DEEP SEA ECOLOGY

Dr. P. SANTHANAM
Assistant Professor
Marine Planktonology & Aquaculture Lab.,
Department of Marine Science, School of Marine Sciences
Bharathidasan University, Tiruchirappalli-620 024, Tamil Nadu.
E-mail: santhanam@bdu.ac.in
Website: www.mpalbdu.weebly.com

DEEP SEA ECOLOGY

- Deep sea (>200 m) covers 2/3rds of earth's surface
- Poorly known because difficult to study
- < 500 m^2 sampled quantitatively!
- Still in pattern discovery & natural history phase
- Historically viewed as monotonous & impoverished (NOT TRUE)
- Some of the water on the surface of the ocean sinks to the deep parts of the ocean. Then the water spends a long time in the deep part of the ocean. Then the water comes back to the surface.
- The deep ocean isn't directly affected by wind or storms or waves or tides. The deep waters in the ocean are in layers. The top layers are less dense than the bottom layers. All of the deep ocean water is very cold and salty.

DEEP SEA ECOLOGY

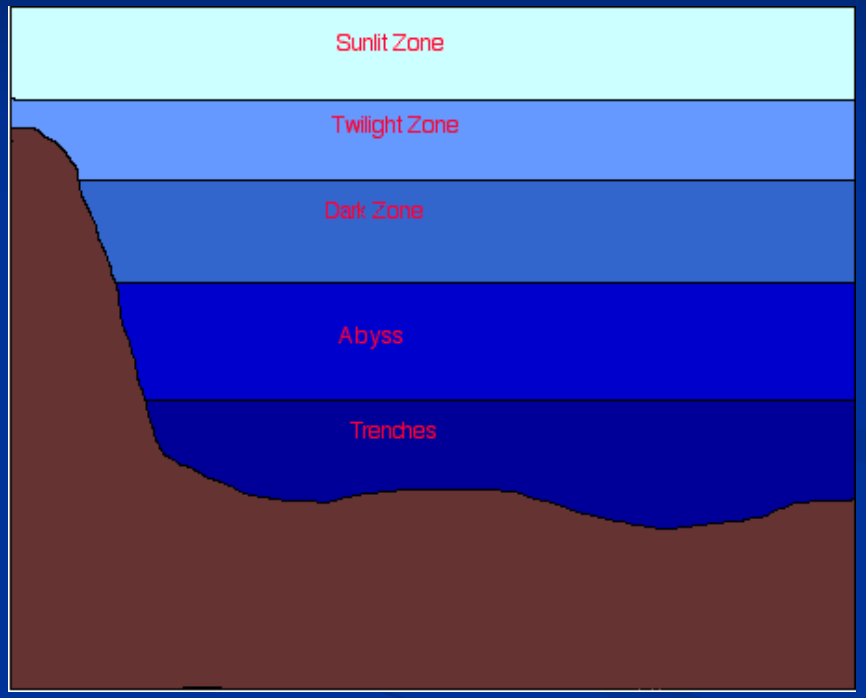
Sunlit Zone 0-600 feet * In the sunlit zone the water is very warm because that is where the sun hits. Most of the plants and animals live in the sunlit zone. This is were you will find most sharks although there is some sharks that live near the ocean floor.

Twilight Zone 600-3,300 feet * The twilight zone temperature can be as low as 41 degrees F. Because there is less light there than in the sunlit zone.

Dark Zone 3,300-13,200 feet * In the dark zone the temperature is about 35 degrees F. There is not so much food in this zone.

Abyss 13,200-19,800 feet * In this layer the mud is made from the skeletons of other small sea animals. The mud can be more than a mile thick.

Trenches over 19,800 feet * Only animals that are adapted to the freezing water can survive in this layer.



DEEP SEA ECOLOGY

Sampling Methods

- Box cores-sediments
- Benthic sleds-sediments
- Towed cameras
- ROVs
- Submarines

DEEP SEA ECOLOGY

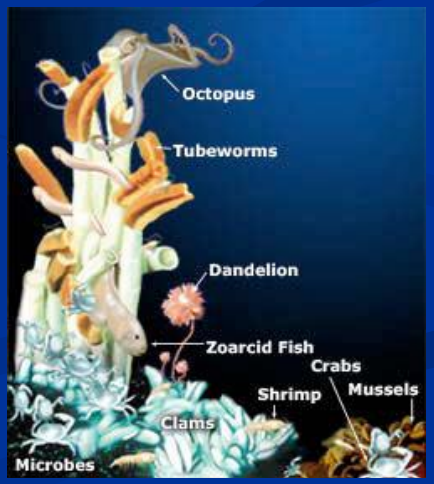
Abiotic Conditions

- Dark
- Cold
- Constant salinity
- Mostly covered in sediments

DEEP SEA ECOLOGY

Organisms

- Mostly similar taxa to shallower areas, but different species
- No primary producers,
- Unique organisms at hydrothermal vents (80% endemic)



Deep Ocean Diversity

Deep sea animals have to live in a very cold, dark, and high-pressure environment.

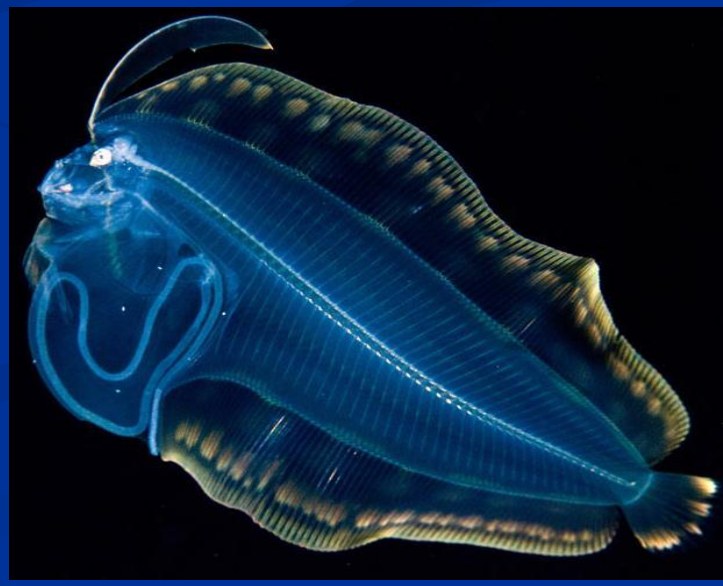
To survive there, they've evolved some very strange adapations.

Some make their own light, an ability called bioluminescence, while others are totally blind.

Some are terrifying looking, like anglerfish, while others are quite beautiful even if there is no one to appreciate it except us people looking at photos.

See some of the remarkable adaptations that deep-sea animals.

Learn more about the deep sea and deep-sea corals.



DEEP SEA ECOLOGY

Fangtooth

- Food is scarce in the deep sea. The fish that live there must rely on what little food floats down from above-often referred to as "marine snow" or eat their neighbors!
- Deep-sea fish typically have big mouths, long sharp teeth, and elastic stomachs to catch prey in the dark and swallow it whole.
- This ferocious-looking fish, called "fangtooth," is found at depths of 800 to 1,524 meters. It grows to about 25 centimeters (10 in) long.

DEEP SEA ECOLOGY

Dragonfish

- Many deep-sea fish rely on *bioluminescent* (light-producing) organs to find a mate and lure prey.
- This fish has a long chin barbel that glows in the dark. The fish uses the barbel like a fishing lure, flashing it on and off and waving it back and forth.
- When an unsuspecting fish nears, its is snapped up in the dragonfish's powerful jaws.
- While this fish grows to only about 6 inches long, it is a ferocious predator.

DEEP SEA ECOLOGY

The vent crab

Like other crabs, the vent crab seems to have a very good sense of smell.

This is important in locating food. We've observed it feeding on several species of deep-sea worms, as well as clams and mussels.

The adult crabs feed on bacterial mats. These are colonies of bacteria so dense they are visible to the naked eye.

DEEP SEA ECOLOGY

Spiny Spider Crab

With its legs extended, this crab measures about 46 centimeters (18 in) across.

It is found in vent site in the Sea of Cortés off Mexico's west coast.

Galatheid Crab

When frightened, it flaps its tail to lift itself backwards into the water.

It averages about 10 centimeters (4 in) long.

Eelpout

Eelpout, or zoarcid is the most common fish found at the vents.

DEEP SEA ECOLOGY

Deep-Sea Octopus

Hair-like projections ("cirri") line the webbed arms of this octopus.

These projections may help it sense food in the darkness.

This species is also equipped with paddle-like fins to help it swim.

DEEP SEA ECOLOGY

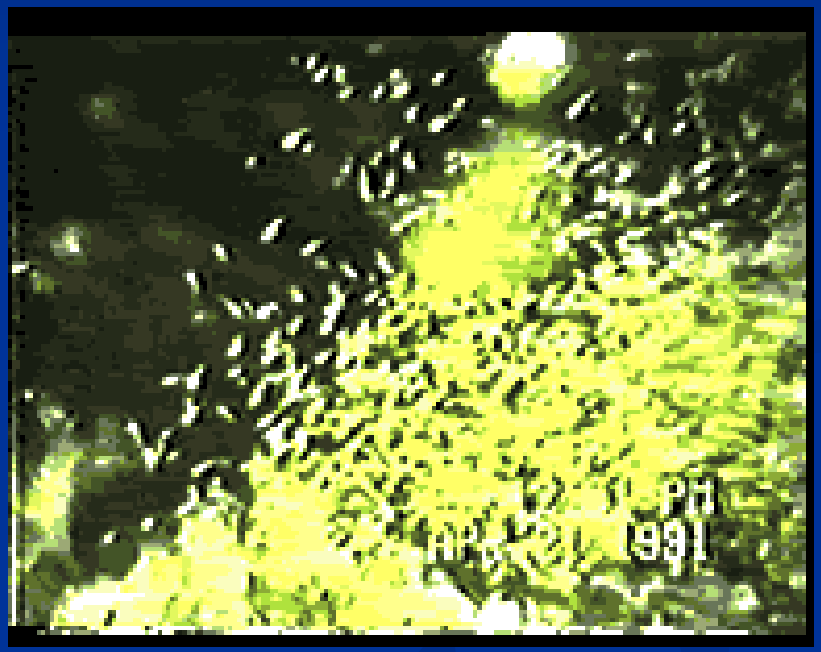
Deep-Sea Dandelion

Scientists have nicknamed these organisms "dandelions."

They are *colonial* organisms- each cluster is composed of many organisms living in close association with one another.

Deep-Sea Shrimp

This "snow" is actually a swarm of amphipods, which are shrimp-like organisms. Sometimes they are referred to as the "insects of the sea."



DEEP SEA ECOLOGY

Tube Worms

- Tubeworms *(Riftia pachyptila)* live over a mile deep on the Pacific Ocean floor near hydrothermal vents.
- They may grow to about 3 meters (8 ft) long. The worms' white tube home is made of a tough, natural material called chitin.
- Tubeworms have no mouth, eyes, or stomach.
- Their survival depends on a symbiotic relationship with billions of bacteria that live inside them. These bacteria convert the chemicals spewing out of the vents into worm food. This chemical-based food-making process is known as chemosynthesis.

DEEP SEA ECOLOGY

Deep-Sea Anemone

Sea anemones are regarded as the "flowers of the sea." Although they look like flowers, these invertebrates are actually predatory animals, and they have no skeleton. They typically live attached to the seafloor, rock, or coral, but they can move around very slowly.

Blind Lobster

This new species of lobster (Dinochelus ausubeli) is blind and has bizarre claws. It was discovered about 300 meters (984 feet) deep in the Philippine Sea by a Census of Marine Life expedition.

Zoanthids on Hydrothermal Vent

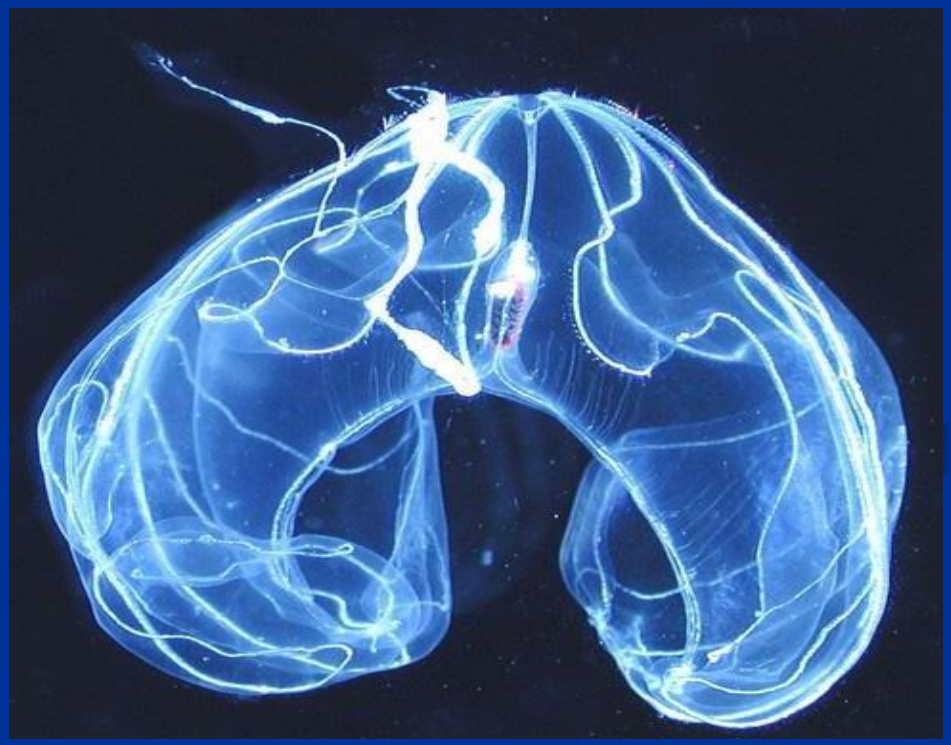
These are the first zoanthids (relatives of coral) recorded at a hydrothermal vent.

Yeti Crab

This yeti crab (*Kiwa hirsuta*) was discovered in 2005 and has no eyes. It was found by the Census of marine Life on a hydrothermal vent near Easter Island at a depth of 2,200 meters.

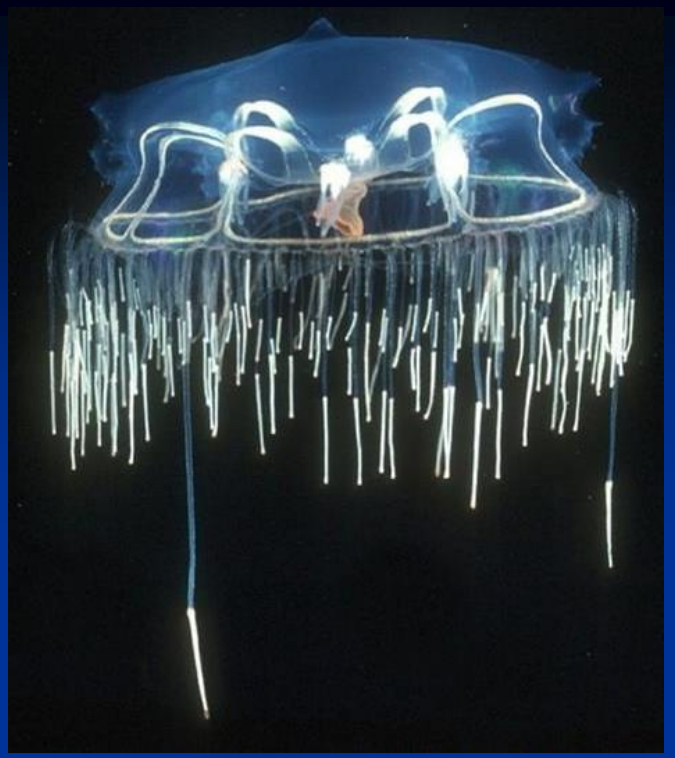
Bioluminescent Comb Jelly

A transparent body helps this tiny comb jelly (*Bathocyroe fosteri*) blend into the water.



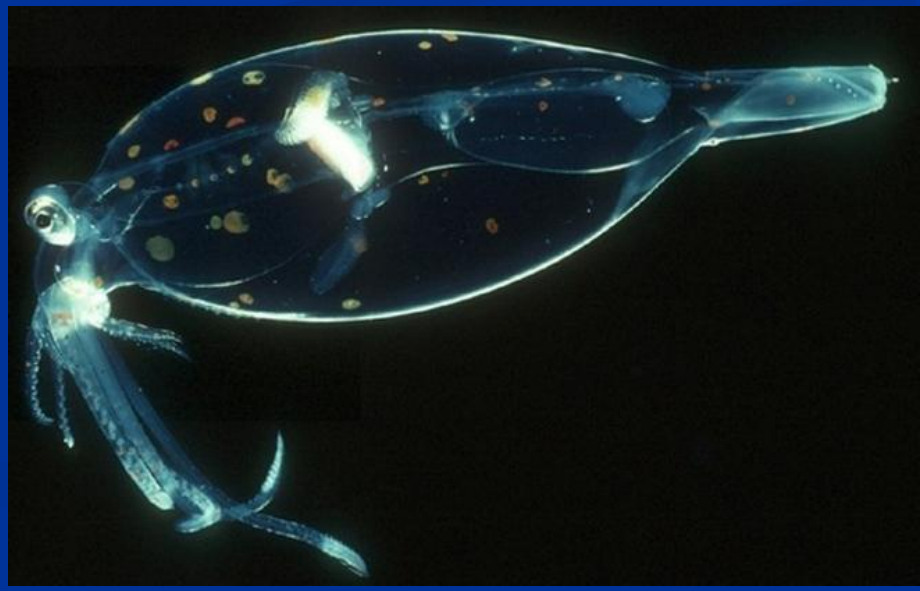
Midwater Jellyfish

A fringe of tentacles surrounds the bell of this sea jelly (*Halicreas minimum*).



Cockatoo Squid

This transparent cockatoo squid, or glass squid, retains liquids, giving it a balloon-like shape and helping it float.



Red Mid-Water Comb Jelly

Like this comb jelly (*Aulococtena acuminata*), many midwater animals are red. Red is an easier pigment to produce than black, and in dark water, can't be seen.

Unidentified Comb Jelly

This jelly's red color provides camouflage in the ocean depths.

Jewel Squid

This jewel squid (*Histioteuthis bonnellii*) lives above the Mid-Atlantic Ridge.

A Fish that Looks Like a Whale

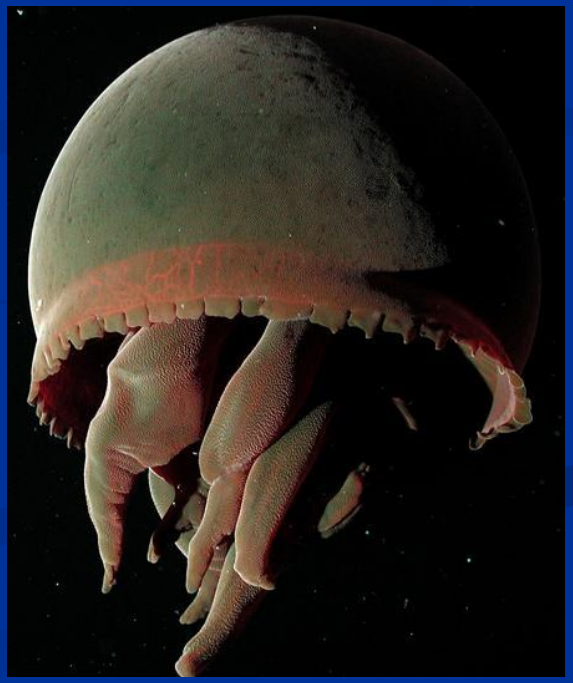
This deep sea creature has a whale-like body and gaping mouth. It grows up to 400 mm (15.7 in) long.

Sea star

A sea star, *Hymenaster pellucidus*, brought up from a benthic ROV dive.

Big Red Jellyfish

"Big red" is the nickname that MBARI marine biologists gave to this startlingly large jellyfish, *Tiburonia granrojo*(also called the giant jellyfish), which grows over one meter (three feet) in diameter.



Sea Whip Coral

The pink strands of this single deep-sea coral harbor a variety of marine life. Sea whips are gorgonian corals and have flexible skeletons.

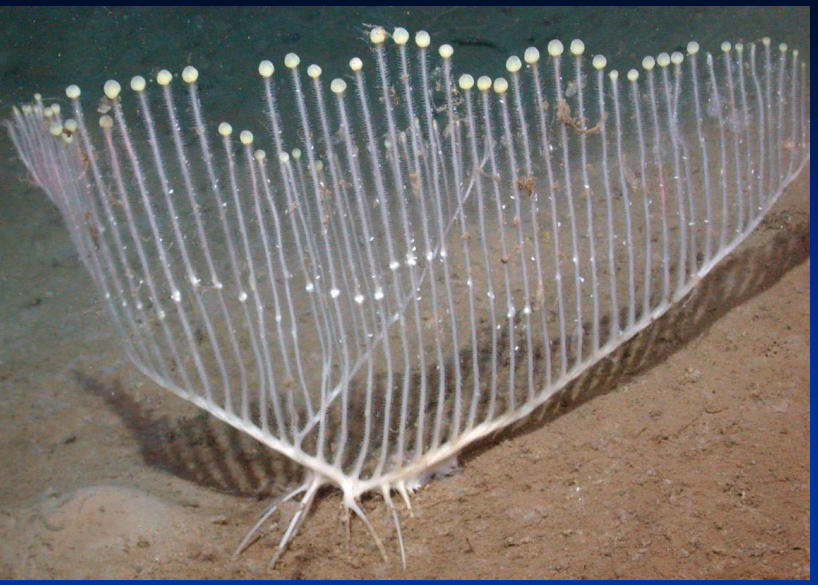
Deep sea Lizardfish

This lizardfish rests on the bottom, waiting to snatch prey.

Venus Fly-Trap Anemone in the Gulf of Mexico

This elegant Venus fly-trap anemone was photographed in the Gulf of Mexico at roughly 4,900 feet (1500 meters).

Harp Sponge

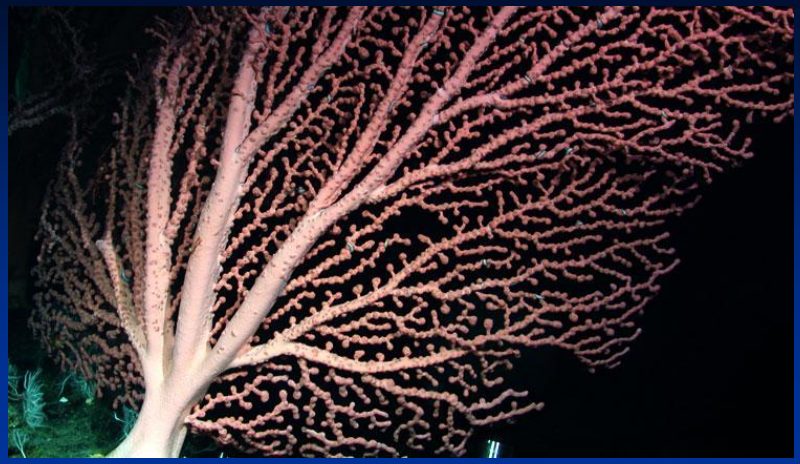


How Many Nights of Hanukkah? A harp has its own place in holiday music, but we also think this sponge looks like a super-sized menorah! This newly-discovered carnivorous sponge (Chondrocladia lyra) was found using robotic submersibles operated by the Monterey Bay Aquarium Research Institute 10,000 feet below the surface in dark waters. It traps small crustacean prey with barbed hooks found along its branch-like limbs. Once it has caught something, the sponge covers it with a thin membrane and the digestion process begins.

Phronima

Giant eyes spot prey. Huge claws grab the prey, and a tiny mouth rips it to shreds.

Bubblegum Coral



This bubblegum coral (Paragorgia arborea) has a fanlike shape. It is growing 1,310 m (4,298 ft) deep on the Davidson Seamount southwest of Monterey, California.Learn more about deep-sea corals in the multimedia feature "Coral Gardens of the Deep Sea."

Bioluminescent Octopod

The yellow bioluminescent ring on this female octopus may attract mates.

A Striped Deep Sea Worm

This beautiful polychaete (bristly worm) called *Tomopteris carpenteri* was photographed by Census of Marine Life researchers in Antarctica's Southern Ocean.

Frilled Shark

Humans rarely encounter frilled sharks, which prefer to remain in the oceans' depths, up to 5,000 feet (1,500 meters) below the surface.

Considered living fossils, frilled sharks bear many physical characteristics of ancestors who swam the seas in the time of the dinosaurs.

This 5.3-foot (1.6-meter) specimen was found in shallow water in Japan in 2007 and transferred to a marine park. It died hours after being caught.

DEEP SEA ECOLOGY

Productivity

- No primary production
- Extremely low input of organic carbon.
- POM from primary producers above

  (e.g., phytoplankton, seagrasses, kelps)
- POM from consumers (e.g., dead animals -"whale falls")

DEEP SEA ECOLOGY

- POM parallels productivity above

  - low in tropics, higher in temperate areas

  - seasonal input in temperate areas

- input of POM declines exponentially with depth

- more carbon input
- more density & biomass

DEEP SEA ECOLOGY

Zonation

- Depth related patterns
- - density declines exponentially with depth
- - biomass declines exponentially with depth
- - species richness/diversity peaks at intermediate depths

DEEP SEA ECOLOGY

Zonation

- zonation at hydrothermal vents
- - high temp areas (50°+ C): alvinellid polychaetes
- - active flows < 30° C: vestimentiferans
- - low temp flows <5° C: bivalves
- - low/no flow: suspension feeders

DEEP SEA ECOLOGY

Diversity

- very high (often > 250 species m^{-2})
- - rivals coral reefs and rainforests
- low dominance
- how can this be?
- - *strong competition for food led to niche diversification?*
- -- little food
- -- density & biomass tightly coupled to POM input