Lecture 09, 29 Sep 2003

Chapter 4, (Role Playing Wrap Up?)

Conservation Biology
ECOL 406R/506R
University of Arizona
Fall 2003

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1. Biodiversity, Scale (Ch4)
2. Exams Returned Wed

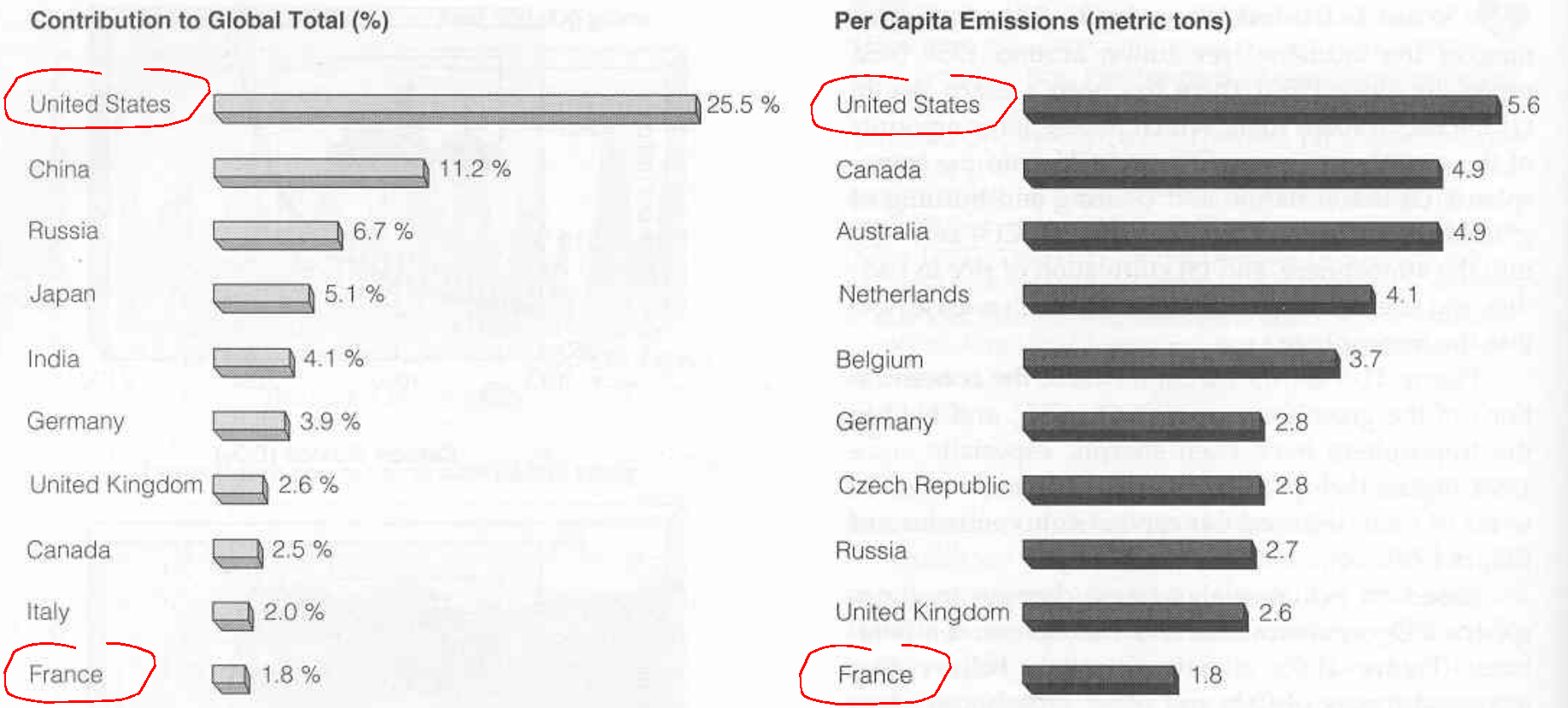

Figure 11-9 The top ten nations in terms of total (left) and per capita (right) emissions of CO_2 in 1999. (Data from World Resources Institute)

Miller, 2003

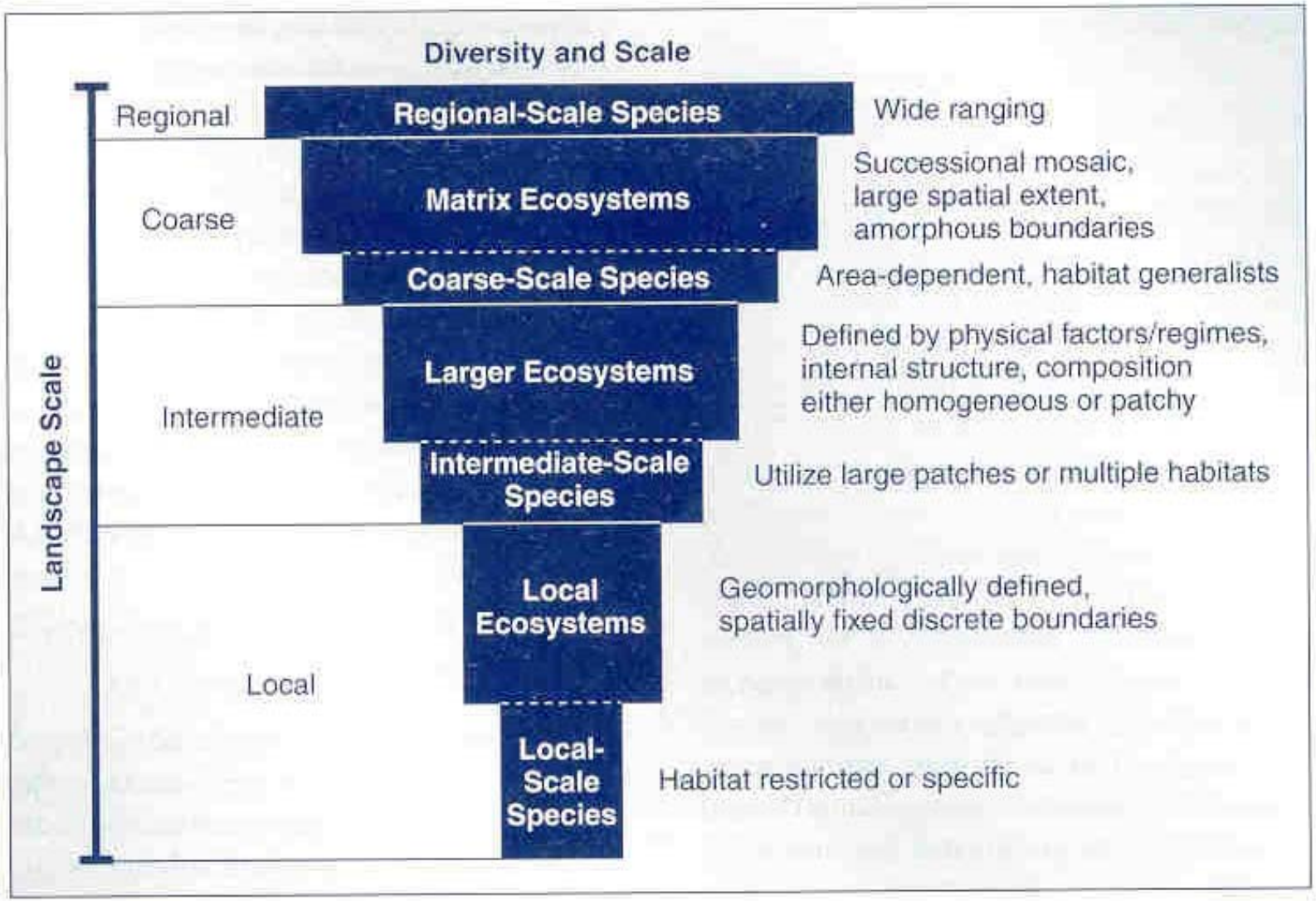

Figure 4.15 Van Dyke 2003

Biodiversity and scale. A method of categorizing biodiversity at regional, coarse, intermediate, and local geographic scales.

Modified from Poiani et al. (2000). © 2001 American Institute of Biological Sciences.

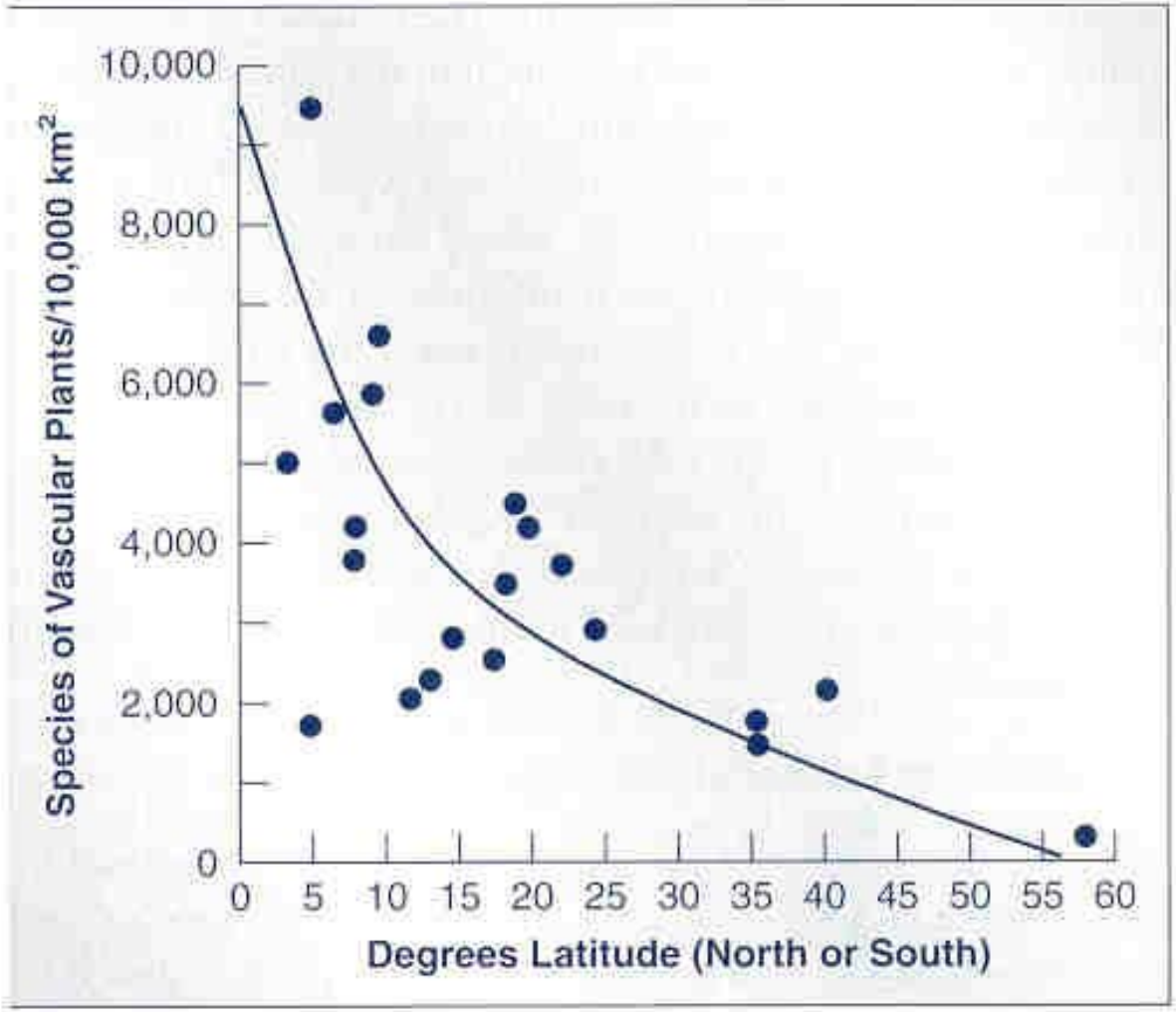

Figure 4.12

Latitudinal patterns in species richness from tropical to temperate regions. In most taxa the number of species increases from temperate to tropical regions.

Van Dyke 2003

After Reid and Miller (1989). Reprinted from Huston (1994).

Species Focus ---> Biodiversity and Process Focus (ESA)

What being lost vs. why…

Biodiversity (Biological Diversity)

"structural and functional variety of life forms at genetic, population, community, and ecosystem levels"

Note different levels (scale)

Species = ?

Biological Species Concept (Mayr)
"a group of interbreeding populations that are reproductively isolated from other such groups"

2-morphological/typological species concept (plants)
3-evolutionary species concept
4-genetic species concept
5-paleontological species concept
6-cladistic species concept

Biological Species Concept

1. Testable and operational
2. Definition compatible with established legal concepts
3. Focus on level of biodiversity that agrees with tradition of conservation

Conserve Species as

TYPES

or as

EVOLUTONARY UNITS

Measuring Biodiversity

- alpha - beta - gamma

Alpha

species within a community

community

- all populations occupying a given area at a given time
- often broken into taxonomic groups or functional roles

1) Species Richness (# of species)
2) Species Evenness (how many of each type?)

Shannon Index

$$H' = -\sum_i p_i \ln (p_i), \quad (i = 1, 2, 3 \ldots S)$$

p_i = proportion of total community abundance represented by ith species

Table 4.3 Abundance (individuals/10 ha) and diversity (Shannon index, $H' = -\Sigma(p_i \ln p_i)$ of avian species from two tallgrass prairie sites at DeSoto National Wildlife Refuge, Iowa. Note that site A, with fewer species (8) and two highly abundant species (common yellowthroat and field sparrow), has a lower value of diversity than site B, which has more species (11) that are more equally abundant. Van Dyke 2003

SPECIES	SITE A	SITE B
Common yellowthroat	8.24	1.21
Field sparrow	2.94	2.84
Dickcissel	1.18	2.23
Red-winged blackbird	0.29	0.81
Brown-headed cowbird	2.06	1.82
American goldfinch	1.47	1.02
Ringneck pheasant	0.59	1.63
Mourning dove	1.18	0.61
Eastern kingbird	—	1.60
Grasshopper sparrow	—	4.48
Northern bobwhite	—	2.64
Shannon diversity (H')	1.64	2.25

Shannon Index in Tallgrass Prairie

(indiv spp abundance relative to total abundance)

What if removed three species from B?

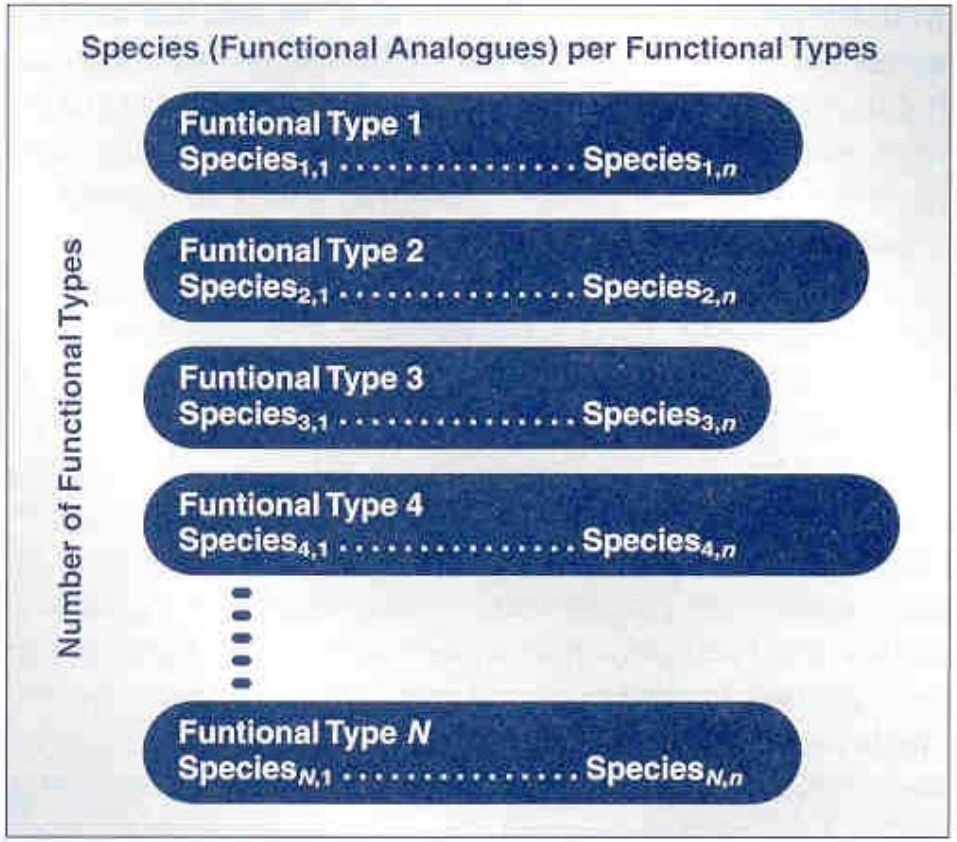

Figure 4.3

Total species diversity can be measured as the product of the number of functional types and the number of species per functional type. Two populations may have the same species diversity and still differ. For example, one may have many functional types and few functional analogues, and the other may have many analogues but few functional types. The relative number of functionally analogous species within each functional type is indicated by the width of the oval.

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Functional types

Measuring Biodiversity

- alpha - beta - gamma

Beta

area or regional diversity (beta richness)

diversity of species among communities across landscape

gradient

- slope, moisture, temperature, precipitation, disturbance, etc.

Whittaker's Measure = S/alpha - 1

where S = # spp in all sites, alpha = avg. # spp/site

a) if no community structure across gradient = 0

-broad ecological tolerances, niche breadth

b) 100/10 - 1 = 9 high beta diversity

Beta Diversity

1) quantitative measure of diversity of communities that experience changing environmental gradients

2) are species sensitive, or not, to changing environments
   are there associations of species that are interdependent
   (plants, pollinators, parasites, parasitoids)

3) how are species gained or lost across a TIME gradient?

Succession, community composition, effects of disturbance

Measuring Biodiversity

- alpha - beta - gamma

Gamma

rate of change of species composition with distance (geography, rate of gain and loss of species)

alpha rarity with increased number of species (fewer of each type)

beta rarity with habitat specialists

gamma rarity if restricted to particular geographic areas

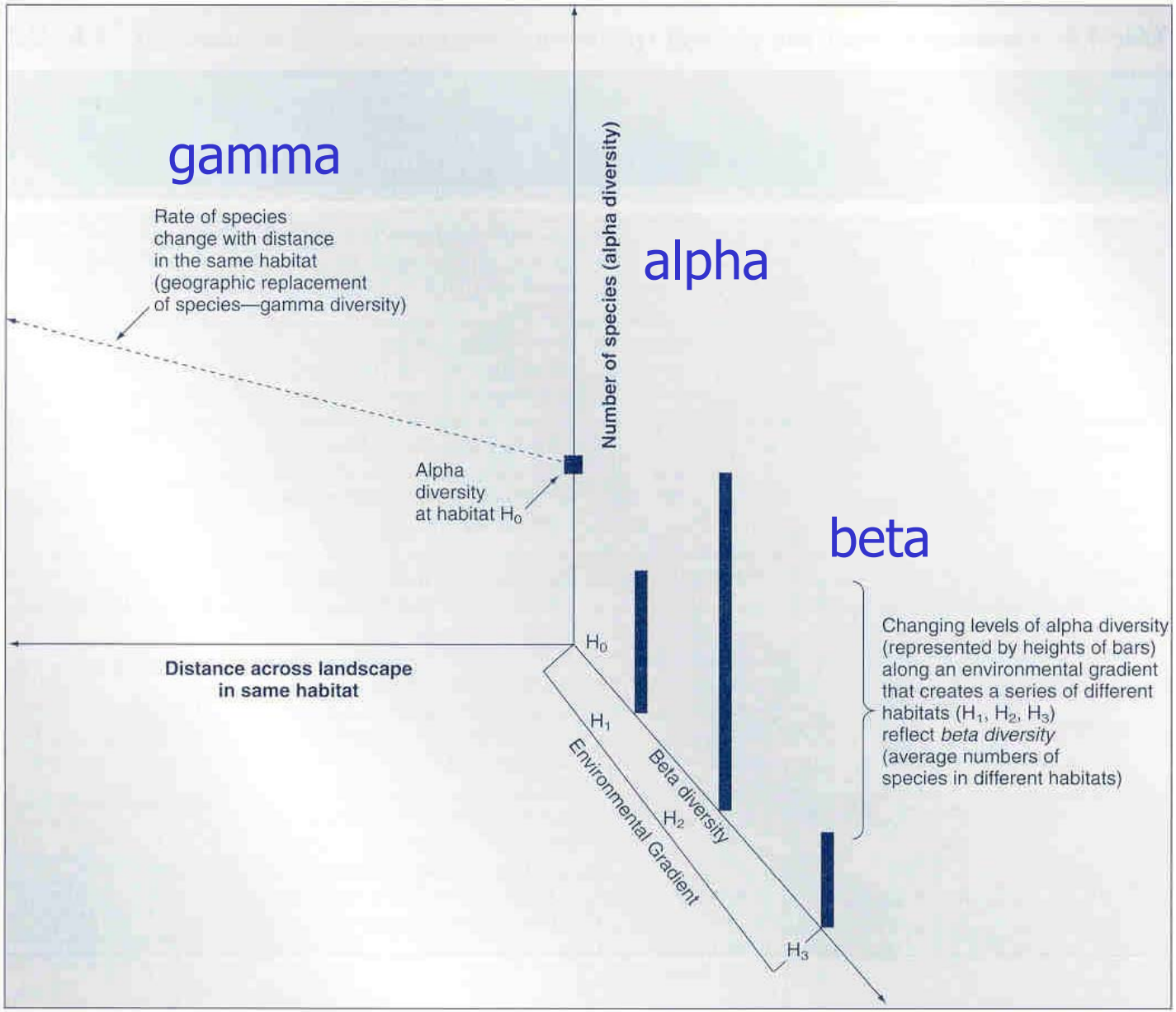

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Figure 4.2

The number of species on a given site in one kind of habitat is a measure of alpha diversity (species richness). The average number of species per site along an environmental gradient (number of species per habitat) is a measure of beta diversity. The *rate* of species change over landscape scale distances in the *same* habitat is a measure of gamma diversity (geographic replacement of species).

Measuring Biodiversity
- alpha - beta - gamma

Missing?

Species role in ecosystem?
Rarity
Phylogenetic Represenation

Edges vs. Interior (e.g., fragmentation)
(spp richness increases, but are broad generalists, not interior habitat specialists)

All species are not equivalent (normative valuation?)

"Madagascar Periwinkle Argument"
(leukemia)

What is it and why do many conservation biologists dislike it?

Callicott:
"Some things have a price, others have a dignity"

Pricing Biodiversity

$R_I = (D_i + U_i)(\text{delta}P_i/C_i)$

D = distinctiveness
U = utility
delta P = enhanced probability of survival
C = cost of strategy

Direct limited funds…
Ecological Contribution?

END