Biodiversity, Ecology, and Conservation Biology
BIO 211-07
(211-06, with McMillan, is in RHSC 121)

Dr. Robert Podolsky (Bob)

Pickup today: syllabus, notes, and index card

name (& nickname)
a. bio courses taken in college
b. what you hope to get from this class
c. concerns about this class
d. future plans/dreams?
e. favorite (non-human) organism

Robert D. Podolsky

Evolutionary Ecology and Functional Biology of Marine Invertebrates

Interests

- Life-history evolution and ecology of invertebrate larvae
- Fertilization ecology and evolution of spawned gametes
- Physiological ecology of development in variable environments
- Plasticity of form and function during ontogeny

Nuts and bolts

What is Biol 211? — **Lecture** *Text, exams* | **Discussions** *Articles, DQs* | **Recitation projects** *Practical skills*

Readings — Biological Science 4/e, Freeman → *or* Biological Science 4/e Vol. 2, Freeman
journal articles

Website — http://podolskyr.people.cofc.edu/biol211/
~ lecture handouts, articles, DQs, information
~ pwd "ecology" (also on your syllabus)

Policies — Attendance & participation (lecture and recitation) →
Assignments
Group projects
Extra credit
Academic integrity

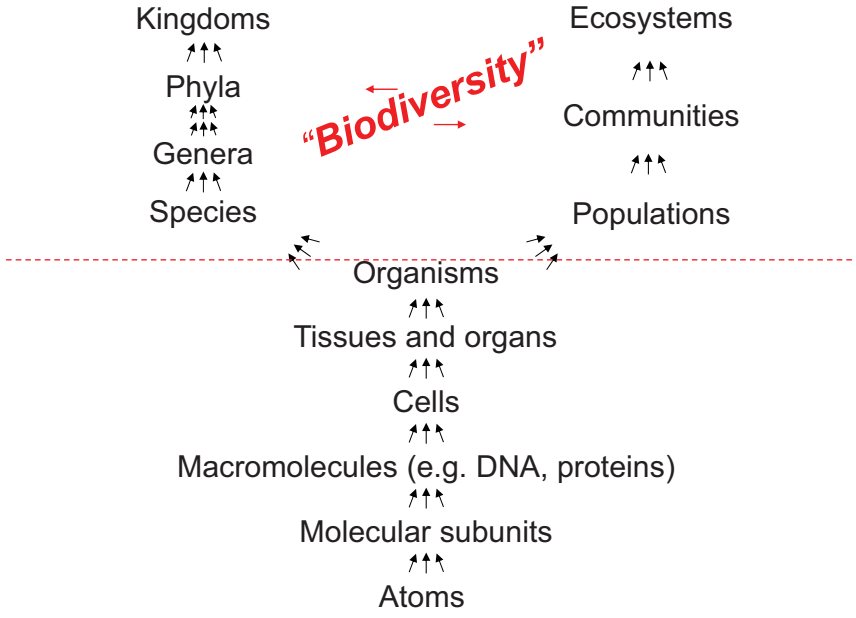
Do you have an iClicker?

Lecture — M & W 3:05-4:20 (followed by office hours)

Recitation — F 11:00-2:00 in RHSC 301
~ DQs due at recitation (this Friday)

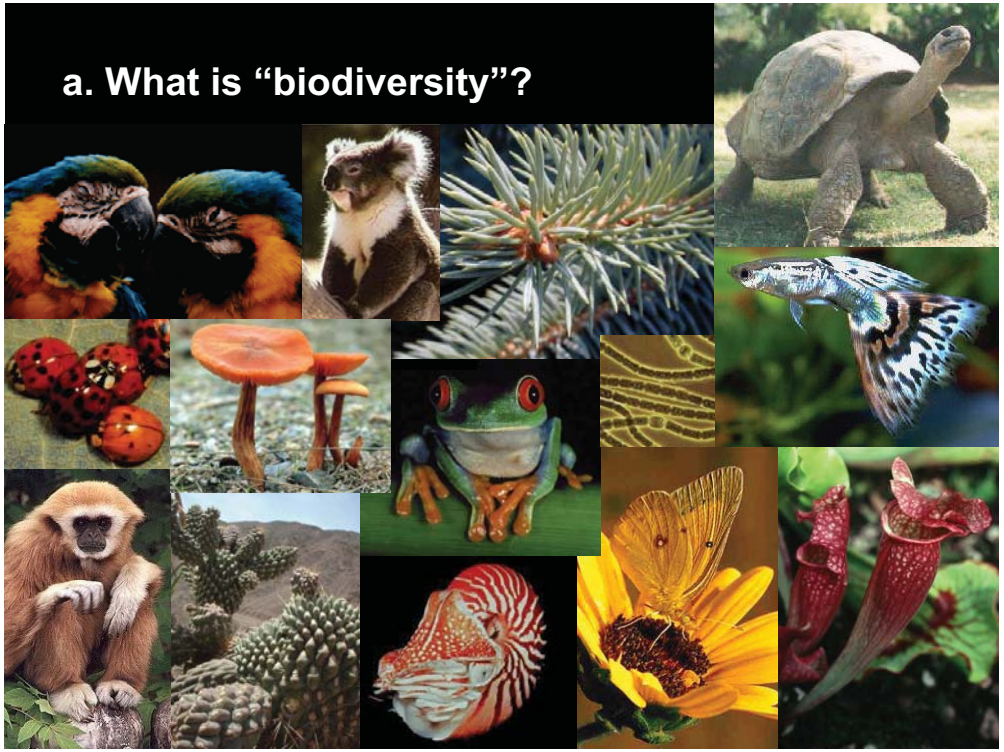
Q: Where does this course fit?

"Biology is inherently hierarchical"



Unit 1: Why study "Biodiversity, ecology, and conservation biology"?

a. What is "biodiversity"?
b. How is biodiversity distributed?
c. What is the "biodiversity crisis"?
d. What are the biggest threats?
e. What are the costs of the crisis?



a. What is biodiversity?

Some components

Genetic
- diversity of allelic or other genetic information harbored within populations or species

~ Selection acts on genetic variation

Taxonomic
- diversity of species in a given location
- " higher taxonomic levels "

~ Taxa are unique resources

Ecosystem
- diversity of biological communities and their specific physical conditions

~ Ecosystems support unique organisms and provide essential services

Q: Are different groups of organisms equally diverse?

Q: Are different parts of the world equally diverse?

b. How is biodiversity distributed?

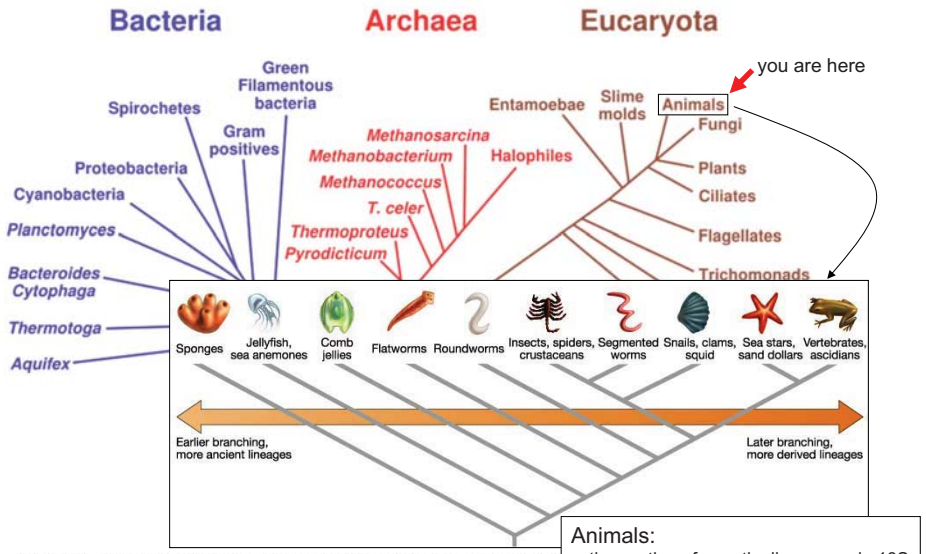
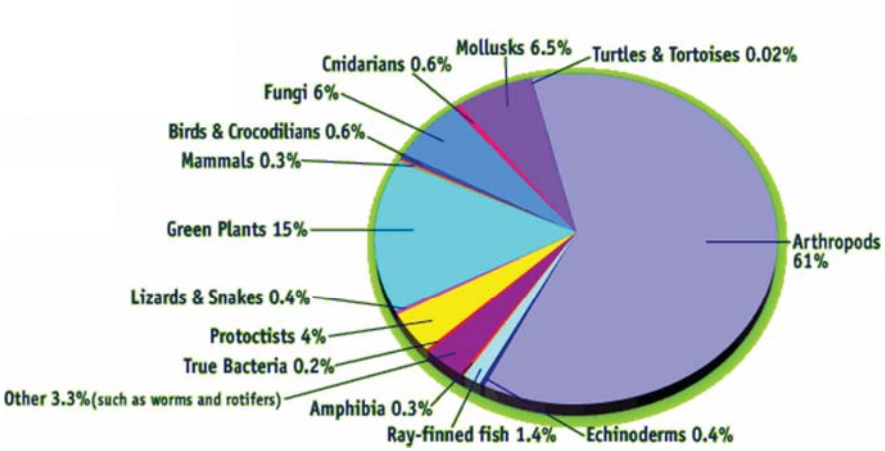


Figure 11.5 **An estimate of the phylogeny of all living organisms** This tree is bas
quences of small subunit rRNAs. From Woese (1996).

Animals:
- tiny portion of genetic divergence in 18S
- 75% of described species
- vast majority of diversity in body design

b. How is biodiversity distributed? *Species richness*

named: ≈ 1.5 million species
estimated: ≈ 5 - 30 million species (how estimated?)



Species richness is not evenly distributed

O. Coleoptera ≈ 40% of described arthropods
≈ 32% of described animals
≈ 25% of all named organisms

"*an inordinate fondness for beetles*" – J.B.S. Haldane

Where do these estimates come from?

1. Taxon-specific surveys

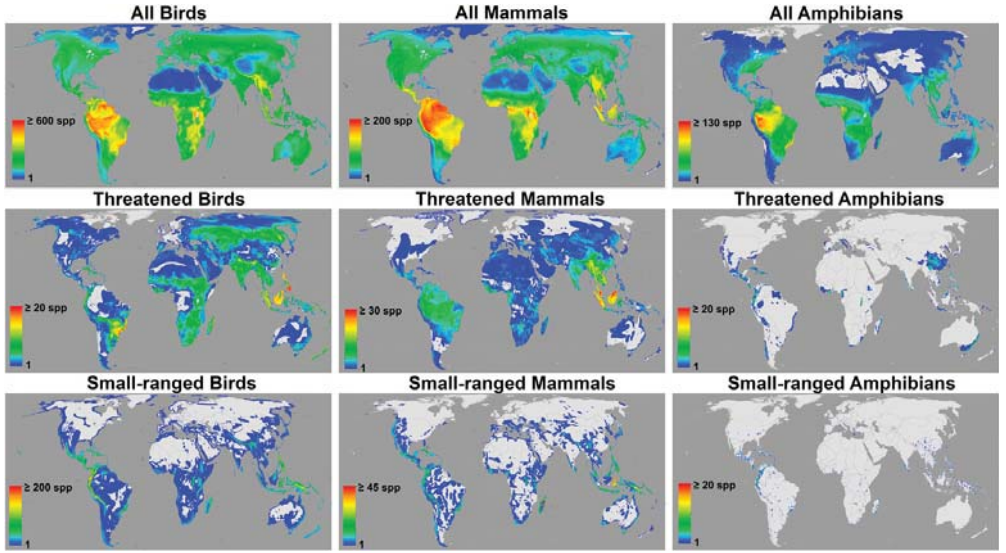
- e.g., researchers fogged canopy of single tropical tree
- found >900 beetle species
- extrapolated to other tree species

2. Intensive local sampling

- Great Smoky Mountains National Park: first effort to find and catalog every species
- Started in 1999, will finish in 2015
- Over 650 new species discovered

b. How is biodiversity distributed?

➢ Biodiversity and conservation "hotspots"



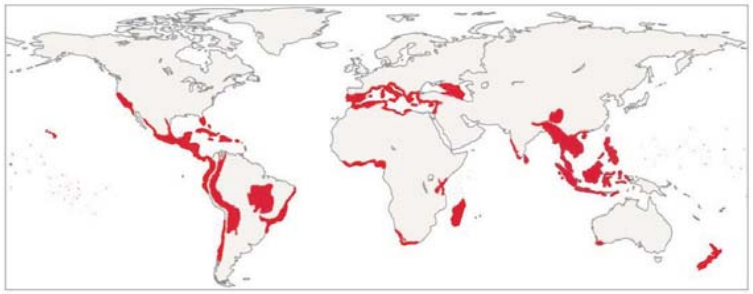
Jenkins et al. (2013) PNAS

Q: Why are endemic (small range) species critical?

b. How is biodiversity distributed?

➢ Biodiversity and conservation "hotspots"

high proportion of endemics and high threat
Ex. endemic and threatened plants



Regions that meet two "conservation hotspot" criteria:

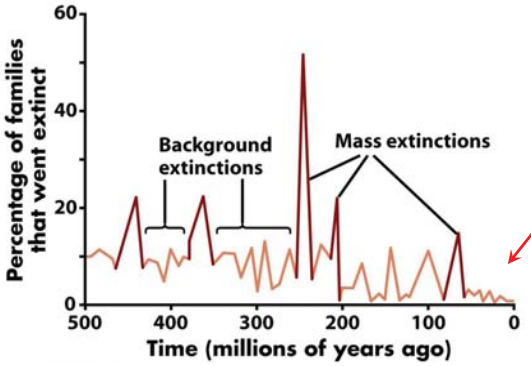
1. Contain at least 1500 endemic plant species

2. Have lost at least 70% of their primary vegetation

c. What is the "biodiversity crisis"?

Human activity is responsible for unprecedented rate of extinction

- *100-1000 times faster than expected without human activity*
- *parallels or exceeds previous **mass extinction** events*



current rate of extinction is at least 100x background

Q: What if extinction > speciation?

d. What are the biggest threats?

- habitat loss and fragmentation

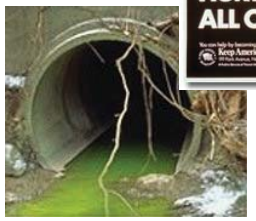
- logging, burning forest
- grazing livestock
- converting wetlands
- housing development

Why do fragments degrade more?

- ***individual range needs***
- ***increased edge habitat***
- ***greater isolation***

d. What are the biggest threats?

- habitat loss and fragmentation
- environmental alteration/pollution



oil spills (Exxon Valdez, 1989)

polar bear: first mammal listed (2008) as endangered species as result of climate change

d. What are the biggest threats?

- habitat loss and fragmentation
- environmental alteration/pollution
- introduced species

Hawaiian honeycreepers
- introduction of rats, mongoose, avian malaria, fowlpox
- 15 extinct, 20 endangered

Kudzu, *Pueraria lobata*

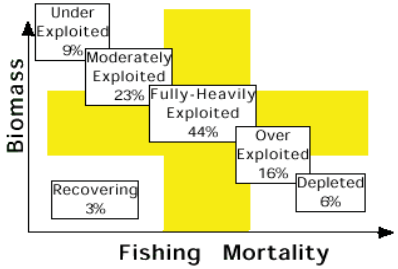
Cogon grass, *Imperata cylindrica*

d. What are the biggest threats?

- habitat loss and fragmentation
- environmental alteration/pollution
- introduced species
- overexploitation

baleen whales
- 9 of 11 severely depleted

Status of World Fisheries

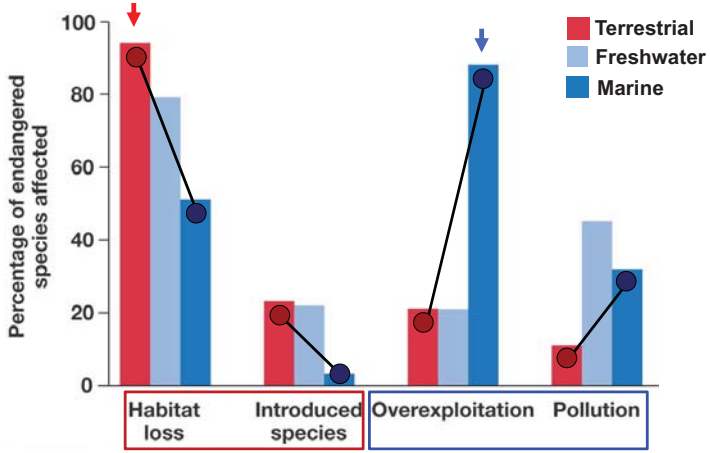


passenger pigeon
- "a mile wide and 300 miles long"
- commercialized as cheap food
- go visit "Martha"! (RIP 9/1/1914)

Human resource use exacerbates other threats

d. What are the biggest threats?

➢ causes of endangerment for a subset of endangered species native to Canada



What are the biggest threats in terrestrial systems? In marine systems? Which threats are relatively large in terrestrial vs. marine systems?

e. What are the potential costs of the loss?

Economic value – resources (e.g. food, raw materials)
– chemicals (e.g., medicines, preservatives)
– genes to produce better crops
– "opportunity costs"

Utilitarian value – healthy ecosystems provide services
control erosion
purify water
recycle CO_2, nutrients
buffer catastrophic events (fire, flood)
regulate climate

Psychological value – direct or indirect enjoyment of nature

Intrinsic value – organisms have value independent of humans

Our goal: biological principles that can be applied to the conservation of biodiversity

I. Populations/ species

How do populations work?

- *Population genetics*
- *Population dynamics*

II. Communities/ ecosystems

How do communities and ecosystems work?

- *Species interactions*
- *Ecosystem function*
- *Community structure*

III. Biological diversity

How has diversity originated?

- *Macroevolution*
- *Major innovations*

How is biodiversity organized?

- *Taxonomic groupings*
- *Phylogenies*