Designing Networks of Protected Areas

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Overall Design Principles

- **Representation**
  - all conservation units must be represented in the reserve

- **Resiliency**
  - reserves must be sufficiently large and well-protected to maintain all conservation units in healthy condition for the foreseeable future

- **Redundancy**
  - reserves must protect enough examples of each conservation unit to ensure long-term existence in the face of uncertainties

- **Reality**
  - funds and political will must exist to acquire and manage reserves
Issues of Reserve Design

Focal questions

- **Size**: how large must nature reserves be to protect species?
- **SLOSS**: is a single large or several small reserves better?
- **Individuals**: how many individuals of a target species must be protected?
- **Shape**: what is the best shape for a reserve?
- **Connectivity**: when several reserves are created, should they be
  - close together or far apart?
  - isolated or connected by corridors?
## Issues of Reserve Design

<table>
<thead>
<tr>
<th></th>
<th>Worse</th>
<th>Better</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>Ecosystem partially protected</td>
<td>Ecosystem completely protected</td>
</tr>
<tr>
<td>(B)</td>
<td>Smaller reserve</td>
<td>Larger reserve</td>
</tr>
<tr>
<td>(C)</td>
<td>Fragmented reserve</td>
<td>Unfragmented reserve</td>
</tr>
<tr>
<td>(D)</td>
<td>Fewer reserves</td>
<td>More reserves</td>
</tr>
<tr>
<td>(E)</td>
<td>Isolated reserves</td>
<td>Corridors maintained</td>
</tr>
<tr>
<td>(F)</td>
<td>Isolated reserves</td>
<td>Stop</td>
</tr>
</tbody>
</table>

### FIGURE 16.1 Principles of reserve design that have been proposed based on island biogeography. Imagine that the reserves are “islands” of the original ecosystem surrounded by land that has been made uninhabitable by human activities such as logging, ranching, or industrial development. The practical application of these principles has been studied and debated, but in general the designs shown on the right are considered preferable to those on the left. (After Shafer 1997.)
Relationship between Population Size and Area

**Figure 16.2** Population studies show that large parks and protected areas in Africa contain larger populations of each species than small parks; only the largest parks may contain long-term viable populations of many vertebrate species. Each symbol represents an animal population in a park. If the viable population size of a species is 1000 individuals ($10^3$; dashed line), parks of at least 100 ha ($10^2$) will be needed to protect small herbivores (e.g., rabbits, squirrels); parks of more than 10,000 ha will be needed to protect large herbivores (e.g., zebra, giraffes); and parks of at least 1 million ha will be needed to protect large carnivores (e.g., lions, hyenas). (From Schonewald-Cox 1983.)
Relationship between Extinction and Area

**FIGURE 16.3** Each dot represents the extinction rate of animal populations for a particular U.S. national park, Canadian national park, or two or more adjacent parks. Mammals have higher extinction rates in smaller parks than in larger ones. (After Newmark 1995.)
Importance of Networked Reserve Systems

- Effectively increases the total area \( \Rightarrow \) reduces the extinction rate
- Corridors increase interchange \( \Rightarrow \) reduces effect of small population size on genetic variation
- Encourages common management practices \( \Rightarrow \) consistency across landscape
- Raises public profile of reserves \( \Rightarrow \) perhaps greater chance of acceptance
Conservation Networks: Case Studies
Germany-Czech Republic Border

- Formerly the Iron Curtain divided wildlife habitat
- Berlin Wall removed on 9 November 1989
- No ecological barrier to movement across border
- First trans-border preserve in European Union
- Red deer still do not cross border

Wall Street Journal, 4 November 2009
Conservation Networks: Case Studies
Klamath-Siskiyou Ecoregion

- Global center of biodiversity
- IUCN Area of Global Botanical Significance (1 of 7 in North America)
- Proposed as a World Heritage Site and UNESCO Biosphere Reserve
Conservation Networks: Case Studies
Klamath-Siskiyou Ecoregion
Conservation Networks: Case Studies
Corridors in Louisiana wetlands: Tensas River basin

- Former habitat of
  - red wolf (*Canus rufus*)
  - Florida panther (*Felis concolor coryi*)
  - ivory-billed woodpecker (*Campephilus principalis*)

- Attempt to link remaining large patches with strategic protection of a small land area

- Examples
  - addition of 400 ha of forest converts largest connected complex from 50,000 ha to 100,000 ha.
  - addition of 600 ha links several 3,000–10,000 ha patches into 63,000 ha complex.
Conservation Networks: Case Studies
Community baboon sanctuary: Bermudian Landing, Belize

- Largely agricultural land
- Declining populations of black howler monkeys (*Alouatta pigra*)
- Community agreement to create forest borders along Belize River and at property/field boundaries
- Forest borders provide pathways linking forest patches

Result: increase in howler monkey population and ecotourism
Wildlands Project: Megalinkages

Continental Megalinkages

Reconnecting North America for Wildlife

Across the continent, many animals no longer have space to travel as their natural habitat has been fragmented into “islands” surrounded by a sea of development. This map of four proposed wildlife linkages—Megalinkages—presents a hopeful vision for reconnecting North America’s wilder places. If human land uses within the Megalinkages can accommodate wide-ranging carnivores such as wolves and cougars, these animals could again fulfill their vital role in healthy ecosystems.

WILDLANDS PROJECT

reconnect restore rewild

PO Box 943, Richmond, VT 05497  802/434-6077  www.wildlandsproject.org
Wildlands Project: Spine of the Continent

Wildlands Conservation Planning

Along the Spine of the Continent

[Map of protected areas along the spine of the continent]
Wildlands Project: New Mexico Highlands
Wildlands Project: Detractors

http://www.wildlandsprojectrevealed.org/


An evolutionary-ecological perspective, chapter 7, pages 119–133. Sinauer, Sunderland, MA.