**Approaches to solving conservation problems**

Habitat patches & landscape in protecting species

I. Habitat v. landscape
II. The landscape mosaic
III. Protected Areas
IV. Cultural Considerations in reserve design
V. Managing the landscape on non-reserve lands

---

**I. Habitat v. landscapes in conservation**

A. Habitat
   - Habitat Selection – a species’ use of a habitat type at frequencies that differ from the relative availability of that habitat in the total area occupied by the population of interest
   - Habitat Use – the pattern of occupancy of a recognized habitat type by members of the population of interest
   - Habitat Quality – a measure of the reproductive success and survival rates (i.e. fitness) of members of the population using a given habitat type relative to other habitat types also used by the population
     - Sampling, direct observation, radio-telemetry data, scat markings, etc.
     - Can determine a species preferred habitat – can come up w/a Habitat Matrix

---

- Most species use more than one kind of habitat
- Habitat use is different from habitat availability
- Habitat use changes over time
- Habitat use differs among individuals in a population
- Habitat alteration may be the single greatest threat to species and ecosystem preservation

> Habitat Temporal Scale – habitat life span relative to the generation time of the organism
> Habitat Spatial Scale – distance between habitat patches relative to the dispersal distance of the organism

Mobile species will utilize an array of habitats in a particular landscape – e.g. Caribou –
a. Community - an association or assemblage of plant and animal populations that are spatially delimited (i.e., they live in a particular habitat) and are often dominated by one or more prominent species, or by a characteristic physical attribute; e.g., the oak-savanna community of Arastadero preserve
   • Communities –

C. Landscape –

II. The Landscape Mosaic

- Landscape ecology - investigating the patterns of habitat types on a regional scale and analyzing their influence on species distribution and ecosystem processes
- Individuals move among suitable patches in the landscape & because populations in the various patches are linked by dispersal, the fates of the populations are interconnected.
- We cannot separate individual "habitats" – it is now recognized that biodiversity is dependent upon the landscape, and as such, a landscape approach is necessary

Landscape components:

- Must consider:
  1) Habitat Heterogeneity
     • Variation in the environment
       • Physical or Biotic
       • Spatial or Temporal
     • Fixed or Dynamic
  2) Habitat Patchiness – quality of habitat arrangement (j- diversity)
     • Patches –
     • Form of spatial heterogeneity in which boundaries may be discerned
A. Habitat Patch Characteristics within the landscape mosaic

1) Area – size of patches
2) Perimeter – circumference of patches
3) Type –
4) Neighbors –

B. Landscape composition

- Variety and relative abundance of patch types represented on the landscape
  - Composition refers to the number of patch types
- Structure, spatial arrangement, position, orientation or shape complexity of the patches on the landscape
  - Structure is determined by the composition, the configuration, and the proportion of different patches across the landscape.
- Pattern is the term for the contents and internal order of a heterogeneous area of land
- Connectedness, functional joinings between patches
  - Matrix –
  - Connectivity
III. Protected Areas

A. Types of protected areas

B. Goals of reserve design

C. Issues in reserve success

A. Types of protected areas

- Protected area = “area of land and/or sea especially dedicated to the protection and maintenance of biological diversity” (IUCN 1994).
- 104,791 protected areas currently exist, covering ~18.38 million km² on land
- 2 million km² at sea worldwide
  - Seven categories:
    I. Strict nature reserve & Wilderness area
    II. National park
    III. Natural monument
    IV. Managed wildlife sanctuaries and nature reserves
    V. Protected landscape/seascape
    VI. Managed resource protected area
7). Biosphere Reserves, Ramsar Wetlands & World Heritage Sites

- **Biosphere reserve**: includes one or more protected areas and surrounding lands that are managed to combine both conservation and sustainable use of natural resources (UNESCO).
  - [http://www.unesco.org/mab/BRs.shtml](http://www.unesco.org/mab/BRs.shtml)
- **Ramsar Wetlands**: The Convention on Wetlands is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources
- **World Heritage sites**

The Golden Gate Biosphere Reserve is a partnership of 13 protected areas in the greater San Francisco Bay area. It extends through the central California coastal region from the Bodega Research Reserve in the north to Jasper Ridge in the south and includes the Farallon Islands, Angel Island and Alcatraz within the San Francisco Bay.

Prairie Creek Redwoods State Park, Del Norte Coast Redwoods State Park, Jedediah Smith Redwoods State Park, and Redwood National Park, comprising 45 percent of all the old-growth redwood forest remaining in California. Together these are a World Heritage Site and International Biosphere Reserve.
The Bolinas Lagoon Ramsar Site has 3 species of amphibians, 23 of birds and 3 of mammals that are identified as "rare, threatened or endangered." Some 245 species of birds have been identified at the Lagoon and its surrounding watershed. In addition, the open water and marsh areas provide productive and diverse habitat for marine fishes and mammals. Bolinas Lagoon occupies some 1,200 acres; the surrounding watershed, 17 square miles.

B. GOALS for RESERVES

- Determining which areas should be protected:
  - GOAL #1
    - Preserve states
  - GOAL #2
    - Preserve processes

Various approaches used to design reserves (depends on the goal)

- Flagship Species Approach
  - Iconic animals that provide a focus for raising awareness and stimulating action and funding for broader conservation efforts
- Umbrella Species Approach
- Hot Spot Approach
  - http://www.biodiversityhotspots.org/asp/Hotspots/tropical
- Footprint-impacted species
- Landscape Approach
- Ecosystem Approach
Gap Analysis Program (GAP)

- Once priorities are established, resources can be directed to most critical conservation areas – also can link new protected areas with existing protected areas to create a reserve network.
- Gap Analysis = systematic conservation planning process, Using satellite imagery and GIS (geographic information system) technology to make computer generated map
  
  - Map species distributions & existing vegetation +physical features
  
  - Map public & private lands – determine what is protected, and what is not
  
  - Acquire additional areas to
  

Data on species distributions are overlaid w/distribution of protected areas using GIS. Species whose distribution coincides w/a protected area are considered “covered.”
C. Issues for reserve success

1). Managing sites & Managing processes
- Need to determine what habitats are important to preserve and how to maintain them

When designing reserves, one must keep in mind the following landscape components:
- Species composition (keystone species present?)
- Patch quality & size
- Edge effects, minimize fragmentation
- Connectivity

Reserve Design – biological considerations reviewed:
- Location, size & shape
- Its connections and spatial relationships
- MVPs needed to maintain critical species
- Colonization/extinction dynamics
- Ecological dynamics
- Land-use dynamics and potential threats outside of the reserve
2) For the reserve approach to be efficient and cost-effective:
- Individual reserves must be sited accurately
- Reserve networks must also be configured to optimize their conservation potential.
- This idea has spawned numerous methods for selecting the most effective (network of) reserves in a given region, and their development is now a sizeable sub-discipline of theoretical conservation biology.


---

Reserve design algorithms

- Select, from a pre-determined collection of land parcels, the minimum area (or cost) subset that embraces the greatest amount of diversity, or whatever metric of biological value is applied.
- Recent versions, for example, preferentially select sites that are close together, an arrangement recommended (in theory) for metapopulation persistence.
- Some algorithms take into account species abundances rather than presence/absence data.
- No universal algorithm exists to handle all reserve planning scenarios.
- Gap analysis appears to offer the most practical guidance for reserve selection.
- It is a matter of judgment whether money is better spent on acquiring data or on land purchase based on imperfect (or sometimes no) data.

---

3. What to keep in mind:

a) Reserve Size -
- Species-area relationship reveals that more species are accommodated in larger reserves.
- Persistence of individual species is a positive function of reserve size.
- Larger reserves are more

-reserve size should be based on the
Determining Reserve Size

- Identify species of interest – one whose disappearance would significantly decrease the value of the reserve or its diversity
- Determine MVP & estimate MDA

Kit Fox home range – 600 acres. On the Carrizo Plain, about 82,000 acres is managed as the Carrizo Plain Natural Heritage Reserve for the San Joaquin Kit Fox.

Grizzly home range – 360 mi²

b). Heterogeneity and Spatial Dynamics

Landscape might contain large expanses of uniform habitat & only a few small areas of rare habitat types...

c. Connectivity - Corridors

- Conservation networks – linking isolated protected areas to sustain metapopulation dynamics
Problems w/corridors

1) Poorly defined
2) Lack of experimental data, few studies show that corridors actually provide connectivity
3) Isolation not always bad
4) Subunits can become more vulnerable to regional variation

d.) Buffer Zones & the Core Preserve

- Local "human landscape" can be maintained, buffer zones insulate the core
- May facilitate dispersal between core areas and human dominated transitional areas
- Will only work if the core is large enough to protect viable populations and if
e). Multiple-use modules

**MUMs** - these are “multiple-use modules” consisting of central, well-protected core areas surrounded by buffer zones of increasingly heavy use by humans (with increasing distance away from the core)

- Attempt to integrate conservation of habitat on both managed and reserve lands
- Individual modules are connected via corridors

<table>
<thead>
<tr>
<th>Name</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Ecosystem protective</td>
<td>Ecosystem completely protected</td>
</tr>
<tr>
<td>(B) Smaller reserve</td>
<td>Larger reserve</td>
</tr>
<tr>
<td>(C) Fragmented reserve</td>
<td>Unfragmented reserve</td>
</tr>
<tr>
<td>(D) Fauer reserve</td>
<td>More reserves</td>
</tr>
<tr>
<td>(E) Isolated reserve</td>
<td>Corridors maintained</td>
</tr>
<tr>
<td>(F) Isolated reserves</td>
<td>“Stepping stones” facilitate movement</td>
</tr>
<tr>
<td>(G) Isolated reserves</td>
<td>“Stepping stones” facilitate movement</td>
</tr>
<tr>
<td>(H) Uniform habitat protected</td>
<td>Diverse habitat fully protected</td>
</tr>
<tr>
<td>(I) Singular shape</td>
<td>Reserve shape (close to central fewer edge effects)</td>
</tr>
<tr>
<td>(J) Only large reserves</td>
<td>Mix of large and small reserves</td>
</tr>
<tr>
<td>(K) Reserve managed individually</td>
<td>Reserves managed irregularly</td>
</tr>
<tr>
<td>(L) Humans excluded</td>
<td>Human integration buffer zones</td>
</tr>
</tbody>
</table>
IV. Cultural Considerations

- Must consider the local residents and their needs
  - Traditional land uses of indigenous peoples
  - Respect for cultural norms and practices
- Must consider the population at large
  - Population density requires extensive farming
- Must consider visitors needs

Managing habitat on non-reserve lands/private lands

- Conservation of species & their habitats can’t be achieved entirely through conservation reserves – no matter how well designed
- Must incorporate careful management of human activity on nonreserve lands
- Mitigation
- Conservation easements
Approaches to protection on private lands

- Educational programs
- Direct incentives for private conservation action
- Market creation and improvement
- Regulatory prohibitions/requirements (EPA)
- Feasibility

Alternative-futures Analysis

- Conservation planning should be more successful when a full landscape analysis is undertaken – should include projections of changes
- afa – makes use of spatially explicit landscape scale projections of several distinct options for future development within a region
- Predicts socioeconomic and biodiversity outcomes of each option
- Consortium of cons. biologists, city & regional planners, and local citizens work together to examine probable consequences (stakeholders)
- Create and analyze integrative landscape maps of change & impacts