

**Intensive Programme “Local Development through Europe: A Multinational and Interdisciplinary approach”**

# The Landscape Ecology approach to wildlife conservation and management

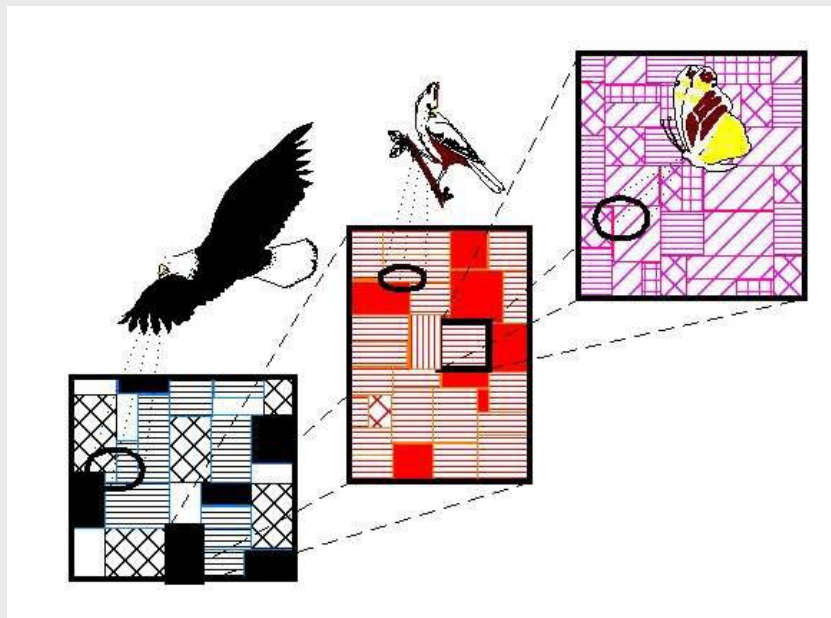


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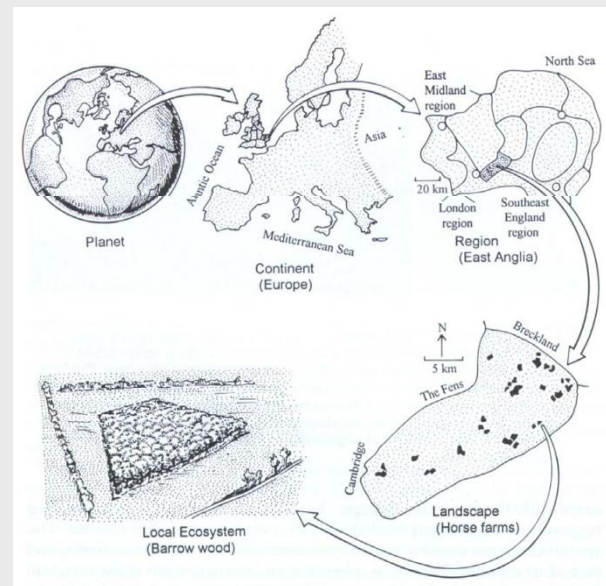
# Landscape ecology

- **Landscape:** interactive mozaic of patches, corridors and matrix.
- **Objective:** to study the spatial pattern influence over ecological processes.

Landscape - species perspective



Landscape - our perspective

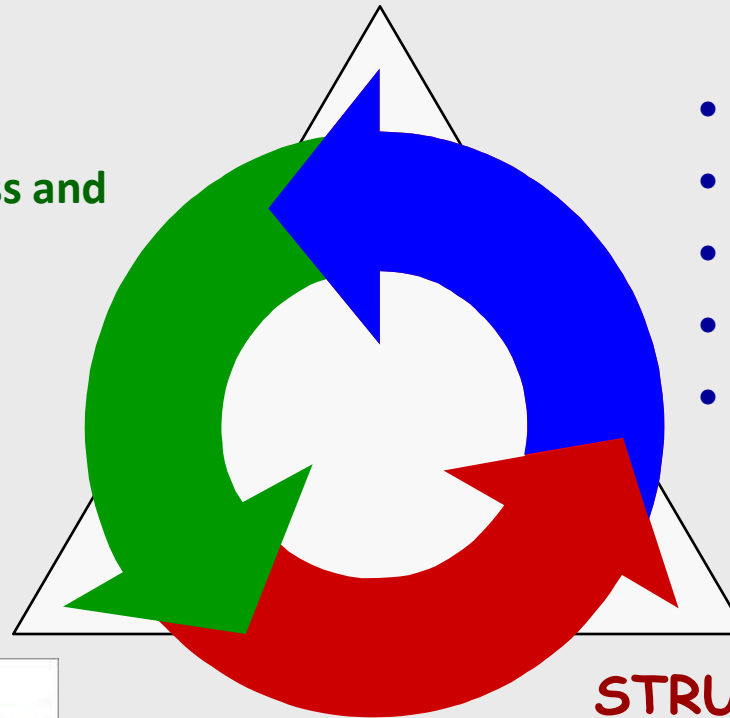


## COMPOSITION

- Genetic diversity
- Species abundance, richness and diversity
- Community diversity
- Habitat diversity

## FUNCTION

- Energy Capture & Trophics
- Mineral and nutrient cycles
- Water movement
- Ecological succession
- Disturbance



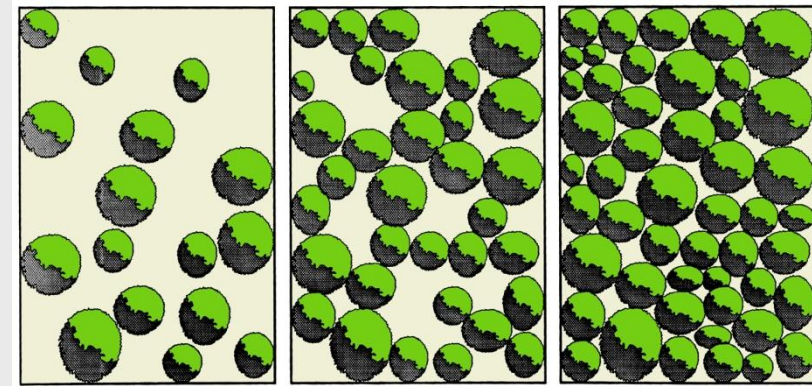
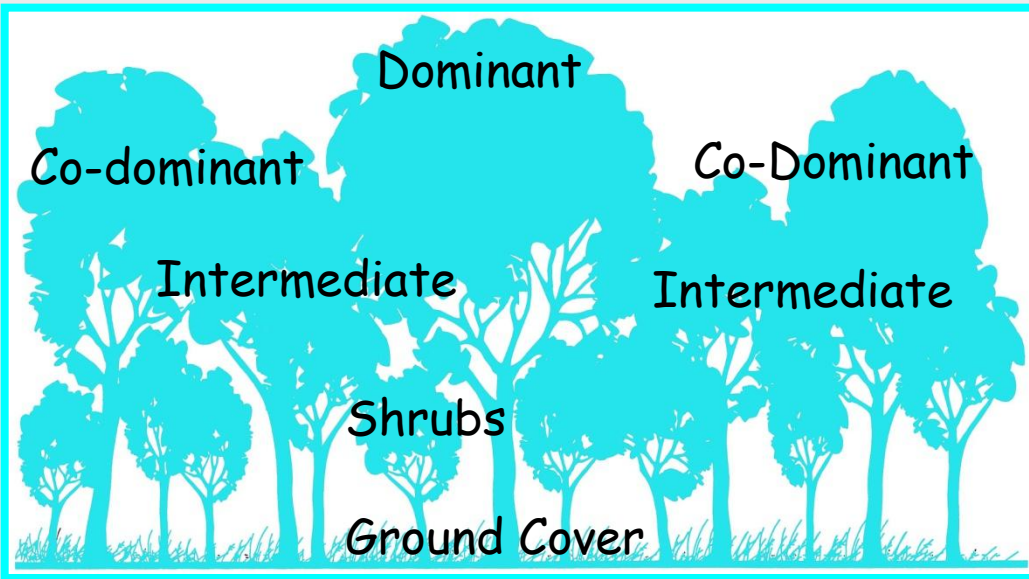
## STRUCTURE

- Vertical and horizontal
- Spatial heterogeneity and density
- Edge Effect
- Island effect and Fragmentation
- Logs and dead trees

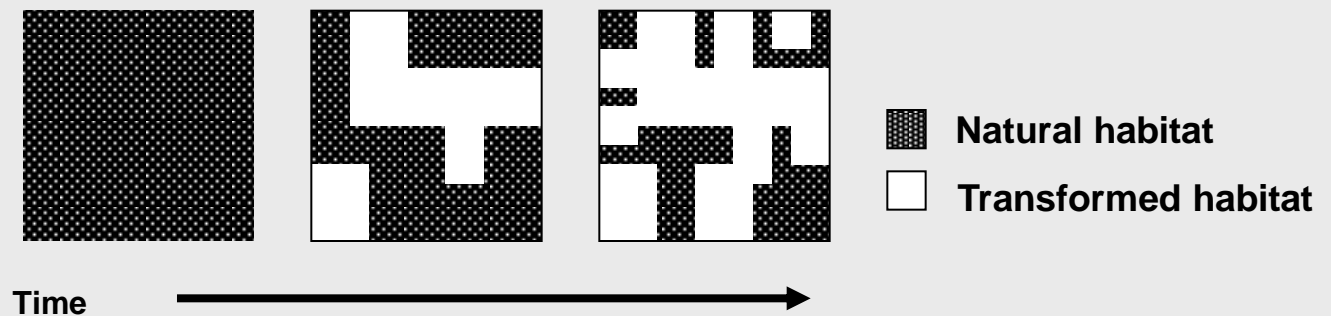


## Vertical Structure

## Horizontal Structure



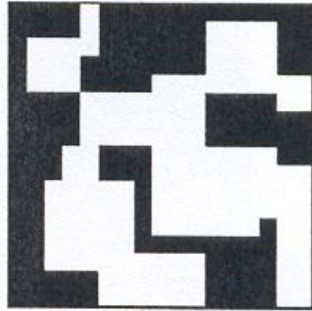
## Spatial heterogeneity



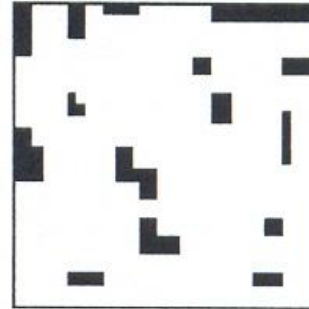
## Fragmentation



1



2



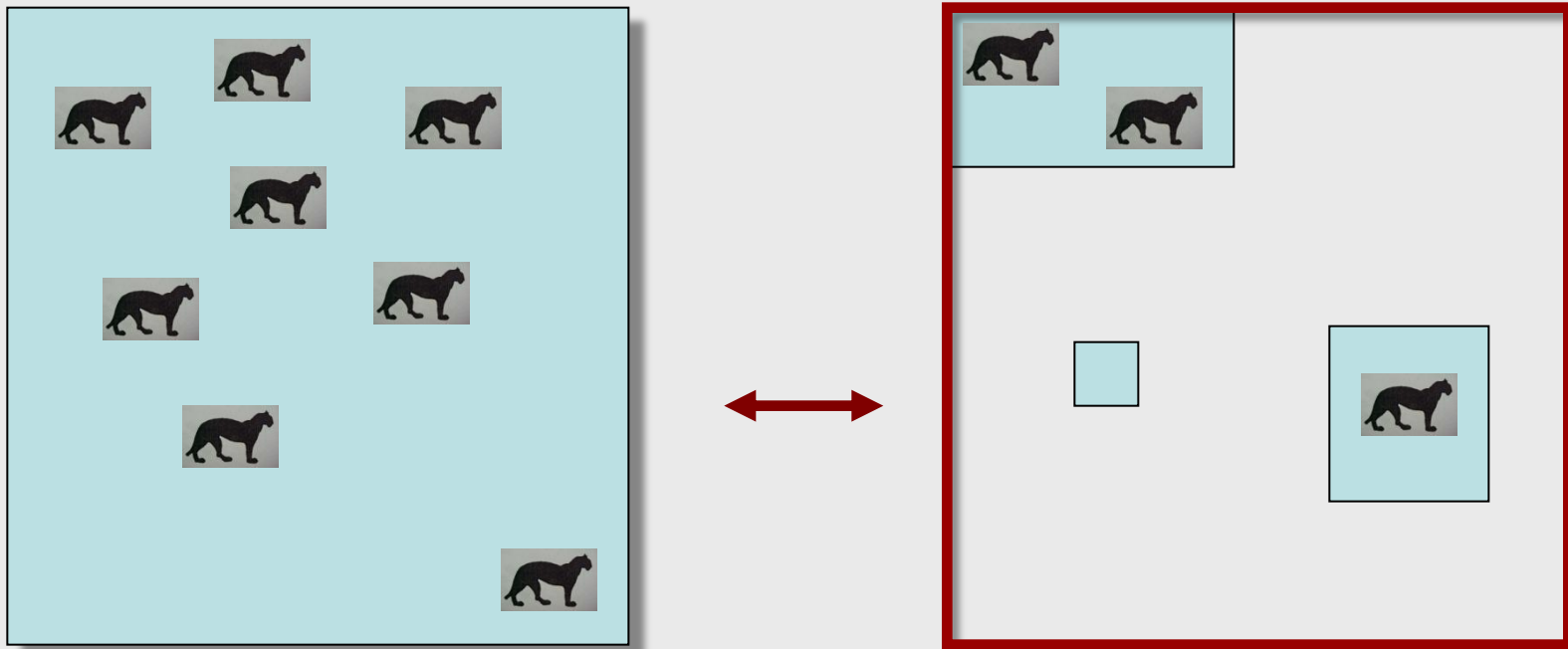
3



time



## Habitat fragmentation



Fragmentation leads to change in a species' abundance and/or distribution via altered species interactions.

# Fragmentation

## Impacts on habitats:

- Area reduction
- Isolation of parts
- Changes in heterogeneity
- Structural impoverishment
- High edge effect (contrast)



## Impacts on species:

- Isolation
- Changes in abundance, richness and composition
- Genetic impoverishment
- Favors invasions by exotics
- Extinctions

## Main factors that affects biodiversity in fragmented forests

- **Area reduction:** changes in species abundance, richness and composition (island effect).
- **Degree of isolation:** distance between fragments and matrix type could be a barrier that prevents the individual spreading.
- **Degree of structural connectivity.**
- **Vegetation structural diversity and heterogeneity:** Often the resources used by a species are not evenly distributed in a forest and fragmentation can cause the loss of resources.

# Island effect

Isolation of forest fragments - Islands Biogeographical Theory (MacArthur & Wilson 1963).

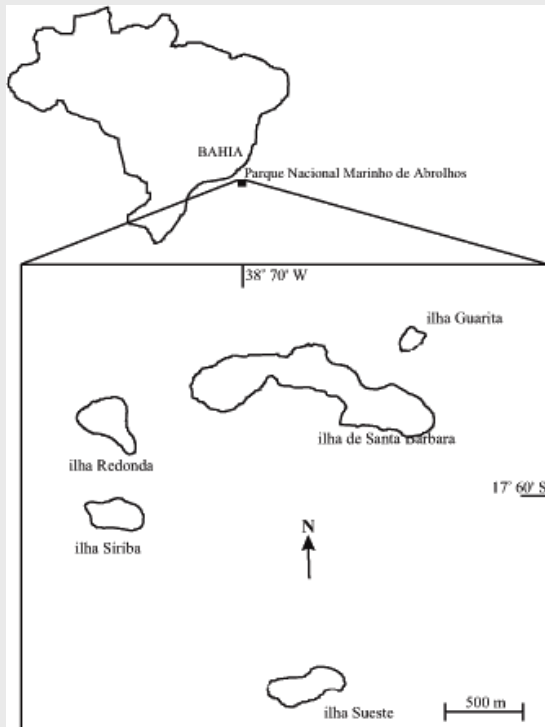


Figura 1. Localização do Parque Nacional Marinho de Abrolhos e disposição das ilhas no arquipélago.

Figure 1. Location of the Abrolhos National Marine Park showing the distribution of islands in the archipelago.

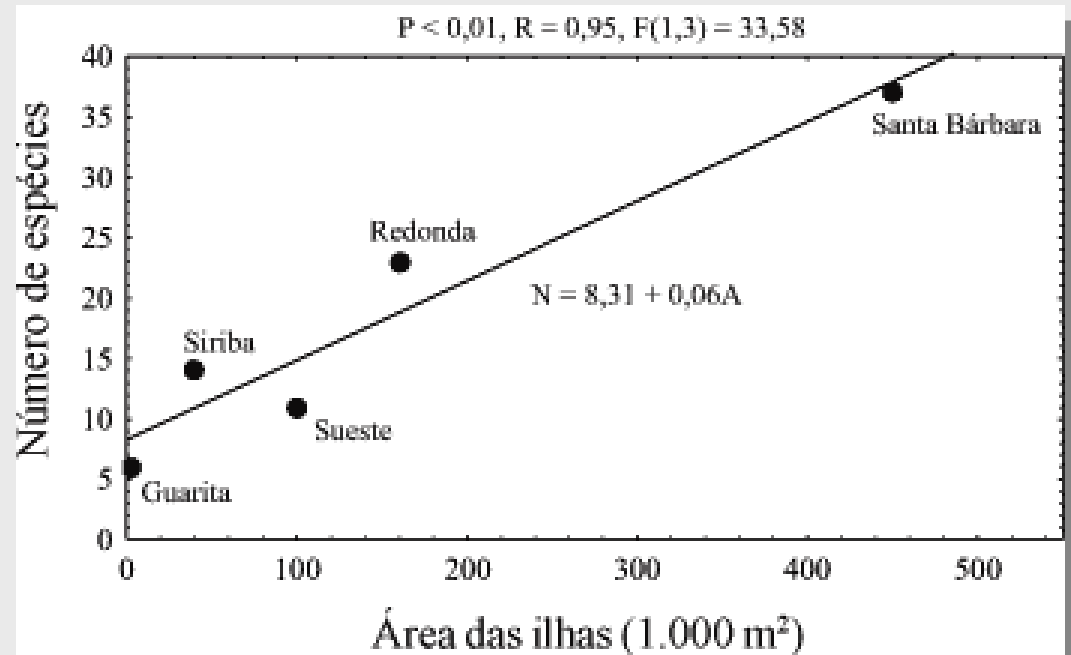
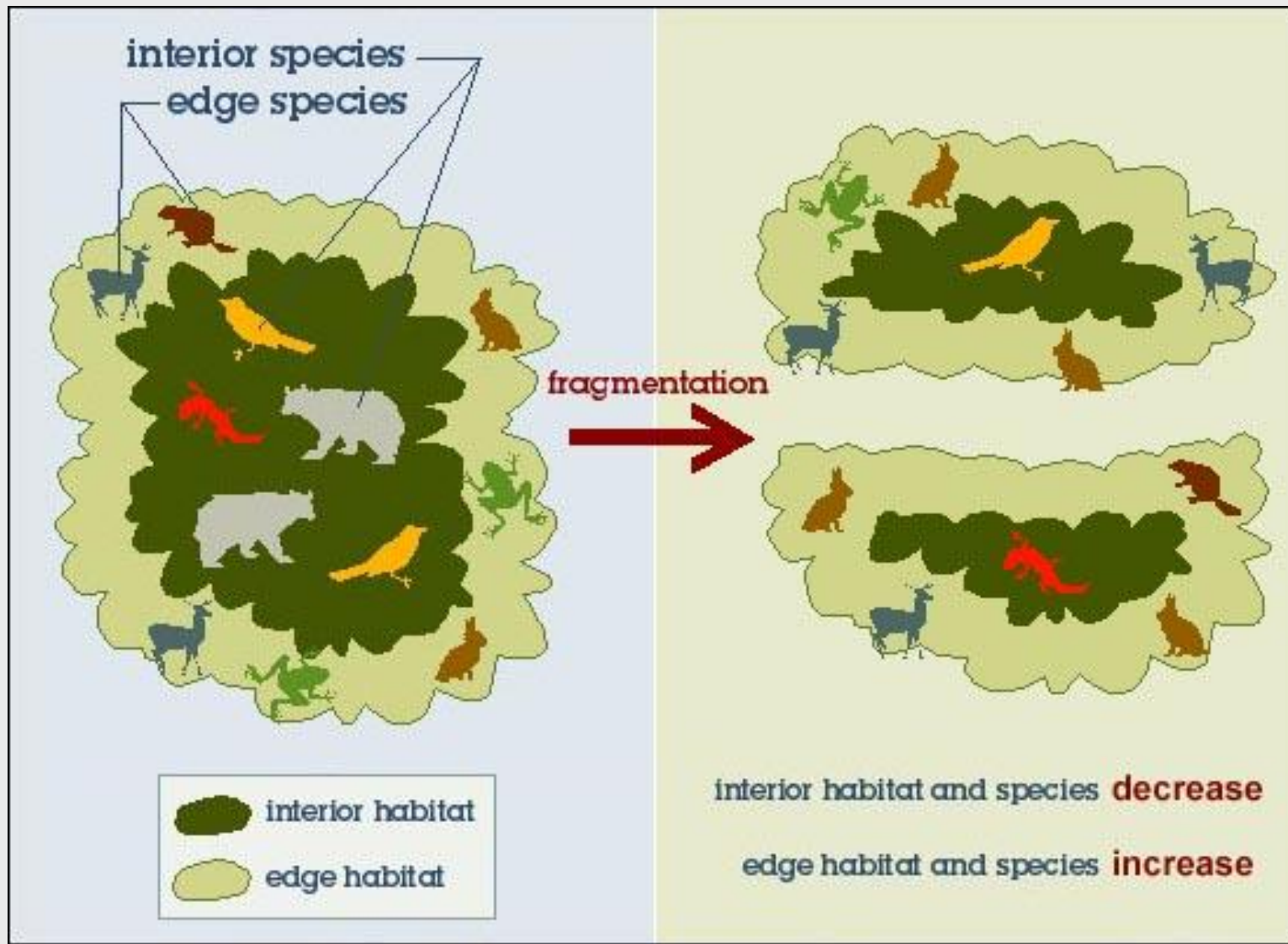


Figura 4. Relação entre o número de espécies e o tamanho das ilhas no arquipélago de Abrolhos.

Figure 4. Relationship between the number of species and the size of the islands in the Abrolhos archipelago.

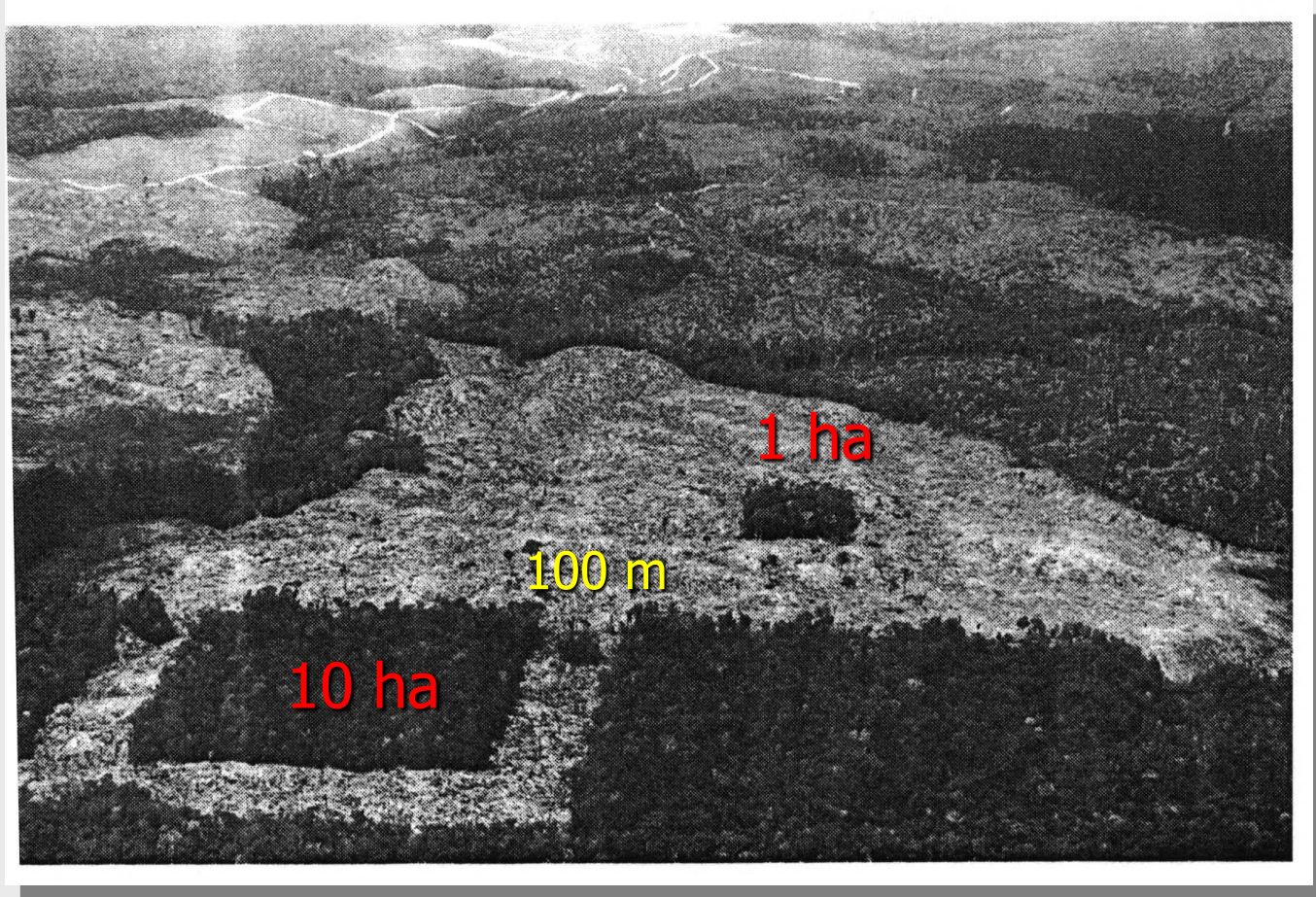
Source: Kemenes, 2003



Source: Defenders of Wildlife, 2011

# Experimental fragments - Brazil

## Project: Minimum Critical Size Ecosystem Project

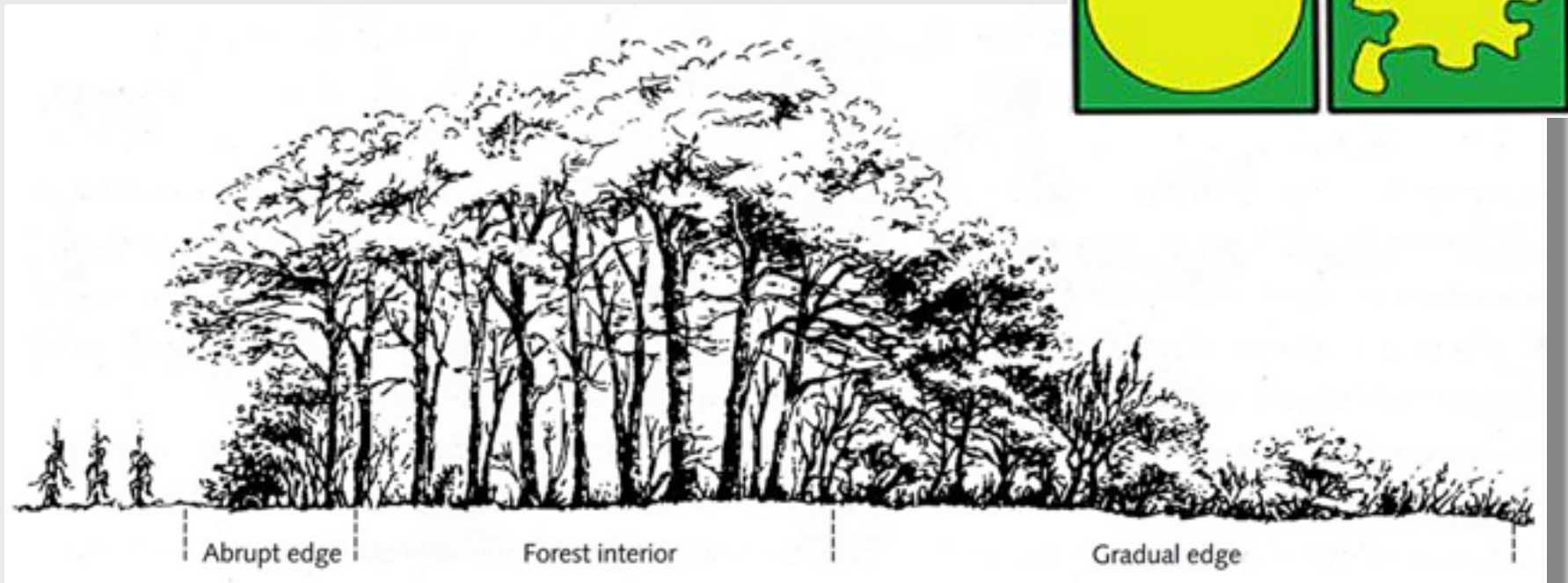


Source: INPA & Smithsonian Institution

## Fragmentation - More sensitive species

- Rares (specialized/ limited distribution)
- That need large areas (e.g., large mammals)
- That requires core areas
- That requires several habitats
- With low mobility (e.g., non-flyer insects)
- With short live cycles
- Vulnerable to human activities or exploitation

## Edge effect



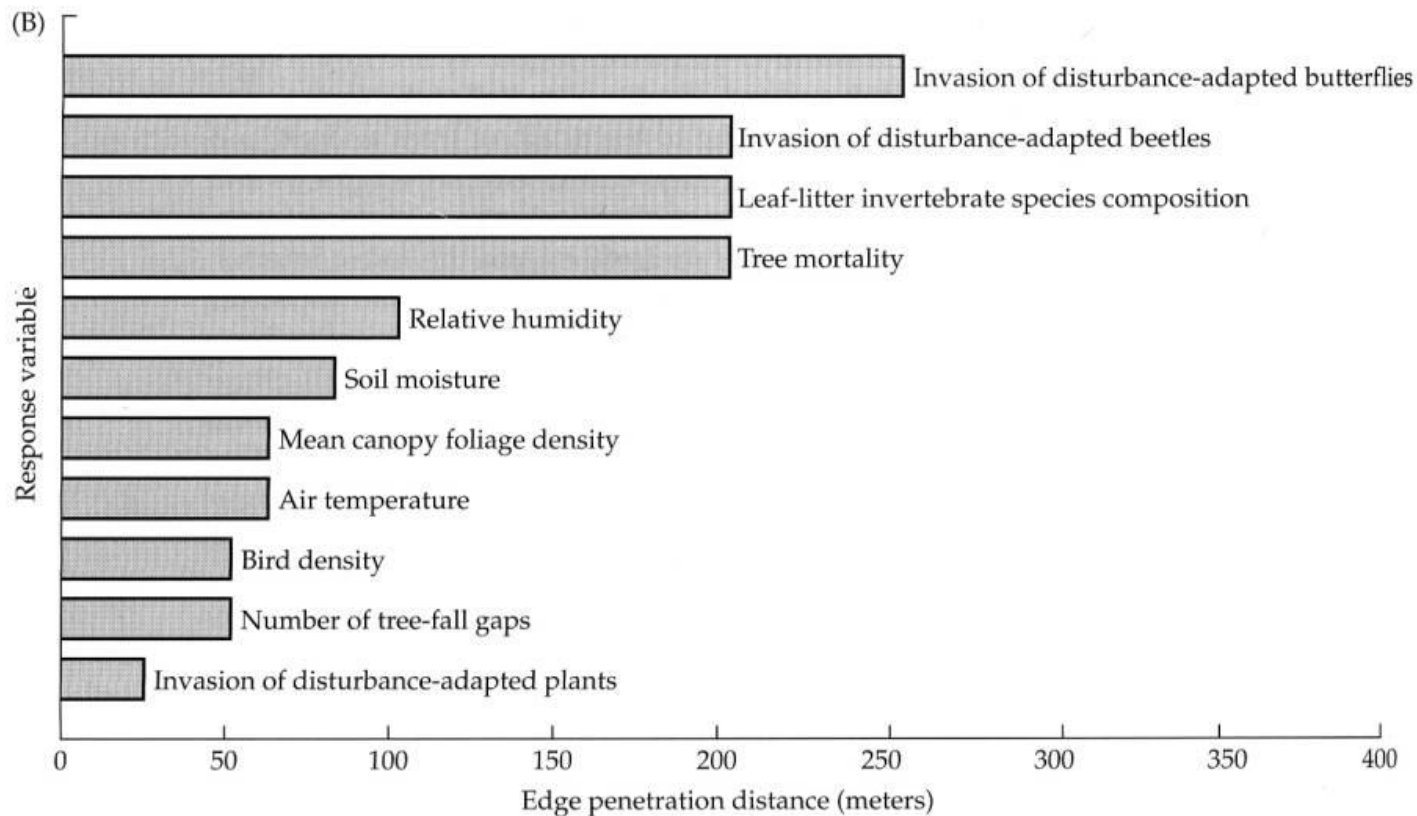
Results from the juxtaposition or placing side by side of contrasting environments on an ecosystem. Creates mixed communities, containing elements of both systems in contact.

## Fragmentation – Edge effect

- **Losses in Core area**
- **Ecological trap (vulnerability to predation)**
- **Invasion by exotics**
- **Microclimate changes**
- **Edge contrast (measure of fragmentation)**

Edge = selective filter

## Fragmentation - Edge effect

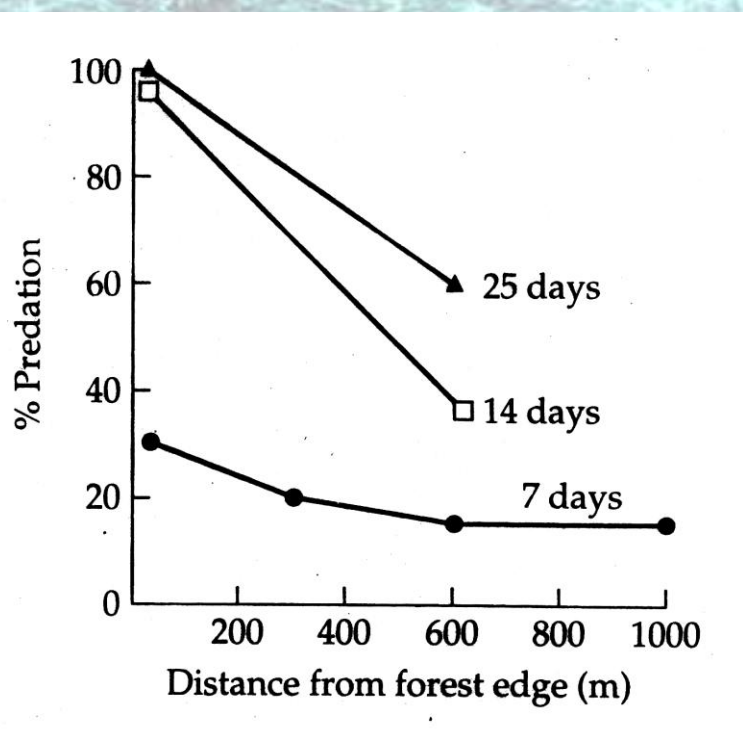


**FIGURE 9.16**

(B) Various effects of habitat fragmentation, as measured from the edge into the interior of an Amazon rain forest fragment. For example, disturbance-adapted butterflies migrate 250 m into the forest from an edge, and the relative humidity of the air is lowered within 100 m of the forest edge. (A, photograph by R. Bierregaard; B, after Laurance and Bierregaard 1997.)

# Fragmentation - Edge effect

## Nests predation



Source: Wilcove et al. (1986)

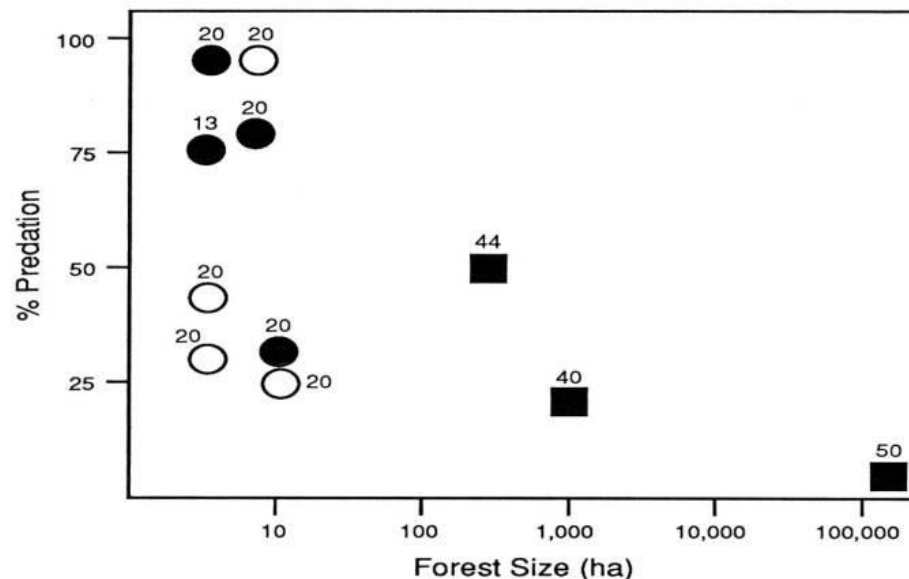
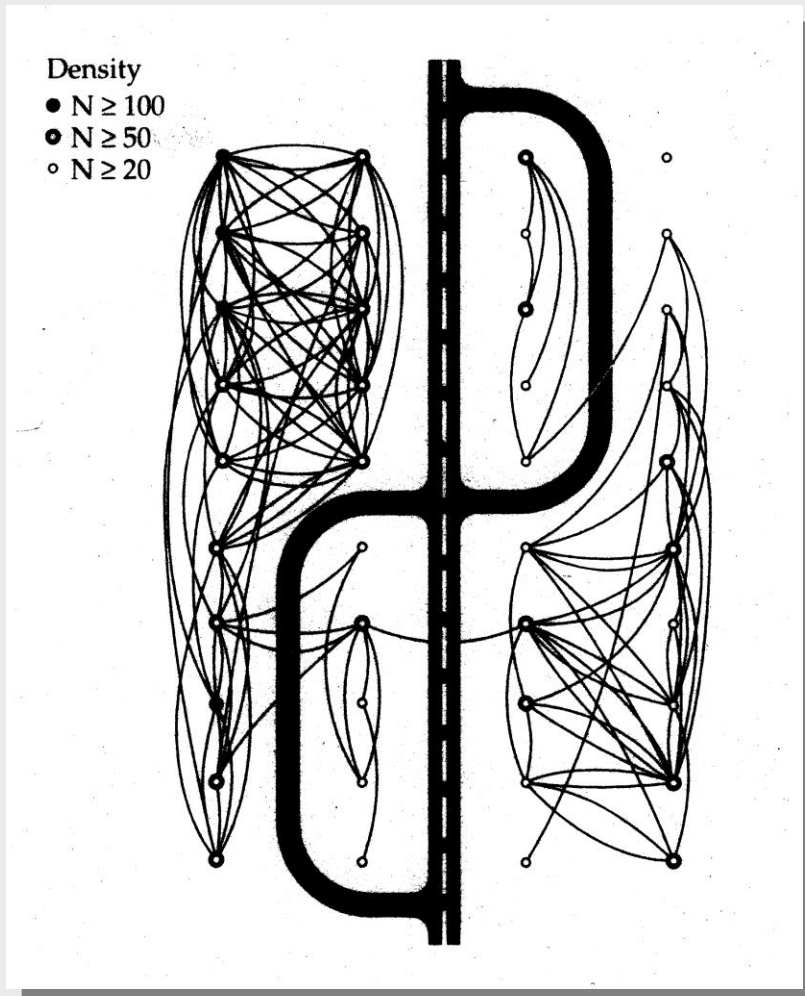


FIG. 5.3 Percentage of nests preyed upon as a function of forest size. Closed squares are large forest tracts, open circles are rural fragments, and closed circles are suburban fragments. The number above each point is the number of artificial nests placed in that forest (Wilcove 1985b).

## Fragmentation - Barriers

### Carabids



Populations of the forest-dwelling carabid beetle were almost completely divided by a road and parking loops (unpaved).

Source: Mader, 1984

## Iberian Agroforestry system “montado” / “dehesa”



### Characteristics:

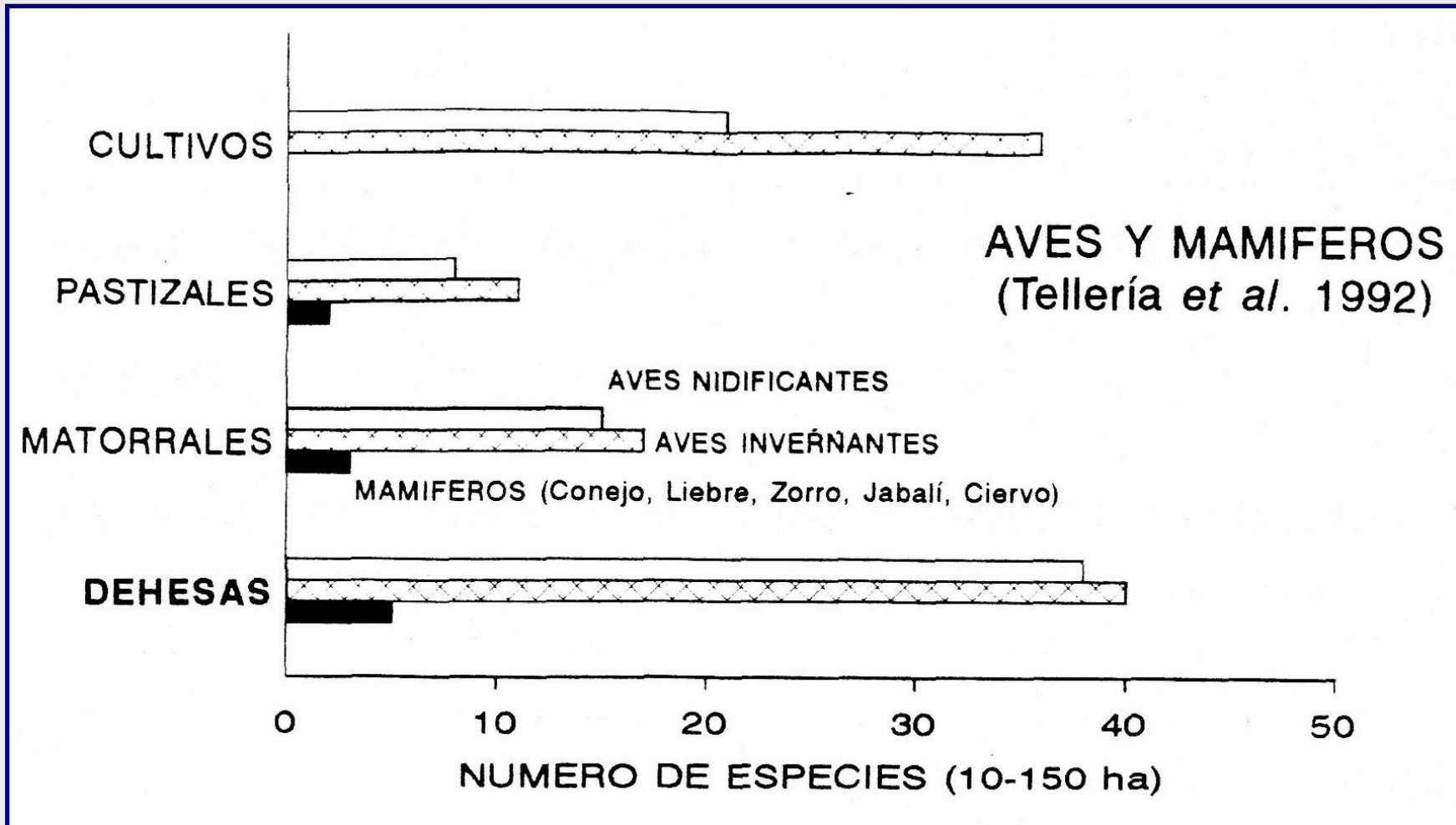
- Perennial oak woodlands (cork oak & holm oak)
- Low tree density (less than 40% cover).
- **Economic value:** acorn for livestock feed, bark from the cork oak, wild mushrooms, charcoal, and firewood.
- **Understory:** annual grasslands for grazing / cereals (wheat, barley, oats, rye).
- Different habitats and food available for wildlife.

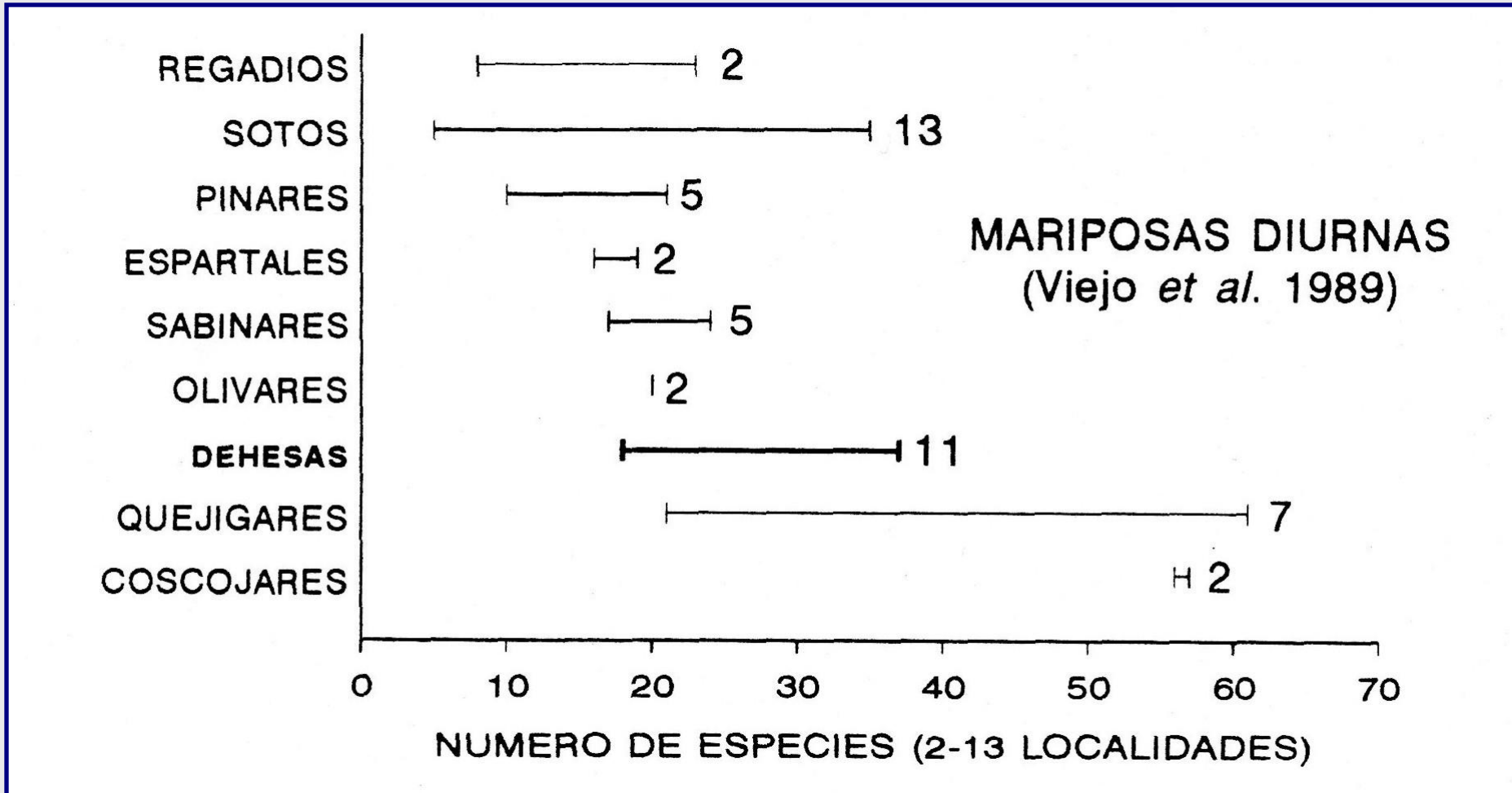
## Iberian Agroforestry system “montado” / “dehesa”

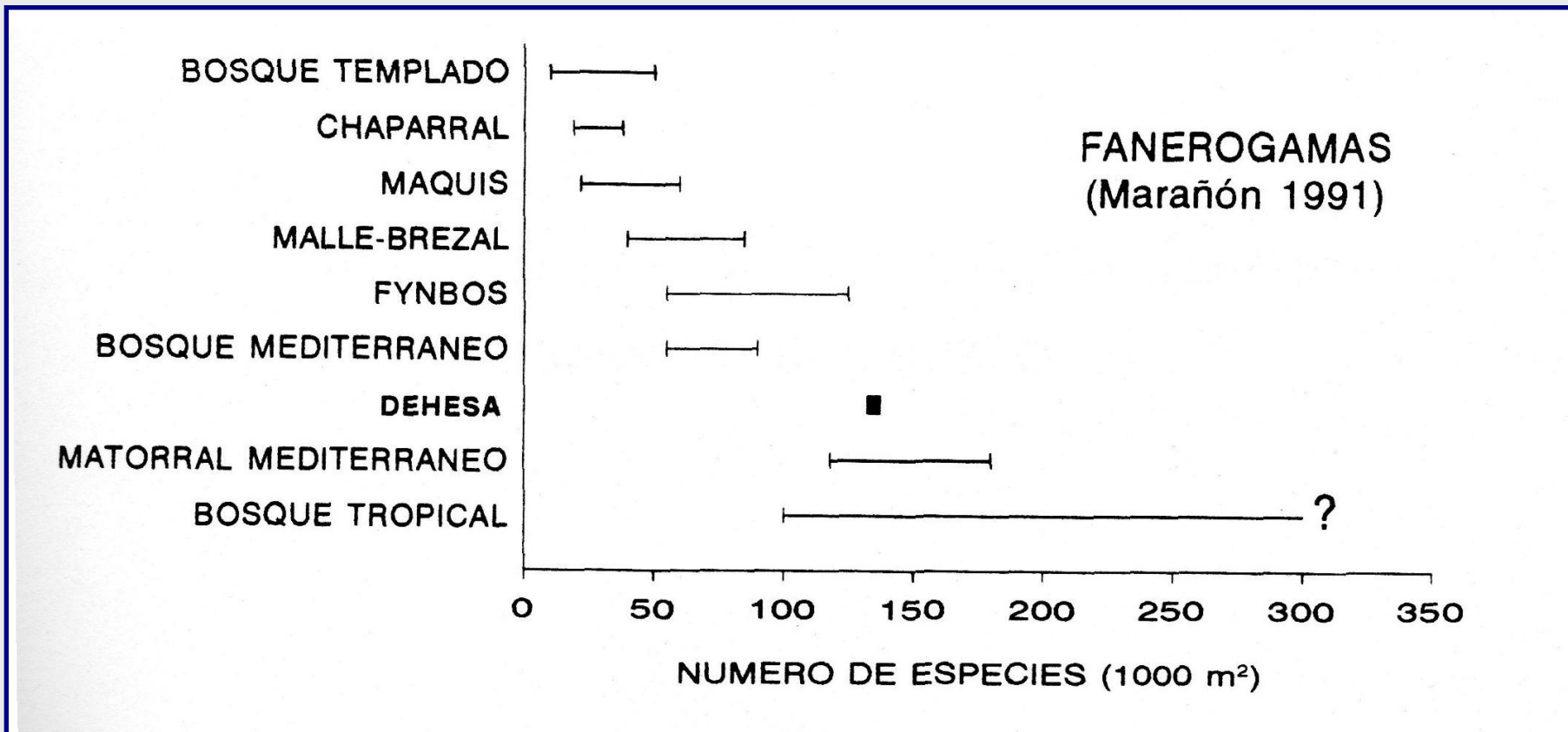




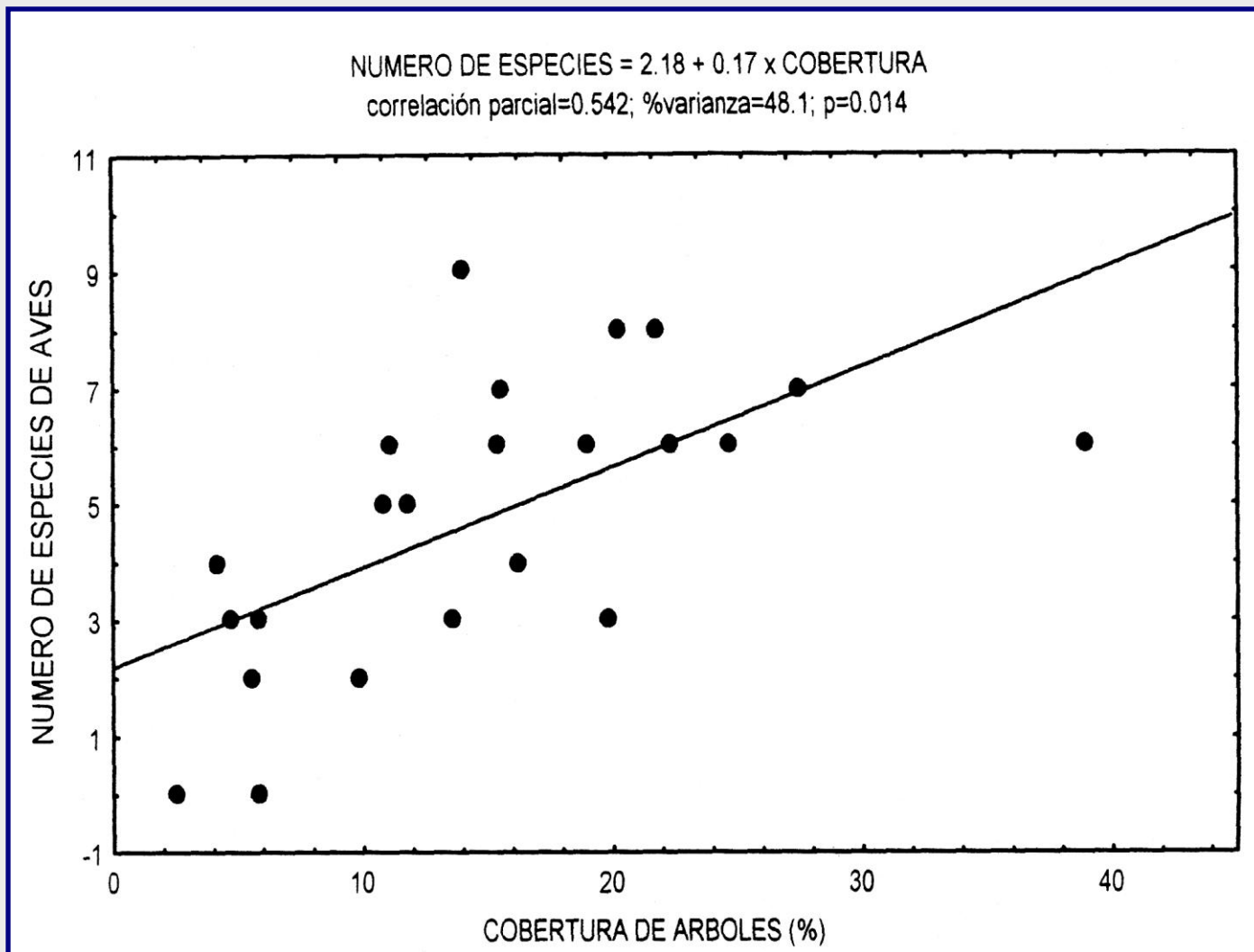
- 1 - pica-pau-verde (*Picus viridis*) e fauna associada;
- 2 - pombo-torcaz (*Columba palumbus*);
- 3 - picanço-real (*Lanius excubitor*)  
e picanço-barreteiro (*Lanius senator*);
- 4 - pega-rabuda (*Pica pica*);
- 5 - águia-calçada (*Hieraetus pennatus*);
- 6 - águia-de-asa-redonda (*Buteo buteo*);
- 7 - águia-real (*Aquila chysaetos*);
- 8 - cegonha-branca (*Ciconia ciconia*);
- 9 - milhano (*Milvus milvus*)  
e milhafre-preto (*Milvus migrans*);
- 10 - mocho-galego (*Athene noctua*);
- 11 - coruja-das-torres (*Tyto alba*);
- 12 - gralha-de-nuca-cinzenta (*Corvus monedula*);
- 13 - morcegos;
- 14 - geneta (*Genetta genetta*);
- 15 - lince (*Lynx pardinus*);
- 16 - coelho-bravo (*Oryctolagus cuniculus*).







**RIQUEZA DE ESPECIES DE AVES NIDIFICANTES EN DEHESAS  
SEGÚN LA COBERTURA DE ARBOLADO**  
(Pulido & Díaz, inédito)



*Foliage height diversity (FHD)*  
 vs.  
 Bird diversity  
 (Wilson, 1974)

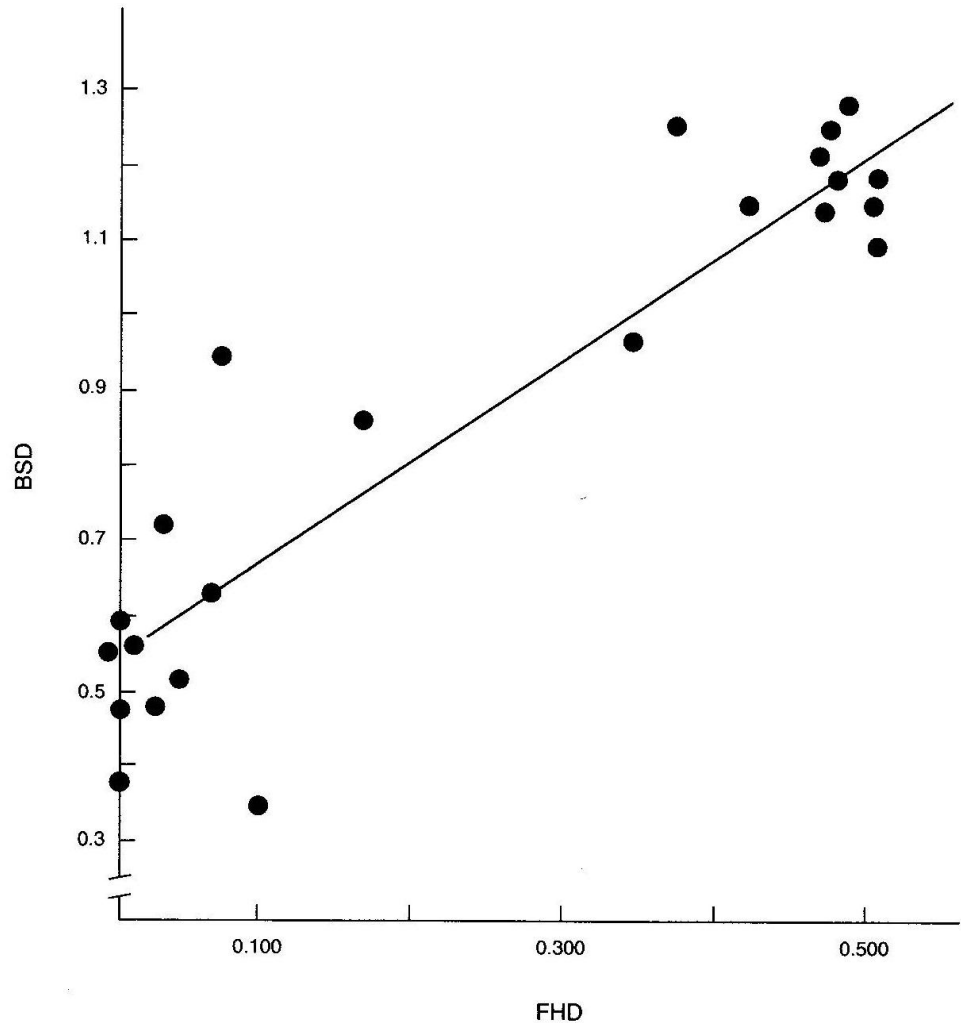


Figure 3.1. Foliage height diversity (FHD) versus bird species diversity (BSD). • represent the study sites. (Reproduced from Willson 1974 [fig. 1], by permission of the Ecological Society of America)

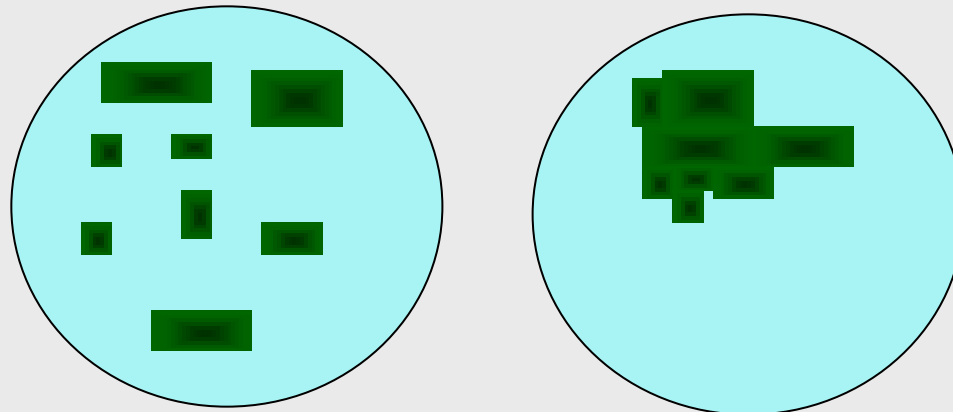
# Conserving biodiversity

- Genetic level: seed, egg, sperm banks
- Population and species level:
  - *Ex-situ* breeding (ex: zoological and botanical gardens)
  - Population management:
    - Protection (hunting, disease, habitat)
    - Genetic management (reintroductions)
    - Habitat restoration
- Ecosystem, habitat and species level:
  - Protected areas
  - Management plans

## Design of protected areas

- Key questions for reserve design:
  - What is better for biota: single large or several small?
  - How important are corridors for wildlife to travel from one reserve to another?

Several small islands lose species faster than one single island of equivalent size (Burkey 1995).



# Design of protected areas - Landscape Ecology

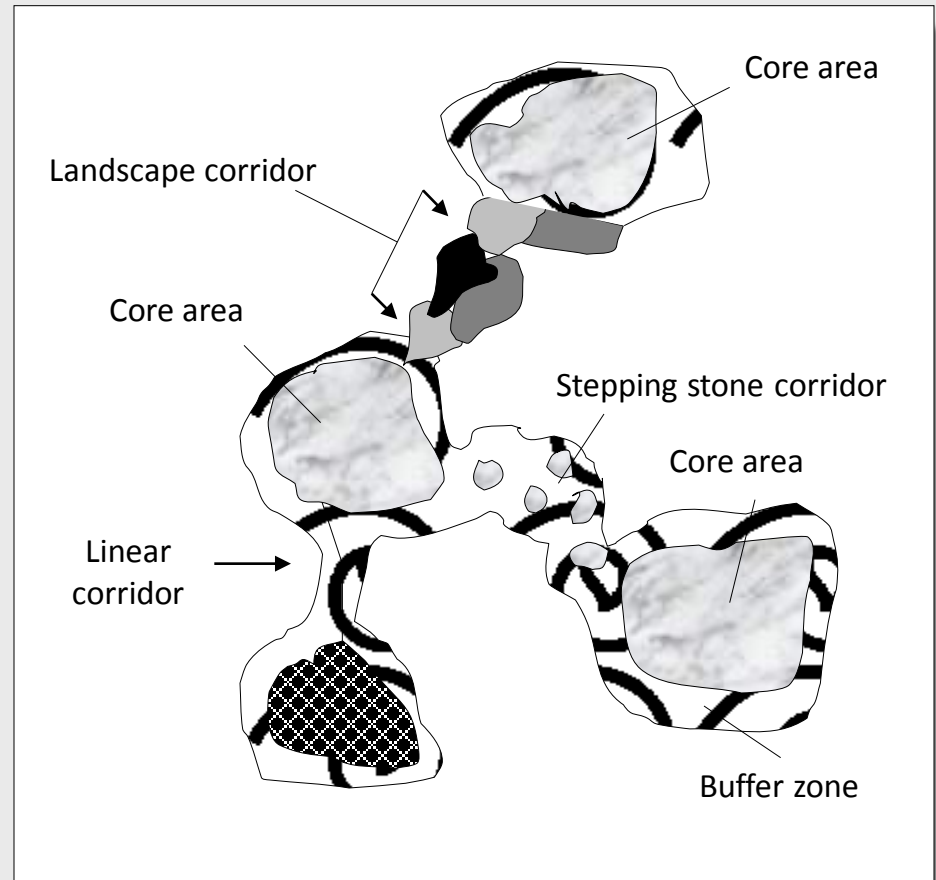
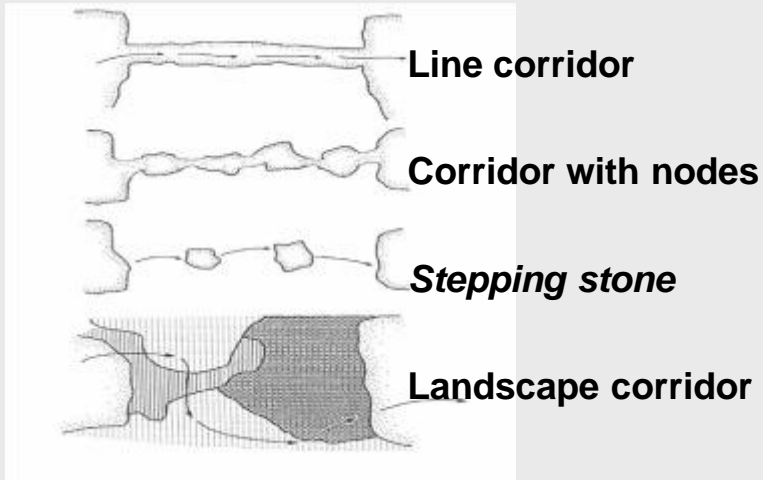
- Before: each area was considered separately.
- Now: Landscape as a set of areas - Landscape Ecology.
- Focus on Habitat Fragmentation: effects of area, edges and degree of isolation on Biodiversity.

## Landscape elements:

- Patches
  - size, number, shape
- Edges
  - structure, shape
- Connectivity
  - Corridors, barriers
- Matrix
  - Network, fragmentation, pattern, scale

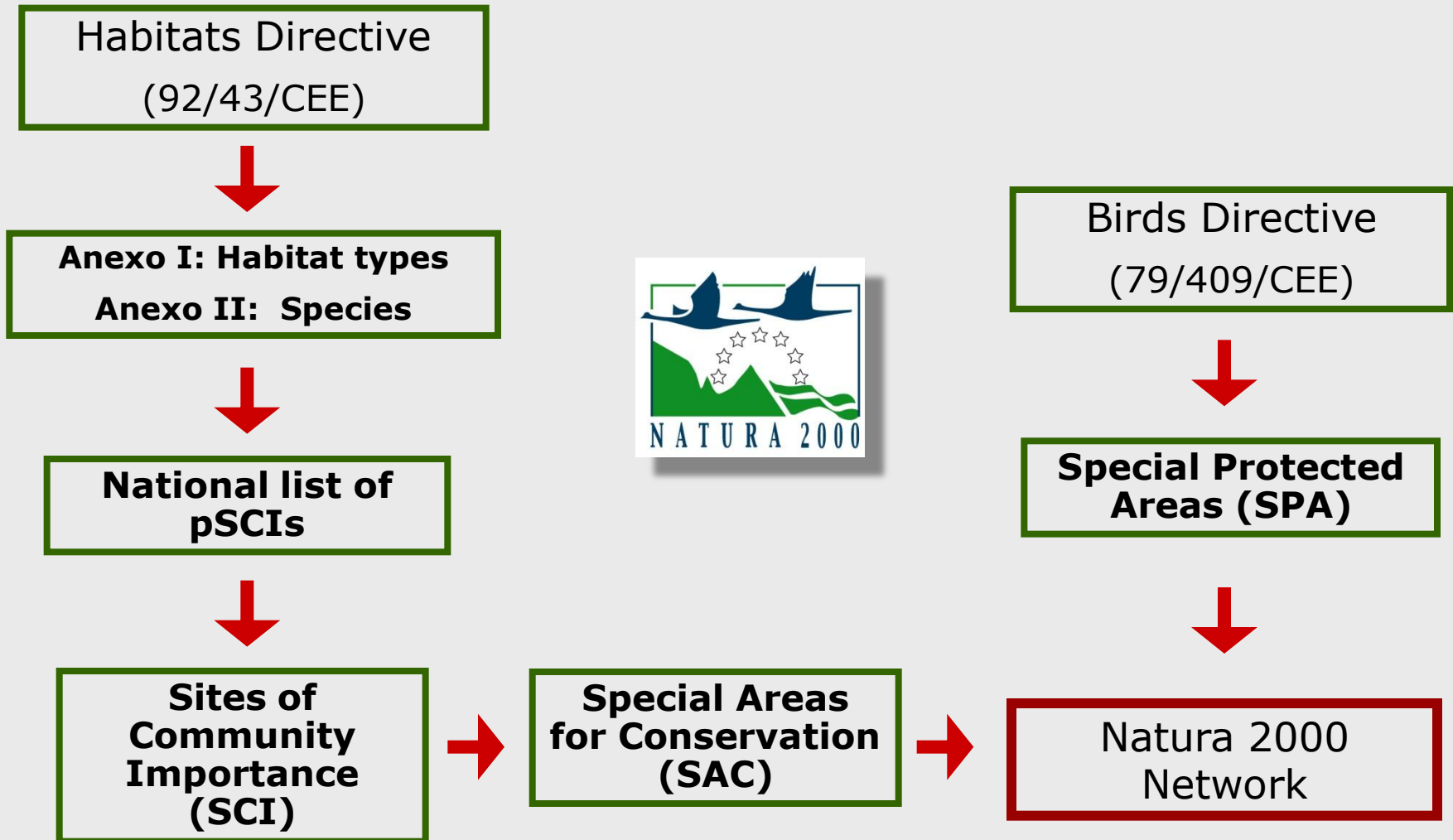


# Design of protected areas



Source: Bennett, 2004

# Natura 2000 Network



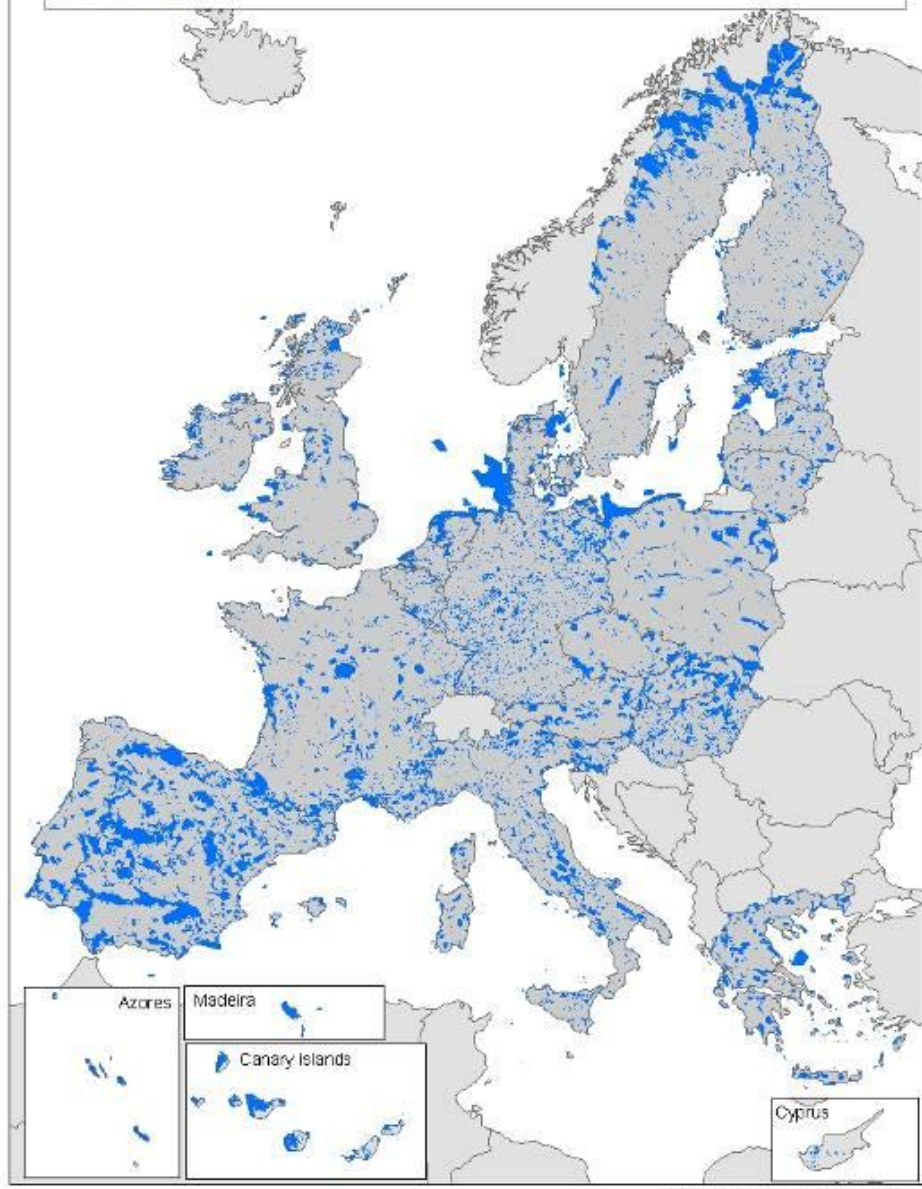


**Indicative map of the European biogeographical regions, 2005**

- Alpine
- Anatolian
- Arctic
- Atlantic
- Black sea
- Boreal
- Continental
- Macaronesia
- Mediterranean
- Pannonian
- Steppic
- Outside data coverage
- Country border



### NATURA 2000 NETWORK Birds and Habitats Directive



EEA - ETC/BD September 2006