Biodiversity

Biodiversity can be described as the variety of life within a given habitat, biome or ecosystem. It includes all the species present, the genetics of those species and the elements of the landscape that support those species. Together these form what is commonly called a community. Noss (1990) recognized three main attributes of biodiversity; composition, structure and function.

Composition shows the identity and species richness of the living components (biotic) as well as the relative amount (abundance, cover and biomass are words used to describe this). The biotic components of biodiversity are the genes, organisms, family units, population, species and other taxonomic classifications.

Structure refers to the elements of a community or landscape: the shape, space arrangement and size of the vegetation community, as well as the density of foliage cover and height, and relative ages and food structures.

Consider for example the habitat at Tecolote Creek, just below the Bacara Resort: It consists of a creekside ribbon of vegetation ranging in height from three to about 45 feet. But as the slope climbs away from the creek, the vegetation height diminishes into a range more typical of chaparral—perhaps from one to six feet. Does this mean that more sunlight strikes the ground beneath the chaparral and sage than beneath the willow? Not necessarily, it will depend on density of foliage and amount of cover. Field techniques are used to measure this, and to compare the two, but the outcome determines what kind of life might thrive on the ground beneath each.

Function includes what scientists refer to as processes: herbivory, predation, parasitism, mortality, production, vegetative succession, nutrient and energy cycling, colonization, extinction, genetic drift and mutations are examples of different processes that affect biodiversity or play a role in it. The complexity of biodiversity is more than the sum of its parts. Each element above will contribute to the biodiversity of a region or habitat, but more importantly the interactions between them and their effect on each other will impact directly or indirectly on the biodiversity of a region.

A snake preying on mice in the Tecolote habitat is an example of a top-down predatory process in which the snake controls the number of mice. But if for some reason the mice began to decline in number, this would produce the reverse—less snakes—an example of a bottom-up influence, but also an example of mortality.

Biodiversity encompasses all of these aspects, as well as the variation of life and their inter-relatedness—for both plant and animal kingdoms, and from single-celled organisms to the greatest living creatures. There have been various estimates of the number of these species currently living. Most of them are microorganisms and tiny invertebrates but estimates fall between 5 million and 30 million species currently living on our planet, with only about 1.75 million formally described and named, more than half of which are insects.

With all of these factors playing a role in biodiversity, it might come as no surprise that biodiversity is not evenly distributed across the earth. A major pattern for example, is called the latitudinal gradient. This shows that species diversity increases as latitude decreases—there are more species in the tropics nearer the equator than in the temperate regions, and even fewer as you approach the Polar Regions. This is due to the combination of increased rainfall, soil types, and energy available from sunlight and increased temperatures. And although it has been extensively researched and shown to be so for terrestrial ecosystems, the question remains as to whether or not this gradation exists in marine ecosystems as well.

What Influences Biodiversity?

A number of factors in nature influence the biodiversity in a community: scientists for example call fire a disturbance event. This can determine the type of species that inhabit an area. Chaparral habitats as found in our bioregion depend on fire cycles for the health and dispersal of seeds. Fires clear the undergrowth of other species and leave it open for new seeds to germinate and establish themselves without competition, and some seeds only germinate after a fire.

Competition between species for resources is another factor affecting community structure and therefore biodiversity. Strong competitors will exclude others from an area and thereby reduce the diversity of an area. As conditions change, some species may thrive and become stronger competitors through adaptation to their environment. Predation may favor one species over another. This will effectively decrease the population of the preferred species giving non-prey species an advantage.

Exotic invasives can be defined as those species that are not naturally found within a specific area or country and are introduced willfully or by accident when seed hitches a ride on boats or car tires for example.

The introduction of exotic species to an area can deal a heavy blow to biodiversity. The iceplant is a good example. Introduced to California from South Africa to stabilize highway embankments it soon spread to the coastal dune habitat it prefers, completely overpowering most native species.

As species move, they can alter the local environmental conditions, producing a tumbledown effect on others. Their presence is usually marked by a damaging result. Species interactions are affected and the system changes, unable to remain functional under the pressure exerted by a new species. When iceplant is removed and native bunch grass reintroduced the invertebrate life beneath the grass begins to flourish, which in turn results in increased bird populations.

It becomes evident therefore, why and how ecosystems are considered to be complex and delicate. Understanding fosters stewardship. Having classified terrestrial systems into seven primary biomes, scientists make it possible for us to learn the vegetation types and their specific indicator species. This in turn helps us recognize when damaging changes are taking place—we can see when something is going wrong and try to amend it.

Man's Impact

Ecosystems around the world are under threat due to the invasion of alien species, expansion of the human population, habitat destruction and fragmentation, over exploitation and pollution—including air, water and soil pollution. Habitat destruction has been identified as one of the major factors in biodiversity loss. Even if no further loss was to occur, vulnerable species would still face extinction as a result of the extensive existing damage.

Conservation therefore requires more than the preservation of a species, we have to focus on habitat protection. You can read more about this under the Conservation link on hiddencorner.us. When we speak of habitat, by default it includes the range of species found in that habitat, as well as the living interactions and dependences between them.

As we lose habitats, we lose not only potential resources but also stability. California for example has lost more than 90 percent of its wetlands. *Creek mouths, salt marshes and vernal pools are important aquatic habitats in our bioregion but have been heavily impacted by highway and housing development. What functions have been lost with their demise?*

Wetlands are efficient natural water treatment works, absorbing chemicals, filtering pollutants and sediments, breaking down suspended solids, and neutralizing harmful bacteria. These waterways clean water before releasing it back into the environment, using the organic content in the process. Without wetlands, large volumes of sediment-heavy water rushes downstream, harming fragile ecosystems. The sediment is dumped into estuaries or shallow coastal areas, which are also sensitive, and play their own role in the life cycle of marine and freshwater species. When the bulldozers arrive to fill a vernal pool or to level wetland, we lose not just the life in that pool and its contribution to the larger ecosystem, but these important functions as well.

So What Does this Loss mean?

Scientists refer to the evidence of redundancy when discussing biodiversity. This is essentially an overlapping of functions, the overlapping or duplication being as essential for the sustainability of the ecosystem as the functions themselves. Organisms relating to, and relying on each other, function as links in a chain. If one disappears, those relying on its functions are immediately stressed, and the habitat begins to function at less than optimal levels and may begin to decline. The effect is of course compounded if another, and then another species in the habitat vanishes. ***Stability is dependent on this redundancy and biodiversity provides it.***

The processes that are linked to biodiversity in a region are ultimately of great benefit to humans, although many of these services are not readily observable and therefore have largely gone unnoticed in the past. However, as ecosystems are disrupted often, the function provided by the system is suddenly noticed when problems arise. For example, wetlands also act as sponges, absorbing excess water, either from rainfall or surging rivers, preventing potential flooding downstream and then slowly releasing the water over time.

Many consider ecosystem functioning to be the driving force of the natural world. Living organisms together cycle all the major elements such as carbon, nitrogen, water and oxygen. Insect pollination, water and air purification and nutrient cycling are all provided free of charge through natural systems, all of which are just too complex for human beings to recreate. All we can do is protect and conserve.

Facts & Figures

Ecosystems provide us with our most basic needs: water, food, energy, shelter, medicines. Although 80 percent of human food supply comes from just 20 kinds of plants, humans use up to 40,000 species each day. But considering the volume of species previously mentioned, we have an untapped potential. Keep in mind too that the food we consume is also in some way dependent on other species, which we do not directly consume. Plants for example are heavily dependent on microorganisms in the soil, which are essential to nutrient cycling.

The Santa Barbara Channel is home to many species that serve as a food source for local inhabitants but just how widely used is fish as a food? Fish stocks are a protein source for over a billion people worldwide, and are also used as a protein supplement for other livestock such as poultry. Seafood products are one of the most widely traded commodities, worth billions of dollars annually and contribute substantially to some countries' economies. But fish stocks are under threat from over-fishing; a problem not easily addressed because the ocean exists beyond borders and is easily exploited.

The thinking behind the development of Marine Protected Areas (MPAs) such as those found at the Channel Islands, was to address this problem by providing a nursery for young fish to grow, mature and reproduce before they are caught, thereby ensuring the next generation of the species.

It is estimated that we use 40 percent more resources per year, than natural systems can restore. This impacts biodiversity directly. Currently, the number of species faced with extinction outstrips all available conservation resources. To alleviate this and to address it, 'biodiversity hotspots' have been identified to help focus conservation efforts in regions that have experienced extensive habitat loss. By protecting the plant diversity of the region, the associated fauna will be protected.

The two criteria for a region to be identified as a hotspot are **(1) it must have 1500 plant species as endemics and (2) it must have lost 70 percent of its original habitat.** ***In the initial study 25 regions were identified as biodiversity hotspots, which collectively contained 44 percent of all plant species and 35 percent of vertebrate species. The combined area comprises only 1.4 percent of the total earth surface, and includes the California Mediterranean region that we live in.***

The hotspot program drew some criticism because by it seemed to elevate the importance of certain areas over others. For example, everyone has heard of the destruction of rainforests, but have you heard about the destruction of grasslands? The features that make grasslands unique also make them ideal for agriculture—90 percent of the world's grasslands have already destroyed and the remaining percentage is being destroyed at an average rate of over 200 square kilometers per annum by commercial afforestation. What makes it worse is that the process is currently considered irreversible.

The study of biodiversity is a relatively new science and developing. What is evident is that it's multidisciplinary. The more we learn and the better we understand the factors and processes contributing to the sustainability of biodiversity, the more success we may have in effectively conserving it. A big part of this process is learning to recognize how we need to change, and where we can cultivate improved care