

Species Concepts

- Agamospecies
- Biological Species*
- Cladistic Species
- Cohesion Species*
- Composite Species
- Ecological Species*
- Evolutionary Significant Unit*
- Genealogical Concordance
- Genetic Species*
- Genotypic Cluster
- Hennigan Species*
- Internodal Species
- Morphological Species
- Non-dimensional Species
- Phenetic Species
- Phylogenetic Species (Diagnosable version)*
- Phylogenetic Species (Monophyly version)
- Phylogenetic Species (Diagnosable and monophyly version)
- Polythetic Species
- Recognition Species*
- Reproductive Competition*
- Successional Species
- Taxonomic Species

*Concepts that reference biological processes (e.g. reproduction and competition) that occur among organisms within species (and less so between species) and that contribute to a shared process of evolution within species.

Essentialist or Typological Species Concept

- Aristotle
 - Subdivided nature into Natural Kinds: discrete groups of organisms which are unchangeable and eternal.
 - Groups were distinguished on the basis of defining characters. If a group could not be subdivided, it was a species.
 - Species stretched infinitely into the past and into the future
- Linnaeus
 - Built upon Aristotle's concept to structure a classification scheme
- Species are fixed, immutable entities

Three general views:

- Species are real and the unit that evolves
- Species are not real and it is breeding populations that evolve (hence, no definition is really required)
- Species are not real but they are the theoretical unit of evolution (hence a definition is required)

Biological Species Concept (BSC)

- The concept of discrete, immutable and eternal natural kinds is contrary to the Darwinian view of natural selection operating on the variation between and within members of a population.
- Ernst Mayr
 - First proposed his species concept in 1942
 - Groups of actually or potentially interbreeding natural populations which are reproductively isolated from other such groups (1963).

Ways to classify species concepts

- Prospective or retrospective?
 - Prospective: invokes criteria that have implications for the future status of populations.
 - Retrospective: species are the end products of speciation.
- Mechanistic or historical?
- Character based or history based?
- Intrinsic or Extrinsic?

Ways to classify species concepts

- Prospective or retrospective?
- Mechanistic or historical?
 - Mechanistic: begins with a theory of how speciation (evolution) works
 - Historical: focuses on the outcome of evolution
- Character based or history based?
- Intrinsic or Extrinsic?

Ways to classify species concepts

- Prospective or retrospective?
- Mechanistic or historical?
- Character based or history based?
 - Species definition should rely simply on characters with no prior inference of historical relationships
 - Defined using the inferred historical relationships (genealogy) among component organisms
- Intrinsic or Extrinsic?

Ways to classify species concepts

- Prospective or retrospective?
- Mechanistic or historical?
- Character based or history based?
- Intrinsic or Extrinsic?
 - Intrinsic: barriers to gene exchange are from the organism
 - Extrinsic: barriers to gene exchange may be from the environment (may be ephemeral and thus not necessarily predictive)

Recognition Species Concept (RSC)

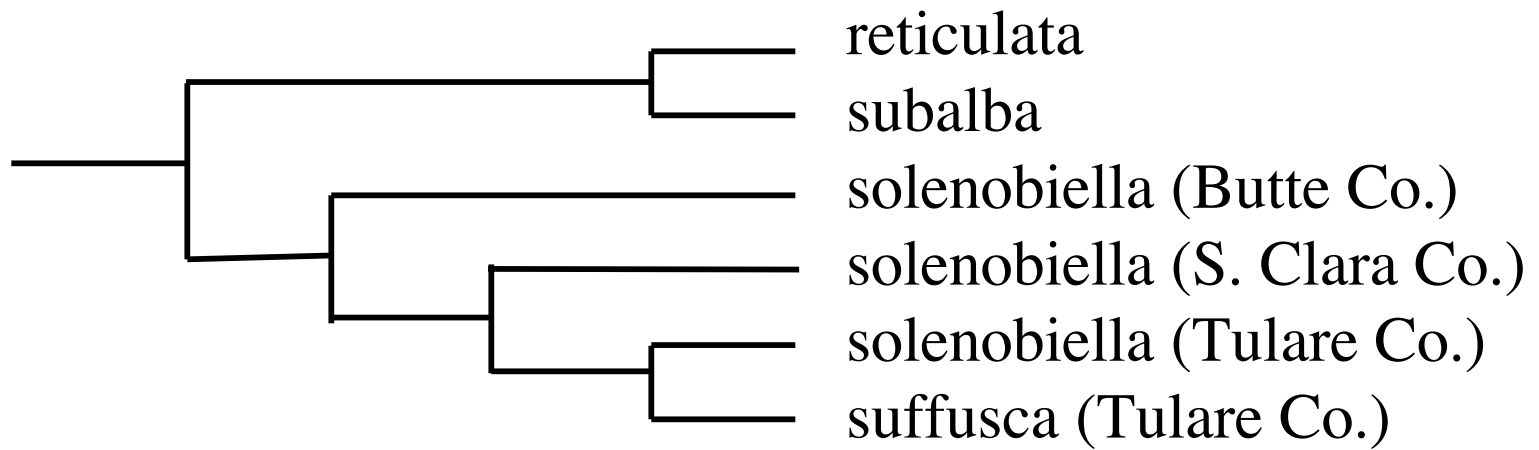
- The most inclusive population of individual biparental organisms which share a common fertilization system (specific mate recognition system)
 - Patterson 1985

Cohesion Species Concept

- The most inclusive population of individuals having the potential for phenotypic cohesion through intrinsic cohesion mechanisms
 - Templeton 1989
- Cohesion can be genetic (as in BSC and RSC) or demographic. Groups of organisms are demographically exchangeable if they are ecologically equivalent (occupy the same niche).

Phylogenetic Species Concept

- An irreducible (basal) cluster of organisms, diagnosably distinct from other such clusters, and within which there is a parental pattern of ancestry and descent
 - Cracraft 1989
- The smallest aggregation of populations (sexual) or lineages (asexual) diagnosable by a unique combination of character states in comparable individuals
 - Nixon and Wheeler 1990



Species of moths of the genus *Greya*.

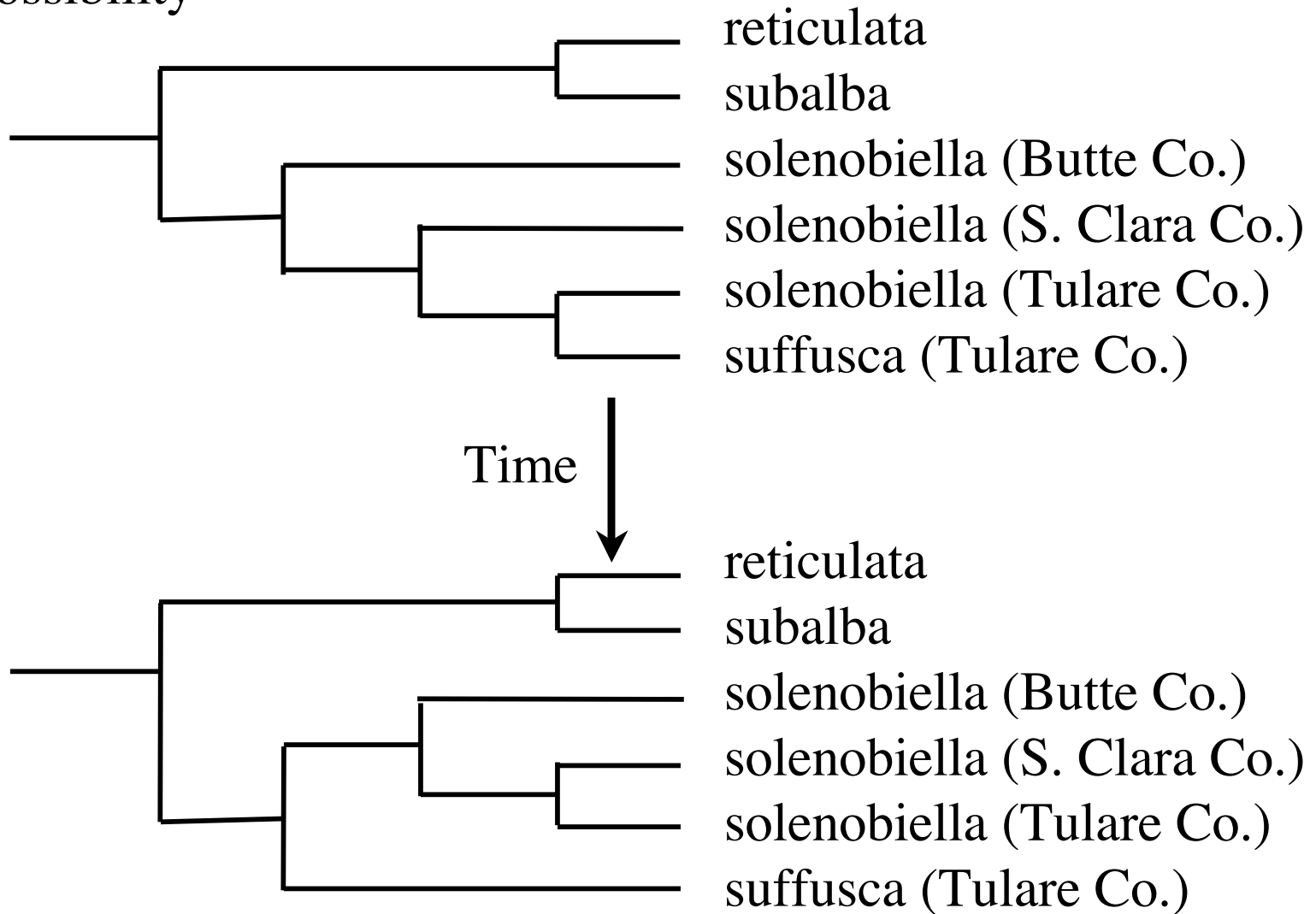
Genealogical Species Concept

- Exclusive group of organisms, where an exclusive group is one whose members are all more closely related to each other than to any organisms outside the group
 - Baum and Shaw 1995
- Not very different from the phylogenetic species concept, except in emphasizing genes to a greater degree

Evolutionary Species Concept

- A single lineage of ancestor-descendant populations which maintains its identity from other such lineages and which has its own evolutionary tendencies and historical fate
 - Wiley 1978

One possibility



Genotypic Species Concept

- Distinguishable groups of individuals that have few or no intermediates when in contact
- Clusters are recognized by a deficit of intermediates, both at single loci (heterozygote deficits) and at multiple loci (strong correlations or disequilibria between loci that are divergent between clusters)
 - Mallet 1995
- Emphasizes evidence used to recognize species, but places greater emphasis on genetics

How different species concepts work

Characteristics of species				Different species?						
Geography	Mating ritual	Habitat	Hybrids	BSC	RSC	Cohesion	Phylogenetic	Genealogical	Evolutionary	Genotypic
Same	Same	Same	Fertile	No	No	Maybe	Maybe	Maybe	Yes	No
Different	Same	Same	Fertile	No	No	Maybe	Yes	Yes	Yes	Yes
Different	Same	Different	Fertile	No	No	Yes	Yes	Yes	Yes	Yes
Different	Different	Same	Fertile	Maybe	Yes	Maybe	Yes	Yes	Yes	Yes
Different	Same	Same	Sterile	Yes	No	Yes	Yes	Yes	Yes	Yes

Species concept classification

Species concept	Retrospective or prospective	Mechanistic or history based	Character or history based	Intrinsic or extrinsic	Sexually reproducing animals	Plants	Asexual animals	Bacteria	Fossils
Biological	Prospective	Mechanistic	Character	Intrinsic	Yes	Most	No	No	No
Recognition	Prospective	Mechanistic	Character	Intrinsic	Yes	Most	No	No	No
Cohesion	Prospective	Mechanistic	Character	Intrinsic	Yes	Yes	Yes	No	No
Phylogenetic	Retrospective	Historical	Character	Extrinsic	Yes	Yes	Yes	Maybe	Yes
Genealogical	Retrospective	Historical	History	Extrinsic	Yes	Yes	Yes	Maybe	Yes
Evolutionary	Retrospective	Historical	History	Extrinsic	Yes	Yes	Yes	Maybe	Yes
Genotypic	Retrospective	Historical	Character	Extrinsic	Yes	Yes	Yes	Maybe	No