Conserving habitats and landscapes

Why it's ecology and not biology

The biggest current problem

- 88% of the species listed by the ESA are there because of …

<table>
<thead>
<tr>
<th>Factor</th>
<th>Mammals</th>
<th>Birds</th>
<th>Amphibians</th>
<th>Gymnosperms</th>
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<tr>
<td>Habitat loss and degradation</td>
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<td>Overexploitation</td>
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<td>Invasive species</td>
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<td>Intrinsic factors</td>
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Data from IUCN  Fig. 3.6

In just one biome?

Does eating matter?

Rainforest loss & fragmentation

- Amazonian deforestation
  - From 1978 to 1988:
    - Deforestation increased 3 fold
    - Adjacent forest degradation increased 3 fold

L & F in action (1)

- Transamazsonian highway—Part 1
Habitat problems are multi-dimensional

- Loss vs. fragmentation
  - Fragmentation is confounded with habitat loss—you need to test for effects of breaking habitat apart after controlling for loss
  - One review (Fahrig, 2003) only found 17 studies available to test these distinct aspects of habitat problems; results?

Fig. 7.4

Fahrig (1997)
We need experiments

Haddad et al. (2015)

Biological Dynamics of Forest Fragments Project

Fragmentation creates edges

Amazon rain forest, Brazil

William Laurance, Thomas Lovejoy, Rob Bierregaard

Implications for global climate change

19% of the remaining area of tropical forests lies within 100 m of a forest edge
50 million km of tropical forest edges today
Edge effects represent 31% of the currently estimated annual carbon releases due to tropical deforestation

Brinck et al. (2017)

Fragmentation vs. species behavior

Hypothetically, removing 2% of habitat can have a big differential impact:
- Interior species lose 46% of habitat
- Edge species gain 76% of habitat

Grey = edge
Black = interior

Also see Fig. 7.12

Or: Wildlife management vs. conservation ecology

Wood thrush
Brown-headed cowbird
One more issue—time

Conserving habitat

Because habitat is so important, conservation reserves are a major focus

This leads to some key questions:

- What and where should we be conserving?

Some past ideas (1)

Some past ideas (2)

Does this agree with biodiversity and rarity?

If you are trying to maximize endemic species richness...

- Should we try to conserve ‘states’ of conditions?
  - OR
- Should we try to conserve natural ‘processes’?
- What is required for each endpoint?
What does ecology have to say about reserve design?

- Many consider MacArthur and Wilson’s Island Biogeography theory (1967) to be a major stimulus for conservation biology.
- Although started with oceanic islands, there have been many applications in other systems.
- Strengths: provided testable hypotheses; brought the landscape into the picture—more 'real-world'.

Some issues

- Considered all species the same—colonization ability not considered, for example.
- Considered all habitats the same as long as they were the same??
- Equilibrium-based theory.
- Actual tests have been pro and con.

The SLOSS debate

- S______ L______
- O______
- S______ S______?

- One 10,000 ha reserve vs. four 2,500 ha reserves—which is better?
- Usually depends on degree of nestedness.

Total area matters

Extinction rates for 299 mammals in 14 western NA Parks.

Heterogeneity also matters (1)

MN stream invertebrates
Terrestrial isopods on Greek islands (Hortal et al., 2009).
Heterogeneity also matters (2)

- How do you incorporate it?
  - Bigger areas
  - Multiple, unique areas
  - Preserve heterogeneity-forming processes
    - Minimum Dynamic Area (MDA)

SLOSS?

The 3 C’s

C________, c_________, and c_________

Some pros and cons of corridors

- Purchase of a small connecting area can:
  - Result in an overall much larger area
  - Enhance gene flow
  - Enhance movement of predators and disease

Overpasses as corridors

- Review by Corlatti et al. (2009) found:
  - Most studies were observational and quantify use/no use vs. numbers of crossings
  - Genetic effectiveness not well studied (i.e., is gene flow enhanced with overpasses?)
  - Then why bother?

1988 Yellowstone NP

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Three examples (1)

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  - Genetic effectiveness not well studied (i.e., is gene flow enhanced with overpasses?)
  - Then why bother?
Sanctuary along Belize River plus aerial bridges help black howler monkeys.

Brudvig et al. (2009)