BIO 111: **Biological Diversity and Evolution**

Varsha 2017

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MODULE: BIODIVERSITY AND CONSERVATION BIOLOGY

Part I - FUNDAMENTAL CONCEPTS OF BIODIVERSITY

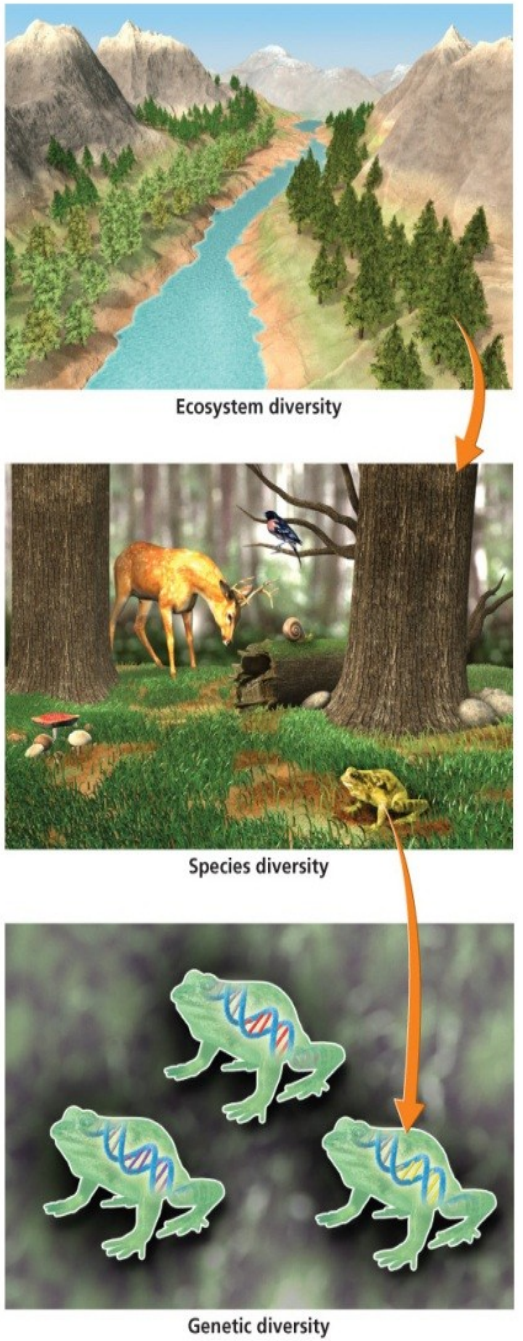
Biodiversity

“biological” + “diversity” = “biodiversity”

“variation of life at all levels of biological organization”

Commonly recognized

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



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Ecosystem diversity

- **Ecosystem diversity** - the number and variety of ecosystems
- Also encompasses differing communities and habitats

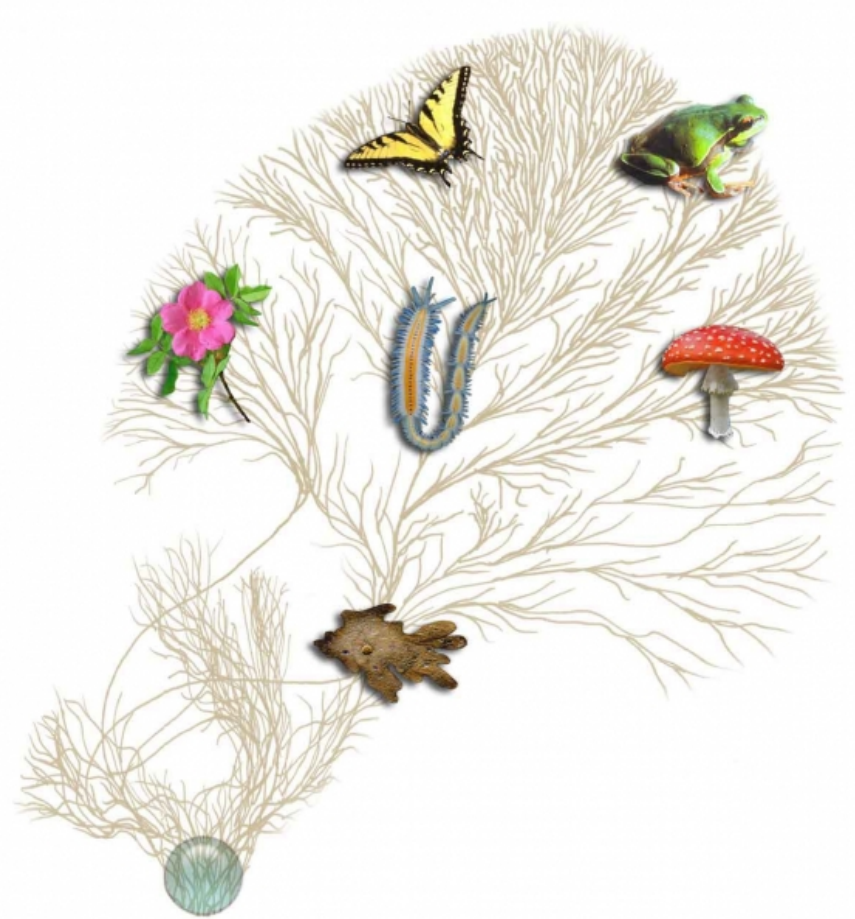
Modified from slide by Jay Withcott and Heidi Marcum

Species diversity

- How many species?

ca 300 new species described each day

ca 90% remain to be discovered?



www.tolweb.org

Terry Erwin – one of the first to estimate global diversity

fogged tropical trees

>1100 beetle species on 19 trees of a single species.

Estimated that ca 160 are restricted to that tree species

Estimated that insect species richness on earth is *30 million*

http://faculty.plattsburgh.edu/thomas.wolosz/howmanysp.htm

https://www.learner.org/courses/biology/textbook/biodiv/biodiv_4.html

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

Does higher genetic diversity equate to higher subspecies diversity?

Measuring species diversity

- *Species richness* - Total number of species in an area

- *Abundance* – numbers of individuals of each species

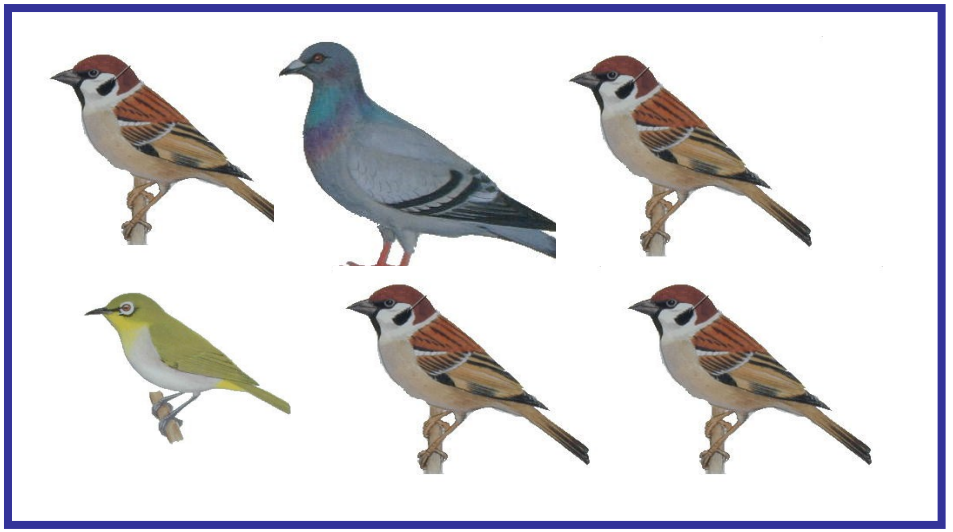
- *Evenness* - How equally abundant are the species in an area?

Species: 4

More diverse

Species: 3

Slide by Anne Chao



Species: 3
Uneven

Species: 3
Even
More Diverse

Slide by Anne Chao

Phylogenetic diversity

Consider not only richness and relative abundance, but also phylogenetic relationships

Silver Oak	Water lily
Grapes	Pepper
Rosewood	Ginger
Rose	Grapes
Eucalyptus	Hibiscus
Hibiscus	Jasmine

Which of these hypothetical communities has a higher diversity?

Phylogeny of angiosperms (flowering plants)

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

'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

The Importance of Biodiversity

Why conserve biodiversity?

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

Direct Economic Value

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

E.g

Wild species serve as reservoirs of desirable genetic traits that might be needed to improve domestic crop species (disease- and insect-resistance).

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

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	-	Animalia	Plantae
Phylum(Division)	-	Chordata	Magnoliophyta
Class	-	Mammalia	Magnoliopsida
Order	-	Carnivora	Rosales
Family	-	Felidae	Rosaceae
Genus	-	*Panthera*	*Malus*
Species	-	*tigris*	*domesticus*

Disadvantages of traditional Linnean system contd…

Classification is subjective. Bias of individual systematist plays a significant role.

Results not reproducible.

The Linnaean system of classification is only an arrangement and in many cases, artificial. Does not take into account evolutionary processes.

Phylogenetic Systematics

A 'natural' system of classification 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.