Protected Areas
Functions and purposes
Design issues
People and protected areas

These include scientific reserves, national parks, natural monuments, nature reserves, wildlife sanctuaries

Costa Rica’s National Parks & Reserves

Goals of a conservation reserves
Many are historical accidents!

Yellowstone and Yosemite were established largely because of the unique geological features of the first and the scenery of the second.

Sequoia and Kings Canyon National Parks in the Sierra Nevada only protected *Sequoiadendron giganteum* incidentally -- established to protect an important watershed providing irrigation water for farms in the Central Valley.
The world's largest national park, 270,000 square miles, is Northeast Greenland National Park, consisting mainly of snow.

Why set up protected areas?

**Preservation of large, intact, functioning ecosystems**
- To protect an intact functioning ecosystem, the area protected must be *very* large.
- Accommodate wide-ranging species, large disturbances, metapopulation dynamics
- Yellowstone and Grand Teton National Parks together are vast but may not be large enough for a viable population of grizzly bears.
Preservation of areas with high biological diversity

- **hot spots**: ~15-25 areas that occupy only 1% of the earth’s land surface but are the exclusive home of one fifth of the world’s plant species.
- Concentrated effort in a few high priority areas can, with careful long-term management, ensure that a large proportion of the world's biodiversity will survive us.

“Hot Spots”

- Increasingly conservation planning is targeted at biodiversity hot spots, where conservation needs are greatest and payoffs from safeguards are highest.
- World Bank, Global Environment Facility and Conservation International have recently joined forces.
- The $150 million fund will build on Conservation International's focus on biodiversity hot spots around the world.

CI will fund NGO’s in each country to assess the condition of each hot spot.

- The partnership may mark a new direction for the bank, usually under fire for its conservation policies.
- **A major reorientation of conservation planning around the world**
Hotspot studies

- But how much “hot spot” overlap is there between taxonomic groups?
- On a 10 km grid that covered all of Great Britain (2,500 cells), Prendergast et al. recorded the number of species of butterflies, dragonflies, aquatic plants, breeding birds, and liverworts.
- Identified for each taxonomic group each tract into the 5% with the highest number of species and the 5% with the lowest number of species.

Study results

- Butterflies and birds share only 10% of hot spots.
- Butterflies and dragonflies share 34% of hot spots, the greatest overlap found.
- None of the 2500 tracts is a hotspot for all five groups.
- Protecting tracts with a high diversity may not protect rare species. 16% of rare birds were found in cold spots.

Protecting focal species

Preservation of significant natural communities

- Salt marshes, the rocky intertidal, red maple swamps, sphagnum bogs, prairie of the Midwest and Great Plains, Florida scrub, and old-growth forest of the Pacific Northwest

Extractive Areas

- Defined groups of people are given exclusive rights on condition they follow sustainable practices
- Generally center around the exploitation of non-timber forest products
- Prevents whole-scale conversion of an area by clarifying issues of access and ownership and generating reliable source of revenue
Rubber-tappers

General principles

Ideally, reserve systems should be:
- Representative
  - protect some of everything
- Resilient
  - effective protection into the future
- Redundant
  - multiple sites as back-up

Parks lose species over time

"faunal relaxation"

Newmark (1987, 1995) study of parks:
- numerous local extinctions
- NOT from direct human activity
- More extinction than colonization
Parks lose species over time

= “faunal relaxation”

Newmark (1987, 1995) study of parks:
- numerous local extinctions
- NOT from direct human activity
- More extinction than colonization
- # extinctions greatest in small parks
- # extinctions greatest in old parks
- 3 smallest parks lost 40% of large mammals
- Largest park lost none (except wolf; killed off by humans)

See also Fig 16.2 and 16.3

Issues of reserve size and isolation

First inspirations were from the Theory of Island Biogeography, developed initially for true, oceanic islands.

-the number of species found on an island increases log-linearly with island/park area

\[ S = CA^z \]

- where \( S \) = number of species, \( A \) = area, and \( C \) is a species-specific constant.
- Values of \( Z \) tend to vary between 0.18 and 0.35,
- to double the number of species the area must be increased by a factor of ~ 100
- To halve species, area needs to decline by 90%

The SLOSS debate

- Suppose you had money to purchase 10,000 hectares of land:
  - buy a single piece of property 10,000 hectares?
  - or 10 pieces of property each of 1,000 hectares?
- Would it be better to have a single large reserve or several small reserves?

Basis for debate:

- Simberloff and Abele (1976) said SL not always best

Simberloff
- Study of mangrove islands
- Removed arthropod fauna
- Measured recolonization rates
- Went back and fragmented some of the islands
- Fragments had >> # species than original island
Arguments for few, large reserves

- Contiguous areas are better able to preserve intact communities of interdependent species.

Arguments for few, large reserves

- Contiguous areas are better able to maintain viable populations of species that occur at low population densities, especially large vertebrates.

Furthermore, small reserves may only have subsets of species present in larger reserves

...for example, birds in variously sized fields in Oklahoma:

![Plethodon petraeus](image)

Arguments for many small reserves

- Small patches are fine for vegetative perennials, and for small, sedentary animals, especially insects (which may comprise the bulk of biodiversity)
- A few hectares may encompass all the appropriate habitat, e.g., a peat bog or a serpentine outcrop.
Other issues

- Small reserves are not always subsets of larger reserves
- You may actually save more different species in a system of small reserves that protect multiple small ecosystems than in a single large one

A combination is best...

- Large reserves to maintain functional ecosystems and large-scale population processes
- Small reserves to protect rare elements
- The essence of coarse filter – fine filter approach advocated by The Nature Conservancy
  - Coarse: ecosystems, common species
  - Fine: rare species

Maximizing the value of small reserves

(often the only option)

Reserve shape matters
- minimize edges
- reduce internal fragmentation

Landscape context matters
- surrounding habitat
- create buffers
Maximizing the value of small reserves

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Use networks to facilitate movements
- stepping stones
- corridors

Isolation Matters

- Lines represent movements of beetles (marked and recaptured)
- Roads and parking loops were barriers to dispersal
  → Roads can be physical or psychological barriers

GAP Analysis

- GAP is a proactive approach to protecting biodiversity.
- Seeks to identify gaps between land areas that are rich in biodiversity and areas that are managed for conservation.

Three assumptions

- The best time to save species is while they are still common;
- cheaper to maintain natural populations, than it is to intensely manage endangered populations; and,
- we can use what we know about the distributions of vertebrate species and vegetation types to assess biodiversity at local, state, regional and national levels.

J. M. Scott found that fewer than 10 percent of the ranges of endangered forest birds on Hawaii were protected.
The problem with gap analysis:

- Presumes that vegetation cover can predict vertebrate distribution accurately
- Assumes predicted vertebrate distribution will be a good surrogate for diversity in other groups

Coda:

- An artist's conception shows the denizens of a future "U.S. Ecological History Park."

Examples of Protected Areas:

Biosphere reserves

Structure:

- Each reserve is intended to contain the following parts:
  - "(a) a legally constituted core area or areas devoted to long-term protection, according to the conservation objectives of the biosphere reserve, and of sufficient size to meet these objectives;"
  - "(b) a buffer zone or zones clearly identified and surrounding or contiguous to the core area or areas, where only activities compatible with the conservation objectives can take place;"
  - "(c) an outer transition area where sustainable resource management practices are promoted and developed."

Biosphere Reserves:

- United Nations designates "Biosphere Reserves"
- Represent the world's varied ecosystems and provide opportunities for scientific research and sustainable economic development based on ecological principles.
- Now consists of 411 sites in 94 countries. Eighteen new sites in 13 countries were added in 2001.
- There are 90 Biosphere Reserves in the United States, including 29 national parks.
- Consider the Champlain-Adirondack Biosphere Reserve!!!
Not all protected areas are “set-asides”

Conservation Easements
- Think of owning land as holding a bundle of sticks.
- Each stick represents the landowner’s right to do something with their property
  - build a house,
  - extract minerals,
  - lease the property,
  - pass it on to heirs,
  - allow hunting
- A landowner may give up certain sticks from the bundle associated with the property through a document called a conservation easement.

Can the owner still sell the property?
- The landowner continues to own the property after executing an easement.
- Therefore, can sell, give or lease the property, as before.
- All future owners assume ownership of the property subject to the conditions of the easement.

Potential for Easements
- Conservationists often interested in only a few “sticks in the bundle” – therefore drastically cheaper to just buy the sticks of interest!
- Landowner often relieved of a significant tax burden
- Much more land protected per $ than outright purchase
- Avoid costs and conflicts of seizing properties outright

People and Reserves: Making Protected Areas Work
Parks all around the world are being degraded

- Hundreds of parks are "paper parks" having no staff, administration, budget or infrastructures.
- Failing to resist the pressures of ongoing development around them.
- Failure to balance use versus make parks "pay”

Use versus Strict Preservation

- Dual objectives of economic development and conservation of biodiversity can fail to achieve either.
- Should people really be removed from parks?
- Or should parks be inhabited, used and defended by people?

Rate at which new protected areas have been established throughout the world

<table>
<thead>
<tr>
<th>Date Established</th>
<th>Number of areas</th>
<th>Total area protected (km²)</th>
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<tr>
<td>Unknown</td>
<td>711</td>
<td>194,395</td>
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<tr>
<td>Pre-1900</td>
<td>37</td>
<td>51,455</td>
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<tr>
<td>1900-1909</td>
<td>52</td>
<td>131,385</td>
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<td>1910-1919</td>
<td>68</td>
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<td>1920-1929</td>
<td>92</td>
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<td>1930-1939</td>
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<td>279,281</td>
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<td>1970-1979</td>
<td>1,317</td>
<td>2,029,302</td>
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<tr>
<td>1980-1989</td>
<td>781</td>
<td>1,068,572</td>
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</tbody>
</table>

From Reid and Miller 1989.

People versus “Wilderness”

- European notions of ‘wild’ landscapes have blinded outsiders to the management practices of indigenous peoples and local communities
- Many so-called ‘pristine’ landscapes are in fact cultural landscapes
- Natural forest management, cultivation, and the use of fire are evident if looked for.

Fire, tree planting, game management, irrigation
Indigenous Peoples & Their Knowledge and Ethics

- For centuries indigenous and traditional peoples (campesinos, caboclos, colonos, caicaras, etc) have been treated with disdain by the ruling elite.
- Most western scientists still believe traditional knowledge is folklore and not scientific.
- Governments, scientists and environmentalists have found it easy to justify the dispossession of native peoples from their land and resources.
- Done by colonialists in the name of
  - development,
  - conservation,
  - progress.

Indigenous peoples often possess a powerful 'conservation ethic' …

- cooperation;
- family bonding and cross-generational communication, including links with ancestors;
- concern for the well-being of future generations;
- local-scale, self-sufficiency, and reliance on locally rights to lands, territories and resources which tend to be collective and inalienable rather than individual and alienable;
- available natural resources;
- restraint in resource exploitation and respect for nature, especially for sacred sites.

TEK

- Traditional Ecological Knowledge not simple compilation of facts
- A complex basis for decisions about
  - natural resource management,
  - Nutrition and food preparation,
  - health,
  - education,
  - community and social organization.
- Holistic, inherently dynamic, constantly evolving
Indigenous people
- Land rights of indigenous people are beginning to be recognized in a growing number of countries.
- Indigenous people’s reserves account for 20 percent of the Brazilian Amazon, whereas areas comprising the highest category of nature preserves account for only 1.5 percent.
- Conservationists must forge alliances with indigenous groups before logging and mining interests lure them into signing contracts.

Summary
- Numerous categories of traditional knowledge among indigenous peoples
- Have great potential for application in a wide range of sustainability strategies.
- Indigenous peoples can conserve biological diversity if they have a reasonable expectation of benefiting from it.
- Also can provide other environmental benefits, for example, soil and water conservation, soil fertility enhancement, and management of game and fisheries.

Some specific means of improving effectiveness of parks and other PA’s

One generalization
- Successful parks are often under the watchful eye of a committed and charismatic individual.
- May be expatriate or local, but devotes years and even decades to a single park.
- A simple research station that generates critical knowledge about the park’s wildlife and management needs is critical.

Prospects for privatization
- Protected areas in the forms of private reserves and park management contracts.
- Already 211 private nature reserves in Costa Rica, for example.
- Will take many forms in the future and offer many alternative strategies for conserving nature and strengthening existing protected areas.

Internationalization
- International financial support of park management has been important since the 1960s (when many tropical developing countries achieved independence).
- International aid is key but not entirely sufficient.
- Vital need for sustained funding programs to replace the short-term assistance projects that have recently been in vogue.
Financing
- New financing mechanisms include a variety of user fees, special taxes levied on tourists and trust funds for nature.
- Already there are more than 30 endowments for nature totaling around $500 million.
- Also need to know how to manage the influx of income
- Burgeoning field of “Conservation finance”

Social instability
- Civil strife and the attendant social disorder can severely threaten protected areas.
- There is a tendency of support organizations (NGOs, bilateral aid agencies, etc.) to pull out of any country immediately when the security of expatriate personnel could not be guaranteed.
- Individuals who persist during a crisis and continued to apply a steady hand are surprisingly effective