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# Genetic, species, and ecosystem diversity

Aquaculture Department, Southeast Asian Fisheries Development Center

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# Genetic, species, and ecosystem diversity

Biological diversity or biodiversity is generally divided into three fundamental categories: genetic diversity, species diversity, and ecosystem diversity.

## Genetic diversity

The genetic material of microorganisms, plants and animals contains information that determines the characteristics of all species and individuals that make up the diversity of the living world. The number of possible combinations of genes and of the molecules making up genes is immense -- much larger than the number of individuals making up a species.

Genetic diversity refers to the differences in genetic make-up between distinct species and to genetic variations within a single species. Individuals belonging to a species share, by definition, certain characteristics, but genetic variation determines the particular characteristics of individuals within the species. In simple terms, genetic material dictates whether we have blue or brown eyes, blond or black hair, and are tall or short. It also determines whether an individual animal or plant has the ability to survive in a particular habitat or under particular environmental conditions. Some plants, for example, are able to grow in saline water as a result of genetic variation.

Genetic variation occurs to varying degrees in most species of plants and animals. There is high genetic variation in Indian rhinos, for example, but little among cheetahs. Furthermore, the genetic make-up of an individual species is not static -- it changes as a result of both internal and external factors.

This variety of genetic material within species has enabled distinct species to evolve through natural selection. Broadly speaking, species that inhabit large areas and interbreed throughout the whole area have a high rate of gene flow and show few or no localized characteristics; however, species living in small or

isolated areas have low rates of gene flow and, as they adapt over time to their particular environment, they develop into distinct, localized populations.

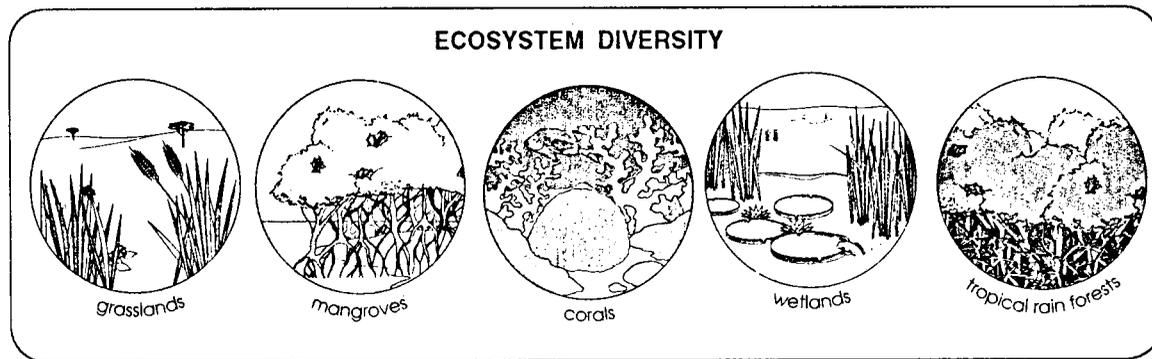
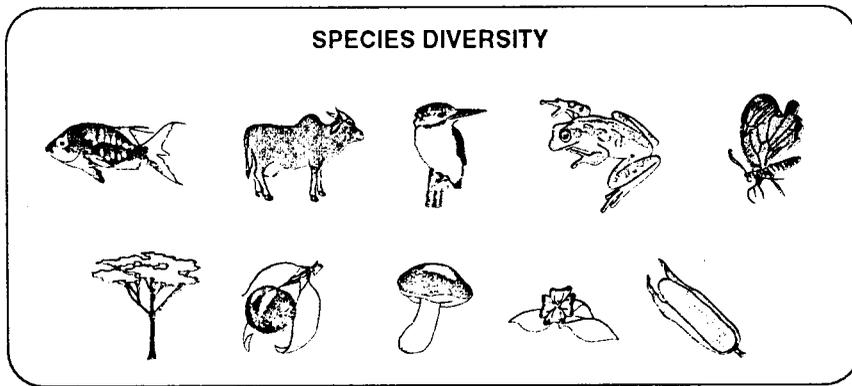
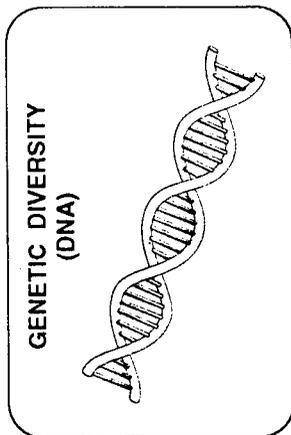
Behavioral traits can also influence the geographical distribution of genetic characteristics within a given species. For example, the North American eel inhabits streams along 4000 km of coastline, but migrates to the Sargasso Sea to reproduce as one massive population. As a result, individual eels inhabiting streams many miles apart do not demonstrate any geographic differentiation. However, other species such as salmon, breed in different streams, but spend most of their life at sea; these species develop marked genetic variations between populations.

## Species diversity

Species diversity is measured in relation to a given area -- from a small field to the entire planet. It can be assessed in terms of the number of species or the range of different types of species an area contains.

So far, 1.7 million species have been described worldwide. Estimates of the total number of species on Earth range from 5 to 100 million -- 12.5 million being a conservative working estimate. Although most of the Earth's species are insects and microorganisms, this is not reflected in the types of species that have been described to date. There has been a definite bias towards describing large organisms, those that are considered attractive or appealing (such as flowering plants and butterflies), those most closely resembling humans (vertebrates, especially mammals), and those that have a direct impact on human activities (such as pests). Organisms that can be studied without complex procedures or expensive equipment have also taken precedence, as have those which are relatively easy to locate.

This, however, underestimates the importance of microorganisms including algae, bacte-



ria, fungi, protozoa and viruses, which are vital to life on Earth. So far, less than 3-5 percent of microorganisms have been described. Yet the very existence of larger organisms depends upon the continued availability of the microorganisms they require. Coral reefs, for example, could not exist without algae. At the ecosystem level, the greatest biomass in soil is microorganisms, especially fungi. These maintain soil structure and composition through, for instance, the biodegradation and incorporation of dead plant and animal remains. Clearly, the loss of micro-organisms can lead to major changes in ecosystems.

Biologists are currently studying both species-rich groups (such as insects) and species-rich areas (such as moist tropical forests) in order to provide a more reliable picture of species richness patterns and a basis for estimating the number of species on Earth.

**Ecosystem diversity**

The enormous range of terrestrial and aquatic environments on earth has been classi-

fied into a number of ecosystems. Major habitat types include tropical rain forests, grasslands, wetlands, coral reefs and mangroves. Measuring changes in the extent of ecosystems is difficult, because there is no globally agreed classification of ecosystems, and boundaries are often variable and elusive. Species contained within a given ecosystem also vary over time.

Studies of ecosystem diversity are carried out on different scales: from one ecosystem to an entire region containing many different ecosystems. Regions containing a great variety of ecosystems are rich in biodiversity, but individual ecosystems containing endemic species also make a significant contribution to global biodiversity.

Some of the world's richest habitats are tropical moist forests. Although they cover only 7 percent of the world's surface, these areas contain at least 50 percent, and possibly up to 90 percent of all plant and animal species. Isolated islands are often rich in endemic species.

Reference: **Global Biodiversity**. 1993. United Nations Environment Programme, Nairobi, Kenya.