Habitat Loss, Fragmentation, and Degradation: Summary

• Greatest threat to biodiversity
• Habitat loss:
  – immediate extinctions
  – greater risk future extinctions
• Fragmented landscapes ≠ natural mosaics
• Fragmentation ↓’s biodiversity: 5 ways
• Shift in dynamics: internal → external
• Species differ in vulnerability
• Recommendations to minimize effects

Habitat Loss, Fragmentation, and Degradation: Questions

Characteristics of fragmented systems?
Ecological consequences?
What to do?

Habitat Loss, Fragmentation, and Degradation: Outline

• Context
• Historical patterns of deforestation
• Fragmentation process
• Characteristics of fragmented ecosystems
• Effects on wildlife
• Recommendations for cons / mgmt

North America at Night, 1995

Context

• 2/3 earth’s primary forest gone (WWF 10/97)
• > 50% wetland area lost (US, 48 states)
• ≈ 25% world’s coral reefs lost, 60% threatened (US Coral Reef Task Force)
• Two components: ↓area, isolation
• Results: – local extinctions
  – shifts in spp comp. & abundance (weedy spp)
• Heterogeneity is “natural”
• Fragmented systems vs. “natural” mosaics
  – internal patch structure
  – edge severity
  – mortality sinks
• Conservation options: rarely proactive

Night Sky Light Pollution

www.lightpollution.it/dmsp
Coral Reef Biodiversity

local spp diversity ∝ reef area


Image of landcover from WA Gap analysis

• Sharp edges
• Linear edges
• Old growth islands
• Lowland old growth?
• Coastal habitat?
• Low-high connectivity?

U.S. Sprawl


State
Historical Patterns of Deforestation

Costa Rica example (slides)

Fragmentation Process

• Gap formation
• Gaps grow; become “matrix”
• Edge sealing
• Shift in dynamics:
  internally driven → externally driven

Parks Become Islands

Adolpho Ducke Forest Reserve, Manaus, Brazil
Science 293:1045 (10 Aug. 2001)

Characteristics of Fragmented Ecosystems

• Altered microclimates within fragments
• Biotic responses to isolation
• Changes in species composition
• Modifying influences

Influential Factors:
  – size  – shape  – landscape position

Altered Microclimates

• Radiation fluxes
  – increased range of temperatures
    – implications for: spp comp.; ecosystem processes
• Wind
  – minimum fetch = 100 - 200 x veg. height
    ⇒ wind profile not @ equilibrium
    – exposure to wind, desiccation
• Water fluxes
  – changes in soil moisture
  – altered hydrology; win & outside fragments
  – increased flooding, soil erosion

Biotic Responses to Isolation

= f( time since isolation, distance betw/ fragments, remaining connectivity )

• Supersaturation
• Species relaxation
  – area effects
  – altered disturbance regimes
  – living “ghosts”
• Invasion
Changes in Species Composition

• Loss of spp requiring large areas
• Loss of endemics
• 3 strategies for persistence:
  – survive in human matrix (weedy spp)
  – viable populations w/in fragments
  – mobile species
• Species w/out strategies go extinct
• Invasion by exotics & weedy species

Species Particularly Vulnerable to Fragmentation

• Naturally rare (limited range or low density)
• Widely ranging
  (large carnivores, migratory ungulates)
• Non-vagile species
• Low fecundity
• Highly variable populations
• Ground-nesting birds
• Interior species

Modifying Influences

• Remnant size
• Shape
• Position in Landscape
• Dispersal barriers
• Roads

Effects of Fragment Size

• Smaller populations
• Stable patch mosaic
• Minimum Dynamic Area
  – complete disturbance regime
  > 50 times area of individual disturbances
• BWCA (404,000 ha) < MDA

Species Loss: 5 Mechanisms

1. Initial exclusion
   (spp outside fragments)
2. Isolation
   (↓ dispersal & movement)
3. Species-area effects
   (smaller populations, fewer immigrants)
4. Edge effects
   (climate; edge predators; edge competitors)
5. Disrupted disturbance regimes
   (& other ecological processes)
Effects on Wildlife

- Shrubsteppe birds: Snake River plains, SW Idaho
- Forest birds: Vancouver Island montane old growth
- Mammals & trees: Barro Colorado Island, Panama
- Vertebrates: Douglas fir forests, NW California
- Pool Frog: south-central Sweden

Recommendations

1. Avoid further fragmentation!
2. Contrast in management of small vs. large areas:
   - large: focus on internal dynamics (esp. disturbance)
   - small: control external influences
3. Consider landscape context
4. Determine minimum subset for original diversity

Recommendations (continued)

5. Prioritize problems likely to disrupt desirable ecosystem processes
6. Integrated management: do not stop @ boundaries
7. Minimize edge effects
8. Maintain natural connectivity
9. Minimize anthropogenic connectivity

Restoring Connectivity

Red squirrel genetics: southern Scotland-northern England


Mesoamerican Biological Corridor

- MCB signed 1997
- funding: $100M - $1B
- UN, Wild Bank, GEF, Dutch, German govs
- political compromises (incl. rural development)
- model project