

# Species & Speciation

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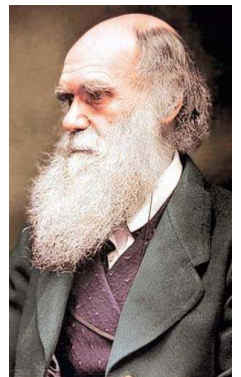


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"In short, we shall have to treat species in the same manner as those naturalists treat genera, who admit that genera are merely artificial combinations made for convenience. This may not be a cheering prospect; but we shall at least be free from the vain search for the undiscovered and undiscoverable essence of the term species."

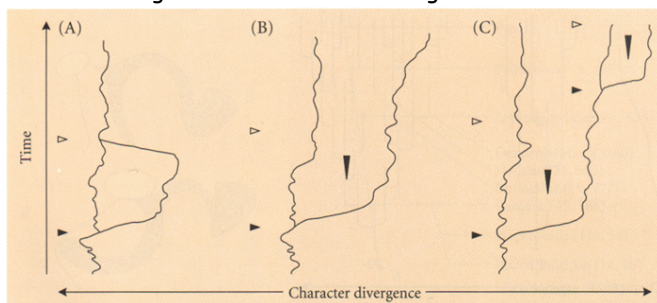


Darwin 1859

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**Microevolution**  
- of populations  
- experimental  
- anagenesis

**Macroevolution**  
- taxonomic diversity  
- paleontology  
- cladogenesis



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## Folk Concept



- Reproductive compatibility
- Discontinuity

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Species = L. "kind"



Raven



Crow

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## Reproductive Isolation

prezygotic  
• extrinsic

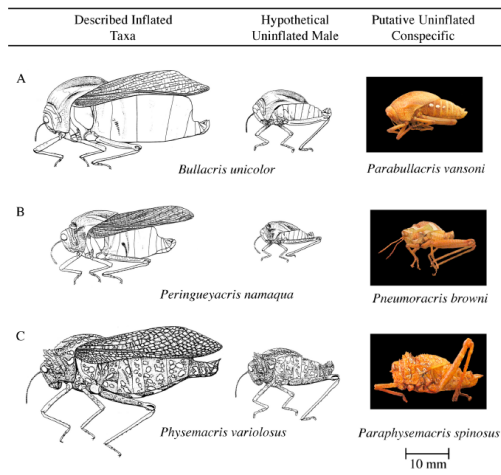
• mate  
discrimination  
• gametic  
incompatibility

postzygotic  
hybrid -

• inviability  
• sterility  
• breakdown



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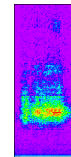


Donelson et al, unpubl.

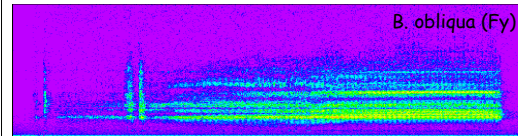
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Freq.  
(kHz)

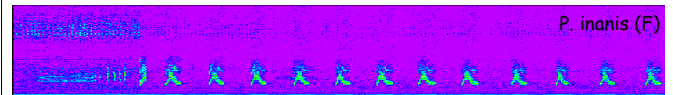
Time (ms)



Ph. variolosus (Fy)



B. obliqua (Fy)



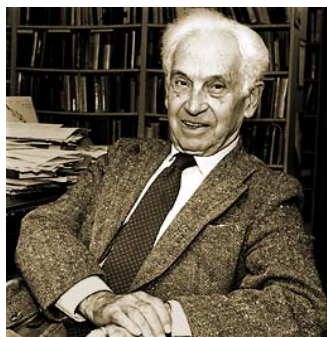
P. inanis (F)

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## Biological Species Concept (BSC)

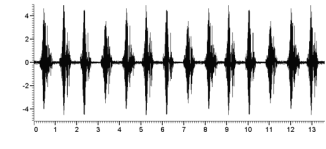
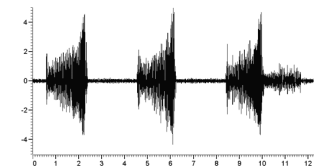
Species are groups of actually, or potentially, interbreeding natural populations that are reproductively isolated from other such groups.

Mayr, 1942



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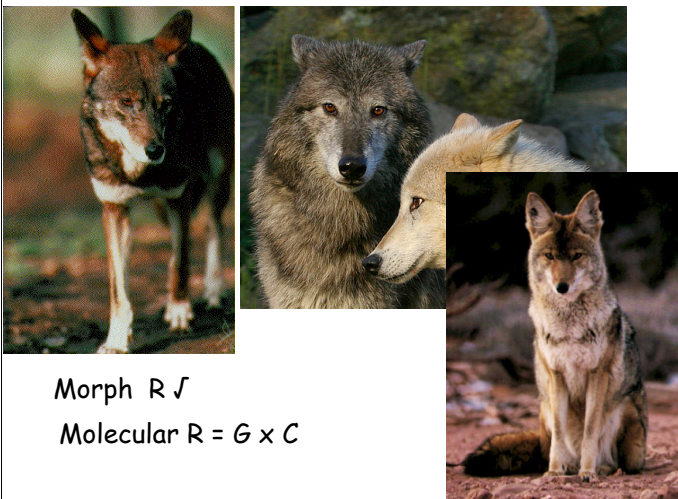
Cryptic species



Chrysoperla (lace wings)

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## Problems

- Limited domain of application
- Inapplicable in practice

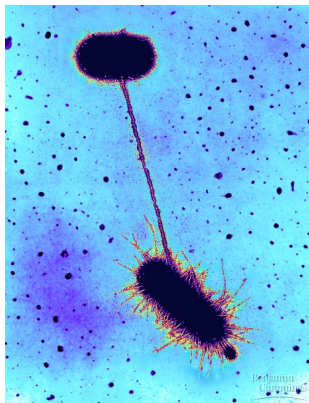


Bluegill sunfish

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## Problems

- Limited domain of application



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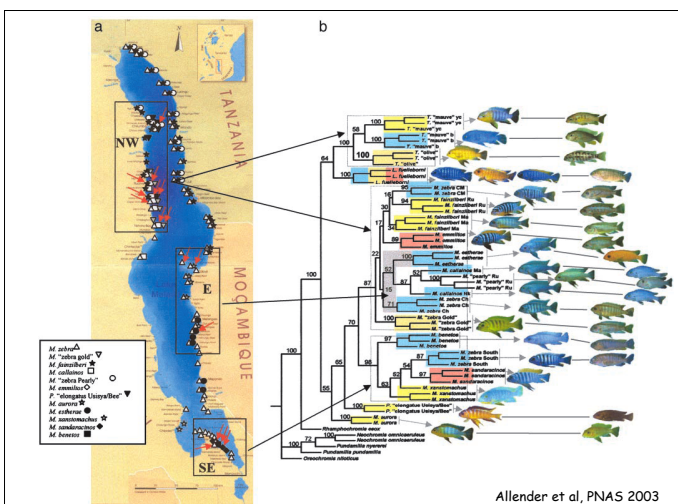
## Problems

- Limited domain of application
- Inapplicable in practice
- Breeding experiments often inconclusive



Bluegill sunfish

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## Problems

- Limited domain of application
- Inapplicable in practice
- Breeding experiments often inconclusive
- Groups which don't co-occur in time cannot be evaluated



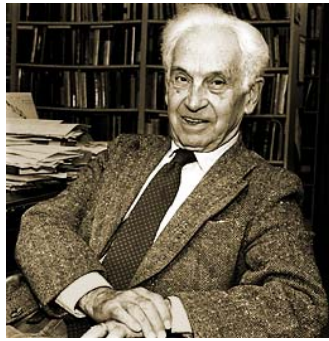
Bluegill sunfish

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## Biological Species Concept (BSC)

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Mayr, 1942



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## Alternatives:

Biological SC  
Evolutionary/ Phylogenetic SC  
Morphological SC  
Recognition SC  
Cohesion SC  
Ecological SC  
Internodal SC .....etc, etc

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In practice...

Introduce other factors e.g. ecology, phenetics

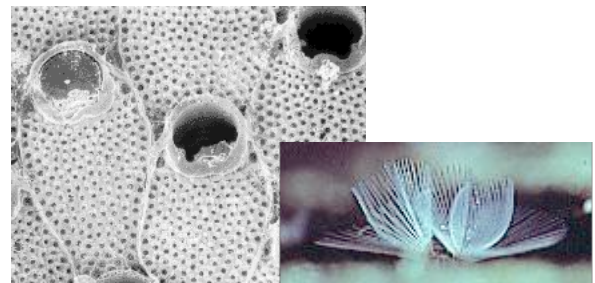
"....a reproductive community of populations (reproductively isolated from others) that occupies a specific niche in nature."

E. Mayr

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## Morphospecies Concept

"....the smallest groups that are consistently and persistently distinct and distinguishable by ordinary means." Cronquist 1988



utility test - correspondence of morphospecies & proteins in 8 spp of Bryozoa

Jackson & Cheetham 1994

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## The Species Problem(s)...

1. Necessary properties (separately evolving lineage)

2. Processes responsible (cluster concept)

3. Methods for inferring limits

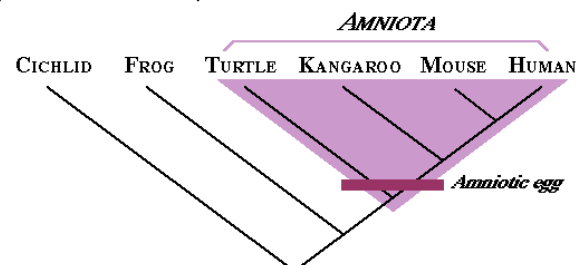


De Queiroz, K. (2005)  
Different species problems and their resolution.  
BioEssays 27: 1263-1269

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## Phylogenetic Species Concept (PSC)

Defn: A phylogenetic species is an irreducible (basal) cluster of organisms diagnosably different from other such clusters, and within which there is a parental pattern of ancestry and descent (Cracraft, 1989).

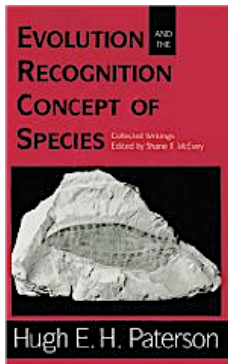


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## Recognition Species Concept (SMRS)

Hugh Paterson 1985



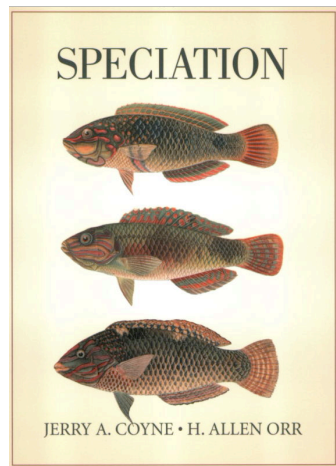
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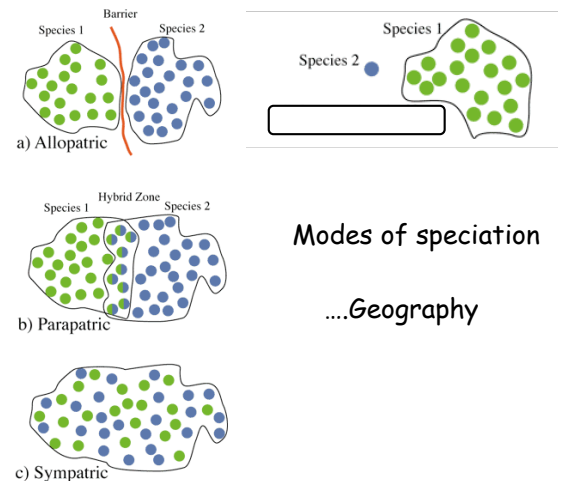
*Aulonocara stuartgranti*

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Recognizing  
speciation events  
depends on ones defn



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### Diverse Cichlid Fishes of Lake Malawi



*Genyochromis mento*:  
eats fish scales and fins



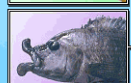
*Caprichromis orthognathus*:  
eats baby fish and eggs



*Trematocranus placodon*:  
eats mollusks



*Rhamphochromis*:  
eats small fish



*Melanochromis labrosus*:  
eats insect larvae



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## ... Mechanism

### 1. Reduce gene flow

vicariance, dispersal, polyploidy

### 2. Genetic & ecological divergence

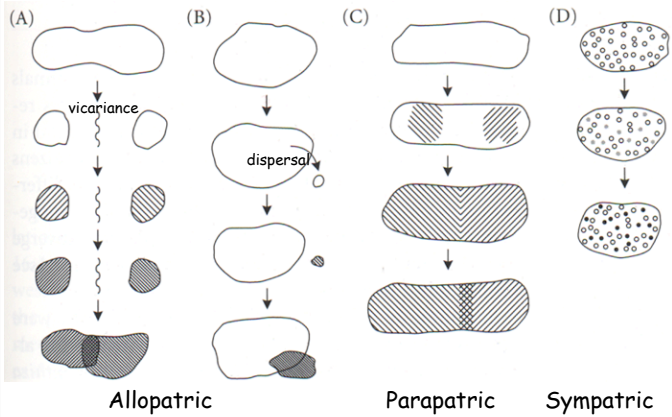
drift, NS, SS

### 3. Reproductive isolation

Reinforcement, hybridization

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## Stage 1: reduction of gene flow



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## • Dispersal

e.g. Hawaiian *Drosophila*

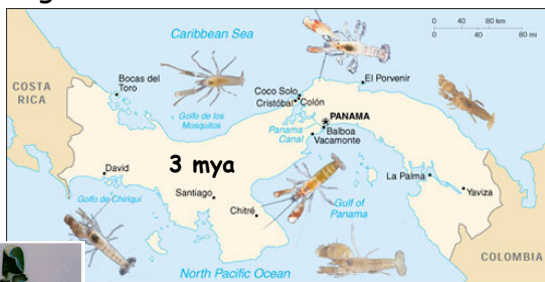
• high ecological diversity

• Origin - Founder H<sup>o</sup>  
(Mayr's peripatric speciation)



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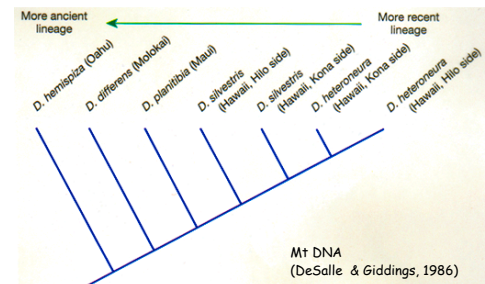
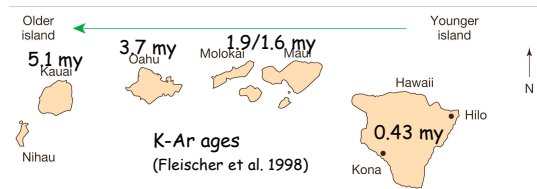
## Reduced gene flow....



• Vicariance  
snapping shrimp

Knowlton et al, 1993

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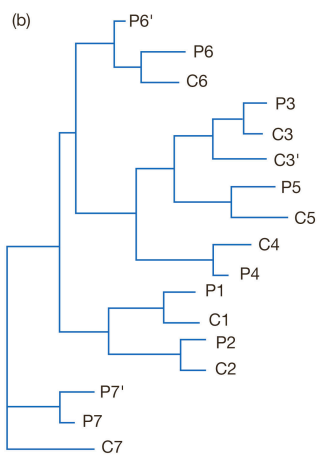
C = Caribbean Sea



P = Pacific/Panama

Behavioral expts  
(Aggro or Mating?)

Seq divergence 6.5-19%  
' cryptic  
1-4 shallow  
6-7 deep



Mt tree for 7 prs of sister taxa

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