

Appendix C

Concepts, Ideas, and Understanding in Ecology*

Biodiversity

1. Earth is home to a huge number of species, and we know few of them well.
2. We have named less than half of Earth's species, perhaps only 1% of them.
3. The species diversity that exists today resulted from adaptive radiations.
4. Each extant species' lineage goes back to the first life on earth.
5. Biodiversity loss is a consequence of disrupting ecological integrity via habitat loss, species introduction, pollution, and over harvesting.
6. Biodiversity provides the materials and functions that permit all life and that provide life support for all organisms including humans.
7. The loss of biodiversity has ecological consequences. Biodiversity loss is ecologically disruptive because: a) species extinction is irreversible, b) evolved and coevolved relations are slow processes, c) efficient, effective energy flow and nutrient cycling are dependent upon ecosystem integrity, and d) habitat loss, pollution, over harvesting, and alien species result in species extinction.
8. The ecological consequences of biodiversity loss have relevance for human activities.
9. Human activities are causing a rate of biodiversity loss equivalent to that which was associated with previous mass extinctions. Earth is entering its 6th mass extinction of multicellular life primarily caused by human economic activities that result in

extinction of species, loss of ecosystems, climate change, alien species, pollution, and over harvesting.

Population growth and its regulation

10. All organisms have the capacity for exponential or unlimited growth.
11. Organisms grow exponentially only for a short time period in relation to their generation time because of biotic and abiotic resistance.
12. Population size is a function of birth and death rates.
13. Species abundance is dynamic in space and time.
14. Human life history is typical of an organism that has an equilibrium pattern of population growth, but humans have shown in the past thousands of years, especially in the last several hundred years, an opportunistic pattern of growth.
15. Human abundance is an ecological aberration that is disrupting planetary biotic integrity.
16. Human abundance results from persistent exponential growth that is a consequence of humans culturally overcoming environmental resistance.

Ecosystem/community structure, function, and interactions

17. Life is possible because of energy from the sun.
18. Photosynthesis in primary producers converts light energy to chemical energy that then moves through an ecosystem from producers to consumers to decomposers and detritus feeders.

19. As energy moves through the trophic levels of an ecosystem, the amount of useful energy (capacity to do work) decreases about an order of magnitude from one trophic level to the next.
20. Each element essential for life is recycled from the environment through organisms back to the environment.
21. Food webs are the aggregate interactions of communities of organisms. The removal of a trophic level causes the abundances of all other trophic levels to change.
22. Energy flows and nutrients cycle through food webs.
23. Some species play particularly important roles in their ecosystems. If removed, the entire ecosystem changes or ceases to exist. Some, but not all, ecosystems have these "keystone" species.
24. An organism lives in and requires a habitat that meets its physical and biological needs.
25. An organism's role in an ecosystem is its niche. An organism's niche includes its habitat and its relations to other community members.
26. The dynamics of coevolution and its resulting selection pressures are observed in three major types of interactions within a community: competition, predation, and symbiosis.
27. Organisms have evolved mechanisms to avoid predation by evolving offensive smelling or tasting chemicals, defensive poisons, bad taste, mimicry, and protective structures all of which predators have coevolved to overcome.

28. Symbiosis, in which two organisms live in close association over an extended period of time, is expressed in three patterns: parasitism where one is harmed and the other benefits, commensalism where one benefits and the other is not influenced, and mutualism where both benefit.
29. Ecosystems express a wide range of change over time including succession by existing species after impoverishment of an existing ecosystem or after creation of virgin space created by a natural disaster like volcanic activity.
30. Some ecosystems are part of a sequence of successional ecosystems that culminate in a final climax type that persists in dynamic equilibrium until perturbed by a major disturbance.
31. Disturbances are ubiquitous and important in determining species diversity. However, too much or too little disturbance reduces species diversity.
32. Major ecosystem type is established by the availability of four basic resources that are requisite for all life: nutrients, energy, water, and temperature appropriate for metabolism.
33. In terrestrial environments rainfall pattern (water availability) and temperature range are predictive of the general type of ecosystem (biome) that will be present.
34. About 70% of the earth's surface is covered by water and these aquatic ecosystems influence terrestrial climate and ecosystems.
35. Aquatic and terrestrial ecosystems differ in the abiotic (physical) selection pressures exerted on species. The major physical differences are: a) the amount of oxygen available in the water is much less than in the air, b) the rate and magnitude of

temperature change is much faster and greater in the air than in the water, c) gravity is counter-balanced by water's buoyancy and therefore a less important force in the water, and d) the extinction coefficient for light is much greater in water than air thereby making energy less available in water environments than in surface, terrestrial environments.

36. Climate influences ecosystems, and human activities (burning fossil fuels and cutting down forests) are changing local and global climates.

37. Pollutants are toxic materials that influence organism and ecosystem integrity. Many like mercury, lead, dioxins, and polychlorinated biphenyls are concentrated to toxic levels in food chains.

38. Pollutants fall into three major categories: materials normally found in ecosystems but present in excess, substances found on earth but not normally free or concentrated, and synthetic compounds invented by humans.

* This list of ecology concepts was developed only for use at Rensselaer. A number of faculty contributed concepts taken from their personal files and perhaps from published sources. Since we had no intention of publishing these concepts (it was requested by reviewers and editor), we did not keep records as to who contributed which concepts and their sources. The concepts themselves are clearly not original, but rather derived from the work of others, and we have no way of identifying sources. We acknowledge that some may be from unknown published sources.