

BIO 111: Ecology and Evolution

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MODULE: BIODIVERSITY AND
CONSERVATION BIOLOGY

Part I - FUNDAMENTAL CONCEPTS

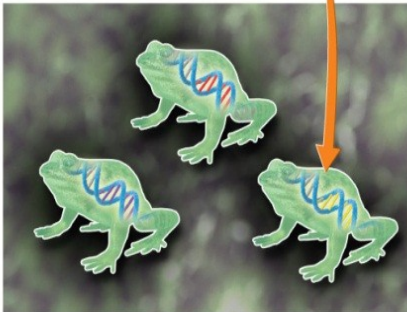
Biodiversity



Ecosystem diversity



Species diversity



Genetic diversity

“biological” + “diversity” = “biodiversity”

“variation of life at all levels of biological organization”

Commonly recognized

- Ecosystem diversity
- Species diversity
- Genetic diversity
- Phylogenetic diversity

Ecosystem diversity

- The number and variety of ecosystems
- Also encompasses differing communities and habitats

Species diversity

- How many species?

ca. 300 new species described each day

ca. 90% remain to be discovered?

Mora et al 2011 PLoS Biol. 9, e1001127

ca. 8.7 million eukaryotes (± 1.3 million)

Genetic diversity

Genetic differences among individuals within species and populations

Reflection point

- Does higher within-species genetic diversity always lead to equate to higher subspecies diversity?

Measuring species diversity

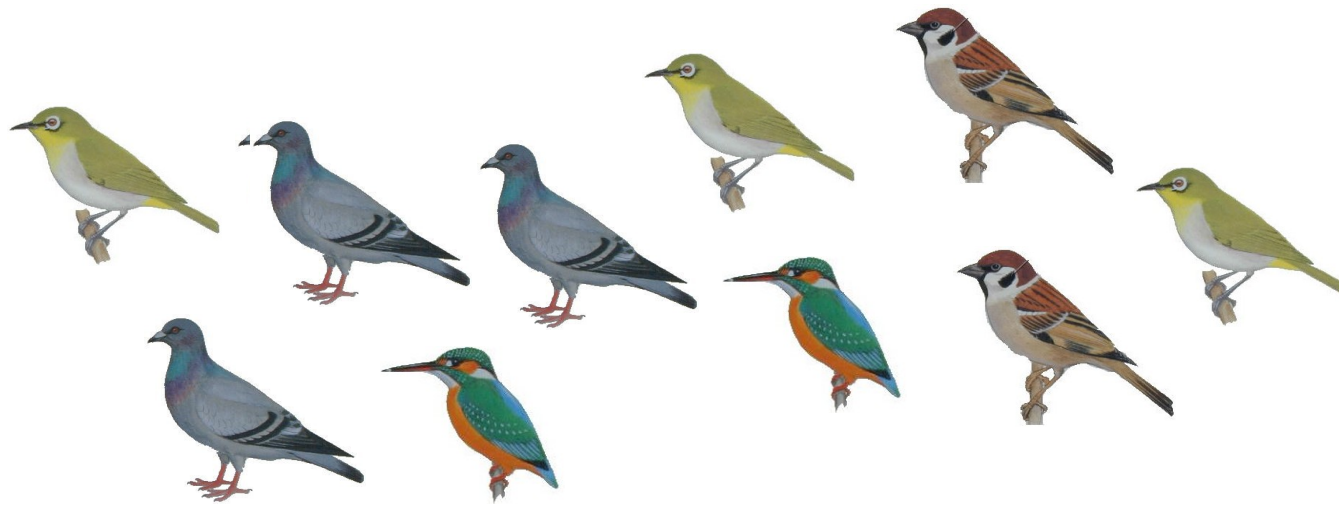
- *Species richness* - Total number of species in an area
- *Abundance* – numbers of individuals of each species
- *Evenness* - How equally abundant the species are



The community below is more diverse because it has higher species richness.



Bird images taken from slides by Anne Chao



The community above is more diverse because of higher *evenness*.



Bird images taken from slides by Anne Chao

Phylogenetic diversity

Considers phylogenetic relationships

Silver Oak

Grapes

Rosewood

Rose

Eucalyptus

Hibiscus

Water lily

Pepper

Ginger

Grapes

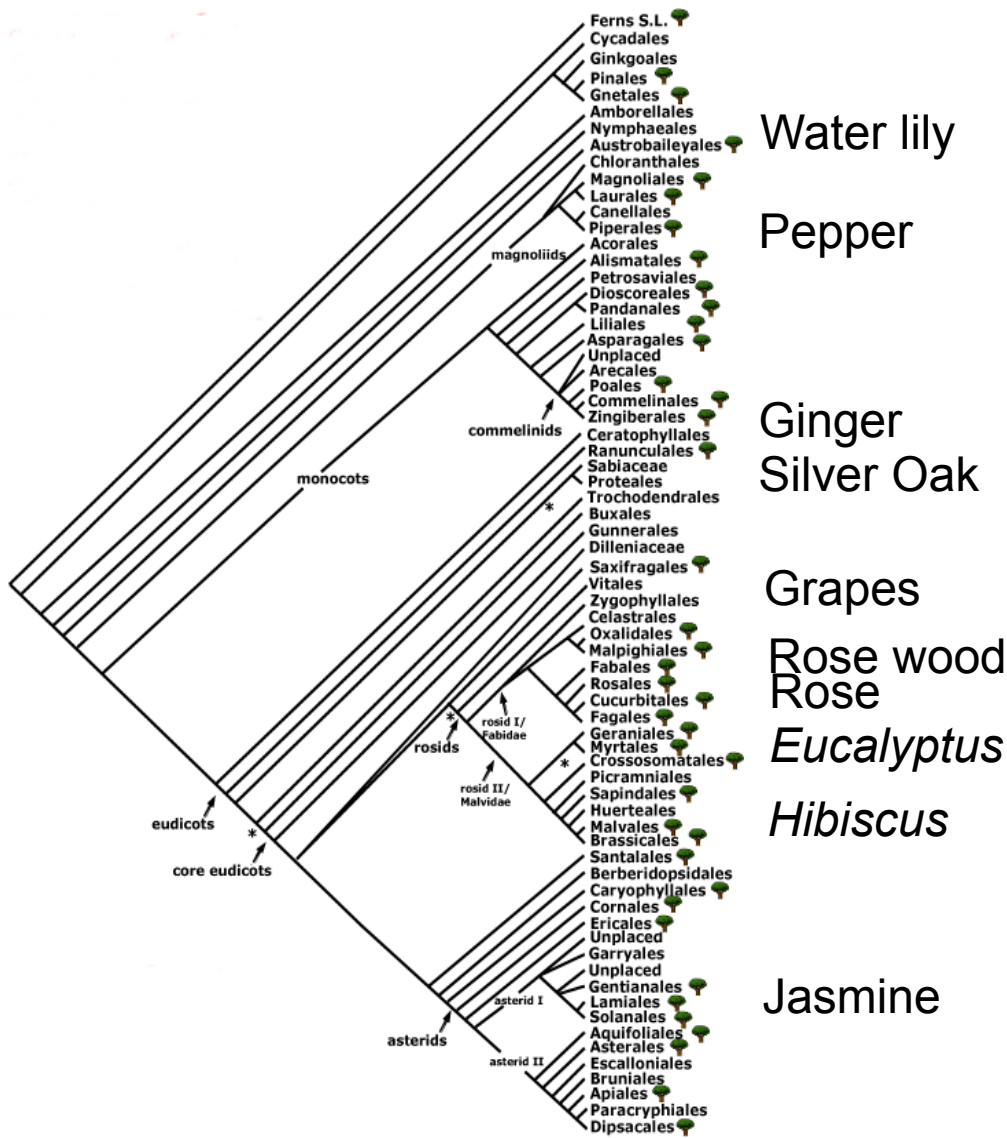
Hibiscus

Jasmine

Which of these hypothetical communities has a higher diversity?

Phylogeny of angiosperms (flowering plants)

www.mobot.org/MOBOT/research/APweb/



Water lily

Pepper

Ginger

Silver Oak

Grapes

Rose wood

Rose

Eucalyptus

Hibiscus

Jasmine

'phylogenetic distance'

- Ideally, species diversity estimates should take into account species richness, evenness and phylogenetic diversity
- Global biodiversity estimates typically estimate only species richness
- Local surveys (especially comparing different localities, habitats, ecosystems, etc) try to account for both richness and evenness
- Phylogenetic diversity is rarely taken into account in practice, because it is time consuming

Importance of Biodiversity

Why conserve biodiversity?

- Direct economic benefits
- Indirect benefits
- Aesthetic & cultural
- Ethical

Direct Economic Value

Food, clothing, energy, medicine, shelter, etc.

For e.g., wild species serve as reservoirs of desirable genetic traits that might be needed to improve domestic crop species (disease- and insect-resistance). *Grassy-stunt virus resistance in rice*

Many medicines are derived from plants or other organisms.

Indirect Economic Benefits

Ecosystem services

Pollination

Carbon sequestration

Pest and disease management

Water and air purification

Nutrient cycling

Waste decomposition

Aesthetic and Cultural

- Recreation
- Tourism
- Cultural activities

Ethical

Systematics and Taxonomy

- making sense of biodiversity

Systematics

Broader science of classifying the diversity of life

Taxonomy

Formal system for naming and classifying species

Distinction between systematics and taxonomy not very clear, sometimes used synonymously

Systematics and taxonomy provide the essential framework without which we cannot recognize or study biological diversity & evolution

- Neither can we utilize biodiversity for human benefit

Components of systematics & taxonomy

- **Nomenclature** - the naming of organisms.
- **Identification** - placement of a new organism into a previously described group.
- **Classification** - ordering of organisms into groups (taxa).

Linnean system of classification

- hierarchical, binomial nomenclature.

RANK	TAXON	
Domain	- Eukaryota	Eukaryota
Kingdom	- <i>Animalia</i>	<i>Plantae</i>
Phylum(Division)	- <i>Chordata</i>	<i>Magnoliophyta</i>
Class	- <i>Mammalia</i>	<i>Magnoliopsida</i>
Order	- <i>Carnivora</i>	<i>Rosales</i>
Family	- <i>Felidae</i>	<i>Rosaceae</i>
Genus	- <i>Panthera</i>	<i>Malus</i>
Species	- <i>tigris</i>	<i>domesticus</i>

Disadvantages of traditional Linnean system

Historically, classification used to be **subjective**.

Classification used to be an **arrangement** and in many cases, taxa were **artificial** - did not take into account evolutionary processes.

Phylogenetic Systematics

- A system of classification that tries to portray evolution i.e. **tries to group together lineages with shared ancestry**
- Each hierarchical taxon is a *monophyletic* group
- Taxonomic groups are '*natural*'
- Organized into nested (Linnean) ranks
- *Tree of life*

Aims of modern systematics & taxonomy

To discover and describe all species

To reconstruct their evolutionary relationships

To classify them according to their evolutionary relationships.