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Protecting Biodiversity: A Guide to Criteria Used by Global Conservation Organizations

Elizabeth A. Gordon

Oscar E. Franco

Mary L. Tyrrell

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Protecting Biodiversity: A Guide to Criteria Used by Global Conservation Organizations

Elizabeth A. Gordon, Oscar E. Franco, and Mary L. Tyrrell
Global Institute of Sustainable Forestry
Yale School of Forestry & Environmental Studies
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Executive Summary

The worldwide decline of forest habitat, and related loss of biodiversity, is one of the most urgent environmental issues of our time. Human activities – such as clearing forests for agriculture and settlement, unsound forest management, and unsustainable hunting – are becoming even more threatening as human populations increase and place more and more demands on forest ecosystems. Habitat decline contributes more than any other factor to the current extinction rate, which exceeds the “background” natural rate by 100-1,000 times (Baillie et al. 2004). Beyond perpetuating high extinction rates, the loss and fragmentation of forested ecosystems impairs critical ecosystem services, such as purifying the air and water, stabilizing the soil, providing renewable timber and non-timber forest products, and providing homes for human communities.

In response to high worldwide deforestation rates and dramatic species decline, conservationists have been joined by a broad array of stakeholders in stressing the importance of protecting habitats, including forests, to maintain biological diversity, preserve ecological functions, and ensure sustainable forest management. The forest products industry in particular has taken a growing interest in integrating ecological factors into management decisions, and placing increasing emphasis on scientifically-based and ecologically-sensitive forest management.

Meanwhile, there is growing emphasis on the importance of conservation planning — which identifies areas of highest priority and directs limited conservation resources in a strategic manner — to help address spreading urbanization and other challenges to biological diversity. Articulated via an assortment of approaches, conservation planning has evolved over the past few decades from focusing mainly on species to encompassing broader aspects of biodiversity. A number of systemized conservation planning approaches have emerged, each with unique methodologies and priorities.

With so many different conservation planning approaches being promoted by ENGOs (Environmental Non-Governmental Organizations), it is sometimes difficult for landowners and other stakeholders to grasp a clear and concise message on how to make land management decisions while incorporating environmental concerns. Someone not closely involved in the process may be left wondering what core principles inspire these different approaches and whether they can work in tandem or are inherently incompatible.
The purpose of this study is to clarify how eight conservation planning approaches, promoted by five prominent scientifically-based conservation ENGOs, guide decisions about which areas to prioritize for conservation. Our focus is primarily on approaches that are global in scale — those that apply certain criteria to the global landscape and often prioritize relatively large areas for conservation.

We sought to obtain and organize this information, not to critique the scientific validity, usefulness, and thoroughness of each approach, nor to endorse a particular methodology. We hope this analysis will be a useful first step in enabling industry, policy makers, ENGOs, professionals, scientists, and others to work together with greater understanding.

We compared and contrasted approaches with specific reference to organizational or partnership missions, planning principles, conservation targets, scientific criteria, and thresholds. Detailed profiles of each global approach are included in the body of the report. In addition, cursory review is given to approaches that work at a regional or landscape level, and two regional approaches employed by The Nature Conservancy and Ducks Unlimited - Canada are profiled in detail in the Appendices.

Five main criteria were used to determine which conservation approaches to include:

1. **Approach relies primarily on scientifically-based criteria.** For example, we did not include organizations or partnerships that based global priorities on political relevance, local opportunity, or other factors.

2. **Approach sets conservation priorities.** We focused on approaches that utilize criteria to set global priorities, rather than collecting data or implementing conservation on-the-ground at local levels (although some organizations or partnerships included here do engage in these activities during other phases).

3. **Approach applies at a global scale and identifies “where” to conserve.** We emphasized approaches that apply criteria to most of or the entire world in setting conservation priorities. Such approaches typically identify “where” to conserve by selecting large areas for protection, whereas approaches that work at a regional, landscape, or local level often address “how” to conserve. Although global approaches are our main focus, we did give some attention to approaches that work at regional or landscape levels (e.g., within ecoregions or hotspots) as this ties into implementation of global priorities.
(4) **Approach emphasizes a variety of taxa**, i.e., approach does not focus on the conservation of just one type of organism. We made an exception for BirdLife International because, although they ostensibly focus on birds, birds are used as an indicator for broader biodiversity.

(5) **Organizational or partnership representatives were willing to participate and share details about their conservation priority setting processes at the level needed for this project.**

Table E-1 includes the final list of organizations and respective approaches selected. Some of the organizations utilize additional approaches that are not discussed in this study.

**TABLE E-1: Organizations and Approaches Included in the Study**

<table>
<thead>
<tr>
<th>ORGANIZATION OR PARTNERSHIP</th>
<th>APPROACHES STUDIED*</th>
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<td>Alliance for Zero Extinction (AZE)</td>
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<td>Wildlife Conservation Society (WCS)</td>
<td>• Range-wide Priority Setting</td>
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<td></td>
<td>• Last of the Wild</td>
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<td>World Wildlife Fund (WWF)</td>
<td>• Global 200</td>
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We relied on a literature search, Internet research, and material review of each approach’s criteria and system structure to develop a framework in which to analyze and present information. We then conducted phone or in-person interviews or e-mail exchanges with at least one representative from each ENGO to obtain the necessary level of detail, clarify information in written materials, and provide the opportunity for the ENGOs to present their methodologies in the context of their conservation objectives. Finally, we had individuals from each organization or partnership review their profiles for accuracy.
COMPARING AND CONTRASTING APPROACHES

APPROACH FUNDAMENTALS

Organizational Missions
The approaches in this analysis have very similar missions — to conserve broadly the world’s biodiversity. Some organizations or partnerships focus their efforts primarily on preventing imminent species extinction (e.g., Alliance for Zero Extinction), others on conserving biodiversity more broadly (e.g., Conservation International and World Wildlife Fund), and still others on protecting wildlife and wild places (e.g., WCS’s Last of the Wild). Most approaches also include discussion of the human relationship with nature in their mission statement, sometimes with explicit reference to the goal of providing sustainable use of natural resources.

Approach Objectives
The primary or immediate objective of most of the conservation planning approaches is to set internal priorities for conservation action. However, a secondary objective is to educate others about a particular methodology and guide general conservation action and attention toward particular areas.

Conservation Planning Principles
The eight conservation planning principles identified on an a priori basis and listed by frequency of use by the eight conservation approaches are: intrinsic value of nature/wildlife (8); functionality (6); efficiency (6); international recognition and cooperation (4); representation (3); sustainable development (2); engaging local stakeholders (1); and utilitarian or sustainable use of wildlife (0).

Issues of Scale
We considered three main aspects in order to understand the spatial and geographical characteristics of any biodiversity conservation approach. We refer to scale as the level at which scientific priority-setting decisions are made, including three broad categories: global, regional, and local. Global scale approaches are those that apply a set of scientific criteria to most or the entire world, often prioritizing relatively large areas (i.e., ecoregions, hotspots, intact forest landscapes) for conservation. All eight approaches emphasized in the main body of the report are global in scale. The term extent refers to the entire geographic area brought under consideration by a given approach, (e.g., the terrestrial earth, or certain regions, e.g. Latin America) (Redford et al. 2003). Approaches varied with respect to their extent, particularly in their inclusion of aquatic and marine ecosystems. Finally, the planning unit (called “grain” by Redford op. cit.), refers to the main unit in which planning will take place (e.g. ecoregion, hotspot, Endemic Bird Area). The term is synonymous with “planning region,” which is also sometimes used to describe units within which conservation planning occurs. Planning units vary in size from smaller local sites identified by the
Alliance for Zero Extinction and Birdlife International’s Important Bird Areas, to larger areas such as World Wildlife Fund’s Ecoregions and Conservation International’s Biodiversity Hotspots and High-Biodiversity Wilderness Areas.

Data Sources
ENGOs use a wide variety of data to inform their conservation planning activities. Much of their work incorporates national and local place-based knowledge development including species lists, vegetation maps, range atlases, field studies, and expert knowledge. Species status data come largely from the IUCN Red List of Threatened Species, the Centers of Plant Diversity data (WWF and IUCN (1994-1997)), and regional data sets such as NatureServe. GIS mapping is heavily relied upon as both an analytical planning tool and a communication strategy. All approaches rely heavily on expert opinion to refine vegetation and habitat mapping, to identify threats, to review data and data compilation, and in some cases, to evaluate species status.

TARGETS
We use the term target to refer to the actual “entity of biodiversity, ecosystem dynamic, landscape feature, and/or human relationship with nature that the approach seeks to conserve” (TNC et al. 2003). The ultimate target of many global approaches is biodiversity conservation in general or endangered species protection. At a global level this is manifested in immediate targets that are generally large spatial areas, such as entire ecoregions (WWF’s Global 200 Approach), Biodiversity Hotspots (CI), or Endemic Bird Areas (BirdLife International). When these global approaches are implemented at a regional or local level, targets switch to include species, populations of species, or particular elements of biodiversity. Common species targets are those that have been listed as threatened (e.g., endangered, critically endangered) by one of a few key authorities in designating these species (e.g., IUCN Red List and NatureServe). Beyond threatened species, a variety of other focal species are identified by conservation approaches, including indicator species, umbrella species, keystone species, and wide-ranging species. There is a tendency to set targets at multiple levels in order to capture the various levels of biodiversity.

CRITERIA
We identified a total of thirteen criteria. Six relate to the biological value of the target being considered (e.g., the number of endemic species in a particular area, or the natural rarity of a particular ecosystem) and seven refer to the conservation value (e.g., the level of protection associated with an area, or the degree of fragmentation). Approaches often rely on a combination of several criteria in setting priorities. Endemism emerged as the most-often cited scientific criterion among approaches. By definition, endemic species are found nowhere else on the planet; therefore, by focusing attention on these areas, conservationists are ensuring that their resources are directed to the most central/urgent location. Intactness — or the existence of large

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areas of land undisturbed by human influence or fragmentation – was the second most prevalent criterion. The presence of a particular species or taxon and a focus on threatened species in particular is less common among these approaches, but their importance becomes more apparent in regional and local approaches.

**MONITORING AND ADAPTIVE MANAGEMENT**

Most of the approaches incorporate some sort of effectiveness monitoring into their processes. We found that developing an approach was often an iterative exercise in which initial criteria and thresholds were first drafted and then provided to local experts and practitioners for further refinement. Beyond initial methodologies, BirdLife has a systematic method of monitoring that uses a two-tier system to obtain both breadth (coverage of the entire IBA network) and depth (more intensive effort at a sample of sites).

**REGIONAL APPROACHES**

The report provides a very brief overview of six approaches that prioritize and implement conservation planning at either the regional or landscape scale. Generally, we consider approaches *regional* if they prioritize and plan within relatively large sub-continental areas such as ecoregions, hotspots, or heartlands (e.g., WWF’s Ecoregion-Based Conservation). In contrast, *landscape-level* approaches work at an even smaller scale often incorporating a network of local sites. The six approaches summarized include: Africa Wildlife Foundation’s African Heartlands program; Conservation International’s Conservation Corridors and a collaborative initiative called Key Biodiversity Areas; Ducks Unlimited - Canada’s Boreal Forest; TNC’s Ecoregional Conservation Planning; World Wildlife Fund’s Ecoregion-Based Conservation; and Wildlife Conservation Society’s Living Landscapes Program. These sub-global approaches consider a variety of economic, social, and political factors in addition to scientific criteria.

**LOCAL IMPLEMENTATION**

Once global and regional priorities have been established, many conservation organizations and partnerships work with in-country experts and local partners to implement priorities at the *site* or *local* level. This step involves a broad range of activities, from direct acquisition and lobbying for protected areas to encouraging sustainable development, abating hunting, and promoting ecotourism operations. Options vary considerably among locales, and there is generally not a systemized approach even within organizations. Although social, economic, and political factors often dictate what conservation looks like on the ground, ENGOs use scientific theories or methodologies to implement conservation at the site level. We discuss very briefly some conservation biology principles relevant to this local level, including biosphere reserves, the use of corridors, patch dynamics, GAP analysis, minimum viable population, and reserve networks. It is difficult to quantify to what
extent these theories are incorporated as they are implemented on-the-ground in various local contexts. In addition, these concepts may not be stated explicitly; rather, they are part of the background knowledge guiding implementation.

KEY FINDINGS
All the approaches share many fundamental elements, such as data collection methods, planning principles, and objectives, as well as significant overlap on more specific measures, including methodology, criteria, and thresholds used in setting conservation priorities. A few apparent trends are:

- **Efficiency and functionality among top priorities.**
  Of the eight planning principles identified, the most common principle is recognition of the intrinsic value of nature or wildlife, which is either explicitly stated or directly implied in all eight approaches studied. Beyond that fundamental principle, *functionality* (the importance of retaining functionality of conservation targets and the ecosystems that support them, not just their structure or number) and the *efficiency* of resource expenditure were both emphasized in 75% of the approaches examined (six of eight).

- **Importance of expert opinion.**
  All approaches rely heavily on expert opinion, which includes field experts, scientists, and local knowledge. It is obvious that much needed information, particularly about species, local conditions, habitat requirements, and ecosystems is not available in the published data. All approaches use some sort of expert input and review of their priority setting.

- **Emphasis on supra-organismal units.**
  Most conservation planning schemes were based on supra-organismal planning units that incorporate the boundaries of ecoregions or specific populations rather than the entire range of a particular species. WCS’s Range-wide Priority Setting stands alone as the single approach entirely based on an organismal planning unit: the range of a wide-ranging species.

- **A focus on habitat.**
  Although biodiversity is the ultimate target for most approaches, the more immediate or concrete targets are either geographic areas or particular species (no approach sets targets at the genetic level). Almost all approaches include some sort of geographic unit as an immediate target for conservation. At the regional and local level, species are often the target, and the most common species targets are those that have been listed as threatened by one of the few key authorities. *Focal species*, including indicator species, umbrella species, keystone species, and wide-ranging species, are often identified as targets. All approaches assume that
implementation of biodiversity conservation at the global level is best accomplished by protecting habitat (and often entire ecosystems), even for those that ultimately target species for conservation.

- **Endemism as a top scientific criterion.**
  Among the thirteen scientific criteria we identified – six of which related to biological value (e.g., natural rarity, species richness) and seven of which related to conservation value (e.g., habitat loss, high future threat) – endemism stood out as the most frequently cited, used in all except WCS’s approaches.

- **Emphasis on both threatened/degraded landscapes and intact/low-threatened areas.**
  Approaches are relatively varied with respect to the level of threat and intactness emphasized. Often applied in tandem with other criteria (such as requiring high levels of biodiversity), approaches tend to prioritize areas that are either highly degraded and/or threatened (e.g., CI’s hotspots, which are highly threatened and characterized by a high level of endemism), or intact with minimal pressure from human population (e.g., WCS’s Last of the Wild; and CI’s High Biodiversity Wilderness Areas). Areas with moderate degradation and threat are not prioritized.

- **Emphasis on vulnerable and irreplaceable targets.**
  A second key combination of criteria is targets that are both highly vulnerable and irreplaceable. Vulnerability could encompass criteria such as low future protection or high past decline; irreplaceability could refer to endemic species, or threatened species. Conservation targets that rank highly both in vulnerability and irreplaceability are the areas most likely to be lost and with the fewest replacements. Conservation International’s Biodiversity Hotspots are a key example of this combination of criteria, as they are areas with high levels of endemic species (irreplaceable) and high past decline (vulnerable).

- **Being practical in a complicated world.**
  The reliability of sources can affect the selection of criteria. For example, approaches commonly use focal species or taxa as a practical, realistic target on which to concentrate efforts to protect broader biodiversity. Another example is in developing thresholds. ENGOs have had to establish specific thresholds even where there is not enough scientific research to provide a definitive value. This happens to some extent because thresholds are arbitrary by nature, and are more a necessity of the decision-making process than a feature of nature itself.
CONCLUSION

Although there are many subtle, and some significant, distinctions among approaches examined in this study, the similarities seem more prominent than the differences. When different approaches work at the same scale (e.g. global), the same areas are consistently prioritized, among them the Tropical Andes, Madagascar, the Atlantic forest region of eastern Brazil, the Mesoamerican forests, the Philippines, most of Indonesia, the Cape Floristic Region of South Africa, and New Caledonia. When working at a smaller scale, approaches often (but not always) prioritize areas that are nested within the larger areas targeted for conservation by global approaches.

There is also an increasing propensity for organizations to collaborate, including sharing information, utilizing the same methodologies, and relying on the same thresholds. For example, we found a considerable amount of overlap in planning units, a consequence of the increasing level of collaboration and complementary research among these organizations. TNC uses WWF’s ecoregions in the work they carry on outside the United States. Similarly, CI has adjusted the boundaries of its hotspots to match the WWF ecoregions so hotspots now represent an amalgamation of extremely high priority ecoregions. In addition to sharing thresholds and planning units, there is also a growing tendency to work together on specific partnerships and projects. An exemplary case of collaboration is the Alliance for Zero Extinction initiative, which bridges nearly forty biodiversity conservation organizations in a streamlined and systematic effort to prevent the most imminent extinctions.
Introduction

The worldwide decline of forest habitat and related loss of biodiversity is one of the most urgent environmental issues of our time. Human activities such as clearing forests for agriculture and settlement, unsound forest management, and unsustainable hunting are becoming even more threatening as human populations increase and place more and more demands on forest ecosystems. Habitat decline contributes more than any other factor to the current extinction rate, which exceeds the “background” natural rate by 100-1,000 times (Baillie et al. 2004). Beyond perpetuating high extinction rates, the loss and fragmentation of forested ecosystems impairs critical ecosystem services, such as purifying the air and water, stabilizing the soil, providing renewable timber and non-timber forest products, and providing homes for human communities.

In response to high worldwide deforestation rates and dramatic species decline, the conservation community has increasingly emphasized the protection of habitats, including forests, to maintain biological diversity, preserve ecological functions, and ensure sustainable forest management in managed areas. However, conservationists are not alone in their concern. A broad array of stakeholders including government agencies, industry groups, forestry schools, and consumers of forest products are taking a growing interest in the protection of biological diversity.

The forest products industry in particular has taken a genuine interest in integrating ecological factors into management decisions, placing increasing emphasis on scientifically-based and ecologically-sensitive forest management. For example, forest products companies in North America now overwhelmingly operate under the auspices of sustainable forestry certification programs such as the Sustainable Forestry Initiative® (SFI), the Canadian Standards Association (CSA), and the Forest Stewardship Council (FSC). Furthermore, the American Forest & Paper Association’s (AF&PA) Forests Conservation Priorities Task Group and the Forest Products Association of Canada’s (FPAC) Boreal Stewardship Task Force have both taken the initiative to communicate with Environmental Non-Government Organizations (ENGOs) to learn more about their approaches to conservation and how to incorporate this information into forest management decisions.

Meanwhile, there is a growing emphasis by ENGOs and other stakeholders on the importance of conservation planning to help address spreading urbanization and other challenges to biological diversity. Articulated in a variety of methodologies –
from Conservation International’s (CI) Biodiversity Hotspots approach to World Wildlife Fund’s (WWF) Global 200 approach – conservation planning identifies areas of highest priority and directs limited conservation resources in a strategic manner to those areas. Without such planning, conservation decisions might lean toward those areas that are easiest to conserve rather than the ones that safeguard the highest number of species or that best represent global biodiversity. With so much biodiversity to conserve, conservation planning aims to use limited resources efficiently to achieve maximum results.

Conservation planning and priority-setting have evolved through time. For example, approaches have emphasized different conservation targets over time, from the 1970s, when species were often the focus of protection efforts, to today, when many approaches address a range of natural and biological features—from geographically distinct populations of species to a broad range of ecosystems and landscapes. ENGOs also set priorities on multiple levels of scale from global to regional to local. Some ENGOs implement their approach themselves through land acquisition and management, while others enlist the help of local partners or lobby governments to direct funding or implement policies to protect priority areas. Although similar in their basic goal of protecting biodiversity, each approach places emphasis on a unique set of values, principles, and combination of scientific criteria and particular methodology.

Study Purpose

With multiple conservation-planning approaches designed and promoted by different ENGOs, it is sometimes difficult to get a clear message on how to make concrete land management decisions while incorporating environmental concerns. Each approach utilizes a unique methodology and places emphasis on slightly different aspects of biodiversity.

Someone not intimately involved in developing these methodologies may be left with questions ranging from what core principles inspire them to whether these approaches can work in tandem or are inherently incompatible. For example, should intact forested areas be prioritized over those that are severely degraded, or vice versa? What is considered to be a good indicator of biodiversity? What is an endemic species and why are they emphasized so much in these approaches?

The purpose of this study is to clarify how eight conservation planning approaches promoted by five prominent scientifically-based conservation ENGOs make decisions about which areas to prioritize for conservation. We focused on approaches that are global in scale and that rely primarily on scientific criteria (rather than social
and political considerations). Further examination of priority-setting at the regional and local levels that considers social and political criteria is critically needed and would be particularly useful to those making decisions on the ground.

Our focus is primarily on approaches that are global in scale—those that apply certain criteria to the global landscape and often prioritize relatively large areas for conservation (exceptions to this are the Alliance for Zero Extinction sites and BirdLife International’s Important Bird Areas, which identify local sites but are still considered global approaches for our purposes. Eight such global approaches implemented by five ENGOs were selected, indicated in Table 1. Approaches were then compared and contrasted with specific reference to organizational or partnership missions, planning principles, conservation targets, scientific criteria, and thresholds. Detailed profiles of each global approach follow.

In addition, a cursory review is given to approaches that work at a regional or landscape level within the body of the report and two regional approaches employed by The Nature Conservancy and Ducks Unlimited - Canada are profiled in detail in the Appendices. Due to their more local nature, regional approaches typically consider a variety of scientific, social, political, and economic factors in setting priorities and a thorough analysis of these multiple considerations is beyond the scope of this report. However, we recognize the importance of comparing and contrasting approaches at regional and local scales and the particular relevance such an analysis would have to the forest products industry and other stakeholders.

We hope this analysis will be useful in enabling industry, policy makers, ENGOs, professionals, scientists, and others to work together with greater understanding. An improved understanding could lead to a process that, when applied by forest products companies to their own lands, would help companies set biodiversity goals based on criteria that may be relevant to more than one ENGO’s scheme, and integrate conservation of biological diversity and economic objectives with more foresight and effectiveness. We also hope to provide a reference point for further discussions between industry and ENGOs in their shared interest in conservation planning.

The goal of this study is to obtain and organize the information, not to critique the scientific validity, usefulness, and thoroughness of each approach, nor to endorse a particular methodology. The study builds on similar analyses that have compared various conservation priority-setting approaches, notably Biodiversity in the Balance: Approaches to Setting Geographic Conservation Priorities (Johnson 1995); Mapping Conservation Approaches (Redford et al. 2003); and A Resource Guide for Terrestrial Conservation Planning at the Regional Scale (TNC et al. 2003).
Study Methods and Framework

This study was executed over the course of approximately four months by three primary researchers at the Yale School of Forestry & Environmental Studies in New Haven, CT. The first step was to determine which conservation approaches would be included. We received initial recommendations from the American Forest & Paper Association’s (AF&PA) Forests Conservation Priorities Task Group, composed of representatives of AF&PA member companies, Forest Products Association of Canada (FPAC), and NCASI (from this point forward, referred to as the Conservation Priorities Task Group) and conducted additional research to identify a range of other approaches to evaluate for inclusion. We utilized five main criteria to determine which conservation approaches to include:

1. **Approach relies primarily on scientifically-based criteria.** We included only approaches that make decisions primarily based on scientific criteria. For example, we did not include approaches that prioritize areas based on political relevance, local opportunity, or other factors. Approaches could incorporate social, political and economic factors when implementing their global priorities; however, the initial decision regarding “where” to conserve was based on scientific criteria.

2. **Approach sets conservation priorities.** Environmental organizations and partnerships have various specialties in the lengthy process involved in making conservation decisions. Some organizations collect and analyze scientific data (e.g., IUCN compiles data on threatened species); some focus on setting priorities based on scientific data; and some work on the ground to implement conservation priorities. These distinctions are not hard and fast, and many organizations participate in more than one of these steps. We focus on approaches where the primary aim is to set conservation priorities.

3. **Approach applies at a global scale and identifies “where” to conserve.** We emphasize approaches that apply scientific criteria to most of or the entire world to set conservation priorities. In many cases, the output of these analyses is the identification of large, sub-continental areas for conservation (e.g., ecoregions), although in some cases, local sites are identified for conservation (one example is the Alliance for Zero Extinction). Global approaches tend to focus on where to conserve rather than “how” to conserve and in doing so rely on scientific
criteria rather than a broader suite of social, economic and political factors that are more sensitive to local context. As explained by Redford et al. (2003), approaches that address where to conserve are about setting geographical priorities, whereas approaches that answer how to conserve are about developing and implementing strategies to conserve conservation targets at priority places and often incorporate a range of socio-economic factors in addition to scientific guidelines. Although global approaches are the main focus, we do give some attention to approaches that work at regional or landscape levels (e.g., within ecoregions or hotspots) as this ties into implementation of global priorities.

(4) **Approach emphasizes a variety of taxa**, i.e., approach does not focus on the conservation of just one type of organism. Approaches included generally have a mission to conserve biodiversity broadly rather than focusing on a particular group of species. We made an exception for BirdLife International because, although they ostensibly focus on birds, birds are used as an indicator for broader biodiversity. In addition, their methodology is quite influential in the context of broader biodiversity conservation efforts.

(5) **Willingness by organizational or partnership representatives to participate and share details about their conservation priority setting processes at the level needed for this project.** Data collection for global approaches relied on phone or in-person interviews with organizational representatives in addition to written materials. All global approach profiles were reviewed by at least one organizational representative.

Table 1 includes the final list of organizations or partnerships and respective approaches selected for this study, including eight global approaches implemented by five conservation NGOs or partnerships. Some of the organizations or partnerships included here use more than one conservation priority-setting approach of which just one or two are discussed. We selected influential approaches that are applied broadly at a global scale to set priorities for conserving biodiversity.
Table 1  Organizations and Approaches Included in the Study

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<td>● Range-wide Priority Setting</td>
</tr>
<tr>
<td></td>
<td>● Last of the Wild</td>
</tr>
<tr>
<td>World Wildlife Fund <em>WWF</em></td>
<td>● Global 200</td>
</tr>
</tbody>
</table>

* In addition to the eight global approaches indicated above, cursory review is given to six regional approaches utilized by the African Wildlife Foundation, Conservation International, Ducks Unlimited Canada, The Nature Conservancy, the World Wildlife Fund, and the Wildlife Conservation Society.

In addition to the approaches identified above, we also sometimes refer to the methodology of other prominent approaches, particularly The Nature Conservancy’s Ecoregion-based conservation approach – which is regional in scale but has been influential in priority setting at multiple scales – and the World Resources Institute’s Forest Program that conducts extensive mapping of Intact Forest Landscapes (among other projects). Since WRI does not set priorities on the ground but rather acts as a key information source, they did not meet our criteria for inclusion; nonetheless, their mapping activities have drawn significant attention toward using intactness as a criterion for selecting forested landscapes for protection. A detailed profile of WRI’s Intact Forest Landscape approach is included as an Appendix.

Once approaches were selected, we conducted background research to develop a Conservation Priorities Framework with which to analyze and present acquired information (See Table 2). In developing the framework we relied on a literature search, Internet research, and material review of each approach’s criteria and system structure. The body of this report and all organizational profiles are based on this Conservation Priorities Framework.
Table 2 Conservation Priorities Framework

<table>
<thead>
<tr>
<th>ORGANIZATION OR PARTNERSHIP APPROACH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>APPROACH FUNDAMENTALS</strong></td>
</tr>
<tr>
<td><strong>Mission:</strong> Mission as defined by the organization or partnership implementing the approach</td>
</tr>
<tr>
<td><strong>Approach Objective:</strong> What does the approach do? Set global and/or local priorities? Or provide data to other organizations?</td>
</tr>
<tr>
<td><strong>Planning Principles:</strong> Aims, purposes and philosophy behind the approach</td>
</tr>
<tr>
<td><strong>Scale:</strong> Spatial scale, geographic area of extent, and planning unit</td>
</tr>
<tr>
<td><strong>Conservation Level:</strong> (e.g., genetic, species, ecosystem, or integrated)</td>
</tr>
<tr>
<td><strong>Data Sources:</strong> (e.g., field data, theory, expert opinion, social data, political considerations, models)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>TARGETS, CRITERIA AND THRESHOLDS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Targets:</strong> (e.g., hotspots, priority ecoregion, an AZE site)</td>
</tr>
<tr>
<td><strong>Criteria &amp; Thresholds:</strong> (e.g., species richness, high levels of endemism)</td>
</tr>
<tr>
<td><strong>Weight:</strong> Are some criteria considered more important than others?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>IMPLEMENTATION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regional and Local Implementation:</strong> Implementation &amp; theory used to guide local decisions</td>
</tr>
<tr>
<td><strong>Monitoring:</strong> Does the organization or partnership engage in any monitoring that leads them to revaluate/alter their criteria or thresholds? Are they engaged in adaptive management?</td>
</tr>
</tbody>
</table>

Upon finalization of the framework, we used a variety of background research methods, including peer-reviewed articles, self-published literature, organizational websites, presentations, and draft documents to identify gaps in knowledge for each approach and clarifications needed. Researchers also utilized texts on conservation biology, ecology, and other scientific disciplines to further explain scientific underpinnings of ENGO decisions.
We then conducted phone or in-person interviews or e-mail exchanges with at least one representative from each ENGO to obtain the necessary level of detail, clarify information in written materials, and provide the opportunity for the ENGOs to present their methodologies in the context of their conservation objectives. Interviews lasted between one and two hours each. Representatives were given the opportunity to review the full report for basic accuracy; however, statements made throughout the body of the report are the interpretations of the authors rather than agreed-upon statements from all organizational or partnership representatives. It should be noted that attempts to compare and contrast approaches are limited by the subjective nature of this exercise and should not be viewed as definitive.

The Conservation Priorities Task Group was also given the opportunity to review and comment on a draft. We have incorporated some of the recommended changes, as deemed appropriate by the authors, into this final draft.
Comparing and Contrasting Approaches

APPROACH FUNDAMENTALS

We compared and contrasted six fundamental aspects of each approach in order to provide a foundation on which to explore scientific criteria more deeply. These fundamental elements include organizational or partnership missions, approach objectives, conservation planning principles, issues of scale, the biological level of conservation targets, and data sources used by different organizations. We discuss five of these six elements in this section; the level of conservation targets is saved for the discussion of targets in the following section.

Missions

The organizations and partnerships included in this analysis have very similar missions to conserve broadly the world’s biodiversity. Some efforts focus primarily on preventing imminent species extinction (e.g., the Alliance for Zero Extinction, of which most organizations included here are partners), others on conserving biodiversity more broadly (Conservation International and World Wildlife Fund), and still others on protecting wildlife and wild places (WCS’s Last of the Wild). These distinctions, however, are not hard and fast and many of the ENGOs we looked at engage in all three of these “missions” at some level. Although they may not explicitly state that preventing species extinction is their core mission, most of these approaches are designed to do just that, either by focusing on preventing biodiversity loss, conserving endemic species and unique habitats, or directing efforts towards protecting habitat for threatened species.

Most approaches also include discussion of the human relationship with nature in their mission statement, sometimes with explicit reference to the goal of providing sustainable use of natural resources. For example, BirdLife International aims to integrate bird conservation into sustaining people’s livelihoods; CI seeks to demonstrate that human societies are able to live harmoniously with nature; and WWF seeks to build a future in which human needs are met in harmony with nature. Regardless of whether or not it is found in their mission statements, all ENGOs do include a consideration of sustainable development, human use, and/or resource management at some level in their planning or implementation processes.
Approach Objectives

The primary or immediate objective of most of the conservation planning approaches is to set internal priorities for conservation action. However, a secondary objective is also to educate others about a particular methodology and guide general conservation action and attention toward particular areas. In some cases a particular methodology might prioritize areas that are beyond the scope of the organization or partnership implementing the approach. For example, CI’s Biodiversity Hotspots approach identifies areas in California and Australia as targets for conservation action even though these areas fall outside of CI’s focus on developing countries.

Conservation Planning Principles

All organizations or partnerships operate with a set of planning principles, which they use as a basis for both strategic and operating decisions. Conservation work, like any other endeavor, is necessarily limited by time, resources, and funds. Decisions about what to focus on (e.g., which species, taxa, or ecosystems); where to do the work; who to engage in partnerships; how to achieve goals (e.g., direct protection or sustainable management); and when to take action are all evaluated in the context of these principles. These principles are not always explicitly stated, but they are certainly keystones on which entire approaches are built.

A list of eight principles was developed a priori from a review of the conservation literature and modified after a review of ENGO written materials. Our list was largely informed by Redford et al. (2003), although expanded and modified by our research. We then categorized the operating principles that the eight ENGOs use in their conservation approaches into these principles. Planning principles used in this study are as follows:

- **Representation** – a portfolio of conservation sites should include sites representing all of the different ecosystems in the area of concern.

- **Efficiency of resource expenditure** – given limited resources, efforts must be concentrated on the fewest high-quality sites possible, or the fewest species (endemic, endangered) that can in turn lead to protection of a broader biodiversity.

- **Functionality** – importance of retaining functionality of conservation targets and the ecosystems that support them, not just their structure or number.

- **International recognition and cooperation** – attention of the international community will help in the conservation of desired targets and improve the chances of achieving results.

- **Engaging local stakeholders** – ensuring benefits to people and conservation success through engaging local communities in conservation planning and action.
• **Intrinsic value of nature** – moral belief in the importance of wildlife/lands for their own sake (i.e., independent of any human use).

• **Sustainable use of natural resources/utilitarian** – sustainable harvesting of ecosystem products, wildlife hunting, and management for non-extractive human use (such as recreation) will aid in achieving conservation goals.

• **Sustainable development** – an integrated community approach to conserving land and wildlife, while at the same time assuring current and future human needs can be met.

Table 3 identifies which planning principles are emphasized by each approach. It could be argued that most, if not all, of these approaches incorporate most of these principles into their planning at some level; however, we have attempted to identify those that seem to be the primary drivers of each approach. For example, an organization that is not specifically identified as engaging local stakeholders may very well work with local stakeholders on planning and implementation. It just does not appear to be a keystone operating principle of their approach.

Due to the nature of the ENGOs involved in the study, the most common principle is the intrinsic value of nature or wildlife, which is either explicitly stated or directly implied by all eight approaches studied. Beyond that fundamental principle, functionality and efficiency are both emphasized in 75% of the approaches (six of eight). Indeed, most approaches focus on conserving functional ecosystems for either their own sake (and the biodiversity they support) or for wildlife habitat, and they seek to have the biggest impact given restricted time and resources.

**Table 3 Planning Principles Emphasized by Conservation Approaches**

<table>
<thead>
<tr>
<th>ENGO</th>
<th>Planning Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alliance for Zero Extinction</td>
<td>Efficiency of resource expenditure, Functionality, International recognition and cooperation, Intrinsic value of nature</td>
</tr>
<tr>
<td>AZE Sites</td>
<td></td>
</tr>
<tr>
<td>BirdLife International</td>
<td>Functionality, Intrinsic value of nature, Sustainable development</td>
</tr>
<tr>
<td>Endemic Bird Areas</td>
<td></td>
</tr>
<tr>
<td>BirdLife International</td>
<td>Efficiency of resource expenditure, Functionality, International recognition and cooperation, Engaging local stakeholders, Intrinsic value of nature, Sustainable development</td>
</tr>
<tr>
<td>Important Bird Areas</td>
<td></td>
</tr>
<tr>
<td>Conservation International</td>
<td>Efficiency of resource expenditure, Intrinsic value of nature</td>
</tr>
<tr>
<td>Biodiversity Hotspots</td>
<td></td>
</tr>
<tr>
<td>Conservation International</td>
<td>Efficiency of resource expenditure, Functionality, Intrinsic value of nature</td>
</tr>
<tr>
<td>High Biodiversity Wilderness Areas</td>
<td></td>
</tr>
<tr>
<td>Wildlife Conservation Society</td>
<td>Representation, Efficiency of resource expenditure, International recognition and cooperation, Intrinsic value of nature</td>
</tr>
<tr>
<td>Range-wide Priority Setting</td>
<td></td>
</tr>
<tr>
<td>Wildlife Conservation Society</td>
<td>Representation, Functionality, Intrinsic value of nature</td>
</tr>
<tr>
<td>Last of the Wild</td>
<td></td>
</tr>
<tr>
<td>World Wildlife Fund</td>
<td>Representation, Efficiency of resource expenditure, Functionality, International recognition and cooperation, Intrinsic value of nature</td>
</tr>
<tr>
<td>Global 200</td>
<td></td>
</tr>
</tbody>
</table>
Principles cited with moderate frequency include international recognition and cooperation, and representation, which is a key emphasis of WWF’s Global 200 as well as WCS’s Last of the Wild approach (which identifies areas within each biome as defined and delineated by WWF). Although identified in the literature and a key focus of regional approaches, sustainable development and engaging local stakeholders are emphasized explicitly at the global level only by BirdLife International. It is important to note that almost all of the other organizations do emphasize sustainable development and engaging local stakeholders, but this becomes a guiding principle at the regional and local levels rather than at the global level. None of the approaches examined focus on utilitarian or sustainable use of wildlife. However, Ducks Unlimited Canada’s (DUC) approach, which is discussed in the regional section, does rely on this as a principle.

Scale

We considered several aspects of scale in order to understand the spatial and geographical characteristics of each biodiversity conservation approach, including: (1) spatial scale, (2) extent, and (3) planning unit.

We refer to special scale as the level at which scientific priority-setting decisions are made, within three broad categories: global, regional, and local. Global scale approaches are those that apply a set of scientific criteria to most of or the entire world, often to prioritize relatively large areas (i.e., ecoregions, hotspots, intact forest landscapes) for conservation, but sometimes to identify specific sites (i.e., AZE sites). All eight approaches emphasized in this study are global in scale. In contrast, approaches such as TNC’s Ecoregional Conservation Planning are regional in scale because the evaluation of criteria and planning takes place within ecoregions rather than across the broader global context. In many cases a single organization works at both a global and regional scale, but under a different planning methodology or brand, as illustrated by the World Wildlife Fund’s Global 200 approach, which works at a global level, and their Ecoregion-based conservation planning that works within select ecoregions. Planning at the local level is set at an even smaller scale than regional planning and typically works to identify and manage conservation sites.

A variety of social, political, and economic factors often influence regional and local-level planning, although science largely informs these decisions (e.g., the consideration of population viability, ecological functionality, edge effects, connectivity, and patch dynamics in local planning).

The term extent refers to the geographic area brought under consideration by a given approach (Redford et al. 2003). Extent is closely related to – but not completely synonymous with – scale. For example, the extent of CI’s Biodiversity Hotspots approach is the terrestrial earth, while WWF’s Global 200 approach expands beyond the terrestrial earth to aquatic systems, and marine ecoregions may be considered in the future. Likewise, WCS’s current human footprint mapping is confined to the terrestrial world, yet they are working on the marine human footprint for future release. The extent of most global approaches is typically most of or the entire planet, while the extent of regional approaches may be more restricted — for example, the
African Wildlife Foundation’s Africa Heartland’s program is confined to the African continent.

Finally, the planning unit (called “grain” by Redford et al. 2003), refers to the main unit in which planning will take place. The term is synonymous with “planning region,” which is also sometimes used to describe units within which conservation planning occurs. Planning units can be entirely contained within a country, may be partially shared by several countries, or may encompass many countries. For conservation purposes, planning regions are generally ecologically derived using such information as climate, vegetation type, and/or characteristic species, though sometimes they may also be based on geographic or political criteria. An example of a planning unit is an ecoregion, which is defined by WWF (2005) as a large area of land or water that contains a geographically distinct assemblage of natural communities that:

(a) share a large majority of their species and ecological dynamics

(b) share similar environmental conditions

(c) interact ecologically in ways that are critical for their long-term persistence

Global approaches typically identify large planning units such as ecoregions, hotspots, or Endemic Bird Areas as the output of their process. For example, WWF’s Global 200 approach prioritizes over 200 ecoregions in which it will work first. Once prioritized, conservation planning takes place within each ecoregion via ecoregion-based conservation. In some cases, however, global approaches identify smaller planning units – or local sites – immediately, such as those identified by the Alliance for Zero Extinction and Birdlife International’s Important Bird Areas approach.

Table 4 identifies the planning unit and other issues of scale for each global approach. All approaches examined in this section are considered global in scale; the table provides some information on what happens once global priorities are set and planning and implementation takes place at the sub-global level. Such activities are considered independent from the global priority-setting scheme that initially prioritizes regions or landscapes for conservation.
<table>
<thead>
<tr>
<th>APPROACH</th>
<th>OPERATIONAL EXTENT &amp; PLANNING UNIT</th>
<th>WHAT HAPPENS AT THE REGIONAL AND LOCAL LEVEL?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alliance for Zero Extinction</td>
<td>Extent: Global terrestrial</td>
<td>AZE sites are developed globally and inform local partners and other conservation organizations or partnerships of imminent priorities.</td>
</tr>
<tr>
<td>AZE Sites</td>
<td>Planning Unit: AZE sites</td>
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<tr>
<td></td>
<td>Sizes are a few km² to 340,000</td>
<td></td>
</tr>
<tr>
<td>BirdLife International</td>
<td>Extent: Global</td>
<td>EBAs are developed globally by the BirdLife International Partnership and inform local planning on where to direct conservation efforts.</td>
</tr>
<tr>
<td>Endemic Bird Areas</td>
<td>Planning Unit: Endemic Bird Areas</td>
<td></td>
</tr>
<tr>
<td>BirdLife International</td>
<td>Extent: Global</td>
<td>IBAs are identified, protected and monitored at the local level using global criteria and are meant to be practical targets for conservation at the local level and/or as part of a regional network.</td>
</tr>
<tr>
<td>Important Bird Areas</td>
<td>Planning Unit: Important Bird Areas</td>
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</tr>
<tr>
<td>Conservation International</td>
<td>Extent: Global terrestrial</td>
<td>CI works with partners to identify key biodiversity areas, which is a quantitative data-driven approach that prioritizes vulnerability and irreplaceability to delineate sites characterized by the presence of a threatened, restricted-range, congregatory or biome-restricted species (Eken et al 2004). CI also sets biodiversity targets at the landscape and seascape scale for those threatened species that cannot be conserved at the site-scale alone.</td>
</tr>
<tr>
<td>Biodiversity Hotspots</td>
<td>Planning Unit: Biodiversity Hotspots</td>
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<tr>
<td>Conservation International</td>
<td>Extent: Global terrestrial</td>
<td></td>
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<tr>
<td>High Biodiversity Wilderness</td>
<td>Planning Unit: High Biodiversity Wilderness Area</td>
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<tr>
<td>Area</td>
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<tr>
<td>Wildlife Conservation Society</td>
<td>Extent: Global-terrestrial; Limited to areas where wide-ranging species exist. Planning Unit: Geographic range of wide-ranging species; species conservation units.</td>
<td>WCS's Living Landscapes Program supports landscape-level conservation efforts; regional programs (Asia, Africa, Latin America, North America, Marine) conduct on-the-ground implementation. Decisions made about conservation investments depend in part on conservation priority studies (their own and others) but also a broad range of other factors.</td>
</tr>
<tr>
<td>Range-Wide Priority Setting</td>
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<tr>
<td>Wildlife Conservation Society</td>
<td>Extent: Current footprint is global-terrestrial. WCS is working on the marine human footprint. Planning Unit: Last of the wild areas. Range in size from 5 km² to 3,815,832 km²</td>
<td>Within priority ecoregions, WWF pursues ecoregion conservation, to develop and implement a comprehensive strategy that conserves the species, habitats, and ecological processes of the ecoregion. Priority areas are often identified – also called landscapes or seascapes. The next step is to develop cost-effective, spatially-explicit strategies that meet the ecological needs of wildlife and habitats while minimizing human-wildlife conflicts and maximizing benefits to resident populations.</td>
</tr>
<tr>
<td>Last of the Wild</td>
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<tr>
<td>World Wildlife Fund</td>
<td>Extent: Global - terrestrial, freshwater, marine. Terrestrial ecoregions selected from a comprehensive set of 825; freshwater and marine units identified individually. Comprehensive freshwater and marine units still under development. Planning Unit: Ecoregion</td>
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<tr>
<td>Global 200</td>
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</table>
Data Sources

ENGOs use a wide variety of data to inform their conservation planning activities (Table 5). Much of their work involves national or even local place-based knowledge involving species lists, vegetation maps, range atlases, field studies, and expert knowledge. For this report, we have only discussed the major internationally recognized data sets; however, it should be noted that there are many national and regional data sets used by the ENGOs at the regional and local planning level (e.g. AZTECA, The Mexico Datasystem; Atlas of Afrotropical Bird Distributions; NatureServe and US State Heritage databases).

All approaches rely heavily on expert opinion to refine vegetation and habitat mapping, to identify threats, to review data and data compilation, and in some cases, to evaluate species status. Species status data come largely from the IUCN Red List of Threatened Species, although the Centers of Plant Diversity data (WWF and IUCN (1994-1997)) are also used. Protected area data come from the World Database on Protected Areas, a comprehensive dataset on global protected areas managed by UNEP-WCMC (www.unep-wcmc.org/) in partnership with the IUCN World Commission on Protected Areas (WCPA) and the World Database on Protected Areas Consortium.

GIS mapping is heavily relied upon as both an analytical planning tool and a communication strategy. Vegetation mapping normally is done using 30-meter resolution Thematic Mapper (TM) satellite imagery, aerial photography, and field observations. Satellite imagery is used for change detection and threat analysis (e.g. from sprawling population centers, road development). The World Resource Institute’s Global Forest Watch, which uses satellite imagery for its analysis, is a key source of information on intact forested landscapes (see Appendix for more information).

Most ENGOs collect field data on species and ecosystems to supplement published information, or in some cases, to create local or species-specific data where they are otherwise unavailable. Research results published in the scientific literature are generally used for establishing thresholds, evaluating trends in species populations and distributions, and determining wildlife habitat requirements. Finally, all approaches rely on the scientific literature of conservation biology theory for an understanding of how to incorporate into their approaches concepts such as island biogeography, fragmentation of landscapes, and habitat for wide-ranging species.
Table 5  Data Sources Used by Conservation Planning Approaches

<table>
<thead>
<tr>
<th></th>
<th>IUCN REDLIST</th>
<th>EXPERT OPINION</th>
<th>LITERATURE</th>
<th>GLOBAL FOREST WATCH</th>
<th>CENTERS OF PLANT DIVERSITY</th>
<th>FIELD DATA</th>
<th>SOCIAL DATA</th>
<th>GIS MAPPING</th>
<th>MODELS</th>
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<tbody>
<tr>
<td>Alliance for Zero Extinction</td>
<td>✓</td>
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<tr>
<td>AZE Sites</td>
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<td>BirdLife International</td>
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<tr>
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<tr>
<td>Biodiversity Hotspots</td>
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<td>High Biodiversity Wilderness Areas</td>
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<td>Wildlife Conservation Society</td>
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<tr>
<td>Range-Wide Priority Setting</td>
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<td>Last of the Wild</td>
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<tr>
<td>World Wildlife Fund</td>
<td>✓</td>
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<td>Global 200</td>
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Internationally Recognized Sources of Conservation Data

- World Conservation Union Monitoring Center: www.unep-wcmc.org
- IUCN Red List: http://www.redlist.org/
- Ramsar Convention on Wetlands: http://www.ramsar.org/
- Centers of Plant Diversity: http://www.nmnh.si.edu/botany/projects/cpd/
- U.S. Fish and Wildlife Service Endangered Species Program: http://endangered.fws.gov/
- NatureServe: http://www.natureserve.org/
TARGETS

We use the term target similarly to A Resource Guide for Terrestrial Conservation Planning at the Regional Scale (TNC 2003), as “the actual entity of biodiversity, ecosystem dynamic, landscape feature, and/or human relationship with nature that the approach seeks to conserve,” rather than a quantity (for example, the target number of individuals in a population). The target of conservation attention has evolved and been refined over the years, from an initial focus in the western world on species and their specific habitat, to include broader aspects of nature, such as whole ecosystems, scenery, biodiversity, landscape perspectives, and human interactions (Redford et al 2003).

We note that a thorough discussion of conservation targets is more appropriate for an analysis that examines regional and local approaches, as concrete conservation targets are generally set at those smaller scales. For this discussion of global targets, we distinguish between targets an approach seeks immediately to conserve and those that are the longer-term or ultimate target. The ultimate target of many of these global approaches is biodiversity conservation in general or endangered species protection. At a global level this is manifested in immediate targets that are generally large spatial areas, such as entire ecoregions (WWF’s Global 200 approach), Biodiversity Hotspots (CI), or Endemic Bird Areas (BirdLife International). When these global approaches are implemented at a regional or local level, immediate targets switch to include species, populations of species, or particular elements of biodiversity. Note that even when species are the ultimate targets for conservation, species conservation is most often implemented through the protection of that species’ habitat.

In some cases, a single concept may serve both as a target and a criterion when applied at different scales. This occurs with threatened species: at a global or regional scale, the presence of threatened species in a certain region or site can be used as a criterion to designate that region or site as a target. When we look at a more local scale, threatened species themselves serve as the target. For example, AZE uses the presence of the entire or overwhelming majority of the population of a Critically Endangered or Endangered species as listed on the 2004 IUCN Red List as a criterion to trigger a site—in this case, the site is the target. However, at a local scale, the threatened species is itself the target for protection.

Biodiversity as a Target?

The ultimate aim of many of these approaches is to protect biodiversity, and as such, most of the approaches could identify biodiversity as a broad, long-term target. A union of the terms biological and diversity, the concept of biodiversity has emerged over the past 10-15 years to refer to the variety of life in all its forms, levels, and combinations including ecosystem diversity, species diversity, and genetic diversity (IUCN, UNEP and WWF, 1991). The term has multiple definitions and there is no one agreed-upon way to define or measure the degree of biodiversity, although a simple measure of species richness or the number of species within an area is sometimes
used. Higher taxonomic diversity and genetic diversity within species is also sometimes measured. Because biodiversity is such a broad term, we discuss specific measures of biodiversity as criteria that are applied to areas in evaluating them as targets for conservation, rather than discussing biodiversity as a target itself. We found no instances in which biodiversity was explicitly stated as an immediate target. Rather, we found that specific measures or indicators of biodiversity — such as the presence of endemic species, outstanding ecological phenomenon, or species richness—were used either as criteria or as targets.

For example, BirdLife’s approach uses birds as an environmental indicator of the general state of biodiversity, and as such, we explain here that birds (or the areas in which they live) are the immediate targets (rather than biodiversity, although biodiversity is an ultimate target). BirdLife International’s premise is that there is a tremendous amount of data on birds spanning longer time periods and geographic ranges than is available on most other taxa; therefore, birds and their habitat needs are a practical conservation target. According to BirdLife International (2004) “Birds have a special place as an environmental indicator for many reasons, not least because of their enormous public appeal. A global network of birdwatchers and ornithologists continues to provide a huge amount of information about birds — information largely lacking for other species.” They contend that changes in the overall threat status of the world’s bird species reflect changes in the underlying threats to biodiversity. This is backed up by citations of published studies showing that birds score very highly on many of the broad criteria defined for selecting indicator taxa (Pearson 1995) and on birds as indicators of species richness and endemism patterns (Burgess et al. 2002; Bibby et al. 1992).

Biological Level of Conservation Targets
We examined the broad biological levels of conservation targets identified by various approaches. Table 6 refers to three biological levels of conservation targets, including genetic, species, and ecosystem levels. We found that almost all approaches focus on ecosystem levels (6 of 8); most approaches focus on species-level targets (5 of 8); and no approach focuses on genetic targets. Genetic diversity may be too elusive a goal for many approaches. However, some approaches may have genetic diversity as an indirect target or at least consider genetic diversity in the process of targeting species for conservation. For example, WCS’s Range-Wide Priority Setting targets species for conservation ultimately, but targets populations of species in different ecological settings more immediately. Such an emphasis recognizes that genetic diversity within a species is critical to its survival.

As illustrated, WCS and AZE are the only two approaches that focus on species exclusively, rather than a combination of both ecosystems and species or solely ecosystems. It should be noted, however, that although species are the main level of conservation attention, the primary method used to conserve species in both cases is to protect habitat. Likewise, both of BirdLife International’s approaches ultimately seek to conserve birds and biodiversity more generally; however, they do this by

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targeting habitat for protection. Additional threats to species, such as addressing hunting pressure or ex-situ conservation are not emphasized, but may complement habitat protection in some cases.

Table 6 Biological Level of Conservation Targets

<table>
<thead>
<tr>
<th>ORGANIZATION AND APPROACH</th>
<th>GENETIC</th>
<th>SPECIES(^1)</th>
<th>ECOSYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alliance for Zero Extinction</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>AZE Sites</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BirdLife International</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Endemic Bird Areas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BirdLife International</td>
<td></td>
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<td>✓</td>
</tr>
<tr>
<td>Important Bird Areas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conservation International</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Biodiversity Hotspots</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conservation International</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>High Biodiversity Wilderness Areas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wildlife Conservation Society</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Range-Wide Priority Setting</td>
<td></td>
<td>✓(^2)</td>
<td></td>
</tr>
<tr>
<td>Wildlife Conservation Society</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Last of the Wild</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>World Wildlife Fund</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Global 200</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) We include approaches that target species ultimately by protecting their habitat immediately.

\(^2\) WCS Range-wide Priority Setting targets populations of species.

Geographic Areas as Targets

All global approaches examined include some sort of geographic unit as a target for conservation. For example, Conservation International has two complimentary methodologies for selecting geographic areas globally: Biodiversity Hotspots – which focus on those regions that harbor a large number of species found nowhere else (using vascular plants as a surrogate), and that are also under severe threat (as measured by % habitat loss) – and High Biodiversity Wilderness Areas, which also harbor a large number of species found nowhere else but are relatively unthreatened. BirdLife International defines Endemic Bird Areas at the global level and Important Bird Areas at the regional and local levels. It is important to note that identifying a certain area as a target does not imply that the ENGO recommends that everything within it be protected. For example, within Biodiversity Hotspots, further sub-units such as Landscapes and Key Biodiversity Areas are defined for conservation action.

Species as Targets

After geographic areas, species of various types are most often targets. One of the most common kinds of species targets are those that have been listed as threatened (e.g., imperiled, threatened, or endangered) by one of a few key authorities in designating these species. The Alliance for Zero Extinction, for example, identifies species targets based on the IUCN Red List, among other criteria. The Nature Conservancy’s Ecoregional Conservation Planning approach – which is discussed in the regional
section as well as in the Appendix — relies on at least three listing sources, including the following categories: (1) critically imperiled and imperiled species are those that have a global rank of G1-G2, respectively, by the NatureServe network (within the Western Hemisphere); (2) endangered and threatened species are those federally listed or proposed for listing by the USFWS, under the Endangered Species Act (within the US); and (3) critically endangered, endangered, or vulnerable categories are those listed as such by the IUCN Red List (internationally). Additional information is included in the TNC profile in the Appendix.

Beyond focusing solely on species that are threatened or vulnerable themselves, a variety of other classes of species may be the target of conservation efforts. The term focal species includes a variety of species that may have “spatial, compositional, and functional requirements that may encompass those of other species in the region and may help address the functionality of ecological systems” (Groves et al. 2000). Several types of focal species are defined across approaches, including the following:

- **Indicator species** are “species or groups of species chosen as an indicator of, or proxy for, the state of an ecosystem or of a certain process within that ecosystem” (WWF 2005). The presence of these species may be useful in indicating a variety of conditions, from the presence of lichen species in forests being a powerful indicator of clean air to the presence of certain bird species serving as a proxy for biodiversity. Margules and Pressey (2000) explain that there is a “strong temptation to use a group of species, for example vascular plants or vertebrates, as a measure of biodiversity.” This statement reflects the practical necessity of using such indicators as well as the fact that such practice is considered reasonably accurate by scientific evidence (e.g., as discussed above with respect to BirdLife International’s approach, there is scientific evidence to suggest that birds are a reliable indicator of biodiversity). Conservation International’s Biodiversity Hotspots approach uses the indicator species concept where the number of species of vascular plants are used as a surrogate measure of richness for entire regions. Similarly, WWF uses the taxonomic groups that have the most available data in their measure of species richness, intending also for the taxa to represent a diverse subset of the region biota. In this way, the better known taxa can be used as an effective proxy for more numerous and less well-known groups (such as insects), and therefore as indicators of overall biodiversity patterns. Examples of taxa often used include: vascular plants, birds, mammals, reptiles, amphibians, butterflies, and mollusks.

- **Umbrella species** are sometimes targeted for conservation due to the fact that by protecting them, whole ranges of other species are also theoretically protected. (See our discussion under Criteria).

- **Keystone species** are defined as those species whose impact on a community or ecological system is disproportionately large relative to
their abundance. These species play a more dominant ecological role than
others and are therefore a target of conservation efforts. They contribute
to ecosystem function in a unique and significant manner through their
activities. Their removal initiates changes in ecosystem structure and often
a loss of diversity (Groves et al. 2000). One classic example of the keystone
species concept is the sea star *Pisaster ochraceous*, which suppresses
mussels, the dominant competitor in the rocky inter-tidal zone of the
Pacific coast of North America. Without this sea star, the area would be
overtaken with mussels and the entire ecology would be dramatically
changed. In such cases, keystone species may be a prime target for
conservation because focusing on them prevents a dramatic change of the
ecosystem dynamics. Other examples of keystone species are bison, prairie
dogs, sea urchins and beavers.

- **Wide-ranging species** are defined as those that depend on vast areas. These
  species include top-level predators (e.g., wolves, grizzly bears, pike min-
  now, killer whale) as well as migratory mammals (e.g. caribou), anadrom-
  ous fish, birds, bats, and insects. Wide-ranging species can be especially
  useful in examining necessary linkages among conservation sites in a true
  “network” of sites (Groves et al. 2000). WCS’s Range-wide Priority Setting
  approach targets wide-ranging species as an ultimate target, and popula-
  tions of those species in different geographic settings as immediate targets.

**Additional Notes on Targets**

In addition to species and particular locations, other targets may include plant
communities, key nesting or breeding sites, or some other concrete element of
biodiversity. Many of these targets are set at the local level and a complete discussion
is beyond the scope of this report.

Targets are often set at multiple levels in order to capture various aspects of
biodiversity. Although TNC does not set global priorities, their methodology for
recognizing these multiple levels is pertinent here. TNC uses the terms ‘fine-filter’ and
‘coarse-filter’ to refer to different targets at different levels. Both ecosystem and
community-level targets are referred to as coarse filter targets; species targets are
referred to as fine-filter targets. Given that it is impractical to plan for all of the
elements of biodiversity, even all of those that are known, TNC selects a subset of
targets at different spatial scales (local, intermediate, coarse, and regional) and levels
of biological organization (species, communities, and ecological systems) that will
best represent all biological diversity. This idea is based on what TNC calls the ‘coarse-
fine filter strategy,’ a working hypothesis that assumes that conservation of multiple,
viable examples of all coarse-filter targets (communities and ecosystems) will also
conserve the majority of species (fine-filter targets); those species that the coarse filter
cannot reliably conserve require individual attention through the fine-filter
approach. Wide-ranging, very rare, extremely localized, narrowly endemic, or
keystone species are all likely to need fine-filter strategies (Groves et al. 2000).
CRITERIA

ENGOS use various scientific and conservation criteria to prioritize targets for conservation, from a high concentration of endemic species to the conservation status of a particular area. We identified thirteen criteria commonly used by the eight approaches examined, including six that relate to the biological value (for example, species richness) and seven that relate to conservation value (for example, habitat that is threatened). Table 7 provides a summary of the thirteen criteria and Table 8 provides a synopsis of which criteria are used by each approach. Approaches often rely on a combination of several criteria, and some key combinations are discussed immediately following the description of each criterion.

Criteria tend to overlap considerably. For example, “degree of fragmentation” and “habitat loss” are two distinct yet often correlated criteria. Areas that are highly fragmented have often also experienced high levels of habitat loss and vice versa – yet these two criteria are not completely synonymous. Similarly, species that have declined (our “species decline” criterion) are often threatened, but not necessarily so. In addition, some criteria apply just at the species level, while others relate solely to habitats or ecosystems, and still others may apply to both. We have defined terms here in order to have a starting reference point, yet individual approaches may use different labels or combine one or more of our criteria into one category (or vice versa).

Finally, as noted earlier, a single concept can serve both as a target and as a criterion, depending on the level of analysis. When setting global priorities – for example when prioritizing ecoregions – the presence of threatened species may be used as a criterion to select the targeted ecoregion. However, when setting priorities at a finer resolution – for example, at the site level – the threatened species itself becomes a target, and the particular listing requirement applied to that species becomes the criterion.

The term threshold is used often in this discussion of criteria. This term refers to a minimum or maximum value associated with a particular criterion necessary to designate it as meeting that conservation criterion. For example, the World Resources Institute’s Forest Program, which maps intact forested landscapes, has a minimum threshold of 50,000 hectares for these areas; any intact landscapes smaller than this size are not large enough to meet this criterion.

BIOLOGICAL VALUE CRITERIA

Representation

Approaches that utilize representation as a criteria base decisions on the notion that a portfolio of conservation areas should include sites representing all of the different ecosystems or different geographic contexts in the area of concern. We discussed representation as a planning principle, but it is also used as a biological criterion to prioritize sites or populations for conservation. WWF’s Global 200, and both WCS’s Last of the Wild and Range-wide Priority Setting all incorporate this criterion. For
example, WWF conducted an analysis of ecoregions representing the Earth’s 30 terrestrial, freshwater, and marine major habitat types (e.g., tropical dry forests, large lakes, coral reefs), identifying 238 ecoregions as priority targets for conservation action because they harbor the most outstanding and representative examples of the world’s diverse ecosystems. As explained by WWF, “We selected outstanding ecoregions within each major habitat type from each of the world’s biogeographic realms and ocean basins to better capture the variation in species assemblages around the world” (Olson and Dinerstein 1998).

Table 7 Criteria Used to Prioritize Conservation Targets

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>REPRESENTATION</td>
<td>A portfolio of conservation sites should include sites representing all of the different ecosystems in the area of concern</td>
</tr>
<tr>
<td>SPECIES RICHNESS</td>
<td>The number of species within a given area; sometimes used as a simple measure of biodiversity</td>
</tr>
<tr>
<td>SPECIES ENDEMISM</td>
<td>The number of species found exclusively in that location, relative to a particular geographic unit</td>
</tr>
<tr>
<td>RARITY</td>
<td>Species and/or ecosystems that are naturally rare</td>
</tr>
<tr>
<td>SIGNIFICANT OR OUTSTANDING ECOLOGICAL OR EVOLUTIONARY PROCESSES</td>
<td>Ordinary and extraordinary ecological processes. Examples: key breeding areas, migration routes, globally outstanding centers of evolutionary radiation, unique species assemblages</td>
</tr>
<tr>
<td>PRESENCE OF SPECIAL SPECIES OR TAXA</td>
<td>Presence of an umbrella, keystone, indicator, or flagship species; Habitat for a particular species or taxa; for example, wide ranging species or waterfowl</td>
</tr>
<tr>
<td>THREATENED SPECIES</td>
<td>Species (or the presence of species) that have been nationally or globally listed as threatened or endangered</td>
</tr>
<tr>
<td>SPECIES DECLINE</td>
<td>Species whose populations have undergone significant decline in recent years</td>
</tr>
<tr>
<td>HABITAT LOSS</td>
<td>Areas that have lost a significant percentage of their primary vegetation or habitat</td>
</tr>
<tr>
<td>FRAGMENTATION</td>
<td>Areas that have been fragmented into smaller parcels and have low connectivity</td>
</tr>
<tr>
<td>LARGE INTACT AREAS</td>
<td>Areas with a certain minimum size with no or minimal human impact</td>
</tr>
<tr>
<td>HIGH FUTURE THREAT</td>
<td>Areas that face high pressure from encroaching human populations or development</td>
</tr>
<tr>
<td>LOW FUTURE THREAT</td>
<td>Areas that have low human population or low development pressure</td>
</tr>
</tbody>
</table>
Table 8  A Comparison of Criteria Used across Approaches

<table>
<thead>
<tr>
<th></th>
<th>BIOLOGICAL VALUE</th>
<th>CONSERVATION VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>REPRESENTATION</td>
<td>SPECIES RICHNESS</td>
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<tr>
<td>Alliance for Zero Extinction AZE Sites</td>
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<td>✓</td>
</tr>
<tr>
<td>BirdLife International Endemic Bird Areas</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>BirdLife International Important Bird Areas</td>
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<td>✓</td>
</tr>
<tr>
<td>Conservation International Biodiversity Hotspots</td>
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<td>✓</td>
</tr>
<tr>
<td>Conservation International High Biodiversity Wilderness Areas</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Wildlife Conservation Society* Range-wide Priority Setting</td>
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<td>✓</td>
</tr>
<tr>
<td>Wildlife Conservation Society Last of the Wild</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>World Wildlife Fund Global 200</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
</tr>
</tbody>
</table>

Species Richness

Species richness is sometimes used as one of several quantitative measures of biodiversity. As mentioned previously, biodiversity is often an ultimate goal in conservation planning approaches, yet it is hard to quantify and use as a criterion. Rather, more tangible and measurable criteria, such as species richness – defined by the number of species existing within a certain area – are often used. The Biodiversity Support Program (Johnson 1995) explains, “Species richness is very important in most schemes to identify biodiversity conservation priorities and is the simplest and most quantitative criterion available to identify priorities.”

An underlying assumption is that the greater the number of species within a given area, the greater the value of an area to biological diversity. For example, an area of a certain size and ecosystem type containing 200 species might be considered more valuable than the same area and ecosystem type containing just 100 species. Acting alone, this measure does not take into account other factors relevant to biodiversity, such as the taxonomic diversity among species or the number of healthy populations of individuals within each species. Richness is most often applied at the species level; however, the concept may also be applied to the ecosystem or even genetic level.

WWF is one of the key organizations that use species richness. The concept is one of four factors that comprise a measure of Biological Distinctiveness at an ecoregional level. Species richness is obtained by adding up the total number of species of
several taxa, usually including vascular plants, birds, mammals, reptiles, amphibians, butterflies and mollusks. To reduce the effect of highly species-rich taxa (for example vascular plants), data are log-transformed, preferred because it condenses the range of the data yet preserves differences among taxa. More information about the process used by WWF in using Species Richness as a criterion can be found in their profile.

**Endemism**

Endemism is the most popular criterion, used by AZE, BirdLife International, Conservation International, TNC, and WWF. Endemic species are defined as those that are found solely within a particular area and nowhere else on the planet. The link between averting extinction and focusing on endemics is clear: a focus on endemics is by definition a focus on the only place on earth where a particular species is found.

Endemism is a relative measure that must be paired with a geographic area. For example, a bird species that is found only on a particular island is endemic to that island. Since species often evolve via a series of specific environmental influences to which they must adapt over many years, areas that are geographically isolated, such as islands, tend to host a greater number of endemic species. For example, nearly all the mammals and birds of Madagascar are found only on that island, so losing the small parcels of intact habitat there will result in the global extinction of those species. However, there are many areas of high endemism on the mainland as well; for example, the Cape region at the southern tip of Africa has a flora of 9,000 plant species, 6,210 of which are endemic (Cowling and Pierce 2004).

Because endemism does not have a particular geographic scale attached to it, some approaches have used a threshold of 50,000 km$^2$ to define a restricted-range or endemic species, rather than relying on an infinite range of geographic scales. This threshold was first used by Terborgh and Winter (1983) in which they defined a “small range” arbitrarily as “any distribution encompassing less than 50,000 km$^2$.” The threshold was then used by BirdLife International to define endemic species, and, following BirdLife’s lead, WWF later incorporated this threshold into their own criteria. WWF’s definition of species endemism is either that the total species range is less than 50,000 km$^2$, and is present in no more than five ecoregions, or the total species range is more than 50,000 km$^2$, but a single ecoregion contains 75 – 100 percent of the species’ range. Additional information about how WWF quantifies endemism can be found in their profile.

**Rarity**

Rarity is a criterion that can be applied at the species or ecosystem level. Rather than referring to species or ecosystems that were made rare by human behavior, rarity is often used to refer to species, ecosystems, or genotypes that are naturally rare based on a particular set of naturally-occurring circumstances. Thus, the rarity criterion places greater conservation value on species, ecosystems, or genotypes that are rare and where the opportunity for conservation is limited due to limited possibilities for intervention.
WWF uses rarity as a criterion by measuring “the number of opportunities to conserve this habitat type worldwide and the corresponding importance of the ecoregions that contain it. This criterion encompasses ecological and evolutionary phenomena, but it addresses those characteristics at the scale of whole ecosystems and biotas, as well as structural features of ecosystems and habitats.” An ecoregion is considered at the highest level of rarity if fewer than eight ecoregions worldwide contain its habitat type.

**Significant or Outstanding Ecological or Evolutionary Processes**

The presence of significant or outstanding ecological or evolutionary processes is broadly defined as referring to a range of processes, from more common occurrences such as key breeding sites and migration routes, to extraordinary features such as globally outstanding centers of evolutionary radiation and unique species assemblages.

The inclusion of this criterion is common in conservation priority-setting approaches, yet this might not be apparent when reviewing Table 8, due to the fact that this criterion is often evaluated at a local level. One global approach that takes this significant process into account is WWF’s Global 200, which includes globally outstanding centers of evolutionary radiation, higher-level taxonomic diversity, and unique species assemblages. Examples of rare ecological phenomena are large-scale migrations of larger vertebrates, extraordinary seasonal concentrations of wildlife, or distinctive processes such as the world’s most extensive sheet-flow grasslands (i.e., the Everglades). The methodology involved in identifying Key Biodiversity Areas – which are used by Conservation International, BirdLife International, and other partners – also considers the presence of a globally-significant congregation of a given species, which may or may not be considered a significant ecological process.

**Presence of a Particular Species or Taxa**

When conservation approaches aim to conserve a particular species or taxa, the presence of that species or group within a particular site or range is often used as a criterion for selecting a geographic area as a conservation target. Examples include WCS’s emphasis on wide-ranging species and BirdLife International’s focus on birds. Note that the use of threatened species as a criterion is discussed separately under the Conservation Value category.

Organizations or partnerships may opt to focus on a particular species or a group of species for several reasons relating to a range of scientific, aesthetic, moralistic, and other values. Often, there is some underlying appreciation for the species or group that originates from a non-scientific origin. For example, in addition to scientifically-based reasoning for BirdLife’s focus on birds there is presumably a deep aesthetic and possibly moralistic appreciation of birds based in elements of personal preference that are beyond the scope of this report.

There are also scientific reasons for focusing on particular species or groups of species. For example, some focal species may serve as an “umbrella” to conserve a
range of other species. Margules and Pressey (2000) explain emphasizing focal species (a term that may include umbrella species) as “attempts to integrate patterns and processes by identifying those species in a landscape that are most demanding of resources and then target them for management . . . if management can maintain these species in a landscape, then most other species will be maintained as well.” Furthermore, as elaborated earlier, some species are considered keystone species (also often considered a sub-category of focal species) because they play an unusually significant role in their ecosystem, and their removal would risk harm to the ecosystem structure. Examples of these species and a more detailed discussion of keystone, umbrella, wide-ranging, and focal species are included under the discussion of Targets.

Species that hold special political or social clout are sometimes referred to as “flagship species,” which WWF defines as “a species selected to act as an ambassador, icon or symbol for a defined habitat, issue, campaign or environmental cause.” Flagship species are often large and considered charismatic by the public. WWF emphasizes pandas, tigers, rhinoceroses, great apes, and elephants as flagship species. While WWF uses these species in conservation activities, their presence is not a criterion to prioritize areas for conservation. Caro et al. (2004) demonstrate the limitations of relying on flagship species, particularly when they are used synonymously as de facto umbrella species to delineate reserve boundaries. They found that the presence of two “flagship species” – jaguars and tapirs – were no more likely to be accurate indicators of five vertebrate taxonomic groups than two non-flagship species, the white-lipped peccaries and spider monkeys. Flagship species may still however, play an important role in rallying conservation support and protecting important areas.

**CONSERVATION VALUE CRITERIA**

**Threatened Species**

The presence of threatened species is a common criterion used to identify an area as a conservation target. Habitat loss is the number one source of species extinction, and as such, protecting the habitat of threatened species is the top priority of these approaches. In addition, the species itself may become a target if a range of actions are aimed at protecting that species, such as controlling for competitive invasive species, or ameliorating hunting pressure.

Internationally, perhaps the most widely referenced authority in designating classes of threatened species is the IUCN Red List (www.iucnredlist.org), which in 2004 evaluated 22,733 vertebrates, 3,487 invertebrates and 11,824 plants into various categories of threatened status. IUCN uses seven categories to rank the level of threat, from most to least severe: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, and Least Concern. Two additional categories include species that do not have enough data (Data Deficient) and those that have not been evaluated (Not Evaluated). These categories are based on various factors including past species decline, small ranges, and small population sizes.
thresholds and criteria for these categories can be found in the Appendix. Several of the approaches examined rely on these data. For example, AZE sites are those that contain the last global populations of species that have been classified by IUCN as Endangered, Critically Endangered, or Extinct in the Wild.

Another source of information about threatened species is the NatureServe network, which provides information on the identification, location, and conservation of at-risk species and ecological communities within the western hemisphere. With a similar yet distinct classification system from IUCN, NatureServe was established in 2000 by The Nature Conservancy as an independent, international nongovernmental organization encompassing a network of independent natural heritage programs and conservation data centers that “connect science with conservation.” These entities develop, manage, and distribute authoritative information about biological diversity to landowners and land managers, consultants, and scientists (NCASI 2004). (See Appendix for additional information on NatureServe).

**Species Decline**

The declining species criterion was not commonly used among the approaches we studied per se, probably because species decline is incorporated into the threatened species criterion. Nearly all species that are classified as some level of threatened (e.g., endangered, critically endangered) have undergone historical decline (refer to Appendix for IUCN listing criteria for Endangered Species); however, not all species that have undergone historical decline are necessarily listed as endangered or threatened. WCS’s Range-wide Priority Setting approach uses species decline among other factors to determine which populations of a species should be targeted for conservation attention. Among regional approaches, TNC uses decline as a criterion, defining declining species as those that have “significant, long-term declines in habitat and/or numbers, are subject to a high degree of threat, or may have unique habitat or behavioral requirements that expose them to great risk” (Groves et al. 2000).

**Habitat Loss**

Habitat loss due to land transformation and severe degradation is often identified as the single greatest threat to biological diversity. Habitat loss is a common criterion for determining priorities for conservation. Often, areas that have experienced significant decline in original vegetation or habitat are targeted for conservation. World Wildlife Fund, TNC, and CI’s Biodiversity Hotspots approach all use this as a criterion in setting priorities. CI’s Biodiversity Hotspots, for example, must have lost at least 70 percent of their original native vegetation (many have lost much more).

WCS’s Human Footprint mapping, from which their Last of the Wild areas are derived, uses a scale from 1-10 for “land transformation,” which is very much a proxy for habitat loss. They assign maximum scores (10) to built-up environments (such as urban areas), lower scores (6-8) to agricultural land cover, and still lower scores (4) to mix-use cover. These scores are incorporated with other dimensions such as human population density to determine an overall score measuring the input of human
influence (Sanderson 2002a). However, note that their Last of the Wild approach prioritizes areas that have undergone minimal habitat loss rather than great habitat loss; that is, while their criteria measures the extent of loss, the approach prioritizes areas that have been relatively undisturbed by humans (see more under “Large Intact Areas”).

**Fragmentation**

Fragmentation is the disruption of extensive habitats into isolated and small patches, and has two negative ramifications for biodiversity: the loss of total habitat areas, and the creation of smaller, more isolated, remaining habitat patches (Meffe 1997). These patches often mean that species populations become isolated from each other, preventing gene flow and metapopulation dynamics. Furthermore, ecological processes are typically disturbed.

Fragmented areas are often prioritized at a global level, when an approach places importance on threat. For example, WWF uses a “degree of fragmentation” measure in evaluating ecoregions for inclusion in the Global 200. Fragments under 100 km² are generally considered inadequate for maintaining viable populations of most large vertebrates. However, small fragments can be particularly valuable for conserving populations of other species with localized habitat requirements and small ranges. Rather than prioritizing fragmentation, many approaches prioritize the conceptual opposite of fragmentation, or intactness, described below.

**Large Intact Areas**

Intactness – or the presence of large intact landscapes free from significant human impact or degradation – is a criterion used by three approaches we examined, including CI’s High Biodiversity Wilderness Areas, WWF’s Global 200 approach, and WCS’s Last of the Wild approach. Large intact areas are considered by some ENGOs to be important for a variety of ecological reasons, including an ability to provide ecosystem services (filtering and purifying the water and air, oxygenation of air and water, soil fertility, acting as a carbon sink, flood prevention/slowing runoff, erosion control, effective sewage treatment, etc.), their ability to contain larger and more stable species populations, and their unique capability to support species with naturally low population densities or large home ranges.

The World Resources Institute’s Forest Program, and their Global Forest Watch initiative is one of the world leaders in mapping intact forested areas. Their analysis includes a basic overview of global intactness and more refined regional data for Canada and Russia. The main criteria for these areas are that they are a minimum threshold of 50,000 hectares in size and almost entirely unaffected by human disturbance, based on satellite imagery, ancillary data, and expert consultation. Human disturbance includes human-induced fire regimes, roads (and areas adjacent to roads), power lines, or pipelines. Citing that the scientific literature provides thresholds between 5,000 hectares and 500,000 hectares, WRI took a pragmatic figure that was intended to incorporate the needs of most wide-ranging species but still be
practical. As explained in the interview, “It’s not perfect, but no threshold is perfect.” Experts at WRI cited the need to be consistent across areas.

Wildlife Conservation Society’s Last of the Wild approach emphasizes intact landscapes with minimal human disturbance. Last of the Wild is based on an analysis known as the Human Footprint Mapping, which applies criteria such as power infrastructure and human population density across the globe to measure human influence. One reason WCS values such intact wild areas is due to their ability to support intact species assemblages. David Wilkie of WCS explains, “We believe that having intact assemblages of species is a key to these systems as self-regulating. For example, one reason that Greater Yellowstone is of biological value is that it contains an intact assemblage of carnivores and thus is a functional landscape.”

Other approaches use intactness or large habitat blocks as a criterion. For example, CI’s High Biodiversity Wilderness Areas are required to have at least 70% of their remaining vegetation left. It should be noted that intact forests often overlap with other types of forests targeted by ENGOs, such as “ancient” and old-growth forests.

**Future Threat (High and Low)**

In addition to evaluating targets for past decline, some approaches consider the level of future threat when prioritizing areas for conservation. An interesting note is that different approaches—sometimes within a single organization—will prioritize areas with both high future threat and low future threat for different reasons. Measures of conservation status and human population density are often used as indicators of the level of future threat.

WWF prioritizes areas for conservation that are not well-protected. WWF’s degree-of-protection criterion assesses how well the existing network of protected areas conserves sufficiently large blocks of habitat, in sufficient number, within a given ecoregion. Ecoregions that are not well protected are higher priority.

In addition, CI’s Biodiversity Hotspots approach refers to hotspots as areas that are highly threatened. We note that CI’s criteria for Biodiversity Hotspots are technically related to past fragmentation rather than a direct measurement of future threat (such as legal protection, or high human population density). However, as noted by Mike Hoffmann of CI, hotspots face high future threat as they host 2 billion people and the average protected area coverage of hotspots, for those protected areas in IUCN categories of protected areas I-IV (those in a higher level of protection), is only 5% of original hotspots’ extent. More importantly, Hoffmann notes, hotspots show a remarkable congruence with the priority regions highlighted in the study of Rodrigues et al. (2004) which illustrates a clear pattern of existing gaps in the protected areas system where highly threatened species have no current protection whatsoever. Finally, we know that hotspots are places of high current threat, because three-quarters of the world’s most threatened (Critically Endangered and Endangered) mammals, birds and amphibians are found only in the hotspots.

In contrast, some approaches prioritize areas that face less future threat, where lower human population density is often used as a proxy. Although the impact of human populations varies considerably with the nature of the human-ecosystem
interaction, Cincotta and Engleman (2000) indicate that greater declines in species and ecosystems are often correlated with higher human population densities. Accordingly, as WCS explains, studies in national parks in Ghana (Brashares et al. 2001) indicate that a 98% variation in extinction rates could be explained by the number of people living in close proximity to parks, in addition to size issues. Finally, in their study of the hunting for bushmeat, Robinson and Bennett (2000) note that land typically cannot support more than one person who relies exclusively on wild meat for food per square kilometer.

Rather than focusing on areas where human population is greatest and hence conservation efforts are most challenging, some approaches emphasize areas with lower population densities. For example, to complement their hotspots approach which prioritizes areas that are already highly degraded (in addition to having exceptionally high levels of endemism), CI also prioritizes High Biodiversity Wilderness Areas which are required to have a low human population density criteria (5 people/km²) as well as high levels of endemism, explaining that these areas are some “good news” in the quest to protect biodiversity. Similarly, WCS uses low human population density as a criterion in establishing their Human Footprint mapping upon which their Last of the Wild areas are selected. WCS recognizes that there is little guidance in the literature about how human influence exactly scales with population density, so they use a continuum approach that relies on the existing scientific information (e.g., Robinson and Bennett 2000, and others) to reflect a linear gradient of human pressure between 1 and 10 km². All of the areas WCS includes in their “Last of the Wild” have a maximum human population density of 1 person per km².

**MONITORING AND ADAPTIVE MANAGEMENT**

Most of the approaches incorporate some sort of monitoring to evaluate the efficacy of their approaches. While this was not a significant focus of this study, we were able to determine that organizations and partnerships value adaptive and flexible approaches. First, we found that the process of developing an approach was often an iterative exercise in which initial criteria and thresholds were first drafted and then provided to local experts and practitioners for further refinement. For example, AZE developed an initial methodology that was distributed to local experts for feedback and then refined into a more finalized methodology.

What is clear is that the approaches are continually evolving and expanding. For example, AZE has initially focused their efforts on vertebrates because information on vertebrates is available; they will re-evaluate this focus as more data on other taxa become available. WCS is currently revising their Human Footprint map (on which their Last of the Wild approach is based), using newer datasets, and they have been working on local and regional human footprints (e.g. for Northern Appalachians, the Adirondack Mountains, Central America, the Amazon Basin) to create better datasets to define wild places. In addition, they are working on the marine human footprint, where the influencing factors are fishing, land-based pollution, water-based pollution, biological introductions from shipping, etc. Likewise, the Conservation Science
Program at WWF has identified 825 terrestrial ecoregions across the globe, and a set of approximately 500 freshwater ecoregions is under development; an analogous global framework of marine ecoregions would be a distant goal.

In addition, some approaches implement monitoring of conservation efforts. BirdLife has a systematic method of monitoring that uses a two-tier system to obtain both breadth (coverage of the entire IBA network) and depth (more intensive effort at a sample of sites). Basic monitoring involves regular assessment, usually annual, of every IBA site against indicators of “state,” “pressure,” and “response.” Detailed monitoring of a sub-set of priority sites is tightly linked to the site conservation objectives and makes use of existing bird counting schemes.

CI engages in monitoring to the extent that it is continually evaluating not only the impact of its approaches, but also the changes that political, social, and biological forces impose on the areas in which it works. CI’s Center for Applied Biodiversity Science has created an Early Warning System to enable proactive responses by the conservation community at large. In addition, CI continually revisits its approach, and although main criteria have not been altered, the approaches have evolved with time. For example, hotspots were originally defined without reference to ecoregions, and now ecoregional concepts are being integrated.
Global Approach Profiles

This section provides a systematic review of eight global conservation approaches implemented by five major international NGOs, including the Alliance for Zero Extinction, BirdLife International, Conservation International, the World Wildlife Fund, and the Wildlife Conservation Society.

Each profile follows the structure of the Conservation Priorities Framework (see Table 2 on page 24), which includes information on the implementing organization; an approach summary; a detailed discussion of how targets and criteria are established and defined; and a related description of implementation and monitoring activities. Maps of prioritized areas are provided wherever possible and all profiles conclude with a table summarizing each approach.

**ALLIANCE FOR ZERO EXTINCTION (AZE)**

**AZE Sites (Pinpointing and Conserving Epicenters of Imminent Extinctions)**

**ORGANIZATIONAL OVERVIEW**

The Alliance for Zero Extinction (AZE) is an international coalition of conservation organizations united in an effort to prevent the most imminent of species extinctions. Established in 2002, AZE’s key charge is to identify and direct conservation attention toward geographic sites that contain the entire global populations of endangered species. In doing this, AZE aims “to create a front line of defense against extinction that will hold until broader scale conservation efforts can restore sufficient habitat to enable populations to rebound.” (AZE 2005). The Alliance is open to any nongovernmental environmental organization with a primary purpose of conserving biological diversity, as well as relevant IUCN commissions. AZE currently consists of over thirty organizations, including global conservation organizations examined in this report.

With a focus largely on vertebrates for the time being, AZE sites are those that provide habitats for species of birds, mammals, reptiles, amphibians, and one category of plant (conifers) that have been identified as endangered or critically endangered by IUCN and have global populations limited to a single functional population in one discrete area (additional taxa are being added as information becomes available). As such, the approach identifies single areas that AZE members believe need to be addressed immediately in order to prevent imminent extinction.
With just two years under its belt, AZE has completed its first and central task of compiling a final list of global epicenters of potential extinctions (AZE Sites), which identifies several hundred sites (See Map 1 below). From there, AZE will conduct a gap analysis to identify which of these areas lack protection, and help direct appropriate attention and conservation action to those sites. While the locations of many of these key sites have already been identified, the actual boundaries have not. More comprehensive information about designated sites will be explained in an upcoming publication with the official launching of this approach. The coalition's website is a useful source that provides specific information about the process, criteria, and thresholds used to identify key sites (http://www.zeroextinction.org).

**Map 1  Alliance for Zero Extinction Sites**

Legend: Map of sites identified by the Alliance for Zero Extinction (n=561) holding endemic Critically Endangered (CR) or Endangered (EN) mammal, bird, reptile, amphibian and conifer species (note: based on 2004 IUCN Red List data, for which reptiles not yet globally assessed). Yellow sites are either fully or partially contained within declared protected areas, while red sites are completely unprotected or have unknown protection status.

Source: The Alliance for Zero Extinction; data version 2.0.

**APPROACH OVERVIEW**

AZE’s approach sets priorities on a global scale; once key global sites are identified, several organizations work to implement those priorities on the ground at the site level. (There is no established process for setting on-the-ground priorities that is developed enough to be discussed by this paper). AZE’s scope is global in extent, in that it looks at the entire globe in selecting areas to pinpoint for conservation. AZE has not yet established how marine and freshwater areas will be evaluated, so the current extent is restricted to land areas. With respect to the planning unit, AZE’s approach does not set minimum or maximum sizes of their sites. However, sites tend
to be much smaller than hotspots and ecoregions, and as such, the approach is similar to many regional programs that set priorities within regions.

AZE’s approach focuses at the species level in its attempt to prevent the imminent extinction of species, rather than targeting larger ecological processes or genetic diversity within. In order to protect species from extinction, AZE focuses on safeguarding habitat while also considering a broader range of threats such as the effects of diseases and hunting. AZE’s streamlined approach emphasizes three main principles – sites need to be practical, usable and replicable. The principle of the inherent value of nature or wildlife underlies this approach.

By identifying epicenters of imminent extinction AZE helps other organizations and stakeholders prioritize these sites for conservation. However, AZE recognizes that the approach does not address other very important conservation targets that are also deserving of attention. For example, wide-ranging species do not inhabit single sites and therefore do not meet one of the necessary criteria to warrant designation of a site under this approach.

AZE sites often fall within larger conservation landscapes. While many AZE partners are engaged in their own conservation planning and priority-setting at a larger scale (i.e., at the ecoregional level), their involvement with the Alliance is complementary by pinpointing smaller areas within the larger landscapes already defined by their organization. For example, many AZE sites occur within the WWF’s Global 200 Ecoregions, CI’s Biodiversity Hotspots, or BirdLife International’s Important Bird Areas. As the criteria for discrete populations of birds are based on BirdLife Internationals’ Endemic Bird Areas, many AZE sites overlap entirely with these areas.

**SOURCES OF INFORMATION**

AZE recognizes The World Conservation Union (IUCN’s Redlist; www.redlist.org) as the listing authority for defining species of concern (criteria and thresholds used by IUCN can be found in the Appendix). Relying on this global authority ensures that critical efforts to identify and list species are not duplicated. AZE will not define sites for newly discovered and data deficient species until these have been assessed and classified by the relevant IUCN authority in order to avoid the development of a parallel assessment process. Rather than engaging in separate data collection, AZE works with IUCN to strengthen the ability to list species quickly and efficiently. For those species considered Endangered or Critically Endangered for which no specific site can currently be selected due to lack of data, AZE encourages expeditions to locate populations in hopes that a site can be selected at a later date. “Known” populations include those localities with a published record of the species, even if there is no recent survey data (i.e., the species is assumed to persist unless proven otherwise).

Beyond IUCN data, AZE’s main source of information has been more than a hundred local, regional, and national experts around the world engaged to identify sites. AZE understands that every situation is different and that the process of identifying local sites must hinge on local knowledge and how it is applied given current circumstances. AZE’s process identifies regional coordinators to conduct an initial site
identification process based primarily on data collected through the IUCN Red List process, such as the Threatened Birds of the World (data managed by the BirdLife International Partnership; see www.birdlife.org) and the Global Amphibian Assessment (www.globalamphibians.org). AZE then confers with in-country experts who complete an initial review of site and species data and evaluate the degree to which sites meet the AZE criteria. This process often involves leveraged regional programs of some partner organizations (such as those of WWF, American Bird Conservancy and CI), to help identify such experts, and also to help identify sites. In addition, AZE makes use of the World Database on Protected Areas, a comprehensive dataset on global protected areas managed by UNEP-WCMC (www.unep-wcmc.org) in partnership with the IUCN World Commission on Protected Areas (WCPA) and the World Database on Protected Areas Consortium.

TARGETS AND CRITERIA

Although species are arguably the conservation target of concern in AZE’s approach, in setting global priorities we identify the AZE site as the immediate target rather than the species itself. This is because AZE decisions focus on selecting these sites rather than a lower level of directing specific conservation action toward individual species.

• **Criterion #1: Endangerment**  
   An AZE site must contain at least one Endangered (EN) or Critically Endangered (CR) species, as listed by IUCN. These are the two most severe categories of species that are threatened and have sufficient data to be evaluated by IUCN (see Appendix for IUCN categories, criteria and thresholds). In addition, if a species is listed as Extinct in the Wild (EW), an AZE site may be identified for which an EW species will have the most viable potential for reintroduction. Although the presence of just one of these species will “trigger” a site, the presence of multiple EN or CR species may make it more urgent. Some taxa of plants and insects have not been assessed completely using Red List criteria. AZE will expand its targets as new information on the status of species and their habitats becomes available.

• **Criterion #2: Irreplaceability**  
   An AZE site must either be the sole area where an EN or CR species occurs or contain the species’ overwhelmingly significant known resident population or life history segment (for example, breeding or wintering grounds). The definition of overwhelmingly significant has a threshold of approximately 95% of the species’ global population for at least one life history segment. This 95% threshold is a somewhat arbitrary number that serves the function of allowing some “wiggle room” in making these decisions. AZE notes that this criterion necessarily eliminates wide-ranging species that are also important conservation targets. It is not that these wider-ranging species are less important, but rather that this particular approach can not address their needs.
**Criterion #3: Discreteness**

An AZE site must have a definable boundary within which the character of habitats, biological communities, and/or management issues have more in common with each other than they do with those in adjacent areas. The boundary of the area should be defined according to the most practical unit for which conservation can be applied.

**IMPLEMENTATION AND MONITORING**

Once an area is selected as an AZE site, the process of defining the boundaries and then proceeding with conservation planning has few concrete rules that can be systematically applied to all sites. AZE understands that each site is unique and that local knowledge and opinion are critical in making these on-the-ground decisions. Local experts must look at various factors that might vary from site to site. For example, indigenous people might have a particular relationship with a forest in one area that needs to be incorporated into local planning that could not be anticipated in advance. As Michael Parr of AZE explained, “Situations are just so radically different from each other; we need to deal with different areas differently. You can’t come up with one cookie-cutter delivery mechanism that is applicable to all sites.”

With this in mind, AZE does provide some general guidance for specific site planning. One key guideline is to consider areas of important habitat that are adjacent to existing protected areas or in the buffer zones for inclusion within each site. In defining discrete areas, AZE recommends considering the extent of contiguous habitat, the potential for significant gene flow between populations (for example, the inclusion of corridors and considering the proximity of populations), and the extent of occurrence of the species relative to practical conservation considerations. However, no specific guidelines or thresholds are provided uniformly across AZE sites to inform these considerations.

AZE engages in monitoring to the extent that it seeks to incorporate new information in an iterative process that is continually open to identifying new sites. IUCN’s Red List, upon which AZE’s decisions are based, reevaluates taxa against the criteria at unspecified intervals. AZE explains that this is especially important for taxa listed under Near Threatened or Data Deficient, and for threatened taxa whose status is known or suspected to be deteriorating.
## ALLIANCE FOR ZERO EXTINCTION
### GLOBAL CENTERS OF IMMINENT EXTINCTION

### OVERVIEW

**Organizational Mission:** To identify and direct conservation attention to global epicenters of species extinction (AZE Sites).

**Approach Objective:** Informs partners and other decision-makers; there is some internal priority-setting, but AZE’s main function is to inform decisions of outside/partner decision-makers.

**Planning Principles:** Functionality and Efficiency.

**Scale:** Global scale; Global extent, limited to land areas.

**Planning Unit:** AZE sites.

**Conservation Level:** Conservation is at a Species Level.

**Data Sources:** IUCN – Red List; World Conservation Monitoring Center; local and regional experts; literature review.

### TARGETS, CRITERIA AND THRESHOLDS

**Targets:** Endangered Species and their habitat.

**Criteria & Thresholds:**
- Endangerment (presence of EN or CR species on site); See IUCN criteria and thresholds in Appendix.
- Irreplaceability (presence of entire global population at site (threshold is ~95% of global population).
- Discreteness (the area must have a definable boundary).

**Weight:** All three criteria are essential and must be met to trigger a site. They are considered of equal weight.

### IMPLEMENTATION AND MONITORING

**Regional and Local Implementation:** AZE’s key role is identifying sites; once sites are identified they work – to some extent – with local partners on-the-ground to protect sites. Some considerations in site shape and designation include core areas, size and edge effects, buffer zones, corridors, gene-flow between populations, and island biogeography.

**Monitoring:** Ongoing monitoring of species and data available so that new species listings can trigger targeting of new sites; criteria and thresholds are recently-developed and relatively replicable and straightforward.
**BIRDLIFE INTERNATIONAL**

*Endemic Bird Areas and Important Bird Areas*

**ORGANIZATIONAL OVERVIEW**

BirdLife International is a global partnership of non-governmental organizations with a special focus on the conservation of birds. Each NGO partner represents a unique geographic territory or country. The BirdLife International Partnership strives to conserve birds, their habitats, and global biodiversity, while working with people towards sustainability in the use of natural resources. By focusing on birds and the sites and habitats on which they depend, the BirdLife Partnership seeks to improve the quality of life for birds, for other wildlife, and for people.

BirdLife’s aims are to:

- prevent the extinction of any bird species;
- maintain and where possible improve the conservation status of all bird species;
- conserve and where appropriate improve and enlarge sites and habitats important for birds;
- help, through birds, to conserve biodiversity and to improve the quality of people’s lives; and
- integrate bird conservation into sustaining people’s livelihoods.

**APPROACH OVERVIEW**

BirdLife’s approach is taxa and species oriented, with the objective of defining particular sites for habitat conservation on an ecosystem level. Thus, although the organization’s focus is very species-specific in how it defines priority areas, the on-the-ground conservation goal is to protect ecosystems that are important to bird diversity, as a proxy for biodiversity.

BirdLife has chosen the approach of conserving general biodiversity by focusing on birds as a result of the relationship between bird populations and global ecosystem integrity: many birds are wide-ranging and migratory, with specific varied habitat needs for breeding, wintering, and migration. BirdLife’s approach uses birds as an environmental indicator of the general state of biodiversity. Its premise is that as there is a tremendous amount of data on birds in most places of the world over long periods of time, much more robust in scope than is available on most other taxa, birds and their habitat needs are a practical conservation target.

According to BirdLife International, “Birds have a special place as an environmental indicator for many reasons, not least because of their enormous public appeal. A global network of birdwatchers and ornithologists continues to provide a huge amount of information about birds – information that is largely lacking for other species.” BirdLife contends that changes in the overall threat status of the world’s bird
species reflect changes in the underlying threats to biodiversity. This concept is backed up by citations of published studies showing that birds score very highly on many of the broad criteria defined for selecting indicator taxa (Pearson 1995) and on birds as indicators of species richness and endemism patterns (Burgess et al. 2002; Bibby et al. 1992).

BirdLife uses existing data sets on bird populations and distributions to identify two types of conservation priority areas: Endemic Bird Areas (EBAs) and Important Bird Areas (IBAs). Map 2 and Map 3 below illustrate Important Bird Areas in Asia and Endemic Bird Areas in Africa respectively.

*Map 2  The Location of Important Bird Areas in the Asian Region*
An EBA is defined as an area that encompasses the overlapping breeding ranges of two or more restricted-range (less than 50,000 km²) landbirds, such that the complete ranges of at least two species fall entirely within the boundary of the EBA (see below for detailed discussion of EBAs). These areas are designated as the most important
places worldwide for habitat-based conservation of birds and other biodiversity, and are also often particularly rich in human culture and languages. There are 218 designated EBAs as of 2004.

IBAs are key sites for conservation, as they are small enough to be conserved in their entirety and are often already part of a protected-area network. IBAs accomplish one (or more) of three things:

- Hold significant numbers of one or more globally threatened species
- Are one of a set of sites that together hold a suite of restricted-range species or biome-restricted species
- Have exceptionally large numbers of migratory or congregatory species

As of 2004, there are some ten thousand IBAs identified in 153 countries or territories. Many IBAs lie within EBAs, although this is not a requirement. IBAs form networks for species, often comprising the best remaining fragments of natural habitat within disturbed landscapes.

BirdLife sets priorities for conservation through these two lists, which are developed at the international (EBA) and national (IBA) levels from local knowledge and local survey data. BirdLife survey data (incorporated into the IUCN Red List of Threatened Species for birds), international experts, and other internationally recognized data sets such as the Ramsar (Wetlands) Convention are used to develop the lists of EBA and IBA sites (see below for more discussion of how the lists are derived).

EBAs are identified without regard to conservation status; however, IBAs are intended to be sites where conservation objectives can reasonably be achieved. Lists are developed at the international scale for EBAs, and at the continental, regional, and national scales for IBAs. Conservation action is at the IBA level and takes place at the national scale. Both designations are without regard to grain (size) or extent. For example, in Africa, EBAs range in size from 17 km$^2$ to 340,000 km$^2$; IBAs range from less than 1 km$^2$ to over 10,000 km$^2$.

Data sources are primarily obtained from the following:

- Bird surveys
- Local expert knowledge (birdwatchers and ornithologists)
- IUCN data on globally threatened species (BirdLife International 2000)
- BirdLife Biodiversity Project for bird species of restricted ranges
- Continental and national bird atlases
- Wetlands International data on International Waterbird Censuses, as well as information on size and geographic ranges of waterbird populations
- National and continental vegetation maps

Data collection is standardized as much as possible and maintained in a BirdLife database (the World Bird Database) for each EBA and IBA, of which a simplified version is available from BirdLife website (http://www.birdfile.org/datazone/index.html).
BirdLife’s planning principles are based on efficiency (IBAs are by definition high quality bird population sites that are amenable to conservation action and management); functionality (IBAs are conserved in order that they may continue to function as high value bird habitat); international recognition and cooperation (IBAs are nationally identified sites meeting international criteria); a belief in the intrinsic value of birds and biodiversity; and engaging local stakeholders in data collection and the identification of IBAs, and in achieving conservation status of IBAs (through so-called Site Support Groups).

**TARGETS AND CRITERIA – ENDEMIC BIRD AREAS (EBAS)**

At the global scale, BirdLife uses endemism as the criterion for designating conservation priority areas. Worldwide, the most important places for habitat-based conservation of birds are the Endemic Bird Areas – critical regions for the conservation of the world’s birds and other biodiversity, that are often also particularly rich in human culture and languages. An EBA is defined as an area that encompasses the overlapping breeding range of two or more restricted-range (smaller than 50,000 km$^2$) land birds, such that the complete range of at least two species falls entirely within the boundary of the EBA.

BirdLife has identified 218 regions of the world as EBAs. Eighty-three percent of EBAs are in forests, especially tropical lowland forest and moist montane forest. EBAs vary in size from a few square kilometers (islands) to 340,000 km$^2$. Birdlife has developed these EBAs by mapping every bird species with a restricted range of less than 50,000 km$^2$, using many thousands of geo-referenced locality records (bird inventory and survey data).

EBAs are broad-scale, large-grain, global priority conservation target areas that according to BirdLife overlap extensively with other global priority schemes such as CI’s Terrestrial Biodiversity Hotspots and WWF’s Global 200 Ecoregions.

**TARGETS AND CRITERIA – IMPORTANT BIRD AREAS (IBAS)**

BirdLife’s IBA program seeks to locate, document, and protect networks of sites – areas that can be delimited and, potentially, managed for conservation – critical for the conservation of the world’s birds. IBAs are small enough to be conserved in their entirety and are often already part of a protected area network. They are particularly important for bird conservation because they regularly hold significant populations of one or more globally or regionally threatened, endemic, or congregatory bird species or highly representative bird assemblages. Conservation targets are those bird species that can be effectively conserved through a network of sites. IBAs are identified, monitored, and protected by national and local organizations and individuals, working on the ground.

A site qualifies as an IBA if it holds species that trigger one or more of the following criteria (see Appendix 6 for details of criteria and thresholds):

- Globally threatened bird species based on IUCN Red List criteria (note: BirdLife is the Listing Authority for birds for the IUCN Red List).
• Restricted range species with distribution of 50,000 km² or less.

• Biome-restricted species found only within a particular biome, and/or habitat.

• Congregations of significant numbers of birds, based on either biogeographic or global population estimates.

This approach is founded on the principle that IBAs are critical sites for the conservation of birds and biodiversity; places of international importance; practical targets for conservation action; selected according to internationally recognized criteria; used to reinforce existing protected area networks; and used as part of a wider approach to conservation.

Data used to evaluate sites for IBA status come from inventories compiled by BirdLife Partnership and other national organizations in a participatory process that involves expert individuals and government and non-governmental organizations. Information on sites is compiled from existing data and is combined with targeted fieldwork. The process is continental in scope, with national and regional evaluations. Within a region, prioritization of IBAs for conservation action is based on the degree of “irreplaceability” and “threat,” with particular emphasis on endemic species for whose conservation the region is globally responsible. Identification and documentation of IBAs are led, as far as possible, by the national BirdLife Partner or Affiliate, or similar organizations or individuals.

In regional conservation planning efforts, replicate examples of all unique ecosystem targets are included in the portfolio design to ensure the principle of representation. For each target, goals are established for the number and distribution of occurrences (examples) of the target to be captured. Individual conservation target occurrences represented in the portfolio design must be judged viable; viability assessments are undertaken and target occurrence viability is described on the basis of size, condition, and landscape context. In addition to biological targets, some ecoregional planners may include non-biological targets such as ecological gradients and/or processes.

Criteria for selection of Important Bird Areas are organized into categories (A1 through A4), which indicate scale and extent of conservation concern. Each category has an associated list of eligible species with a numerical population threshold that must be matched or exceeded in order for a site to qualify for that category. These population thresholds are derived, whenever possible, from internationally recognized sources of bird population data. Bird distribution data and population estimates for candidate sites are also required. In order for a site to be considered for IBA status, information is needed on location, bird species, reasons for importance, habitats and land uses, threats, protection status, and conservation action.

IMPLEMENTATION AND MONITORING

EBAs are developed globally by the BirdLife International Partnership and meant to inform local planning as to where to direct conservation efforts. IBAs are identified, protected and monitored at the local level using global criteria and are meant to be
practical targets for conservation at the local level and/or as part of a regional network. Implementation approaches are based on bird survey data and habitat mapping, considering representativeness, birds as umbrella species, spatial needs for birds, habitat fragmentation, connectivity, and migration corridors.

<table>
<thead>
<tr>
<th>BIRDLIFE INTERNATIONAL ENDEMIC BIRD AREAS (EBA) AND IMPORTANT BIRD AREAS (IBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OVERVIEW</strong></td>
</tr>
<tr>
<td><strong>Organizational Mission:</strong></td>
</tr>
<tr>
<td>To conserve birds, their habitats, and global biodiversity, while working with people towards sustainability in the use of natural resources.</td>
</tr>
<tr>
<td><strong>Approach Objective:</strong></td>
</tr>
<tr>
<td><strong>EBA:</strong> To identify areas of high bird endemism using birds as an environmental indicator of the general state of biodiversity, and focus international conservation attention to those areas.</td>
</tr>
<tr>
<td><strong>IBA:</strong> To identify key sites for conservation of birds, small enough to be conserved in their entirety and often already part of a protected-area network.</td>
</tr>
<tr>
<td><strong>Planning Principles:</strong></td>
</tr>
<tr>
<td><strong>EBA:</strong> Functionality (viable habitat for endemic species) and intrinsic value of wildlife.</td>
</tr>
<tr>
<td><strong>IBA:</strong> Efficiency (focus on threatened, endemic, biome-restricted, and congregatory species), functionality (viable habitat and networks), international cooperation (regional networks), engaging local stakeholders, and intrinsic value of wildlife.</td>
</tr>
<tr>
<td><strong>Scale and Planning Unit:</strong></td>
</tr>
<tr>
<td><strong>EBA:</strong> The EBA approach is global in scale (Continental within global context of areas of high bird endemism).</td>
</tr>
<tr>
<td><strong>IBA:</strong> IBAs have been identified on all continents but they are developed through national and regional (networks of IBAs) sites based on bird status. Emphasis is on countries where there are active BirdLife partners.</td>
</tr>
<tr>
<td><strong>Planning Unit:</strong></td>
</tr>
<tr>
<td><strong>EBA’s</strong> vary in size from a few square kilometers to 340,000 km²</td>
</tr>
<tr>
<td><strong>IBA’s</strong> vary in size from less than one square kilometer to over 10,000 km²;</td>
</tr>
<tr>
<td><strong>Conservation Level:</strong></td>
</tr>
<tr>
<td>Ecosystems, based on endemic, threatened and endangered, and congregatory bird habitat.</td>
</tr>
<tr>
<td><strong>Data Sources:</strong></td>
</tr>
<tr>
<td>IUCN Red List (for birds originates with BirdLife, hence they are using their own field data); expert opinion; published field data, museum collections, scientific literature, local field data, GIS mapping.</td>
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</table>

<table>
<thead>
<tr>
<th><strong>TARGETS, CRITERIA &amp; THRESHOLDS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(EBA)</strong></td>
</tr>
<tr>
<td><strong>Targets:</strong></td>
</tr>
<tr>
<td>Endemic bird habitat</td>
</tr>
<tr>
<td><strong>Criteria &amp; Thresholds:</strong></td>
</tr>
<tr>
<td>Areas with 2 or more overlapping breeding ranges of endemic birds. Bird endemism is defined as breeding ranges restricted to less than 50,000 km².</td>
</tr>
<tr>
<td><strong>Weight:</strong> N/A</td>
</tr>
<tr>
<td><strong>(IBA)</strong></td>
</tr>
<tr>
<td><strong>Targets:</strong></td>
</tr>
<tr>
<td>Habitat that supports endangered, threatened, endemic, or congregatory birds</td>
</tr>
<tr>
<td><strong>Criteria &amp; Thresholds:</strong></td>
</tr>
<tr>
<td>The site regularly holds significant numbers of a globally threatened species, or a significant assemblage of endemic or biome-restricted species, or globally significant numbers of a congregatory species. See “Summary of global (‘A’) criteria for selection for selection of Important Bird Areas.”</td>
</tr>
<tr>
<td><strong>Weight:</strong></td>
</tr>
<tr>
<td>All criteria are weighted equally, i.e. any one qualifies a site as an IBA.</td>
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</tbody>
</table>

<table>
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<tr>
<th><strong>IMPLEMENTATION &amp; MONITORING</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implementation:</strong> EBA’s are developed globally by the BirdLife International Partnership and meant to inform local planning as to where to direct conservation efforts. IBAs are identified, protected and monitored at the local level and are meant to be practical targets for conservation at the local level and/or as part of a regional network.</td>
</tr>
<tr>
<td><strong>Monitoring:</strong> Monitoring for IBAs is a two-tier system to obtain both breadth (coverage of the entire IBA network) and depth (more intensive effort at a sample of sites). Basic monitoring involves regular assessment, usually annual, of every IBA site against indicators of “state,” “pressure,” and “response.” Detailed monitoring of a sub-set of priority sites is tightly linked to the site conservation objectives and makes use of existing bird counting schemes.</td>
</tr>
</tbody>
</table>

YALE SCHOOL OF FORESTRY & ENVIRONMENTAL STUDIES
BirdLife’s monitoring framework uses a two-tier system to obtain both breadth (coverage of the entire IBA network) and depth (more intensive effort at a sample of sites). Basic monitoring involves regular assessment, usually annual, of every IBA site against indicators of “state,” “pressure,” and “response.” State refers to species or site-specific data trends on populations and habitat; pressure refers to threats to bird habitat such as habitat destruction, unsustainable hunting, and climate change; and response refers to actions to recognize and preserve IBAs. Detailed monitoring of a sub-set of priority sites is tightly linked to the site conservation objectives and makes use of existing bird counting schemes.

**CONSERVATION INTERNATIONAL**

**Biodiversity Hotspots**

**High Biodiversity Wilderness Areas**

**ORGANIZATIONAL OVERVIEW**

Conservation International (CI) is one of the most prominent international organizations that sets global conservation priorities and implements these priorities at regional, national, and local levels. Based in Washington, D.C. and working in over forty countries on four continents, CI’s main mission is to “conserve the earth’s natural living heritage, our global biodiversity, and to demonstrate that human societies are able to live harmoniously with nature.” (CI 2004)

Conservation International employs three main approaches in setting conservation priorities, including Biodiversity Hotspots, High Biodiversity Wilderness Areas (HBWAs) and Important Marine Areas. Perhaps the most well-known among these is the Biodiversity Hotspots approach, which prioritizes areas that are both biologically rich (as indicated by the number of endemic plants) and among the most threatened in the world (as indicated by historical habitat loss). Similar to Biodiversity Hotspots, the High Biodiversity Wilderness Area approach – based upon Major Tropical Wilderness Areas – also emphasizes biologically rich areas, but unlike Biodiversity Hotspots, these areas have large tracts of intact forest and are not immediately threatened by human population pressure.

CI’s approaches help set internal priorities while also informing the conservation community and other stakeholders about areas that should be prioritized for conservation in order to mitigate the global extinction crisis. For example, the Biodiversity Hotspots approach identifies hotspots in California and Australia which fall beyond CI’s focus on developing countries. However, this methodology draws attention to these important areas for others to work on.

**Approach Overview**

CI’s Biodiversity Hotspots and HBWA approaches were developed in tandem to inform global priorities with two distinct and complementary sets of criteria. First defined in 1988 by British ecologist Norman Myers, the Biodiversity Hotspot
approach places great emphasis on efficiency of resources and the time-pressure associated with the global extinction crisis. Biodiversity Hotspots are areas under immediate threat and hold the highest proportions of the world’s biodiversity. These are areas that require immediate protection in order to combat the loss of a significant portion of the world’s species to extinction. As discussed further below, the primary biological criterion for hotspots is **endemism** as indicated by the number of endemic plant species. The secondary criterion is threat, based on percent decline of original vegetation; all hotspots must have lost at least 70% of their primary vegetation, although many have a much higher percentage decline.

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**What’s the difference between a Biodiversity Hotspot and a High-Biodiversity Wilderness Area?** Biodiversity Hotspots and High-Biodiversity Wilderness Areas both have high levels of biodiversity. However, Biodiversity Hotspots consist mainly of heavily exploited and highly fragmented ecosystems greatly reduced in extent, whereas High-Biodiversity Wilderness Areas are larger in size, still relatively intact, and have low human population density. Thus, hotspots are the places where action is most urgently needed to stop extinctions, while wilderness areas offer a few remaining opportunities to be proactive about conservation.

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CI has identified twenty-five hotspots as the “richest and most threatened reservoirs of plant and animal life on Earth.” A list of current Biodiversity Hotspots is included in Table 9 (future global analyses by CI may include slightly more hotspots and revised boundaries). As noted, these hotspots represent several habitat types, yet tropical forests are predominant comprising fifteen of the twenty-five. Mediterranean-type zones are also well-represented, comprising an additional five of the hotspots.

Protecting the remaining habitat of these twenty-five areas, which constitute just 1.4 percent of the earth’s surface, would put a major dent in the extinction crisis. These are the places that uniquely support 44% of the world’s vascular plants and 35% of all species in four vertebrate groups (Myers et al. 2000). “Over the next few decades, focusing conservation efforts on areas with the greatest concentrations of biodiversity and the highest likelihood of losing significant portions of that biodiversity will achieve maximum impact for conservation investment” (Mittermeier et al. 1998).

It should be noted that CI’s Biodiversity Hotspots approach is not intended as a triage method that discounts the importance of other areas for long-term conservation. CI understands that other areas are important for conservation. However, as Mike Hoffmann, at CI explained, “The hotspots approach is about where we need to go first, because this is where we stand to lose the largest portion of the
world’s biodiversity in the smallest area. In other words, if we fail in the hotspots, we will lose about half of global biodiversity.”

Complementary to hotspots, HBWAs also have high rates of endemism but are typically larger in size, relatively intact, and face lower immediate pressure from human populations. CI first identified 24 wilderness areas, all greater or equal to one million hectares in size with at least 70% of their original pristine vegetation remaining and a human population density of less than five people per square kilometer. Collectively, wilderness areas as defined by CI cover 44% of the earth’s land but are inhabited by only 3% of the world’s human population (Mittermeier et al. 2003). As explained by CI, these wilderness areas:

- Represent important storehouses of biodiversity and major watersheds.
- Are controls against which CI can measure the management of the more devastated hotspots.
- Play a vital role in climatic stability.
- Are often the last places where indigenous peoples may maintain their traditional lifestyle.
- Are likely to assume increasing recreational, aesthetic, and spiritual values.

Of this initial group of 24 wilderness areas, CI distinguished the five with the highest rates of endemic species as High-Biodiversity Wilderness Areas. This group includes such areas as Amazonia, the Congo Forests of Central Africa, and New Guinea. These five wilderness areas serve as “good news” in the conservation realm, as their conservation is made easier by limited human population pressure, yet they contribute significantly to the world’s biodiversity.

Current Biodiversity Hotspots and High-Biodiversity Wilderness Areas are included below in Table 9 and illustrated below in Map 4.
Table 9: Current Biodiversity Hotspots and High Biodiversity Wilderness Areas

<table>
<thead>
<tr>
<th>Biodiversity Hotspots</th>
<th>High Biodiversity Wilderness Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth’s 25 biologically richest and most threatened places, where more than 70 percent of the original vegetation has been lost:</td>
<td>Five-species rich regions that are more than 70 percent intact and have low human population density:</td>
</tr>
<tr>
<td>● Tropical Andes</td>
<td>● Amazonia</td>
</tr>
<tr>
<td>● Philippines</td>
<td>● Congo Forests</td>
</tr>
<tr>
<td>● New Caledonia</td>
<td>● New Guinea</td>
</tr>
<tr>
<td>● Central Chile</td>
<td>● North American Deserts Complex</td>
</tr>
<tr>
<td>● Sundaland</td>
<td>● Miombo-Mopane Woodlands and Savannahs of Southern Africa</td>
</tr>
<tr>
<td>● Cape Floristic Region</td>
<td>● Chocó-Darién-Western Ecuador</td>
</tr>
<tr>
<td>● Chocó-Darién-Western Ecuador</td>
<td>● Guinean Forests of West Africa</td>
</tr>
<tr>
<td>● Polynesia/Micronesia</td>
<td>● Mediterranean Basin</td>
</tr>
<tr>
<td>● New Zealand</td>
<td>● Mesoamerica</td>
</tr>
<tr>
<td>● Caucasus</td>
<td>● Guinean Forests of West Africa</td>
</tr>
<tr>
<td>● Mediterranean Basin</td>
<td>● Eastern Arc Mountains &amp; Coastal Forests of Tanzania &amp; Kenya</td>
</tr>
<tr>
<td>● Guinean Forests of West Africa</td>
<td>● Indo-Burma</td>
</tr>
<tr>
<td>● Wallace</td>
<td>● Southwest Australia</td>
</tr>
<tr>
<td>● Madagascar and Indian Ocean Islands</td>
<td>● California Floristic Province</td>
</tr>
<tr>
<td>● Brazilian Cerrado</td>
<td>● Caribbean</td>
</tr>
<tr>
<td>● Western Ghats and Sri Lanka</td>
<td>● Mountains of Southwest China</td>
</tr>
<tr>
<td>● Eastern Arc Mountains &amp; Coastal Forests of Tanzania &amp; Kenya</td>
<td>● Succulent Karoo</td>
</tr>
</tbody>
</table>


APPRAIS SPECIFICS

The Biodiversity Hotspots approach emphasizes the principle of efficiency: given limited resources and immediate threats, efforts must be prioritized in the places where there is the most urgent likelihood of the most irreplaceable losses (i.e., those places with the greatest concentration of endemic species under threat of extinction). Discussion of hotspots often refers to how investment dollars are spent and where the conservation community can get the most “bang for its buck.” High Biodiversity Wilderness Areas likewise focus on efficiency in that they identify areas with highly irreplaceable biodiversity but also emphasize the functionality of ecosystems.

Both the Biodiversity Hotspots and the HBWA approaches set priorities at a global scale and are global-terrestrial in extent since they apply to all regions on earth (with the exception of marine areas). Once global priorities are set, CI proceeds with conservation at the finer level striving to achieve success at three different levels (termed “outcomes”): the landscape-level, the site level, and the species level. These second-level priorities are not wedded to a specific global approach. For example, local planning within a biodiversity hotspot would not be distinguishable in nature from local planning within a HBWA. At the global level, both hotspot and HBWA conservation are focused on ecosystem conservation; however, CI also focuses on species-level targets at sub-global levels. CI does not focus on the sub-species or genetic level.

With respect to planning units, both HBWAs and Biodiversity Hotspots are relatively large areas (HBWAs must be at least 10,000 km²) and typically encompass several ecoregions, as delineated by the World Wildlife Fund. When the boundaries of Biodiversity Hotspots and Major Tropical Wilderness Areas (the predecessor of
HBWAs) were first being defined, they were based largely on areas that could be considered in some way homogenous or discrete based on biological commonalities such as the floristic affiliations associated with islands groups, New Zealand and Polynesia/Micronesia among them. Secondary considerations for delineating boundaries for hotspots and wilderness areas were influenced by practical considerations (for example, political boundaries) and decisions from experts in the field. However, later iterations of the Biodiversity Hotspots and HBWAs were harmonized with the WWF’s ecoregional approach.

As Biodiversity Hotspots and HBWAs are generally larger than WWF’s ecoregions, a single hotspot might be a composite of many ecoregions, yet the boundaries would match the outside of the overall cluster. There is significant overlap between Biodiversity Hotspots and HBWAs and the ecoregions identified by the WWF’s Global 200 approach. In other words, the two conservation organizations have identified many of the exact same locations as the highest of conservation priorities.

CI replies on extensive scientific data and theory to identify HBWAs and Biodiversity Hotspots. For example, the publication that provided the basis for designating the current Biodiversity Hotspots strategy relied on “data from more than 100 scientists with abundant experience in countries concerned and around 800 references in the professional literature.” Similarly, for the designation of HBWAs, CI contacted “over 200 specialists on the potential wilderness areas, compiling data on intactness, biodiversity, human populations, threats, and existing conservation initiatives” (Mittermeier et al. 2003).

In addition, CI uses both internal and external sources of information on landscapes, human use patterns, and ecological change. CI’s Center for Applied Biodiversity Science’s (CABS) Regional Analysis Program uses satellite, aerial, and field observations to characterize and monitor the impacts of human activities on biodiversity in the hotspots. These data are then integrated with comprehensive databases on social, economic, political, and legal factors, which allow for a better understanding of the relationships between the biophysical environment and patterns of human use.

External sources of global biological information include the IUCN Red List of species and hundreds of other sources, such as WWF’s and TNC’s Centers of Plant Diversity. In order to determine the percent of primary vegetation remaining, CABS analyzed the vegetation cover within selected areas using a combination of digitized forest cover data and satellite information provided by the World Conservation Monitoring Centre, along with reference material on past and present trends in the distribution of original pristine vegetation, and a combination of other techniques, including information from Global Forest Watch’s aerial maps and information from contacts in the field.

Given the range of sources for local biological information, CI acknowledges that there is variability in the precision and accuracy of the data regarding Biodiversity Hotspots. In many cases the accuracy is considered to be within 5% statistical accuracy, whereas in other cases it is a working estimate with considerable support. CI explains, “This overall approach, uneven as it is, is justified for an analysis that seeks
to convert a profound problem into a fine opportunity. After all, to decide that a potential hotspot should not be evaluated because it lacks a conventional degree of accurate data is effectively to decide that its conservation needs cannot be evaluated either, in which case its cause tends to go by default. Uncertainty can cut both ways” (Myers et al. 2000).

It is difficult to demonstrate to what extent basic ecological theory guides CI’s approaches, as their conservation efforts are developed and implemented by numerous experts integrating various levels of sometimes conflicting information. Nonetheless, references to classical conservation biology theory surface in CI’s discussion. For example, in a key article on hotspots, CI refers directly to the principle of island biogeography, which theorizes that when an area loses a large proportion of its original habitat – as hotspots have – the area will lose many species through a process of ecological equilibration. CI addresses the limitations of smaller and fragmented areas by complementing their hotspots approach with High Biodiversity Wilderness Areas, which counter these concerns of island biogeography.

TARGETS AND CRITERIA

Biodiversity Hotspots

As indicated above, the two key criteria used by CI to identify hotspots are species endemism and degree of threat. CI ranks biological criteria as the most essential in the early phases of priority-setting. CI believes that including criteria relating to social and political feasibility indicators “may result in certain high-priority areas being underfunded because of considerations such as social factors and political will” (Mittermeier et al. 1998).

- **Species endemism** is the first criterion used to identify hotspots. CI uses the total number of endemic plants as an indicator of overall endemism. (Plants are used as a surrogate as they form the underpinnings on which the broader biological community depends.) The threshold for a hotspot is a number of at least 1,500 endemic plant species, translating into 0.5% of the global total. Many hotspots exceed this number of endemic plant species by thousands. The Tropical Andes, for example, has 20,000 plant species found nowhere else in the world (Myers et al. 2000).

Although plant endemism is the sole kind of endemism used as a criterion to identify hotspots, other indicators of endemism—such as the presence of endemic vertebrates or the ratio of endemic plants or vertebrates to the area of the hotspot—have been used in the past to confirm that plant endemism is a good indicator of overall endemism. Furthermore, there is often a congruence of species: a high count for endemic plants is matched by high counts for endemic vertebrates. For example, the Tropical Andes hold as endemics 6.7% of all plant species worldwide and 5.7% of all vertebrates. This trend of congruence is high in the tropical forest hotspots; other areas, such as the Mediterranean Basin have a high percentage of endemic plants but a relatively lower percentage of the world’s vertebrates.
Threat. Existing primary vegetation is the basis for assessing human impact in a region and hence its level of perceived threat. To qualify as a hotspot, a region must have lost at least 70% of its primary vegetation. Myers et al. (2000) explains, “The 70% cutoff is justified on the grounds that most large-scale concentrations of endemic plants species occur within the 25 hotspots as delineated.” This was further explained by John Pilgrim, a Biodiversity Analyst at CI. “The aim of the hotspots prioritization is to encompass the priority areas that hold a large portion of threatened biodiversity worldwide. Given this, a reasonable combination of — necessarily somewhat arbitrary — endemism and threat thresholds should produce a set of priority areas that is both an achievable short-medium term target, yet is also ambitious enough that it actually does contribute significantly to biodiversity conservation at a global level.” The thresholds for wilderness areas employ similar reasoning. There also exists a “natural gap” along the continuum at the 70% threshold value; a 60% threshold would admit hardly any additional hotspots, whereas a 90% threshold would exclude eleven of the hotspots.

High Biodiversity Wilderness Areas

The three key criteria for all wilderness areas (both High Biodiversity Wilderness areas, and lower-biodiversity wilderness areas) are that they

- Are large (at least 10,000 km²) in size,
- Are intact, i.e., they must retain at least 70 percent of their primary vegetation, and
- Have low human population density of less than or equal to five people per square kilometer.

From the 24 wilderness areas identified using above criteria, the areas with the highest levels of endemism were then identified as “high biodiversity wilderness areas.” Endemism was measured as a function of the number of endemic vascular plants with a threshold of at least 1,500 endemic plant species or 0.5% of the global total, the same threshold used for biodiversity hotspots.

Once Biodiversity Hotspots or HBWAs are defined at a global scale, there are several additional layers of conservation planning needed to effect results on the ground. CI sets three levels of targets beneath the global level: species, site, and landscape level. CI does not go to the sub-species or genetic level. These smaller-scale approaches do not differ based upon which global-setting approach was used to identify the area.

IMPLEMENTATION AND MONITORING

Conservation International provides an overview of their local implementation on their website as follows:
A variety of conservation approaches are needed to protect biodiversity . . . from the establishment of traditional protected areas to the implementation of innovative economic alternatives such as ecotourism and conservation concessions. Hotspots conservation also requires influencing the behavior of people at the local level, through education, and at the national level, through policy work and awareness campaigns. It involves working with international corporations to ensure that their business practices do not contribute to further biodiversity loss. CI employs scientific, economic, policy, and education tools to create effective conservation strategies.

The challenge of conserving biodiversity in the hotspots, and indeed worldwide, is so great that no one organization can do it alone. CI works with partners at many different levels, from collaborating with a single expert to protect an endangered species to working with the government of a country like Brazil to facilitate national conservation initiatives. Leveraging other organizations to protect biodiversity in the hotspots is a crucial part of CI’s strategy.

CI engages in monitoring to the extent that it is continually evaluating not only the impact of its approaches, but also the changes that political, social, and biological forces impose on the areas in which it works. CI’s Center for Applied Biodiversity Science has created an Early Warning System to enable proactive responses by the conservation community at large. In addition, CI continually revisits its approach, and although main criteria have not been altered, the approaches have evolved with time. For example, hotspots were originally defined without reference to ecoregions; ecoregional concepts are now being integrated.
# CONSERVATION INTERNATIONAL
## BIODIVERSITY HOTSPOTS & HIGH BIODIVERSITY WILDERNESS AREAS

### OVERVIEW

**Organizational Mission:** To conserve the earth’s natural living heritage, our global biodiversity, and to demonstrate that human societies are able to live harmoniously with nature.

**Approach Objective:** Help set internal priorities that they then work with local partners to execute on the ground. Their approaches also may inform others in the conservation community, industry, and other stakeholders.

**Planning Principles:** BH: Efficiency; HBWA: Efficiency and Functionality.

**Scale:** Biodiversity Hotspots and HBWAs are set at a global level; however, CI works with local and regional partners to implement at various other levels (regional, national, local). **Extent:** Global-Terrestrial.

**Planning Units:**
- **Biodiversity Hotspots:** Hotspots are the Planning Region; they are large areas of land, often encompassing several ecoregions. There is no defined threshold for the size of a hotspot.
- **HBWAs:** HBWAs are the Planning Region; they are large areas of land, often encompassing several ecoregions (for example, as defined by WWF). 10,000 km² is the lower threshold.

**Conservation Level:** Ecosystem (at regional and local levels, CI focuses on species as well).

**Data Sources:** IUCN Red List, Global Forest Watch, Local Experts, Extensive Literature Review, Others.

### TARGETS, CRITERIA & THRESHOLDS

**Targets:** Hotspots: Examples: Tropical Andes, Indo-Burma, California Floristic Province; High Biodiversity Wilderness Areas: Examples: Amazonia, Congo Forests, New Guinea.

**Criteria & Thresholds:**
- **Hotspots:** (1) Endemism as a function of the number of endemic vascular plants. Threshold = at least 1,500 species of endemic plant species or 0.5% of the global total. (2) Threat as a function of past decline: at least 70% loss of original vegetation.
- **HBWA:** (1) Size greater or equal to 10,000 km²; (2) Intactness = Greater or equal to 70% primary vegetation; (3) Low Human Population Density = less than 5 people/km²; (4) Endemism as a function of the number of endemic vascular plants. Threshold = at least 1,500 species of endemic plant species or 0.5% of the global total.

**Weight:** All criteria must be met.

### IMPLEMENTATION

**Implementation:** Same for BH and HBWA: core areas, size and edge effects, buffer zones, corridors (in two senses of the term); shifting mosaic/patch dynamics; source and sink dynamics; wide-ranging species (to the extent that their coarse filter approach addresses them); island biogeography (to the extent that they note that smaller and highly disturbed areas are likely to experience species extinction).

**Monitoring:** Yes, but have not revised their criteria and thresholds as of yet.
WILDLIFE CONSERVATION SOCIETY

Range-Wide Priority Setting

Last of the Wild

ORGANIZATIONAL OVERVIEW

The Wildlife Conservation Society (WCS) defines its mission as saving wildlife and wild places (WCS 2005a). WCS accomplishes this through careful science, international conservation, education, and the management of the world’s largest system of urban wildlife parks, led by the flagship Bronx Zoo. In concert, these activities aim to change individual attitudes toward nature and help people imagine wildlife and humans living in sustainable interaction on both a local and a global scale. WCS is committed to this work, and believes it is essential to the integrity of life on Earth.

WCS has not delved deeply into global priority-setting to the extent of other organizations such as Conservation International, BirdLife International, or World Wildlife Fund. Rather, WCS focuses a majority of its work at the landscape level, where decisions are strongly tempered by factors such as opportunities for long-term conservation success, and cases in need of the support it provides. WCS’s Living Landscapes Program supports landscape-level conservation efforts, while their regional programs (Asia, Africa, Latin America, North America, Marine) actually conduct on-the-ground implementation. In setting conservation priorities, WCS feels that the answer lies not only in “where to work,” but also in “how to work” and which issues to address. Decisions made about conservation investments at site depend in part on conservation priority studies (WCS’s own and others), but also on a broad range of other factors.

Despite its deeper focus on landscape level planning, however, WCS has contributed significantly to global analyses by:

- Developing an assessment of the “Human Footprint,” a spatial representation of the impact of human activities across the globe as well as those areas of lesser impact, known as “Last of the Wild.”

- Conducting species-specific priority-setting analyses, using existing information to identify where important and troubled populations of wide-ranging species exist, while also noting the cases in which information is still needed. This analysis is known as “Range-wide Priority Setting.”

- Mapping species richness patterns for the carnivore guild across the world.

This profile discusses two of these global approaches, including (1) Range-wide Priority Setting and (2) Last of the Wild, which is derived from the Human Footprint mapping.
1. RANGE-WIDE PRIORITY SETTING

APPROACH OVERVIEW

Range-wide Priority Setting is based on the premise that saving a species means saving populations of that species in all significantly different ecological settings in which they occur. These different settings encompass not only the genetic distinctiveness of the species across the range, but also behavioral, demographic, and ecological distinctiveness. The primary goal of the planning process, therefore, is to identify priority areas for the conservation of the wide-ranging species on a range-wide basis in each regional habitat type, based on factors important for the long-term survival of the species. For example, in conserving jaguars, WCS would not determine the most important site for jaguar conservation overall, or the most important site in a given country, but rather the most important sites for ecologically distinct populations of jaguars.

To examine the range-wide species approach, we referred to Sanderson et al. 2002, “Planning to Save a Species: the Jaguar as a Model” a geographically based, range-wide assessment and priority-setting exercise for the jaguar initiated in 1999 by the WCS and the Institute of Ecology at the National Autonomous University of Mexico. Although the focus of that particular study was on jaguars, the methodology used and the conclusions drawn present a model for conservation planning that can and has been applied to many widely ranging species. The approach has now been applied for American crocodiles and Mongolian gazelles, and WCS is actively working on exercises for white-lipped peccary, lowland tapir and Asian elephant. We do not consider elements that were present in the methodology but were not strictly part of the planning process. For example, the objective of “building a community of researchers and conservationists with shared goals for conservation of the species and a consensus on how best to achieve those goals” has not been considered.

The need for a species-based approach to add to the matrix of conservation planning approaches is clear to WCS. With the increasing emphasis on biodiversity, there has been an increase in the scale of planning for conservation work, typically through mechanisms that emphasize entities other than the population or the species as a target for conservation efforts. International conservation organizations, both governmental and nongovernmental, have altered their approach to focus increasingly on strategies that range from regional to global in scope and are based on conserving supra-organismal entities such as hotspots of species diversity, globally significant ecoregions, and endemic bird areas. Such approaches seek to conserve ecosystem functions and the diversity of habitat types, despite a lack of knowledge of the extent of biological diversity and the complex array of factors that maintain it. In short, these approaches seek to conserve the whole when faced with the impossibility of knowing all the parts (Sanderson et al. 2002b).

But according to WCS, the parts are important too. Wide-ranging species can form the basis for large-scale conservation planning. Range-wide, species-based conservation planning for broadly distributed species, complements other coarse-
filter approaches to conservation planning by testing their generality through an emphasis on single-species requirements. However, in the case of wide-ranging species, conserving supra-organismal entities such as hotspots or ecoregions provides no guarantee of conserving the species across all the ecological settings where they occur outside hotspots and across a large number of ecoregions. Range-Wide Priority Setting seeks to develop a community of conservation practitioners with shared priorities for a species.

The work is built on a geographic data framework that respects the kinds and qualities of information available. From this information, a group of experts assesses the status of the wide-ranging species across the range and develops a prioritization mechanism to determine the most important areas for the species’ conservation.

With respect to planning unit, the historic range of the species is subdivided into species geographic regions (WSGRs). These are geographic units defined by potential habitat and bioregion across the species’ historic range. It is presumed that because of ecological and regional differences, the role of the species is significantly different in each WSGR. Representing the ecological differences geographically by means of WSGRs provides a convenient, ecological unit for planning. Each WSGR is named by its geographic region and then its habitat type (e.g., northeast Amazon/tropical moist lowland forest). In the specific case of the jaguar, the “historic range was subdivided into 36 Jaguar Geographic Regions (JGRs) lumping together North American and South American ecoregions (Dinerstein et al. 2000) to create units similar to the regional habitat types used in previous conservation priority-setting exercise for Latin America (Biodiversity Support Program et al. 1995).”

Entire WSGRs or divisions of WSGRs are then assigned different codes according to the status of the species across its range. Areas that are unknown are designated “status unknown – priority for survey.” Areas that are known but are no longer occupied by the species are designated “no species.” For areas that are known and currently occupied by the species, one of the following is assigned: high, medium, or low probability of long-term survival. In the case of the jaguar exercise, these assignments were based on qualitative evaluation of habitat size and connectivity, the status of the prey base, the status of the jaguar population, and the level of threat from human activity.

**TARGETS AND CRITERIA**

Although the ultimate target for WCS’s wide-ranging species approach is the species itself, the immediate targets are the populations of the species across their geographic range and species conservation units (WSCUs), which can be defined as important areas for wide-ranging species conservation. By definition, each WSCU represents a core population of the target species on which conservation might be based. In the case of the jaguar, they were defined either as (1) areas with a stable prey community, currently known or believed to contain a population of resident jaguars large enough to be potentially self-sustaining over the next one hundred years; or (2) areas containing fewer jaguars but with adequate habitat and a stable, diverse prey base, such that jaguar populations in the area could increase if threats were alleviated.

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1 The original term used in the article is Jaguar Geographic Region (JGR). Whenever possible, we have extrapolated the jaguar scheme to a wide-ranging species scheme; when this was not possible, we have provided the jaguar scheme as a specific example of the overall method.
Several criteria are used to prioritize WSCUs including representation, significant ecological processes, species decline, habitat loss, large intact areas and level of threat. These criteria are established for each individual species, and there are no strict criteria and thresholds held across species. In the case of the jaguar, six factors are taken into account: JCU size, connectivity, habitat quality, hunting of jaguar, hunting of prey, and population status. For the American crocodile criteria include natural habitat quality, habitat connectivity (forming a regional crocodile metapopulation), habitat destruction, man-made habitat improvements, nesting habitat, killing of crocodiles, contamination, potential for commercial management and potential for crocodile ecotourism. The factors were weighted according to their relative importance for long-term jaguar survival.

WCS then runs a workshop including a session to develop the weighting scheme to develop priorities. According to this weighting scheme, WSCUs within the same WSGR are ranked and prioritized to determine the most important WSCU within each WSGR. WSCUs within a given WSGR are compared only among one another.

This species-based methodology was pioneered for tigers (Wikramanayake et al. 1998). However, WCS reports that its application contains a number of innovations that advance the methodology of geographic priority setting, particularly for single-species-based conservation planning. The most important innovation is also the simplest: planning across the complete biological range of the species, so that all conservation efforts can be placed in the most important context, that of the species’ biology. Another innovation is for the data sets to be nested in a geographic hierarchy that accounts for the different types of knowledge currently held about the species. The most basic distinction separates areas in which WCS had knowledge of jaguars (extent of knowledge) from areas in which it lacks knowledge (unknown areas). Another innovation reported by WCS is that it limits conclusions about the currently occupied range only to known areas. The practice with range maps prepared previously had been to include all “internal” areas if habitat exists there, even if a species’ status in those areas is unknown.

**IMPLEMENTATION AND MONITORING**

Once WCS prioritizes areas on a global scale, their Living Landscapes Program supports landscape-level conservation efforts, while their regional programs (Asia, Africa, Latin America, North America, Marine) actually conduct on-the-ground implementation. For example, implementation activities for jaguar conservation include (WCS 2005c):

- Addressing jaguar-livestock conflicts and rancher outreach.
- Population status and distribution surveys.
- Establishment of long-term ecological studies of jaguars in various habitats and across a range of human impacts.
- Monitoring jaguar populations, their prey and their habitat.
- Assessing and monitoring genetic changes in populations of jaguars.
• Assessing and monitoring health issues among jaguar populations.

Monitoring species populations is a key part of WCS’s wide-range species approach. For example, many of WCS’s jaguar conservation program sites are involved in active monitoring of jaguar populations, in addition to their research and conservation activities. Furthermore, WCS-funded work recently led to the first ever comparison of jaguar densities across habitat type. Lessons learned from monitoring activities may be applied to subsequent range-wide analyses.
**WILDLIFE CONSERVATION SOCIETY**

**RANGE-WIDE PRIORITY SETTING**

**BASIC OVERVIEW**

**Organizational Mission:** Saving wildlife and wild lands through careful science, international conservation, education, and the management of the world’s largest system of urban wildlife parks.

**Approach Objective:** To find the most important sites for ecologically distinct populations of wide-ranging species.

**Planning Principles:** The principle of representation is emphasized in that “Saving a species means saving populations of the species in all significantly different ecological settings in which they occur”. Other principles are efficiency, the intrinsic values of nature, and international cooperation.

**Scale:** The approach is set on a global in scale.

**Planning Unit:** Wide-ranging species range.

**Conservation Level:** Species (populations of the species in different ecological settings).

**Data Sources:** Expert opinion, field data, GIS mapping.

**TARGETS, CRITERIA AND THRESHOLDS**

**Target:** Wide-ranging species conservation unit (WSCU).

**Criteria & Thresholds:** WCS considers generally the following criteria in designating target populations: representation, significant ecological processes, species decline, habitat loss, large intact areas, level of threat. Specific criteria include WSCU size; connectivity; habitat quality; hunting on wide-ranging species and species they depend on; wide-ranging species population status.

**Weight:** In the case of the jaguar exercise (Sanderson et al. 2002), different criteria were assigned the following weights: jaguar conservation unit size: 30 points; connectivity: 23 points; habitat quality: 23 points; hunting of jaguar: 10 points; hunting of prey: 10 points; population status: 4 points.

**IMPLEMENTATION**

**Regional and Local Level:** Once WCS prioritizes areas on a global scale, WCS’s Living Landscapes Program supports landscape-level conservation efforts, while their regional programs (Asia, Africa, Latin America, North America, Marine) actually conduct on-the-ground implementation.

Examples of implementation for Jaguar conservation include (WCS 2005c):

- Addressing jaguar-livestock conflicts and rancher outreach.
- Population status and distribution surveys.
- Establishment of long-term ecological studies of jaguars in various habitats and across a range of human impacts.
- Monitoring jaguar populations, their prey and their habitat.
- Assessing and monitoring genetic changes in populations of jaguars.
- Assessing and monitoring health issues among jaguar populations.

**Monitoring:** Species populations are often monitored.
II. LAST OF THE WILD

APPROACH OVERVIEW

WCS’s “Last of the Wild” approach recognizes that humans play a profound role in shaping ecological processes on the global scale, on par with such forces as astronomical variations and global climatic variations. Given the major influence of humans over ecology, a premise of this approach is that areas with less human pressure (i.e., lower population density, fewer roads, etc.) are the areas where conservation efforts may be most successful. WCS explains, “...it is within these wildest places that the greatest freedom and opportunity to conserve the full range of nature still exists” (Sanderson et al. 2002a). This prioritization scheme is not intended to be a comprehensive biodiversity strategy; rather it adds one key piece to the suite of conservation strategies. WCS also warns that the Human Footprint and the Last of the Wild datasets should not be used for local or regional conservation planning without consultation with local expertise.

The approach begins with an analysis known as “Human Footprint,” a joint effort between WCS and the Center for International Earth Science Information Network (CIESIN) at Columbia University to systematically map and measure the influence of humans on the earth’s land surface. The process uses nine data sets from a variety of sources to measure four types of human influences including: (1) population density; (2) land transformation; (3) accessibility; and (4) electrical power infrastructure across the terrestrial global landscape. Less immediately measurable impacts such as pollution, global warming, and increased exposure to ultraviolet radiation are not included in the analysis but are recognized as bearing important influence over the world’s ecological processes (Sanderson et al. 2002a).

The analysis finds that a majority of the world’s land surface (83%) is influenced by humans though a variety of pressures, including human land uses, access from roads, railways or major rivers, electrical infrastructure, or direct occupancy by human beings at densities above 1 person per km². The remaining 17% of the earth’s land surface is less influenced by human beings, and it is within those areas where some of the best conservation opportunities lie (Sanderson et al. 2002; CIESIN 2002).

Upon completion of the Human Footprint mapping, WCS identified the 569 largest areas in the world where human conflicts are minimal and where conservation efforts may be more successful. These Last of the Wild areas were identified by biome, and as such, embody a representative approach to conservation. Due to differences in biome and geography, these wild places vary enormously in their biological productivity and diversity (CIESEN 2005).

Data sources used for this approach include the National Imagery and Mapping Agency (NIMA), the Joint Research Centre of the European Commission, the US National Oceanic and Atmospheric Administration, World Wildlife Fund, and several other sources. The process also draws on scientific studies and consultation with a range of biologists, social scientists, and conservationists (Sanderson et al. 2002a). Data sets were selected for their coverage and consistency among other factors, and
were projected onto a single map at a resolution of one square kilometer after being coded into standardized scores. Data can be viewed and downloaded at: http://www.ciesin.org/wild_areas/.

**TARGETS AND CRITERIA**

For the purpose of this study, the targets are defined as the actual areas designated as the Last of the Wild. These areas range from 5 km$^2$ to 3,815,832 km$^2$ in size. In order to identify these areas, WCS first engages in Human Footprint mapping, which looks at four broad categories of data as described below:

**Criterion #1: Human Population Density**

The human population criterion is based on the idea that the higher the number of humans living in given area, the more resources will be used, and the more pressure will be placed on the local ecology. Indeed, human population is frequently cited as the primary cause of biodiversity decline (i.e., Cincotta and Engleman 2000). Such assertions are supported by individual studies in specific locales, such as in Brasheres et al. (2001) that demonstrates a correlation between extinction rates in a national park and the number of humans surrounding them.

WCS recognizes that data on how human population density scales with human influence are limited and that the degree of influence depends not only on the strict number of humans in a given area but the nature of the relationship between humans and their local ecology. However, there is still some scientific guidance on which to base a scale for correlating human density with ecological impact. For example, Robinson and Bennett (2000) suggest that in terms of sustainable hunting levels, the land’s carrying capacity for people who depend exclusively on the meat from wild animals will generally not exceed one person per km$^2$. Based on this and other studies, WCS estimated that human influence will increase linearly between 0-10 people per km$^2$ and then level off. In other words, areas with a density of 10 people per km$^2$ and those with 20 km$^2$ were treated the same (Sanderson et al. 2002a).

**Criterion #2: Land Transformation**

Perhaps the greatest threat to biodiversity is the fragmentation and loss of habitat brought about by human settlements, agriculture, roads, and other types of land transformation (Sanderson et al. 2002a). A measure of land transformation is the second category of criteria used in Human Footprint mapping. WCS uses a scale from 1-10 to measure the degree of land transformation, with high scores (10) applied to built-up environments, medium scores (6-8) applied to agricultural land cover, and lower scores (<4) to mixed-use cover land uses. The presence of roads is also recognized as a form of land transformation because roads alter species composition, and decrease native species through direct and indirect mortality and by modifying hydrologic and geomorphic processes. For example, WCS sites an estimate by Lalo (1987) that one million vertebrates a day are killed on roads in the United States alone. Accordingly, WCS assigned a score of 8 for the direct effect of roads and railways.
within a 2 km buffer, possibly a simplistic but practical estimate (Sanderson et al. 2002a).

**Criterion #3: Human Access**
The presence of roads, rivers and coastlines provides human access to more remote habitats, facilitating hunting, the spread of pollution, extraction of natural resources, and other ecological disruptions. To calculate the effect of roads and other points of human access, WCS uses a rough estimate that a person could walk in one day approximately 15 km in difficult-to-traverse ecosystems. As such, all areas within 2 to 15 km of road, major river, or coast were assigned a modest human influence score (4) to reflect intermittent use (Sanderson et al. 2002a).

**Criterion #4: Power Infrastructure**
WCS cites electric power as an excellent estimate of the technological development of a local area (based on Elvidge et al. 1997a) and the use of fossil fuels. In addition, lights visible at night from satellites provide a proxy for population distribution and have been correlated with human settlements (Sutton et al. 1997, Elvidge et al. 1997b). To calculate the human influence based on power infrastructure, WCS assigns a score of 10 to areas that have lights visible more than 80% of nights, 8 to areas with lights visible 40%-80% of nights, 4 to areas with lights visible less than 40% of nights, and 0 to areas where no lights were visible (Sanderson et al. 2002a).

**Combining Criteria**
WCS combined the scores of the four criteria described above from nine datasets to create a Human Influence Index (HII) on the land’s surface. The results are fairly intuitive, as the top 10% of the highest scoring areas includes many of the world’s largest cities, such as New York, Mexico City, Calcutta, Beijing, London, etc. The minimum score (0) is found in large tracts of land in the boreal forests of Canada and Russia, in the desert regions of Africa and Central Australia, in the Arctic tundra, and in the Amazon basin (Sanderson et al. 2002a).

WCS notes that the distribution of major ecosystem types and the human histories of different regions modify the biological outcomes of human influence. For example, “an absolute score of 25 in the mixed broadleaf forests of North America might have a different effect, and definitely a different biological context, than the same score in the rain forests of the African tropics” (Sanderson et al. 2002a). Therefore, WCS normalized scores within each biome to determine more consistent and comparable scores with relation to other areas within the same biome. For example, a score of 1 in moist tropical forests in Africa indicates that that grid cell is part of the 1% least influenced or “wildest” areas in that biome. Biome information was based on biogeographic information provided by WWF-US.
Determining the Last of the Wild

Once Human Footprint mapping was completed, WCS determined the wildest areas within each biome. Specifically, they determined the 10% wildest areas in each biome within each biogeographic realm around the world (Sanderson et al. 2002a). From that set of wildest areas, WCS selected the 10 largest contiguous areas within each biome as the Last of the Wild. These areas vary in size from 5 km$^2$ to over 100,000 km$^2$. A complete listing of the last-of-the-wild areas can be found at www.wcs.org/human-footprint.

Sanderson et al. 2002a explain that the Last of the Wild, “are the places where we might conserve the widest range of biodiversity with a minimum of conflict” as well as areas where a broader range of conservation actions may be possible. For example, where human influence has been severe some species may have already been extirpated from the area and many ecological processes disrupted. Conservation activities in those areas would focus on rehabilitating the area by reconnecting habitat and perhaps reintroducing particular species. In contrast, where human influence has been low, a wider spectrum of conservation activities may be possible (Sanderson et al. 2002a). WCS further explains that these places should not be interpreted as a self-contained prescription for complete nature conservation, but rather just one consideration within a range of approaches.

This analysis is not only applicable in prioritizing areas for conservation, but also may provide additional insight into the dynamic between humans and their environment. For example, one use might be to identify places where sensitive species thrive despite high levels of human influence and determine which human behaviors enable coexistence.

IMPLEMENTATION AND MONITORING

Once WCS prioritizes areas on a global scale, WCS’s Living Landscapes Program supports landscape-level conservation efforts, while their regional programs (Asia, Africa, Latin America, North America) conduct on-the-ground implementation.

WCS does not monitor Last of the Wild places per se, except for places where they are doing site-based conservation work. They are, however, in the process of revising the Human Footprint using newer datasets, and they have been working on local and regional Human Footprints (e.g. for Northern Appalachians, the Adirondack Mountains, Central America, the Amazon Basin) which allow them to use better datasets to define wild places. In addition, WCS is also working on the marine Human Footprint, where the influencing factors are fishing, land-based pollution, water-based pollution, and biological introductions from shipping, among others.
# WILDLIFE CONSERVATION SOCIETY
## LAST OF THE WILD

## BASIC OVERVIEW

**Organizational Mission:** Saving wildlife and wild lands through careful science, international conservation, education, and the management of the world’s largest system of urban wildlife parks.

**Approach Objective:** To identify the top 10% “wildest” areas within each biome across the globe. It is within these areas where conservation activities may be met with the least resistance from human pressure and where the broadest range of conservation opportunities may exist.

**Planning Principles:** Representation; Functionality; Intrinsic value of nature.

**Scale:** The approach is global in scale and global-terrestrial in extent.

**Planning Unit:** Last of the Wild areas, which range in size from 5 Km² to over 100,000 km².

**Conservation Level:** Ecosystem.

**Data Sources:** Human Footprint mapping used nine data sets as well as expert consultation. Sources included:
- Joint Research Center of the European Commission, US Geological Survey, and University of Nebraska at Lincoln’s Global Land Use/Land Cover Mapping.
- National Imagery and Mapping Agency maps (several).
- WWF’s Terrestrial Biomes and Biogeographic Realms.
- National Oceanic and Atmospheric Administration and National Geophysical and Data Center Satellite Imagery.
- Published scientific studies, consultation with biologists, social scientists, and conservationists.

## TARGETS, CRITERIA AND THRESHOLDS

**Target:** Last of the Wild Areas. Areas range from 5 km² to 3,815,832 km² in size

**Criteria & Thresholds:**
- Human population density (lower density is prioritized).
- Land transformation (lower land-transformation is prioritized).
- Human Access (remote areas prioritized).
- Power infrastructure (less power infrastructure is prioritized).

**Weight:** WCS combines all four categories of criteria

## IMPLEMENTATION

**Regional and Local Level:** Once WCS prioritizes areas on a global scale, WCS’s Living Landscapes Program supports landscape-level conservation efforts, while their regional programs (Asia, Africa, Latin America, North America, and Marine) actually conduct on-the-ground implementation.

**Monitoring:** WCS is in the process of revising the Human Footprint using newer datasets, and they have been working on local and regional Human Footprints (e.g. for Northern Appalachians, the Adirondack Mountains) which allow them to use better datasets to define wild places. In addition, WCS is also working on the marine Human Footprint, where the influencing factors include fishing, land-based pollution, water-based pollution, biological introductions from shipping, among others.
WORLD WILDLIFE FUND

Global 200

ORGANIZATIONAL OVERVIEW

The World Wide Fund for Nature (WWF), known as the World Wildlife Fund within the United States and Canada, is a global organization whose mission is the conservation of nature. With offices in over fifty countries (WWF 2005), WWF aims to preserve the diversity and abundance of life on earth and the health of ecological systems by protecting natural areas and wild populations of plants and animals, promoting sustainable approaches to the use of renewable natural resources, and promoting more efficient use of resources and energy. WWF’s activities range from policy work to campaigning, education, and capacity building.

WWF takes a leadership role in setting global conservation priorities through its Global 200 approach, which identifies entire ecoregions for conservation. Once global priorities are set, WWF develops cost-effective, spatially-explicit strategies that meet the ecological needs of wildlife while minimizing human-wildlife conflicts and providing benefits to local communities (WWF 2005). Such activity takes place within each ecoregion at both the ecoregional and landscape scale. These efforts are supported through a combination of individual ecoregion action programs (EAPs) and global thematic programs, such as WWF’s Forests for Life and Species programs. Landscape-level work is distinct from the Global 200 priority setting process, which is the primary focus of this profile. Additional information about WWF’s work within ecoregions is included under our discussion of regional approaches in the next section.

APPROACH OVERVIEW

From a global suite of 825 terrestrial ecoregions, and individually delineated freshwater and marine units, WWF has identified 238 terrestrial ecoregions as the “Global 200.” These areas are judged to be a representative set of the earth’s biological wealth that is the most distinctive and rich, and are therefore the most critical for conservation. Ecoregions are defined as relatively large areas of land or water that contain a geographically distinct assemblage of natural communities. These communities (1) share a large majority of their species, dynamics, and environmental conditions, and (2) function together effectively as a conservation unit at global and continental scales (Dinerstein et al. 2000). See map 5 below of WWF’s Global 200 Terrestrial, Freshwater, and Marine Ecoregions or visit http://worldwildlife.org/wildworld/ for an interactive map of these ecoregions.
WWF believes that biodiversity conservation is important in all ecoregions to ensure preservation of many distinct species and communities as well as the genetic and functional diversity of populations across species ranges. However, by designating the Global 200, WWF has prioritized the most globally outstanding ecoregions, in terms of unique or extraordinarily diverse flora or fauna, or unusual ecological phenomena. These regions may also be at extreme risk from anthropogenic forces such as extensive habitat loss or fragmentation. With limited resources and time available for conservation, WWF believes it is important to strategically allocate and coordinate conservation effort and funding into these selected ecoregions.

The Global 200 is at its core a ‘representational’ approach that seeks to include both geographic and ecological diversity. Ecoregions are first categorized as representing one of twelve Major Habitat Types (MHTs), such as tropical and subtropical moist broadleaf forests, tundra, or savannas and shrublands. Rather than geographically defined units, MHTs refer to the dynamics of ecological systems and to the broad vegetative structures and patterns of species diversity. WWF then looks to identify examples of each MHT across eight biogeographical realms, including Australasia, Antarctic, Afrotropic, Indo-Malayan, Nearctic, Neotropic, Oceania, and Palearctic.

**TARGETS AND CRITERIA**

WWF refers to the broad categories of criteria as discriminators, and uses two major discriminators to prioritize ecoregions within each MHT: (1) biological distinctiveness and (2) conservation status. These discriminators lead separately to the construction of two indices, the Biological Distinctiveness Index (BDI) and the Conservation Status Index (CSI). The further integration of these two indices results in the final list of categories. Criteria discussed here are based on Ricketts et al. (1999).
Biological Distinctiveness

The biological importance of an ecoregion is the degree to which its biodiversity is distinctive at different biogeographic scales, particularly with respect to its species, ecosystem diversity, and ecological processes. Specifically, biological distinctiveness is based on four main criteria, including broad measures of two species distribution criteria (species richness and species endemism), and two ecoregion-scale criteria (unusual ecological and evolutionary phenomena, and the global rarity of MHTs), as further explained below.

1. **Species richness**

Species richness is obtained by summing the total number of species of several taxa within an ecoregion. WWF uses taxonomic groups that have the most available data for each specific ecoregion, intending these taxa to represent a diverse subset of the regional biota. Data on well-known groups such as vascular plants, birds, mammals, reptiles, and amphibians can thus be used as an effective proxy for more numerous and less well-known groups (such as insects). To reduce the effect of highly species-rich taxa, data are log transformed to condense the range of the data yet preserve differences among taxa.

Ecoregions are then assigned a point value based on species richness, including high (15 points), medium (10 points), and low (5 points). Ecoregions that receive a “high” ranking are then reassessed to determine whether they are “globally outstanding” in the richness of their species assemblages. This determination is made by comparing flora and fauna lists for selected taxa with ecoregions of the same MHT in different biogeographic realms. Ecoregions designated as globally outstanding are awarded 100 points to ensure that they will obtain a globally outstanding designation in the synthesis of the final BDI (see more on calculation of the BDI below).

2. **Species endemism**

WWF considers endemism a highly significant factor in determining an ecoregion’s distinctive biodiversity value. A species is considered endemic if (1) the total species range is more than 50,000 km², but a single ecoregion contains 75 to 100 percent of the species’ range, or (2) the total species range is less than 50,000 km², and is present in no more than five ecoregions. As with richness, there is usually a disparity of endemism levels in ecoregions both within and among taxa, and again, WWF uses the logarithmic transformation method to give greater weight to the high-species taxa, while dampening its influence on the entire analysis.

Using graphical representations of the distribution of total endemism by ecoregion, threshold values are assigned and are given high,
medium, or low rankings, corresponding to 25, 15, and 5 points respectively. Ecoregions receiving a “high” ranking are compared to similar MHT ecoregions around the world to determine if they are globally outstanding in terms of species endemism. Globally outstanding ecoregions receive one hundred points to ensure that they will obtain a globally outstanding designation in the synthesis of the final BDI.

3. **Rare ecological or evolutionary phenomena**

This category includes globally outstanding centers of evolutionary radiation, higher-level taxonomic diversity, and unique species assemblages. Examples of rare ecological phenomena are large-scale migrations of larger vertebrates, extraordinary seasonal concentrations of wildlife, or distinctive processes such as the world’s most extensive sheet-flow grasslands (i.e., the Everglades). Ecoregions are placed into one of three categories of criteria: globally outstanding (100 points), regionally outstanding (5 points) or not rare (0 points). Ecoregions judged to contain globally outstanding ecological or evolutionary phenomena are awarded one hundred points for this criterion, automatically categorizing them as globally outstanding in the overall BDI. This criterion emphasizes only those phenomena that are truly outstanding at global or continental scales.

4. **Rare habitat type**

This measure represents the number of opportunities to conserve this MHT worldwide and the corresponding importance of the ecoregions that contain it. This criterion encompasses ecological and evolutionary phenomena, but it addresses those characteristics at the scale of whole ecosystems and biotas, as well as structural features of ecosystems and habitats. Ecoregions are placed in one of three categories: globally outstanding if fewer than eight ecoregions worldwide contain its MHT (100 points); regionally outstanding if fewer than three occur in its Region (i.e., the Neotropics) (5 points); and not rare (0 points). Like the rare ecological or evolutionary phenomena criterion, an ecoregion that was judged to contain globally rare MHTs is automatically categorized as globally outstanding in the overall BDI, regardless of its scores for other criteria, by awarding it 100 points.

Once ecoregions are evaluated with respect to the above four criteria, the BDI is obtained by totaling the scores. Each ecoregion is placed in one of four overall biological distinctiveness categories: globally outstanding, regionally outstanding, bioregionally outstanding, and nationally important. It should be noted that an ecoregion could earn the designation of globally outstanding by accruing forty-five or more points, or by being designated globally outstanding in any one of the four criteria.
Conservation Status

The Conservation Status discriminator has been designed to estimate the current and future ability of an ecoregion to meet three fundamental goals of biodiversity conservation including:

1. maintaining viable species populations and communities
2. sustaining ecological processes
3. responding effectively to short- and long-term environmental change.

The first step of this process is to calculate a "snapshot" conservation status, which measures the current (rather than future) conservation status as based on four essential landscape-level criteria, detailed below. This index is then modified by an assessment of future threats over the next twenty years to arrive at the threat-modified conservation status, or final conservation status. This approach relies on landscape-level features because the loss of biodiversity and the degradation of an ecosystem's function are difficult to measure directly for spatial units as large as regions (i.e., North America). Imperiled species, although considered ideal as a criterion for the conservation status index, were not included due to a variety of factors, including biases and weakness in available data sets.

1. Habitats loss

Loss of habitat reduces biodiversity by (1) eliminating species or communities limited to particular geographic localities, and (2) decreasing the area of available original habitat below the minimum size needed to maintain viable populations of important ecosystem dynamics.

2. Remaining habitat blocks

In addition to the simple reduction in habitat area, the spatial pattern of habitat loss is critically important to maintain native species, communities, and ecological processes across large landscapes. Large blocks of habitat generally contain larger and more stable species populations, and are uniquely able to support species with naturally low population densities or large home ranges.

3. Degree of habitat fragmentation

Habitat fragmentation often results in many small blocks of habitat lacking critical functions. Fragments under 100 km² are generally inadequate for maintaining viable populations of most large vertebrates. However, small fragments can be particularly valuable for conserving populations of other species with very localized habitat requirements and small ranges.
(4) **Degree of existing protection**

The degree-of-protection criterion assesses how well the existing network of protected areas conserves sufficiently large blocks of habitat, in sufficient number, within the ecoregion.

**Snapshot Conservation Status Index (CSI).** The four criteria listed above are weighted and combined into a single index, from which five categories of conservation status are derived: critical, endangered, vulnerable, relatively stable, and relatively intact, as detailed below. To assess the conservation status of ecoregions, WWF has adopted categorical schemes similar to those used in the IUCN Red Data Book series. The rationale for these criteria is that almost 90% of all species found in the Red Data Books are listed as endangered because of loss of habitat. As many more species that share those same ecoregions are either undescribed or unlikely ever to be officially listed, it makes sense to apply Red Data Book criteria directly to ecoregions to determine where overall species loss or declines are most likely to occur.

- **Critical**
  The remaining intact habitat is restricted to isolated small fragments with low probabilities of persistence over the next five to ten years without immediate or continuing protection and restoration. Many species are already extirpated or extinct due to the loss of viable habitat. Remaining habitat fragments do not meet the minimum area requirements for maintaining viable populations of many species and ecological processes. Land use in areas between remaining fragments is often incompatible with maintaining most native species and communities. Spread of alien species may be a serious ecological problem, particularly on islands. Top predators have or have almost been exterminated.

- **Endangered**
  The remaining intact habitat is restricted to isolated fragments of varying size (a few large blocks may be present) with medium to low probabilities of persistence over the next ten to fifteen years without immediate or continuing protection or restoration. Some species are already extirpated because of loss of viable habitat. Remaining habitat fragments do not meet the minimum area requirements for most species populations and large-scale ecological processes. Land use in areas between remaining fragments is largely incompatible with maintaining most native species and communities. Top predators are almost exterminated.

- **Vulnerable**
  The remaining intact habitat occurs in habitat blocks ranging from large to small; many intact clusters will likely persist over the next fifteen to twenty years, especially if given adequate protection and moderate restoration. In many areas, some sensitive or exploited species have been extirpat-
ed or are declining, particularly top predators and game species. Land use in areas between remaining fragments is sometimes compatible with maintaining most native species and communities.

- **Relatively stable**

Natural communities have been altered in certain areas, causing local declines in exploited populations and disruption of ecosystem processes. These disbursed areas can be extensive but are still patchily distributed relative to the area of intact habitats. Ecological linkages among intact habitat blocks are still largely functional. Guilds of species that are sensitive to human activities, such as top predators and ground-dwelling birds, are present but at densities below the natural range of variation.

- **Relatively intact**

Natural communities within an ecoregion are largely intact with species, populations, and ecosystems processes occurring within their natural ranges of variation. Guilds of species that are sensitive to human activities, such as top predators and ground-dwelling birds, occur at densities within the natural range of variation. Biota move and disperse naturally within the ecoregion. Ecological processes fluctuate naturally throughout largely contiguous natural habitats.

The snapshot CSI, the total of the four criteria, has a point range from 0 to 100, with higher values denoting a higher level of endangerment. The point thresholds for different categories of conservation status are: critical (89 – 100); endangered (65 – 88); vulnerable (37 – 64); relatively stable (7 – 36); and relatively intact (0 – 6).

To develop the final CSI, the snapshot conservation status of each ecoregion is modified according to the degree of expected future threat. This measure looks beyond the ecological threat implicit in existing habitat loss and fragmentation to evaluate the future trajectories of these phenomena. The cumulative impacts of all threats on habitat conversion, habitat degradation, and wildlife exploitation over the next twenty years are estimated to categorize ecoregions into three levels of threat: high, medium, and low. An ecoregion with high threat is promoted to the next highest conservation status category to arrive at its final (threat modified) conservation status. For example, an endangered ecoregion with high threat is promoted to critical. Conservation status for ecoregions with moderate or low threat is unchanged.

**Integrating BDI and CSI**

Both the BDI and CSI combine an evaluation of the relative biological importance of ecoregions with a measure of current and projected anthropogenic impacts that face each ecoregion. Considered together, the two indices provide a powerful tool for indicating appropriate conservation activities within ecoregions and for setting regional priorities.

Ecoregions, based on their categories for both indices, can be placed into one of twenty cells in a matrix (Table 10 below) organized into five classes that reflect the
nature and extent of the management activities likely to be required for effective biodiversity conservation. As a result of the priority setting process, each ecoregion is assigned a roman numeral that indicates its level of priority.

<table>
<thead>
<tr>
<th>Biological Distinctiveness</th>
<th>Critical</th>
<th>Endangered</th>
<th>Vulnerable</th>
<th>Relatively Stable</th>
<th>Relatively Intact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Globally Outstanding</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>III</td>
<td>III</td>
</tr>
<tr>
<td>Regionally Outstanding</td>
<td>II</td>
<td>II</td>
<td>II</td>
<td>III</td>
<td>III</td>
</tr>
<tr>
<td>Bioregionally Outstanding</td>
<td>IV</td>
<td>IV</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Nationally Important</td>
<td>IV</td>
<td>IV</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
</tbody>
</table>

By summing these two indices, WWF develops a final list of categories:

- **Class I**: Globally outstanding ecoregions requiring immediate protection of remaining habitat and extensive restoration. These ecoregions contain elements of biodiversity that are of extraordinary global value or rarity and are under extreme threat. Conservation actions in these ecoregions must be swift and immediate to protect the remaining source pools of native species and communities for restoration efforts.

- **Class II**: Regionally outstanding ecoregions requiring immediate protection of remaining habitat and extensive restoration. These ecoregions have high regional biodiversity and are under serious threat. Conservation actions should be swift and may include extensive and costly habitat restoration.

- **Class III**: Globally or regionally outstanding ecoregions that present rare opportunities to conserve large blocks of intact habitat. Ecoregions contain globally or regionally high levels of biodiversity or rare ecological processes. Conservation action in these ecoregions is not immediately needed, but these ecoregions represent some of the last remaining areas where it is possible to conserve large patches of intact, globally or regionally outstanding habitat.

- **Class IV**: Bioregionally outstanding and nationally important ecoregions requiring protection of remaining habitat and extensive restoration. Ecoregions contain bioregionally or nationally important elements of biodiversity that are under extreme threat. Conservation actions include protection of remaining habitat and extensive restoration of degraded habitat. Proper stewardship or expansion of protected areas, conservation management on native lands, and vigilant monitoring of ecological integrity are needed.
• **Class V:** Bioregionally outstanding and nationally important ecoregions requiring protection of representative habitat blocks and proper management elsewhere for biodiversity conservation. Conservation actions include proper stewardship or expansion of protected areas, conservation management on public and private lands, and vigilant monitoring of ecological integrity.

**IMPLEMENTATION AND MONITORING**

Once global priorities are established, WWF works within each ecoregion at the ecoregion, country, and landscape levels. WWF’s Ecoregional Planning is very similar to and sometimes partnered with TNC’s Ecoregional Conservation Planning. Monitoring takes place both at the ecoregional and landscape level. Specific indicators are monitored for features in categories of focal species, habitat representation, ecological processes, threats, and key conditions. These indicators are monitored over the long term with respect to final success goals.
| **WORLD WILDLIFE FUND**  
| **GLOBAL 200 APPROACH** |
| **BASIC OVERVIEW** |
| **Organizational Mission:** Conservation of Nature |
| **Approach Objective:** Identify the world’s most outstanding and threatened/intact ecoregions within each major habitat type (e.g., tropical dry forests, temperate grasslands). |
| **Planning Principles:** The Global 200 approach emphasizes representation by protecting the most biologically outstanding ecoregions within each Major Habitat Type. Principles of efficiency and the intrinsic value of nature are also emphasized. |
| **Scale:** Global in scale and global in extent. |
| **Planning Unit:** Ecoregion. |
| **Conservation Level:** Species and Ecosystem level (not genetic level). |
| **Data Sources:** Literature, maps, data sets and expert opinion. |
| **TARGETS, CRITERIA AND THRESHOLDS** |
| **Targets:** Ecoregions. |
| **Criteria & Thresholds:** (1) Biological distinctiveness (species richness, species endemism, rare ecological or evolutionary phenomena, and rare habitat type), and (2) Conservation status (specific criteria: habitat loss, remaining habitat blocks, degree of fragmentation, degree of protection, future threat). |
| **Weight:** Different weights are assigned to each of the specific criteria to ensure that the most biologically distinct and threatened ecoregions rank highest. |
| **IMPLEMENTATION** |
| **Landscape Level Implementation:** Once global priorities are established, WWF works within each ecoregion at the ecoregion, country, and landscape level. WWF's Ecoregional Planning is very similar to and sometimes partnered with TNC's Ecoregional Conservation Planning. |
| **Monitoring:** At the ecoregional and landscape level, specific indicators are monitored for features in categories of focal species, habitat representation, ecological processes, threats, and key conditions. These indicators are monitored over the long term with respect to final success goals. |
Regional Approaches

This section provides a brief overview of six approaches that prioritize and implement conservation planning at either the regional or landscape scale. At these sub-global scales, a variety of economic, social, and political factors are often considered in addition to scientific criteria. Generally, we consider an approach as regional if it guides decisions and planning within relatively large sub-continental areas such as ecoregions, hotspots, or heartlands. In contrast, landscape-level approaches work at an even smaller scale often incorporating a network of local sites.

Organizations and partnerships may work at the regional or landscape level for several reasons, one of which may be to implement priorities established during a systematic global-level analysis. For example, WWF works at a regional level (via Ecoregion-based Conservation Planning) within each of the over 200 ecoregions identified during their Global 200 analysis. Alternatively, organizations may work within a particular region for other factors such as local capacity or organizational preference. For example, The Nature Conservancy (TNC) currently works within ecoregions of North America, Latin America, and Asia.

WWF (2005) emphasizes the importance of working on a smaller landscape-level: “While many policy and institutional needs for conservation are addressed at ecoregional and national scales, these scales are often too large for the kind of detailed spatial analysis necessary to develop specific guidance regarding land management options and their geographical configuration.” They further explain that priority areas identified at the landscape level emerge as an important operational unit for implementation. “Working at the intermediary scale of landscapes, while still supporting ecoregional goals, allows for development of more specific land use recommendations, and for engagement with the land and resource managers who are responsible for the land areas in question.”

Below are brief summaries of six regional or landscape-level approaches. These approaches were not systematically selected based on a suite of criteria; rather, we selected a sample of prominent approaches at the sub-global scale. In-depth profiles for The Nature Conservancy’s Ecoregional Conservation Planning and Ducks Unlimited Canada’s approach to protecting Canada’s Boreal Forest are included in the Appendix, in addition to brief summaries below.
AFRICAN WILDLIFE FOUNDATION – AFRICAN HEARTLANDS PROGRAM

The African Wildlife Foundation’s African Heartlands program is a “collaborative, landscape-level management approach to conserving Africa’s unique wildlife resources” (AWF 2003). Heartlands are defined as large, cohesive conservation landscapes that are biologically important and have the scope to maintain healthy populations of wild species and natural processes well into the future. In addition, they also tend to form an economic unit in which tourism or other natural resource-based activities can contribute significantly to the livelihoods of people living in the area (AWF 2005). Most of the African Heartlands comprise land units under different management and ownership regimes, including national parks, private land, and community land in a single ecosystem. Heartlands range in size from one million acres to over 40 million acres and extending in many cases across the borders of two or more countries (AWF 2003).

AWF first prioritizes and selects heartlands, and then plans and implements activities in these priority landscapes (AWF 2003). AWF works within heartlands through partnerships with local people, governments, and organizations to improve economic and environmental sustainability of land use. The process relies on a science-based planning process developed with The Nature Conservancy to establish conservation goals for each Heartland, identify threats and to design interventions to address these threats (AWF 2003).

Some Heartland activities as described on AWF’s website include:

- Strengthening the infrastructure and management of national parks and game reserves that frequently constitute the core of these landscapes.
- Identifying and securing wildlife migration corridors, water sources and other critical sites which must be protected for the long term health of the landscape.
- Working with rural communities to develop plans to manage their land and wildlife resources as part of the Heartland.
- Assisting these same communities with technical assistance and capital to engage in wildlife related enterprises, such as ecotourism, to improve their livelihoods from conservation.
- Conducting on-going research and monitoring across the Heartland to ensure the health and viability of priority conservation targets.

Eight Heartlands have been identified to date, including: Congo (Democratic Republic of Congo); Kazungula (Zambia, Zimbabwe, Botswana and Namibia); Kilimanjaro (Kenya and Tanzania); Limpopo (Mozambique, South Africa and Zimbabwe); Maasai Steppe (Tanzania); Samburu (Kenya); Virunga (Uganda, Rwanda and the Democratic Republic of Congo); and Zambezi (Zimbabwe, Zambia and Mozambique).

1 Specifically, AWF uses TNC’s Site Conservation Planning methodology (AFW 2003).
CONSERVATION INTERNATIONAL — CONSERVATION CORRIDORS AND KEY BIODIVERSITY AREAS

In order to protect biodiversity within the Biodiversity Hotspots and High Biodiversity Wilderness Areas that it has identified via its global analyses, CI works at a regional or landscape level via its “Conservation Corridors” approach (corridor in this context is analogous to a landscape rather than small linkages between non-contiguous habitats). This level of conservation is seen as critical for long-term maintenance of species protected in the short-term by site-based conservation and serves as a coarse filter to capture ecological processes and species that have not been targeted in finer grain approaches. Structurally, a conservation corridor is typically composed of “core areas, connecting linkages, and buffer zones or areas of compatible land/ resource use.” The backbone of a biodiversity conservation corridor is “a system of protected areas (core areas) designed to conserve key biodiversity areas” (CI 2004).

CI sees conservation corridors as one of several broad-scale approaches to conservation planning that have evolved in recent years, such as wildlands networks, ecoregion-based conservation and bioregional planning, “in response to concerns that isolated protected areas are too small to protect viable populations of wide-ranging species or maintain essential ecological processes” (CI 2004). Criteria for identifying corridor-level targets include the area that is needed for wide-ranging threatened species, as well as ecosystem processes that are crucial for the persistence of those threatened species or key biodiversity areas.

The key elements of conservation corridors are the same as those of any ecological network approach. According to CI, these are:

- A focus on conserving biodiversity at the ecosystem, landscape, or regional scale.
- An emphasis on maintaining or strengthening ecological coherence, primarily through ecological interconnectivity.
- Protecting critical areas from the effects of external activities.
- Restoring degraded ecosystems.
- Promoting complementarity between land uses and biodiversity conservation objectives.

At an even finer scale, CI also works with partners BirdLife International, PlantLife International and others to identify Key Biodiversity Areas, that build on the successful framework of BirdLife International’s Important Bird Areas applied to other taxonomic groups. As with the global analyses, this is a quantitative data-driven approach based on two important criteria: vulnerability and irreplaceability. The current criteria and thresholds need considerable testing and there is not yet fully agreed-upon scientific consensus. Key biodiversity areas would be triggered by meeting any one of the following criteria that are equally weighted:
• Presence of one or more globally threatened species.
• Presence of one or more restricted-range species.
• Presence of a globally-significant congregation of a given species.
• Presence of biome-restricted species.

**DUCKS UNLIMITED CANADA (DUC) – CANADA’S BOREAL FOREST APPROACH**

The Ducks Unlimited family has identified Canada’s boreal forest as one of its most urgent conservation priorities. This designation is based on the value of the boreal ecosystem to waterfowl; its intact forests and wetland complexes; and threats from resource extraction (forestry, oil, gas and mineral), agriculture, hydropower development, and global warming.

DUCs approach aims to identify the most important wetland resources within the priority ecoregion of the Canadian boreal forest, and to maintain ecological integrity to support historical numbers of breeding, molting and migrating waterfowl and other wetland-dependent wildlife. The purpose is to conserve waterfowl habitat by conserving landscape-level functionality of boreal watersheds. The number one criterion for selecting areas is the existence of key breeding areas, migration routes, and staging areas for waterfowl; the second is function at the landscape (large watershed) level. Since little is known about boreal hydrological function and critical habitat size for waterfowl in the boreal ecosystem, the emphasis is on protecting undisturbed habitat.

Priority areas are chosen based on a combination of expert knowledge, waterfowl population data (particularly high breeding areas), wetland density, intact habitat, social values (aboriginal communities), opportunity, partners, threats, and funding. Hotspots are defined as areas with high density (greater than 30-40%) of wetlands, as determined by landcover analysis, and high waterfowl populations. DUC focuses on selecting large areas with linear boundaries where the combination of high-value habitat, high waterfowl populations, imminent threat, community interest, and landowner/land manager interest converge to create a significant conservation opportunity. Other considerations include partnerships, international attention, and funding. See the Appendix for a complete profile and map.

**THE NATURE CONSERVANCY (TNC) – ECOREGIONAL CONSERVATION PLANNING**

The Nature Conservancy (TNC) defines its mission as preserving the plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive (TNC 2005). Since its foundation in 1951, TNC has worked with people, communities, and businesses to protect millions of
acres in the United States and around the world. As one of its key endeavors, TNC has developed a strategic planning process called “Conservation by Design,” which seeks to ensure biodiversity over the long term. Organized by the world’s ecoregions as defined and delineated by the World Wildlife Fund, this approach involves four main stages including: setting priorities, developing strategies, taking action, and measuring success. As explained on their website, “Conservation by Design allows us to achieve meaningful, lasting conservation results” (TNC 2005).

The first step of the process—setting priorities—is accomplished through global major habitat type assessments and *ecoregional conservation planning*. Ecoregional Conservation Planning approach seeks to conserve all the species, plant communities, and ecosystems of an ecoregion. To do this, TNC selects its targets, which are all the ecosystems present in the ecoregion, and the plant communities and species that are not well represented in the targeted ecosystems. To estimate the level of conservation efforts necessary to sustain a target at viable numbers over a specified planning horizon, TNC then sets conservation goals for each target, in order “to define the number and spatial distributions of on-the-ground occurrences of targeted species, communities, and ecosystems that are needed to adequately conserve the target in an ecoregion” (Groves et al. 2000). The final output of an ecoregional planning exercise is a portfolio of areas of biodiversity significance. See the Appendix for a complete profile and map.

**WORLD WILDLIFE FUND – ECOREGION-BASED CONSERVATION**

WWF’s overall Global 200 conservation strategy is implemented through the combination of ecoregion action programs (EAPs) and target driven programs (TDPs), such as Forests for Life, Climate Change, and Species programs (WWF 2005). Both types of programs focus primarily on Global 200 ecoregions. Ecoregion-Based Conservation (ERBC) in particular focuses on identifying and protecting priority areas that are essential to conserving the full expression of biological diversity in the ecoregion (Dinerstein et al. 2000). The fundamental aspects of the approach include (WWF 2005):

- Planning and implementing conservation on the scale at which natural ecosystems operate.
- Articulating a 50-year biodiversity vision that conserves the full range of species, natural habitats, and ecological processes characteristic of an ecoregion over the long term.
- Providing a geographical/ecological flagship for developing a sense of stewardship.

ERBC focuses on five biodiversity targets in developing a biodiversity vision that maps priority areas for conservation within ecoregions (Dinerstein et al. 2000), including: distinct communities, habitats, and species assemblages; large expanses of intact habitats and intact biotas; keystone ecosystems, habitats, species, or phenomena; large-scale ecological phenomena; and species of special concern.
The biodiversity vision is considered the principal outcome of the ERBC process. It identifies and maps priority areas or even a specific conservation area network that the ecoregion should protect in order to conserve its biodiversity and ecological processes in the future (WWF 2005). Once priority areas for an ecoregion have been defined, the next important step is to develop “cost-effective, spatially-explicit or “mapped-out” strategies that meet the ecological needs of wildlife and habitats while minimizing land use conflicts and maximizing benefits to resident populations.” WWF provides detailed direction to local staff in implementing these visions. The following seven steps are discussed as essential to landscape level and ecoregional conservation:

1. Clarify roles and stakeholder/partnership process
2. Design a biological landscape
3. Understand and map social landscape(s)
4. Develop conservation landscape scenarios with stakeholders
5. Negotiate a conservation landscape design and develop implementation strategies
6. Implement conservation landscape with partners
7. Monitor biodiversity and threats and evaluate performance

For more information on WWF’s Ecoregional approach see http://worldwildlife.org/science/pubs/vision_to_ground.pdf

WILDLIFE CONSERVATION SOCIETY – LIVING LANDSCAPES PROGRAM

WCS conducts a majority of their work at the landscape level, where decisions are tempered strongly by conservation issues, opportunities for long-term conservation success, and cases in need of the support it provides, among other factors. WCS’s Living Landscapes Program supports landscape-level conservation efforts, while their regional programs (Asia, Africa, Latin America, North America, Marine) actually conduct on-the-ground implementation. When considering “conservation priorities,” WCS feels that the answer lies not only in “where to work,” but also in “how to work” and which issues to address. Decisions made about conservation investments depend in part on conservation priority studies (WCS’s own and others) but also a broad range of other factors.

The Wildlife Conservation Society’s Living Landscapes program is dedicated to the conservation of large, wild ecosystems, but recognizes that few places on Earth remain free from human influence (WCS 2005b). WCS explains that while parks and protected areas are crucial to saving wildlife, they cannot do it alone because they are always embedded in larger, human-dominated landscapes (WCS 2005b). WCS currently works within twelve core sites (including Bolivia, Congo, Ecuador, Guatemala, Belize, Mongolia, Tanzania, Cambodia, Argentina, Coastal Patagonia, and two sites in...
North America) that represent large, relatively intact ecosystems of global biodiversity conservation. These sites are all considered important conservation sites, based on one or more global priority setting exercises (Hotspots, Global 200 Ecoregions, Last Wild Places, World Heritage Sites, Endemic Bird Areas, Ramsar sites).

The first tool that the Living Landscapes Program developed was the Landscape Species Approach, that concentrates on wide-ranging species that “play crucial roles in maintaining the health of large ecosystems that span both inside and outside of protected areas” such as jaguars, tapirs, and elephants. The approach is focused on planning conservation to address the environmental needs of, and human threats to, viable populations of a suite of landscape species. As discussed in the Targets section, the umbrella species typically require large and ecologically diverse areas. Their conservation is often essential to the protection of their respective ecosystems as they typically have a significant impact on the structure and function of their environments and they are also often susceptible to human activities. Focusing on landscape species helps WCS to define the size and shape of the landscape to be protected, based on what these species need to ensure the long-term persistence of species populations and the underlying ecological processes upon which they depend. Given the usually important human presence in these “landscapes” that lie outside the protected areas, the approach aims to reconcile people’s use of the land with the needs of wildlife, often by studying how people use the landscape and how they sometimes clash with landscape species. (WCS 2005b)
Local Implementation

Once global and regional priorities have been established, many conservation organizations and partnerships work with in-country experts and local partners to implement priorities at the site or local level. This step involves a broad range of activities, from direct acquisition and lobbying for protected areas to encouraging sustainable development, abating hunting, and promoting ecotourism operations. Options vary considerably among locales, and there is generally not a systemized approach even within organizations.

For example, WCS’s Range-Wide Priority Setting approach considered the following issues for the American crocodile in both prioritizing different populations of the species and then in implementing the conservation:

- Natural habitat quality.
- Habitat connectivity (forming a regional crocodile metapopulation).
- Habitat destruction.
- Man-made habitat improvements.
- Nesting habitat.
- Killing of crocodiles.
- Contamination.
- Potential for commercial management and potential for crocodile ecotourism.

Site-level implementation must consider a range of social and economic factors that earlier larger-scale planning and analysis did not. Larger-scale planning typically relies primarily on scientific analysis, whereas local implementation must incorporate economic, social, political, logistical, and institutional considerations in addition to scientific guidelines. Mittermeier et al. (1998) explain that incorporating social and political feasibility into global or priority-setting would be undesirable because it “may result in certain high-priority areas for biodiversity conservation being underfunded or unfunded because of social factors and political will of the nation.” However, once these priorities are established based on scientific criteria, the way they are implemented is affected greatly by non-scientific factors. Margules and Pressey (2000) explain, “Conservation planning is an activity in which social, economic and political imperatives modify, sometimes drastically, scientific prescriptions.”
Although social, economic, and political factors often strongly influence how conservation planning is manifested on the ground, ENGOs also use scientific theories or methodologies to implement conservation at the site level. Included below is a brief summary of key scientific concepts that often guide conservation approaches at the regional, landscape, and local level. Definitions in italics are from *Principles of Conservation Biology* (Meffe and Carroll 1997); comments regarding use of these principles sometimes follow the definitions.

- **Biosphere Reserve**: A concept of reserve design in which a large tract of natural areas is set aside, containing an inviolate core area for ecosystem protection, a surrounding buffer zone in which nondestructive human activities are permitted (such as ecotourism, low-intensity agriculture, or sustainable extraction of natural resources), and a transition zone in which human activities of greatest impact are permitted. Three goals of a biosphere reserve are conservation, training (education), and sustainable human development compatible with conservation.

This biosphere concept takes form in a global network of biosphere reserves promoted via United Nations Educational, Scientific, and Cultural Organization’s (UNESCO) “Man and the Biosphere” (MAB) Programme which was launched in 1970. These reserves are internationally recognized, nominated by national governments, and remain under sovereign jurisdiction of the states where they are located (UNESCO 2005). Biosphere reserves are a critical part of on-the-ground conservation, and as such, are relevant to all organizations and partnerships that implement conservation at a local level (e.g., TNC). They also are a key illustration of sustainable development, as they emphasize the wedding of conservation and development objectives and the importance of incorporating local human use. Figure 1 illustrates the multiple-use nature of biospheres.

- **Corridors**: Corridors are strips of habitat connecting otherwise isolated habitat patches (fragmented landscape). They are important features of reserves to allow movement and recolonization among high-quality habitat. Wildlife corridors have two major purposes: (1) allow for periodic movements among different habitat types used for different purposes, such as breeding, birthing, feeding, or roosting, ranging from annual migrations of large herbivores to daily movements of birds between feeding and roosting sites; and (2) allow permanent immigration and emigration of individuals among habitat patches in a metapopulation context, allowing gene flow and recolonization after local extinction.
Noss (1991) describes three types of corridors at three different scales:

- **Fencerow scale** – connects small, close habitat patches, such as woodlots, using narrow rows of appropriate habitat, such as trees or shrubs, for the movement of small vertebrates, such as mice, chipmunks, or passerine birds

- **Landscape mosaic scale** – broader and longer corridors that connect major landscape features rather than small patches. They may function for daily, seasonal, or more permanent movement of interior as well as edge species and result in a landscape-level mosaic of reserves

- **Regional scale** – largest corridor scale; connects nature reserves in regional networks

**Patch Dynamics:** A conceptual approach to ecosystem and habitat analysis that emphasizes dynamics of heterogeneity within a system. Diverse patches of habitat created by natural disturbance regimes are seen as critical to maintenance of diversity. TNC uses this concept systematically in their approach (refer to their profile for more information).

**Edge Effects:**
1. The negative influence of a habitat edge on interior conditions of a habitat, or on species that use interior habitat;
2. The effect of adjoining habitat types on the population in the edge ecozone, often resulting in more species in the edge than in either habitat alone. Edge effects are one factor influencing the design of the size and shape of protected areas. For example, a circular reserve would have a higher proportion of interior area than an elongated square reserve, and a larger reserve would have a higher proportion of interior habitat than a smaller reserve.

**GAP analysis:** The use of various remote sensing data sets to build overlaid sets of maps of various parameters (e.g., vegetation, soils, protected areas, species distributions) to identify spatial gaps in species protection and management programs.

**Minimum Viable Population (MVP):** Refers to the smallest isolated population that has a specified statistical chance of remaining extant for a specified period of time in the face of foreseeable demographic, genetic, and environmental stochasticities, plus natural catastrophes. For example, how many breeding pairs of birds are needed in a population in order for the population to endure over 100 years of environmental, genetic, and demographic uncertainty? Along these lines, a population viability assessment can help predict the likelihood that a certain population will persist into the future given various conditions. BirdLife International uses this concept to establish goals for the number and distribution of occurrences (examples) of the target to be captured in the portfolio design. Individual conservation target occurrences represented in the portfolio design must be judged viable; viability assessments are...
undertaken and target occurrence viability is described on the basis of size, condition, and landscape context.

- **Network:** A reserve system connecting multiple nodes and corridors into a landscape that allows material and energy flow among the various components.

- **Species-Area Relationship:** Larger areas capture a greater number of species than smaller areas (however, the ratio of species-to-area decreases as size increases).

- **Biogeography:** The study of biogeography seeks to explain the distribution of organisms across local, regional, and global ranges. For example, how do size, shape, temporal factors, and connectivity between parcels of land affect the kinds and distribution of species and organisms found there? One of the most classic biogeography theories is that of island biogeography, which predicts that species richness—or the number of species existing on an island—is influenced by the size of the island and the distance of the island from the mainland (the term island can also mean a parcel of protected land that is isolated from other patches by development). The model predicts that species richness rises as island area increases and decreases the further the island is from the mainland (Purves et al. 1995). The application of island biogeography theory to terrestrial ecosystems that are highly fragmented (and thus mimic islands) was once considered relevant but there is now considerable debate surrounding its usefulness.

It is difficult to quantify to what extent each approach utilizes these scientific principles. First, conservation priorities are implemented on-the-ground in various local contexts utilizing local experts rather than in a top-down approach that can be systematically examined easily from afar. Second, the extent to which these principles come into play is not stated explicitly but rather is part of the background knowledge of the ecologists and other conservation professionals implementing conservation on-the-ground. Furthermore, these principles are often adapted and conflated with other non-scientific priorities as the local circumstances demand.
Key Findings

It should be no surprise that these five conservation ENGOs share an overarching goal to broadly conserve the world’s biodiversity. Beyond this basic intent, these approaches also overlap considerably with respect to how they obtain data, identify thresholds, and evaluate criteria. Still, approaches retain distinctive identities via the particular combinations of criteria and other factors emphasized. Below is a summary of the key trends that emerge from this analysis.

EFFICIENCY AND FUNCTIONALITY AMONG TOP PRIORITIES

Of the eight planning principles identified by the authors, the most common principle is recognition of the intrinsic value of nature or wildlife, which is either explicitly stated or directly implied in all eight approaches studied. Beyond that fundamental principle, functionality (the importance of retaining functionality of conservation targets and the ecosystems that support them, not just their structure or number) and the efficiency of resource expenditure (given limited resources, efforts must be concentrated on the fewest high-quality sites possible, or the fewest species (endemic, endangered) that can in turn lead to protection of a broader biodiversity) were both emphasized in 75% of the approaches examined (six of eight). Sustainable development and engaging local stakeholders were not common principles at the global level but are used at the regional and local levels by several of the organizations and partnerships.

THE IMPORTANCE OF EXPERT OPINION

All approaches rely heavily on expert opinion, which includes field experts, scientists, and local knowledge. It is obvious that much needed information, particularly about species, local conditions, habitat requirements, and ecosystems is not available in the published data. All approaches use some sort of expert input and review of their priority setting.

EMPHASIS ON SUPRA-ORGANISMAL UNITS

Most of the conservation planning schemes are based on “supra-organismal planning units”, whose boundaries are a function of larger ecoregional, habitat, or political factors rather than the distribution of a particular species. WCS’s Range-wide Priority Setting stands alone as the single approach entirely based on an organismal planning
unit: the range of a wide-ranging species. From the WCS point of view, approaches based on planning units such as hotspots, ecoregions or endemic bird areas “seek to conserve the whole (i.e., ecosystem functions) when faced with the impossibility of knowing all the parts (i.e., extent of biological diversity).” But, according to WCS, “the parts are important too,” and in the case of a wide-ranging species such as the jaguar, conserving supra-organismal entities “provides no guarantee of conserving jaguars across all the ecological settings where they occur outside hotspots and across a large number of ecoregions.” However, WCS considers that its approach complements the coarse-filter approaches by “testing their generality through an emphasis on single-species requirements.”

**A FOCUS ON HABITAT**

Although biodiversity is the ultimate target for most approaches, the more immediate or concrete targets are either geographic areas or particular species (no approach sets targets at the genetic level). Almost all approaches include some sort of geographic unit as an immediate target for conservation. For example, WCS’s range-wide priority setting selects species conservation units (WSCUs), which can be defined as important areas for wide-ranging species conservation. At the regional and local level, species are often the target, and the most common species targets are those that have been listed as threatened by one of the few key authorities. *Focal species*, including indicator species, umbrella species, keystone species, and wide-ranging species, were also often identified as targets. All approaches assume that implementation of biodiversity conservation at the global level is best accomplished by protecting habitat (and often entire ecosystems), even for those that ultimately target species for conservation.

**ENDEMISM AS A TOP SCIENTIFIC CRITERION**

Among the thirteen scientific criteria we identified – six of which relate to biological value (e.g., natural rarity, species richness) and seven of which relate to conservation value (e.g., habitat loss, high future threat) – endemism stood out as the most frequently cited scientific criterion, used in all except WCS’s approaches. An emphasis on endemism is intuitive as by definition endemic species are found nowhere else on the planet; by focusing attention on these areas, conservationists ensure that their resources are directed to the most urgent location. It is less common for these approaches to focus on the presence of a particular species or taxon at the global level, but this becomes more prominent at the regional and local levels especially as a particular species or taxon (i.e., birds) may serve as a proxy for biodiversity in general.
EMPHASIS ON AREAS THAT ARE BOTH HIGHLY DEGRADED/THREATENED AND INTACT/LOW THREAT

Approaches are relatively dichotomous with respect to the level of threat and intactness emphasized by their criteria. Often applied in tandem with other criteria (such as requiring high levels of biodiversity), approaches tend to prioritize areas that are either highly degraded and/or threatened or intact with minimal pressure from human population. Areas with moderate degradation and threat were not prioritized. This combination results in a U-shaped curve when plotting conservation priorities versus conservation status (from relatively intact to critically endangered, for example). Perlman and Adelson (1997) diagram this situation in Biodiversity: exploring values and diversity in conservation. An approximate replication is shown in Figure 2.

Figure 2  The Relationship between Conservation Status and Conservation Priorities

EMPHASIS ON VULNERABLE AND IRREPLACEABLE TARGETS

Another key trend is the focus on targets that are both highly vulnerable and irreplaceable. This combination is discussed in the literature particularly by Margules and Pressey (2000) as a critical formula when identifying conservation priorities. Vulnerability (or threat) reflects a lack of temporal options, places of higher threat being those that are more likely to lose their biodiversity value sooner; Irreplaceability reflects the lack of spatial options for the conservation of species; at its most extreme, for example, if a particular species is confined to one or a handful of sites, there are no other (or limited) spatial options available for the conservation of that species. Conservation targets that are both highly vulnerable and irreplaceable are those most likely to be lost first and with the fewest replacements.

Conservation International’s Biodiversity Hotspots illustrates this combination. Hotspots have two main criteria: high levels of endemic species – which are irreplaceable by definition – and high levels of threat (measured by remaining habitat...
intact), which is an indicator of vulnerability. Protection is urgent if targets are not to be compromised. Key Biodiversity Areas, which is the approach used by Conservation International and partner organizations to identify site-based priorities, also emphasizes this combination of criteria, as does AZE, whose sites are a nested subset of Key Biodiversity Areas — specifically, areas that contain the last remaining populations of a highly threatened species. Figure 3 below illustrates the relationship between vulnerability and irreplaceability with specific reference to Conservation International’s Biodiversity Hotspots and High-Biodiversity Wilderness Areas.

Figure 3 A Key Combination of Criteria: Vulnerability and Irreplaceability
Adapted from Mittermeier et al. 1998

<table>
<thead>
<tr>
<th>Irreplaceability</th>
<th>Vulnerability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher biodiversity, lower threat</td>
<td>Higher biodiversity, higher threat</td>
</tr>
<tr>
<td><strong>HIGH BIODIVERSITY WILDERNESS AREAS</strong></td>
<td><strong>HOTSPOTS</strong></td>
</tr>
<tr>
<td>Lower biodiversity, lower threat</td>
<td>Lower biodiversity, higher threat</td>
</tr>
<tr>
<td><strong>DESERT AND BOREAL WILDERNESS AREAS</strong></td>
<td><strong>TEMPERATE AREAS</strong></td>
</tr>
</tbody>
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**BEING PRACTICAL IN A COMPLICATED WORLD**

The reliability and extent of information available can affect how and whether certain criteria are used. One example of this is the exclusion of imperiled species as a criterion for assessing the conservation status of the Earth’s terrestrial ecoregions in WWF’s Global 200. Imperiled species are explicitly considered by WWF as “ideal to be used as a criterion for the conservation status index.” Nevertheless, all of the criteria used in this approach are landscape-level features such as habitat loss, presence of large blocks of remaining habitat, degree of habitat fragmentation, and degree of existing protection. This is partly due to a lack of reliable information about imperiled species.

The need to be practical plays a significant role in developing thresholds as well. In general, thresholds are based on conservation biology literature and science. But to develop their conservation planning approaches, ENGOs have had to establish specific thresholds even where there is limited scientific research available to inform the process. This is to some extent because thresholds are arbitrary by nature, and are more a necessity of the decision-taking process than a feature of nature itself.

WRI’s Forest Program’s minimum size threshold for “intact forested areas” is an enlightening example. Scientific literature does not provide a consensus on a specific

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1 Listing bias was one of several factors. According to WWF: “Imperiled species, although considered as ideal to be used as a criterion for the conservation status index, were not included because (1) lists of imperiled species are often biased toward vertebrates as opposed to invertebrates, (2) political rather than biological factors also preclude the inclusion of certain taxa that otherwise should be listed, and (3) there are likely to be many species that should be listed for which only limited data exist.”
threshold for “intactness,” but rather an array of thresholds that range between 5,000 and 500,000 hectares. In order to establish their own threshold, WRI considered the current situation of intact forests together with knowledge about the needs of most wide-ranging species and decided on a 50,000 hectares threshold.

In CI’s approach, a region has to have lost at least 70% of its primary vegetation to qualify as a hotspot. This is based not on any current scientific threshold but on considerations born from the prioritization process itself. John Pilgrim of CI explains, “Given that the aim of the prioritization is to encompass the priority areas that hold the most biodiversity worldwide . . . a reasonable combination of endemism and threat thresholds set at largely arbitrary levels should produce a number/area of priorities that is both an achievable short-medium term target, yet also ambitious enough that it actually does contribute significantly to biodiversity conservation at a global level.” In addition, CI found that the 70% value corresponded with a natural gap: reducing the threshold to 60% would produce few additional hotspots, whereas a 90% cutoff would exclude 11 of the hotspots. Finally, the successful output of the process confirms the validity of the threshold with respect to the conservation objective: “the 70% cutoff is justified on the grounds that most large-scale concentrations of endemic plants occur within the 25 hotspots as delineated” (Myers et al. 2000).

A final example includes the scientific threshold associated with the concept of endemism. Because endemism does not have a particular geographic scale attached to it, some approaches have used a threshold of 50,000 km² to define a restricted-range or endemic species, rather than relying on an infinite range of geographic scales. This threshold was first used by Terborgh and Winter (1983) in which they arbitrarily defined a “small range” as “any distribution encompassing less than 50,000 km².” The 50,000 km² range threshold was then used by BirdLife International to define endemic species, and, following BirdLife’s lead, WWF later incorporated this threshold into their own criteria. Although there is some reasoning behind these thresholds, a natural, scientifically-definitive threshold does not exist; rather, many approaches combine scientific knowledge with practical constraints in establishing best-guess thresholds for many criteria.
Conclusion

We found that although there are many subtle, and some significant, distinctions among conservation approaches, the similarities are more prominent than the differences. The repeated reliance on popular criteria – such as high levels of endemic and threatened species – means that the same areas are prioritized by different approaches time and time again, despite unique combinations of goals, targets, subtleties of criteria, and principles. As Mike Hoffmann of CI explained, “If one compares WWF’s Global 200 ecoregions and the Endemic Bird Areas of BirdLife International with our Biodiversity Hotspots, the same priority regions usually rise to the top, among them the Tropical Andes, Madagascar, the Atlantic forest region of eastern Brazil, the Mesoamerican forests, the Philippines, most of Indonesia, the Cape Floristic Region of South Africa, and New Caledonia.” This study confirms this general trend.

When approaches work at the same scale (e.g. global), the same areas are often prioritized. But beyond that, when working at a smaller scale, approaches often (but not always) prioritize areas that are nested within the larger areas targeted for conservation by global approaches. For example, AZE Sites (which are much smaller in spatial scale than most of the other approaches studied here) are often nested within the Global 200 Ecoregions, Hotspots, EBAs, and IBAs.

Beyond simply confirming similar conclusions, perhaps the most prominent trend we identified is the increasing propensity for organizations to collaborate, including sharing information, utilizing the same methodologies, and relying on the same thresholds. For example, we found a considerable amount of overlap in the different approaches’ planning units, a consequence of the increasing level of collaboration and complementary research among these organizations. TNC uses WWF’s ecoregions in the work they carry on outside the United States. Similarly, CI has adjusted the boundaries of its hotspots to match the WWF ecoregions so hotspots now represent an amalgamation of extremely high priority ecoregions. Beyond planning units, approaches often look to each other in establishing scientific thresholds and guidelines. WWF uses Birdlife’s 50,000 km² for defining endemism and CI and partners use the same threshold to identify key biodiversity areas in hotspots for restricted-range species.

In addition to sharing thresholds and planning units, there is also a growing tendency to work together on specific partnerships and projects. An exemplary case of collaboration is the Alliance for Zero Extinction initiative, which bridges nearly forty biodiversity conservation organizations in a streamlined and systematic effort to prevent the most imminent extinctions. In addition, the use of Key Biodiversity Areas by
Conservation International, BirdLife International, and others is another important collaborative development. Further collaboration between ENGOs and other stakeholder groups, including the forest products industry, may result in even greater synergies and the ability to protect the greatest biodiversity in the most efficient manner.
Sources


Biodiversity Support Program


Glossary of Terms

Background extinction rate: natural (non-human caused) extinction rate, estimated at one species extinction every four years.

Biodiversity: (also called biotic or biological diversity) the variety of organisms considered at all levels, from genetic variants belonging to the same species through arrays of species to arrays of genera, families, and still higher taxonomic levels; includes the variety of ecosystems, which comprise both communities of organisms within particular habitats and the physical conditions under which they live (Wilson 1992; Ricketts et al. 1999).

Biological value: criteria for determining biological value include species richness, species endemism, rarity, significant or outstanding ecological or evolutionary processes, and presence of special species or taxa.

Conservation planning: aims to use limited resources efficiently and achieve maximum results in the least amount of time. Organizations advocating conservation planning believe in taking a proactive approach to identify areas of highest priority and guide funding and other resources in a strategic manner.

Conservation site: an area that maintains the target species, communities, and ecological systems and their supporting ecological processes within their natural ranges of variability (Groves et al. 2000).

Conservation value: criteria for determining conservation value include endangered species, species decline, habitat loss, fragmentation, large intact areas, high future threat, and low future threat.

Declining species: a Nature Conservancy term meaning species that have significant, long-term reductions in habitat and/or numbers, are subject to a high degree of threat, or may have unique habitat or behavioral requirements that expose them to great risk.

Disjunct species: as defined by The Nature Conservancy, species that have populations geographically isolated from those of other populations.

Ecoregion: a large area of land or water that contains a geographically distinct assemblage of natural communities that (a) share a large majority of their species and ecological dynamics, (b) share similar environmental conditions, and (c) interact ecologically in ways that are critical for their long-term persistence (Ricketts et al. 1999). For conservation purposes, ecoregions are generally ecologically derived, using infor-
mation such as climate, vegetation type and/or characteristic species, although they may also be based on geographic or political criteria.

**Ecosystem service:** service provided free by an ecosystem, or by the environment, such as clean air, clean water, and flood amelioration (Ricketts et al. 1999). Other examples include stabilizing soil, providing renewable resources, and providing homes for human communities.

**Ecosystem:** a system resulting from the integration of all living and nonliving factors of the environment (Tansley 1935; Ricketts et al. 1999)

**Efficiency:** concentration, given limited resources, on the fewest high-quality sites possible, or the fewest species (endemic, endangered) that can in turn lead to protection of a broader biodiversity. Often this incorporates an evaluation of threat whereby it is deemed most efficient to conserve the most threatened ecosystems or species, especially if the goal is stemming biodiversity loss.

**Endangered species:** a species at some level of risk for extinction. The most widely referenced authority in designating species as endangered or threatened is the IUCN Red List.

**Endemic species:** species that are found solely within a particular area and nowhere else on the planet.

**Endemism:** degree to which a geographically circumscribed area, such as an ecoregion or a country, contains species not naturally occurring elsewhere (Ricketts et al. 1999).

**Environmental indicator:** see indicator species.

**Evolutionary radiation:** see radiation.

**Extent:** total area that is under consideration by a conservation approach (e.g., the terrestrial earth; or a particular region such as Latin America).

**Flagship species:** species that hold special political or social clout. WWF’s definition is “A species selected to act as an ambassador, icon, or symbol for a defined habitat, issue, campaign, or environmental cause.”

**Focal species:** according to The Nature Conservancy, focal species have “spatial, compositional, and functional requirements that may encompass those of other species in the region and may help address the functionality of ecological systems.” May encompass umbrella species as well as other categories of special species.

**Fragmentation:** the disruption of extensive habitats into small and isolated patches. Fragmentation has two negative ramifications for biodiversity: the loss of total habitat areas and the creation of smaller, more isolated, remaining habitat patches (Meffe and Carroll 1997).

**Functionality criterion:** importance of retaining functionality of conservation targets and the ecosystems that support them, not just their structure or number.
Global approach: an approach that applies a certain set of criteria to most of or the entire globe to prioritize areas for conservation. Global approaches are most often used to identify ecoregions, hotspots, or wilderness areas to prioritize for conservation; also included are sites designated by the Alliance for Zero Extinction, which are smaller in size. The global approach most often results in the prioritization of certain regions (or ecoregions) for conservation action above others.

Globally outstanding: biological distinctiveness category for units of biodiversity whose biodiversity features are equaled or surpassed in only a few other areas around the world (Ricketts et al. 1999).

Habitat loss: landscape-level variable that refers to percentage of the original land area of the ecoregion that has been lost (converted).

Habitat: an environment of a particular kind, often used to describe the environmental requirements of a certain species or community (Wilson 1992; Ricketts et al. 1999)

Indicator species: a species whose presence signals (acts as a surrogate for) the existence of broader biodiversity.

Intact habitat: relatively undisturbed areas characterized by the maintenance of most original ecological processes and by communities with most of their original native species still present. (Ricketts et al. 1999). There is no consensus on a minimum size for an area to be considered intact; thresholds range from 5,000 to 500,000 hectares.

Invasive species: exotic species (i.e., alien or introduced) that rapidly establish themselves and spread through the natural communities into which they are introduced (Ricketts et al. 1999).

Keystone species: species that are critically important for maintaining ecological processes or the diversity of their ecosystems (Ricketts et al. 1999). The Nature Conservancy defines keystone species as those species whose impact on a community or ecological system is disproportionately large for their abundance.

Local approach: incorporates not only scientific planning tools, but also a range of practical social, economic, and political factors, and often varies considerably among sites. Examples of planning regions or units at the local level are watersheds and protected areas.

Matrix communities (as defined by The Nature Conservancy): “matrix-forming” associations that have embedded within them patch-like plant associations. Nearly all matrix communities are, in fact, ecosystems made up of co-occurring communities (plant associations) tied together by similar ecological processes and environmental conditions. Typically, matrix communities cover hundreds to millions of acres, exist under a broad range of environmental conditions, are driven by regional-scale ecological processes, and are important habitats for wide-ranging species, such as sagebrush steppe in the Great Basin, and salt marshes in Louisiana. They are not synonymous with common communities. Matrix communities can be rare or common, as well as secure or imperiled. See also “patch communities.”
**Patch communities (as defined by The Nature Conservancy):** refers to the communities that nest within the matrix communities (see above), and cover relatively smaller portions of land surface. Patch communities are maintained primarily by specific environmental features rather than, or in addition to, disturbance processes. The majority of biodiversity of an ecoregion, as measured by the number of species, tends to be concentrated in these patch communities. Patch communities can be large when they form extensive cover (e.g. aspen communities in the Rockies), or small, requiring specific ecological conditions (e.g., bogs, fens, and midshore rocky inter-tidal zones). Conservation goals for patch communities must be set higher than those for matrix communities, based on the assumption that patch communities are more ecologically variable than matrix communities and, because of their smaller size, subject to higher probabilities of attrition over time, meaning that they may be lost at a higher rate.

**Planning unit:** the main unit in which conservation planning takes place (e.g. ecoregions, hotspots, Endemic Bird Areas). Also called “grain” or “planning region.”

**Radiation:** the diversification of a group of organisms into multiple species, due to intense isolating mechanisms or opportunities to exploit diverse resources (Ricketts et al. 1999).

**Rarity:** species or ecosystems that are rare based on a particular set of naturally-occurring circumstances.

**Regional approach:** in many cases, regional approaches take place within areas that have been identified by global priority-setting approaches, i.e., within hotspots or ecoregions. The Nature Conservancy works at the regional scale because TNC does not prioritize certain ecoregions above others, but rather works in every ecoregion in which it is located.

**Representation:** a portfolio of conservation sites should include sites representing all of the different ecosystems in the area of concern (Redford et al. 2003).

**Scale:** see spatial scale.

**Site:** see “conservation site.”

**Spatial scale:** the level at which priority-setting decisions are made, within three broad categories: global, regional, and local. Global scale approaches apply a set of scientific criteria to most of or the entire world; regional scale approaches evaluate criteria and conduct planning within ecoregions; and local scale approaches evaluate criteria and conduct planning at the local and site level.

**Species richness:** the number of species existing within a certain area.

**Species:** the basic unit of biological classification, consisting of a population or series of populations of closely related and similar organisms (Wilson 1992; Ricketts et al. 1999)

**Sustainable development:** an integrated community approach to conserving land and wildlife that assures that current and future human needs can be met.
**Sustainable use:** harvesting of ecosystem products, wildlife hunting, and management for non-extractive human use at a level that can be sustained through multiple generations without diminishing attributes.

**Target:** the actual entities of biodiversity, ecosystem dynamics, landscape features and/or human relations with nature that the approach seeks to immediately conserve (adapted from TNC 2000 definition)

**Threshold:** a minimum or maximum value established for a target that designates it as meeting a certain criterion. For example, the World Resources Institute’s Forest Program, which maps intact forested landscapes, has a minimum threshold of 50,000 hectares for their “intactness” criterion.

**Umbrella species:** a species whose effective conservation will benefit many other species and habitats, often due to its large area requirements or sensitivity to disturbance.

**Vulnerable species:** according to The Nature Conservancy, species with some aspect of their life history that makes them especially vulnerable (e.g., migratory concentration or rare/endemic habitat).

**Wide-ranging species:** species that depend on vast areas.
IUCN Red List Categories & Criteria


PURPOSE

The IUCN Red List Categories and Criteria are intended to be an easily and widely understood system for classifying species at high risk of global extinction. The general aim of the system is to provide an explicit, objective framework for the classification of the broadest range of species according to their extinction risk. However, while the Red List may focus attention on those taxa at the highest risk, it is not the sole means of setting priorities for conservation measures for their protection.

NATURE OF THE CATEGORIES

Extinction is a chance process. Thus, a listing in a higher extinction risk category implies a higher expectation of extinction, and over the time-frames specified more taxa listed in a higher category are expected to go extinct than those in a lower one (without effective conservation action). However, the persistence of some taxa in high-risk categories does not necessarily mean their initial assessment was inaccurate.

CATEGORIES AND CRITERIA

• EXTINCT (EX) A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon’s life cycle and life form.

• EXTINCT IN THE WILD (EW) A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity, or as a naturalized pop-
ulation (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon’s life cycle and life form.

• CRITICALLY ENDANGERED (CR) A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see below), and it is therefore considered to be facing an extremely high risk of extinction in the wild.

• ENDANGERED (EN) A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see below), and it is therefore considered to be facing a very high risk of extinction in the wild.

• VULNERABLE (VU) A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see below), and it is therefore considered to be facing a high risk of extinction in the wild.

• NEAR THREATENED (NT) A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered, or Vulnerable now, but is close to qualifying for, or is likely to qualify for, a threatened category in the near future.

• LEAST CONCERN (LC) A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable, or Near Threatened. Widespread and abundant taxa are included in this category.

• DATA DEFICIENT (DD) A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

• NOT EVALUATED (NE) A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.
EXAMPLES OF CRITERIA

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing an extremely high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred, or suspected population size reduction of 90% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
   
   (a) direct observation
   (b) an index of abundance appropriate to the taxon
   (c) a decline in area of occupancy, extent of occurrence, and/or quality of habitat
   (d) actual or potential levels of exploitation
   (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors, or parasites.

2. An observed, estimated, inferred, or suspected population size reduction of 80% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of 80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected, or suspected population size reduction of 80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 100 km², and estimates indicating at least two of a-c:
a. Severely fragmented or known to exist at only a single location.

b. Continuing decline, observed, inferred, or projected, in any of the following:

   (i) extent of occurrence
   (ii) area of occupancy
   (iii) area, extent, and/or quality of habitat
   (iv) number of locations or subpopulations
   (v) number of mature individuals.

c. Extreme fluctuations in any of the following:

   (i) extent of occurrence
   (ii) area of occupancy
   (iii) number of locations or subpopulations
   (iv) number of mature individuals.

2. Area of occupancy estimated to be less than $10 \text{ km}^2$, and estimates indicating at least two of a-c:

   a. Severely fragmented or known to exist at only a single location.
   
   b. Continuing decline, observed, inferred, or projected, in any of the following:

      (i) extent of occurrence
      (ii) area of occupancy
      (iii) area, extent, and/or quality of habitat
      (iv) number of locations or subpopulations
      (v) number of mature individuals.

   c. Extreme fluctuations in any of the following:

      (i) extent of occurrence
      (ii) area of occupancy
      (iii) number of locations or subpopulations
      (iv) number of mature individuals.

C. Population size estimated to number fewer than 250 mature individuals and either:

1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):

   (a) Population structure in the form of one of the following:

      (i) no subpopulation estimated to contain more than 50 mature individuals, OR
(ii) at least 90% of mature individuals in one subpopulation.

(b) Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

NatureServe Categories & Criteria

NatureServe is a non-profit organization specializing in producing and providing scientific information related to biological diversity and its conservation status. NatureServe encompasses an international network of member programs operating in all 50 US states, Canada, Latin America and the Caribbean (LAC) that collect, analyze, and distribute authoritative scientific information about the biodiversity found within their jurisdictions. With a collective annual budget of more than $US 45 million, nearly 800 scientists and support staff, 54 member programs in the US (where they are typically called natural heritage programs – NHPs), 11 provincial and territorial offices in Canada, and 11 national and territorial offices in the LAC region (where they are known as conservation data centers – CDCs), the NatureServe network is recognized as the western hemisphere’s leading authority on the identification, location, and conservation of at-risk species and ecological communities (NCASI 2004).

NatureServe is one of the leading sources for the ENGOs consulted for this study, especially regarding information about rare and endangered species and threatened ecosystems. NatureServe has developed its own methodology for assessing the conservation status of plant, animal, and fungi species, as well as ecological communities and systems (NCASI 2004). Following, we list the “NatureServe Global Conservation Status” ranks:

- **Presumed Extinct (GX).** Not located despite intensive searches and virtually no likelihood of rediscovery.
- **Possibly Extinct (GH).** Missing; known from only historical occurrences but still some hope of rediscovery.
- **Critically Imperiled (G1).** At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
- **Imperiled (G2).** At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
- **Vulnerable (G3).** At moderate risk of extinction or of significant conservation concern due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
- **Apparently Secure (G4).** Uncommon but not rare; some cause for long term concern due to declines or other factors.
• Secure (G5). Common; widespread and abundant.

The “G” in the rank’s nomenclature refers to the global or range-wide conservation status for a given species or ecological community. The ranks can be complemented by augmenting the status at a national level (designated by an “N”) and at a state/provincial/territorial level (“S,” for subnational). In the same way, intra-specific taxa (subspecies, varieties, and populations) status can be mentioned using a “T.” G2S1 and G4T5 are examples of the use of this augmented ranking.

WORLD RESOURCES INSTITUTE
Forest Program – Intact Forest Landscapes

ORGANIZATIONAL OVERVIEW

The World Resources Institute (WRI) is a Washington DC-based environmental think-tank consisting of over 100 scientists, economists, policy and business experts with a charge to provide “objective information and practical proposals for policy and institutional change that will foster environmentally sound, socially equitable development.” Rather than direct advocacy, WRI works to provide sound information with an ultimate mission to achieve inter-generational access to a prosperous environment.

The World Resources Institute’s mission is to move human society to live in ways that protect Earth’s environment and its capacity to provide for the needs and aspirations of current and future generations. Because people are inspired by ideas, empowered by knowledge, and moved to change by greater understanding, WRI provides – and helps other institutions provide – objective information and practical proposals for policy and institutional change that will foster environmentally sound, socially equitable development.

Key WRI projects are aligned with its five main goals, including: ensuring biological resources for future generations; mitigating human-induced climate change; harnessing markets and enterprise systems for environmental protection; guaranteeing public access, environmental information, and decision-making; and maintaining institutional excellence. WRI has become a leading source of information in many of these key areas. For example, its on-line EarthTrends environmental information portal has extensive searchable databases on biodiversity and protected areas, health and human well-being, energy and resources, environmental governance and institutions, and other key areas.

This profile examines the activities of WRI’s Forest Program, which serves just the first of WRI’s five goals - ensuring biological resources for future generations. Serving the forest-concerned community with detailed maps, satellite images, and reports, Global Forest Watch (GFW) is one of WRI’s Forest Program’s prominent initiatives, launched in 1998. GFW represents an international network through which WRI’s Forest Program establishes partnerships with non-governmental organizations, research institutions, government agencies and private corporations in five forest areas around the world – North America, South America, Central Africa, Russia/Eastern Europe, and Southeast Asia. GFW is not an institution itself but the
umbrella under which partnerships take place. No advocacy is permitted under the GFW name.

WRI’s Forest Program and the GFW initiative seeks to provide detailed information and data analysis so that conservation organizations, industry, and other stakeholders can make more informed decisions about these areas, whether they are working within them or seeking to conserve them. GFW’s Data Warehouse has more than 35 gigabytes of current map data that may be downloaded free of charge over the Internet. Several of the organizations examined in this report use GFW’s maps and data as a tool in their own decision-making.

**APPROACH OVERVIEW**

WRI’s Forest Program’s involvement in mapping intact forest landscapes is the approach discussed in this profile. However, it should be noted that WRI’s Forest Program does not engage in global or local conservation priority-setting and their focus on intact forest landscapes is based on a variety of technical, organizational, and other factors rather than an institutional determination that intact areas are in some way a higher priority than other areas. For example, the technical ability to identify and map *intactness*—as compared to other more elusive criteria such as *biodiversity*—contributes to their reasoning, along with the institutional opinion that intactness deserves attention in decision-making. It should also be noted that WRI’s Forest Program’s work is not limited to intact forest landscapes; they also engage in defining and locating sensitive areas in the forest landscape (i.e. areas with characteristics that are important for classification as High Conservation Value Forests, Endangered Forests, etc.), in monitoring changes in these areas, and in assessing the compliance of forest practices with criteria for legal and sound management.

WRI’s Forest Program’s focus on intact forest landscapes is explored in this report because it is influential in highlighting the importance of these areas; however, a full discussion of their activity as a decision-maker is not possible as they do not fulfill this role.

The most fundamental principle behind WRI’s Forest Program’s work is the importance of providing science-based information to decision-makers, managers, policy makers, and society in general. WRI’s Forest Program’s work is meant to enable and catalyze well-informed decisions, but does not bring a specific agenda as to what exactly should be the outcome of those decisions. They identify gaps in expertise or knowledge, evaluate their own capacity to contribute technical or informational expertise, and apply this service where it will be most appreciated and needed. An important consideration for WRI’s Forest Program is to produce information that is credible and accepted as accurate by all stakeholders.

WRI’s Forest Program also emphasizes the role of *maps* as being powerful agents in the decision-making process, due to their ability to make scientific information accessible to stakeholders. Maps provide a basis for moving forward with decisions, reducing environmental conflict and social polarization, and bringing all stakehold-
ers onto the same page. For these reasons, GFW uses maps as a key planning and communication tool.

**A FOCUS ON INTACT FOREST LANDSCAPES**

WRI’s Forest Program has focused its work on the criteria of intactness through the development of mapping tools. The term *intact forest landscapes* refers to “large, ecologically intact, and relatively undisturbed mosaics of natural ecosystems in the forest landscape which are likely to survive indefinitely without human assistance.” These forests exist, for example, across 25-30 percent of Russia, and represent more than half of Canada’s forest area. There are few such areas on the planet that have all degrees of freedom left—that have been completely untouched by humans. While WRI does not make specific policy recommendations for these areas, it highlights their importance around the world and advises that anyone who considers developing or altering these habitats understand that once the current status is modified, they will be irreversibly changed.

WRI highlighted relatively undisturbed large blocks of forests in 1997 through their publication *Last Frontier Forests: Ecosystems and Economies on the Edge*, by Dirk Bryant, Daniel Nielsen and Laura Tangle. The book highlights the importance of frontier forests, particularly in their capacity to enable and protect natural ecological and evolutionary processes to an extent that fragmented landscapes are unable.

Of the forests that do remain standing, the vast majorities are no more than small or highly disturbed pieces of the fully functioning ecosystems they once were. These modified forests should not be forgotten . . . Yet, they may have lost their ability to sustain themselves in the long term. To support their full complement of plant and animal inhabitants, fragmented forests will probably need regular interventions by resource managers. In contrast, frontier forests—large, ecologically intact, and relatively undisturbed natural forests—are likely to survive indefinitely without human assistance. Within these forests, natural ecological and evolutionary processes will continue to generate and maintain the biodiversity upon which we all rely. Frontier forests also contribute a large portion of the ecological services—such as watershed protection and climate stabilization— that make the planet habitable. And they are home to many of the world’s remaining indigenous peoples.

The original analysis for frontier forests was *global* in scale. With respect to extent, it applies to all areas on earth that feature forest landscapes or the natural mosaic of different ecosystems (includes wetlands and naturally treeless areas) that are part of larger forested landscape.

It is important to note that a focus on intact forest landscapes is an important element of WRI’s Forest Program’s work, but it is not the only criteria on which they have focused. WRI’s Forest Program has worked on defining and mapping sensitive
areas such as High Conservation Value Forests using consensus-based strategies that include a variety of stakeholders. Their work has also included analyses of forest change, and the location of exploitation and development in relation to protected areas, communities, and official forest production zones. This information underpins discussions concerning sustainable forest management and illegal logging in central Africa, Southeast Asia, and Russia.

TARGETS AND CRITERIA

The process for the initial global assessment of frontier forests involved working with several partners—including the UNEP World Conservation Monitoring Centre (WCMC) and the World Wildlife Fund—to identify large roadless areas undisturbed by people. Areas surrounding roads were excluded on the assumption that they were probably disturbed. WRI used GIS to coordinate information and obtain global data sets from various sources. Once these preliminary data were established, WRI sent out the initial maps to experts all over the world, asking them to refine the maps and discuss any potential threats to the areas identified, for example, whether frontiers were in timber concessions or housed high-value resources such as timber, oil, or gold. This process resulted in the first worldwide, systematic global set of information of this kind, albeit at a relatively simplistic level of detail. As described by WRI on their website, “Far from perfect, these maps nonetheless provide the first realistic picture of the location and status of the world’s frontier forests.”

As defined in that assessment, a frontier forest was required to meet seven criteria: (Source: http://forests.wri.org/pubs_content_text.cfm?ContentID=1075)

- Primarily forested.
- Large enough to support viable populations of all indigenous species associated with that forest type—measured by the forest’s ability to support wide-ranging animal species.
- Large enough to keep these species’ populations viable even in the face of natural disasters—such as hurricanes, fires, and pest or disease outbreaks.
- Structure and composition determined mainly by natural events, though limited human disturbance by traditional activities of the sort that have shaped forests for thousands of years—such as low-density shifting cultivation—is acceptable.
- In forests where patches of trees of different ages would naturally occur, the landscape exhibits this type of heterogeneity.
- Dominated by indigenous tree species.
- Home to most, if not all, of the other plant and animal species that typically live in this type of forest.
Intact landscapes need to be large enough to be viable on their own and not endangered by edge effects. The 50,000 hectare threshold is used because WRI believes this is an area large enough to contain all ecological features, maintain its wide-ranging species, and absorb edge effects. Citing scientific literature that provides thresholds between 5,000 hectares and 500,000 hectares, WRI took a pragmatic and somewhat arbitrary figure that would incorporate the needs of most wide-ranging species but still be practical. As explained in the interview, “It’s not perfect, but no threshold is perfect.” WRI experts cited the need to be consistent across areas.

After conducting their preliminary Frontier Forest Analysis, WRI became more heavily involved in mapping intact forest landscapes when they were approached by Greenpeace and IKEA to help locate and map ancient or intact forests in Russia. IKEA asked WRI to develop a practical way to put these areas on the map. No such method existed so WRI developed its own that included a reliance on satellite images, and much more developed detailed criteria than the preliminary frontier forest assessment. This assessment has now been completed in Russia and is underway in Canada and Alaska. The materials developed by WRI are used extensively by the forest sector in Russia.

The main criteria for these areas was that a minimum of 50,000 hectares with no evidence of human disturbance, based on satellite imagery interpretation and followed by expert consultation and a peer review process. In Russia the peer-review process involved scientific experts and stakeholders, including representatives from the Russian government and Russian NGOs, who provided written feedback. Intact areas were required to show no signs of modern human disturbance, including human-induced fire regimes, power lines, or pipelines. Roads and areas adjacent to roads (buffer zones to factor the impact in the landscape of the uses of the road) were eliminated.

In determining which fires were human-induced, WRI decided to defer to regional information. Forest fires, if ignited by lighting, are a natural element of the boreal forest ecosystem. In Canada, most experts believe that the majority of forest fires are natural, so areas that have been burned can be considered intact for these purposes. In contrast, in Russia due to historic land use, many forest fires have an anthropogenic origin. The exact proportion of anthropogenic fires is unknown. Since the cause of a fire scar could not be determined from satellite images, a decision rule had to be constructed, so that the fire regime associated with each fire scar could be classified in a consistent way as either “natural” or “anthropogenic.” Fire scars or fire mosaics occurring directly adjacent to infrastructure or some other conduit of human activity, were considered the result of anthropogenic fires. Fire scars that did not reach human infrastructure or human activity were considered to be from natural fires.
IMPLEMENTATION AND MONITORING

WRI does not directly implement conservation of intact forest landscapes, rather, local partners will use their maps to prioritize areas for conservation. Maps are used as a basis for stakeholder negotiation on the use of sensitive areas. Changes in the intactness baseline will be monitored over time.

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<td><strong>Planning Region:</strong> Large intact forests.</td>
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DUCKS UNLIMITED CANADA (DUC)
Canada’s Boreal Forest

ORGANIZATIONAL OVERVIEW

Since 1938, Ducks Unlimited Canada (DUC) has established more than 7,100 habitat conservation projects and helped to conserve nearly 25 million acres of land in Canada. Beyond Canada’s borders, DUC directly benefits from the work of Ducks Unlimited organizations in the United States and Mexico. Sharing a unified conservation mission, the Ducks Unlimited organizations conserve, restore, and manage wetlands and associated habitats for North America’s waterfowl. These habitats also benefit other wildlife and people.

The Ducks Unlimited family has identified Canada’s boreal forest as one of its most urgent conservation priorities. This designation is based on the value of the boreal ecosystem to waterfowl, its intact forests and wetland complexes, and threats from resource extraction (forestry, oil, gas and mineral), agriculture, hydropower development, and global warming. “[Canada’s boreal forest] . . . contains almost one-quarter of the world’s remaining intact forests and holds more fresh water in its wetlands, lakes and rivers—the foundation for a rich diversity of life—than any other place on Earth. Home to tens of millions of breeding, staging, and molting waterfowl, and some one hundred million shorebirds, the wetland areas of the forest are also critically important to bears, wolves, beavers, woodland caribou, moose, and more than three billion land birds” (DUC Publication Canada’s Boreal Forest).

DUC has been researching and designing conservation watershed-based solutions in the western portion of Canada’s boreal forest since 1997 and ranks the Western Boreal Forest (WBF) second only to the Prairie Pothole region in terms of continental importance to North American waterfowl. This study focuses on DUC’s regional approach for setting conservation priorities within the Canadian boreal forest. Most of their other “global” conservation priority areas are in prairie ecosystems. As such we did not investigate the global priority setting scheme used by DUC.

The goal of this organization is “to help conserve all of the wetlands in Canada’s boreal forest through a combination of ecosystem-based sustainable development that utilizes state-of-the-art best management practices, and by promoting the establishment of an extensive network of large, interconnected wetland-rich protected areas. DUC will use its foundation of strong science and strategic partnerships to help move towards this goal.”
DUC sets priorities for watershed-level protection of wetlands and associated uplands habitat within the priority ecoregion of the Canadian boreal forest. Its goal is to identify the most important wetland resources and to maintain ecological integrity to support historical numbers of breeding, molting, and migrating waterfowl and other wetland-dependent wildlife. There are currently twelve priority project areas in the western boreal forest ranging from 5 to 20 million acres. These areas have been chosen based on a combination of waterfowl breeding populations, wetland density, and threats to wetland function and waterfowl habitat. A key consideration for those areas north of 60° latitude is the interest of the community: ENGOs cannot work in these areas without being invited to do so by the aboriginal peoples living there.

**APPROACH OVERVIEW**

Although DUC’s conservation target is species specific (waterfowl), its approach is ecosystem-based because waterfowl are wide-ranging and use different habitats for different life history segments. In addition, there are insufficient population data in boreal ecosystems to use species as the primary conservation approach. DUC’s guiding principle is to protect and restore the ecological integrity of wetland ecosystems and critical associated uplands. Its emphasis is on ecosystems of the highest productive capacity, defined as habitat for breeding, staging, and molting waterfowl. The planning principle of functionality is therefore the most dominant principle in DUC’s approach. DUC supports the sustainable use and harvest of renewable resources based on sound science and supports waterfowl hunting, when conducted in an ethical and sustainable manner, as a legitimate and acceptable use of a renewable resource.

Access to sites within the boreal forest is difficult to gain, so there is little information about critical habitat size for waterfowl in the boreal ecosystem. Although DUC is starting to do some basic research in this area, they are admittedly “working in the dark,” pushing for spatial targets that link water bird inventory data to land cover classification and model key habitat areas for breeding, migration, and staging. They aim to use this research to base conservation priorities on habitat classification rather than numbers of birds.

DUC’s current approach to setting conservation priorities is holistic, looking at landscapes and entire watersheds (large drainages, including uplands) and working at different scales, from large river basins to ponds. Map 6 below illustrates DUC’s Boreal Forest Program Area. Planning begins at the boreal ecozone, then works down to ecoregions, followed by stratified survey-work based on ecodistricts, using Canada’s national classification system (http://sis.agr.gc.ca/cansis/nsdb/ecostrat/intro.html). According to DUC scientists, watershed delineation is very difficult in boreal ecosystems and little is known about the hydrological function of these systems. There is therefore a great need to protect habitat at the landscape scale. DUC emphasizes wetland function and the need to limit disturbances to the permafrost and peat—both significant factors in boreal ecosystem function. (Peat essentially
functions like a pond or lake by retaining large amounts of water.) DUC is also starting to look at using measures of linear disturbance, such as roads and pipelines, (similar to work done by the World Resources Institute’s Global Forest Watch) to target priority areas for working with industry.

Priority areas are chosen based on a combination of expert knowledge, waterfowl population data (particularly high breeding areas), wetland density, intact habitat, social values (aboriginal communities), opportunity, partners, threats, and funding. Hotspots are defined as areas with high density (greater than 30-40%) of wetlands, as determined by landcover analysis, and high waterfowl populations. An important feature of the Canadian landscape is the line of 60° latitude. Less land north of this latitude has been allocated, so opportunities for protection are greater. Canadian law dictates that protection above this latitude must be led by the local communities. Forty percent of DUC’s priority sites are south of 60°, while 60% are north of this latitude.

All fourteen priority project areas are in the Western Boreal Forest, which includes Bird Conservation Region 6—the boreal plain, and the taiga plain. Productivity is defined as species numbers (populations) and richness (number of species), with targets established as historical numbers of breeding, molting, and migrating waterfowl and wetland-dependent wildlife. Historical population goals are based on the 1970s
U.S. Fish and Wildlife Service (USFWS) and Canadian Wildlife Service (CWS) survey data. The decade of the 1970s was chosen because this was a particularly wet climate and populations of species of concern have experienced dramatic declines since then. There are three species of concern, which have experienced greater than 50% decline in population since the 1970s, and are known to primarily breed in the boreal: lesser scaup, white wing scoter, and trumpeter swan. The scoter, known by locals as black duck, is the first fresh meat available to aboriginal people in the springtime and therefore has a community subsistence value. Riparian areas are considered very special habitat as are wetlands with high waterfowl use.

DUC relies on a range of sources for information. Sources for waterfowl populations are derived from annual waterbird inventories conducted by USFWS and CWS along transects. DUC uses TM satellite mapping to delineate wetlands, ponds, and vegetation types. Within project areas, land cover mapping from satellite imagery is used to inventory wetland ponds and vegetation types, using a stratified sampling method conducted over a three-year inventory of all waterbirds that can be identified from a helicopter. Waterfowl population goals are established in the DU International Conservation Plan and the North American Waterfowl Management Plan (http://www.nawmp.ca/) using USFWS breeding population index data. Goals are established for twenty-one species of ducks and geese that breed in the western boreal for which survey data exist. Current research priorities are landcover, waterfowl population inventories, and waterfowl and wetland ecology, with an overall goal of identifying key habitat sites and elucidating the relationships between waterfowl, wetland characteristics, and landscape and climatic controls. DUC has a team of scientists on staff and partners with other research institutions.

TARGETS AND CRITERIA

According to DUC literature, conservation objectives in the Western Boreal Forest will be achieved through protecting and restoring the ecological integrity of wetland systems. Ecological integrity refers to the ecological functions within a landscape and the interaction of natural processes that determine the unique ecological character of that system. Addressing ecological integrity requires recognition of the temporal and geographic variation in natural processes and the critical role of adjacent systems (uplands) in overall ecosystem functions. Although some data on the ecological function of the WBF wetlands and associated uplands exist, there is a need for more data prior to the development of detailed conservation strategies. Development of this information is a priority of DUC. In the meantime, the preservation and restoration of WBF wetlands and critical associated uplands will serve as a proxy to preservation and restoration of wetland ecological integrity.

Criteria for selecting priority sites are waterfowl productive capacity; landscape-level watershed function; threat; and the knowledge and interests of aboriginal peoples. DUC focuses on selecting large areas with linear boundaries where the combination of high-value habitat, high waterfowl populations, imminent threat,
community interest, and landowner/land manager interest converge to create a significant conservation opportunity. Other considerations include partnerships, international attention, and funding.

DUC has no minimum size for conservation, although their priority areas are relatively large (the smallest being seven million acres). Project size is based on available satellite imagery, partner interests, and knowledge of the area. Thresholds for waterfowl populations are 1970s USFWS/CWS breeding population index data based on survey data for nineteen species of ducks and two species of geese that are known to breed in the WBF.

Habitat goals are based on conservation objectives being applied for 100% of the boreal forest through protection and enhanced BMPs (best management practices) and watershed based conservation planning focused around water on a landscape level. The habitat goals are of a general nature—to maintain habitat in order to sustain the waterfowl population goals. Activities have commenced to gather habitat information (e.g. breeding ranges) to establish more specific habitat goals over the next five years. Nevertheless, habitat is weighted more heavily than population criteria due to the mobile nature of waterfowl.

DUC does not currently use any formal modeling of risk in determining thresholds and targets for habitat to support population goals. Necessary information is lacking about the basic biology of survival rates and survival functions for boreal waterfowl. Due to the lack of scientific data, DUC prefers spatial targets rather than quantified targets. DUC is currently reviewing thresholds and targets related to disturbance with the goal of developing a science to use disturbance as a risk factor in the future.

Monitoring, although not in place now, is planned to be one component of an overall evaluation program for DUC’s priority project areas and the organization will add an assessment program within the next five years. Currently there is not enough on-the-ground information to do an assessment of the project areas, for which ten years of data would be required. DUC has in place specific monitoring of a number of protected acres. Waterfowl populations are monitored annually by USFWS, but there is not enough monitoring in DUC project areas, a situation which DUC is working to improve.

**IMPLEMENTATION**

DUC’s implementation approach is based primarily on habitat needs for all life stages of wide-ranging, migratory wildlife. This leads to defining core areas of wetland and waterfowl density, along with associated uplands, in order to protect hydrological function and riparian corridors. Sites are selected based on these criteria plus aboriginal community interests, threats to habitat integrity (i.e. hydroelectric development, oil and gas development, industrial timber harvest, mining), potential for international collaboration, funding interests, and opportunity for sustainable development partnerships.
Priority sites are selected based on knowledge (expert opinion), waterfowl surveys (traditional long-term transects), hotspots (high density of wetland and waterfowl populations), and species of concern. This is a very habitat-oriented protection planning approach. Within priority areas, DUC uses a matrix approach to achieve 100% conservation objectives across the boreal forest, with protected areas at one end of the spectrum and sustainable development at the other. Monitoring is not yet in place.
# Ducks Unlimited Canada (DUC)  
**Canada’s Boreal Forest**

## Basic Overview

**Organizational Mission:** All Ducks Unlimited organizations conserve, restore and manage wetlands and associated habitats for North America’s waterfowl. These habitats also benefit other wildlife and people.

**DUC’s Vision for Canada:** DUC is working to achieve a mosaic of natural, restored and managed landscapes capable of perpetually sustaining populations of waterfowl and other wildlife.

**Approach Objective:** Sets national priorities for watershed-level protection of wetlands and associated uplands habitat within the priority ecoregion of the Canadian boreal forest to identify the most important wetland resources and maintain ecological integrity to support historical numbers of breeding, molting, and migrating waterfowl and other wetland-dependent wildlife.

**Planning Principles:** Purpose is to conserve waterfowl habitat by conserving landscape-level functionality of boreal watersheds; the philosophy is based on both the intrinsic value of waterfowl and their sustainable use for sport and subsistence lifestyles of aboriginal communities.

## Approach Specifics

**Geographic Scale and Extent:** National (Canada). Emphasis on regions of highest productive capacity (waterfowl).

**Planning Unit:** Planning is done at the regional (i.e. western boreal forest), ecoregional (i.e. boreal plain, taiga plain), and watershed level. Ecoregions based on Canada’s national classification system.

**Conservation Level:** Whole watershed-level conservation planning.

**Data Sources:** Field data (DUC; USFWS; CWS); TM satellite mapping; expert opinion; aboriginal community knowledge.

## Targets, Criteria and Thresholds

**Targets:** DUC focused their conservation efforts on Canada’s western boreal forest in 1997. At this point, DUC pushes for spatial targets rather than quantified targets because they do not have the data to quantify.

Hotspots: high density of wetlands; high density of waterfowl populations; habitat for waterfowl species of concern; wetland dependent wildlife

**Criteria & Thresholds:** The number one criterion is the existence of key breeding areas, migration routes, and staging areas for waterfowl; the second is function at the landscape (large watershed) level. A further criterion for DUC work north of 60 degrees latitude is “aboriginal community goals.” Threat from development and resource use is also considered when selecting priority areas. Waterfowl population goals (thresholds) are based on DU International Conservation Plan and North American Waterfowl Management Plan goal of achieving historical (1970s) numbers of species that are tracked in the USFWS/CWS long-term survey data.

**Weight:** Habitat is weighted heaviest as waterfowl are mobile and population inventories are difficult to conduct in the boreal forest.

## Implementation

Selection of priority areas based on size, concentration of wetlands, concentration of waterfowl for breeding, staging and molting. Priorities are set based on knowledge (expert opinion), waterfowl surveys (traditional long-term transects) and hotspots (high density of wetland and waterfowl populations). Within priority areas, a matrix approach to achieve 100% protection across a spectrum of conservation objectives from completely protected to sustainable development.

**Monitoring:** Not yet in place
THE NATURE CONSERVANCY
Ecoregional Conservation Planning

ORGANIZATIONAL OVERVIEW

The Nature Conservancy’s (TNC) mission 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 (TNC 2005). Since its foundation in 1951, TNC has worked with people, communities, and businesses to protect millions of acres in the United States and around the world.

TNC has developed a strategic planning process rooted in science called “Conservation by Design,” which seeks to ensure biodiversity over the long term. Conservation by Design involves four main stages, including:

• setting priorities
• developing strategies
• taking action and
• measuring success

TNC believes the Conservation by Design strategy allows them to achieve meaningful and lasting conservation results (TNC 2005). The first step of the CBD process—setting priorities—is accomplished through two processes including global major habitat type assessments and ecoregional planning. It is this ecoregional planning that is the focus of this profile.

APPROACH OVERVIEW

The need to work at increasingly larger scales and measure its progress against its mission led to TNC’s current ecoregional conservation planning approach. This approach, outlined in Designing a Geography of Hope (Groves et al. 2000), places emphasis on the conservation of all communities and ecosystems, emphasizes conservation at multiple spatial scales and levels of biological organization, and recognizes the value of comprehensive biodiversity planning on ecoregional rather than geopolitical lines. The approach is organized by the world’s ecoregions as defined and delineated by the World Wildlife Fund. Map 7 below illustrates the ecoregions of the United States.
Developed originally by Bailey (1995), this data layer was modified by The Nature Conservancy (TNC) to be used in its Biodiversity Planning exercises in the process known as Ecoregional Assessments in the continental United States, Alaska, and Hawaii. Several Ecoregions were modified from the original by TNC staff developing the aforementioned assessments. The modifications are based on ecological, bio-physical and political rationales.


TNC’s ecoregional planning approach aims to:

- Select and design networks of conservation sites that will conserve the diversity of species, communities, and ecological systems in each ecoregion.
- Identify areas of conservation importance that contain multiple, viable, or feasibly restorable examples of all native plants, animals, and ecological communities and systems across important environmental gradients.

**TARGETS AND CRITERIA**

TNC defines targets as elements of biological diversity or surrogates that will be the focus of planning efforts. TNC’s goal is to identify targets at four spatial scales: local, intermediate, coarse, and regional; and three levels of biological organization: species, communities, and ecological systems. These targets will serve to identify conservation sites across the ecoregion.

Since it is impractical to plan for every element of biodiversity, even all of those that are known, TNC must select a subset of targets at different spatial scales and levels of biological organization that will best represent all biological diversity. This idea is based on what TNC calls the “coarse-fine filter strategy,” a working hypothesis that assumes that conservation of multiple, viable examples of all coarse-filter targets (communities and ecosystems) will also conserve the majority of species (fine-filter targets). Those species that the coarse filter cannot reliably conserve require individual attention through the fine-filter approach. Wide-ranging, very rare, extremely localized, narrowly endemic, or keystone species are all likely to need fine-filter strategies.

**COARSE FILTER TARGETS**

Both ecosystem and community-level targets are referred to as coarse filter targets.

- **Ecosystem targets**
  All ecosystems that represent the entire range and variety of ecosystems found within an ecoregion should be considered targets. The number of systems for any given ecoregion should generally range between fifteen and fifty.

- **Community-level targets**
  Only those (plant) communities that are either imperiled (ranked G1-G2 by Heritage Programs) or occur as patch communities and are not adequately encompassed by broader ecological systems (i.e., those that are not likely to be captured by ecosystem-level targets).

  *Terrestrial coarse-filter targets* should be identified on three spatial scales:
  - Local – small patch communities and ecosystems (< 2,000 acres);
• Intermediate – large patch communities and ecosystems (1,000–50,000 acres); and
• Coarse – matrix communities and ecosystems (20,000–1,000,000 acres).

Aquatic coarse-filter targets should be identified also on three spatial scales:
• Local – aquatic macrohabitats (< 10 river miles);
• Intermediate – stream systems and medium lake systems (1st–3rd order streams and their tributaries, 250–2500 acre lakes); and
• Coarse – medium to large river systems and large lake systems (4th order and larger rivers and their tributaries, > 2500 acre lakes).

FINE FILTER TARGETS

Species targets or fine-filter targets include all viable imperiled, threatened, and endangered species. To qualify as an imperiled species in the U.S., it must have a global rank of G1-G2 by the Natural Heritage Programs/Conservation Data Centers. Endangered and threatened species are those that are federally listed or proposed for listing by the USFWS under the Endangered Species Act. For international programs, the IUCN Red List is used as a guide, selecting species in the critically endangered, endangered, or vulnerable categories. TNC also considers as targets representative subsets (i.e. those not likely to be captured by ecosystem-level targets) of species of special concern, including declining, endemic, disjunct, vulnerable, or focal species as defined as follows:

• **Declining** species are defined as those species that exhibit significant, long-term declines in habitat and/or numbers, are subject to a high degree of threat, or may have unique habitat or behavioral requirements that expose them to great risk.

• **Endemic** species are those restricted to an ecoregion (or a small geographic area within an ecoregion), depend entirely on a single area for survival, and therefore are often more vulnerable.

• **Disjunct** species have populations that are geographically isolated from those of other populations.

• **Vulnerable** species are usually abundant and may or may not be declining, but some aspect of their life history makes them especially vulnerable (e.g., migratory concentration or rare/endemic habitat). For example, sandhill cranes are a vulnerable species because a large percentage of the entire population aggregates during migration along a portion of the Platte River in Nebraska.

• **Focal** species have spatial, compositional, and functional requirements that may encompass those of other species in the region and may help address
the functionality of ecological systems. They may not always be captured in the portfolio through the coarse filter. Several types of focal species can be considered. For TNC’s purposes, the two most important types of focal species are: keystone and wide-ranging species.

- **Keystone** species are those whose impact on a community or ecological system is disproportionately large for their abundance. They contribute to ecosystem function in a unique and significant manner through their activities. Their removal initiates changes in ecosystem structure and often a loss of diversity (e.g., beavers, bison, prairie dogs, and sea urchins).

- **Wide-ranging** species depend on vast areas. They include top-level predators (e.g., wolves, grizzly bears, pike minnows, killer whales) as well as migratory mammals (e.g. caribou), anadromous fish, birds, bats, and insects. Wide-ranging species can be especially useful in examining necessary linkages among conservation sites in a true “network” of sites.

A final category of fine-filter targets includes species aggregations, species groups, and/or hotspots of richness. These targets are unique and irreplaceable examples for the species that use them, or are critical to the conservation of a certain species or suite of species.

- **Species aggregations** includes critical migratory stopover sites that contain significant numbers of migratory individuals of many species.

- **Major groups of species** that share common ecological processes and patterns, or have similar conservation requirements and threats (e.g. freshwater mussels and forest-interior birds); it is often more practical to target such groups as opposed to each individual species of concern.

- **Biodiversity Hotspots** contain large numbers of endemic species and usually face significant threat. TNC considers this particular target category as largely applicable only to its work in tropical forests in Latin American, Caribbean, and Asia-Pacific Regions.

Species targets are identified at regional (> 1,000,000 acres, migrate long distances), coarse (20,000–1,000,000 acres, 4th order and larger river network, > 2500 acre lakes), intermediate (1,000–50,000 acres, 1st–3rd order stream network, 250–2500 acre lakes), and local scales (< 2,000 acres, < 10 river miles, < 250 acre lakes).

**TARGET GOALS**

Conservation goals in TNC’s ecoregional planning define the number and spatial distributions of on-the-ground occurrences of targeted species, communities, and ecosystems that are needed to adequately conserve the target in an ecoregion. A con-
servation goal in TNC’s ecoregional planning has two components: the number of populations of a species or occurrences of a community or system needed to conserve the target in an ecoregion; and a distributional component, that should ensure that the geographical range and environmental gradient (in which the target lives within the ecoregion), are captured as part of the goal setting (for example, two populations in each of five ecoregional sections or spatial sub-divisions).

The purpose of setting goals is to estimate the level of conservation efforts necessary to sustain a target at viable numbers over a specified planning horizon (one hundred years). Setting goals also enables TNC to measure the success of a portfolio of conservation sites in representing and conserving targets in an ecoregion. Conservation of multiple, viable examples of each target, stratified across its geographic and ecological range, is necessary to capture the variability of the target (i.e., subspecies) and to provide sufficient replication to ensure persistence in the face of environmental variability.

**Geographic scale and spatial pattern** is defined by how a community or ecosystem is distributed across the landscape. TNC considers three broad pattern types: matrix communities or ecosystems, large patch communities or ecosystems, and small patch communities or ecosystems. (See the glossary for more information on matrix communities and patch communities.)

**Range-wide distribution pattern** refers to the complete spatial extent (range) and to the occurrences within the range (distribution). One community or species might be either clumped, or evenly distributed across its range. Types include:

- restricted/ endemic, that occur primarily in one ecoregion;
- limited, that occur in the ecoregion and a few other adjacent ecoregions;
- widespread, characterized by being widely distributed in several to many ecoregions;
- disjunct, that occur in an ecoregion as a disjunct from the core of its distribution; and
- peripheral, more commonly found in other ecoregions.

The number of occurrences recommended for each target is shown in Table 11 below.

Table 11. Recommended number of community occurrences for coarse-filter targets.

<table>
<thead>
<tr>
<th></th>
<th>MATRIX</th>
<th>LARGE PATCH</th>
<th>SMALL PATCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restricted</td>
<td>10</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>Limited</td>
<td>5</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Widespread</td>
<td>2/3</td>
<td>4/5</td>
<td>5/6</td>
</tr>
<tr>
<td>Disjunct</td>
<td>1*</td>
<td>2*</td>
<td>3*</td>
</tr>
<tr>
<td>Peripheral</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

* Goals determined on a case-by-case basis.
For species, TNC provides overall goals to determine how many viable populations over what distribution need to be conserved in the ecoregion to ensure the long-term sustainability of species, taking into account the entire range of species. The TNC approach suggests that quantitative goals for each target species should be obtained in terms of the number of populations and distribution, based on the range-wide distribution attributes of the target. Rather than providing a recommended goal for each type of species, TNC uses a default minimum goal – which applies across taxa – of two viable populations per ecoregional section in which the species occur with a minimum of ten viable populations range-wide. For vertebrate species, these populations should represent breeding populations of at least two hundred individuals. For plant and invertebrate populations, what constitutes a viable population size should be determined on a case by case basis. Threatened species endemic to an ecoregion or limited in distribution may need goals set relatively higher than for widespread species or the standard default goal.

For wide-ranging species whose populations are distributed over more than one ecoregion, goals are first set range-wide by working across ecoregional lines and subsequently set for each ecoregion based on range-wide needs.

**VIABILITY OF TARGETS**

As defined by TNC, viability is the ability of a species to persist for many generations or a community or ecosystem to persist over some specified time period. In ecoregional planning, the objective is to identify viable populations and occurrences of conservation targets to the greatest practical extent, by using the criteria of size, condition and context. Size is measured by population size (in the case of species) and by spatial extent (in the case of ecosystems); condition is evaluated by population trends and health, such as age structure or signs of disease (for species) and age structure of dominant species and species composition (for communities); and the landscape context refers to the broader patterns of the landscape that affect the targets.

**IMPLEMENTATION AND MONITORING**

The final output of an ecoregional planning exercise is a portfolio of areas of biodiversity significance, which is different from conservation areas as TNC must still assess whether or not an area of biodiversity significance will be chosen as an actual conservation area or site. In order to select these areas of biodiversity significance, TNC uses the following criteria:

- **Coarse-scale focus**
  
  Represent or “capture” all coarse-scale targets in the ecoregion (including those that are feasibly restorable) in conservation sites followed by targets at finer spatial scales.

- **Representativeness**
  
  Capture multiple examples of all conservation targets across the diversity of species.
environmental gradients appropriate to the ecoregion (e.g., ecoregional section or subsection, ecological land unit, or some other physical gradient).

- **Efficiency**
  Give priority in the site selection process to occurrences of coarse-scale ecological systems that contain multiple targets at other scales. Accomplish this through identification of functional sites and landscapes.

- **Integration**
  Give priority to sites that contain high-quality occurrences of both aquatic and terrestrial targets.

- **Functionality**
  Ensure all sites in a portfolio are functional or feasibly restorable to a functional condition. Functional sites maintain the size, condition, and landscape context within the natural range of variability of the respective conservation targets.

- **Completeness**
  Capture all targets within functional sites.

Once priority conservation areas are identified, TNC employs a “5-S Framework for Conservation Project Management” a well-tested, science-based process for developing and evaluating the effectiveness of conservation strategies that achieve tangible results. The approach is implemented by community-based conservation which combines an on-site local staff presence with a “common strategic approach of site conservation planning that is supported by adequate resources. Community-based conservation represents a proven means of achieving enduring, tangible conservation results” (TNC 2005). The 5-S planning approach focuses on the following components (TNC 2005):

- **Systems** – the focal conservation targets and their key ecological attributes.
- **Stresses** – the most serious types of destruction or degradation affecting the conservation targets or key ecological attributes.
- **Sources of stress** – the causes or agents of destruction or degradation.
- **Strategies** – the full array of actions necessary to abate the threats or enhance the viability of the conservation targets.
- **Success measures** – the monitoring process for assessing progress in abating threats and improving the biodiversity health of a conservation area.

In evaluating success, TNC defines conservation success as the combination of three outcomes: the maintenance of viable biodiversity, abatement of critical threats, and effective protection and management of places where they take action with partners. These outcomes are measured in a variety of ways and at multiple scales, from local conservation areas to global habitats within the framework of both the 5-S approach and through ecoregional assessment methods. The results are used to guide
management actions, resource allocation and future investments. Collectively, these measures seek to quantify conservation impact—the direct contribution of the Conservancy and its partners to conserving biodiversity (TNC 2005).
| **THE NATURE CONSERVANCY**  
| **ECOREGIONAL CONSERVATION PLANNING**  
| **BASIC OVERVIEW**  
| **Organizational Mission:** 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.  
| **Approach Objective:** Selecting a portfolio of areas of conservation importance that will conserve the diversity of species, communities, and ecological systems in each ecoregion.  
| **Planning Principles:** Representativeness, efficiency, integration, functionality, completeness.  
| **APPROACH SPECIFICS**  
| **Scale:** Regional in scale, continental in extent (Latin America, North America, Asia-Pacific).  
| **Planning Region:** Ecoregion.  
| **Conservation Level:** Ecosystems, plant communities and species.  
| **TARGETS, CRITERIA AND THRESHOLDS**  
| **Targets:** Ecosystems, plant communities and species.  
| **Criteria & Thresholds:** All ecosystems and plant communities are considered as targets. In the case of species, they are selected with the following criteria: level of threat, endemism, declining species, disjunct species, rarity, vulnerability, and focal species (keystone species, wide-ranging species).  
| **Weight:** TNC has not developed a system for giving different weights to different targets or elements of biodiversity.  
| **IMPLEMENTATION**  
| **Theory & Approach Used on a Local level:** “TNC often employs community-based conservation as a central strategy. Combines on-site local staff presence with the common strategic approach of site conservation planning that is supported by adequate resources.”  
| **Monitoring:** TNC has an entire step of its “Conservation by Design” process devoted to monitoring. This does not refer to monitoring of their criteria, but rather monitoring their conservation success.
**Summary of Global (‘A’) Criteria for Selection of Important Bird Areas**

<table>
<thead>
<tr>
<th>A1 SPECIES OF GLOBAL CONSERVATION CONCERN</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>The site regularly holds significant numbers of a globally threatened species, or other species of global conservation concern.</td>
<td>The site qualifies if it is known, estimated, or thought to hold a population of a species categorized as Critical or Endangered. Population-size thresholds for Vulnerable, Conservation Dependent, Data Deficient, and Near Threatened species are set regionally, as appropriate, to help in site selection.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A2 ASSEMBLAGE OF RESTRICTED-RANGE SPECIES</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>The site is known or thought to hold a significant component of the restricted-range species whose breeding distributions define an Endemic Bird Area (EBA) or Secondary Area (SA).</td>
<td>The site has to form one of a set selected to ensure that, as far as possible, all restricted-range species of an EBA or SA are present in significant numbers in at least one site in the set and, preferably, in more.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A3 ASSEMBLAGE OF BIOME-RESTRICTED SPECIES</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The site is known or thought to hold a significant component of the group of species whose distributions are largely or wholly confined to one biome.</td>
<td>The site has to form one of a set selected to ensure that, as far as possible, species restricted to a biome are adequately represented.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A4 CONGREGATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) The site is known or thought to hold, on a regular basis, 1% of a biogeographic population of a congregatory waterbird species.</td>
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<td></td>
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<tr>
<td>---</td>
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<tr>
<td>ii) The site is known or thought to hold, on a regular basis, ≥ 1% of the global population of a congregatory seabird or terrestrial species.</td>
</tr>
<tr>
<td>iii) The site is known or thought to hold, on a regular basis, ≥ 20,000 waterbirds or ≥ 10,000 pairs of seabirds of one or more species.</td>
</tr>
<tr>
<td>iv) The site is known or thought to exceed thresholds set for migratory species at migration bottleneck sites.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>AF&amp;PA</td>
<td>American Forest &amp; Paper Association</td>
</tr>
<tr>
<td>AZE</td>
<td>Alliance for Zero Extinction</td>
</tr>
<tr>
<td>CI</td>
<td>Conservation International</td>
</tr>
<tr>
<td>CWS</td>
<td>Canadian Wildlife Service</td>
</tr>
<tr>
<td>DU</td>
<td>Ducks Unlimited</td>
</tr>
<tr>
<td>DUC</td>
<td>Ducks Unlimited Canada</td>
</tr>
<tr>
<td>EBA</td>
<td>Endemic Bird Area (BirdLife International)</td>
</tr>
<tr>
<td>ENGO</td>
<td>Environmental Non-Governmental Organization</td>
</tr>
<tr>
<td>ESA</td>
<td>Endangered Species Act</td>
</tr>
<tr>
<td>FPAC</td>
<td>Forest Products Association of Canada</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information Systems</td>
</tr>
<tr>
<td>HBWA</td>
<td>High Biodiversity Wilderness Areas (Conservation International)</td>
</tr>
<tr>
<td>IBA</td>
<td>Important Bird Area (BirdLife International)</td>
</tr>
<tr>
<td>IUCN</td>
<td>International Union for Conservation of Nature and Natural Resources (The World Conservation Union)</td>
</tr>
<tr>
<td>KBA</td>
<td>Key Biodiversity Areas</td>
</tr>
<tr>
<td>MVP</td>
<td>Minimum Viable Population</td>
</tr>
<tr>
<td>NCASI</td>
<td>National Council for Air and Stream Improvement, Inc.</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-Governmental Organization</td>
</tr>
<tr>
<td>TM satellite imagery</td>
<td>Thematic Mapper satellite imagery</td>
</tr>
<tr>
<td>TNC</td>
<td>The Nature Conservancy</td>
</tr>
<tr>
<td>USFWS</td>
<td>United States Fish and Wildlife Service</td>
</tr>
<tr>
<td>WBF</td>
<td>Western Boreal Forest</td>
</tr>
<tr>
<td>WCS</td>
<td>Wildlife Conservation Society</td>
</tr>
<tr>
<td>WRI</td>
<td>World Resources Institute</td>
</tr>
<tr>
<td>WWF</td>
<td>World Wildlife Fund</td>
</tr>
<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific, and Cultural Organization</td>
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</tbody>
</table>
Authors

Elizabeth Gordon is the Program Director for the Yale Program on Forest Certification at the Yale School of Forestry and Environmental Studies, where she conducts outreach, training, and research on the emergence of forest certification as a non-state market-driven approach to promoting sustainable forestry. In May 2003, she completed her master’s degree in wildlife conservation at Yale's School of Forestry and Environmental Studies, where her research focused on the commercial trade in bushmeat and its impact on great ape populations of Africa. She holds a BA in Human Biology from Stanford University.

Oscar Franco is a master’s student at the Yale School of Forestry and Environmental Studies, where he is focusing on strategies for biodiversity protection and the conservation of endangered ecosystems. He has several years of experience at Peru's Fundación Pro Naturaleza developing conservation initiatives on private and public land and promoting local and regional conservation tools. Prior to his work in conservation, he worked as an investigative journalist in Peru.

Mary Tyrrell is the Executive Director of the Global Institute of Sustainable Forestry at the Yale School of Forestry and Environmental Studies. She previously served as Associate Director and has been the Director of the Global Institute’s Program on Private Forests since 2000. Her research focuses on forest fragmentation, land use change, invasive species, and sustainability of private forestlands.