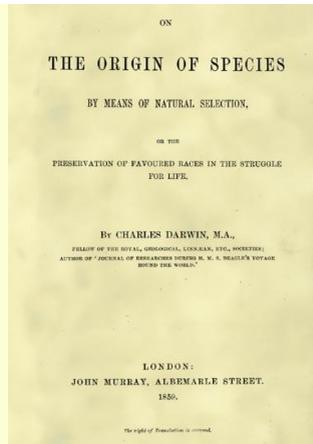


Speciation

Macroevolution



Lecture outline

- Species definitions
- Keeping species separate
- Modes of speciation



What's a species?

- **Species** is Latin for 'kind' or 'appearance'
- Biologists have *officially described* MANY species
 - Roughly 1.8 million
 - Is there an official count?
 - The Catalogue of Life
 - Includes **1,837,565** species as of 2019

Catalogue of Life



A brief detour on writing

- "Species" is both singular and plural
- Species names are written using binomial nomenclature of Latin or Latinized versions of words
- **Genus species**
 - The actual names are *italicized*
 - *Genus* is always capitalized
 - *species* is always lower case
- *Pycnopsyche gentilis*



Species concepts

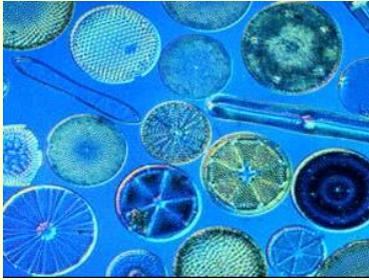
- Our ideas about how best to define a species have changed over time
- A challenge:
 - If speciation is occurring, no species concept will "work" all the time - you should always be able to find debatable forms

How can you tell when something is a different 'kind' than something else?



Morphological species concept (1)

- Defined by...
- Type specimen
- Morphospecies?



Diatoms

Morphological species concept (2)

- Any problems?



Fig. 24.2b



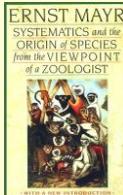
Golden silk orb weaver *Nephila clavipes*

Biological species concept

- Ernst Mayr (1904-2005)
 - German ornithologist
 - Modern Synthesis
- Population or group of populations that have the potential to interbreed in nature and produce viable, fertile offspring (1942)
- Gene flow?
- Problems?



Mayr on right in New Guinea



Reproductive isolation

- Two types of biological barriers to reproduction
 - **Prezygotic vs. Postzygotic** barriers



Fig. 24.3

Prezygotic barriers overview

- Habitat isolation
- Temporal isolation
- Behavioral isolation
- Mechanical isolation
- Gametic isolation

Notice anything in common?



Fig. 24.3

Prezygotic barriers (1)

- **Habitat isolation**



Three-spined stickleback species differ by lake habitat: benthic vs. pelagic zones



Peichel et al. (2001)

Prezygotic barriers (2)

• Temporal isolation



Eastern spotted skunk (*Spilogale putorius*) winter



Western spotted skunk (*Spilogale gracilis*) summer

Fig. 24.3 c & d

Prezygotic barriers (3)

• Behavioral isolation

Song

Eastern meadowlark



Fig. 24.2a

Song

Western meadowlark



Prezygotic barriers (4)

• Mechanical isolation



Familiar bluet pic by Giff Beaton



Robertson & Paterson 1982

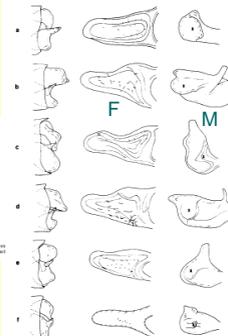
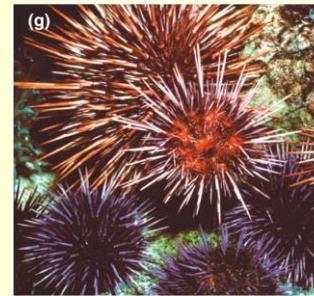


FIG. 7. Male anal appendages and female mesostigmal grooves of six species of *Enallagma*. The first column presents lateral views of the male anal appendages ($\pm 18\times$), the second the left mesostigmal grooves, with sensilla, of the females ($\pm 37\times$), and the third the inner surfaces of the male superior appendages ($\pm 30\times$). The "X" marks the area believed to fit into the female groove. The species are (a) *E.*

Prezygotic barriers (5)

• Gametic isolation



Sea urchins

Fig. 24.3g

Postzygotic barriers overview

- Reduced hybrid viability
 - Reduced hybrid fertility
 - Hybrid breakdown
- Notice anything in common?



Fig. 24.3

Postzygotic barriers (1)

- **Reduced hybrid viability:** hybrid offspring dies during development



Drosophila melanogaster



Drosophila simulans

+ = Male hybrids that die as larvae

Hutter & Ashburner 1987

Postzygotic barriers (2)

- **Reduced hybrid fertility:** hybrid offspring are sterile



Postzygotic barriers (3)

- **Hybrid breakdown:** hybrids are fertile, but *their* offspring either die or are sterile

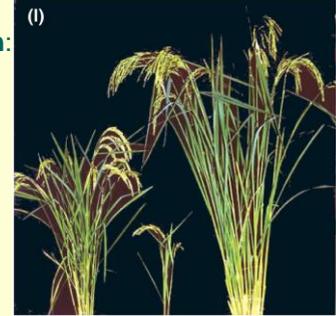


Fig. 24.31 Hybrid cultivated rice plants with stunted offspring (center)

Several other species concepts have been proposed

- **Phylogenetic species concept**
 - Minimum number of individuals that share a common ancestor forming a branch on an evolutionary tree
- **Ecological Species Concept**
 - Group of organisms adapted to a particular set of resources, called a niche, in the environment
- Different species concepts agree most of the time
 - They differ mostly when applied to borderline or poorly understood cases

Modes of speciation

- 2 species from 1
 - = cladogenesis
- **Allopatric vs. sympatric speciation**

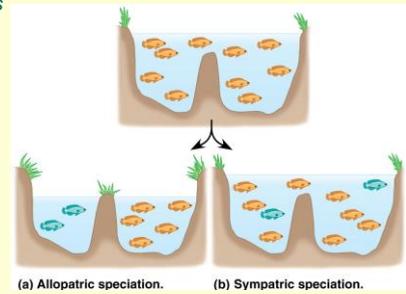


Fig. 24.5

Evidence for allopatric speciation



Fig. 24.8

Sympatric speciation (1)

- Habitat differentiation*
- Sexual selection
- **Polyploidy**
 - 80%(!) of plants



Bread wheat

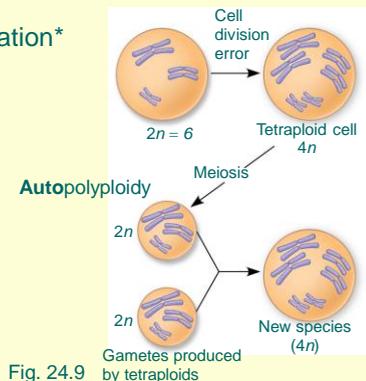


Fig. 24.9

Sympatric speciation (2)

- Polyploidy in tree frogs

Cope's gray tree frog
Hyla chrysocelis

Call



24 Diploid

Gray tree frog
Hyla versicolor

Call



Tetraploid 48

Sympatric speciation (3)

- Sexual selection/Mate choice

Cichlids

EXPERIMENT

Normal light

Monochromatic orange light

P. pundamilia



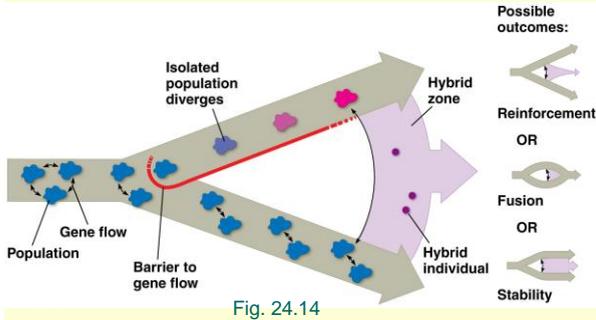
P. nyererei



Fig. 24.12

What happens when allopatric populations meet?

- Hybrid zone formation



Hybrid zones: Reinforcement

Phlox spp.

In Texas where *P. cuspidate* and *P. drummondii* occur together, the *P. drummondii* has evolved dark-red flowers. This newly evolved flower color causes pollinators to only visit the correct species. Photo credit (A) David L. Des Marais and (B) Robin Hopkins.



Matute & Ortiz-Barrientos (2014)
Current Biology

Hybrid zones: Fusion



Pundamilia nyererei *Pundamilia pundamilia*



Pundamilia "turbid water," hybrid offspring from a location with turbid water

Fig. 24.15