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>
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<tr>
<th>Problem</th>
<th>Mammals</th>
<th>Birds</th>
<th>Amphibians</th>
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<td>Intrinsic factors</td>
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Data from IUCN

Fig. 3.6

In just one biome?

To human use, esp. ag.

Does eating matter?

53%

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.

- Fragmentation is confounded with habitat loss—you need to test for effects of breaking habitat apart after controlling for loss.
- One early review (Fahrig 2003) only found 17 studies available to test these distinct aspects of habitat problems; results?
A recent review (Fahrig 2017) found 118 studies available to test for effects of fragmentation after controlling for habitat loss. According to the authors of each study, why?

Fahrig (2017; book chapter, not Annual Rev. Ecol. Syst.)

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

We need experiments

Haddad et al. (2015)
Fragmentation and 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)

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?

Haddad et al. (2015)

Some past ideas (1)

Some past ideas (2)
Does this agree with biodiversity and rarity?

Jenkins et al. (2015)

Fig. 4. Summed priority scores across all taxa and recommended priority areas to expand conservation: 1, Middle to southern Blue Ridge Mountains; 2, Sierra Nevada Mountains, particularly the southern section; 3, California Coast Ranges; 4, Tennessee, Alabama, and northern Georgia watersheds; 5, Florida peninsula; 6, Florida Keys; 7, Klamath Mountains, primarily along the border of Oregon and California; 8 South-Central Texas around Austin and San Antonio; 9, Channel Islands of California.

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’

An important figure (1)

Rate of immigration or extinction

An important figure (2)

Rate of immigration or extinction

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

- 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

Newmark (1995)

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)

1988 Yellowstone NP

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

The 3 C's

How Corridors Reduce Indigo Bunting Nest Success

AIMEE J. WELDON

Department of Zoology, Box 7647, North Carolina State University, Raleigh, NC 27695-7647, U.S.A.

Edge effects, not connectivity, determine the incidence and development of a foliar fungal plant disease

BRENDAL. JOHNSON AND NICK M. HAHN

North Carolina State University, Department of Biology, Box 7617, Raleigh, North Carolina 27695-7617 USA

2006

2011
Human corridors beget the need for wildlife corridors.

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
  - Remains a current research topic

Some examples: Banff

- Banff National Park
- Highways & Nature area
- Effect zone & Compensation site
- Mitigation measure & Dispersal routes
- Road collisions with large mammals decreased by 96% after fencing & corridors

More Banff data

- Sawaya et al. (2014) found 47% of black bears and 27% of grizzly bears that used crossings successfully bred; included both genders

Some examples: Ecopassages

- SREL

Some examples: SREL

- Tewksbury et al. (2002)
- Brudvig et al. (2009)