

# Forest Conservation Biology

- Objectives:
  - Overview of Conservation Biology
    - Biodiversity
      - What is it?
      - Why is it important?
      - What are the threats to biodiversity?
      - How do we manage for biodiversity?

\*Parts of this lecture were adapted from online materials provided by the Network of Conservation Educators and Practitioners, Center for Biodiversity and Conservation, American Museum of Natural Heritage

(<http://ncep.amnh.org/index.php?globalnav=home&sectionnav=home>).

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# Forest Conservation Biology

- Terminology
  - *Conservation biology*
    - *science of analyzing and preserving existing biological diversity (i.e., biodiversity)*
      - Save it before it becomes damaged, degraded, or destroyed
      - Based on fundamental ecological and evolutionary principles
      - Conservation biology (the science) vs. biological conservation (the practice)
      - Society for Conservation Biology (<http://www.conbio.org/>)
        - » **SCB Mission:** *To advance the science and practice of conserving the Earth's biological diversity.*

# Forest Conservation Biology

- *Conservation biology vs. Restoration ecology*
  - Conservation biology is to biological conservation what restoration ecology is to ecological restoration
  - “conserving what is left” vs. “restoring what once was”



Manukā Tropical Dry Forest Protected Area

vs.



Ka'upulehu Tropical Dry Forest Restoration

# Forest Conservation Biology

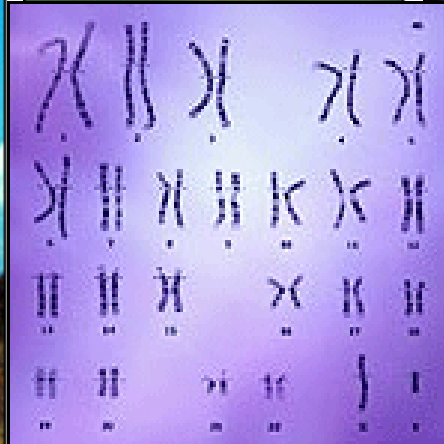
- What is biodiversity?

- Biodiversity (biological diversity) refers to the living, or biotic component of ecological systems
- There are several *levels* of biodiversity
  - Genetic, species, population, community, ecosystem, and landscape
  - Important interactions exist between and within levels
- Ecological and evolutionary processes are fundamental
  - Drive observed patterns in biodiversity at all levels

# Forest Conservation Biology

- What is biodiversity?

- the variety of life on Earth at all its levels, from genes to ecosystems, and the ecological and evolutionary processes that determine and sustain it



# Forest Conservation Biology

- Dimensions of biodiversity

<b>Genetic component</b>	<b>Spatial component</b>	<b>Functional component</b>	<b>Temporal component</b>
within individuals	communities	e.g. reproductive behavior, predation, parasitism	daily
within populations	ecosystems		seasonal
between populations	landscapes		annual
between species	ecoregions		geological or evolutionary
	biogeographic regions		

# Forest Conservation Biology

- Genetic diversity

HBB Sequence in Normal Adult Hemoglobin (Hb A):							
Nucleotide	CTG	ACT	CCT	GAG	GAG	AAG	TCT
Amino Acid	Leu	Thr	Pro	Glu	Glu	Lys	Ser
	3			6			9

HBB Sequence in Mutant Adult Hemoglobin (Hb S):							
Nucleotide	CTG	ACT	CCT	GTG	GAG	AAG	TCT
Amino Acid	Leu	Thr	Pro	Val	Glu	Lys	Ser
	3			6			9

The variation in the nucleotides, genes, chromosomes, or whole genomes of organisms

Source: Human Genome Project, Department of Energy

# Forest Conservation Biology

- Genetic diversity



# Forest Conservation Biology

- Phenotypic (morphological) diversity
  - ***Phenotype*** - the physical constitution of an organism that results from its genetic constitution (genotype) and the action of the environment on the expression of the genes



***Phenotypic diversity*** refers to variation in the physical traits of the organism.

# Forest Conservation Biology

- Population diversity
  - Variation in the quantitative and spatial characteristics between populations



# Forest Conservation Biology

- Community diversity
  - Variation in the groups of populations and species that share an environment



# Forest Conservation Biology

- Ecosystem diversity

- Variation in ecosystem types across the landscape

Tropical Dry Forest



Tropical Wet Forest



Tropical Grassland



Tropical Shrubland



Tropical Wetland

# Forest Conservation Biology

- Landscape diversity
  - Variation in landscapes within a region



# Forest Conservation Biology

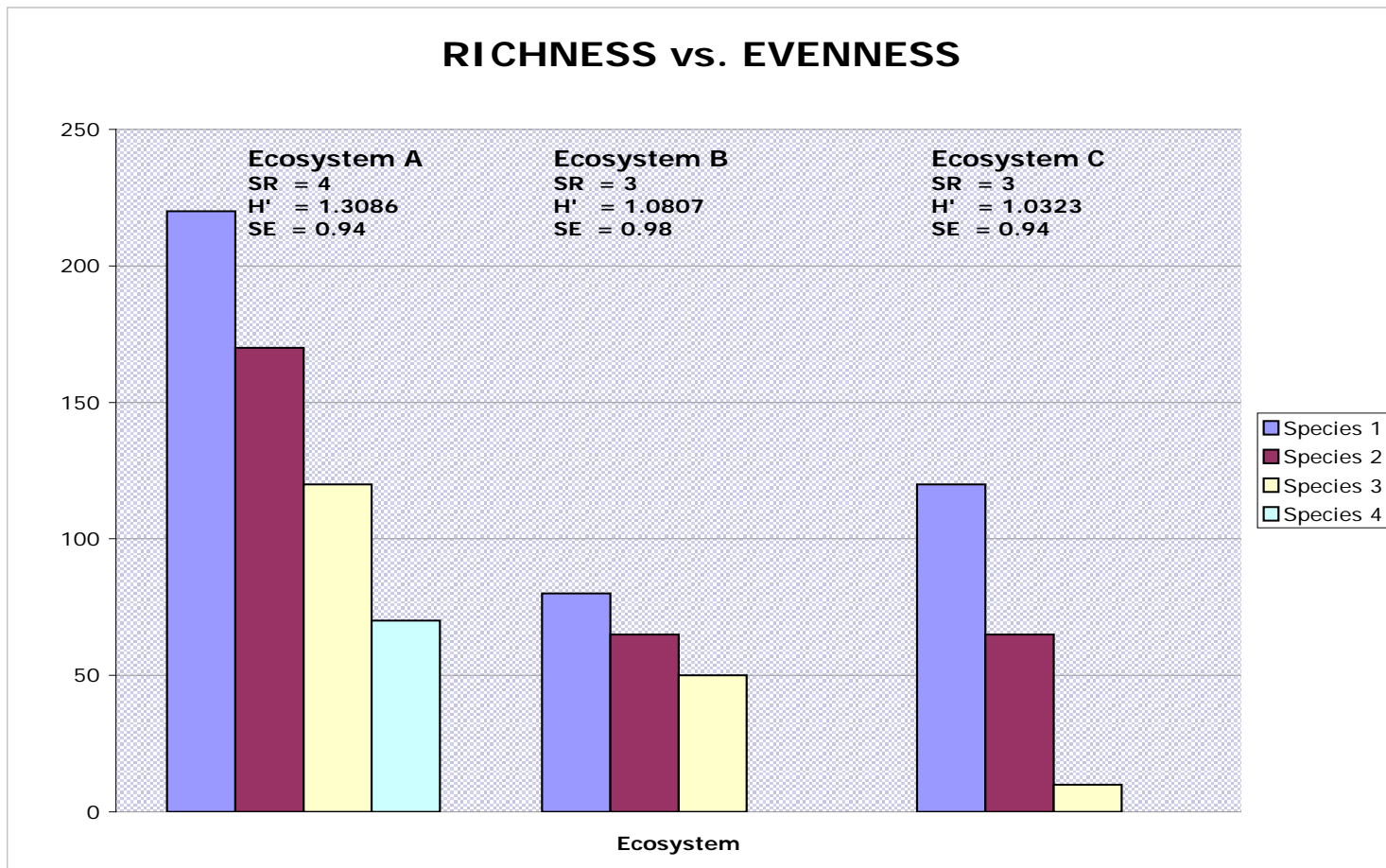
- Species diversity
  - Most common level at which biodiversity is quantified
  - Can be defined differently based on:
    - Morphological (looks)
    - Biological (sex)
    - Phylogenetic (taxonomy)
  - Different definitions produce different estimates of the total number of species
    - Implications for management and conservation planning

# Forest Conservation Biology

- Species diversity
  - Consists of two metrics
    - Species Richness: the number of species present in a given area
    - Species Evenness: species number weighted by measure of importance, such as abundance, productivity or size
      - Also referred to as species abundance
  - Diversity Indices
    - Shannon's diversity index ( $H$ ) =  $-\sum \rho_i \ln \rho_i$ 
      - where  $\rho_i$  is the proportion of the total number of specimens of species  $i$  expressed as a proportion of the total number of specimens for all species in the ecosystem

# Forest Conservation Biology

- Species diversity



Adapted from: Hunter, M. Jr. 2002. Fundamentals of Conservation Biology. 2nd Edition.

# Forest Conservation Biology

- Species diversity

- Species richness measured differently at different scales

- Alpha-diversity

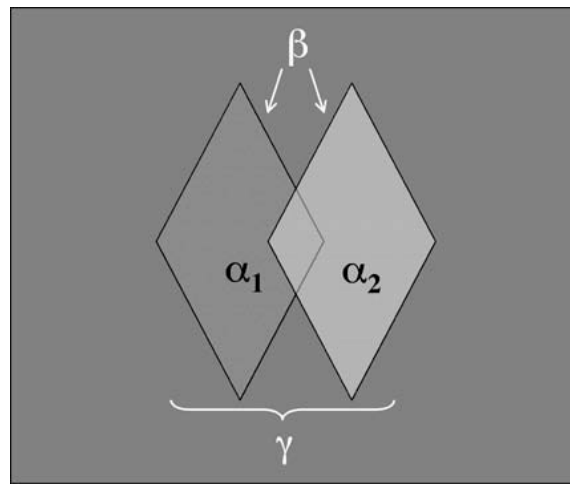
- Measured locally, at a single site

- Beta-diversity

- Measures the uniqueness, or the difference between two sites

- Gamma-diversity

- Measured over a large scale (same concept as alpha-diversity)



# Forest Conservation Biology

- Species diversity
  - Alpha vs. Beta vs. Gamma Diversity

Hypothetical species	Woodland habitat	Hedgerow habitat	Open field habitat
A	X		
B	X		
C	X		
D	X		
E	X		
F	X	X	
G	X	X	
H	X	X	
I	X	X	
J	X	X	
K		X	
L		X	X
M			X
N			X

Alpha diversity	10	7	3
Beta diversity	Woodland vs. hedgerow: 7	Hedgerow vs. open field: 8	Woodland vs. open field: 13
Gamma diversity	14		

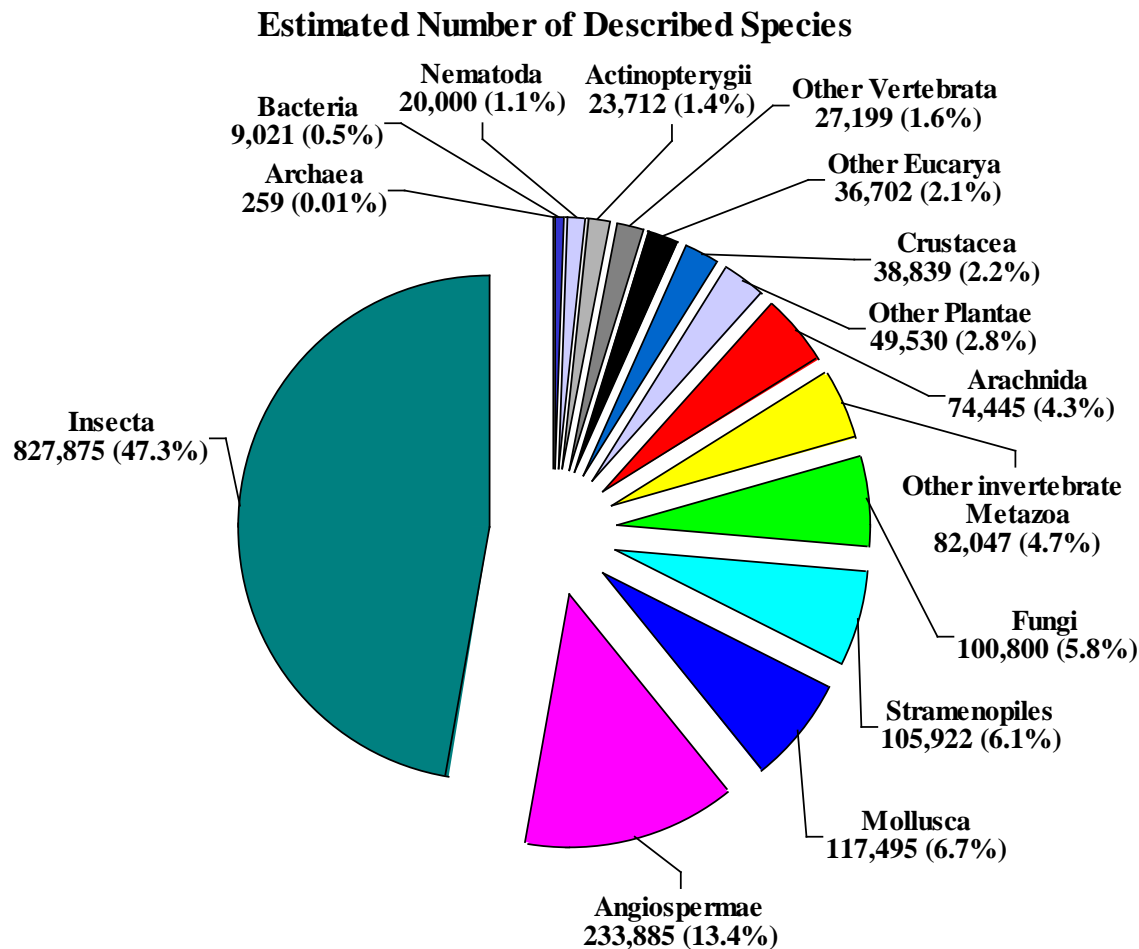
(Meffe *et al.* 2002)

# Forest Conservation Biology

- Global Species diversity
  - How many species exist globally?
    - So far, about 1.5-1.75 million species have been identified.
    - Scientists estimate that there may be between 3 and 117 million species.
      - Most estimates range between 13-20 million species

# Forest Conservation Biology

- Global Species diversity



# Forest Conservation Biology

- Hawai'i Species diversity

**Table 1.** Numbers of presumed original colonists, derived native species, and endemic species for the major groups of Hawaiian biota.

	Minimum number of original colonists	Number of native species	Number of endemic species (% endemism)
Microscopic marine algae*	?	ca. 5000	?(probably low)
Macroscopic marine algae*†	?	ca. 500	54 (13%)
Ferns and fern allies 2‡§	ca. 114	145	102 (70%)
Mosses	225	233	112 (46%)
Gymnosperms	0	0	0
Flowering plants	ca. 260*	ca. 970**	ca. 880 (91%)
Marine decapods††	?	ca. 600	ca. 150–180
Terrestrial molluscs‡‡	22–24	ca. 1000	997 (99%)
Marine molluscs§§	?	ca. 1000	300–450 (30–45%)
Terrestrial arthropods	300–400	ca. 6000	ca. 5950 (99%)
Mammals	2	2	2 (100%)
Birds**	ca. 25	ca. 135	109 (81%)
Fish***†††	?	ca. 600	ca. 174 (29%)

