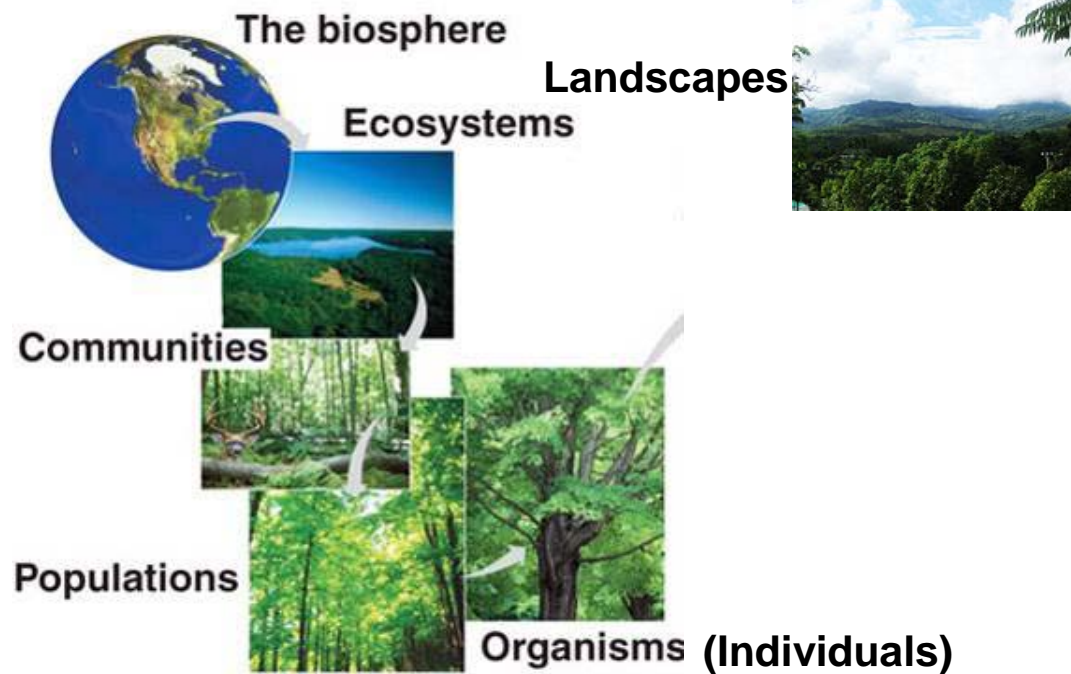


Restoration Ecology - Landscape Perspective

- Objectives:
 - How can the foundations of and theory in landscape ecology ↔ restoration ecology ↔ ecological restoration
 - Landscape Ecology 101
 - Landscape Ecology in a restoration context
 - Macroecology Perspective

Restoration Ecology - Landscape Perspective

- Ecological Hierarchy



Restoration Ecology - Landscape Perspective

- Landscape
 - heterogeneous region consisting of 2 or more interacting ecosystems (≥ 2 landscapes = region) that exchange organisms, matter, energy, H_2O , nutrients, etc.
 - Mosaic of habitat patches of varying sizes and shapes
 - Patches, edges, and connectivity (corridors and barriers)

**Windward
Mauna Kea
Landscape**



Restoration Ecology - Landscape Perspective

- Landscape Ecology
 - The ecology of regions; Study of the spatial arrangement of ecosystems & how this affects biotic and abiotic components & processes
 - Integrating discipline incorporating knowledge of ecological systems at all levels

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Mauna Kea
Landscape**



Restoration Ecology - Landscape Perspective

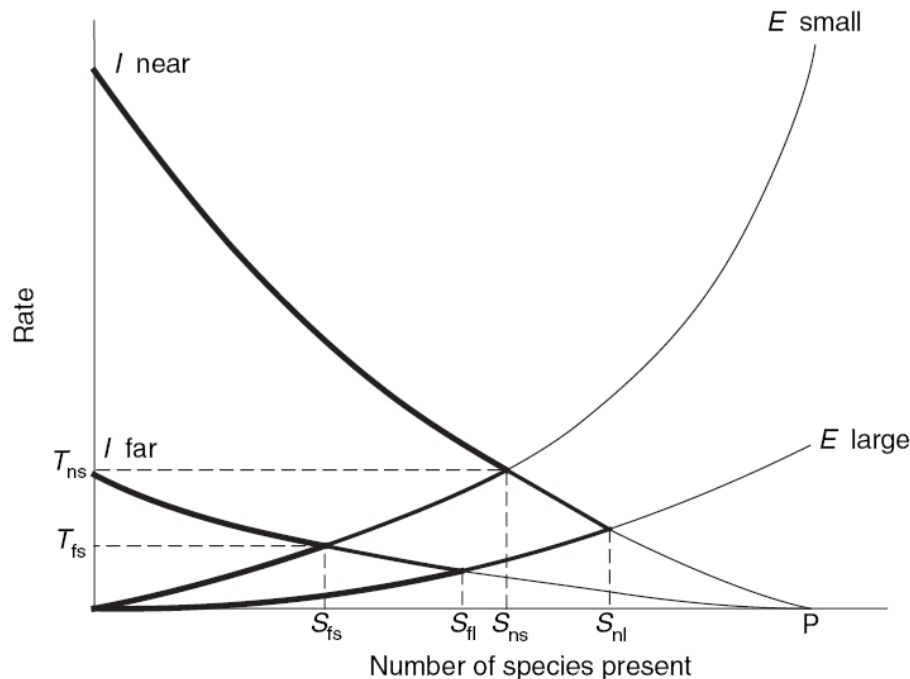
- Landscape Focal Areas
 1. Landscape planning & land use issues in regional development and conservation
 - More practical and applied aspects
 2. How the ecological world works on a large scale
 - How does the spatial arrangement of habitats impact the distribution and abundance of species?
 - How do landscape patterns affect ecosystem processes?

Restoration Ecology - Landscape Perspective

- Landscape ecology

- Rooted in theory set forth in island biogeography

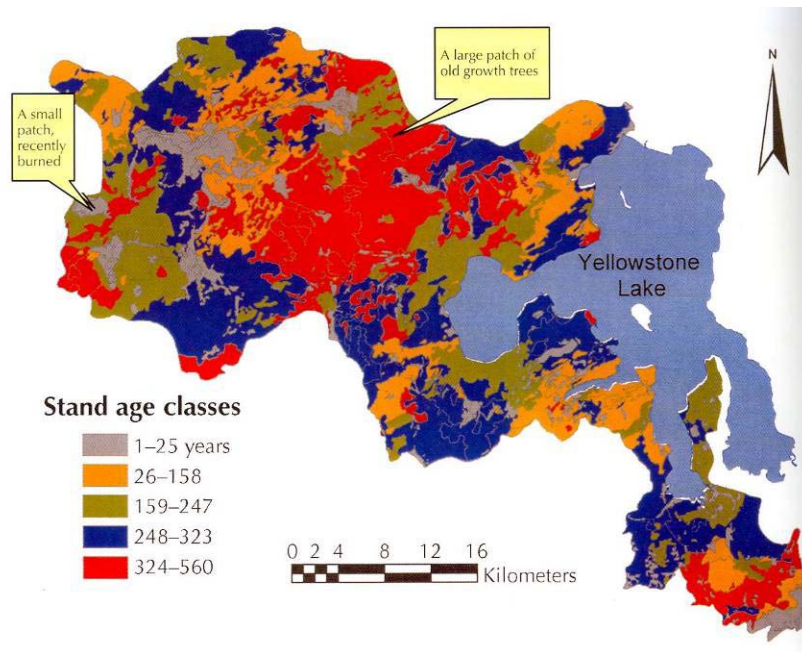
- Patch size & proximity to recruitment sites → dispersal & diversity
- Need to consider processes maintaining viable populations



(MacArthur and Wilson 1967)

Restoration Ecology - Landscape Perspective

- Patch
 - Area that is relatively homogeneous
 - Landscapes have several types of patches, the most common = Matrix

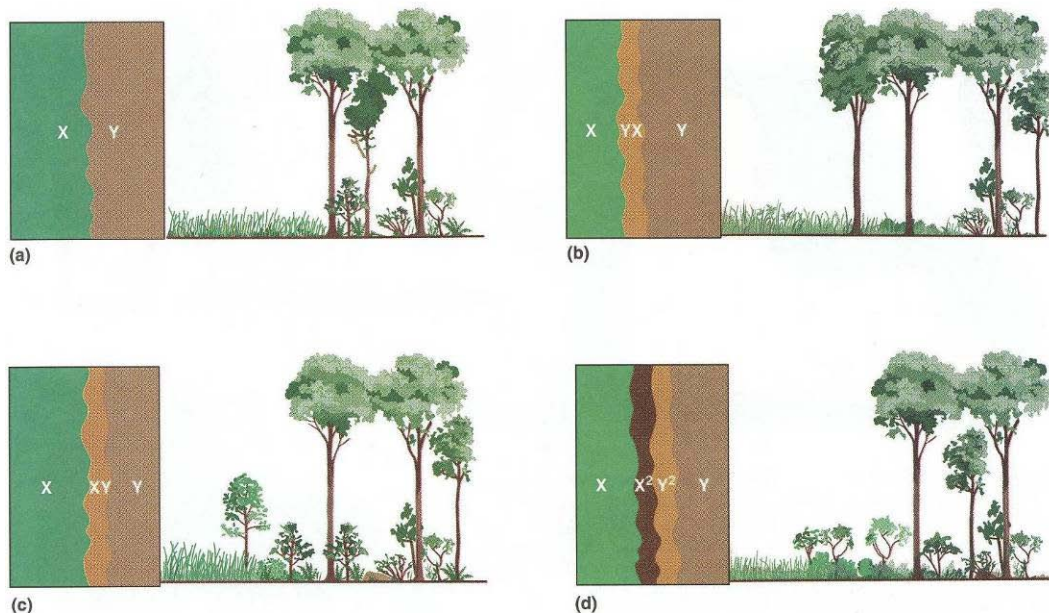


Restoration Ecology - Landscape Perspective

- Patch

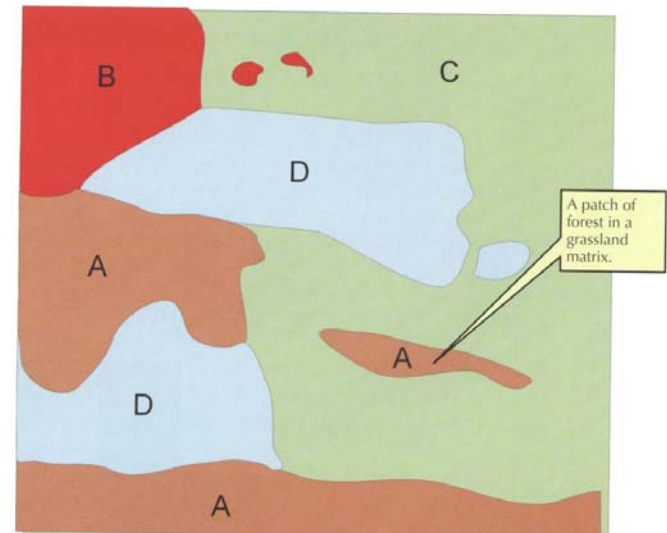
- All patches have edges

- Edges have abiotic environments that are different from the interior of a patch → differences in biota & processes
- The larger a patch, the more interior (core) it contains



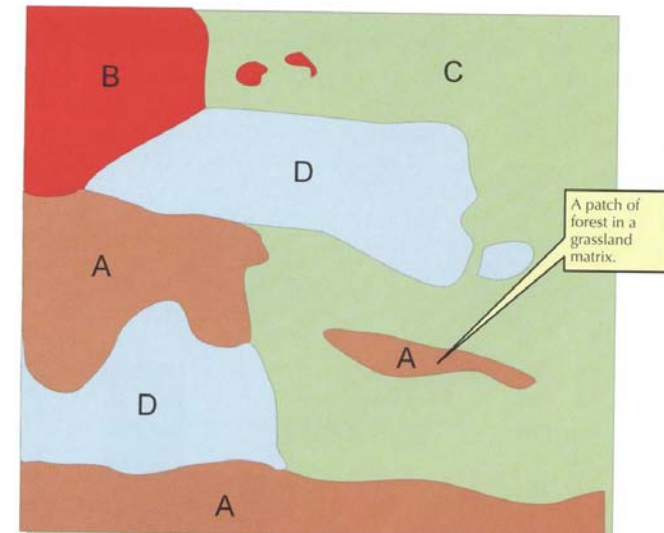
Restoration Ecology - Landscape Perspective

- Characteristics of single patches
 - Type (forest, grassland, lake)
 - Origin (disturbance, remnant, etc.)
 - Total edge (perimeter)
 - Size (area)
 - Total area vs. core area
 - Shape (perimeter:area)
 - Age (time since disturbance)
 - Distance to other patches



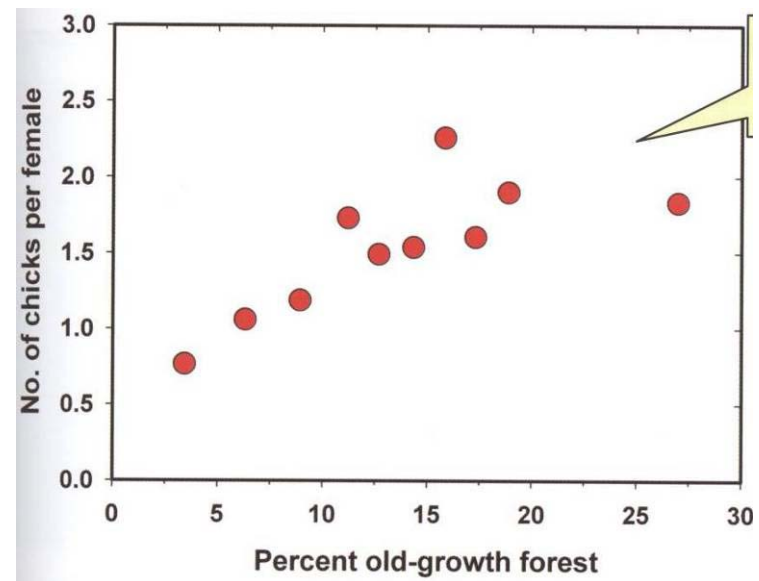
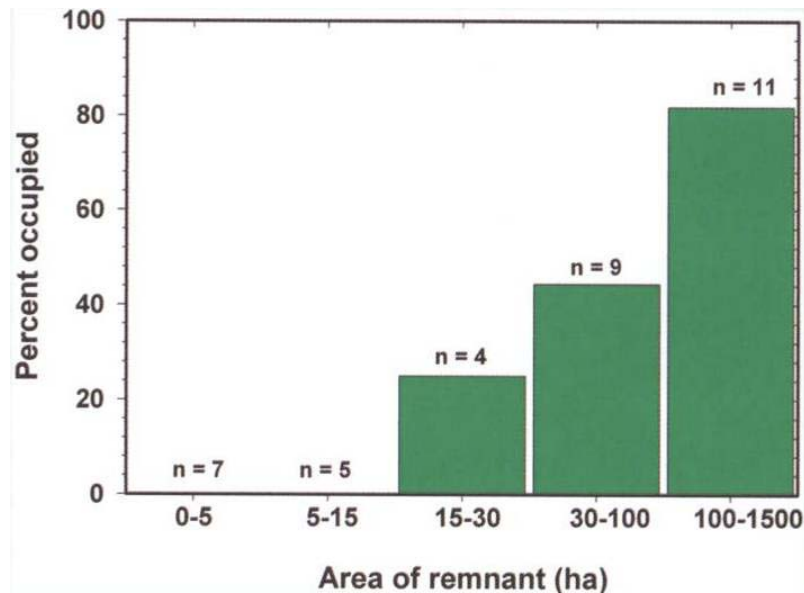
Restoration Ecology - Landscape Perspective

- Characteristics of multiple patches
 - Density (# of patches)
 - Total, or by type/age/size/shape/etc.
 - Cover (% of total landscape)
 - Diversity (richness, dominance, etc.)
 - Texture (contagion; of clumping)
 - Spatial pattern (regular, random, clumped)
 - Fractal dimension (complexity of boundaries)



Restoration Ecology - Landscape Perspective

- Patch importance
 - Index of fragmentation of degraded landscapes
 - Important implications for lower levels of ecological hierarchy



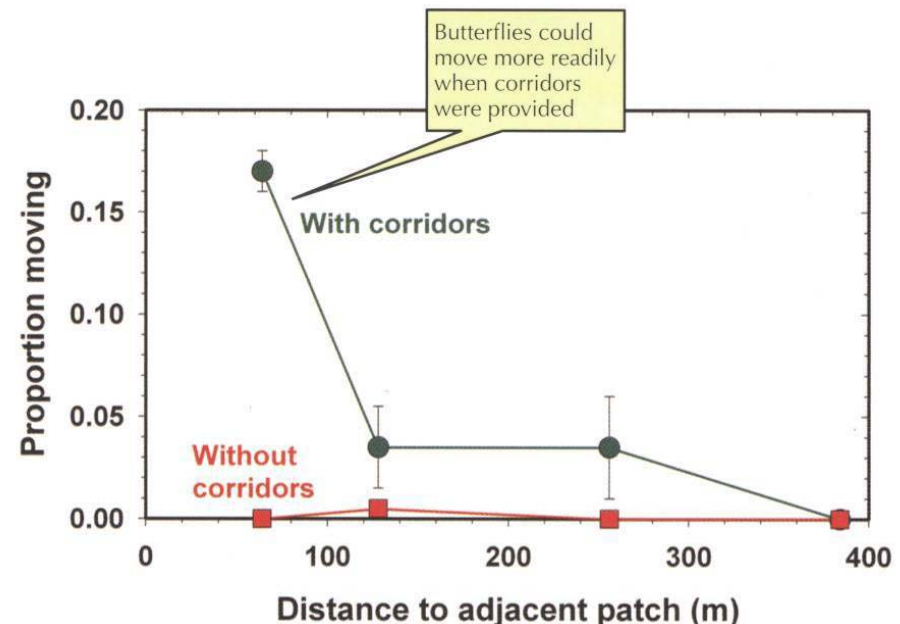
Restoration Ecology - Landscape Perspective

- Connectivity
 - Corridors
 - Provide connections between patches of the same or different types
 - Facilitate the movement of organisms
 - Barriers to species movements



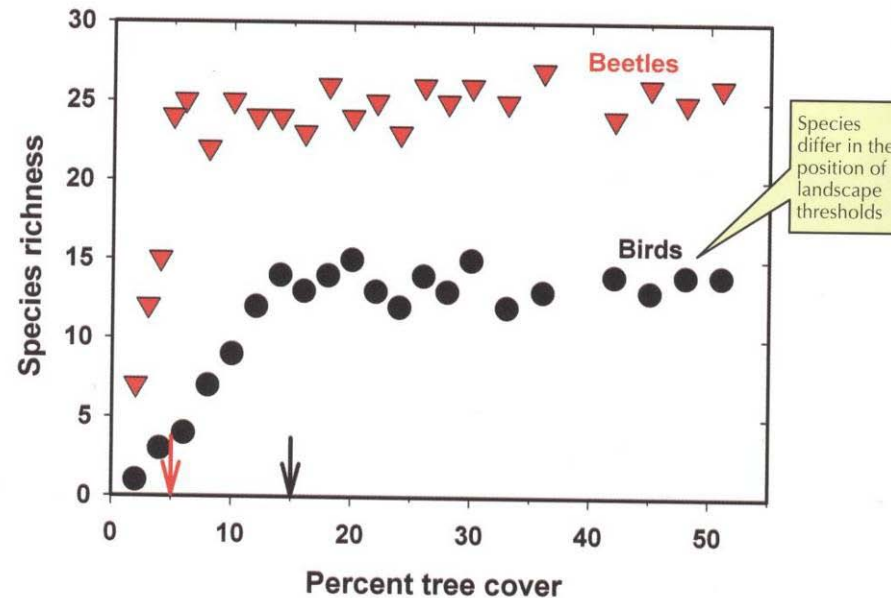
Restoration Ecology - Landscape Perspective

- Corridor characteristics
 - Type (line, strip, stream)
 - Origin (disturbance, remnant, etc.)
 - Total length
 - Width
 - Shape (curvilinearity)
 - Age



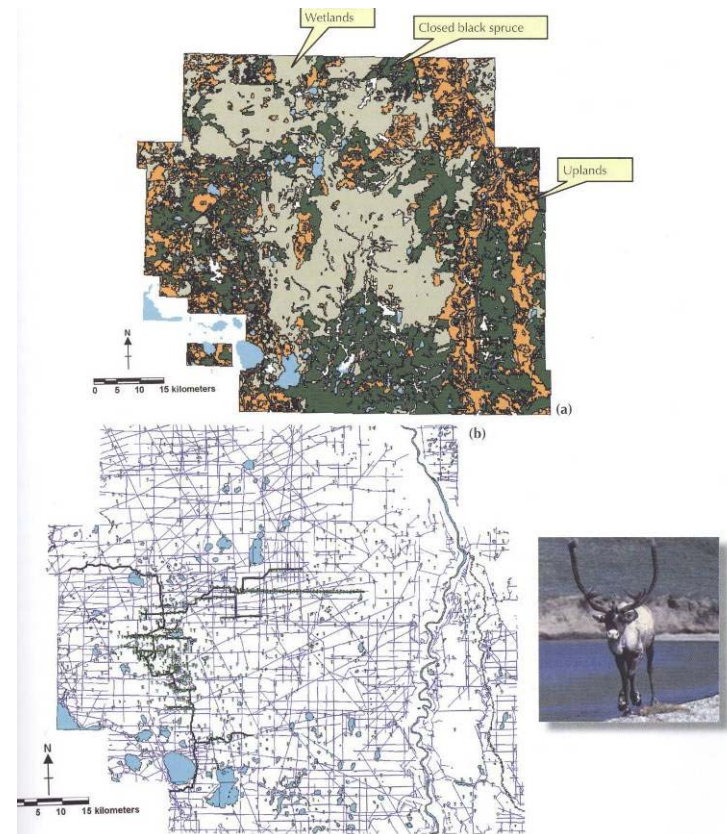
Restoration Ecology - Landscape Perspective

- Landscape mosaic
 - Not all species are created equally
 - Threshold effects



Restoration Ecology - Landscape Perspective

- Landscape mosaic
 - The ever-present influence of humans
 - Even modest human activity can have big impacts
 - Dominated by “suitable” habitat
 - » Only 1% occupied by humans
 - Only ~50% of available habitat used by caribou

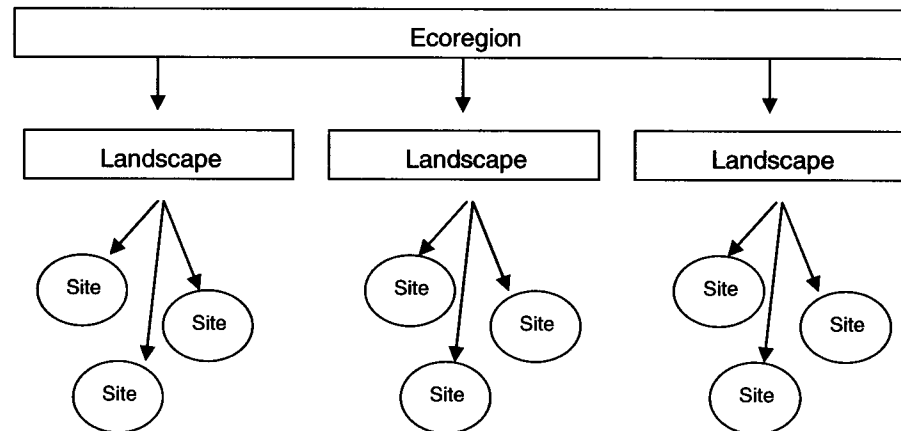


Restoration Ecology - Landscape Perspective

- Implications for restoration
 - Focus is shifting from restoration of small degraded patches to a landscape scale
 - The only practical way to restore large, degraded areas
 - Landscape ‘context’ of restored sites may have changed
 - Landscape ecology can aid restoration by providing (Bell *et al.* 1997):
 - Guidance for selecting reference sites, identifying project goals, and monitoring success
 - Suggestions for appropriate spatial configurations of restored sites (e.g., to facilitate recruitment of biota)
 - Assessment of natural spatial heterogeneity → basis for developing strategies that incorporate landscape metrics such as patch configuration and connectivity

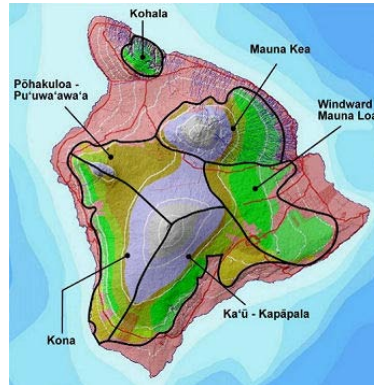
Restoration Ecology - Landscape Perspective

- Implications for restoration (Mansourian *et al.* 2005)
 - Landscape restoration grounded in Ecoregion conservation
 - Planning process designed to restore ecological integrity and enhance human well-being in degraded landscapes
 - Incorporates human needs and biodiversity
 - Restoration often occurs at the stand/site level
 - Effectiveness of restoration & chance of sustainability is much greater if local efforts are incorporated into the larger landscape context



Restoration Ecology - Landscape Perspective

Ecoregion
ID Priority Landscapes



Landscape
ID Restoration Goals &
Monitoring Mechanisms



Site
Action at Ind. Sites



Restoration Ecology - Landscape Perspective

- Macroecology
 - Structure and function of ecosystems on geographic spatial scales
 - Considers processes operating at large spatial scales
 - Patterns in distribution, abundance and body size at continental scales
 - Empirical basis for biological diversity & ecosystem processes
 - Many similarities to landscape ecology
 - Patch size and connectivity
 - Species area relationships (SAR)
 - Biodiversity & ecosystem function
 - Island biogeography theory (IBT)
 - Metapopulation theory

Restoration Ecology - Landscape Perspective

- Macroecology
 - Explicitly considers spatial context
 - Ecosystems are defined by what occurs within their boundaries **and** the flow of materials and energy across their boundaries
 - Spatial & temporal scales important to ecological systems often extend beyond political or geographical scales
 - Restoration context
 - Large scale context needed to restore at the local level
 - Likelihood of maintaining species diversity in a restored setting?
 - If the spatial context has changed in a restoration setting, then important across-boundary dynamics may be missing
 - Biosphere II Project

Restoration Ecology - Landscape Perspective

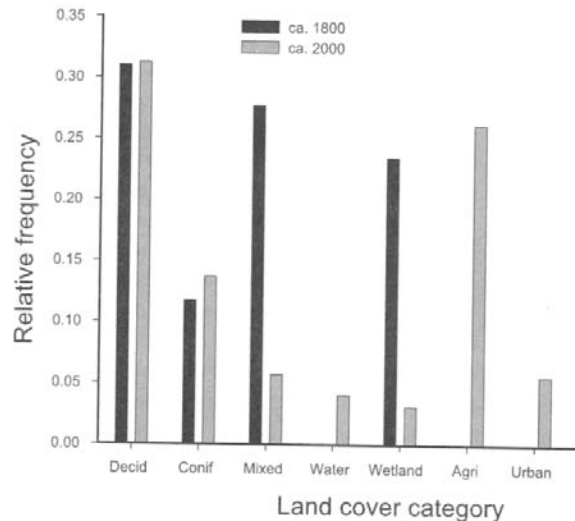
- Macroecology

- Modification of spatial extent of wetlands in MI

- Wetland area reduced from 25% to <5%

- Different ecological context for wetlands today

- Patch size and connectivity greatly modified
- Management to replace external transport processes needed



A



B

