❖Standard 10: Conduct an analysis of the severity and geographic scope of threats to conservation targets/biodiversity elements and their occurrences, and analyze the root causes of priority threats. [plan]

Rationale

The type, source, severity, and scope of threats drive portfolio design, strategy development and conservation actions. Threat prevention and abatement are keys to securing biodiversity. Updated analyses of threats are critical to evaluate the dynamic landscape to better inform conservation actions and opportunities, and offer a critical indicator of the status of threats to biodiversity and degree of success of our conservation actions.

Recommended Products

- List of dominant threats to each conservation target or to groups of targets.
- Analysis (including maps and database) of the severity (degree of impact to target viability) and the geographic scope (distribution) of the threat to target occurrences.
- Descriptive narrative or schematic diagram of the root causes, or driving forces to dominant threats across the ecoregion linking them to biodiversity elements/targets and their occurrences.

GUIDANCE

A threat is an anthropogenic source and/or action that decreases the potential for biodiversity to persist. Threats are generally partitioned as sources (direct threat, proximate pressures), stresses, and underlying causes (root causes). Understanding patterns and trends of threats to biodiversity are necessary to define viability, portfolios/biodiversity visions, strategies and geographic priorities for implementing them, and assessing conservation success.

Ecoregional assessments cannot pragmatically define every source, stress and root cause of threats to every occurrence of biodiversity targets/features. More in-depth information on threats should be collected and analyzed when working on specific conservation projects. However, experiences over the past decade have taught us that better threats assessment strengthens our ability to evaluate biodiversity status and inform conservation actions. The level of sophistication in threats assessments will vary greatly depending on available information, time and resources. In most cases, ecoregional assessments will focus on the source of threat since this information is the most readily available. For instance, land use/cover data indicate patterns of agriculture, roads and urban areas however, it is difficult to quantify the stresses (how much sediment and nutrients are coming off of the agricultural lands, how much are roads affecting stream hydrology and fish passage, etc.) from these data. Ecoregional assessments are therefore an initial evaluation of the threats to biodiversity, not the ultimate one.

Historically, threats assessments at the scale of the ecoregion, have focused on informing strategies and priorities for conservation actions (see Groves 2003). In addition to this, we should consider threats during the development of the portfolio itself because threats affect the viability of a target occurrence. In ecoregions where there are multiple options for places to "capture" the same quality of occurrences of targets, the ones with the lower threats are more viable, as they have higher potential to exist for longer periods of time without preemptive actions. One way to incorporate threats in portfolio design is to include them as a cost factor in optimization software for developing portfolios.

Assessing threats over time is necessary to assess the impact and progress of conservation actions. This informs adaptive management, allowing us to change and improve strategies, and the geographic priorities of strategies. It also provides a solid measure of conservation progress in abating threats. (See Measures standard).

To evaluate the scope and severity of threats and understand their causes, we need to:

- Organize information on threats
- Use multiple sources of threats Information
- Describe or diagram the source (root cause) and stress of threats

Organize information on threats

We use information on threats to inform target occurrence viability, portfolio design/biodiversity vision, strategies, priorities for actions, and the assessment of the effectiveness of conservation actions. Information on threats should be organized by conservation targets, conservation target occurrences, spatial units being used for portfolio design, and areas of biodiversity significance.

<u>Conservation Targets</u>
In order to determine whether something is a threat, we need to establish that it affects conservation targets and the key ecological factors necessary for their persistence. This precludes focusing on things that are not threats. This also allows the sorting of the types of threats by conservation target to provide clarity when assessing the spatial patterns of threats to target occurrences and areas of biodiversity significance. Since all taxa are not responsive to the same types of threats, we need to understand which threats are affecting which targets where, and why.

Depending on the number of conservation targets, we can evaluate targets individually or by groups that have the same or similar key ecological factors necessary for persistence. Grouping species targets by taxa and guild (e.g. wading birds, diving birds, migratory freshwater fishes, gravel spawning freshwater fishes etc.) is a good way of organizing biodiversity and threats, and provides a fairly simple way to identify key ecological processes affected by threats. Communities and ecological systems can be grouped by key ecological processes that sustain them, such as those that depend on regular fire, annual flooding, salinity gradients, etc.

Conservation Target Occurrences

We would like to know the threats to conservation targets everywhere they occur. All occurrences of a specific target do not necessarily share the same suite or severity of threats. Comprehensive information on threats generally does not exist for every target occurrence. Some species targets, ecological community targets, and all ecological system targets are represented spatially, and many of the dominant threats can be assessed using spatial information. However, there are some dominant threats that cannot be spatially represented, and other sources of information should be used to characterize threats to occurrences when data are available and it is deemed necessary.

Spatial Units being used in ecoregional portfolio design

Optimization programs require a consistent spatial unit to evaluate patterns of target occurrences and threats. Hexagons and watersheds are the most common polygons that are used. The types and numbers of conservation targets, and threats are attributed to the polygons. Because of the vast number of polygons used in optimization programs, these analyses are generally limited to spatial threats data. While indirect and limited, it is a way of evaluating patterns of certain threats to target occurrences.

Areas of Biodiversity Significance

Once a portfolio/biodiversity vision has been generated, the types and severity of threats should be summarized by areas of biodiversity significance. This summary should include all sources of information available. Caution should be taken in limiting the analyses of spatial threats data to only the overlap with areas of biodiversity significance. Threats may originate outside these areas, such as sedimentation from upstream that can affect downstream freshwater and marine targets.

Time Frames

Threats should be partitioned into current threats and future threats. Current threats are already taking place, and are a component of condition analyses. A future threat is any threat that is likely to begin or continue in the future, or is likely to intensify in scope and/or severity and could potentially result in the transformation of a target occurrence from viable to nonviable. While we have not had much experience at forecasting future threats, categorizing them by time frames that are informative and correspond to time frames for new data analyses or ecoregional assessment iterations is important. For future threats, we suggest these as initial categories, while finer categories can be used as well:

- 1-3 years in the future
- 3-10 years in the future
- >10 years in the future

Use multiple sources of threats Information

Information on the type and level of threat can be obtained through experts, existing databases and reports, and spatial data. Expert information on threats to targets and areas of biodiversity significance can be gathered during portfolio design by asking experts to list the top threats to the biodiversity targets and key ecological factors at each portfolio site as they are being suggested or reviewed for inclusion in the portfolio (see CTPE case study). This approach allows for analysis of types and scope of threat, with identification of the most severe threats to each area and target in the portfolio.

Information on threats to targets, specific occurrences and areas can be gathered from literature, reports and databases. IUCN, Natural Heritage Programs, NatureServe, Conservation Data Centers and government agency sources are good initial sources of information.

Spatial data used to assess threats often include land use/cover, roads, population densities, point sources of pollution, dams, and resource extractions. Spatial data on threats can be obtained from many sources (see Resources). Such spatial data are used as part of the cost surface in developing a portfolio. A method has been developed by WCS that combines many of these data and others, culminating in the "human footprint" (http://www.wcs.org/humanfootprint). While this product was developed from 1:1,000,000 scale data that may be outdated for some regions of the world, it is a useful method to develop a cost surface for portfolio development.

Models of scenarios of dominant current threats as well as future threats are warranted. These models can inform ecoregional portfolio design as well as prioritization and strategies for actions once a portfolio is designed. Methods for using potential amount of environmental change from climate change are being developed and applied to create alternative future portfolio designs. Population growth and associated impacts to biodiversity have been modeled and applied to setting priorities and developing strategies for a portfolio (see Gorenflo 2002, Theobald 2003). Another approach to identifying future threats is to evaluate the spatial distribution of valuable natural resources that are not currently being tapped, although economic drivers and infrastructure development are making threats from resource extraction more likely. Examples include mining, oil and gas extraction, grazing, logging, water diversions, dams, and wind energy development. . Examples of threat forecasting within TNC can be viewed here.

Describe or diagram the source (root cause) and stress of threats

Strategies to abate threats should address their root causes. We often address the stresses associated with threats and not the root causes. This is like addressing the symptoms of an illness and not the underlying cause. Root Cause Analysis is an analytical method employed to determine: 1) What are the underlying policies, institutional dynamics, market forces and human actions driving the direct causes which lead to biodiversity loss? 2) How are these direct and root causes interlinked? 3) which factors are key at local levels, which at regional levels, and which at national or international levels (WWF 2001)? WWF has developed the *Analytical Approach* to identify root causes of biodiversity loss (see tools and resources).

Creating a model of the stresses and underlying sources of stresses provides necessary insight or conservation planners to identify the appropriate foci of strategies.

Key Steps:

- Conduct a search of information on the types and general patterns of threats to conservation targets in the ecoregion. Summarize threats by targets and/or groups of targets with similar key ecological factors.

- Identify the most severe current and future threats. Identify the sources and formats of information that are readily available for these threats and identify gaps that can be filled through surveying experts or derivation from existing information. Identify information needs to develop models of future threat scenarios.

- Identify the type, relative severity, scope and time frame of threats to targets, target occurrences and spatial units being used for analyses in the ecoregion. Use information on existing threats and models of future threats. Since it is difficult to define meaningful quantified thresholds for threats, qualify general categories from expert information, or quartiles/quintiles of densities of spatial attributes to provide relative level of impact.

- Define the type of threat using the Taxonomy of Direct Threats developed by the Conservation Measures Partnership. (A taxonomy of threats in a given ecoregional assessment might be more detailed than the one presented here, but at a minimum a crosswalk to the categories presented should be conducted.) This taxonomy is being used to describe threats to biodiversity at the project level as well. Using a consistent taxonomy among projects and ecoregional assessments will enhance rolling up information on threats from projects to ecoregions to major habitat types.

- Analyze severity of threats to spatial units (if being used for portfolio design) across the ecoregion for developing portfolios. An ecoregional-wide assessment of all units is used to help select areas that have the lowest levels of threats (when there are options) to be included into a portfolio.

- Analyze the relative severity of threats among areas of biodiversity significance in the portfolio/biodiversity vision. This step is separate from the previous one because these areas are often different spatial polygons than the initial ones used to assess the broader patterns of threats across an ecoregion. Areas of biodiversity significance are generally places that are affected the least by threats within the ecoregion. Understanding the relative ranking of threats among these areas informs strategy development and priorities for actions.

    Suggested categories for severity include:

    VERY HIGH (Impact from threat will cause destruction of the target, or represents highest quartile)

HIGH (Impact from threat will cause significant degradation of the target, or represents second quartile)
MODERATE (Impact from threat will cause some or uncertain degradation of target, or represents third quartile)
LOW (Impact from threat will have a slight impact on targets, or represents fourth quartile)

- Evaluate the scope (distribution and abundance) of threats and their severity to the target occurrences and areas comprise the portfolio/biodiversity vision. Scope of threats should be summarized spatially and in tabular format.

Suggested categories for scope include:

WIDE SPREAD (>50% of the occurrences or areas of biodiversity significance are affected by the threat)
COMMON (10-50% of the occurrences or areas of biodiversity significance are affected by the threat)
LIMITED (<10% of the occurrences areas of biodiversity significance are affected by the threat)

- Evaluate the time frame of threats. This is a component of urgency, although the urgency of threats can be further informed by their likelihood and potential impact.

Suggested categories for time frame include:

CURRENT: existing to 1 year in the future
FUTURE: 1-3 years in the future
FUTURE 3-10 years in the future
FUTURE >10 years in the future

- Develop scenarios of important future threats and evaluate their potential scope and severity to inform portfolio design and priorities for conservation actions among them. Describe the level of confidence in the models or variability in model outcomes.
- Describe or develop schematic models of the root causes of the most widespread and severe threats. (See Ratsifandrihamanana article in resource section).
- Conduct iterative assessments of threats when new data are available and there are indications that significant changes in patterns of threats have occurred, or it is determined by a programmatic need.

OPPORTUNITIES FOR INNOVATION

Evaluations of threats in ecoregional assessment have focused primarily on informing priorities for actions. Threats are also used to define viability, as a cost surface in designing portfolios, inform strategies and evaluate conservation success. Further descriptions of the relationships of threat sources, stresses and root causes would greatly enhance the understanding of the nature of threats, better inform the development of strategies and monitoring the effects of conservation actions. The link between threats to an area of biodiversity significance, and conservation target occurrences needs to be evaluated. The relationships between spatial data and threats should be scrutinized. Are we measuring what we think we are? We are limited in our ability to quantify the severity of threats to categories based on the relative density of threats. The thresholds of categories are not based on biological responses to threats, as this information is generally not known. Thresholds may or may not exist, and biological responses to threats may or may not be linear. Research on biological responses to threats needs to continue to better characterize the severity of threats, and to better inform programmatic goals for threat abatement.

CASE STUDIES

- Assessment of Threats to the Marine Biodiversity of the Caribbean Using Expert Workshops. The assessment of threats to biodiversity priority areas in the Caribbean was determined by experts in a workshop setting. Experts were asked to rank current threats, the persistence of threats to specific seascape and integrity features and future threats. Results were summarized in a web-based report and interactive map and were used to inform priority actions.

- The Use of Experts to Assess Threats to Aquatic Targets in the Central Tallgrass Prairie. Threats to coarse and fine filter targets were identified by experts at a workshop. Experts provided a rank order of major stresses and sources of stress as well as an urgency rating and suggestions for management. A worksheet is provided to assist experts in the process.

- Tennessee/Cumberland Freshwater Ecoregion Threats to areas of biodiversity significance were documented to inform site based and regional strategy development. Information was summarized by area of biodiversity significance, ecoregion and region (all four ecoregions). The World Wildlife Fund, US and TNC conducted additional spatial analyses to display patterns of sources of stress to the areas of biodiversity significance to inform strategy development.

- Examples of threat forecasting from The Nature Conservancy. A one page document summarizing three examples of forecasting future threats for Ecoregional Assessments.

- Root Cause Analysis of Threats. Provides an overview of root cause analysis as employed by WWF during the ecoregion conservation process to help understand threats to biodiversity conservation and the root cause of those threats.

- Analysis of critical threats in the Vildivian Temperate Rainforest. An ecoregion conservation team conducted a detailed analysis of pervasive threats in the Vildivian Temperate Rainforest. The five top threats to biodiversity in this region are: conversion to plantations, extraction of firewood, extraction for timber, anthropogenic fire and overgrazing.

TOOLS

General/terrestrial

Socio-Economic Buffer Analysis ArcView Extension is a ArcView 3.x script designed to examine the socioeconomic factors affecting a particular target.

A population simulation model written in BASIC language and used to measure the threat posed to small populations by environmental variability and infrequent catastrophes. Model text can be found in Appendix 4 of Cox et al. 1994.

Conventions for Defining, Naming, Measuring, Combining, and Mapping Threats in Conservation: An Initial Proposal for a Standard System. Salafsky et al. (2003). Foundations of Success at www.fosonline.org

Proposed Taxonomy of Direct Threats by the Conservation Measures Partnership. Version: June 13, 2005.

Users Guide to Assessing the Socio-Economic Root Causes of Biodiversity Loss by WWF's Macroeconomics office is a guidance document describing an approach to Root Cause Analysis.

Freshwater

Guide to information for assessing quality of and threats to biodiversity of freshwater systems. DePhilip, M. (1999). Chicago, IL, The Nature Conservancy.

Marine

Reefs at Risk: Bryant, D., L. Burke, et al. (1998). Reefs at Risk: A map-based indicator of potential threats to the world's coral reefs, World Resources Institute: 56.

RESOURCES

Websites

Sustainable Waters Program has information on freshwater threats and assessment tools at www.freshwaters.org

NatureServe's central information on habitats and ecological needs is posted species by species on the North American web site at http://www.natureserve.org/explorer/

Nonindigenous Aquatic Species information resource website serves as a repository for accurate and spatially referenced biogeographic accounts of nonindigenous aquatic species. http://nas.er.usgs.gov/

GIS data on the Human Footprint. www.ciesin.columbia.edu/wild_areas/

Root Cause Analysis is a method for identifying threats developed by WWF. Provided here is a case study by Ratsifandrihamanana from Madagascar. Also see fig.1 and fig 2.

Fishbase is a web-based database with extensive information on ecological needs of fishes. Visit www.fishbase.org.

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