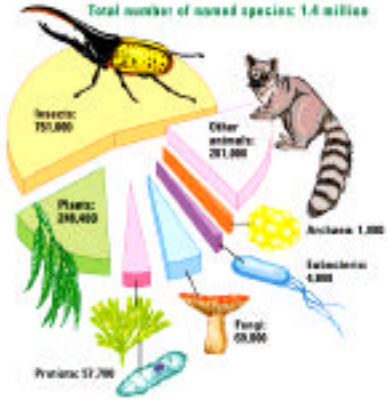
Chapter 22

Macroevolution

Species and their formation



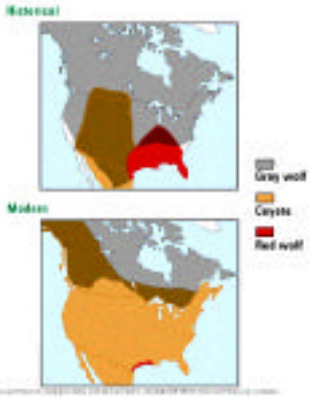
Some species are found to be invalid or synonymous with those already described.

About 27% of mammalian species will become invalid.

This translates into about 38% overestimate of Biodiversity

Proc Natl. Acad. Sci. 99, 3706 (2002)

Species?



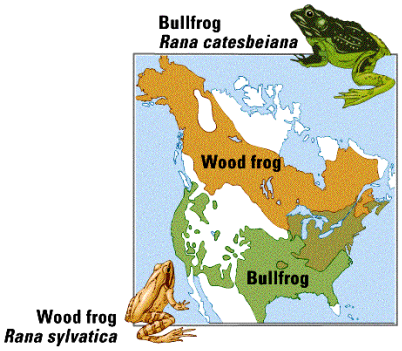
Unrelated robins

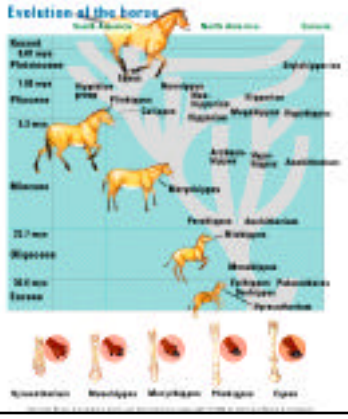
Sunflower's characteristics depend on water and light

Defining "species"

- ✓1942 Mayr -
  - ✒"Groups of actually or potentially interbreeding populations, which are reproductively isolated from other such groups."
- ✓The largest unit of a population of similar organisms in which gene flow is possible.

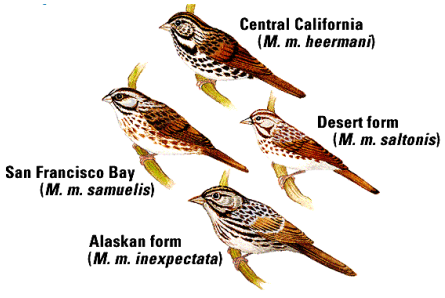
These two species look different from each other and do not interbreed





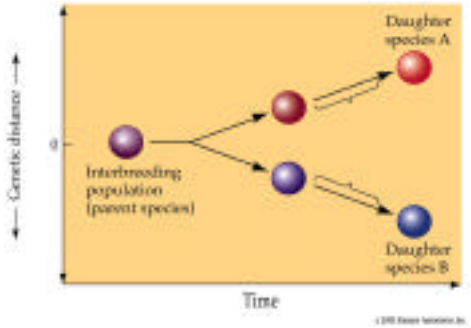
Species definition does not apply to fossils

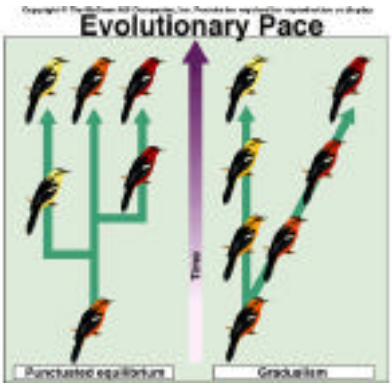
Races or subspecies



Subspecies of the song sparrow, *Melospiza melodia*

Formation of species

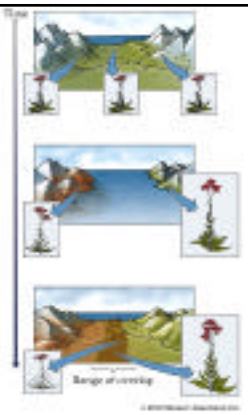




Geography and gene flow

- ✓Allopatric speciation *(away from)*
  - ✒Geographical isolation
- ✓Sympatric speciation
  - ✒Disruptive selection
    - ☞Daughter species are *with each other*
- ✓Parapatric speciation
  - ✒*Beside* each other
  - ✒contact exists between species
  - ✒Difference in conditions; i.e. soil

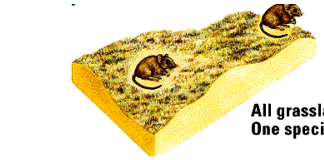
Allopatric speciation or geographical isolation



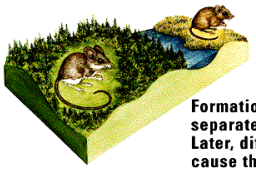
Founders effect lead to allopatric speciation

Geographic barriers

Allopatric speciation

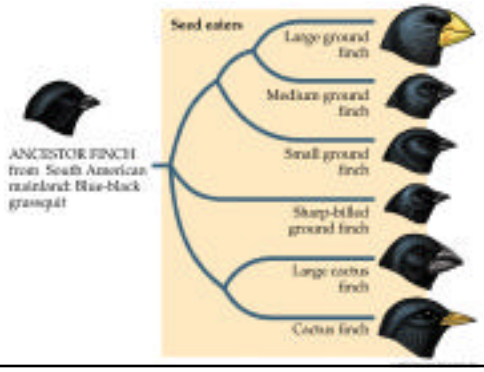


All grassland.
One species of mouse.

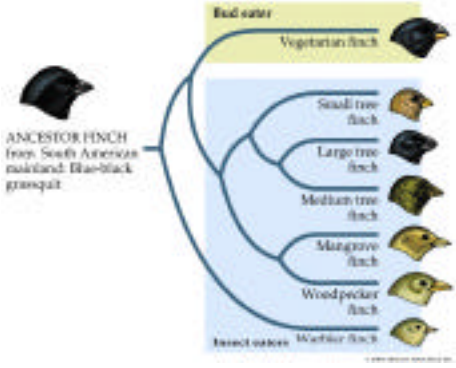


Formation of a river
separates the mice.
Later, differences in habitat
cause the two species to diverge.

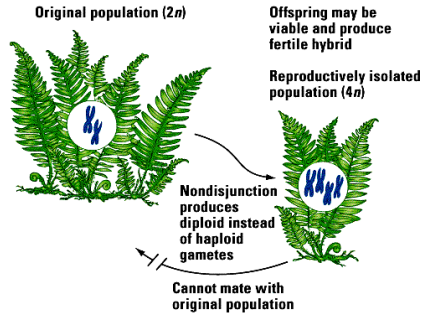
Founders effect

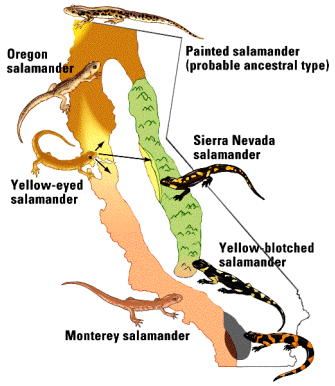


Founders effect



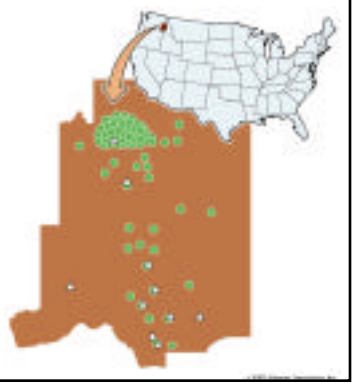
Sympatric speciation - Reproductive isolation by polyploidy - postzygotic





Sympatric speciation

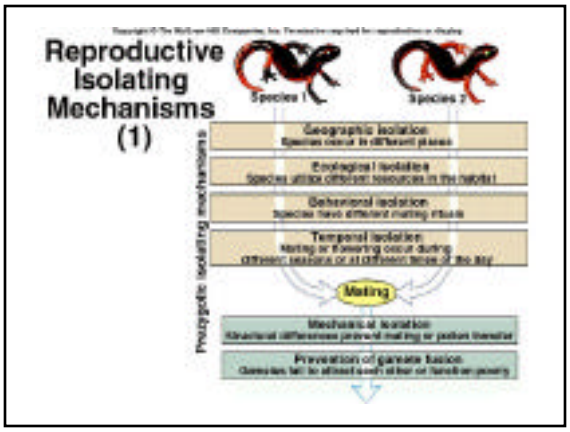
Sunflower tetraploids

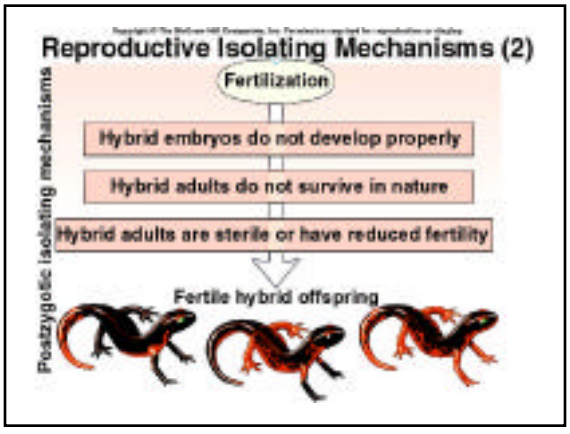


Parapatric

✓Plants growing on mine tailings

- ✒Grasses
- ✒Poor soils





Barriers that isolate populations

✓Prezygotic barriers prevent syngamy.
- ✒Ecological isolation (spatial)
- ✒Temporal isolation (mating periods)
- ✒Behavioral isolation (Mating rituals)
- ✒Mechanical isolation (differences in reproductive organs)
- ✒Gametic isolation (sperm / egg incompatibilities)

✓Postzygotic barriers make the zygote inviable
- ✒Hybrid zygote abnormality (zygote dies)
- ✒Hybrid infertility (Sterile offspring)
- ✒Hybrid is weak
- ✒Hybrid has only one viable sex

Reproductive Isolation

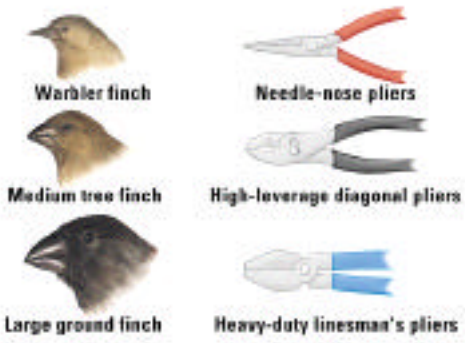
prezygotic

Patterns of descent

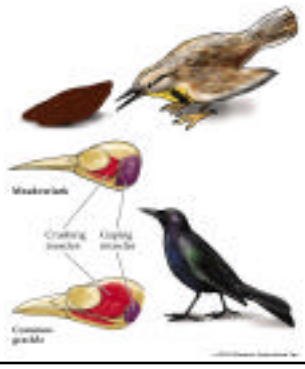
✓Divergent evolution
- ✒Separation of one species into two species.
- ✒Adaptive radiation

✓Convergent evolution
- ✒Independent development of similar features.

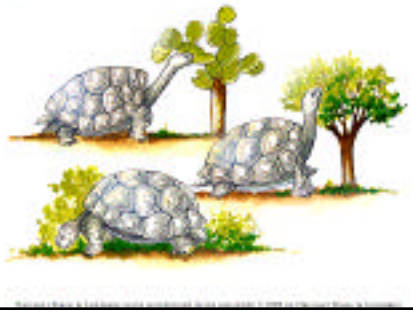
Adaptive radiation



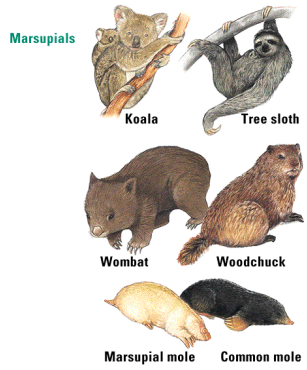
Gaping muscles in blackbirds



Galápagos tortoise

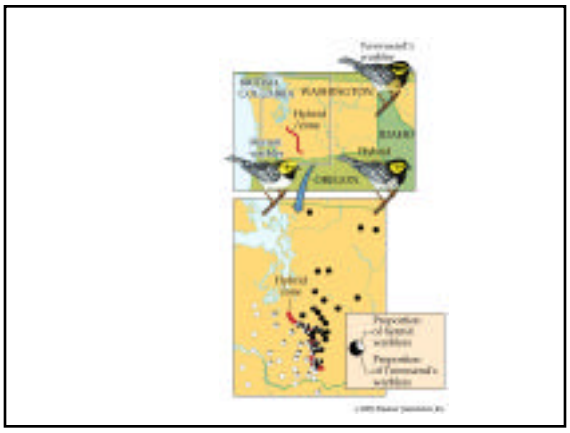


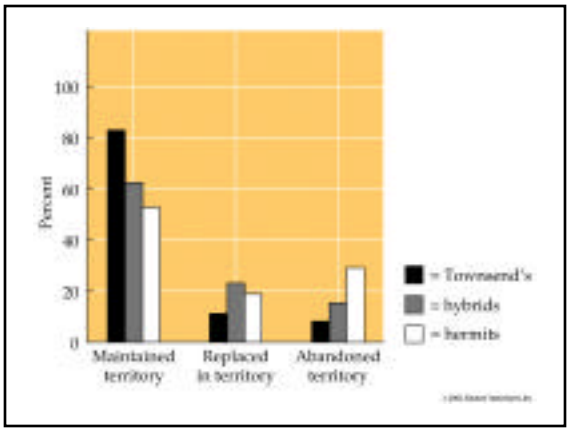
Convergent evolution



Convergent Evolution

Convergent evolution


WASHINGTON
OREGON
Hybrid zone
Hybrid zone
Proportion of hybrid warblers
Proportion of Townsend's warblers


Percent
100
80
60
40
20
0
Maintained territory
Replaced in territory
Abandoned territory
= Townsend's
= hybrids
= hermits


Allele A
Allele B
Parking lot
Store

Speciation related to climate