity of an ecoregional system or the viability of a biodiversity target, and thereby diminishes its potential contribution toward meeting ecoregional goals.

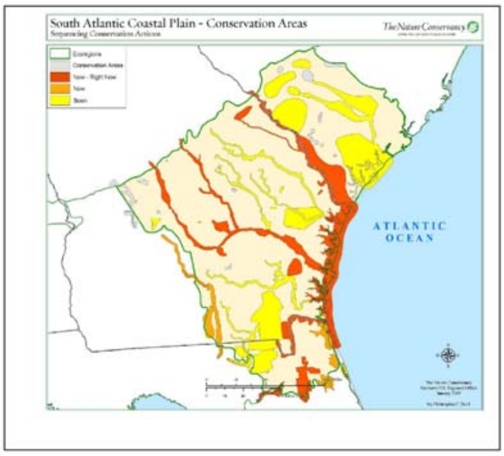
There are myriad threats to biodiversity, ranging from illegal logging in the tropics to unsustainable fishing in temperate seas to melting polar ice in the Arctic. Recent efforts at ranking (e.g., Wilcove et al, 1998) and analyzing (van Schaik et al., 1997) threats to biodiversity have demonstrated the utility of having a common framework for classifying threats. Tracking the overall frequency, intensity and distribution of a common set of threats within and across ecoregions can enable better strategy development, conservation planning and adaptive management. The use of a common set of threats should not, however, preclude the assessment of more detailed threats within on ecoregion (see Box 8). Rather, such a taxonomy is simply a convention that enables more systematic analyses and comparisons across ecoregions, and potentially enables better learning and coordination between ecoregions.

Box 8: Using detailed threat assessments to guide priorities within the South Atlantic Coastal Plain

The South Atlantic Coastal Plain Ecoregional team conducted anecoregional assessment of 30 different threats. They looked at the degree of each threat to each conservation area, and used the data to prioritize and sequence their conservation actions.







Forestry Conversion
Incompatible Forestry Practices
Forestry Roads
Agricultural Conversion
Incompatible Agricultural Practices
Conversion to Pasture
Incompatible Grazing Practices
Livestock Feedlots/Production Practices
Incompatible Resource Extraction Practices
Proposed Mineral Resource Extraction
Urban/Suburban Development
Industrial Development
Second Home/Vacation Development
Development of Roads/Utilities
Proposed Dams/Impoundments
Operations of Dams/Impoundments
Water Withdrawal
Proposed Water Withdrawal
Excessive Groundwater Withdrawal
Channel Modification
Incompatible Water Quality
Invasive Species
Parasites and Pathogens
Altered Fire Regime
Recreation
Overexploitation of Species
Air-borne Pollutants/Nutrients
Shoreline Stabilization
Sea Level Rise
Global Climate Change

Source: Sutter, 2005.

Threat classification systems that attempt to classify site-level threats can be very comprehensive. The recent threats taxonomy proposed by the Conservation Measures Partnership (www.ConservationMeasures.org), for example, includes 39 specific threats under 9 categories, and the South Atlantic Coastal Plain identified

30 separate threats (see Box 8). When reporting on ecoregional status measures, however, the proposed list of threats is somewhat shorter, consisting of habitat conversion; resource use and alteration; transportation; energy and mining; pollution; invasive species, pests and pathogens; and global climate change (see Box 9).

Box 9: Recommended threats to include in reporting on ecoregional threats to system targets

	FOREST	DESERT	GRASSLAND	FRESHWATER	MARINE
HABITAT CONVERSION	Conversion to housing, development and agriculture	Conversion to housing, development and agriculture	Conversion to housing, development and agriculture	Conversion of riparian buffer to housing and agriculture	Conversion or alteration of near shore systems
RESOURCE USE AND ALTERATION	Intensive forestry practices	Intensive agricultural practices and grazing	Intensive agricultural practices and grazing	Surficial and ground water withdrawal	Intensive fishing
TRANSPORTATION	Roads and resulting fragmentation	Roads and resulting fragmentation	Roads and resulting fragmentation	Locks, levees	Shipping corridors
ENERGY AND MINING	Oil, gas and coal mining and exploration	Oil, gas and coal mining and exploration	Oil, gas and coal mining and exploration	Dams and resulting fragmentation	Oil and gas mining and exploration
POLLUTION	Acid deposition	---	---	Agricultural and industrial pollution	---
INVASIVE SPECIES, PESTS AND PATHOGENS	Invasive species and forest pests	Invasive species	Invasive species	Invasive species	Invasive species
GLOBAL CLIMATE CHANGE	Conversion to different forest system or species composition and/or isolation of targets	Conversion to different desert system or species composition and/or isolation of targets	Conversion to different grassland system or composition and/or isolation of targets	---	Coral bleaching

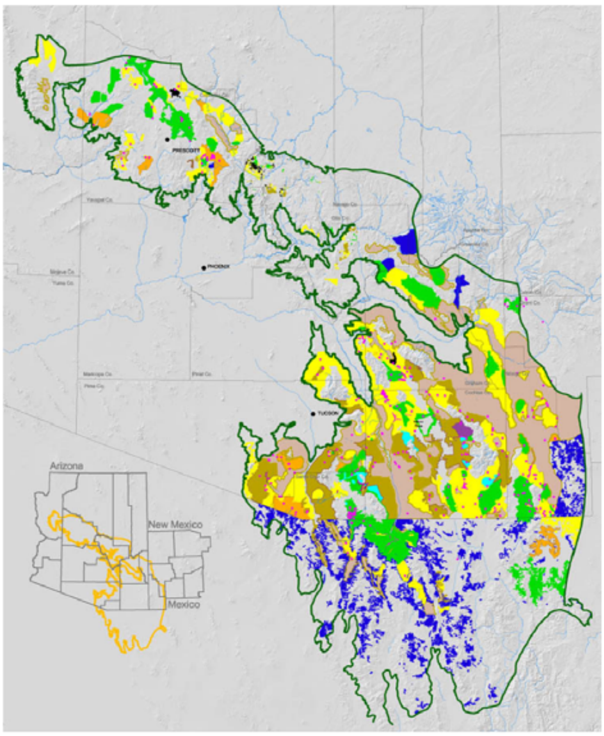
All ecoregional teams should ensure that an ecoregional threat assessment considers at least the actual and potential impact of the threats listed in Box 9 (not all threats may apply, and ecoregional teams may include much more detailed threat assessments). An ecoregional threat assessment entails a consistent ranking of the relative scope and severity of ecoregional threats to all viable occurrences of each conservation target. While a summary of site-level threat assessments can also provide useful information about the status of threats within an ecoregion, a consistent ranking across all target occurrences, using the same criteria and thresholds, will ensure more reliable results and more meaningful comparisons between target occurrences. Furthermore, an occurrence by occurrence threat assessment may be possible, but a system-wide assessment that considers the existing and potential impact of a range of threats to all system occurrences is likely to be far more efficient and cost effective. Regional science staff have a key role in ensuring consistency between threat assessments across ecoregions.

Current and future threats

All threats have a temporal dimension. A threat may have occurred in the near or distant past, it may be ongoing, it may continue to occur, or it may begin to occur in the future. Distinguishing between threats that have already occurred and threats that are likely to occur in the future is an important distinction in guiding conservation priorities and strategies. Conservation plans that do not adequately consider future threats cannot fully plan for the persistence of biodiversity with any degree of confidence (Rouget et al., 2003). Therefore, the guidelines for conducting ecoregional assessments (TNC, 2005), as well as the ecoregional status measures, recommend measuring the status of both current and future threats.

In the context of an ecoregional threat assessment, a current threat is any threat that is currently present within a viable target occurrence, but has not yet resulted in the transformation of the occurrence from viable to non-viable. An assessment of current threats is very closely related to an assessment of the current condition of a target. (See Box 10).

Box 10: Relation between condition assessment and threat assessment in Apache Highlands



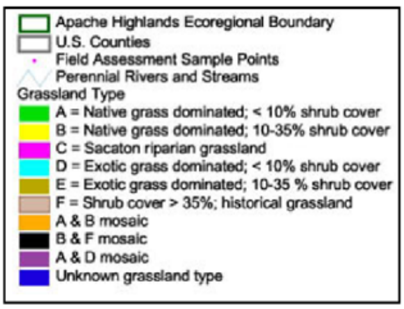
ASSESSMENT OF THE CURRENT AND FORMER GRASSLANDS OF THE APACHE HIGHLANDS ECOREGION

An assessment of the spatial extent and condition of grasslands in the Apache Highlands Ecoregion revealed six primary grassland condition types: native grassland with low shrub cover; shrub-encroached native grassland with restoration potential using prescribed fire; sacaton riparian grassland; non-native grassland with low shrub cover; shrub-encroached non-native grassland and former grassland that has undergone a type conversion to shrubland.

The study integrated the effects of three major threats: fire suppression, grazing and invasive species, and classified the condition of grasslands based on the cumulative impact of these three threats.

These data can be translated into a measure of current threat, based on the cumulative impact of each threat on target occurrences.

Source: Gori and Enquist, 2003.



In the context of an ecoregional threat assessment, a future threat is any threat that a) is likely to begin or continue in the future, or is likely to intensify in scope and/or severity within a target occurrence; and b) could potentially result in the transformation of that occurrence from viable to nonviable. For example, conversion to housing may be present as a current threat in a forest target occurrence, but at low enough densities that the target occurrence still ranks as 'good.' Continued conversion to housing may also be a future threat within the target occurrence, and may eventually reach densities that result in only a 'fair' viability ranking. The recommended timeline for considering and measuring future ecoregional threats is 20 years from the assessment date. This is a short enough time horizon to enable realistic planning, while being long enough to be able to detect and respond to patterns and trends.

An ecoregional threat assessment may draw upon a range of information that relates to threat assessments, including GIS data layers and analyses (e.g., suitability indices and cost surfaces); local, state, national and global statistics and data sets; and remotely-sensed data such as land cover and land use data. Data for future threat assessments may come from several sources, including a) an assessment of the vulnerability or risk to threats[9]; b) predictive models for the likely spatial configuration of threats based on underlying environmental features[10]; and c) the development of multiple threat scenarios[11].

Collection of the data for many ecoregional threats will likely entail a collaboration between various levels within TNC, including coordination and sharing of data sets currently housed by the Conservation Strategies Group (including by the habitat assessment team and the fire, invasives and climate change initiatives), regional science teams, and state and country programs. In addition, TNC is exploring partnerships with groups such as USGS, University of Maryland's Global Land Cover Facility, NASA, University of Colorado and others, to ensure that data sets on widespread threats are readily available to ecoregional teams.

Reporting on current and future threats

Current and future ecoregional threats can be ranked by their *scope* (the spatial extent to which they affect a target); and by their *severity* (the degree to which they have an impact on the size, condition and landscape context of a target occurrence).

Nearly all target occurrences contain more than one threat. Because of the complexities inherent in aggregating multiple threats within a target occurrence, three methods of aggregating multiple threats are recommended: a) a simple additive model; b) a rule-based algorithm similar to TNC's "Conservation Action

[9] See Zalba et al., 2000 as an example of vulnerability of terrestrial targets to invasive species
[10] See Rouget et al., 2003; Theobald, 2003 and Dirnböck et al., 2003 for future threat assessments that use predictive models and hindcasting
[11] See Reyers, 2004 for an example of multiple threat scenarios

Planning" workbook[12]; and c) a composite score that takes into account the synergies and interrelationships[13] between multiple threats (see Boxes 11 and 13). This composite score will be used in factoring in whether or not a occurrence is 'effectively conserved.'

Box 11: Guidelines for ranking and aggregating scope and severity within a system target occurrence

MEASURING THREATS TO INDIVIDUAL TARGET OCCURRENCES

SCOPE — Scope refers to the geographic extent of a threat within a single target occurrence. In the simplified figure below, the forest matrix block occurrence has 45% of its area in a protected area (green), 10% of its area in a certified forestry area (yellow), 20% has been converted to housing, agriculture and development (gray), and 25% is developable land.

SEVERITY — Severity refers to the degree of existing and future impact to the size, condition and/or landscape context of target occurrence. The specific thresholds will vary depending on the threat. For habitat conversion, for example, the following severity rankings for could apply:

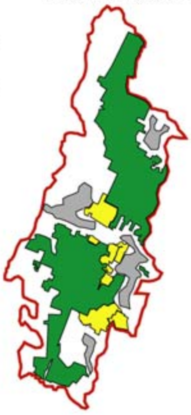
CURRENT SEVERITY

Very high: permanent conversion to non-viable status
High: partial conversion
Moderate: some conversion
Low: mild conversion
Nil: Nil or negligible conversion

FUTURE SEVERITY

Very high: very high potential of conversion
High: high potential of conversion
Moderate: moderate potential of conversion
Low: low likelihood of conversion
Nil: little or no likelihood of significant conversion

Forest matrix block



Scope and severity of CURRENT habitat conversion within single occurrence		
Ranking	%	Rationale
Very high	7%	High-density development
High	5%	Agriculture
Moderate	3%	Medium-density housing
Low	5%	Low-density, exurban
Nil	80%	Non-converted forestland

Scope and severity of FUTURE habitat conversion within single occurrence		
Ranking	%	Rationale
Very high	15%	High dev't potential
High	5%	Moderate dev't potential
Moderate	5%	Low dev't potential
Low	10%	Certified forest lands
Nil	45%	In protected areas

THREAT INDEX AND VALUE

A single threat index can be derived from the scope and severity rankings within a target occurrence by multiplying the percentage of the occurrence in 'very high' status by 1, the percentage in 'high' status' by .75, 'moderate' status by .5, 'low status' by .25, and 'nil' status by 0, and adding the scores. A value can be assigned based on the index.

RECORDING SCOPE AND SEVERITY OF CURRENT AND THREATS TO A SINGLE OCCURRENCE

System Targets	Occurrence 1						
	V	H	M	L	N	Index	Synthesis
Current	0.05	0.02	0.06	0.12	0.75	0.13	Low
Future	0.32	0.26	0.11	0.27	0.04	0.64	High

AGGREGATING MULTIPLE THREATS TO A TARGET OCCURRENCE

There are three ways to aggregate multiple threats within a target occurrence:

SIMPLE ADDITION
The indices for each threat (current and future) can be added for all threats, resulting in an overall 'threatload' for a single target occurrence.

RULE-BASED ALGORITHM
The values for each threat (current and future) can be combined, using a rule-based algorithm similar to that used in aggregating multiple threats in the CAP workbook.

COMPOSITE SCORING
Perhaps most useful will be a composite score that takes into account the synergies between multiple threats. Some threats are simply additive, such as habitat conversion to housing and intensive forestry; they simply result in overall decreases in forest cover. Other threats are multiplicative and interactive, such as fire, invasive species and logging. In such cases, the impact of these three threats is nonlinear and based on ecological thresholds and feedback loops. Therefore, ecoregional teams should carefully consider the composite and cumulative impacts of multiple future and current threats, and assign a synthetic threat score to each targe occurrence. This synthetic score should indicate the degree to which an occurrence is likely to shift from a 'viable' ranking to a 'non-viable' ranking, and will be the basis for calculating the 'effective conservation' of that target. In developing a composite score, ecoregional teams should consider a "rule, review and revise" approach of developing preliminary 'rules' for combing threats, reviewing the results, and revising where necessary.

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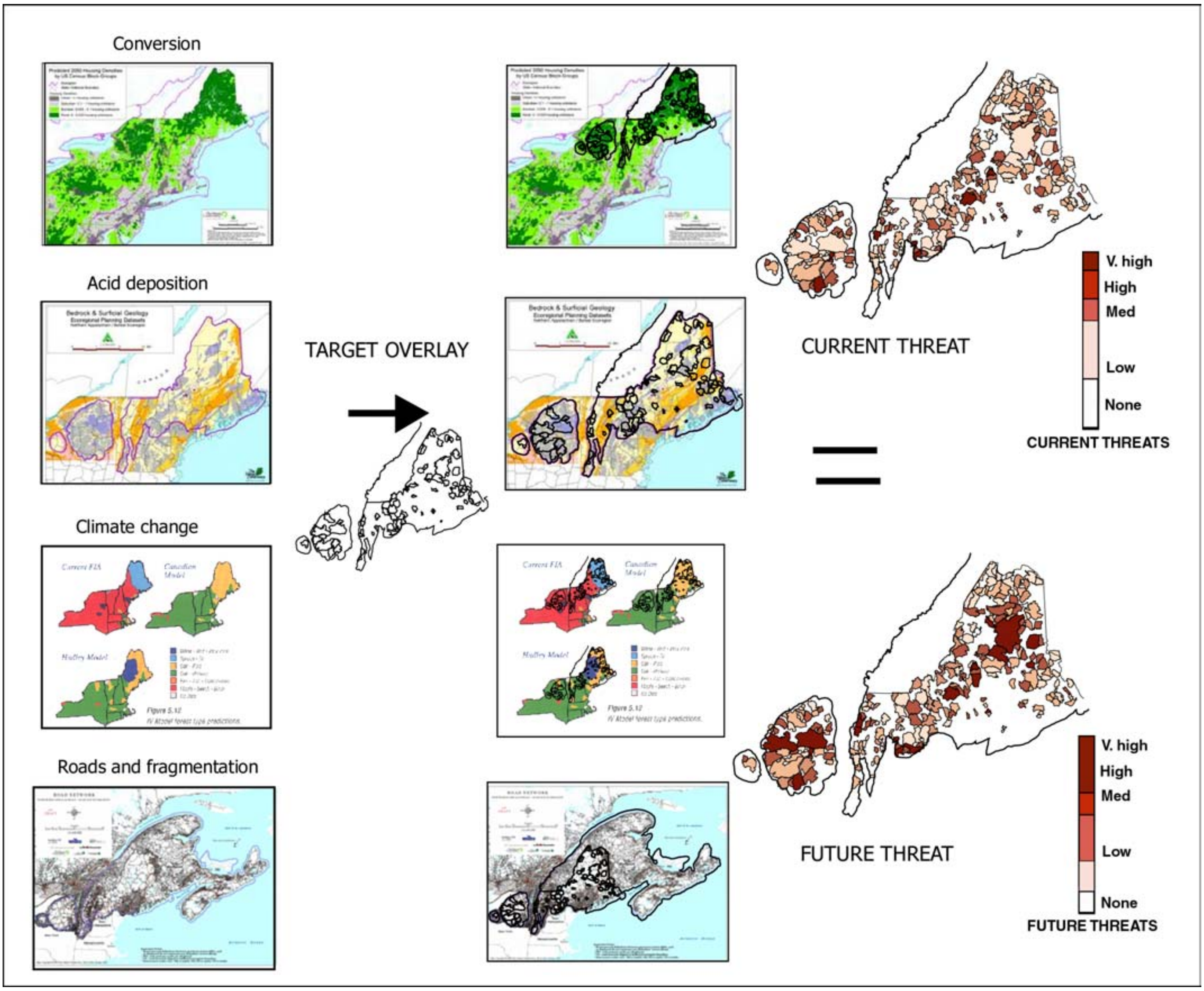
[12] The CAP Workbook was previously known as the 5-S or Enhanced 5-S Workbook.
[13] See Laurance and Williamson, 2001 and Travis, 2003 for a discussion on the synergistic effects between threats, such as forest fragmentation, drought and climate change.

The basic recommendations for reporting current and future threat status within an ecoregion are as follows:

a) a threat ranking of scope and severity for applicable current and future threats to all viable target occurrences (see Boxes 9, 11 and 13);
b) aggregate threat ranking (including current and future) for all viable target occurrences (Box 11)

Box 12: Spatial example of reporting the status of current and future threats in the U.S. portion of the Northern Appalachians



Box 13: Tabular example of reporting the status of current and future threats

Ranking of current and future threats to system targets from habitat conversion															
System Targets	Current Threat							Future Threat							TOTAL
	V	H	M	L	N	Index	Synthesis	V	H	M	L	N	Index	Synthesis	
Montane wet meadow															
Occurrence 1	0.05	0.02	0.06	0.12	0.75	0.125	Low	0.32	0.26	0.11	0.27	0.04	0.6375	High	0.7625
Occurrence 2	0.02	0.08	0.09	0.11	0.7	0.1525	Low	0.61	0.1	0.22	0.05	0.02	0.8075	V. high	0.96
Occurrence 3	0.03	0.02	0.09	0.08	0.89	0.11	Low	0.32	0.29	0.13	0.07	0.19	0.62	High	0.73
Occurrence 4	0.07	0.08	0.12	0.31	0.42	0.2675	Moderate	0.22	0.23	0.17	0.03	0.35	0.485	Moderate	0.7525
Montane dry grasslands															
Occurrence 1	0.12	0.05	0.09	0.22	0.52	0.2575	Moderate	0.04	0.02	0.06	0.19	0.69	0.1325	Low	0.39
Occurrence 2	0.03	0.04	0.06	0.11	0.76	0.1175	Low	0.07	0.14	0.17	0.23	0.39	0.3175	Moderate	0.435
Occurrence 3	0	0.05	0.03	0.04	0.88	0.0625	Nil	0.12	0.23	0.31	0.1	0.24	0.4725	Moderate	0.535
Occurrence 4	0.04	0.02	0.12	0.31	0.51	0.1925	Low	0.16	0.25	0.22	0.26	0.11	0.5225	Moderate	0.715

RANKING OF ALL CURRENT AND FUTURE THREATS TO SYSTEM TARGETS																								
SYSTEM TARGET	Habitat conversion			Resource use and alteration			Transportation and fragmentation			Energy and mining			Pollultion			Invasives, pests and pathogens			Global climate change			Summary for target occurrence		
	Curr.	Fut.	Sum	Curr.	Fut.	Sum	Curr.	Fut.	Sum	Curr.	Fut.	Sum	Curr.	Fut.	Sum	Curr.	Fut.	Sum	Curr.	Fut.	Sum	Index	Value	Synthesis
Montane wet meadow																								
Occurrence 1	0.01	0.05	0.06	0.01	0.06	0.07	0.02	0.12	0.14	0.26	0.03	0.39	0.19	0.16	0.35	0.11	0.02	0.13	0.09	0.18	0.39	1.53	Low	Low
Occurrence 2	0.15	0.81	0.96	0.04	0.22	0.26	0.12	0.42	0.54	0.12	0.53	0.44	0.07	0.32	0.39	0.14	0.22	0.36	0.12	0.32	0.44	3.38	Mod	High
Occurrence 3	0.11	0.62	0.73	0.02	0.15	0.17	0.14	0.51	0.65	0.06	0.67	0.54	0.18	0.29	0.47	0.16	0.15	0.31	0.06	0.47	0.54	3.40	Mod	Mod
Occurrence 4	0.27	0.67	0.94	0.05	0.62	0.67	0.22	0.13	0.35	0.19	0.82	0.72	0.14	0.31	0.45	0.17	0.62	0.79	0.19	0.52	0.72	4.63	High	High
Montane dry grasslands																								
Occurrence 1	0.26	0.13	0.39	0.11	0.77	0.88	0.19	0.25	0.44	0.22	0.34	0.56	0.19	0.44	0.63	0.19	0.22	0.41	0.19	0.44	0.63	3.94	Mod	High
Occurrence 2	0.12	0.32	0.44	0.12	0.11	0.23	0.07	0.32	0.39	0.14	0.22	0.36	0.08	0.32	0.40	0.07	0.32	0.39	0.07	0.32	0.39	2.60	Mod	Mod
Occurrence 3	0.06	0.47	0.54	0.17	0.31	0.48	0.14	0.29	0.43	0.16	0.15	0.31	0.32	0.56	0.88	0.18	0.29	0.47	0.32	0.56	0.88	3.99	High	V. High
Occurrence 4	0.19	0.52	0.72	0.21	0.44	0.65	0.09	0.31	0.40	0.17	0.62	0.79	0.23	0.67	0.90	0.14	0.31	0.45	0.26	0.67	0.93	4.84	High	High
TOTALS	1.17	3.59	4.76	0.73	2.68	3.41	0.99	2.35	3.34	1.32	3.38	4.10	1.40	3.07	4.47	1.16	2.15	3.31	1.30	3.48	4.91			
AVERAGES	0.15	0.45	0.60	0.09	0.34	0.43	0.12	0.29	0.42	0.17	0.42	0.51	0.18	0.38	0.56	0.15	0.27	0.41	0.16	0.44	0.61			

Ecoregional status measures and TNC's 2015 goal

TNC's 2015 Goal

The mission of The Nature Conservancy is "to preserve the plants, animals and natural communities that represent the diversity of life on earth by protecting the lands and waters they need to survive." In a more explicit recognition of the global nature of its mission, TNC recently adopted an ambitious goal for the next ten years:

> By 2015, The Nature Conservancy will work with others to ensure the effective conservation of places that represent at least 10%* of every Major Habitat Type on Earth.

Embedded in this goal are several concepts: "effective conservation," representativeness, and a qualified target of ten percent.

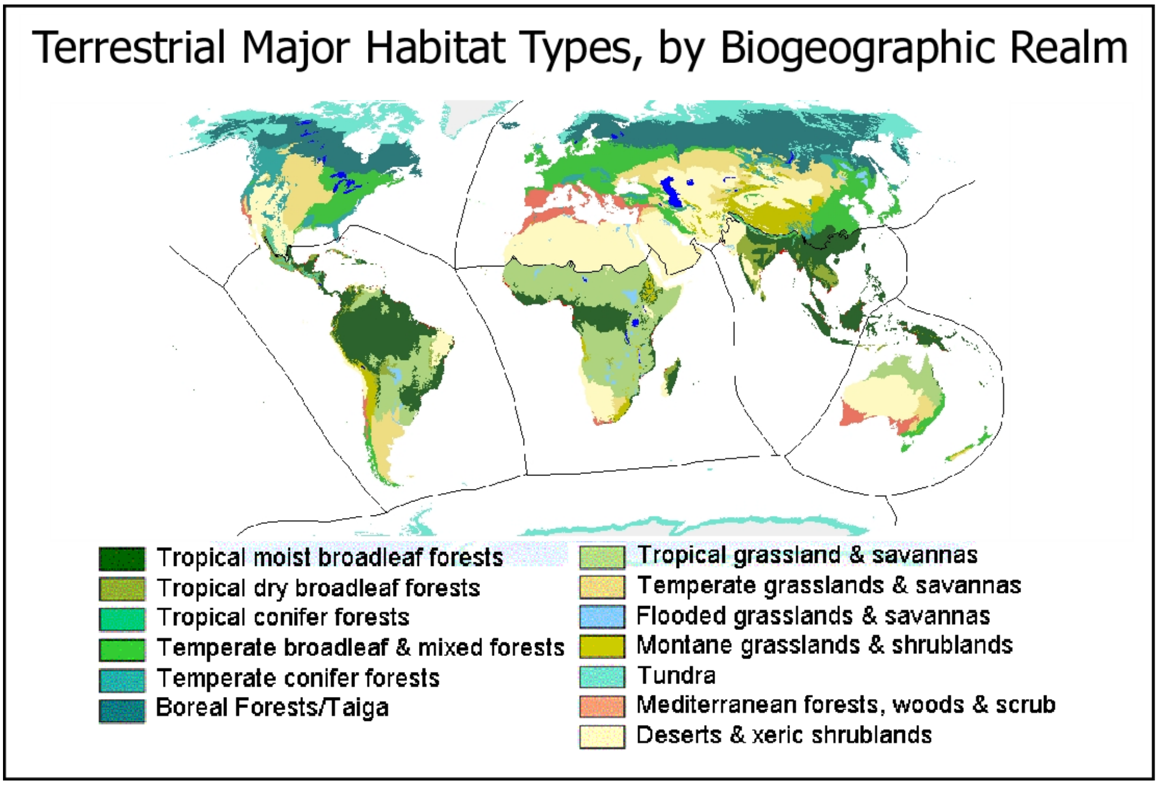
"Effective conservation" is defined as places where species, natural communities and ecological systems are viable, threats are adequately abated and prevented, and the conservation status is sufficient to enable long-term persistence of biodiversity. In the context of ecoregional status measures and the 2015 goal, 'effective conservation' is the degree to which target occurrences within ecoregions have adequate biodiversity, threat and conservation status, and the extent to

which these effectively-conserved target occurrences meet their numeric and distribution goals.

To determine preliminary geographic priorities, the habitat assessment team will be conducting a very coarse resolution assessment of the effective conservation of ecoregions by assessing broad levels of biodiversity, threat and protection status. To measure progress toward the 2015 goal, however, the main currency is the synthetic analysis of the effective conservation of biodiversity, as determined by the ecoregional status measures.

Representativeness is defined at three levels. At an ecoregional level, representativeness refers to the distribution of target occurrences across stratification units within the ecoregion (e.g., subsections, biophysical units). At a biogeographic realm level, representativeness refers to the distribution of ecoregions sharing a major habitat type (e.g., temperate grasslands) within a particular realm (see Box 21). At a global level, representativeness refers to the distribution of biogeographic realms across the planet.

Box 21: Terrestrial major habitat types, by biogeographic realm



The goal of ten percent is provisional for several reasons. First, the target of ten percent refers to both the *area* of places within ecoregions, as well as the *biodiversity* within that ecoregion.

Second, the target of ten percent is generally considered a minimum – already over 11 percent of the world's terrestrial surface is in some form of legal protection. However, problems of inadequate representation persist across the world, with the 'rock and ice' phenomenon widely recognized (Scott et al., 2001). Furthermore, in some ecoregions a goal of ten percent may be far too little, in other cases far too ambitious. The 2015 goal process will therefore include groups of stakeholders, including TNC and partner organizations, who will define thresholds and milestones for effective conservation for each ecoregion within a biogeographic realm.

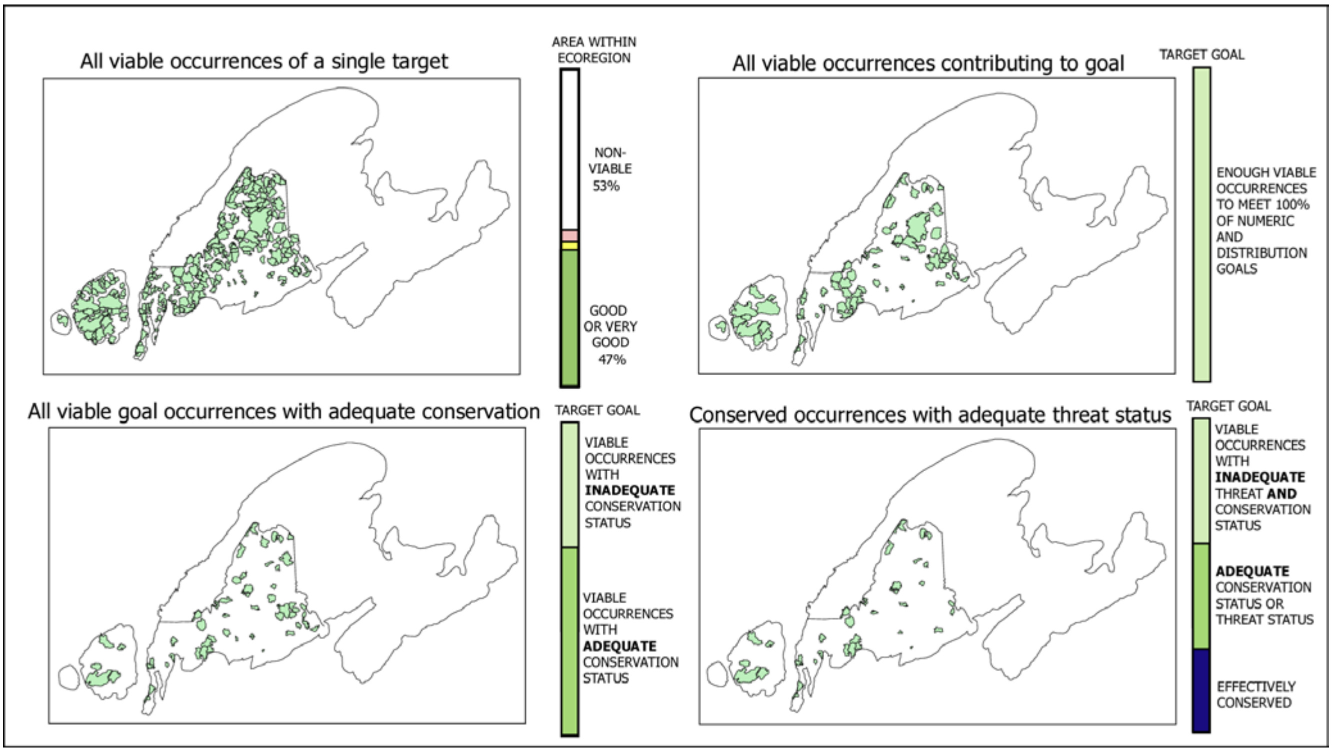
Measuring effective conservation within an ecoregion

The currency for measuring effective conservation within an ecoregion are the ecoregional status measures – the biodiversity, threat and conservation status of biodiversity. These measures are an inextricable part of the ecoregional assessment process; they rely upon the goals, and the viability, threat and conservation data outlined in such assessments.

The baseline measure of effective conservation is biodiversity status – the viability of target occurrences for all system and focal species targets, and the degree to which there are enough, well-distributed occurrences to meet persistence goals for each target. From these, (which collectively define a conservation portfolio), is a smaller subset of areas that has adequate conservation status. From this subset is a smaller subset still of viable conserved target occurrences that have adequate abatement of current and prevention of future threats. This smallest subset is the degree of 'effective conservation' of a particular target within an ecoregion (see Box 22).

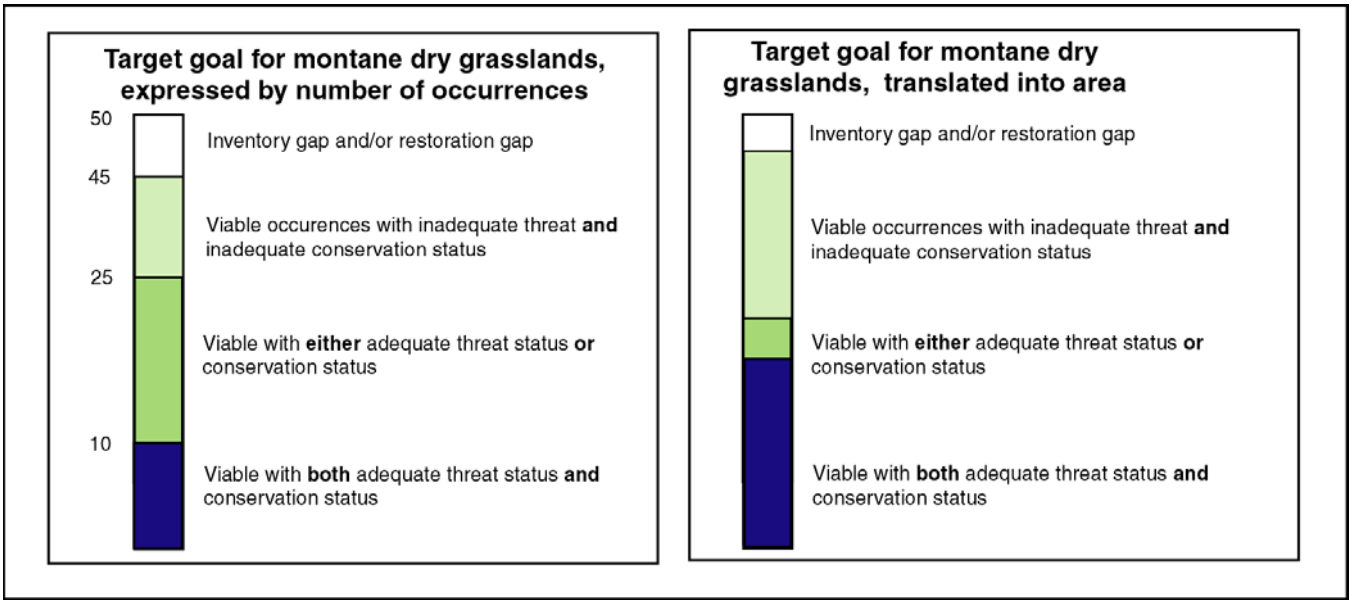
There is a great deal of overlap between biodiversity status, threat status and conservation status. The degree of current threat of a target is closely linked with its overall condition, and therefore viability. The degree of current and future threat is also closely linked with a target's conservation status – a protected area is relatively secure from the threat of habitat conversion (although not, necessarily, from other types of threat, such as global climate change). This interconnectedness will be reflected when calculating 'effective conservation;' when the conservation status of a target goes up, the future threat will likely go down, for example.

Box 22: Spatial example of defining effective conservation of a target within the U.S. portion of the Northern Appalachian Ecoregion



This measure can also be translated into area, which can be useful in developing specific milestones for conservation work (see Box 23).

Box 23: Reporting on effective conservation by number of occurrences and translated into area



Aggregating targets and ecoregions

Within an ecoregion there are generally an average of about 40 to 60 system targets. The degree of effective conservation for a single system target can be averaged across multiple targets[14], as well as across focal species targets[15]. The summary of all target data can thus be aggregated into a single measure, or index, for any particular ecoregion. These indices can, in turn, can enable comparisons of effective conservation across ecoregions that share a major habitat type within a biogeographic realm (see Box 24).

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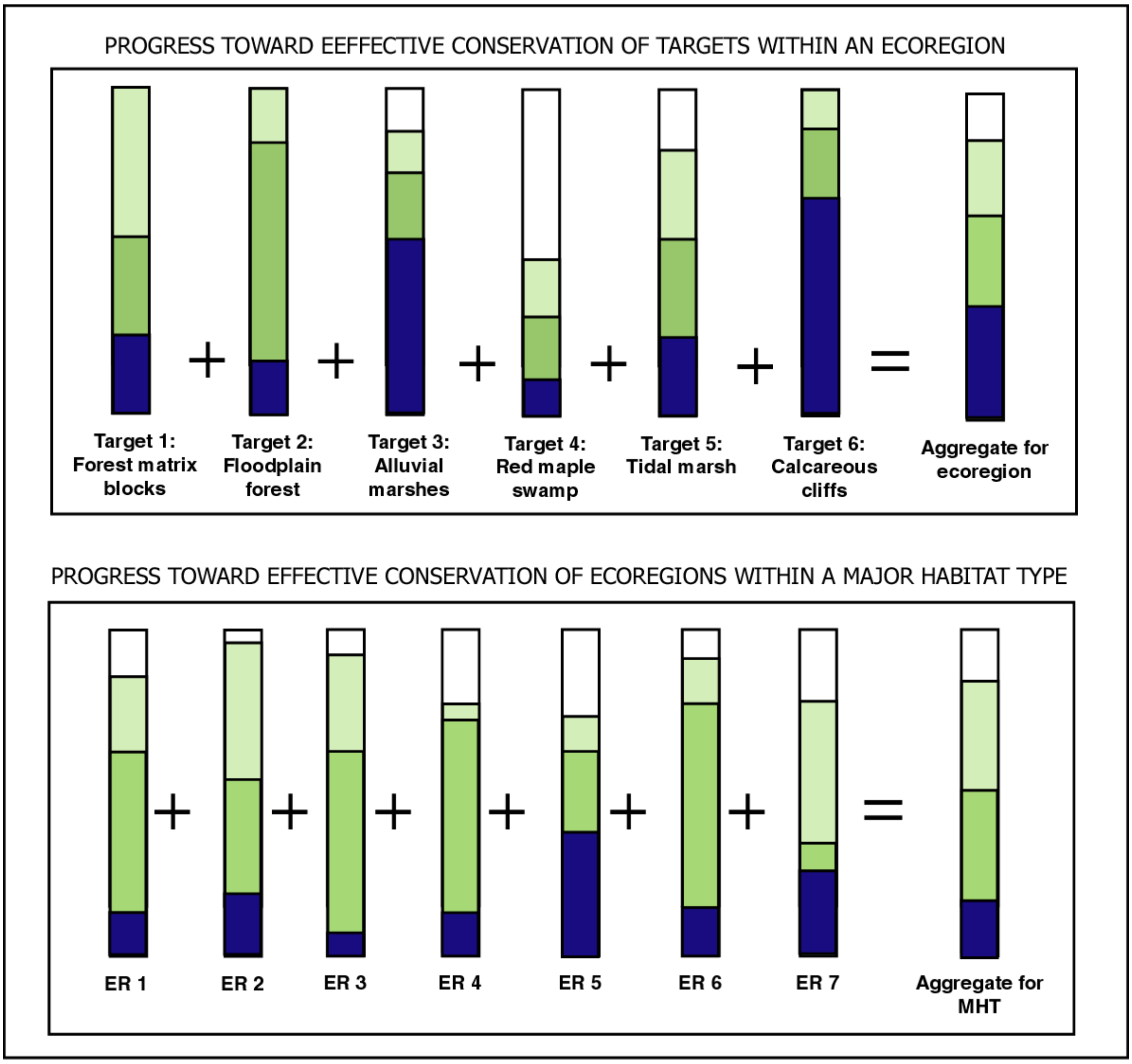
[14] This process may involve the weighting of individual targets, based upon factors such as relative size, biodiversity significance, extent of historical vs. existing range, and other factors. The first phase of implementation of the ecoregional status measures in fiscal year '06 will explore these weighting factors.

[15] The early implementation phase will also explore when and how system target data should be combined with focal species target data.

Box 24: Measuring progress toward effective conservation of biodiversity within and across ecoregions

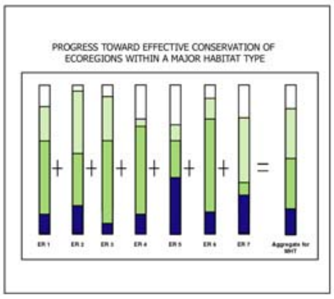


Reporting on ecoregional status measures

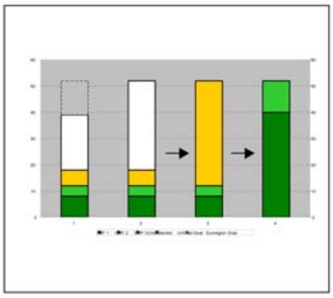
The ecoregional status measures can be used for a wide variety of purposes. Box 25 shows just a few of the ways these measures can be combined and reported.

Box 25: Examples of reports generated by ecoregional status measures

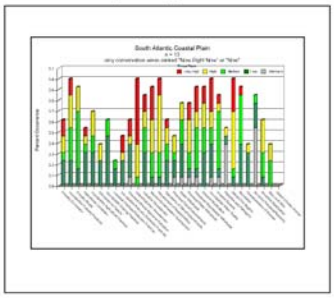
Measuring effective conservation



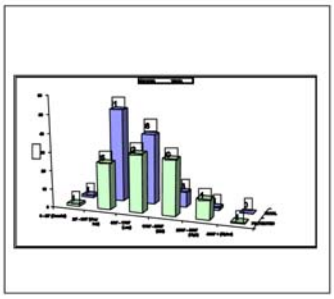
Setting milestones



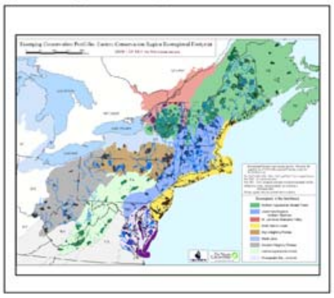
Comparing threats



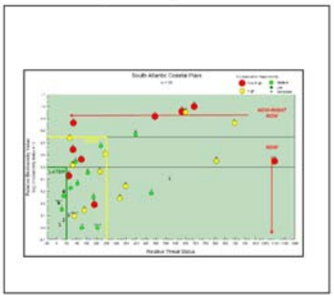
Evaluating biases in protection



Updating ecoregional assessments

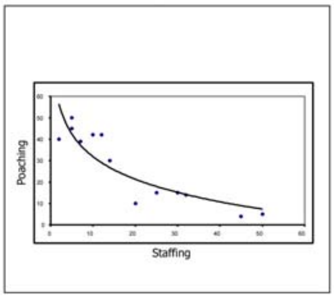


Sequencing actions

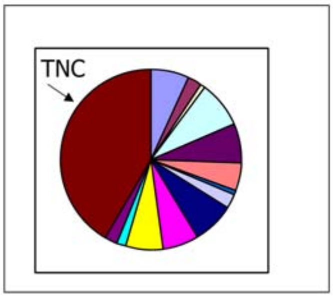


Prioritizing geographies

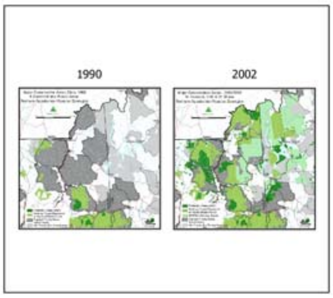
Discovering correlations



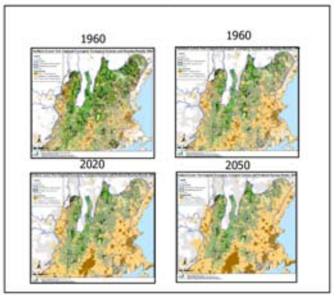
Accounting for TNC actions



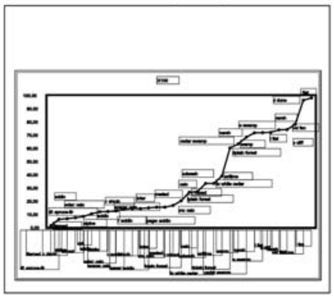
Measuring local change



Predicting change



Prioritizing targets



Implementation plan for ecoregional status measures

Implementation goals and sequencing

In order to establish a baseline of effective conservation and to measure progress toward the 2015 goal, the Conservation by Design Group[16] is proposing that by 2008, all ecoregional measures should be in place for all ecoregions where TNC works, and ecoregional measures should be an integral part of all new geographies where TNC works.

To do so will require a phased process. The CbD group is proposing the following:

Year 1 (FY 06):
- Ecoregional measures should be completed within two regions (MesoAmerican/Caribbean and Eastern US regions)
- Measures for at least one ecoregion in each of the six remaining ecoregions should be completed
- Ecoregional measures in at least one freshwater and one marine ecoregion should be completed

Year 2 (FY 07):
- Ecoregional measures should be completed within four regions (South America, Southeast US, Rocky Mountains, Pacific North America regions)
- Measures for at least three ecoregions in each of the two remaining ecoregions should be completed
- Ecoregional measures in at least four freshwater and four marine ecoregions should be completed

Year 3 (FY 08):
- All remaining ecoregional measures should be completed where TNC works (Asia Pacific, Central US regions)
- Ecoregional measures should be thoroughly integrated into ecoregional assessments in new geographies

Retrofitting ecoregional plans

Ecoregional assessments are variable across TNC. Goal setting is highly variable and scientific thresholds inconsistently used. Threat assessments range from sophisticated spatial analyses of current and future threats to a simple list of most commonly occurring threats in the ecoregion. Few ecoregions have conducted assessments of either protected area management effectiveness assessments or of the coverage of stewardship areas. Therefore, in implementing ecoregional status measures, a certain amount of retrofitting will need to take place, depending on the age and comprehensiveness of the existing assessment.

[16] Formerly known as something else; name to be decided.

Role of regional science offices

Regional science offices will play a vital role in building capacity for, and ensuring the consistency of, the implementation of ecoregional status measures. Because ecoregions typically cross state and country boundaries, wide-ranging species cross multiple ecoregions, threats cross multiple boundaries, and priorities are set and strategies developed across more than one state or country, regional science offices are central in ensuring a coordinated approach to ecoregional assessments, strategies and measures.

Specifically, regional science staff can improve the implementation of ecoregional status measures by:

a) coordinating the selection of focal species targets for ecoregional measures
b) encouraging the use of a consistent approach to classifying ecological systems and encouraging a common system taxonomy
c) encouraging a common regional approach to assessing system viability status
d) coordinating ecoregional threat assessments within the region, and ensuring a common set of thresholds and criteria for determining threat status
e) providing regional data sets on various threats
f) coordinating assessments of protected area management effectiveness
g) coordinating data on legally-designated protected area coverage and category
h) gathering data on stewardship programs within the region
i) coordinating the reporting of ecoregional status measures

Recommended next steps for enabling measures

There are several next steps that CSG and the CbD Group can take (and in many cases is already taking) to increase the adoption of ecoregional measures in the near future, including:

a) Support to the IABIN proposal that would seek consensus of OAS states on a common reporting framework for protected area management effectiveness
b) Increase CoP – 7 activities related to protected area management effectiveness
c) Work with NatureServe, and others to standardize and map ecosystems and system occurrences across the Americas
d) Form partnerships with groups such as USGS, NASA, and GLCF to better integrate remote sensing data into ecoregional threat assessments
e) Conduct assessment of future threats across Eastern US and South America (pending NASA grant)
f) Hold TNC/WWF workshop in fall '06 on protected area management effectiveness and stewardship measures
g) Engage Dave Theobald in learning how to implementation predictive modeling of urbanization to other areas besides US
h) Engage TNC's initiatives (fire, invasives, global climate change) in learning how to aggregate synergistic threats

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GLOSSARY

(To be developed)

Abundance goal
Biodiversity target
Biogeographic realm
Coarse filter target
Current threat
Design goal
Ecological system
Ecoregion
Ecoregional measures target
Ecoregional portfolio
Ecoregional subsection
Ecoregional threat assessment
Ecologically viable population
Effective conservation
Enabling conditions
Fine filter target
Focal species
Forest matrix block
Future threat
Integrity
Landscape context
Major habitat type
Minimum dynamic area
Minimum viable population
Numeric goal
Persistence goal
Protected area
Protected area management effectiveness
Restoration feasibility
Rule-based algorithm
Scope
Severity
Status measure
Stewardship area
Stratification unit
System target
Target condition
Target occurrence
Viability

Conservation Status

Protected areas, stewardship areas and enabling conditions

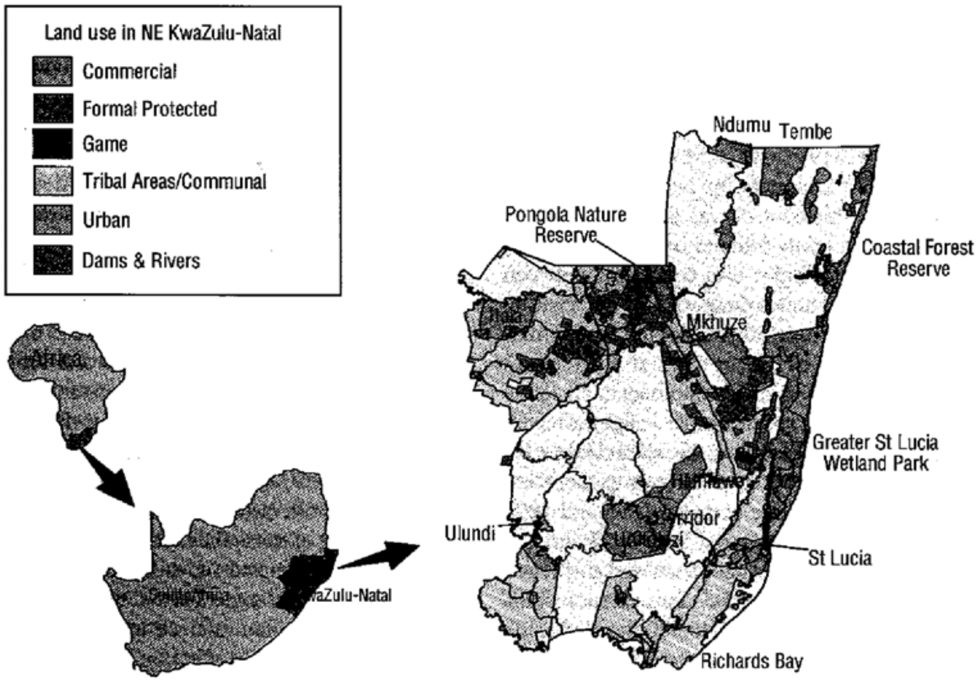
Protected areas are the cornerstone of conservation strategies worldwide; they are among the most efficient and cost-effective strategies for conserving biodiversity (Balmford et al., 1995), and are generally considered as a basic starting point for large scale conservation (Soulé and Terborgh, 1999). They are a major thrust of the Convention on Biological Diversity, and their importance to biodiversity conservation is regularly reaffirmed at meetings of the World Conservation Congress and the World Commission on Protected Areas.

The Nature Conservancy has long been a proponent of private protected areas; it has helped to protect more than 117 million acres of land and 5,000 miles of river around the world through easements and direct purchases. Over the past two decades, TNC has also become more involved with management planning and actions on public protected areas through its many partnerships with US Fish and Wildlife, US Forest Service, Bureau of Land Management, US Forest Service, National Park Service and other land management agencies.

Increasingly, conservation practitioners and policy makers alike have recognized the importance of lands and waters outside of legally-designated protected areas[17]. These areas, called 'stewardship areas,' range from private game reserves to forest certification to elevational restrictions in zoning ordinances. While stewardship areas may or may not be explicitly managed for biodiversity, they can still provide an array of benefits to biodiversity, such as increasing core habitat, acting as a buffer between more intensively managed lands, serving as refugia for key species, and providing connectivity between protected areas (see Box 14).

Box 14: Example of compatibility between protected and stewardship areas in KwaZulu Natal Province, South Africa

[17] See for example Pierce et al., 2002 and Dudley et al., 2005.



Over the past 25 years, there has been a wholesale shift in the South African province of KwaZulu-Natal from cattle and crop agriculture to private game ranching. In tandem with tribal and community reserves, these game ranches have the potential to restore vast wildlife corridors across the northern part of the province. The protected area of Mkhuze Game Reserve, for example, was an isolated park in a sea of agriculture in the mid-1970; it is now connected to large tracts of land that are jointly managed for to maximize wildlife benefits. (Source: Goodman et al., 2002).

The following section describes the measurement of protected area and stewardship area status. Combined, these measures are the basis for defining the 'conservation status' of a target occurrence. The conservation status of a target occurrence is not a direct measure of the effectiveness of the management itself, nor of the direct benefits to biodiversity, but rather it provides a degree of confidence that the management regime will maintain the target's viability and prevent major threats over time.

Protected areas and stewardship areas can be spatially mapped and are directly related to the viability and threat status of system targets. However, there are many factors that are neither spatially explicit nor directly relate to a target's viability or threat status (e.g., laws and policies) but nonetheless have a strong bearing on the likelihood of effective conservation. Such measures are called "enabling conditions." They include factors such as the conservation financing, governance, policy and capacity within an ecoregion.

Reporting on protected area status

Protected area status has two components: coverage and management effectiveness. Protected area coverage can be ranked according to categories established by the IUCN (Box 15). Regional science staff should coordinate the process of categorizing protected areas (e.g., crosswalking 'GAP' status with IUCN categories and assigning IUCN categories to protected areas) to ensure consistent interpretation within and across ecoregions.

Box 15: IUCN's definition and categories of protected areas

IUCN's definition of a protected area is: "An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means."

IUCN's Protected Area Management Categories are:

CATEGORY Ia: Strict Nature Reserve: protected area managed mainly for science
Area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological features and/or species, available primarily for scientific research and/or environmental monitoring.

CATEGORY Ib Wilderness Area: protected area managed mainly for wilderness protection
Large area of unmodified or slightly modified land, and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

CATEGORY II National Park: managed mainly for ecosystem protection and recreation
Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.

CATEGORY III Natural Monument: managed mainly for conservation of specific natural features
Area containing one, or more, specific natural or natural/cultural feature which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance.

CATEGORY IV Habitat/Species Management Area: managed mainly for conservation through management intervention
Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species.

CATEGORY V Protected Landscape/Seascape: managed mainly for landscape/seascape conservation and recreation
Area of land, with coast and sea as appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area.

CATEGORY VI Managed Resource Protected Area: managed mainly for the sustainable use of natural ecosystems
Area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

The amount and type of protected areas within each target occurrence should be tracked based on IUCN Categories I through IV[18], as well as the amount, type and distribution of protected areas within the ecoregion. The creation and maintenance of comprehensive protected area databases will entail close collaboration between TNC state and country programs, regional science staff, and central TNC staff, and will rely upon a combination of global and national databases, supplemented with state and local databases.

TNC is currently working with the Land Trust Alliance on a project to track and spatially map lands protected with conservation easements. Ecoregional teams should ensure that spatial data for all TNC protected areas (including easements and fee ownerships) are up to date.

Simply because an area is designated as legally protected does not necessarily mean it is effective in conserving biodiversity. The problem of 'paper parks' is widely recognized (van Schaik et al., 1997; Ervin, 2003b). The need to assess the management effectiveness of protected areas is widely recognized by the international conservation community (CBD 2004a; CBD 2004b). The Convention on Biological Diversity's work plan on protected areas for example, calls for signatory countries to assess the effectiveness of 30 percent of their protected areas by the year 2010.

Protected area management effectiveness is defined as a set of elements that provide a degree of confidence that effective protected area management is likely to occur. The elements are a set of preconditions for effective management, the absence of any one of which may lead to ineffective management and subsequent biodiversity losses.

This definition varies from TNC's approach to measuring project-level effectiveness, which defines success by measuring whether a project manager has identified clear biodiversity objectives, developed effective strategies, practiced adaptive management, and measured conservation outcomes.

Numerous schemes for assessing protected area management effectiveness exist (Ervin, 2003b) the majority of them organized around a framework developed by a task force on management effectiveness of the World Commission on Protected Areas (Hockings et al., 2000). Many governments and conservation organizations, including TNC, have developed a wide array of different assessment methodologies, and have already implemented hundreds of assessments worldwide[19].

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[18] Categories V and VI involve much broader areas and more intensive resource management, and therefore will be captured under stewardship measures.

[19] WWF, for example, has implemented it's RAPPAM methodology in 822 protected areas across 25 countries, and its Tracking Tool scorecard in 206 protected areas across 37 countries, and has plans to implement additional system-wide assessments in five additional countries in South America in fiscal year '06.

There is an emerging agreement among many international conservation organizations[20] that a common reporting framework (Box 16) – one that could capture the results of many different assessment types in a consistent format – would be more expedient than trying to reach global consensus on a single methodology.

In reporting on protected area management effectiveness, ecoregional teams are encouraged to use existing data where they are available, and to report the results using the common reporting framework in Box 16. At a minimum, ecoregional teams should track the management effectiveness status of major protected areas[21] that occur within all viable target occurrences (or vice versa). Where such assessments have not been conducted, TNC regional, state and country staff should take an active part in encouraging and facilitating such assessments. The degree of TNC's involvement in protected area management effectiveness assessments will depend in part not only on the availability of existing data, but also on the extent of protected areas within the ecoregion, their overlap with target occurrences, and their importance in TNC conservation strategies within the ecoregion.

Because of the complexities inherent in aggregating the elements of protected area management into a single score, two methods of ranking management effectiveness should be used in reporting on this measure. The first is a simple additive score for each protected area, based on the individual scores for each element. The second is an aggregate score of management effectiveness (very high, high, medium and low levels of confidence) within each target occurrence that considers the results of the scores of each element, as well as the specific relationship between the protected area objectives, the threats, and the viability status of the target occurrence.

This second aggregate score will be used as part of the process of defining the overall status of effective conservation within an ecoregion. Ecoregional teams should ensure that the rationale for assigning this aggregate score is clearly articulated and maintained as metadata.

[20] The following organizations are working to develop a common a framework: World Conservation Monitoring Centre, World Wide Fund for Nature, The Nature Conservancy, World Commission on Protected Areas and World Bank, IUCN, InterAmerican Biodiversity Information Network, among others.

[21] Ecoregional teams may decide to identify and prioritize protected areas (e.g., including only those over a certain size, or of a certain type).

Box 16: Proposed framework for reporting on protected area management effectiveness

1. LEGAL STATUS
a) The PA has permanent, legally-binding status as a protected area.
b) The PA is free from disputes regarding land tenure and use rights.
c) The objectives for the protection and conservation of biodiversity are compatible with other PA objectives.

2. PLANNING
a) The management plan and planning process, including an operational plan, are adequate to enable timely and strategic management decisions and actions.
b) The inventory of natural resources is adequate to enable the protection and conservation of key biodiversity elements.
c) Participatory processes are adequate to ensure full and timely dialogue with key stakeholder groups, including indigenous groups.

3. RESOURCES
a) The PA has adequate human resources to conduct all critical management activities.
b) The PA has adequate funding to conduct all critical management activities.
c) The PA has adequate infrastructure and equipment to conduct all critical management activities.

4. MONITORING
a) Research needs for monitoring and assessment are identified and prioritized.
b) Monitoring and assessment activities enable the identification of major trends and threats.
c) The results of monitoring and assessment are adequately and routinely incorporated into management plans and annual work plans.

5. UTILIZATION OF PA RESOURCES
a) Recreational and visitor activities within the PA are consistent with the PA's biodiversity objectives, and protect key biodiversity elements.
b) Harvesting activities are consistent with the PA's biodiversity objectives and protect key biodiversity elements.
c) The demarcation of land use zones within the PA is adequate to ensure the protection of key biodiversity elements.

6. IMPLEMENTATION OF CRITICAL MANAGEMENT ACTIVITIES
a) Law enforcement activities are adequate to detect, prevent and abate major illegal threats.
b) Threat detection, prevention and mitigation activities are adequate to ensure the protection of key biodiversity elements.
c) Conservation activities (e.g., prescribed burning, site restoration) are adequate to maintain natural processes and protect key biodiversity elements.

In addition, the framework includes space for recording threats to protected areas, which may include the threats listed in Box 9, as well as well as finer-scale threats.

The area, type and management effectiveness of protected areas provides a substantial but incomplete picture of the overall status of protected areas[22]. By intersecting these data layers with biodiversity layers, such as target occurrences, a clearer picture of the representativeness and overall effectiveness of the protected area system will emerge. Such analyses, often called 'gap assessments,' can be conducted using the recommended ecoregional status measures, and can be an important contribution to ongoing gap assessments that TNC is already engaged in.

More specific questions related to protected area design, layout and management practices are the purview of more intensive site-level assessments, and more general questions related to protected area policies are the purview of policy-level reviews. Neither of these are included in the ecoregional status measures, but both may be appropriate additional measures within an ecoregion or region.

Reporting on stewardship area status

Stewardship areas are areas of land or water whose management or tenure provides demonstrable benefits to biodiversity, but whose legal status is not typically defined as a protected area. As with protected areas, stewardship areas provide a degree of confidence in, rather than a direct measure of, the effective conservation of biodiversity. In order to be included in ecoregional measures, a stewardship area must a) be spatially explicit, b) be clearly related to the viability or threat status of a target occurrence, and c) have a status or tenure of least five years.

In reporting on stewardship measures, the amount, type and degree of stewardship area within each target occurrence should be tracked. Although TNC has long engaged in strategies related to stewardship areas, such efforts have not been systematically tracked. The proposed scheme for tracking stewardship areas, which is closely related to the Conservation Measures Partnership's "Conservation Action Taxonomy," is currently under development, and will be further refined during the coming fiscal year (see Box 17).

[22] See Ervin, 2003a for a summary of additional types of protected area assessments.

Box 17: Types, examples and proposed ranking system for stewardship areas

Provisional categories, definitions and examples of stewardship areas		
Category	*Definition*	*Examples*
Private, community and tribal reserves	Lands and waters owned by private individuals or companies, communities with some	• Private game ranches • Tribal lands • Indigenous extractive reserves • Set aside areas in commercial forestry operations
Independent certification of well-managed lands and water	Lands and waters that are independently certified as meeting a set of objective indicators and criteria.	• FSC-accredited certified forests • IFOAM-accredited certified organic • MSC-accredited certified fisheries • Certified rangelands • Certified agricultural products (e.g., shade grown)
Leases, tax incentives and temporary easements	The temporary restriction of rights on lands or water through financial mechanisms	• Purchase of forest harvesting, and other rights • Leasing of submerged lands • Private floodplain leasing • Current use tax enrollment program for forest management • Payment for ecosystem services (e.g., water catchment area protection)
Voluntary practices, cooperatives and agreements	Public and/or private individuals or groups complying voluntarily to manage resources for biodiversity	• Cooperative forestry associations (e.g., Coverts) • Cooperative grazing groups (e.g., Milpai Borderlands group)
Place-based laws and policies	Laws and policies that are geographically based and either prevent future threats from occurring or increase viability of targets	• Elevational zoning restrictions that prohibit development • Green space/open space • Water flow management policies • Riparian buffer area requirements
Proposed system for ranking/scoring stewardship areas The ranking system should include an assessment of the degree to which the following issues are addressed in the stewardship program: a) presence of a management plan; b) permanency and timeframe of enrollment; c) presence of written/legal contractual relationship; d) degree of oversight or enforcement; and e) scope and extent of biodiversity benefits afforded by the stewardship program. Further guidance for scoring stewardship areas will be forthcoming in early FY '06.		

Because of the nuances of varying stewardship programs, and their sometimes indirect relationships with the viability and threat status of target occurrences, two methods of ranking ranking stewardship areas should be used in reporting on this measure. The first is a simple additive score for each stewardship area, based on the individual scores for each element. The second is an aggregate score of stewardship area (very high, high, medium and low levels of confidence) within each target occurrence that considers the type of stewardship program and its specific relationship to the target occurrence.

This second aggregate score will be used as part of the process of defining the overall status of effective conservation within an ecoregion. As with the aggregate score for protected area management effectiveness, ecoregional teams should ensure that the rationale for assigning this aggregate score is clearly articulated and maintained as metadata.

Until guidance on scoring stewardship areas is finalized, ecoregional teams and regional science staff working on ecoregional measures should identify the range of programs that could apply within their regions, assess the availability of data, and begin tracking the distribution and area of such programs. The 'strategies' field of the newly created 'conservation project inventory' can aid the identification of potential programs that TNC is already engaged in, as can TNC's 'Developing Strategies Group.' Central TNC staff will also be working with national and international programs (e.g., Forest Stewardship Council) to enable more efficient and comprehensive access to data regarding stewardship areas.

Enabling conditions

Enabling conditions are the set of environmental circumstances within which effective conservation is likely to take place. Enabling conditions include, for example, conservation financing, conservation-related laws and policies, governance, and conservation capacity (see Box 18).

While enabling conditions do not directly apply to target occurrences, and therefore are not an integral part of defining effective conservation status, they are important preconditions that enable effective conservation actions to take place, and should be tracked at an ecoregional, rather than target, level. Box 18 outlines some preliminary thinking on enabling conditions. Further research and development on this measure will be conducted during the coming fiscal year.

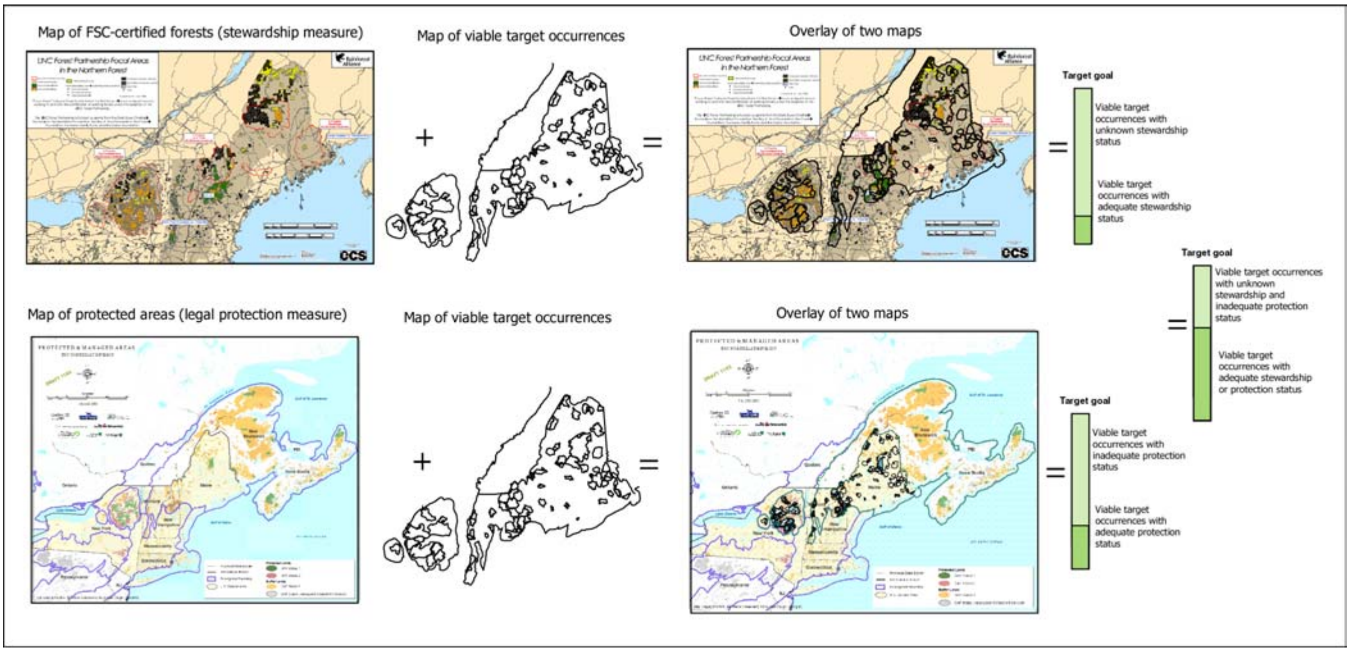
Box 18: Preliminary guidance on tracking enabling conditions

Preliminary categories for enabling conservation conditions			
Conservation financing	*Conservation laws and policies*	*Governance*	*Conservation capacity*
• State licensing, fees and other mechanisms for conservation financing • Conservation funds dedicated to land/water protection (e.g. Legacy fund, municipal conservation funds)	• Land use planning laws and policies • Resource extraction laws and policies • Land tenure policies • Protected area policies	• Law enforcement • Governmental stability	• NGO environmental sector capacity (e.g., local land trusts) • Social capital • Local citizen planning efforts (e.g., cross-boundary watershed groups) • Civic planning groups

The basic recommendations for reporting conservation status within an ecoregion are as follows:

a) the area, type and management effectiveness of protected areas within each viable target occurrence (or occurrences within protected areas)
b) the area, type and degree of stewardship areas within each target occurrence
c) the total amount, type, distribution and management effectiveness of protected areas within the ecoregion
d) enabling conditions within the ecoregion

Box 19: Spatial example of reporting conservation status in the U.S. portion of the Northern Appalachian Ecoregion



Box 20: Tabular example of reporting conservation status

System target and occurrences	Category I			Category I			Category I			Category I			Stewardship		TOTAL
	%	Mgmt. Eff.		%	Mgmt. Eff.		%	Mgmt. Eff.		%	Mgmt. Eff.		%	Synthetic score	
		Additive score	Synthetic score		Additive score	Synthetic score		Additive score	Synthetic score		Additive score	Synthetic score			
Montane wet meadow															
Occurrence 1	0.53	32	V. high	0	n/a	n/a	0	n/a	n/a	0	n/a	n/a	0.21	V. high	V. High
Occurrence 2	0	n/a	n/a	0.25	n/a	n/a	0.1	24	High	0	n/a	n/a	0.34	Moderate	V. High
Occurrence 3	0	n/a	n/a	0	n/a	n/a	0	n/a	n/a	0	n/a	n/a	0	n/a	Nil
Occurrence 4	0.15	17	Low	0.25	18	Low	0	n/a	n/a	0	n/a	n/a	0.35	High	High
Montane dry grasslands															
Occurrence 1	0.72	36	V. high	0	n/a	n/a	0	n/a	n/a	0	n/a	n/a	0	n/a	V. High
Occurrence 2	0.34	22	High	0.15	28	High	0	n/a	n/a	0	n/a	n/a	0	n/a	Moderate
Occurrence 3	0	n/a	n/a	0	n/a	n/a	0.25	17	High	0	n/a	n/a	0.15	High	High
Occurrence 4	0.15	24	High	0.25	37	V. High	0	n/a	n/a	0	n/a	n/a	0.32	High	V. High