

ECOLOGY

Derived from Greek oikos = house, logos = study, literally = study of our home

Ecology = study of organisms and their interactions with each other and with their environment.

Population - group of individuals of the same species that interact and interbreed with each other.

Habitat - place where an organism lives.

Niche - what an organism does, its role in the environment.

(habitat = address, niche = job)

Community - group of associated species sharing a common habitat.

Ecosystem - a large group of interacting organisms together with the non-living environmental factors with which they interact.

Biome - large terrestrial complex of communities of living organisms that are characterized by distinctive vegetation and climate.

A given habitat may support a number of populations, each with their own niche. Usually partition the habitat to reduce competition for scarce resources.

Communities may alter their habitat in such a way that it can support new populations, and may become less suitable for some of the established populations. This may lead to changes in communities over time.

ECOLOGICAL SUCCESSION

Succession - progressive changes in the composition of communities over time.

Primary succession - occurs where no life is present. Pioneering organisms move in and occupy an area such as rocky outcropping, newly deposited soil (landslide), lava flows, etc. Lichens and mosses tend to be pioneer species.

Secondary succession - changes in communities following disturbance of an ecosystem. May involve new species, or re-introductions of previous species.

Climax community - stable and self-maintaining. Here, climax community is the oak-hickory forest. Part of temperate deciduous forest biome.

FOOD CHAINS AND FOOD WEBS

Life depends on flow of energy through communities. Energy is captured by **producers** who use the energy to produce food compounds. Photosynthetic autotrophs - plants.

Primary consumers - eat the producers

Secondary consumers - eat the primary consumers, and so on.

Forms a chain of trophic levels. (trophos = food/feeding)

Food chain is formed.

Food chain - sequential linkage from plants (primary producers) to consumers (herbivores, then carnivores) to decomposers.

It is the inter-related, associated trophic levels of producers and consumers.

In nature, one is more likely to see **food webs**.

Food web - system of associated and inter-related food chains.

The greater is the extent of inter-relationships, the greater is the stability of the ecosystem. The greater is the diversity seen in the food web, the greater is the ecological stability!

Remember: DIVERSITY IS STABILITY!!!

POPULATION ECOLOGY

population - group of individuals of a single species that interact and interbreed with each other.

Population density - number of individuals per unit area or per unit volume.

Biotic potential - reproductive capacity of a population, when unrestricted.

It is a potential of the intrinsic rate of growth, and when plotted, forms a J-shaped curve.

Environmental resistance - all physical and biological limiting factors that prevent a species from reproducing at its maximum rate.

Environmental resistance prevents populations from growing at their biotic potential, instead populations usually grow according to a logistic (S-shaped) curve.

The population usually levels off at its carrying capacity. The **carrying capacity** is the maximum number of individuals that can be supported by a given habitat without loss of quality to that habitat.

POPULATION REGULATION

Control may be through **reproduction**.

Large parental investment may help survival of offspring, but parents cannot afford to produce as many offspring. Organisms that do not invest in parental care often produce many offspring so that some may survive.

Control through **mortality**.

Mortality may be the result of density-dependent controls such as competition, predation, parasitism and disease. Density-dependent controls are often biotic in nature.

Mortality may be the result of density-independent controls, such as weather (drought, cold), or natural catastrophes (flood, volcanoes, hurricanes, etc.). Density-independent controls are often abiotic in nature.

Populations may overshoot their carrying capacity, in which case environmental resistance will bring the population back toward equilibrium around the carrying capacity. The population may overcorrect and fall below the carrying capacity for a period of time.

If a population overshoots the carrying capacity by too much, the quality of the environment will be degraded and the carrying capacity of the habitat will be reduced.

HUMAN POPULATION

Human population has increased dramatically over last several hundred years compared to last 8,000 years. Several factors may account for this increase.

1. We have developed the capacity to expand into new habitats and new climatic zones.
2. We have increased the carrying capacity of occupied environments.
3. We have removed some limiting factors (immunizations against some diseases).

In the 1970s the rate of increase of the human population slowed. Possible factors that may account for this decrease in rate of increase include:

1. Changing role of women in society.
2. Changes in attitudes toward family size.
3. Advances in birth control.
4. Liberalized abortion laws.

BIOMES: THE VALUE OF BIODIVERSITY

On the planet earth, there is incredible biological diversity. Perhaps 30 million species of organisms live on this planet. Because habitats are so diverse, the genetic diversity among those organisms is also very large.

That genetic diversity represents a vast warehouse of potential resources as well as offering a kaleidoscope of beauty and a sense of man's place in the world. Humans have expanded into every habitat in the world and may shepherd the planet or may ruin the planet. What we do in the next 30 years may well decide what will be left for your children and their children.

If we want this genetic diversity to persist, we must maintain the habitats that foster that diversity. Is habitat diversity and genetic diversity important to us, or should we have nothing but apartments, shopping centers, and corporate farms? If we overexploit a single part of a biome so that the structure of the biome is disturbed, because of the interconnections between organisms, we stand to lose the entire biome and many additional resources.

Yet there are economic and political pressures to drain and develop the wetlands, to open the remaining old-growth forests to logging, to mine the tundra for oil, coal and minerals, to use the oceans and deserts as dumping grounds. As one example, consider what has happened to watersheds and natural waterways. What is the result of channelization of natural waterways, the removal of forests from watersheds, and the covering of acres of land with pavement and buildings? Why do we see recurring flooding in developed areas? Why are so-called 100 year floods and 500 year floods occurring so regularly?

You don't have to make a choice between jobs and the environment. It is possible to have economic development while preserving the environment. Many would claim that it is a necessity that development occur in balance with environmental protection if we are to survive as a species. Today's biomes house all of tomorrow's natural products.

There is still another side to this we have not examined much. All of our discussion has been very anthropocentric. It is extremely egotistical and arrogant to think of the earth's life forms as being nothing more than potential products for human use. We should at least consider that these life-forms have an intrinsic right to life just as much as humans. With our ability to dominate events on this planet, we have a responsibility to shepherd and nurture the planet, not exploit and ruin.

These organisms add to the natural beauty of the world. They have been an inspiration to mankind for centuries. Artists, poets, architects, have all found inspiration in nature. We can find fulfillment in ourselves by helping to maintain the beauty of the natural world and in studying and trying to understand our part in a scheme that is far greater than ourselves. Humans have been developing their sense of the aesthetic ever since they stopped being hunter-gatherers. It is part of human culture and human nature. Are we losing that quality of our humanity?

You cannot save isolated parts of a system and save the system. Everything is interconnected ecologically. **Biological diversity = ecological stability.**

Aquatic Ecosystems

In addition to their importance as sources of food, as breeding grounds and homes for countless organisms, below are listed some of the unique attributes of these ecosystems which may be beneficial in terms of commercial development for human use.

Freshwater Ecosystems - Often subject to freezing, these ecosystems may hold important information about unique physiological adaptations. Animals that can survive freezing may provide answers as to how we may freeze organs and tissues. Cryogenic organ banks may reduce the pressure to find organ donors when people are in critical need of transplants.

Estuaries - Here is where freshwater runs into seawater. Here we find organisms that can tolerate salt, but can live in freshwater. We may find unique mechanisms for regulation of salt balance and maintenance of metabolism. Salt tolerance mechanisms may be transferable to crops.

Salt water marshes - We find lots of nitrogen-fixing bacteria that may be important as future food sources. There are other unique bacteria and fungi whose properties we are just beginning to examine.

Ocean – This extensive ecosystem is the home to fish, sponges, corals and algae, all of which are proving to be important sources of medicines. Also we are finding pigments, neuroactive agents for medicinal uses and potential cancer cures.

These are just a few examples of the resources that we can develop if, and only if, we protect the habitats that foster their survival.

Terrestrial Ecosystems

In Table 1 you will find listed the various terrestrial biomes with descriptions of their characteristics and a brief sampling of some of the unique qualities found there.

Table 1. Characteristics of biomes and examples of one or more unique features found in each biome.

BIOME	CLIMATE	VEGETATION	UNIQUE FEATURES
Temperate deciduous forest	Temperate, seasonal changes, 30-50 inches annual rainfall	Hardwood trees: oak, hickory, maple, beech, poplar	Polyzonia millipede produces a chemical that is a strong insect repellent
Grassland	Tropical or temperate, 10-40 inches annual rainfall	Grasses, small shrubs	World's most abundant food sources; world's most efficient photosynthetic systems
Desert	Temperature extremes, hot days, cold nights, less than 10 inches annual rainfall	Cacti, succulents, short life cycle annuals	genes for drought tolerance; physiological adaptations for stress metabolism; potentially useful for kidney problems and trauma patients
Tropical rain forest	Hot, rainy season, 80-160 inches annual rainfall	Broad-leaved evergreens, air plants (epiphytes), multilayers	Biotically most diverse regions of earth; many predator-prey interactions; many host-pathogen interactions; many potential cancer cures, anti-viral agents, and anti-parasitic compounds
Tundra	Snowbound most of year, Less than 10 inches annual rainfall	Lichens, mosses, small herbs, small and prostrate shrubs	Moss that can survive desiccation; genes for drought tolerance
Taiga	Short summers; long, cold, wet winters; most precipitation is frozen	Conifers: pine, spruce, fir, hemlock, sparse understory	Tree communication by chemical signaling; inducible insect resistance