

# History of Plant Ecology



Plato and Aristotle  
From Raphael's fresco "The School of Athens", ca. 350 BC

8/26/09

1

---

---

---

---

---

---

---

---

## Early Philosophers

- Plato recognized erosion during his time. "Our land, compared with what it was, is like a skeleton of a body wasted by disease. The plump soft parts have vanished, and all that remains is the bare carcass."
- Aristotle believed that nature was provident; extinction could not occur
- Theophrastus, considered the father of Botany, determined that some plants were found in certain regions and not others (plant geography)
- In 70 BC, Lucretius wrote about succession in his book "On the Nature of Things."

8/26/09

2

---

---

---

---

---

---

---

---

## Age of Exploration



- Plant geographers played an important role in the 18th and 19th centuries
- They observed PATTERNS of plant species distributions over elevation and climatic gradients
- Alexander von Humboldt was one of the most famous; born in the late 1700s in Prussia (which became Germany)
- In South America, he explored the Orinoco and Amazon Rivers, climbed Mount Chimborazo in Ecuador (21,000'), and brought back 60,000 plant specimens
- He had inherited a fortune, and spent it on travel and publishing his books.
  - Plant Geography, published in 1807
  - Five-volume encyclopedia "Kosmos" was his last

8/26/09

3

---

---

---

---

---

---

---

---

## Baron von Humboldt



- Attributed vegetation zonation in the tropics to:
  - Temperature
  - Humidity
  - Atmospheric Pressure (!)
  - Electrical Charge (!)
- Visited President Thomas Jefferson in 1804; he encouraged support of the Lewis and Clark Expedition (later, Jefferson explored the Alps and described vegetation zones there)
- von Humboldt's work was an inspiration for Charles Darwin, but ironically Humboldt died in 1859, the year the Origin of Species was published
- One of von Humboldt's famous ideas:
  - "In the great chain of causes and effects, no thing and no activity should be regarded in isolation."

8/26/09

4

---

---

---

---

---

---

---

---

## More important dead white men



- Charles Darwin: wasn't just a zoologist; he studied orchids too
  - Corresponded with a famous American botanist, Asa Gray, about the adaptations of alpine plants
  - Wrote about adaptation and natural selection, both fundamental concepts in ecology
- Henry David Thoreau was a contemporary of Darwin's
  - Wrote about "succession" and "phenology"
  - He may have been the first to use both words, which are fundamental concepts in ecology

8/26/09

5

---

---

---

---

---

---

---

---

## Phytogeography becomes Plant Ecology

- Eugenius Warming wrote the first book on ecology, The Oecology of Plants, widely translated from Danish
  - May have taught the world's first ecology course at the University of Copenhagen, in Denmark – in the mid-1890s.
  - Emphasized importance of soils, moisture, and temperature
  - Introduced terms like halophytes, hydrophytes, xerophytes, and mesophytes

8/26/09

6

---

---

---

---

---

---

---

---

- Henry Cowles taught the first ecology course at the University of Chicago in 1897; used Warming's book
  - Worked on succession on the nearby sand dunes of Lake Michigan; recognized dynamic nature of vegetation
  - Many students of Cowles helped in the development of the Chicago school of ecology
- Arthur Tansley taught first ecology course in England in 1899, also used Warming's book
  - Later, in 1935, Tansley coined the word "ecosystem."

8/26/09

7

---

---

---

---

---

---

---

---

### The History of a Controversy: Clements vs. Gleason



- Frederick Clements (1874-1945)
  - Prominent American ecologist, U. of Nebraska, influenced by Cowles
  - Co-authored the first textbook of plant ecology in North America, "Plant Ecology," with Weaver
  - Concluded that plant communities acted as discrete entities; and that there were sharp transitions from one super-organism to another

8/26/09

8

---

---

---

---

---

---

---

---

- Henry Gleason (1882-1975) challenged Clements' views and proposed the individualistic concept of the plant community



- Each species has its own distribution pattern according to dispersal, environmental conditions present at establishment, and tolerance range of mature plant
- Eventual acceptance of his work led to wide application of gradient analysis to ecology

8/26/09

9

---

---

---

---

---

---

---

---

## Robert H. Whittaker (1920-1980)



- Helped develop ordination techniques, which quantitatively showed gradual changes in species distributions
- With John Curtis, provided support for Gleason's ideas of individualistic responses of species to environment

8/26/09

10

---

---

---

---

---

---

---

---

## Raymond Lindeman



- Studied aquatic ecosystems while a graduate student at the University of Minnesota
- Developed the trophic-dynamic concept, by which organisms are classified according to how they obtain, use, and pass on energy to the next trophic level
- Had trouble getting the paper published, but finally it was published in 1942 (after his death) and it became very influential

8/26/09

11

---

---

---

---

---

---

---

---

## Eugene P. Odum, 1913-2002



- Called "the father of modern ecology," popularized the word *ecosystem* by making it the organizing concept in his 1953 *Fundamentals of Ecology* (translated into 12 languages)
- Chapters on energy flow, nutrient cycling, population dynamics, and ecosystem development
- With his brother, the ecologist Howard T. Odum, powerfully influenced the development of ecosystem ecology
  - symbiosis and biological diversity promotes stability.

8/26/09

12

---

---

---

---

---

---

---

---

## Modern Trends in Ecology

- Interactions among environmental factors and ecosystem components is emphasized
  - Plant/animal interactions
  - Biosphere-atmosphere gas exchange
- Increasing use of quantitative analyses
  - data, statistics, computer models
- More experimental and analytical
  - Hypothesis testing
- Increasingly multidisciplinary
- Long-term research
  - permanent plots, grazing exclosures

8/26/09

13

---

---

---

---

---

---

---

---

- Broader spatial scales
  - Models, remote sensing to scale up observations
- Sustainable land management
  - Conservation biology
  - Protection of rare species
  - Maintenance of species diversity
- Importance of human effects is recognized
  - Climate and global change
  - Urban ecology
  - Invasion & restoration ecology

8/26/09

14

---

---

---

---

---

---

---

---

## Great ideas in ecology (Odum, 1992)

1. Ecosystems are thermodynamically open, and far from equilibrium.
3. Stability in ecosystems increases with increasing scale; parts are less stable than wholes.
4. Smaller ecosystem components are less stable than larger components (corollary to #3).
6. Natural selection may occur at more than one level (another corollary to #3).

8/26/09

15

---

---

---

---

---

---

---

---

- 7. Two kinds of natural selection: one driven by **biota**, which leads to competition; one driven by **environment**, which leads to mutualism.
- 8. Competition may lead to diversity rather than to extinction.
- 9. Evolution of mutualism increases as resources become scarce.
- 11. Organisms have modified the environment, making Earth more habitable.

8/26/09

16

---

---

---

---

---

---

---

---

- 13. Biodiversity studies should range over genetic to landscape scales.
- 14. Ecosystem development (autogenic succession) occurs in two phases: pioneer stages are stochastic; later stages are more organized.

8/26/09

17

---

---

---

---

---

---

---

---

- 17. Energy is required to maintain energy flow and mass (nutrient) cycles.
- 18. Sustainable ecosystem management is urgent.
- 19. Transitions from one state to another require energy expenditure.
- 20. If humans are parasitic on our Earth host, we must reduce our virulence.

8/26/09

18

---

---

---

---

---

---

---

---