Assess landscape integrity to estimate long-term persistence of biodiversity

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OVERVIEW

This process requires that the results of the focal species analysis be incorporated into the Draft Biodiversity Vision (Chapter 3) to estimate the minimum numbers and sizes of blocks that are required within conservation landscapes to ensure their viability. The focus of the analysis is on landscape features to evaluate whether these elements can be conserved indefinitely. An analysis of area requirements must also take account of important landscape features such as special soil types, watersheds or migration staging areas, or important refugia such as caves, cliffs or lakes.

To complete the biological assessment, we need to know the amount of each habitat available. Specifically, we will consider:

- The size, shape, and configuration of remaining blocks (i.e., are they in small fragments or large patches, or both? are the patches evenly distributed or clumped?)
- The distribution of patches between montane and lowland habitats in ecoregions with elevational variation, or the adjacency of riparian and high-ground habitats
- The status of neighboring patches of habitat (how much is intact, how much is degraded)
- The degree of connectivity among habitat blocks
- The degree of fragmentation among habitat blocks
- The level of degradation and isolation
- The adjacent or intervening land use between and among habitat blocks
- The distance from habitat edges where intense hunting pressure diminishes
- The minimum sizes of blocks, and habitat elements required for natural habitats to persist in the face of extreme disturbance events (e.g., fires may completely burn through small reserves).

These data are especially important in ecoregions, because they serve as good indicators for the persistence capacity of an ecoregion's biodiversity in the face of major habitat conversion and degradation. Species distributions are strongly correlated with habitat; thus, fragmentation by human activities will provide a reliable estimate of the changes in species ranges from their original distributions to the present.

The distribution of forest patches can be determined from accurate habitat maps. Forest cover or habitat distribution maps at scales of 1:200,000 (or even coarser) are generally sufficient for evaluating intactness at ecoregion, and priority area scales. The most recent information is best suited for this purpose; use of dated information or inaccurate maps may entail the extra step of ground-truthing the information.

Extensive ground-truthing will be required for ecoregions that are nonforested or only lightly forested such as Mediterranean climate shrublands, savannas, and grasslands. We have no simple method for estimating intactness in nonforested ecoregions. Our best suggestion is to use one day of the experts' workshop to identify varying degrees of intactness among natural habitat blocks based on the collective field experience. If the categories of intactness are clearly defined and are applied evenly across the ecoregion by the experts, they will produce a useful estimation.

Evaluating the intactness of habitat is important both to conserve a representative example of biodiversity and to hold on to the last source pools for restoration of biodiversity over the next 50 years. Here, we propose a three-class system in which terrestrial landscapes are categorized as intact, altered (i.e., degraded), or heavily altered.

- Intact habitat: represents relatively undisturbed areas that maintain most original ecological processes and communities and that support most of their original suite of native species. Altered habitat represents areas that are more substantially affected by human disturbance but that still have the potential to sustain native species and processes.
- Heavily altered habitat: represents areas that have been degraded to the point of retaining little or no potential value for biodiversity conservation without long-term and extensive restoration.

These definitions were discussed, modified, and adopted during the experts workshop for the Chihuahuan Desert and can be applied to other terrestrial ecoregions. General definitions for states of intactness are as follows (Dinerstein et al. 1995):

Broadleaf and conifer forests

- Intact: Canopy disturbance through human activities such as logging is restricted to less than 10 percent of the defined habitat block. The understory is largely undisturbed by timber extraction, intensive management, or grazing. Natural fire regimes are still present. Although large mammals and birds may be absent from some blocks of habitat because of exploitation, insufficient area, or diminished resources, such blocks sustain many native communities and populations of plant, invertebrate and vertebrate species, and associated ecological processes.
- Altered or Degraded: The canopy and understory are significantly disturbed by human activities, but habitat remains suitable for some native species. Species composition and community structure are altered, and a large proportion of native species are absent but likely to return, given sufficient time for recovery and adequate source pools. Examples include large expanses of selectively logged forests; forests in which natural fires have been suppressed; areas where clearcuts are limited to between 10 percent and 25 percent of the landscape and have been patterned to facilitate natural ecological processes and recolonization; and 100-year old clearcuts that have been allowed to regenerate and contain adequate source pools for restoration.
- Heavily Altered: The habitat is almost completely altered. Substrate alteration, exotic species introduction, and distance from source pools make recovery of the

original habitat unlikely without large and expensive restoration efforts. Examples include urban and suburban development, forests converted to pastures and cropland, extensive clearcuts, and intensively managed plantation forests of nonnative species or monocultures.

Grasslands, xeric shrublands and deserts

- Intact: The habitat remains unplowed or unaltered by major changes in hydrologic patterns. The full suite of native plant species is still present in abundance within its natural range of variation. Successional patterns follow natural cycles (e.g., grazing by domestic livestock has not had a major effect on species composition or several stages). Natural fire regimes are still present. Although large mammals and birds may be absent from some blocks of habitat because of exploitation, insufficient area, or diminished resources, such blocks still sustain many native communities and populations of plant, invertebrate and vertebrate species, and associated ecological processes.
- Altered: Heavy grazing has altered dominance patterns of plant species. Some exotic species are present, and surface water patterns may be altered, but the substrate has not been disturbed or plowed. Natural fire regimes have been largely suppressed. The original habitat is likely to return with time, moderate restoration, and adequate source pools.
- Heavily Altered: The habitat is almost entirely altered by activities, such as human development, plowing, or crop cultivation. Native species are almost entirely replaced by exotics and crops. Surface water patterns have been extensively altered. Natural fire regimes have been completely suppressed. Evaluating potential for habitat restoration

A biodiversity vision should be ambitious. Thus, an effort to create conservation landscapes that allow for adequate protection and for providing the habitat area necessary for many species—especially the wide-ranging species—will often require habitat restoration. It behooves us at this stage to start thinking about which areas should become immediate targets for restoration efforts.

APPLICATION

Evaluating landscape integrity and persistence of biodiversity over the long term

In this section, we present two possible approaches for evaluating landscape integrity, especially of the candidate priority areas. These analyses are most easily and quickly carried out by experts, conservation biologists with experience in the region. The recommended approach is to use a GIS to sort the candidate priority areas into the following classes of habitat integrity listed in table 5.2, with a brief explanation of the capacity to conserve biological diversity (see also fig. 5.1). The experts will evaluate the classifications. For example, candidate areas that are considered Intact (Level 1) should consist of an unbroken, pristine habitat block that is at least as large as the minimum area required for sustaining viable populations of focal species and processes in the ecoregion. A candidate area that is ranked as Relatively Intact with Multiple Large Blocks (Level 2)

will consist of an area where several blocks of pristine habitat are two-thirds or three-fourths the minimum size necessary for sustaining the ecoregion's biodiversity.

Table 5.2. Landscape integrity categories for ranking candidate priority areas for the Integration Matrix

Level of Landscape Integrity	Examples of elements of biodiversity effectively that is conserved or lost at this level of landscape	Description
1. Intact, contiguous landscape	Conserves top predators, sensitive species, area-limited species, natural disturbance regimes	Habitat blocks greater than minimum required to sustain biodiversity in the ecoregion
2. Relatively intact landscape, multiple large blocks remain	Conserves top predators, sensitive species, area-limited species, natural disturbance regimes	At least one habitat block > ¾ minimum required to sustain biodiversity, total exceeds minimum required area
3. Relatively intact landscape, some large or medium-sized blocks remain	Maintains effective dispersal of wide-ranging species	At least one habitat block ½ - ¾ minimum size required to sustain biodiversity, high level of connectivity among habitats
4. Relatively intact landscape, multiple medium-sized blocks remain	Begin to lose populations of top predators and other area-limited species	Habitat blocks ½ minimum size required to sustain biodiversity, intermediate level of connectivity among habitats
5. Altered landscape; moderately fragmented; some large and medium blocks remain	Conserves mesopredators, continues to lose some area-limited species	At least one block > ½ minimum size required to sustain biodiversity, contains no connected habitats
6. Altered landscape, highly fragmented, some medium-sized blocks remain but no large blocks	Conserves some meso-predators, serves as population sinks for large predators	At least one block ¼ - ½ minimum size required to sustain biodiversity, contains no connected habitats
7. Altered landscape, highly fragmented; mostly small blocks remain,	Conserves populations of plants; invertebrates, small vertebrates; stepping stones; source pools for restoration	All blocks < ¼ minimum size required to sustain biodiversity
9. Heavily degraded but restorable large blocks remain	Conserves populations of plants, invertebrates, small vertebrates; stepping stones; source pools for restoration	At least one block > ½ minimum size required to sustain biodiversity
10. Heavily degraded but restorable medium-sized blocks remain	Serves as potential source pools for restoration	At least one block ¼ - ½ minimum size required to sustain biodiversity

To evaluate landscape integrity, follow this process:

- In the candidate priority areas, use recent maps (ideally the maps should represent interpretations of habitat from satellite images) to evaluate the distribution, configuration, and size of remaining habitat areas.
- Identify and rank habitat within the candidate priority areas using three classes: intact, altered (degraded), and heavily altered.

- For ecoregions where forestedcover data exist, use your GIS to calculate the sizes of remaining habitat blocks.
- Give all remaining areas that are above a certain size threshold (identified by the experts) unique identification numbers using the persistence analysis (see chap. 4).
- If you do not have GIS capability, try to create a grid (based on the scale of the map) using graph paper to estimate the size of landscapes, and assign landscapes to broad size categories (e.g., >3,000 km2, 1,000-3,000 km2, 500-1,000 km2, etc.) rather than determine exact size of the area.

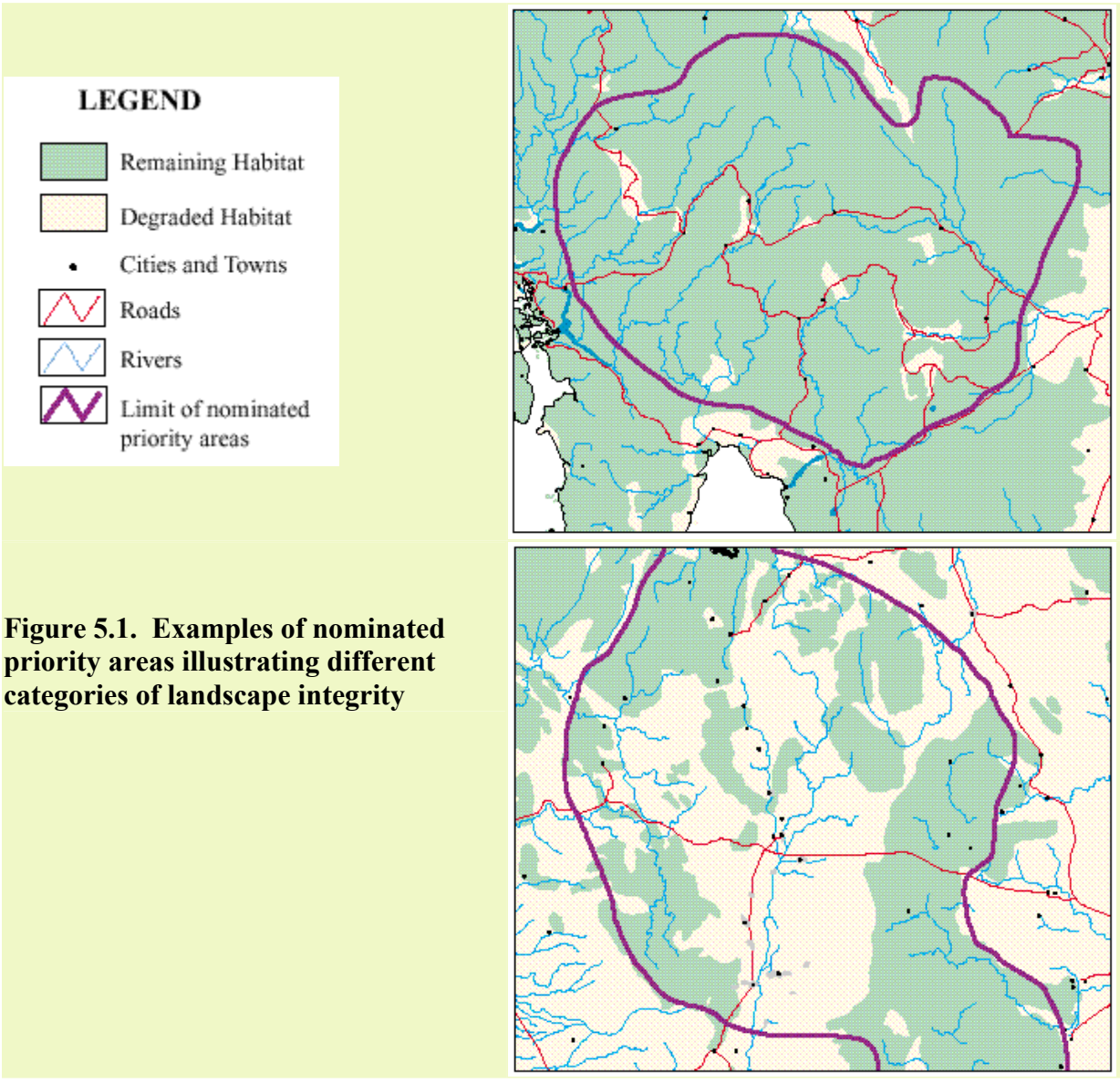

Figure 5.1. Examples of nominated priority areas illustrating different categories of landscape integrity

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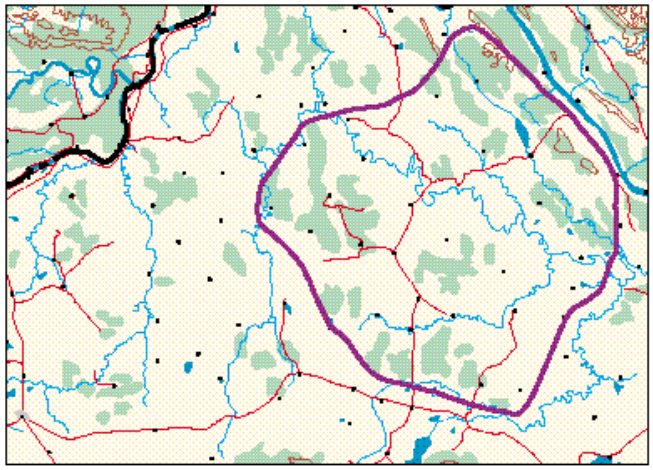

An alternative and more simplified approach is to decide on some arbitrary size thresholds, based on the best available data for the Major Habitat Type to which the ecoregion belongs, and to sort the blocks accordingly. For example, in the Chihuahuan Desert, we decided to classify units of habitat in the following way: >1,000 km2 is large, 100-1,000 km2 is intermediate, and <100 km2 is small.

After these habitat blocks and landscapes are mapped, we can begin to rank candidate priority areas based on habitat integrity; then biological distinctiveness is assigned. This procedure is explained in the next chapter.

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