**Global Ecology**

[Human activity has caused significant damage to ecosystems and biomes worldwide. ]

Ecology is the scientific study of the relationship between plants and animals and their environment. Ecologists study and analyze the complex interactions between organisms and the world around them in populations, communities and ecosystems. By studying the inter-relationships between living and non-living things, ecologists gain valuable information that can be used to help protect and preserve the environment for future generations. Before we discuss ecology on a global scale, we must first define some of the common terms used in ecology.

A habitat is an organism's environment. Related to the habitat is the niche of an organism, which is the function of that organism within a habitat. In other words, the habitat describes where a living thing dwells, while the niche tells what it does.

The word 'population' is used in ecology to describe a single species population. A group of individuals belonging to one species (of bacteria, fungi, plant, or animal) living in an area is a population. The subfield of ecology that deals with populations focuses on the number of organisms that live in a particular area and the biological and physical factors that sustain them.

This is a photo of a Costa Rican waterfall, which is part of the rainforest biome. Courtesy: Daniel F. Banales

A community is a group of populations of different organisms that interact with one another in a given habitat or area. Within a community, all the organisms are interdependent (that is, they depend on each other for survival).

An ecosystem is a large area where materials are exchanged between living communities and nonliving things. This exchange of materials depends on the decomposition of living organisms and the intake of inorganic materials into living organisms (to put it simply, this means eating). Balance is extremely important in an ecosystem, where disturbances and slight fluctuations in stability can threaten the lives of the organisms within the system. Ecosystems are basically self-contained energy and nutrient cycles. Soil, air, water, sunlight, minerals, and nutrients are all important components of a healthy ecosystem.

Finally, a biome is the largest ecological unit. It consists of many ecosystems which interact with each other in complex ways. Different biomes are distinguised from each other by variations in climate, rainfall, soil type, food sources, plants and animals. There are nine major terrestrial biomes: coniferous forest, desert, grassland, mediterranean, mountain, rainforest, savanna, temperate forest, and tundra. There are also aquatic biomes: coastal waters, coral reef, freshwater, and open ocean, to name only a few.

Unfortunately, human activity has caused significant damage to ecosystems and biomes worldwide. Pollution has destroyed many ecological habitats throughout the world beyond hope of repair. Myriad species of organisms have become extinct without ever being discovered and potential forms of medicine have died with them. The devastation that the human species has caused through the exploitation of natural resources and the sake of making money is sickening. Disturbing the global ecology of our planet will have serious repercussions in the future. For this reason, ecology is an important field of study. By studying the relationships between biotic and abiotic things, we will gain an understanding of and an appreciation for the incredibly complex world we live in. This understanding will help us improve the environment, manage natural resources and ultimately protect the health of the planet Earth.

**Ecology**

Ecology is the study of how organisms interact with each other and their surroundings in a given environment. Ecologists spend their lives compiling data on ecosystems, giving both the scientific and broader world valuable data on how species are surviving and what is happening to the environment. Although many ecologists choose to specialize in a particular type of ecosystem, such as marine ecology or freshwater ecology, these ecosystems don't exist in a vacuum. The planet Earth is one vast ecosystem in and of itself, and global ecology is the study of how all organisms interact and survive in their planetary environment.

Since the earliest days of scientific study, attempts have been made to observe and report on the flora and fauna of every ecosystem. With 20th and 21st century advances in travel, technology and communication, field scientists have been able to share gathered data with nearly impossible speed and accuracy. As many governments and influential groups have focused their attention on creating the concept of a global community, many people have begun to think of the planet as one interdependent ecosystem worthy of study. These advances have created a shift in thinking that has contributed to the creation of many highly-funded and lauded centers for global ecology, such as the Carnegie Department of Global Ecology at Stanford University.

Global ecology is a tremendously complex form of science that requires a broad spectrum of knowledge. If it is accepted that the planet is an interdependent system, every aspect of every local ecosystem must be considered to fully understand a problem. For instance, if a logging or mining project starts at one end of a river, global ecologists might look at not only the localized effects, but how the runoff would effect the whole river, ecosystems far down stream, and even the possible added pollution to the ocean at the end of the river. Additionally, scientists might study how the added pollution would affect the composition of the air, how far any fumes or gases might rise, if harmful vapors might be absorbed into clouds, and where the contaminated rain might then fall.

Clearly, global ecologists need a tremendous amount of data from specialized studies in order to conduct their work. Keeping tabs on Earth-wide environmental issues, such as the thinning of the ozone layer, require dozens if not hundreds of dedicated field researchers obtaining information in different areas around the globe. While a relatively new form of research, global ecology can capitalize and even invent new technology to improve communication speed and data sharing, and even boost relationships with other nations through scientific collaboration.

Some critics consider global ecology to be heavily biased toward environmentalists and anti-industry by nature. As a serious science, global ecology is motivated primarily by the search for data, rather than for political or even environmental concerns, but by nature it has certain overtones consistent with an environmentalist position. Most research on global ecology suggests that no one part of the world is expendable; that to protect humans, people must protect the Earth.

**Global Warming**

While the greenhouse effect maintains the appropriate temperature for life on Earth, problems arise when the quantity of greenhouse gases in the Earth's atmosphere increases drastically.

Global warming is the rise in the Earth's average temperature as a result of the accumulation of greenhouse gases. Water vapor, methane and carbon dioxide, three of the most important greenhouse gases in the atmosphere, exert control over the temperature of the Earth through a phenomenon called the greenhouse effect. Energy from the sun warms the Earth’s atmosphere. A portion of this energy is radiated back into space while the other portion is absorbed by heat-trapping gases in the atmosphere. According to scientists, the Earth’s average temperature would be below freezing without the greenhouse effect.

**Global Warming and the Ozone**

Although often confused with each other, global warming and ozone depeletion are two seperate problems threatening the Earth’s ecosystem today.

Global warming is caused by the build-up of heat-trapping gases in the atmosphere, It was dubbed the ‘greenhouse effect’ because it is is similar to a greenhousein that the sun's rays are allowed into the greenhouse but the heat from these rays is unable to escape.

Ozone depletion, however, is the destruction of the ozone layer. Chemicals such as chlorofluorocarbons and methyl bromide react with ozone, leaving a ‘hole’ in the ozone layer that lets dangerous UV rays through.

Both are serious threats to life on Earth.

While the greenhouse effect maintains the appropriate temperature for life on Earth, problems arise when the quantity of greenhouse gases in the Earth’s atmosphere increases drastically. When this occurs, the amount of heat energy that is insulated within the Earth’s atmosphere increases correspondingly and results in a rise in global temperature. Since 1860, the temperature has risen 0.3 degrees Celsius, and if global warming continues at the same rate, the temperature will have risen 2.5 degrees Celsius within a century.

On paper, an increase of a mere few degrees Celcius does not appear very threatening. However, numbers can be deceiving. When you consider that the Ice Age resulted from temperatures only slightly cooler than those today, it is obvious that even very subtle temperature changes can significantly impact global climate. The repercussions of even a slight increase in global temperature are frightening. Global warming threatens to destroy the natural habitats of living organisms on Earth and disturb the stability of the Earth's ecosystem. The climate changes that would result from global warming could trigger a variety of natural disasters such as droughts, heat waves, floods and other extreme weather events.

Like most other environmental problems, humans are the cause of global warming. The burning of fossil fuels is largely responsible for the increase in the concentration of carbon dioxide in the atmosphere. Every time someone drives a car or powers their home with energy derived from power plants that use coal, carbon dioxide is released into the atmosphere. The atmospheric concentrations of carbon dioxide and methane have risen meteorically since preindustrial times, mainly due to the contributions of factories, cars and large-scale agriculture. Global warming has resulted from these increased concentrations of greenhouse gases, and we've only begun to see the ramifications of the temperature rise. Even if we immediately stopped emitting greenhouse gases, we would continue to see the effects of global warming for decades because of the damage we've already inflicted.

Earth storm from orbit. Global warming can trigger severe storms. Courtesy: NASA

Despite this pessimistic outlook, there are things that can be done to reduce global warming. Alternate energy sources, such as wind and solar power, need to be exploited and implemented on a large scale. This would reduce fossil fuel consumption and cut back on the amount of greenhouse gas being released into the atmosphere. Forest preservation is another way of reducing and even reversing global warming. Plants remove carbon dioxide from the atmosphere and release oxygen into the atmosphere through photosynthesis. The desecration of the world's forests not only destroys the habitats of forest-dwelling organisms, but exacerbates the problem of global warming.

Although the problem may seem overwhelming, individuals can make a positive difference in combating global warming. Simple things like driving less, using public transportation and conserving electricity generated by the combustion of fossil fuels can help reduce the emissions of greenhouse gases. It is important to realize that it's not too late to make a difference. If everyone does what they can to reduce their contributions of greenhouse gases to the atmosphere, the efforts of people around the world will act in concert to thwart the progression of global warming. If the effort isn't made immediately, the delicate global ecosystem could be thrown irreversibly out of balance, and the future of life on Earth may be jeopardized.

## Coastal ecosystem…..

coastal ecosystem ecology;

betaines, prolines and dimethylsulphoniopropionate (DMSP);

coastal environments properties;

biological components of coastal environments;

coastal wetlands and high rates of biological activity;

coastal environments and geomorphic features;

coastal and open water column ecosystems;

nutrient dynamics in coastal systems;

salt marsh ecosystem control;

top-down control role

Summary

This chapter contains sections titled:

Introduction

Properties of Coastal Environments

Biological Components of Coastal Environments

Geomorphic Features of Coastal Environments

Hydrograpic Features

Contrasts of Coastal and Open Water Column Ecosystems

Controls of Production and Abundance in Coastal Environments

**Pelagic zone**

| | |
|---|---|
| Pelagic | Aphotic |
| Photic | Mesopelagic |
| Epipelagic | Bathyalpelagic |

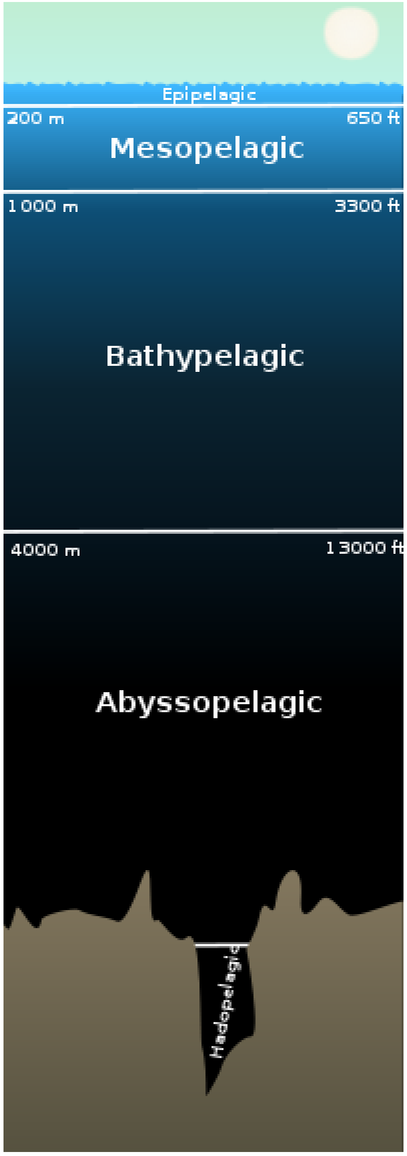
- Abyssopelagic
- Hadalpelagic
- Demersal
- Benthic
- Stratification
  - Pycnocline
    - Isopycnal
    - Thermocline
    - Halocline
    - Thermohaline
    - Chemocline
- Ocean habitats
- Lake stratification
- Aquatic ecosystems
- Wild fisheries
- Land habitats

Any water in the sea that is not close to the bottom or near to the shore is in the pelagic zone. The word pelagic comes from the Greek πέλαγος or pélagos, which means "open sea." The pelagic zone can be thought of in terms of an imaginary cylinder or water column that goes from the surface of the sea almost to the bottom, as shown in the diagram below. Conditions change deeper down the water column; the pressure increases, the temperature drops and there is less light. Depending on the depth, scientists further subdivide the water column, rather like the Earth's atmosphere is divided into different layers.

The pelagic zone occupies 1,370 million cubic kilometres (330 million cubic miles) and has a vertical range up to 11 kilometres (6.8 miles).[citation needed] Fish that live in the pelagic zone are called pelagic fish. Pelagic life decreases with increasing depth. It is affected by light levels, pressure, temperature, salinity, the supply of dissolved oxygen and nutrients, and the submarine topography. In deep water, the pelagic zone is sometimes called the open-ocean zone and can be contrasted with water that is near the coast or on the continental shelf. However in other contexts, coastal water that is not near the bottom is still said to be in the pelagic zone.

The pelagic zone can be contrasted with the benthic and demersal zones at the bottom of the sea. The benthic zone is the ecological region at the very bottom of the sea. It includes the sediment surface and some sub-surface layers. Marine organisms living in this zone, such as clams and crabs, are called benthos. The demersal zone is just above the benthic zone. It can be significantly affected by the seabed and the life that lives there. Fish that live in the demersal zone are called demersal fish. Demersal fish can be divided into benthic fish, which are denser than water so they can rest on the bottom, and benthopelagic fish, which swim in the water column just above the bottom. Demersal fish are also known as bottom feeders and groundfish.

**Depth and layers**




A scale diagram of the layers of the pelagic zone.

Depending on how deep the sea is, there can be up to five horizontal layers in the ocean. From the top down, they are:

1. Epipelagic (sunlit)

From the surface (MSL) down to around 200 m (650 ft).

This is the illuminated zone at the surface of the sea where there is enough light for photosynthesis. Nearly all primary production in the ocean occurs here. Consequently, plants and animals are largely concentrated in this zone.

Examples of organisms living in this zone are plankton, floating seaweed, jellyfish, tuna, many sharks, and dolphins.

2. Mesopelagic (twilight)

From 200 m down to around 1,000 m (3,300 ft).

The name for this zone stems from Greek μέσον, middle.

Although some light penetrates this second layer, it is insufficient for photosynthesis. At about 500 m the water also becomes depleted of oxygen. Still, life copes, with gills that are more efficient or by minimizing movement.

Examples of animals that live here are: swordfish, squid, wolffish and some species of cuttlefish. Many organisms that live in this zone are bioluminescent.[1] Some creatures living in the mesopelagic zone will rise to the epipelagic zone at night in order to feed.[1]

3. Bathypelagic (midnight)

From 1,000 m down to around 4,000 m (13,000 ft).

The name stems from the Greek βαθύς (bathýs), meaning deep.

At this depth the ocean is pitch black, apart from occasional bioluminescent organisms, such as lanternfish. There is no living plant-life.

Most animals living here survive by consuming the detritus falling from the zones above, which is known as "marine snow", or, like the marine hatchetfish, by preying on other inhabitants of this zone.

Other examples of this zone's inhabitants are giant squid, smaller squids & dumbo octopodes. The giant squid is hunted here by deep-diving sperm whales.

4. Abyssopelagic (lower midnight)

From 4,000 m down to above the ocean floor.

The name is derived from the Greek ἄβυσσος (ábyssos), abyss, meaning bottomless (a holdover from the times when the deep ocean was believed to be bottomless). Very few creatures are sufficiently adapted to survive in the cold temperatures and incredible pressures found at this depth.[1] Among the species found in this zone are several species of squid; echinoderms including the basket star, swimming cucumber, and the sea pig; and marine arthropods including the sea spider.[1] Many of the species living at these depths have evolved to be transparent and eyeless as a result of the total lack of light in this zone.[1]

5. Hadopelagic

The deep water in ocean trenches.

The name is derived from the Greek ᾍδης (Haidēs), Hades, the classical Greek underworld. This zone is mostly unknown, and very few species are known to live here (in the open areas). However, many organisms live in hydrothermal vents in this and other zones. Some define the hadopelagic as waters below 6,000 m (19,685 ft), whether in a trench or not.

The bathypelagic, abyssopelagic, and hadopelagic zones are very similar in character, and some marine biologists combine them into a single zone or consider the latter two to be the same. The abyssal plain is covered with soft sludge composed of dead organisms from above.

**Pelagic ecology**

The pelagic sooty tern spends months at a time flying at sea, returning to land only for breeding.

Pelagic birds

Pelagic birds, also called oceanic birds, are birds that live on the open sea, rather than around waters adjacent to land or around inland waters. Pelagic birds feed on planktonic crustaceans, squid and forage fish. Examples are the Atlantic puffin, macaroni penguins, sooty terns, shearwaters, and procellariiforms such as the albatross, procellariids and petrels.

The term seabird includes birds which live around the sea adjacent to land, as well as pelagic birds.

Pelagic fish

Pelagic fish are fish that live in the water column of coastal, ocean and lake waters, but not on the bottom of the sea or the lake. They can be contrasted with demersal fish, which live on or near the bottom, and reef fish which are associated with coral reefs.[3]

These fish are often migratory forage fish, which feed on plankton, and the larger fish that follow and feed on the forage fish. Examples of migratory forage fish are herring, anchovies, capelin and menhaden. Examples of larger pelagic fish which predate the forage fish are billfish, tuna and oceanic sharks.

**Marine biology**

Marine biology is the scientific study of organisms in the ocean or other marine or brackish bodies of water. Given that in biology many phyla, families and genera have some species that live in the sea and others that live on land, marine biology classifies species based on the environment rather than on taxonomy. Marine biology differs from marine ecology as marine ecology is focused on how organisms interact with each other and the environment, and biology is the study of the organisms themselves.

Marine life is a vast resource, providing food, medicine, and raw materials, in addition to helping to support recreation and tourism all over the world. At a fundamental level, marine life helps determine the very nature of our planet. Marine organisms contribute significantly to the oxygen cycle, and are involved in the regulation of the Earth's climate.[1] Shorelines are in part shaped and protected by marine life, and some marine organisms even help create new land.[2]

Marine biology covers a great deal, from the microscopic, including most zooplankton and phytoplankton to the huge cetaceans (whales) which reach up to a reported 48 meters (125 feet) in length.

The habitats studied by marine biology include everything from the tiny layers of surface water in which organisms and abiotic items may be trapped in surface tension between the ocean and atmosphere, to the depths of the oceanic trenches, sometimes 10,000 meters or more beneath the surface of the ocean. It studies habitats such as coral reefs, kelp forests, tidepools, muddy, sandy and rocky bottoms, and the open ocean (pelagic) zone, where solid objects are rare and the surface of the water is the only visible boundary.

A large amount of all life on Earth exists in the oceans. Exactly how large the proportion is unknown, since many ocean species are still to be discovered. While the oceans comprise about 71% of the Earth's surface, due to their depth they encompass about 300 times the habitable volume of the terrestrial habitats on Earth.

Many species are economically important to humans, including food fish. It is also becoming understood that the well-being of marine organisms and other organisms are linked in very fundamental ways. The human body of knowledge regarding the relationship between life in the sea and important cycles is rapidly growing, with new discoveries being made nearly every day. These cycles include those of matter (such as the carbon cycle) and of air (such as Earth's respiration, and movement of energy through ecosystems including the ocean). Large areas beneath the ocean surface still remain effectively unexplored.

**Subfields**

The marine ecosystem is large, and thus there are many subfields of marine biology. Most involve studying specializations of particular animal groups, such as phycology, invertebrate zoology and ichthyology.

Other subfields study the physical effects of continual immersion in sea water and the ocean in general, adaptation to a salty environment, and the effects of changing various oceanic properties on marine life. A subfield of marine biology studies the relationships between oceans and ocean life, and global warming and environmental issues (such as carbon dioxide displacement).

Recent marine biotechnology has focused largely on marine biomolecules, especially proteins, that may have uses in medicine or engineering. Marine environments are the home to many exotic biological materials that may inspire biomimetic materials.

**Related fields**

Marine biology is a branch of oceanography and is closely linked to biology. It also encompasses many ideas from ecology. Fisheries science and marine conservation can be considered partial offshoots of marine biology (as well as environmental studies).

Lifeforms

i. Microscopic life

Microscopic life undersea is incredibly diverse and still poorly understood. For example, the role of viruses in marine ecosystems is barely being explored even in the beginning of the 21st century.

The role of phytoplankton is better understood due to their critical position as the most numerous primary producers on Earth. Phytoplankton are categorized into cyanobacteria (also called blue-green algae/bacteria), various types of algae (red, green, brown, and yellow-green), diatoms, dinoflagellates, euglenoids, coccolithophorids, cryptomonads, chrysophytes, chlorophytes, prasinophytes, and silicoflagellates.

Zooplankton tend to be somewhat larger, and not all are microscopic. Many Protozoa are zooplankton, including dinoflagellates, zooflagellates, foraminiferans, and radiolarians. Some of these (such as dinoflagellates) are also phytoplankton; the distinction between plants and animals often breaks down in very small organisms. Other zooplankton include cnidarians, ctenophores, chaetognaths, molluscs, arthropods, urochordates, and annelids such as polychaetes. Many larger animals begin their life as zooplankton before they become large enough to take their familiar forms. Two examples are fish larvae and sea stars (also called starfish).

### ii. Plants and algae

Plant life is widespread and very diverse under the ocean. Microscopic photosynthetic algae contribute a larger proportion of the worlds photosynthetic output than all the terrestrial forests combined. Most of the niche occupied by sub plants on land is actually occupied by macroscopic algae in the ocean, such as Sargassum and kelp, which are commonly known as seaweeds that creates kelp forests. The non algae plants that survive in the sea are often found in shallow waters, such as the seagrasses (examples of which are eelgrass, Zostera, and turtle grass, Thalassia). These plants have adapted to the high salinity of the ocean environment. The intertidal zone is also a good place to find plant life in the sea, where mangroves or cordgrass or beach grass might grow. Microscopic algae and plants provide important habitats for life, sometimes acting as hiding and foraging places for larval forms of larger fish and invertebrates.

### iii. Marine invertebrates

As on land, invertebrates make up a huge portion of all life in the sea. Invertebrate sea life includes Cnidaria such as jellyfish and sea anemones; Ctenophora; sea worms including the phyla Platyhelminthes, Nemertea, Annelida, Sipuncula, Echiura, Chaetognatha, and Phoronida; Mollusca including shellfish, squid, octopus; Arthropoda including Chelicerata and Crustacea; Porifera; Bryozoa; Echinodermata including starfish; and Urochordata including sea squirts or tunicates.

### iv. Fish

Fish have evolved very different biological functions from other large organisms. Fish anatomy includes a two-chambered heart, operculum, swim bladder, scales, fins, lips, eyes and secretory cells that produce mucous. Fish breathe by extracting oxygen from water through their gills. Fins propel and stabilize the fish in the water.

Well known fish include: sardines, anchovy, ling cod, clownfish (also known as anemonefish), and bottom fish which include halibut or ling cod. Predators include sharks and barracuda.

### v. Reptiles

Reptiles which inhabit or frequent the sea include sea turtles, sea snakes, terrapins, the marine iguana, and the saltwater crocodile. Most extant marine reptiles, except for some sea snakes, are oviparous and need to return to land to lay their eggs. Thus most species, excepting sea turtles, spend most of their lives on or near land rather than in the ocean. Despite their marine adaptations, most sea snakes prefer shallow waters not far from land, around islands, especially waters that are somewhat sheltered, as well as near estuaries.[3][4] Some extinct marine reptiles, such as ichthyosaurs, evolved to be viviparous and had no requirement to return to land.

### vi. Seabirds

Seabirds are species of birds adapted to living in the marine environment, examples including albatross, penguins, gannets, and auks. Although they spend most of their lives in the ocean, species such as gulls can often be found thousands of miles inland.

### vii. Marine mammals

There are five main types of marine mammals.

**Cetaceans** include toothed whales (Suborder Odontoceti), such as the Sperm Whale, dolphins, and porpoises such as the Dall's porpoise. Cetaceans also include baleen whales (Suborder Mysticeti), such as the Gray Whale, Humpback Whale, and Blue Whale.

**Sirenians** include manatees, the Dugong, and the extinct Steller's Sea Cow.

**Seals** (Family Phocidae), sea lions (Family Otariidae - which also include the fur seals), and the Walrus (Family Odobenidae) are all considered pinnipeds.

**The Sea Otter** is a member of the Family Mustelidae, which includes weasels and badgers.

**The Polar Bear** (Family Ursidae) is sometimes considered a marine mammal because of its dependence on the sea.

**Oceanic habitatsOcean habitats**

Corals and reef fish in Papua New Guinea

Littoral zone

- Intertidal zone
- Estuaries
- Kelp forests

Coral reefs

Ocean banks

Continental shelf

Neritic zone

Straits

Pelagic zone

Oceanic zone

Seamounts

Hydrothermal vents

Cold seeps

Demersal zone

Benthic zone

**viii. Reefs**

Reefs comprise some of the densest and most diverse habitats in the world. The best-known types of reefs are tropical coral reefs which exist in most tropical waters; however, reefs can also exist in cold water. Reefs are built up by corals and other calcium-depositing animals, usually on top of a rocky outcrop on the ocean floor. Reefs can also grow on other surfaces, which has made it possible to create artificial reefs. Coral reefs also support a huge community of life, including the corals themselves, their symbiotic zooxanthellae, tropical fish and many other organisms.

Much attention in marine biology is focused on coral reefs and the El Niño weather phenomenon. In 1998, coral reefs experienced the most severe mass bleaching events on record, when vast expanses of reefs across the world died because sea surface temperatures rose well above normal.[5][6] Some reefs are recovering, but scientists say that between 50% and 70% of the world's coral reefs are now endangered and predict that global warming could exacerbate this trend.[7][8][9][10]

**Deep sea and trenches**

The deepest recorded oceanic trenches measure to date is the Mariana Trench, near the Philippines, in the Pacific Ocean at 10,924 m (35,838 ft). At such depths, water pressure is extreme and there is no sunlight, but some life still exists. A white flatfish, a shrimp and a jellyfish were seen by the American crew of the bathyscaphe Trieste when it dove to the bottom in 1960.[11]

Other notable oceanic trenches include Monterey Canyon, in the eastern Pacific, the Tonga Trench in the southwest at 10,882 m (35,702 ft), the Philippine Trench, the Puerto Rico Trench at 8,605 m (28,232 ft), the Romanche Trench at 7,760 m (24,450 ft), Fram Basin in the Arctic Ocean at 4,665 m (15,305 ft), the Java Trench at 7450 m (24,442 ft), and the South Sandwich Trench at 7,235 m (23,737 ft).

In general, the deep sea is considered to start at the aphotic zone, the point where sunlight loses its power of transference through the water.[citation needed] Many life forms that live at these depths have the ability to create their own light a unique evolution known as bio-luminescence.

Marine life also flourishes around seamounts that rise from the depths, where fish and other sea life congregate to spawn and feed. Hydrothermal vents along the mid-ocean ridge spreading centers act as oases, as do their opposites, cold seeps. Such places support unique biomes and many new microbes and other lifeforms have been discovered at these locations .[citation needed]

**Open ocean**

**Pelagic zone**

The open ocean is relatively unproductive because of a lack of nutrients, yet because it is so vast, in total it produces the most primary productivity. Much of the aphotic zone's energy is supplied by the open ocean in the form of detritus. The open ocean consists mostly of jellyfish and its predators such as the mola mola.

**Intertidal and shore**

Tide pools with sea stars and sea anemone in Santa Cruz, California

Intertidal zones, those areas close to shore, are constantly being exposed and covered by the ocean's tides. A huge array of life lives within this zone.

Shore habitats span from the upper intertidal zones to the area where land vegetation takes prominence. It can be underwater anywhere from daily to very infrequently. Many species here are scavengers, living off of sea life that is washed up on the shore. Many land animals also make much use of the shore and intertidal habitats. A subgroup of organisms in this habitat bores and grinds exposed rock through the process of bioerosion.

**Distribution factors**

An active research topic in marine biology is to discover and map the life cycles of various species and where they spend their time. Marine biologists study how the ocean currents, tides and many other oceanic factors affect ocean lifeforms, including their growth, distribution and well-being. This has only recently become technically feasible with advances in GPS and newer underwater visual devices.

Most ocean life breeds in specific places, nests or not in others, spends time as juveniles in still others, and in maturity in yet others. Scientists know little about where many species spend different parts of their life cycles. For example, it is still largely unknown where sea turtles and some sharks travel. Tracking devices do not work for some life forms, and the ocean is not friendly to technology. This is important to scientists and fishermen because they are discovering that by restricting commercial fishing in one small area they can have a large impact in maintaining a healthy fish population in a much larger area far away.

**Scientists Investigate Ocean's Role In Carbon Cycle, Global Warming**

Ocean carbon uptake distribution map. "How much is sinking? What are the controlling mechanisms? Those are our most basic questions, and there's an ongoing debate in the scientific community about it," said the Kingston resident.

**Kingston RI (SPX) Oct 05, 2005**

With concerns about global warming on the rise, a team of scientists from the University of Rhode Island and the Hellenic Center for Marine Research in Greece are trying to improve the current understanding of the ocean's role in transferring carbon dioxide from the surface to the deep sea.

Led by URI Professor of Oceanography S. Bradley Moran, the scientists have just completed their second research cruise of 2005 to study the carbon cycle - the movement of carbon atoms from land to air to sea.

According to Moran, carbon dioxide from the atmosphere is transferred to seawater, where phytoplankton - microscopic marine plants - in the upper layers of the ocean use it during photosynthesis. When those plants eventually die, some of that carbon sinks to the ocean bottom.

"How much is sinking? What are the controlling mechanisms? Those are our most basic questions, and there's an ongoing debate in the scientific community about it," said the Kingston resident.

If all the extra carbon dioxide being added to the atmosphere by fossil fuel combustion sunk to the ocean bottom, it could potentially reduce global warming.

Using particle-collecting sediment traps and measurements of the naturally occurring radioactive isotope thorium-234, the researchers have collected data from the Arctic Ocean, Mediterranean Sea and North Atlantic Ocean to compare the magnitude of sinking carbon in different locations and at different times of the year. According to Moran, the data so far suggests that there are interesting differences from season to season and from place to place.

Because there is no light for half the year in the Arctic, no photosynthesis occurs during the winter and therefore less carbon sinks through the ocean water column. But with the constant light and ice melting that occurs during the summer months, there is a rapid and active biological growth cycle that increases the amount of carbon that sinks to the deep sea.

Conversely, there is less seasonal variability in phytoplankton growth and the associated sinking of carbon in the Mediterranean, which is low in nutrients. The magnitude in the North Atlantic falls in between that of the Arctic and Mediterranean.

Moran said that in addition to data collection, the researchers have been focusing on how to obtain the most accurate measurements of sinking carbon. "We're challenging the existing view on how it should be done, so we're not particularly popular right now among all of those studying the carbon cycle," he said.

The next step in the researchers' project is to determine what mechanisms control the sinking carbon. They will study how fast and how far the carbon sinks, and the extent to which it eventually returns to the surface or remains in the bottom waters and sediments.

Funded by the National Science Foundation, the joint research project with the Hellenic Center for Marine Research is an outgrowth of a partnership established between URI and the Center in 2001. Two Rhode Island high school teachers participated in the research as part of the state-funded Rhode Island Endeavor Program. Steve Vincelette of South Kingstown High School participated on the Mediterranean cruise in May, and Lucy Rainho of Shea High School in Pawtucket was on the North Atlantic cruise in August.

**CLIMATE SCIENCE**

[Hamburg, Germany (SPX) Oct 04, 2005]

Scientists at the Max Planck Institute for Meteorology presented on Thursday, September 29, their first model calculations for the future of the climate. According to the calculations, in the next 100 years, the climate will change more than ever.