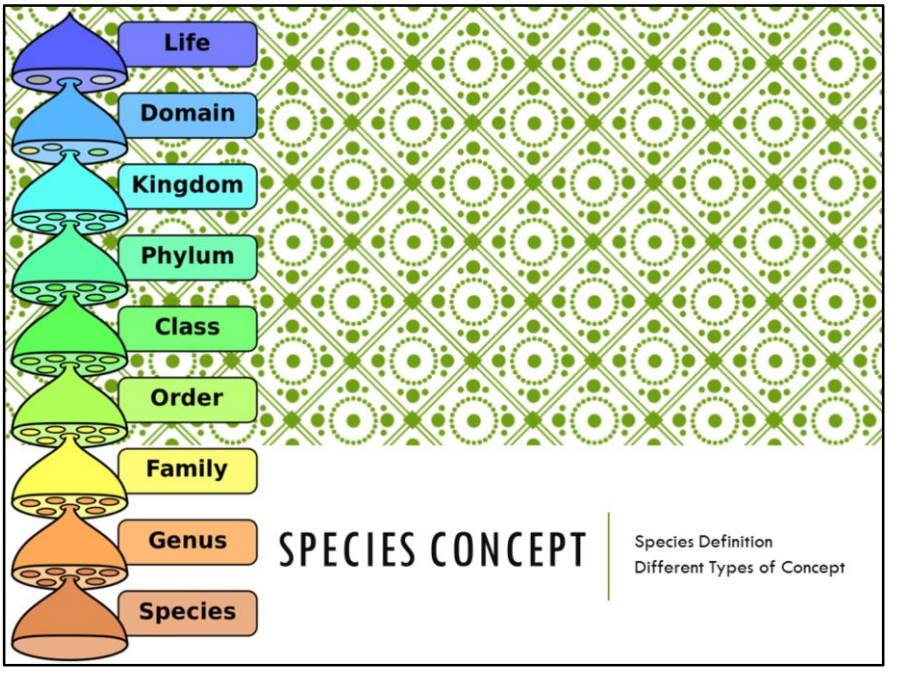

Life
Domain
Kingdom
Phylum
Class
Order
Family
Genus
Species
SPECIES CONCEPT
Species Definition
Different Types of Concept

DEFINITION

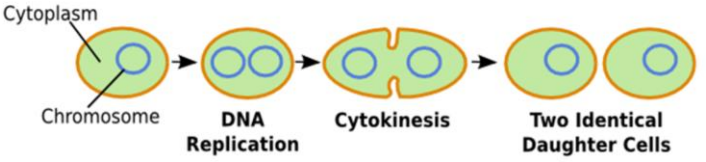
A species is often defined as the largest group of organisms in which two individuals are capable of reproducing fertile offspring, typically using sexual reproduction.

- For example, these happy face spiders look different, but since they can interbreed, they are considered the same species: *Theridion grallator*

SPECIES PROBLEM

There are lots of places where it is difficult to apply this definition.

- For example, many bacteria reproduce mainly asexually. The bacterium shown at right is reproducing asexually, by binary fission.

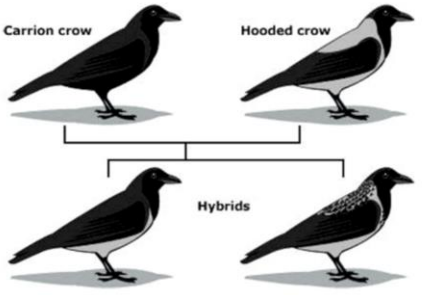


That definition of a species might seem cut and dried, but it is not — in nature, there are lots of places where it is difficult to apply this definition. For example, many bacteria reproduce mainly asexually. The bacterium shown at right is reproducing asexually, by binary fission. The definition of a species as a group of interbreeding individuals cannot be easily applied to organisms that reproduce only or mainly asexually.

SPECIES PROBLEM

Many plants, and some animals, form hybrids in nature.

- For example, Hooded crows and carrion crows look different, and largely mate within their own groups; but in some areas, they hybridize.



Many plants, and some animals, form hybrids in nature. Hooded crows and carrion crows look different, and largely mate within their own groups — but in some areas, they hybridize. Should they be considered the same species or separate species?

If two lineages of oak look quite different, but occasionally form hybrids with each other, should we count them as different species? There are lots of other places where the boundary of a species is blurred. It's not so surprising that these blurry places exist — after all, the Idea of a species is something that we humans invented for our own convenience!

BIOLOGICAL SPECIES CONCEPT

The biological species concept defines a species as members of populations that actually or potentially interbreed in nature, not according to similarity of appearance.

1. Species are groups of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups (Mayr, 1940).
2. A species is a reproductive community of populations (reproductively isolated from others) that occupies a specific niche in nature (Mayr, 1982).
3. Species are the members in aggregate of a group of populations that breed or potentially interbreed with each other under natural conditions (Futuyma, 1986)

APPEARANCE ISN'T EVERYTHING

The Western meadowlark (left) and the Eastern meadowlark (right) appear to be identical, and their ranges overlap, but their distinct songs prevent interbreeding.

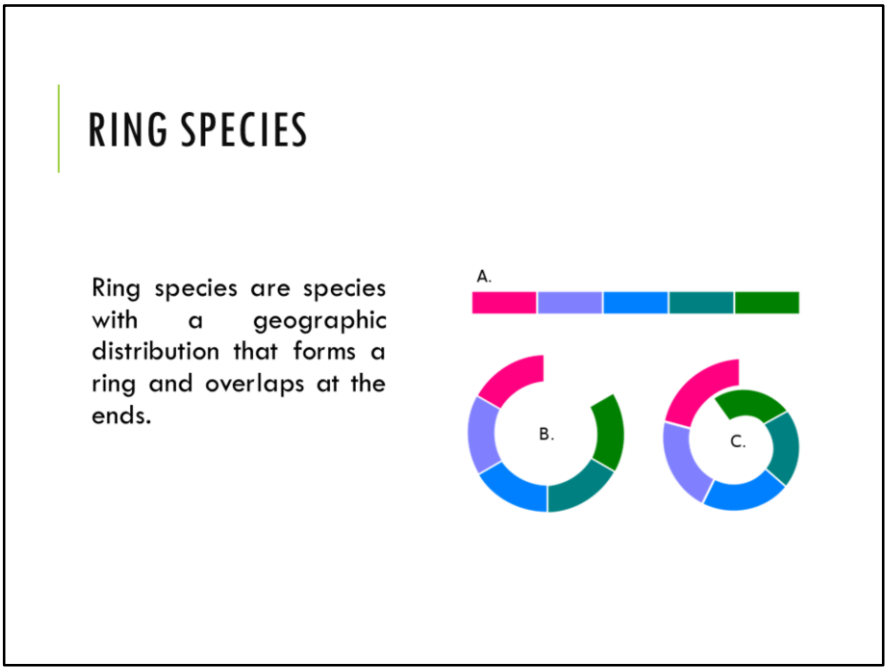
Organisms may appear to be alike and be different species. For example, Western meadowlarks *(Stumella neglecta)* and Eastern meadowlarks *(Stumella magna)* look almost identical to one another, yet do not interbreed with each other - thus, they are separate species according to this definition.

APPEARANCE ISN'T EVERYTHING

Organisms may look different and yet be the same species.

For example, these ants might look like that they are distantly related species. In fact, they are sisters: two ants of the species *Pheldole barbata,* fulfilling different roles in the same colony.

Organisms may look different and yet be the same species. For example, look at these ants. You might think that they are distantly related species. In fact, they are sisters—two ants of the species *Pheldole barbata,* fulfilling different roles in the same colony.



The coloured bars show a number of natural populations, each population represented by a different colour, varying along a cline (a gradual change in conditions which gives rise to slightly different characteristics predominating in the organisms that live along it).

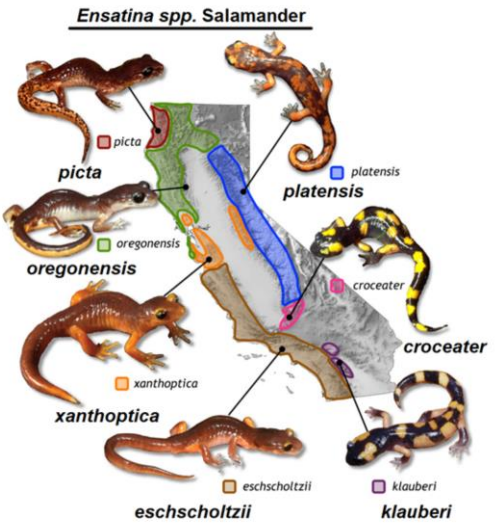
Such variation may occur in a straight line (for example, up a mountain slope) as is shown in A, or may bend right around (for example, around the shores of an ocean), as is shown in B. In the case where the cline bends around, populations next to each other on the cline can interbreed, but at the point that the beginning meets the end again, as is shown in C, the differences that have accumulated along the cline are great enough to prevent interbreeding (represented by the gap between pink and green on the diagram). The interbreeding populations in this circular breeding group are then collectively referred to as a ring species.

An **ecotone** is a transition area between two biomes. It is where two communities meet and integrate. It may be narrow or wide, and it may be local (the zone between a field and forest) or regional (the transition between forest and grassland ecosystems). An ecotone may appear on the ground as a gradual blending of the two communities across a broad area, or it may manifest itself as a sharp boundary line.

In biology and ecology, an **ecocline** or simply **cline** (from Greek: κλίνω "to possess or exhibit gradient, to lean") describes an ecotone in which a series of biocommunities display a continuous gradient. The term was coined by the English evolutionary biologist Julian Huxley in 1938.

RING SPECIES

The many subspecies of *Ensatina* salamanders in California exhibit subtle morphological and genetic differences all along their range.



They all interbreed with their immediate neighbors with one exception: where the extreme ends of the range overlap in Southern California, *E. klauberi* and *E. eschscholtzii* do not interbreed.

CHRONOSPECIES

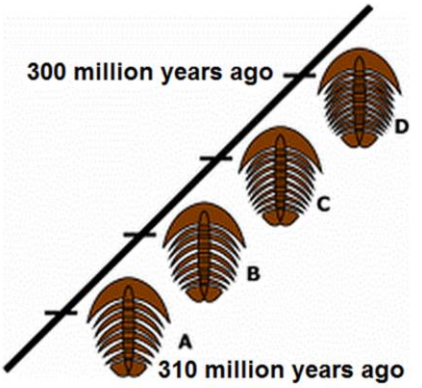
A group of one or more species derived from a sequential development pattern which involves continual and uniform changes from an extinct ancestral form on an evolutionary scale.

- Chronospecies are different stages in the same evolving lineage that existed at different points in time.

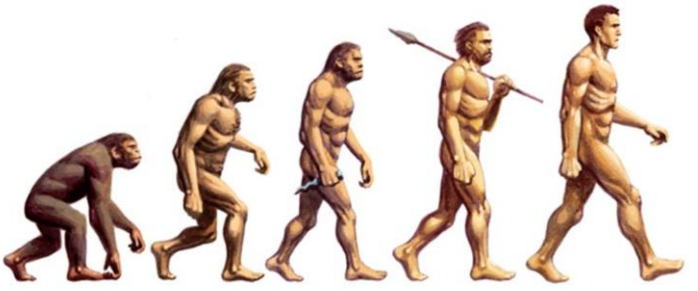
Chronospecies present a problem for the biological species concept

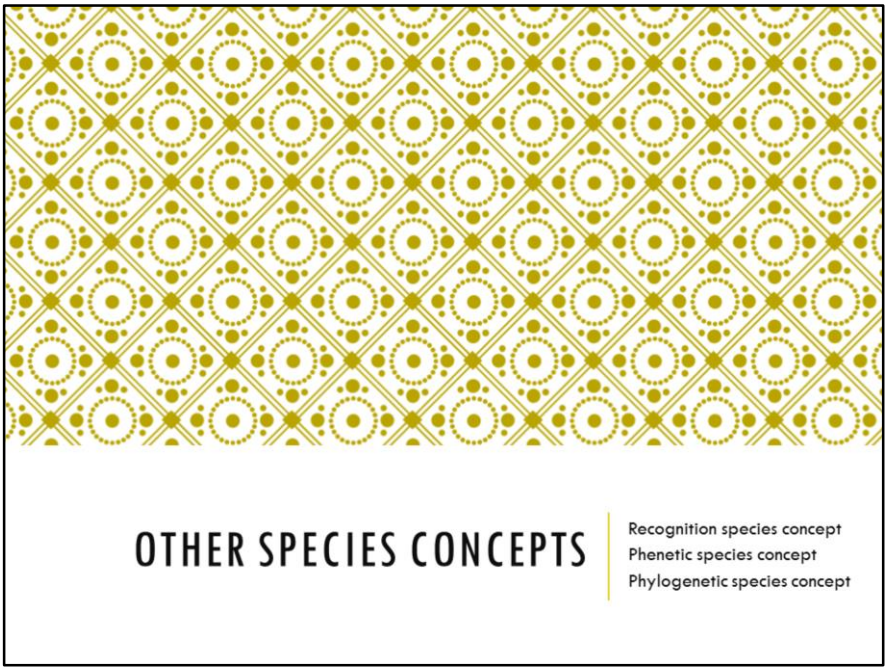
- For example, it is not really possible (or very meaningful!) to figure out whether a trilobite living 300 million years ago would have interbred with its ancestor living 310 million years ago.

CHRONOSPECIES



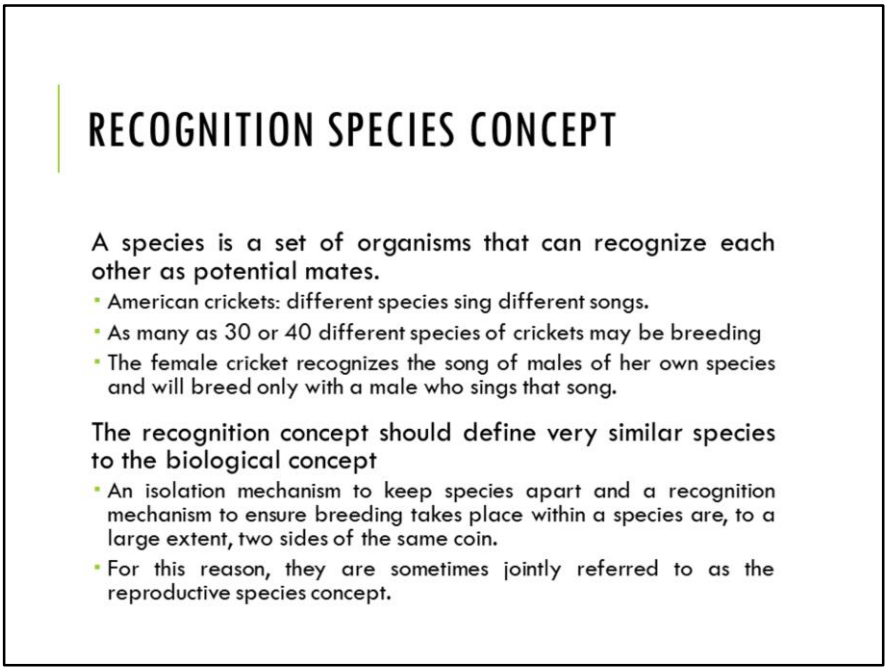
CHRONOSPECIES



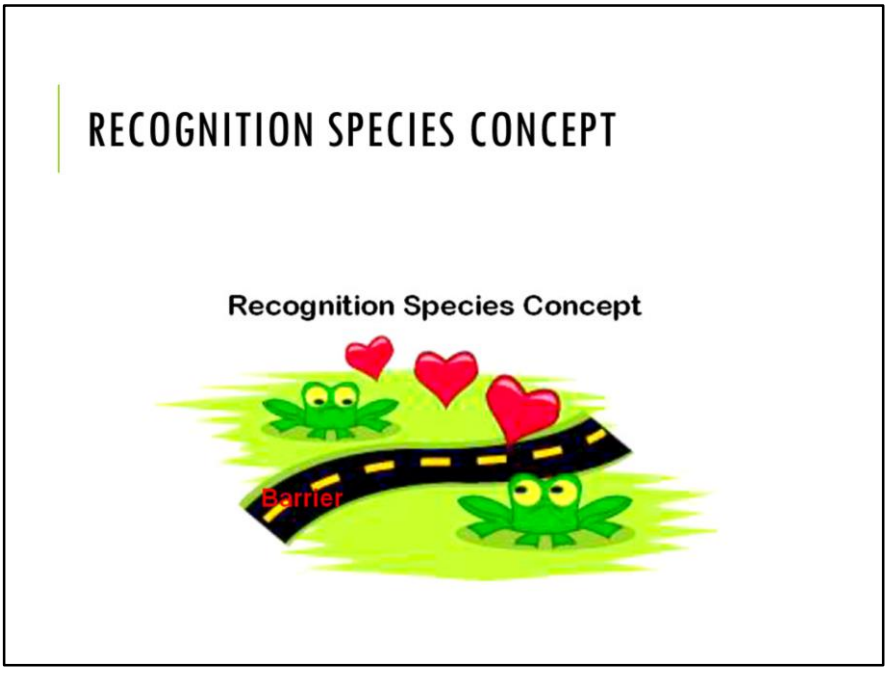


The biological species concept has its limitations (although it works well for many organisms and has been very influential in the growth of evolutionary theory). In order to address some of these limitations, many other "species concepts" have been proposed, such as:

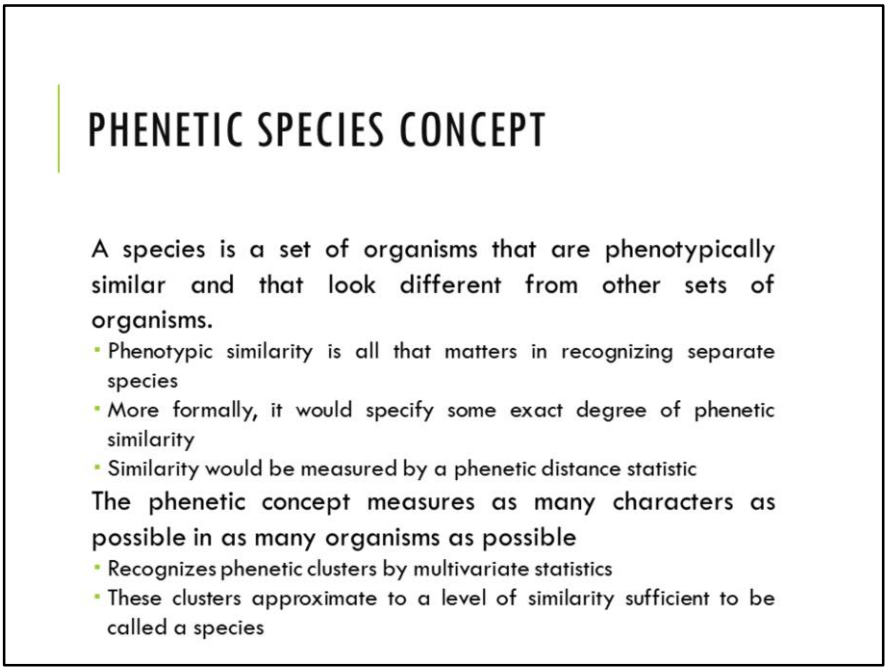
Recognition species concept
Phenetic species concept
Phylogenetic species concept



American crickets: different species sing different songs.
Within a single habitat in the USA, as many as 30 or 40 different species of crickets may be breeding but the female cricket recognizes the song of males of her own species and will breed only with a male who sings that song. The song, and the female recognition of it, constitutes a mate recognition system: the species has a specific mate recognition system by which it can be identified.
The recognition concept should define very similar species to the biological concept: an isolation mechanism to keep species apart and a recognition mechanism to ensure breeding takes place within a species are, to a large extent, two sides of the same coin. For this reason, they are sometimes jointly referred to as the reproductive species concept.



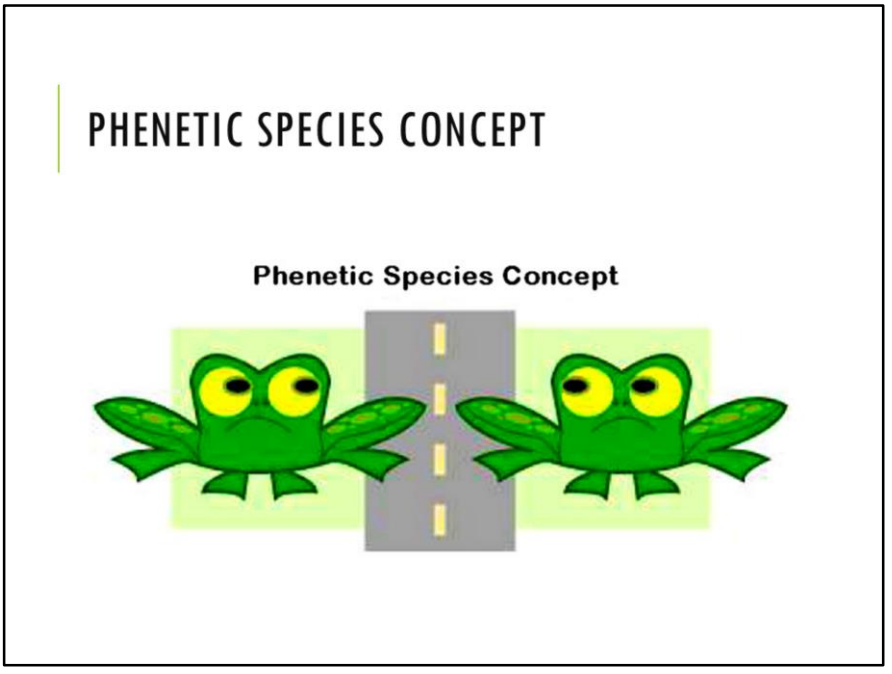
Even though these two frogs have been prevented from mating, the fact that they recognize each other as potential mates makes them the same species under the recognition species concept.



More formally, it would specify some exact degree of phenetic similarity, and similarity would be measured by a phenetic distance statistic.

In practice, the phenetic concept measures as many characters as possible in as many organisms as possible, and then recognizes phenetic clusters by multivariate statistics. These clusters approximate to a level of similarity sufficient to be called a species.

The phenetic species concept can be criticized on theoretical grounds and should be compared with the biological, ecological and recognition species concepts.



Since the frogs depicted here look the same — even though they are prevented from mating with each other — they would be considered the same species according to the phenetic species concept.

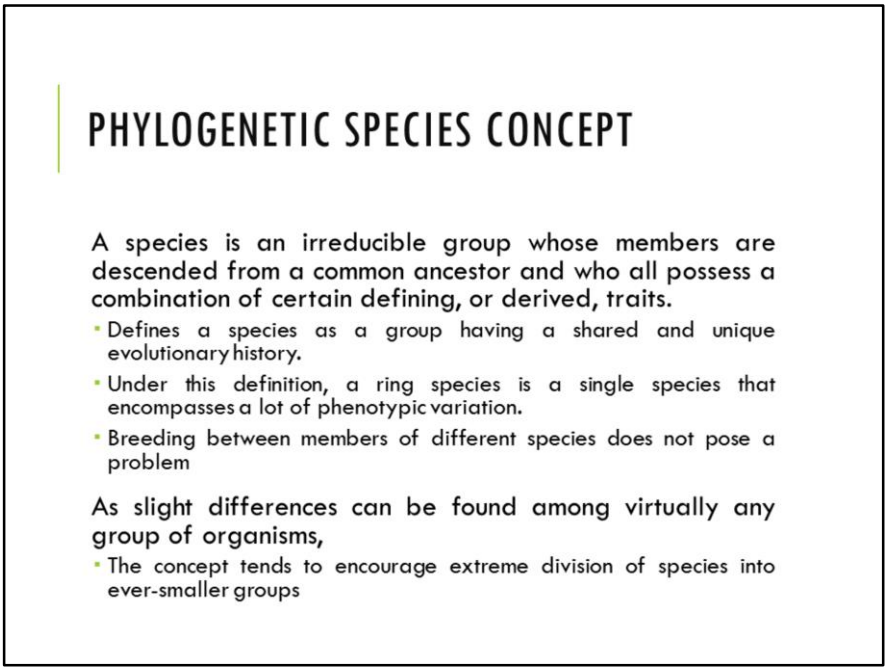
ECOLOGICAL SPECIES CONCEPT

An ecological species is a set of organisms belonging to a single or closely related lineages that basically occupy the same niche in an ecosystem, i.e., have the same habitat and the same habits and needs for physical resources and conditions to survive.

- Different species use ecological resources differently
- They do so to become divergent in aspect, behavior and location
- Leading to isolating from one another as a species

Maybe they would be able to interbreed, but it doesn't use to happen because of their different locations or time of mating.

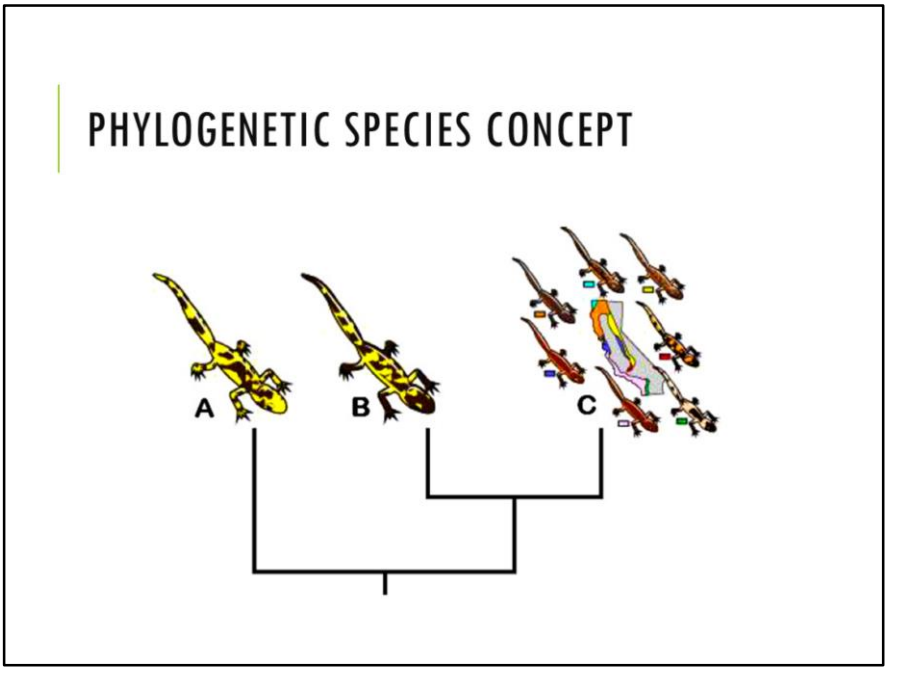
Two species of giant roundworms, *Ascaris lumbricoides* and *A. suum*, are very closely related and similar in shape, but the first is a parasite of humans and the latter a parasite of pigs, so that they are isolated from each other for using different habitats.
Another example are the grizzly bear *Ursus arctos* and the polar bear *Ursus maritimus*. Even though living in different habitats and having different behaviors, including the fact that the grizzly tends to mate on land while the polar mates in the water, several hybrids have been reported, including wild ones, and they are fertile, so that by the biological concept, they would belong to a single species, even though by ecological aspects they are quite different ones.



Phylogenetic species concept (PSC) The concept of a species as an irreducible group whose members are descended from a common ancestor and who all possess a combination of certain defining, or derived, traits (see apomorphy). Hence, this concept defines a species as a group having a shared and unique evolutionary history.

It is less restrictive than the biological species concept, in that breeding between members of different species does not pose a problem. Also, it permits successive species to be defined even if they have evolved in an unbroken line of descent, with continuity of sexual fertility.

However, because slight differences can be found among virtually any group of organisms, the concept tends to encourage extreme division of species into ever-smaller groups.



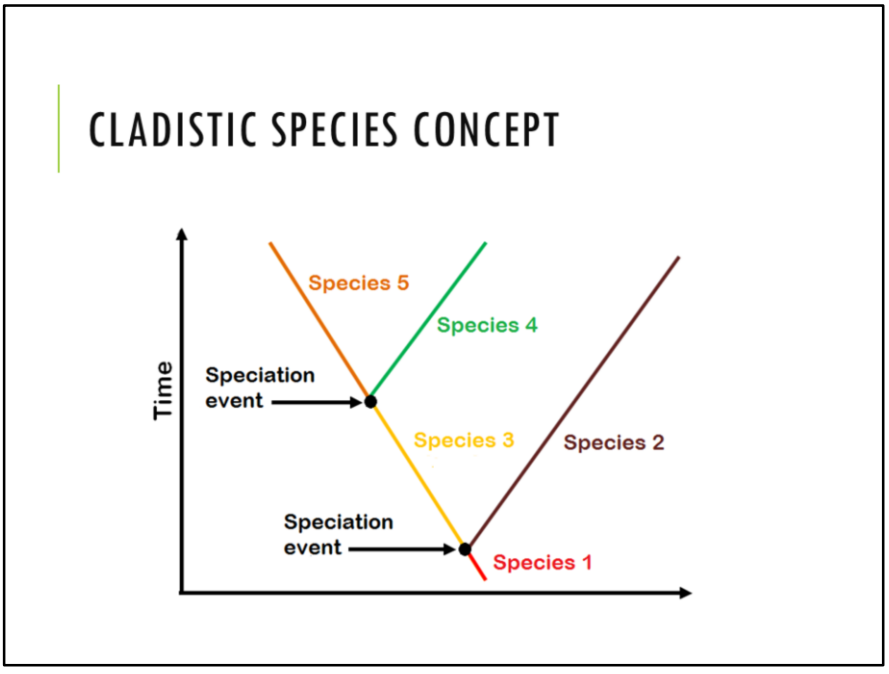
Ensatina salamander lineages A and B are separate species. Each has a common ancestor that Individuals of other species do not. Even though it has diversified a lot, Lineage C Is a single species, according to the phylogenetic species concept. None of the subspecies of Lineage C has a single common ancestor separate from the other subspecies.

CLADISTIC SPECIES CONCEPT

A species as a set of organisms between two speciation events, or between one speciation event and one extinction event.

According to this, a species comes to exist when a lineage of organisms is split in two.

- When a speciation event occur, the ancestral species becomes extinct, giving rise to two new species.



Cladistic concept: every time a speciation event occur, two new species are created and the ancestral species becomes extinct.

EVOLUTIONARY SPECIES CONCEPT

An evolutionary species is defined as a set of organisms from a single lineage that has its own evolutionary tendencies and historical fate.

Unlike cladistic species, the evolutionary species does not necessarily become extinct when another lineage split from it

- Able to be paraphyletic, i.e., if a population is divided in two, the one that continues to have the same general features and the same evolutionary path is considered the same species as the ancestral one.

EVOLUTIONARY SPECIES CONCEPT