



Measure Development Summary

Conservation Status

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Revision History

Revision #	Date	Revision Summary	Revised by
0.1	20080915	Initial version	John Gross
0.2	20081013	Additions, edits, name change	Leona Svancara
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Background and Justification

The conservation status (ownership, stewardship, and use) of land surrounding parks can have profound impacts on resources (GAO 1994; Hansen et al. 2005). Impacts – positive or negative – can be driven by a number of different mechanisms within general categories of changes in the effective size of reserves, changes in ecological flows, loss of critical habitat, and increased exposure to humans (Hansen and DeFries 2007). Within each category, Hansen and Defries (2007) distinguished the types of mechanisms that drive changes, such as species area effects, trophic structure, migration habitats outside parks, and hunting and poaching. A common feature of these effects is that they are known or strongly postulated to be directly related to land use intensification. While it can be difficult to directly measure impacts, several broad-scale data sets can provide important information to evaluate the likely condition of parks, and current or likely threats to park resources.

The impacts articulated above may originate directly from the behaviors of humans (e.g., poaching), or indirectly from the infrastructure used to support humans (e.g., roads). There is utility provided by data on both direct and indirect impacts, and from a variety of measures or metrics currently in use.

As an example, changes in land use and stewardship near and adjacent to parks is important for assessing current threats and impacts, and for evaluating how the situation around parks might change in the future. Globally, Hoekstra et al. (2005) examined broad scale patterns of habitat conversion and protection (stewardship) and used the ratio to estimate a ‘Conservation Risk Index’ and help identify biomes that were at greatest risk. Svancara et al. (1999) have applied this index to counties within the coterminous US to identify counties surrounding National Park Service units and National Wildlife Refuges most at risk.

Information on the ‘context’ of parks is important to evaluate not only the current status of parks, but also to identify potential threats and key conservation opportunities.

Monitoring Questions and Objectives

Information on context is useful from local to national scales and key for linking across scales. Monitoring questions are thus stated in a general form, recognizing that refinements are necessary to clarify the desired objectives, the area of analysis, and suitable comparisons. General questions include:

- What percent of lands surrounding my park are protected and what does this say about future risks to resources?
- In which biomes/ecoregions/divisions are park units potentially most at risk?
- What is the spatial relationship of my park boundary with surrounding protected areas and converted lands?

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- For what parks does the current conservation status of surrounding lands provide the best conservation or education opportunities? Conversely, which parks appear to be most at risk?

Anticipated Inferences and Uses

- Provide information necessary to assess conservation status of lands surrounding parks.
- Provide basis for estimating changes protection status and land conversion over time.
- Serve as base data for estimating conservation risk.
- Reveal opportunities for cooperative management, conservation, and education.
- Provide context for evaluating conservation status among regions of the country.

Metrics

Percent Protected

Protected areas are often seen as the primary means of conserving biodiversity. Calculating the percent of land area protected provides an indication of conservation status and offers insight into potential threats (how much land is available for conversion and where is located in relation to the park boundary) as well as opportunities (connectivity and networking of protected areas).

Percent protected is calculated as area of land protected divided by the total area of land. Open water may or may not be included in the total, depending on the management status and jurisdiction of the water which, often times, is not actively owned or managed by any one entity. Various combinations of the metric can be used to gain insights into the protection status of various species and habitat types, as is done with the gap analysis process (see Scott et al. 1993).

While generic, *a priori* targets of 10 and 12 percent protected land are often seen as conservation goals for political entities, values based on scientific evidence are nearly three times as high (Svancara et al. 2005). Setting quantitative conservation targets can have utility, but those targets need to be informed by conservation planning processes based on the biological needs of species, communities, and ecosystems. In addition, social and economic constraints may apply.

Percent Ownership

Land ownership and stewardship often dictate and direct potential changes in land use. Identifying the percent of land area owned and managed by various entities near and adjacent to parks is important for assessing potential current threats and impacts, and for evaluating how the situation around parks might change in the future.

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Percent ownership is calculated as the area of land within each of the broad ownership categories divided by the total area of land. Ownership categories will include all federal agencies (identified separately), non-federal public (for state, county, etc), tribal, and private. Open water may or may not be included in the total, depending on the management status and jurisdiction of the water which, often times, is not actively owned or managed by any one entity.

Conservation Risk Index

The Conservation Risk Index (CRI) (Hoekstra et al. 2005) represents a comprehensive measure of whether particular land units (e.g., states, counties) protect their natural environments on the same scale as those it converts.

CRI is calculated as the percent area converted to the percent area protected. It requires the use of 2 datasets: 1) land cover/land use from which the amount of converted land can be obtained (e.g., NLCD) and 2) management status from which the amount of protected land can be obtained (e.g., PAD). Percent protected land is typically defined as those lands with GAP management status 1 or 2. Calculating the percent converted land typically requires aggregating the original land cover/land use data to broad ‘converted’ versus ‘natural’ categories as is shown in Table 1 for the 2001 NLCD.

A GIS is used to overlay the protected area data with the converted lands and calculate area summaries. Calculating the ratio can easily be done in a GIS, statistical package, or spreadsheet program.

Table 1. Example aggregation of 2001 NLCD for calculating percent of land converted.

General Category	NLCD Classes (class number)
Converted	Low intensity developed (22), Medium intensity developed (23), High intensity developed (24), Open space developed (21), Pasture/hay (81), Cultivated crops (82)
Natural	Grassland/herbaceous (71), Shrub/scrub (52), Mixed forest (43), Evergreen forest (42), Deciduous forest (41), Barren land (31), Perennial ice/snow (12), Woody wetlands (90), Emergent herbaceous wetlands (95), Open water (11)

The CRI is most easily interpreted as for every acre (hectare) converted, “x” acres are protected. For example, in Edmonson County, KY the area outside of Mammoth Cave NP is 35% converted with only 0.8% protected (based on the 2001 NLCD and 2006 PAD data) resulting in a CRI of 44 (see Svancara et al. in review). So, for every 35 acres that have been converted outside the park, only 0.8 have been protected. In contrast, lands outside of Craters of the Moon National Monument and Preserve in Blaine County, ID are 5% converted and 21% protected resulting in a CRI of 0.2. In this county, for every 5 acres converted, 21 have been protected.

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Hoekstra et al. (2005) further classifies areas with >20% conversion and CRI >2 as 'vulnerable,' those with >40% conversion and CRI >10 as 'endangered' and those with >50% conversion and CRI > 24 as 'critically endangered.' Combining this information with the percent urban area and human population change can help identify potential conservation and educational opportunities (see Svancara et al. 2009).

Various modifications can be calculated to assess the potential risks from agriculture (percent agriculture to percent protected) and urban (percent urban to percent protected) separately. Similarly, multiple-use lands (GAP status 3) can be assessed separately from those traditionally considered protected (GAP status 1, 2) depending on the question being addressed.

The CRI assumes that every land unit has at least a portion of its area under protection, if not the index will divide by zero. Two options are available for addressing this issue: 1) assign an extremely low value for the percent protected (e.g., 0.0001%) for those areas lacking protection or 2) calculate the inverse of the CRI. Doing the latter requires reversing the interpretation described above and makes the assumption that at least a portion of the land unit is converted.

Issues and Assumptions

In addition to the issues and assumptions identified in the land cover/land use MDS, the following apply:

- GAP only identifies private land as a single homogeneous category and does not differentiate individual private land units, owners, or management status, unless the information was provided voluntarily (typically to recognize a long-term commitment to biodiversity through binding conservation easements, covenants, or institutional dedication).
- State GAP products are not necessarily consistent across state lines. Therefore, the PAD may also be inconsistent. Regional GAP products are developed across multiple states to alleviate this issue but, there may still be inconsistencies between regions.
- The CRI assumes that every land unit has at least a portion of its area under protection, if not the index will divide by zero. See discussion above.
- The described process does not account for land units smaller than the minimum mapping unit (MMU) of either of the input datasets and is valid only at the point in time that the data were acquired. In addition, as with all spatial analyses, inaccuracies in the input data will multiply in the output.
- Calculating the proportion of area in any manner is always a function of the sampling unit being measured (e.g., county, biome, grid cell size) and must be interpreted within that context.

Development Schedule and Interim Products

Further work is needed to define base layers for analysis and metrics that are best evaluated. Work on this MDS will likely begin in late 2008, with key decisions at the end of 2008 or early 2009.

Products for all counties in the coterminous US are available from Svancara et al. (2009). These include percent protected (based on a modified version of PAD4), converted (based on NLCD 2001) and CRI as well as various modified versions specifically for urban and agricultural areas as well as multiple-use (GAP status 3) lands.

Data Descriptions

Data Availability

Data on land use (conversion) is available at several scales from multiple sources. Those consistently available at regional and national scales include:

- National Land Cover Data
- LANDFIRE
- Gap Analysis Program (GAP)
- NatureServe Ecological Systems
- NOAA Coastal Change Program (C-CAP)
- National Agricultural Statistics Service (NASS)
- National Resources Inventory (NRI)
- Waisanen and Bliss (2002)

Additional information on each of these can be obtained from the Land Cover Land Use MDS.

Data on land ownership, stewardship, and management status may be available at local scales in some areas, but for regional to national assessments the only sources are:

- Gap Analysis Program (GAP)
- Protected Areas Database (Conservation Biology Institute 2006)
- Protected Areas Database – US (version 1)

Gap Analysis Program (GAP)

Land stewardship is one of the three main data layers developed and used by the Gap Analysis Program (GAP) (for additional information see GAP 2007). In GAP, land stewardship combines attributes of ownership, management, and a measure of intent to maintain biodiversity. The term “stewardship” is used in place of “ownership” in recognition that legal ownership of a land area does not necessarily equate to the entity charged with managing the resource, and that the mix of ownership and managing entities is complex and can change rapidly. At the same time, it is necessary to distinguish between stewardship and management status in that a single land steward, such as a national forest, may contain several degrees of management for biodiversity. In

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developing the stewardship layer, three primary pieces of information are incorporated: 1) geographic boundaries of public land ownership (and voluntarily provided private conservation lands [e.g., TNC preserves]), 2) the manager/owner attributes of each mapped land unit, and 3) the biodiversity management status rank of each mapped unit.

GAP currently uses a scale of 1 to 4 to denote the relative degree of management commitment to the maintenance of biodiversity for each land unit ('status'). A status of "1" denotes the highest, most permanent level of commitment, and "4" represents the lowest level or unknown status. In assigning status, the gap analysis process follows certain principles. The first principle is that prescribed management, not land ownership, is the primary determinant in assigning status. The second principle is that while data are imperfect, and all land is subject to changes in both ownership and management, the intent of a land steward as evidenced by legal and institutional factors can be used to assign status. The criteria used in assigning a ranking include:

- Permanence of protection from conversion of natural land cover to unnatural (human-induced barren, arrested succession, cultivated exotic-dominated).
- Relative amount of the land unit managed for natural cover, with 5% allowance for intensive human use.
- Inclusiveness of the management (i.e., single feature or species versus all biota).
- Type of management (e.g., suppresses or allows natural disturbance) and degree that it is mandated through legal and institutional arrangements.

Using the above criteria, the four biodiversity management status ranks can generally be defined as follows (after Scott et al. 1993, Edwards et al. 1994, Crist et al. 1996):

Status 1: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.

Status 2: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.

Status 3: An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining). It also confers protection to federally listed endangered and threatened species throughout the area.

Status 4: There are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent

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conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.

Status 1 and 2 lands are those considered “protected” and on which GAP bases its analysis of species and habitat protection.

GAP program standards are to map stewardship to a minimum mapping unit (MMU) of 40 acres/16 ha (quarter-quarter section) or smaller. This is based on the Public Land Survey System (PLSS), which dominates the land ownership patterns in the western US, and therefore has some western bias. Most state and regional GAP programs actually map to a much smaller MMU (e.g., Idaho used 2 ha).

As of this version, GAP stewardship data are available online for all states (Alabama is provisional) and Puerto Rico, but not for other Pacific and Caribbean Islands. GAP data are freely distributed through the GAP NBII portal (http://gapanalysis.nbii.gov/portal/community/GAP_Analysis_Program/Communities/GAP_P_Home/). (Note: the Alabama data are currently only available on the Alabama GAP website but will be moved to the NBII portal when no longer provisional). Dates of the data vary by state and region as do revisions or updates. Regional GAP products representing updates to the state-level analyses are available for the Southeast (KY, VA, TN, NC, SC, GA, AL, MS, FL) and the Southwest (NV, UT, CO, AZ, NM). The Northwest (WA, OR, ID, MT, WY) Re-GAP will have draft stewardship data available winter 2008. Updates efforts for the Northeast and California are pending.

Protected Areas Database (Conservation Biology Institute 2006)

In an attempt to consistently represent protected areas in the coterminous US, Alaska, and Canada, the original Protected Areas Database (PAD) was developed in 1999 by the Conservation Biology Institute and the World Wildlife Fund (see DellaSalla et al. 2001). It built upon the Managed Areas Database (MAD), a 1:2 million scale dataset depicting major managed areas in the conterminous US (McGhie 1996). The second (2001), third, and fourth (2006) version of PAD have focused on only the coterminous US and Alaska. Each version incorporates additional information from the state GAP data as they become available and the most current changes to agency datasets if not reflected in the GAP data. The GAP assigned management status is included.

Assembled on a state-by-state basis using existing data, PAD incorporates dozens of different source data at varying scales (though most are 1:100,000) and accuracy levels. Metadata is provided by state for each data source.

The PAD (version 4, 2006) is available through the Conservation Biology Institute Client Portal (<http://www.cbiclientportal.org/downloads/>) or by purchase of a CD-ROM.

Protected Areas Database – United States (Version 1)

Governmental and non-profit organizations are currently collaborating on a redesign process co-funded by the USGS and Doris Duke Foundation to improve the national inventory of protected areas. The result of this partnership will be the next generation of PAD, called PAD-US.

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The first soft release of PAD-US version 1.0 was released in April 2009 and, following extensive review, version 1.1 is scheduled for later in fall 2009. Additional information on PAD-US can be obtained from <http://protectedlands.net>.

Data Dimensions (spatial, temporal, thematic)

Gap Analysis Program (GAP)

- State level data available for all 50 states plus Puerto Rico
- 1:24,000 scale (Status 1 and 2); 1:100,000 scale (all others)
- Land ownership, stewardship, and management status
- Dates vary state
- Available for free from <http://gapanalysis.nbii.gov>

Protected Areas Database (PAD)

- National level data for coterminous U.S. and Alaska
- Various scale and accuracy of source data
- Land ownership, stewardship, and management status
- Dates vary by state and ownership
- Available for free from <http://www.cbiclientportal.org/downloads>

Protected Areas Database – United States (PAD-US)

- National level data for all 50 states
- Updates to, and combinations of, GAP and PAD
- Various scale and accuracy of source data
- Land ownership, stewardship, and management status
- Dates vary by state and ownership
- Available for free from <http://www.protectedlands.net/>

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