

Development and evolution

Ecological succession or ecosystem development:
Community development over the short term (1000 years or less). Involves changes in both the organisms and the physical environment.

Organic evolution: changes over geological times (millions of years).

Stages of ecological succession:

Seral stages: at the beginning, temporarily or pioneer communities colonize the area

gradually more permanent communities develop

Climax stage: metabolically balanced stage takes over

regional climate

soil structure

topography

water conditions

} Important factors

EXAMPLE: Pattern of ecological succession

Time in years

1-10

20-25

25-100

>100

grassland

shrubs

Pine forest

Hardwood forest

Grasshopper sparrow

Field sparrow

Downy woodpecker

Yellowthroat

Pine warbler

cardinal

Number of common species 2

8

15

19

Density(pairs per acre) 27

123

113

233

Types of succession

Primary succession: succession that begins on a sterile site

Sand dune, lava flow

Slow, >1000 years for forest

Secondary succession: community development on sites previously occupied by well developed communities or sites with favorable conditions

Abandoned cropland, cut forest

Fast, <500 years for forest

Autotrophic succession:

begins in predominantly inorganic environment

early and continued dominance of green plants

Energy does not necessarily decline, is usually sustained or increased

Heterotrophic succession:

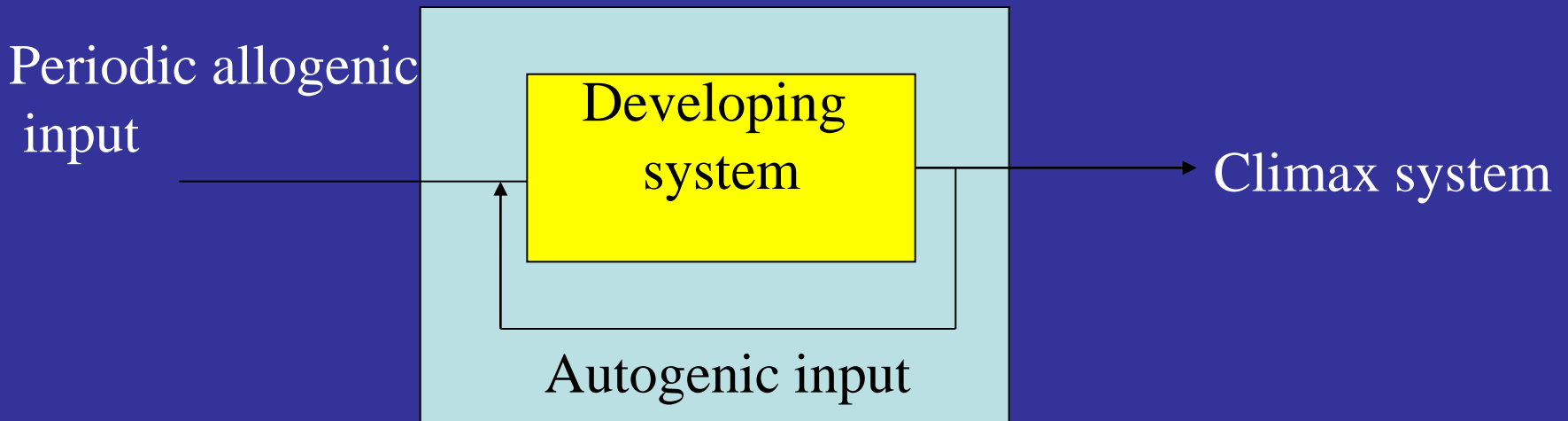
Begins in primarily organic environment

early dominance of heterotrophs

energy is maximum at the beginning and declines in time

unless additional organic matter is imported

Models of ecosystem development



Autogenic: internal; drive the system toward equilibrium

Allogenic : periodic external; disrupt progress toward equilibrium
(sewage dump)

Aging and cyclic succession

Even without external perturbations, the climax stage may not remain unchanged.

Aging:

Old Forest: self destructive biological processes:

 lack of replacement of old trees by young ones

 lagging of nutrient regeneration

 slowing down of metabolism

Cyclic succession:

Disease, fire, storms, death of community at or before climax,
and start of a new cycle of seral stages,

Chaparral fires

The Mechanism of Evolution

Organic evolution: Change in organisms with time

Involves long term development from simpler to the more complex or better adopted conditions.

Natural selection: Individuals that are best able to survive and produce the most offsprings are selected by natural processes to populate the next generation.

Survival of fittest (Darwin)

Fitness:

Organism vs organism: competition

Organism vs environment: mutualism

To survive, an organism does not compete with environment, as it might with another organism, but must adopt to or modify *its environment and its community* in a cooperative manner.

Darwin:

Evolutionary change is slow,
Small changes and mutations in gene structure
Accompanied by natural selection, those individuals should survive

However

There are gaps in the fossil records for the transitional forms

Punctuated equilibrium:

A small population splits off and rapidly evolves into entirely different species without transitional forms being deposited in the fossil record.
(A macroevolutionary leap) no good explanation yet.

Speciation

The formation of new species and the development of species diversity

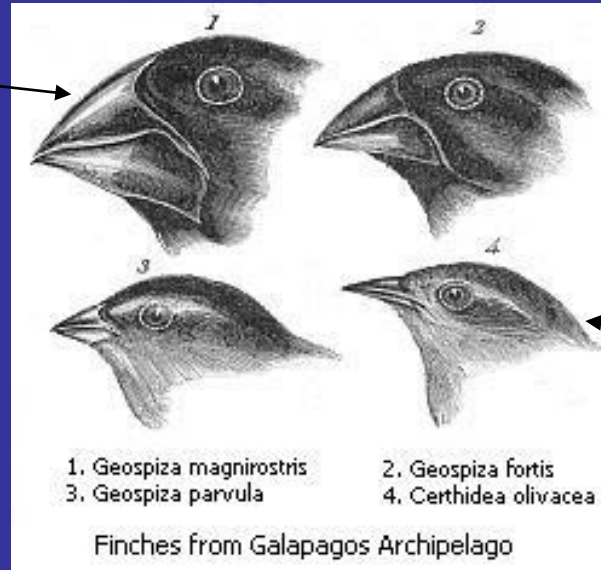
occurs when gene flow within a common pool is interrupted by an isolating mechanism.

Allopatric speciation, also known as geographic speciation, is the phenomenon where huge biological populations are physically isolated by an extrinsic barrier and evolve intrinsic (genetic) reproductive isolation, such that if the barrier breaks down, individuals of the populations can no longer interbreed.

Evolutionary biologists agree that allopatry is a common way that new species arise. (The word is derived from Greek *allos*, "other" + Greek *patrā*, "fatherland".)

the frequency of other types of speciation, speciation, such as parapatric, peripatric and sympatric speciation, is debated.

Seed eater



Insect eater



Ecology, Eugene P. Odum, Sinauer Associates, Inc., Rev. Ed. of 2nd Ed. 1993

The birds are all about the same size (10–20 cm). The most important differences between species are in the size and shape of their beaks, and the beaks are highly adapted to different food sources. The birds are all brownish or black. Their behaviour differs, and they have different song melodies.

Evolution of the biosphere

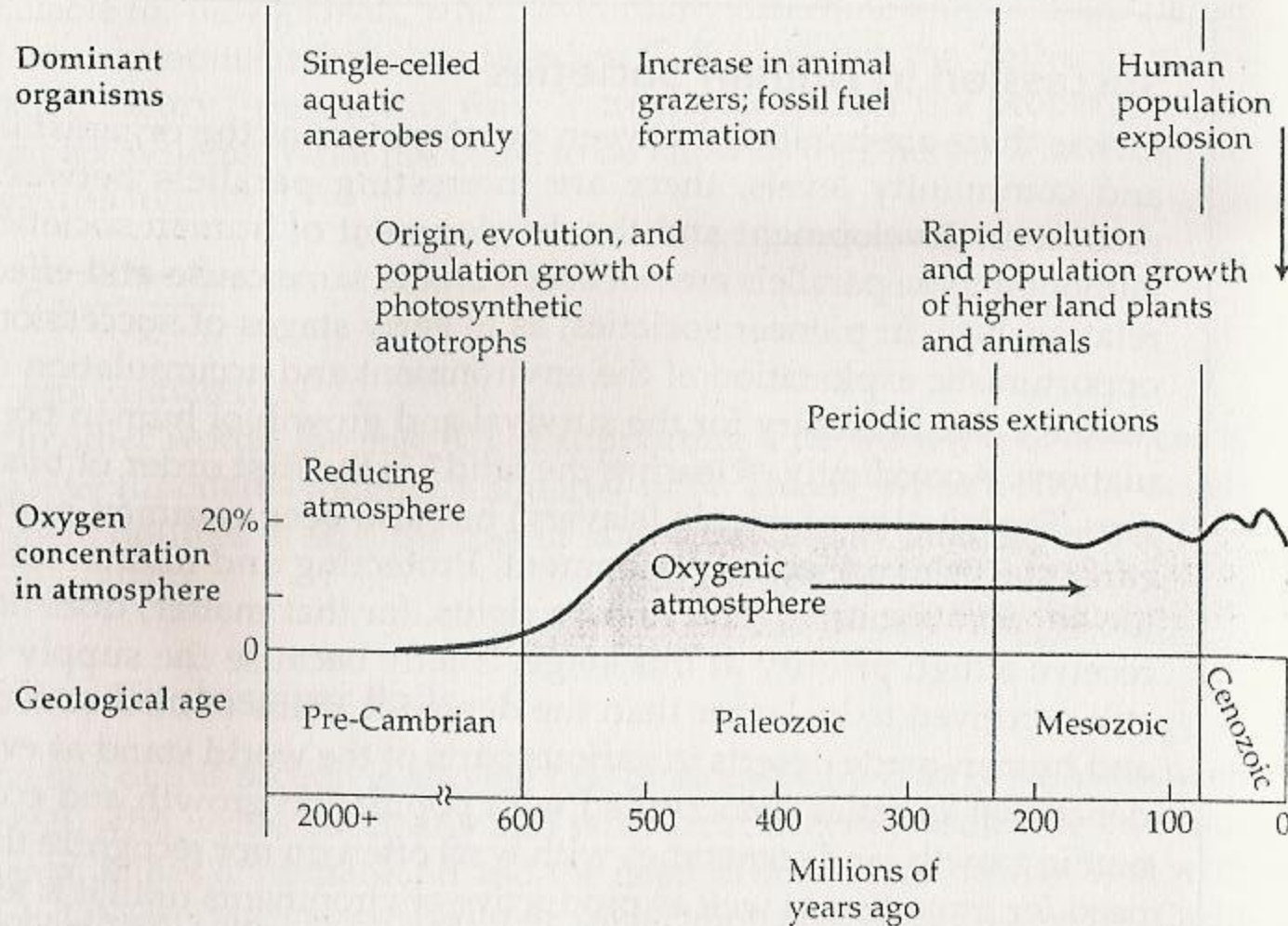


FIGURE 6