Establishing Protected Areas

Brook Milligan

Department of Biology
New Mexico State University
Las Cruces, New Mexico 88003
brook@nmsu.edu

Fall 2009
Establishing Protected Areas: Primary Issues

- How much protected land exists?
- How much protected land is appropriate?
- Where should protected land be located?
- What degree of human use should be allowed on protected land?
Growth in Number of Protected Areas

**FIGURE 15.1** The solid line graphs the number of new protected areas worldwide since 1872, including both terrestrial and marine sites; the shaded bars indicate the total area encompassed in protected areas (in km²) of terrestrial sites alone at 15-year intervals. (After Chape et al. 2003.)
Change in Number of Protected Areas

Figure 15.1 The solid line graphs the number of new protected areas worldwide since 1900; the bars indicate the area encompassed in new protected areas (in km²) at 5-year intervals. (After McNeely et al. 1994.)
IUCN Classification System For Protected Areas

- Category I: strict nature reserves and wilderness areas
- Category II: national parks
- Category III: national monuments and landmarks
- Category IV: managed wildlife sanctuaries and nature reserves
- Category V: protected landscapes and seascapes
- Category VI: managed-resource protected areas
IUCN Classification System For Protected Areas

- Category I: strict nature reserves and wilderness areas
- Category II: national parks
- Category III: national monuments and landmarks
- Category IV: managed wildlife sanctuaries and nature reserves
- Category V: protected landscapes and seascapes
- Category VI: managed-resource protected areas

<table>
<thead>
<tr>
<th>Category</th>
<th>Sites</th>
<th>Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>5,201</td>
<td>1,922,831</td>
</tr>
<tr>
<td>II</td>
<td>3,383</td>
<td>4,001,463</td>
</tr>
<tr>
<td>III</td>
<td>2,122</td>
<td>193,022</td>
</tr>
<tr>
<td>IV</td>
<td>11,169</td>
<td>2,460,110</td>
</tr>
<tr>
<td>V</td>
<td>5,578</td>
<td>1,057,450</td>
</tr>
<tr>
<td>VI</td>
<td>30,350</td>
<td>3,601,447</td>
</tr>
</tbody>
</table>

2006(?) Status
Existing Protected Areas: 1998 Status

- 10,706 IUCN protected areas (categories I–III) covering $6 \times 10^6$ km$^2$
- 47,097 partially protected areas (IUCN categories IV–VI) covering $7 \times 10^6$ km$^2$
- Total of 9% of Earth’s land surface
- World’s largest park: Greenland, 7% of total protected area
Existing Protected Areas: 2003 Status

- 104,791 IUCN protected areas (categories I–IV) covering $18 \times 10^6 \text{ km}^2$
- Total of 12.5% of Earth’s land surface
- World’s largest park: Greenland, 5% of total protected area
Existing Protected Areas

- **Strict protection**
  - 1993: Only 4% of Earth’s (land?) surface
  - 2006: Only 6% of Earth’s (land?) surface

- **Marine protection**
  - Less than 1% of marine environment protected
  - Half of marine protection due to 3 largest reserves
    - Great Barrier Reef Marine Park
    - Galápagos Marine Park
    - North Sea Reserve (Netherlands)

- **Needs**
  - Are these levels of protection too low or too high?
Percent Protected Land (2003): IUCN Categories I–V

Percent of Total Land Area that is Protected (IUCN Designations I-V), 2003

Map Projection: Robinson
Citation: WRI 2003

© EarthTrends 2003 World Resources Institute. All rights reserved. Fair use is permitted on a limited scale and for educational purposes.
Percent of Total Land Area that is Protected (all designations), 2003

Map Projection: Robinson
Citation: WRI 2003

© EarthTrends 2003 World Resources Institute. All rights reserved. Fair use is permitted on a limited scale and for educational purposes.
Creating New Protected Areas

- Mechanisms for creation
  - Government action
  - Land purchase by private individuals and NGOs
  - Established customs of native peoples
  - Development of biological field stations

- Steps involved, questions to answer
  - Which species and biological communities are the highest priority for conservation?
  - Which areas of the world should be protected to meet conservation priorities?
  - How can new conservation areas be linked to existing conservation networks?
Identifying Priorities For Protecting Biodiversity

Criteria for identifying regions to conserve

- **Distinctiveness**
  - Is the biological community distinctive, e.g., composed of many rare endemic species, unusual genotypes?

- **Endangerment**
  - Are the species to be protected in unusual danger of extinction or decline?

- **Utility**
  - Do the species to be protected have potential value to humans?
Identifying Priorities For Protecting Biodiversity

Prioritization systems
- Species approaches:
  - Focus on preserving focal, indicator, flagship species
  - Hope that preserving habitat for focal species also preserves entire communities and ecosystems
- Biological diversity indicator approaches
  - Focus on preserving areas of high biological diversity
  - Subset of species groups used to identify such areas
- Community and ecosystem approaches
- Threat-based approaches
- Practical approaches
# Species-Based Approaches

## TABLE 15.3 “Top ten” rankings for countries with the largest number of species from well-known groups

<table>
<thead>
<tr>
<th>Rank</th>
<th>Higher plants&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Mammals</th>
<th>Birds</th>
<th>Reptiles</th>
<th>Amphibians</th>
<th>Freshwater fish</th>
<th>Butterflies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Brazil 53,000</td>
<td>Brazil</td>
<td>Colombia 1815</td>
<td>Australia 755</td>
<td>Colombia 583</td>
<td>Brazil &gt;3000</td>
<td>Peru 3532</td>
</tr>
<tr>
<td>2</td>
<td>Colombia 47,000</td>
<td>Indonesia 515</td>
<td>Peru 1703</td>
<td>Mexico 717</td>
<td>Brazil 517</td>
<td>Colombia &gt;1500</td>
<td>Brazil 3132</td>
</tr>
<tr>
<td>3</td>
<td>Indonesia 37,000</td>
<td>China 499</td>
<td>Brazil 1622</td>
<td>Colombia 520</td>
<td>Ecuador 402</td>
<td>Indonesia 1400</td>
<td>Colombia 3100</td>
</tr>
<tr>
<td>4</td>
<td>China 28,000</td>
<td>Colombia 456</td>
<td>Ecuador 1559</td>
<td>Indonesia 511</td>
<td>Mexico 284</td>
<td>Venezuela 1250</td>
<td>Bolivia 3000</td>
</tr>
<tr>
<td>5</td>
<td>Mexico 24,000</td>
<td>Mexico 450</td>
<td>Indonesia 1531</td>
<td>Brazil 468</td>
<td>China 274</td>
<td>China 1010</td>
<td>Venezuela 2316</td>
</tr>
<tr>
<td>6</td>
<td>South Africa 23,000</td>
<td>USA 428</td>
<td>Venezuela 1360</td>
<td>India 408</td>
<td>Indonesia 270</td>
<td>DRC 962</td>
<td>Mexico 2237</td>
</tr>
<tr>
<td>7</td>
<td>Ecuador 19,000</td>
<td>DRC 415</td>
<td>India 1258</td>
<td>China 387</td>
<td>Peru 241</td>
<td>Peru 855</td>
<td>Ecuador 2200</td>
</tr>
<tr>
<td>8</td>
<td>Peru 19,000</td>
<td>India 350</td>
<td>Bolivia 1257</td>
<td>Ecuador 374</td>
<td>India 206</td>
<td>Tanzania 800</td>
<td>Indonesia 1900</td>
</tr>
<tr>
<td>9</td>
<td>PNG 18,000</td>
<td>Peru 344</td>
<td>China 1244</td>
<td>PNG 305</td>
<td>Venezuela 204</td>
<td>USA 790</td>
<td>DRC 1650</td>
</tr>
<tr>
<td>10</td>
<td>Venezuela 18,000</td>
<td>Uganda 315</td>
<td>DRC 1094</td>
<td>Madagascar 300</td>
<td>PNG 200</td>
<td>India 750</td>
<td>Cameroon 1550</td>
</tr>
</tbody>
</table>


Note: PNG = Papua New Guinea; DRC = Democratic Republic of the Congo; USA = United States of America.

<sup>a</sup>Flowering plants, gymnosperms, and ferns.
Species-Based Approaches: U.S. Species Richness

**FIGURE 15.6** Peaks of species richness in the United States, calculated by employing an index that gives extra weighting to rare species. The Hawaiian Islands, not shown here, have the greatest concentration of rare species. Darker shading indicates greater concentrations of rare species. (After Stein et al. 2000.)
Richness and Endemism by River Basin

Species Richness and Endemism by River Basin

Map Projection: Interrupted Goode's Homolosine
Citation: World Resources Institute - PAGE, 2000
Notes:

© EarthTrends 2001 World Resources Institute. All rights reserved. Fair use is permitted on a limited scale and for educational purposes.
World Watersheds: Endemic Bird Areas

Watersheds of the World - Endemic Bird Areas

Map Projection: Robinson
Key Forest Areas for Threatened Birds in Latin America

Map Projection: Interrupted Goode's Homolosine
Citation: World Resources Institute - PAGE, 2000
Notes:

Key areas by habitat type
- Wet forest
- Dry forest
Figure 15.4 Two large projects have identified global centers of diversity. BirdLife International has identified Endemic Bird Areas (EBAs) that include concentrations of restricted-range species; and the Centers of Plant Diversity Project (CPD) has identified high concentrations of restricted-range plant species. There is considerable overlap between the areas of species concentration, with many of the sites found in tropical areas. Many EBAs are also found on islands, and CPDs are sometimes found in more temperate and Mediterranean climates. (From Stattersfield et al. 1998.)
Endemic Bird Areas and Centers of Plant Diversity in Forests

Map Projection: Interrupted Goode’s Homolosine
Citation: World Resources Institute - PAGE, 2000
Notes:
Identifying Priorities For Protecting Biodiversity

- Prioritization systems
  - Species approaches
  - Biological diversity indicator approaches
  - Community and ecosystem approaches
    - Preserve functioning ecosystem services
    - Identify a series of representative sites
- Threat-based approaches
  - Identify regions of high threat
  - Identify regions with high potential impact of protection
- Practical approaches
  - Identify regions that happen to be reasonably pristine
  - Identify regions with few competing interests available for preservation
Comparison of Biomes

**Figure 15.7** For 13 major biomes, the percent of the total area converted to other uses, and the percent of the total area that is protected from conversion. Also shown is the C:P ratio, the ratio of the percent converted to the percent protected. (After Hoekstra et al. 2004.)
Watersheds of the World - Tropical Deforestation

Map Projection: Robinson

Current Protection and Future Potential

**Figure 15.5** Distribution of Indo-Pacific countries based on (1) the percentage of their forests that are currently protected and (2) the percentage of unprotected forest predicted to remain intact in 10 years. The figure highlights countries in Category III with at least 20% forest cover but less than 4% of that protected; these are high-priority countries for establishing reserves. (After Dinerstein and Wikramanayake 1993.)
Determining Which Areas Should Be Protected

- Primary question
  - Given priority system, what allocation of land within and without protected areas will best achieve the goal?

- Approaches
  - Current biological resources: centers of biodiversity, “hot spots”, indicator species, representative sites
  - Current protection versus future threats
  - De facto wilderness areas, i.e., not officially designated protected areas but areas of very low human impact: e.g., former military sites, nuclear energy production facilities
How Much Protection Is Needed?

- Establishing protected areas with limited data
  - Example: Irian Jaya Diamond (1986)
  - Requires principles: Chapter 16
- Size and effectiveness
  - Small protected areas can be effective today
  - Questions
    - How large must a protected area be in order to be effective?
    - How does the answer to the previous question depend on the landscape in which the protected area is embedded?