

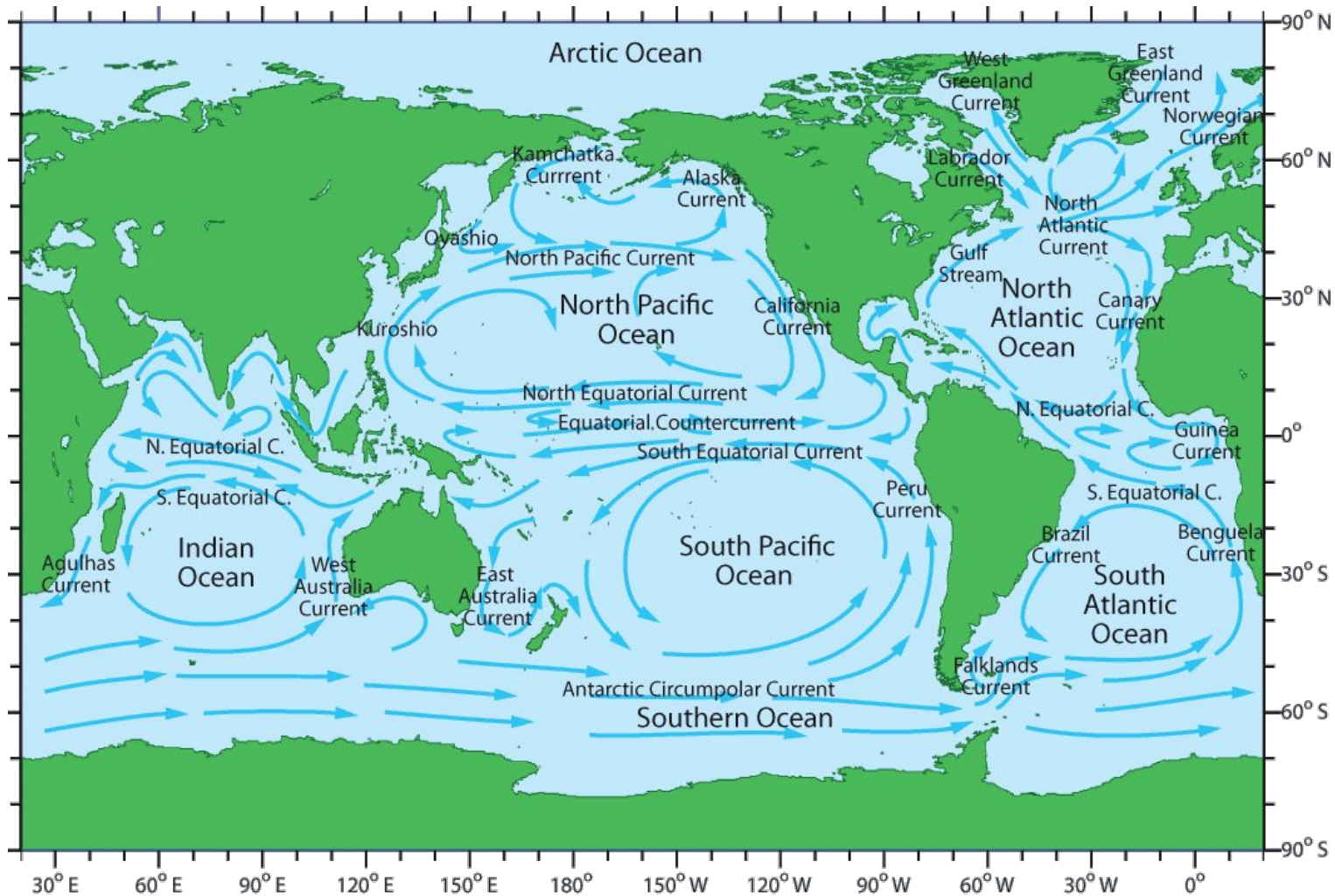
Marine Biomes

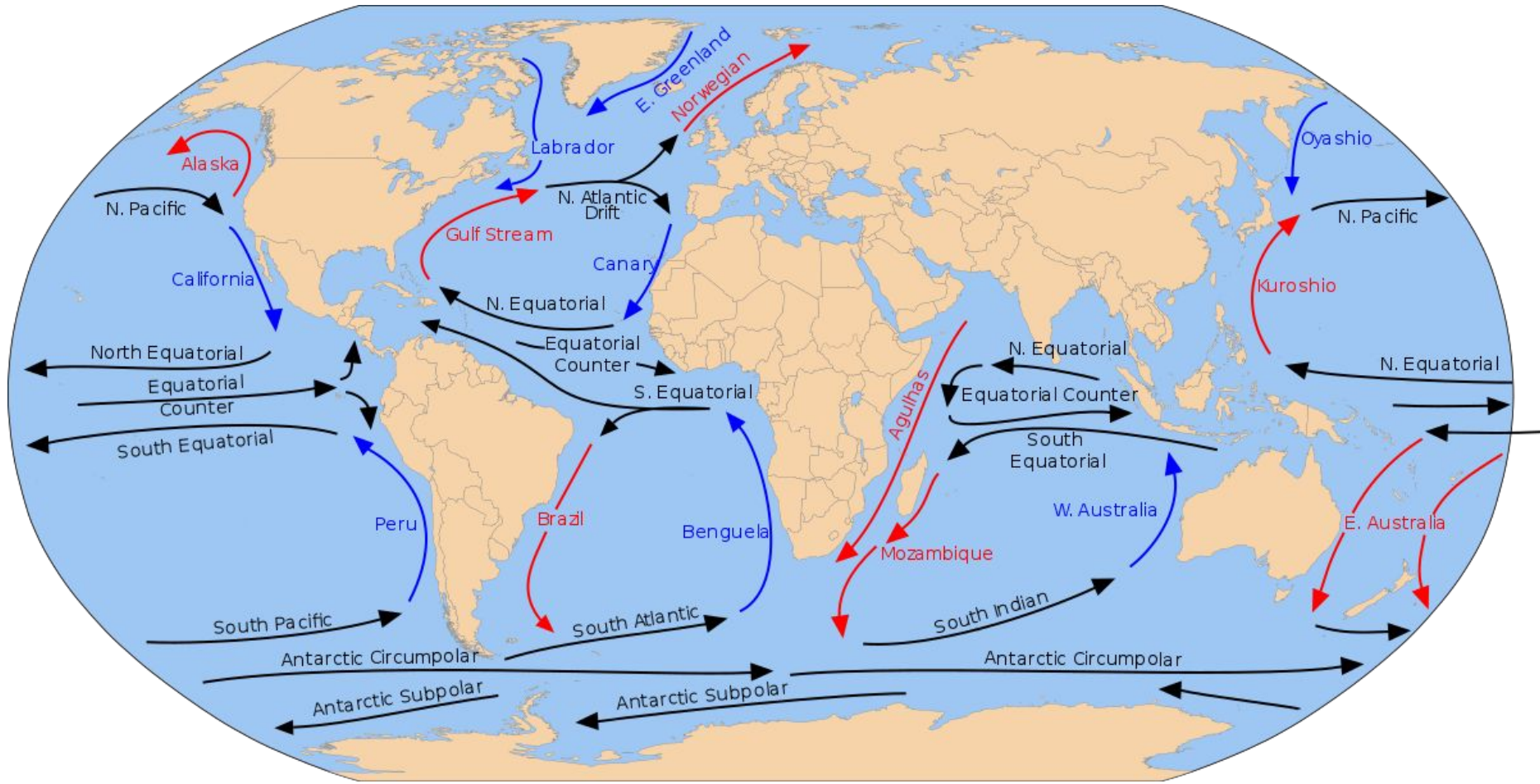
Ms. Larsh

Although the marine biome is primarily made up of the oceans, it can be divided up into three types:

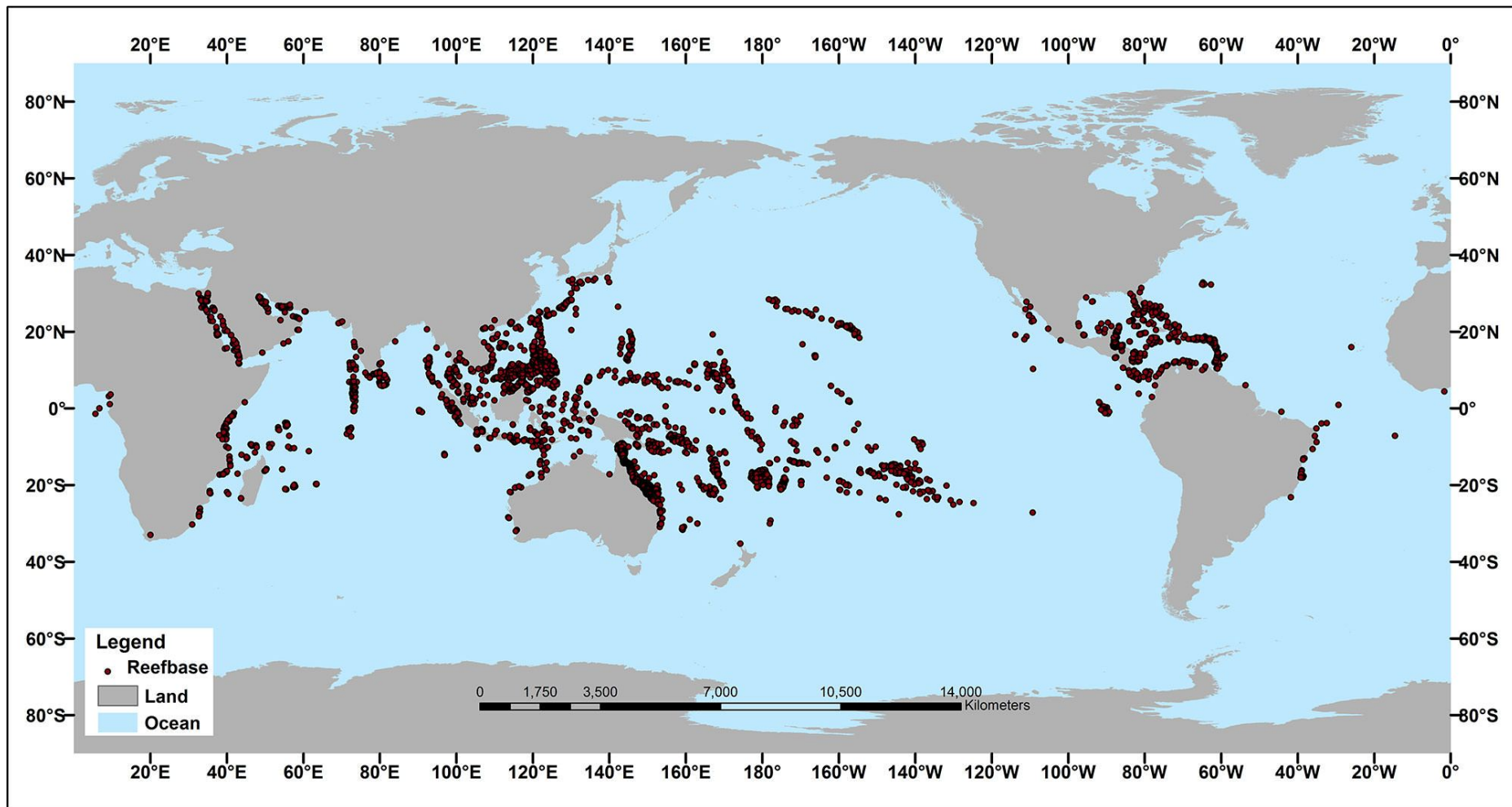
- Oceans
- Coral reefs
- Estuaries

Oceans - These are the five major oceans that cover the world including the Atlantic, Pacific, Indian, Arctic, and Southern Oceans.





Coral reefs - Coral reefs are small in size when compared to the oceans, but around 25% of marine species live in the coral reefs making them an important biome.





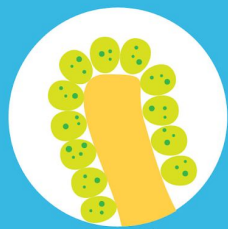


CORAL BLEACHING

Have you ever wondered how a coral becomes bleached?

HEALTHY CORAL

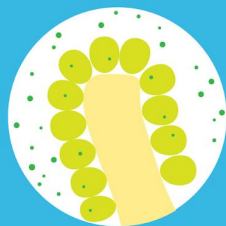
1 Coral and algae depend on each other to survive.



Corals have a symbiotic relationship with microscopic algae called zooxanthellae that live in their tissues. These algae are the coral's primary food source and give them their color.

STRESSED CORAL

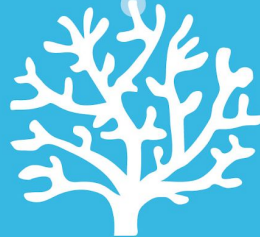
2 If stressed, algae leaves the coral.



When the symbiotic relationship becomes stressed due to increased ocean temperature or pollution, the algae leave the coral's tissue.

BLEACHED CORAL

3 Coral is left bleached and vulnerable.



Without the algae, the coral loses its major source of food, turns white or very pale, and is more susceptible to disease.

WHAT CAUSES CORAL BLEACHING?



Change in ocean temperature

Increased ocean temperature caused by climate change is the leading cause of coral bleaching.



Runoff and pollution

Storm generated precipitation can rapidly dilute ocean water and runoff can carry pollutants — these can bleach near-shore corals.



Overexposure to sunlight

When temperatures are high, high solar irradiance contributes to bleaching in shallow-water corals.



Extreme low tides

Exposure to the air during extreme low tides can cause bleaching in shallow corals.



Coral reefs are dying around the world. Damaging activities include coral mining, pollution (organic and non-organic), overfishing, blast fishing, the digging of canals and access into islands and bays. Other dangers include disease, destructive fishing practices and warming oceans.



What is Coral bleaching?

Coral bleaching occurs when coral polyps expel algae that live inside their tissues.

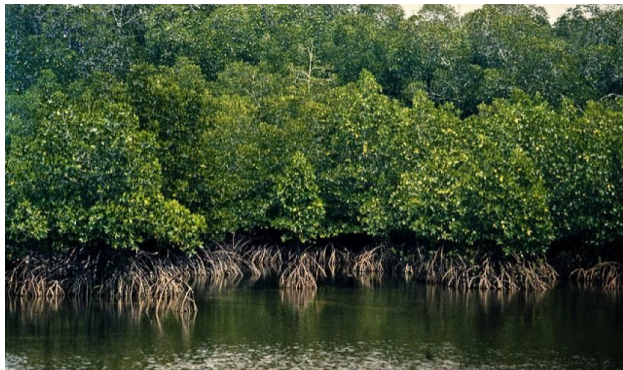
Normally, coral polyps live in an endosymbiotic relationship with these algae, which are crucial for the health of the coral and the reef. The algae provides up to 90 percent of the coral's energy.

What is Ocean Acidification?

Ocean acidification is the ongoing decrease in the pH of the Earth's oceans, caused by the uptake of carbon dioxide (CO₂) from the atmosphere.

Seawater is slightly basic (meaning pH > 7), and ocean acidification involves a shift towards pH-neutral conditions rather than a transition to acidic conditions (pH < 7).

Estuaries - Estuaries are areas where rivers and streams flow into the ocean. This area where freshwater and saltwater meets, creates an ecosystem or biome all its own with interesting and diverse plant and animal life.



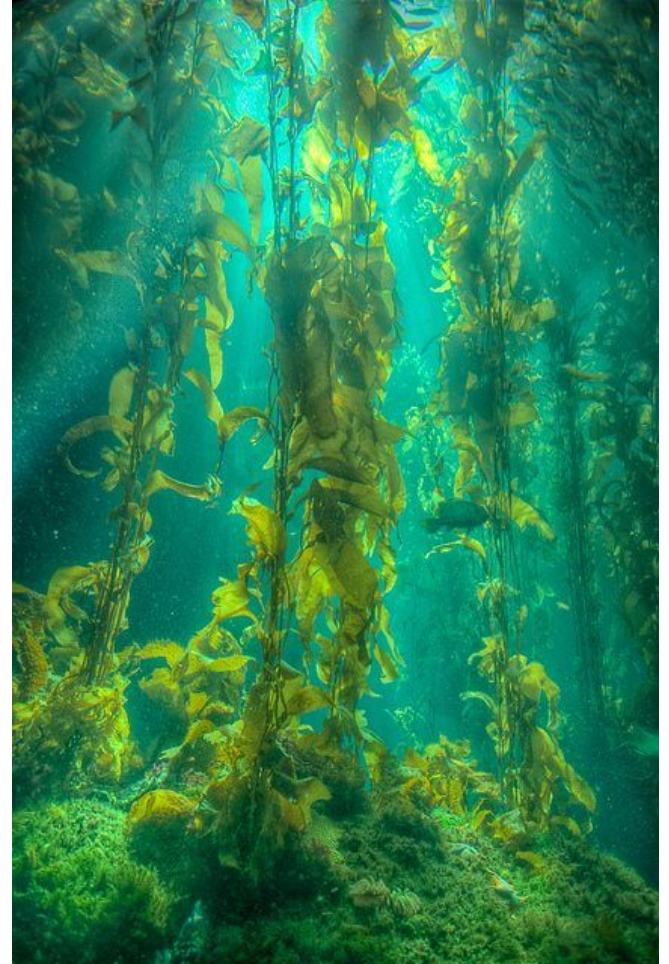
Marine Ecosystems Defined

What are Kelp Forests?

Kelp forests are underwater areas with a high density of kelp, which covers about 25% of the world's coastlines. They are recognized as one of the most productive and dynamic ecosystems on Earth

Smaller areas of anchored kelp are called kelp beds

Kelp Forests



Salinity: 35 ppt

pH: [Monterey Bay](#) 8.1

Kelp Forests

Average Temperature: 5°C to 20°C or 42°F to 72°F

Found along 25% of the world's coastlines in temperate, polar, & tropical regions

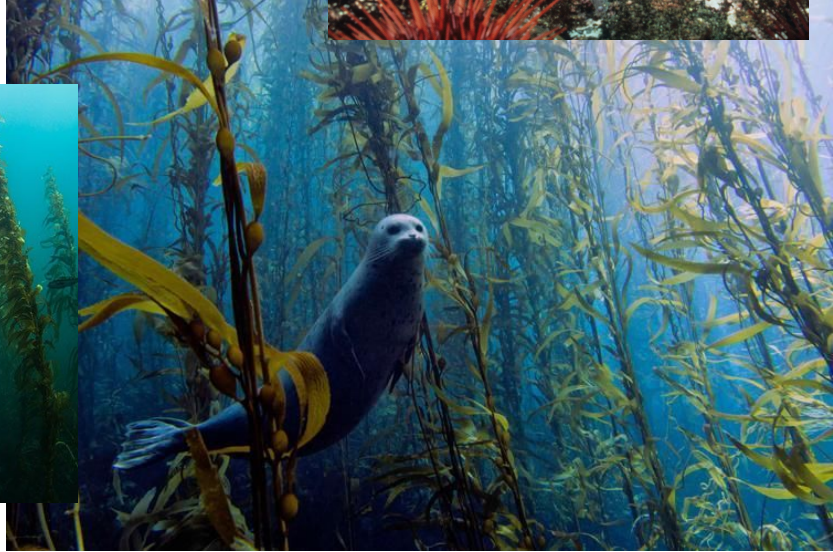
Characteristics: Dominated by kelp! Areas with small patches of kelp are called kelp beds. Kelp is considered an *ecosystem engineer*

NPP - They are recognized as one of the most productive and dynamic ecosystems on Earth

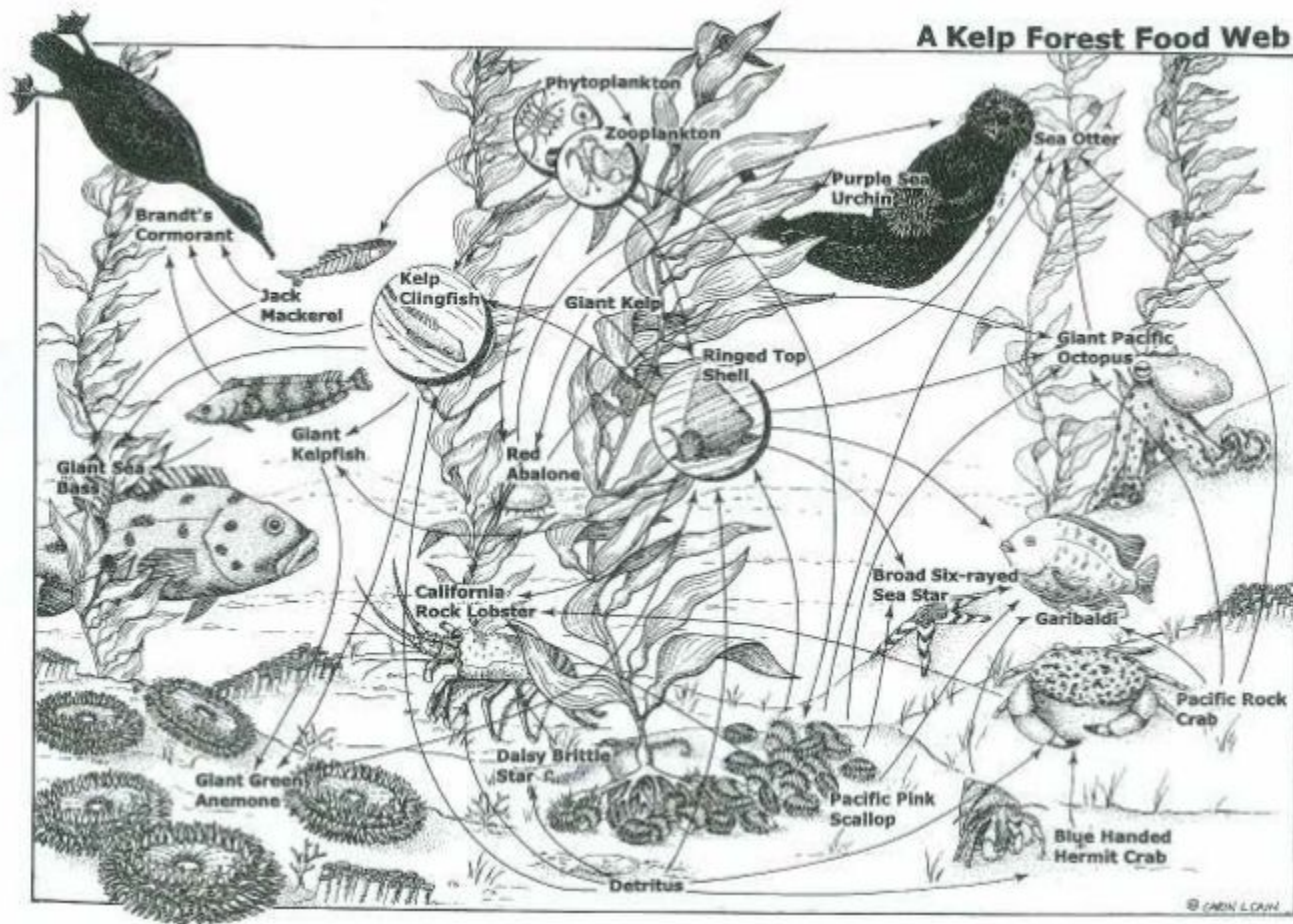
What is an Ecosystem Engineer?

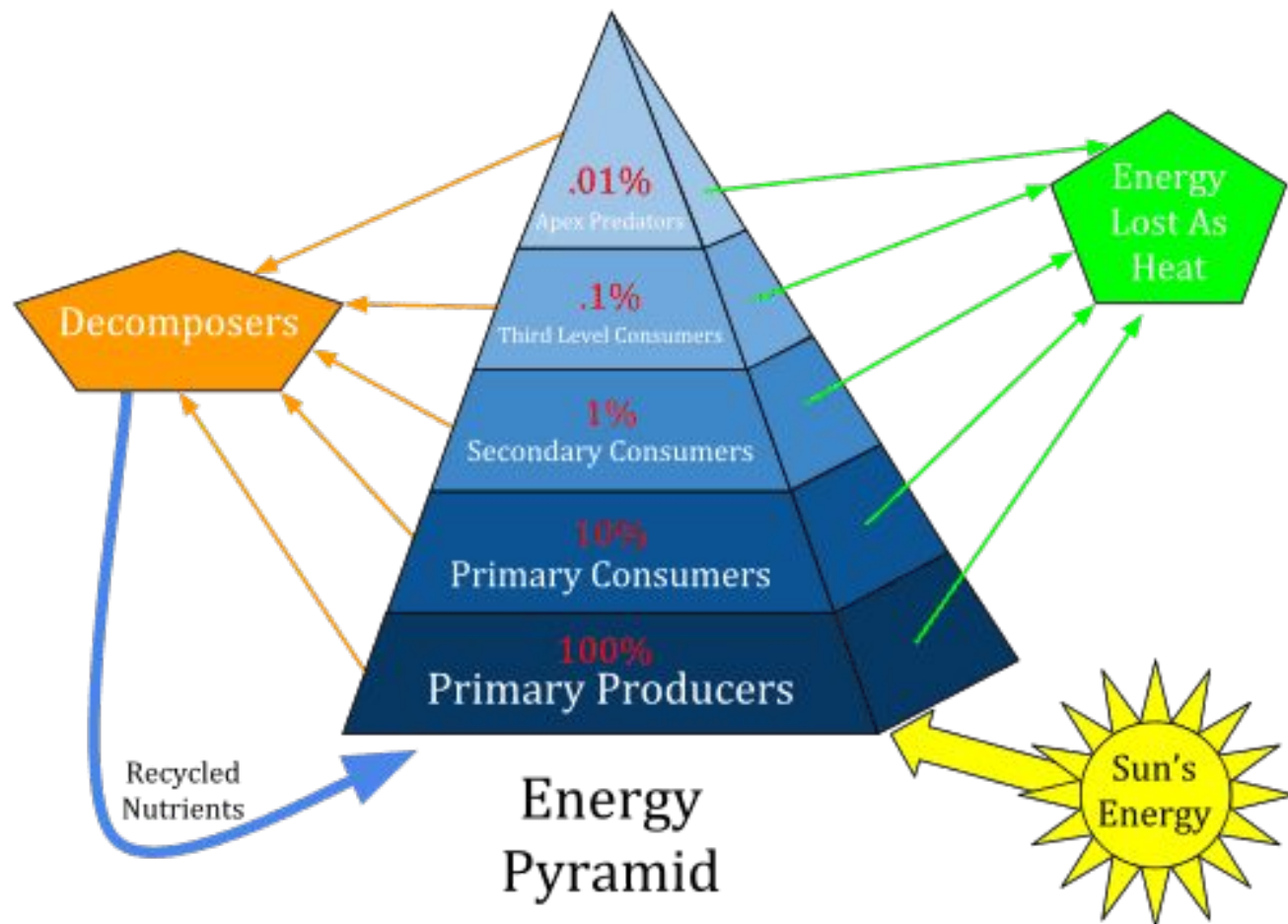
An ecosystem engineer is any organism that creates, significantly modifies, maintains or destroys a habitat. These organisms can have a large impact on the species richness and landscape-level heterogeneity of an area.

Kelp significantly modifies and maintains a unique habitat by providing a physical barrier that influences ocean currents along the coastline and provides shelter to a diverse collective of invertebrates



A Kelp Forest Food Web





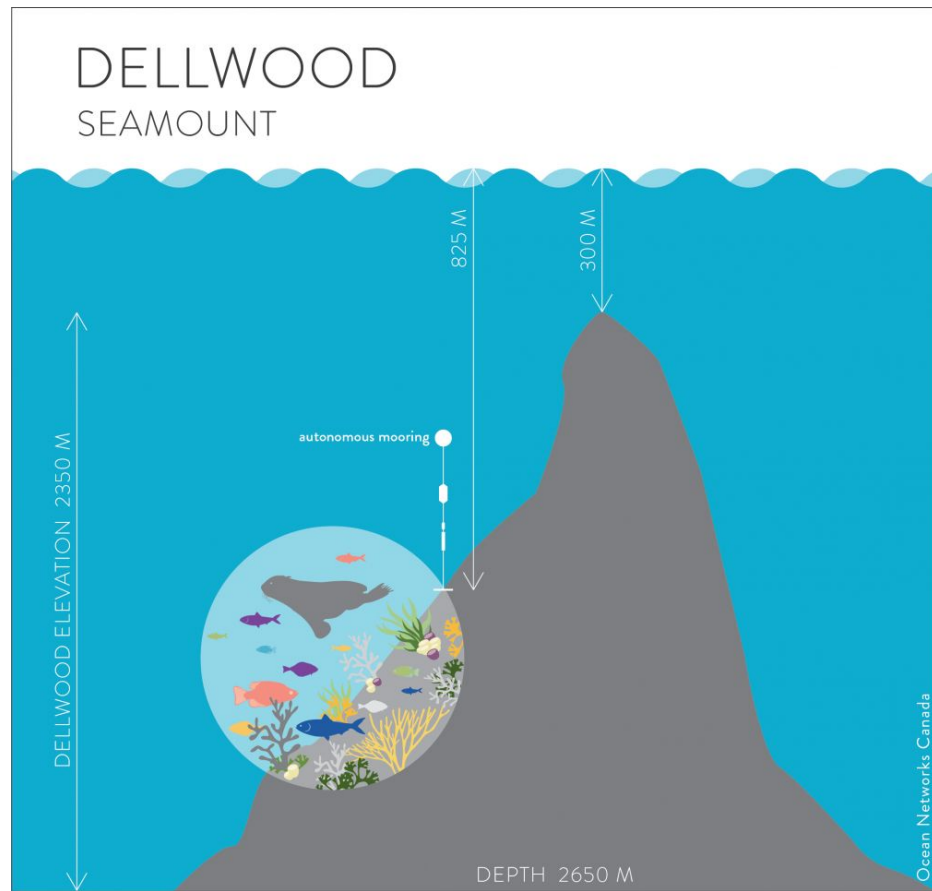
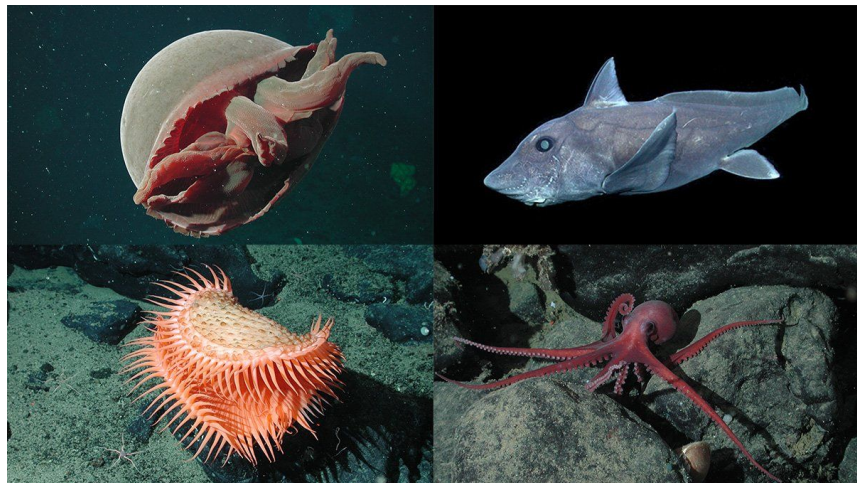
What are Seamounts?

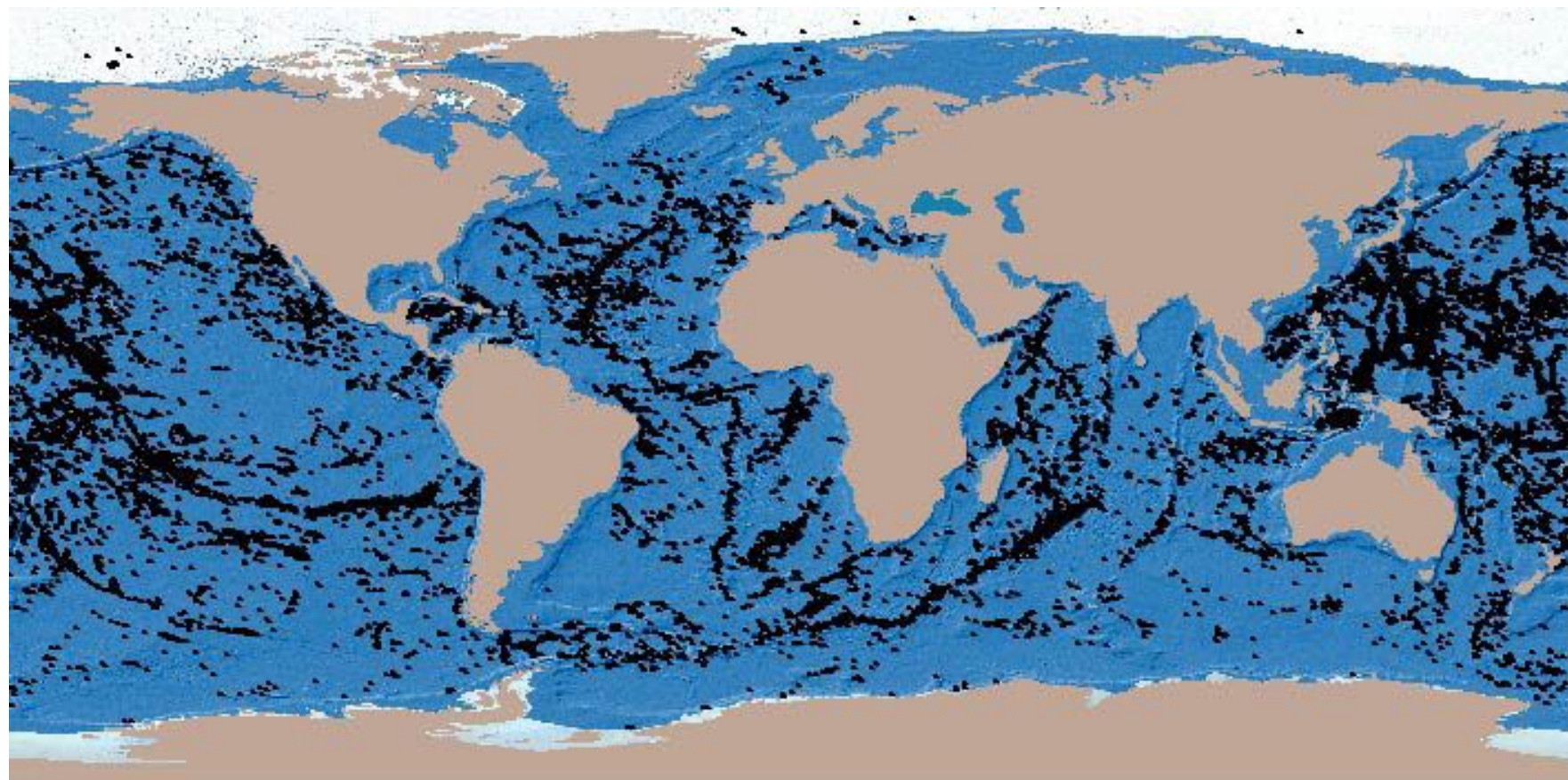
Seamounts are undersea mountains formed by volcanic activity

The biological richness of seamount habitats results from the shape of these undersea mountains. Thanks to the steep slopes of seamounts, nutrients are carried upwards from the depths of the oceans toward the sunlit surface, providing food for creatures ranging from corals to fish to crustaceans.

“Scientists estimate there are at least 100,000 seamounts higher than 1,000 meters around the world. These provide hard foundations for deep-sea life to settle on and grow. In addition, seamounts rising into the ocean create obstacles that shape ocean currents and direct deep, nutrient-rich waters up the sloping sides of seamounts to the surface. These factors combine to make seamounts fertile habitats for diverse communities of marine life, including sponges, crabs, sea anemones, commercially important fish, and deep-sea corals”

-Woods Hole Oceanographic Institution





Salinity: 35 PPT

pH: 12.2 (seamounts have low pH levels)

South Chamorro
Seamount

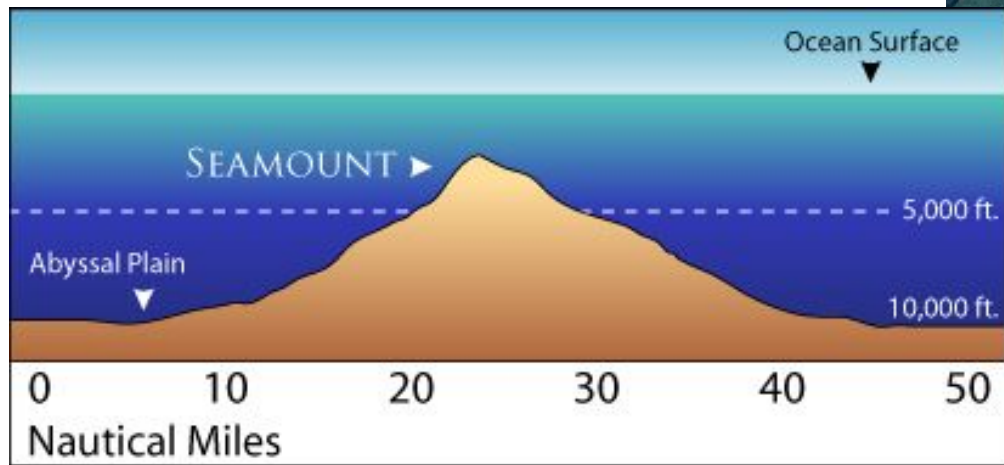
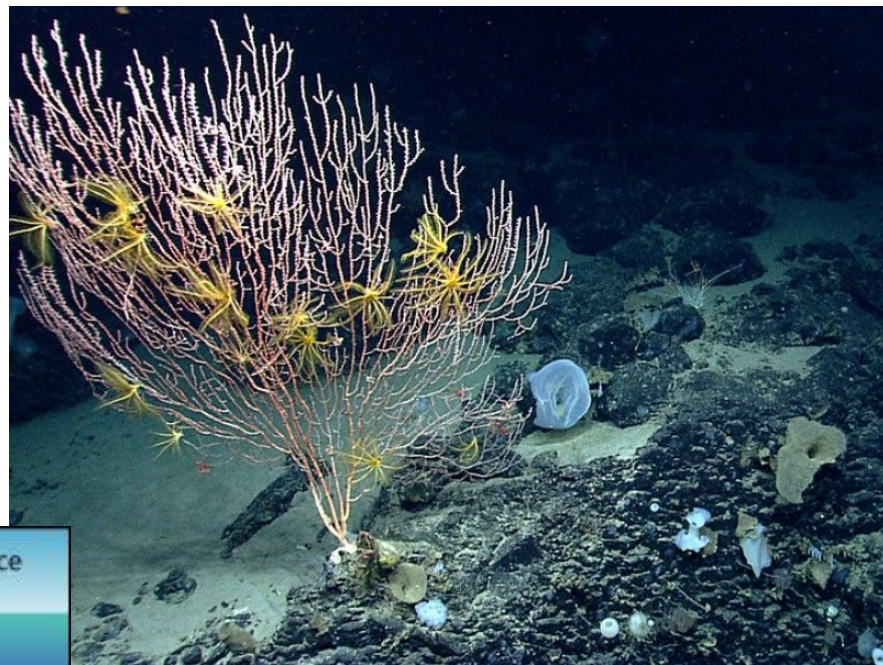
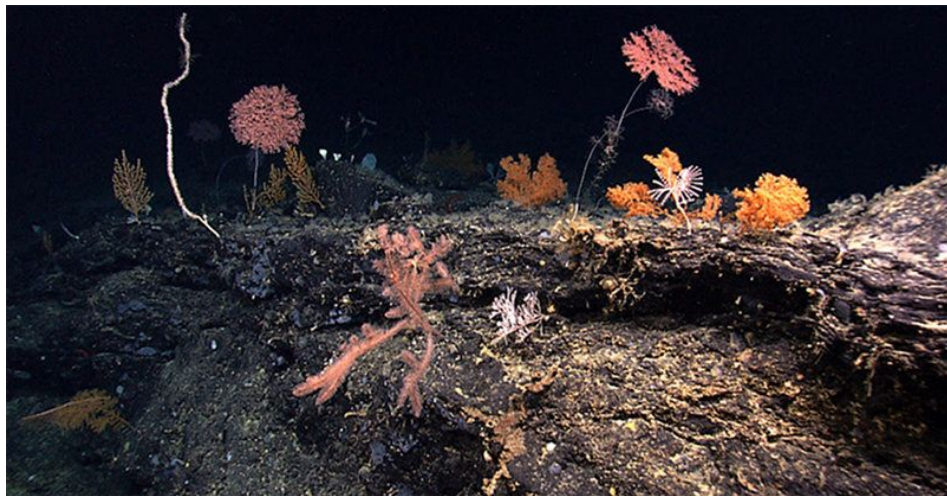
Average Temperature: 0°C to 3°C or 32°F to 37.4°F

****Height of 2,400 m (7,874 ft)***

Found in every ocean basin in the world, distributed extremely widely both in space and in age, defined as an isolated rise in elevation of 1,000 m (3,281 ft) or more

Characteristics: Deep sea hydrothermal vents and orographic lifting give rise to unique fauna and chemosynthetic organisms

NPP - Relatively low



Giant Tube Worms w/ chemosynthetic bacteria instead of a gut

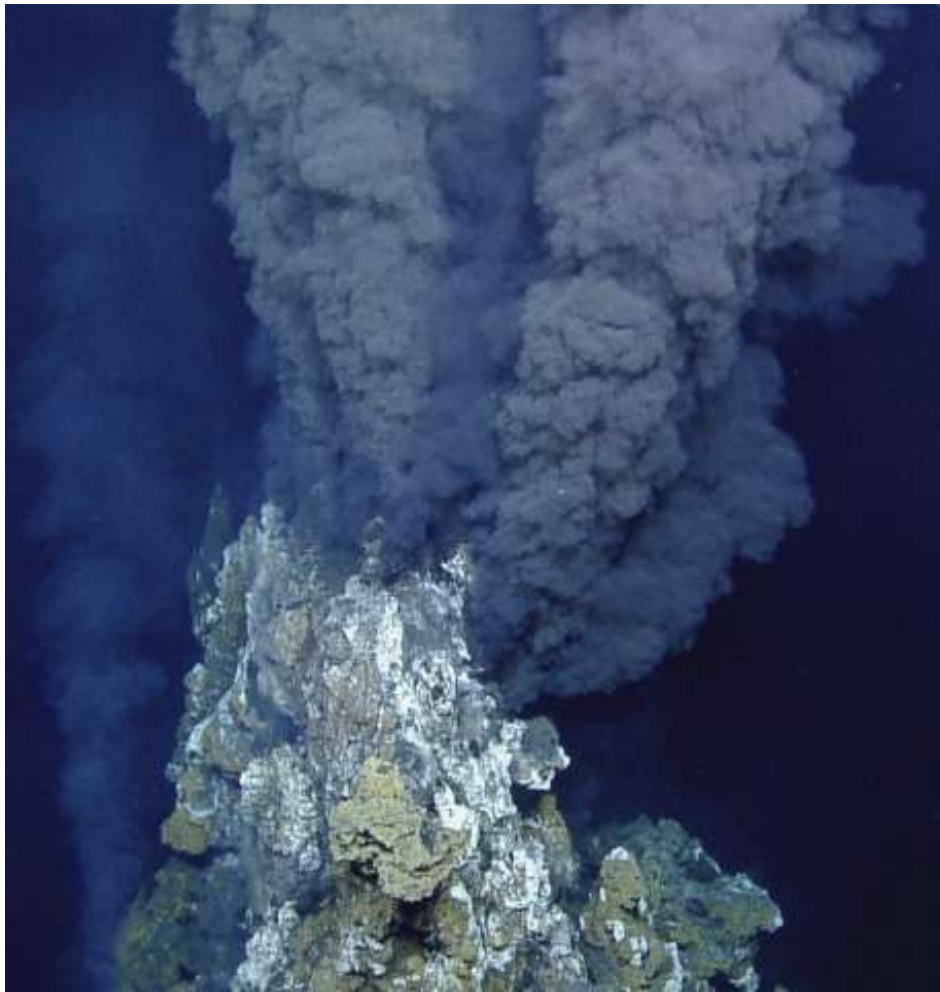


Archaea

What are Hydrothermal Vents?

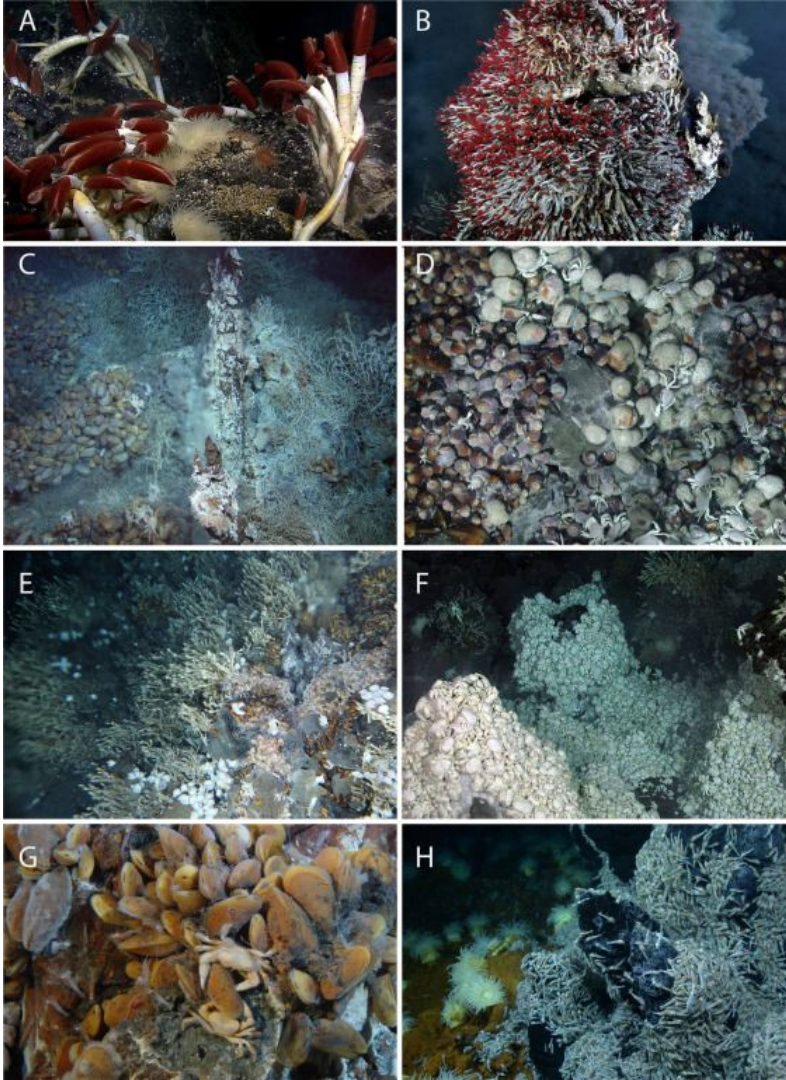
Hydrothermal vents occur at both diverging and converging plate boundaries. Heat is released as magma rises and cracks the ocean floor and overlying sediments. Seawater drains into the fractures and becomes superheated, dissolving minerals and concentrating sulfur and other compounds.

Hydrothermal vents are biologically important, harboring massive animal communities at densities that make them one of the most productive ecosystems on Earth



“Despite the extreme temperatures and pressures, toxic minerals, and lack of sunlight that characterized the deep-sea vent ecosystem, the species living there were thriving. Scientists later realized that bacteria were converting the toxic vent minerals into usable forms of energy through a process called chemosynthesis, providing food for other vent organisms”

-Woods Hole Oceanographic Institution



Deep-sea chemosynthetic ecosystems are fueled by microbial primary production which uses reduced chemical compounds, usually hydrogen sulphide or methane, to produce organic matter

They help regulate ocean chemistry and circulation

Salinity: varies - black smokers/ white smokers 34.6 - 38 ppt

pH: Some measured Under 3.0, similar to vinegar Hydrothermal Vent
Others range from 3-5 (acidic)

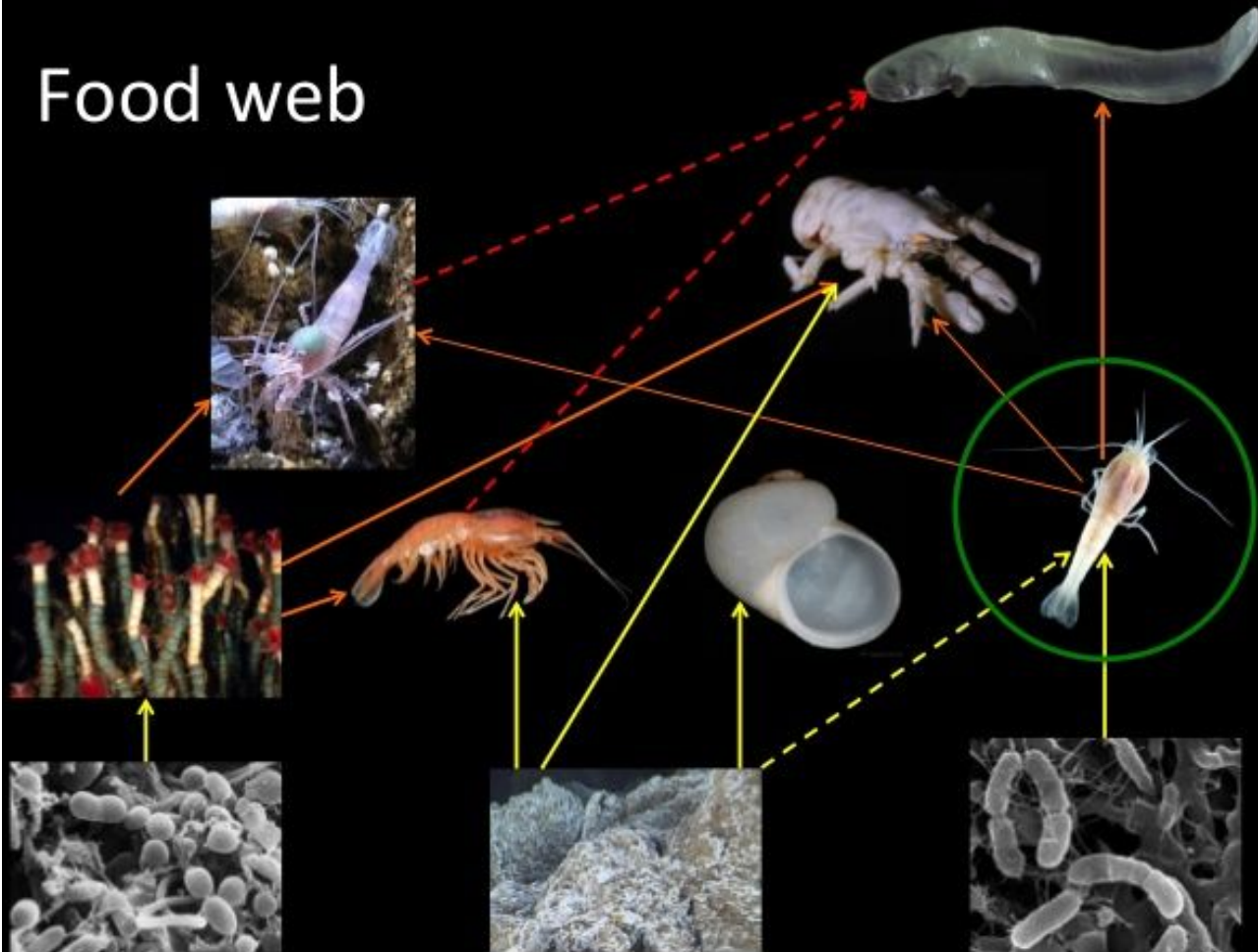
Average Temperature: Hot End 60°C to 450°C or 140°F to 752°F
Cold End 10°C to 20°C or 50°F to 68°F

****Hydrothermal fluid temperatures can reach 400°C or 750°F +, but they do not boil under the extreme pressure of the deep ocean.***

Found along mid-ocean ridges & subductions zones
***convergent & divergent plate boundaries**

Characteristics: Dominated by chemoautotrophic bacteria. ... The bacteria use hydrogen sulfide for chemosynthesis from mineral rich waters

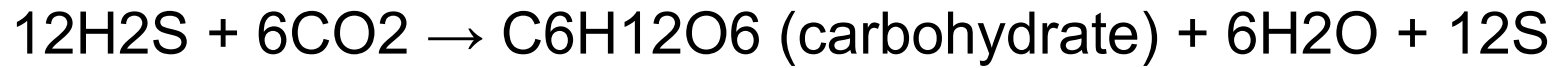
Food web



NPP - Unique & High Considering the Environmental Conditions

The dense aggregations of animal and bacterial life at the deep-sea hydrothermal vents are supported, at least in part, by sulfide-energy-based primary productivity. Sulfide-oxidizing bacteria are found free-living in the vent waters, on the surface of basaltic rocks, and as symbionts within certain tissues of the large vent tube worms and bivalve molluscs.

NPP is comparable to that of Coral Reefs! Primary productivity occurs via hydrogen sulfide chemosynthesis:



What is an Abyssal Plain?

An abyssal plain is an underwater plain on the deep ocean floor, usually found at depths between 3,000 metres (9,800 ft) and 6,000 metres (20,000 ft). Lying generally between the foot of a continental rise and a mid-ocean ridge, abyssal plains cover more than 50% of the Earth's surface.

DISTANCE SUNLIGHT TRAVELS IN THE OCEAN

sea level



TUNA

sunlight (euphotic) zone

Sunlight rarely penetrates beyond this zone.

200 meters



SHRIMP



SWORDFISH



HATCHET FISH

twilight (dysphotic) zone

Sunlight decreases rapidly with depth.
Photosynthesis is not possible here.

1000 meters



ANGLER FISH



GIANT SQUID



TRIPOD FISH

midnight (aphotic) zone

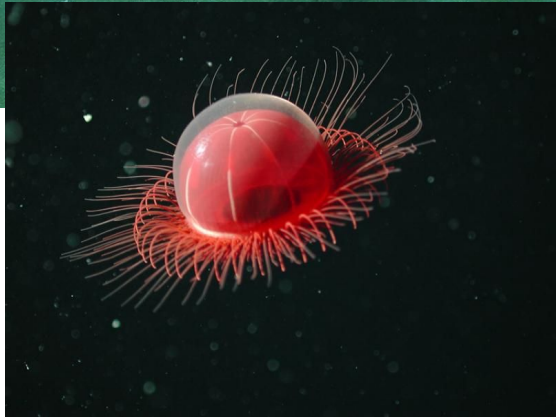
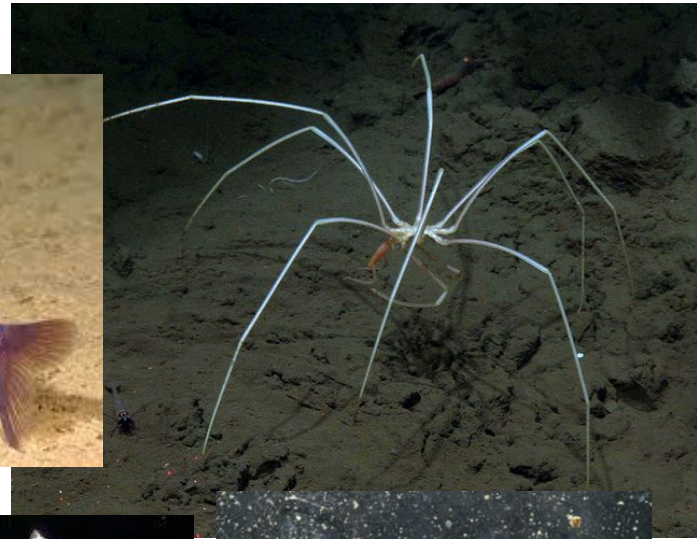
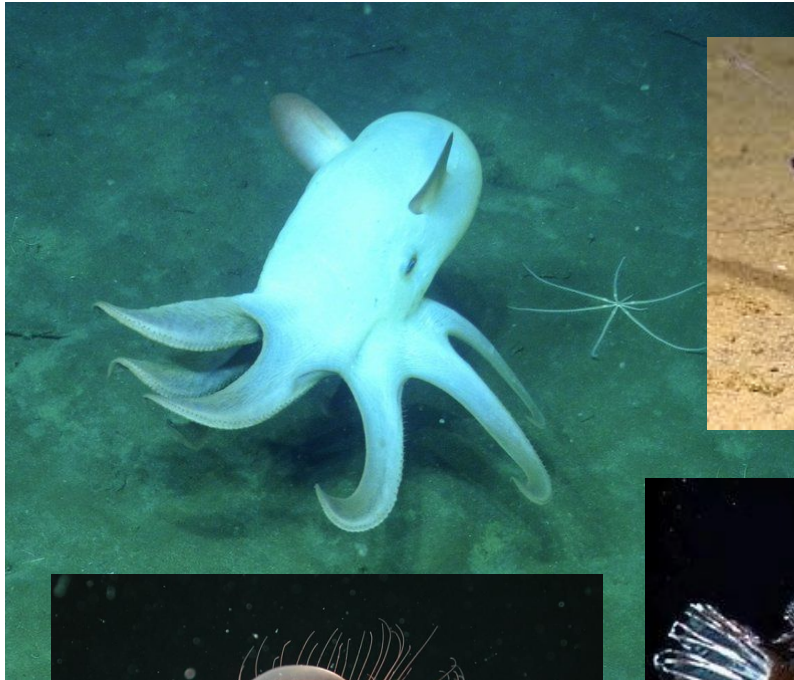
Sunlight does not penetrate at all.
This zone is bathed in darkness.



oceanservice.noaa.gov







Salinity: 34.6 PPT - 35 PPT

Abyssal Plains

pH: 7.6- 7.9 MAX

Average Temperature: 0°C to 4°C or 32°F to 39°F

****Areas away from seamounts/ hydrothermal vents***

Found across 40% of Earth's ocean floor

Characteristics: Dominated by vast, flat, sediment-covered areas of the deep ocean floor. They are the flattest, most featureless areas on the Earth

NPP - Low due to lack of sunlight most organisms do not rely on sight for survival

What is pH? Potential Hydrogen

pH is a measure of hydrogen ion concentration, a measure of the acidity or alkalinity of a solution. ...

The range goes from 0 to 14, with 7 being neutral

Aqueous solutions at 25°C with a pH less than 7 are acidic, while those with a pH greater than 7 are basic or alkaline

The pH of seawater is controlled by the chemical equilibria between carbon dioxide (CO_2), carbonic acid (H_2CO_3), carbonate ion (CO_3^{2-}) and bicarbonate ion (HCO_3^-)

Deeper waters are more acidic because seawater acidity depends on the amount of carbon dioxide dissolved in it. The more CO_2 in the water, the higher the H^+ concentration, so the pH is lower, and the water is more acidic

Organic matter from dead organisms sinks, which also consumes oxygen via decomposer respiration

This is why the depths of minimum dissolved O_2 and minimum pH often coincide in the ocean.

What are Coral Reefs?

A coral reef is an underwater ecosystem characterized by reef-building corals

Reefs are formed of colonies of coral polyps held together by calcium carbonate

Most coral reefs are built from stony corals, whose polyps cluster in groups





Salinity: 32 PPT to 42 PPT

pH: 7.7 - 8.5 (min in spring and max during fall)

Coral Reefs

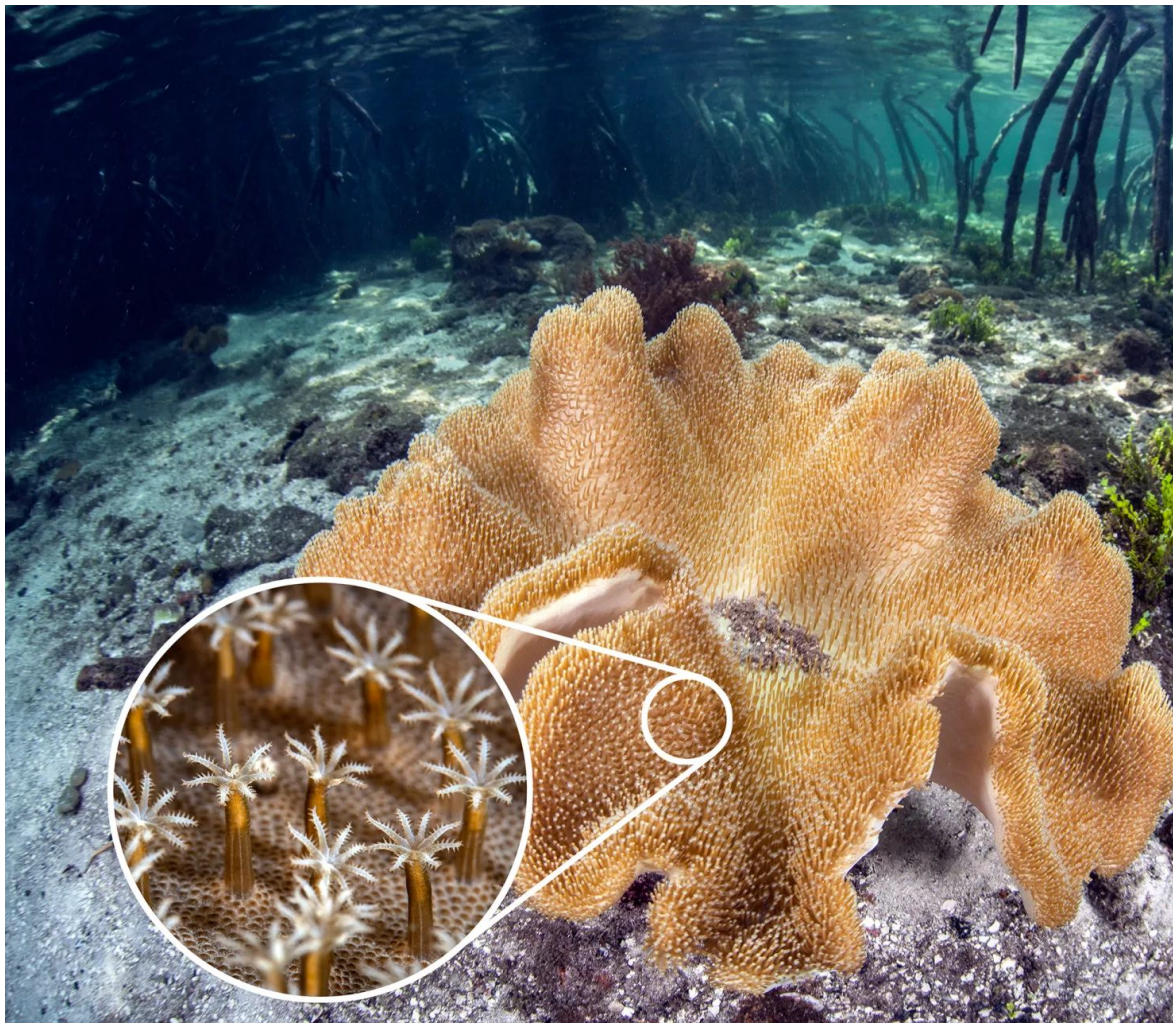
Average Temperature: 23°C to 29°C or 73°F to 84°F

****Cannot exist in temperatures below 18°C or 64°F, but some can tolerate temperatures as high as 40°C or 104° F for short periods***

Found in tropical oceans near the equator

Characteristics: Dominated by corals, the massive structure that the coral reef is comprised of is actually built out of coral polyps, which are small marine animals that thrive in colonies

NPP - Highest of all marine ecosystems



What are Intertidal Zones?

The intertidal zone, also known as the foreshore or seashore, is the area that is above water level at low tide and underwater at high tide

This area can include several types of habitats with various species of life, such as starfish, sea urchins, and many species of coral



Salinity: 5 ppt to 30 ppt

pH: 6.9 - 9.5

Intertidal Zone

Average Temperature: The average range of air temperature is from 23°C to 39°C or 75°F to 102°F

****The temperature can range from very hot with full sunshine to near freezing in colder climates***

Found along every coastline in the area between high tide and low tide

Characteristics: Consists of 4 distinct zones- submerged during high tide and exposed during low tide. Specifically adapted organisms able to withstand severe changes in temp, pH, & salinity.

NPP - Low

Rocky Shore Zonation

Splash Zone

Periwinkles

High-Tide Zone

Limpets

Barnacles

Spiral Wrack

Mid-Tide Zone

Limpets

Hermit Crab

Bladder Wrack

Mussels

Saw Wrack

Anemones

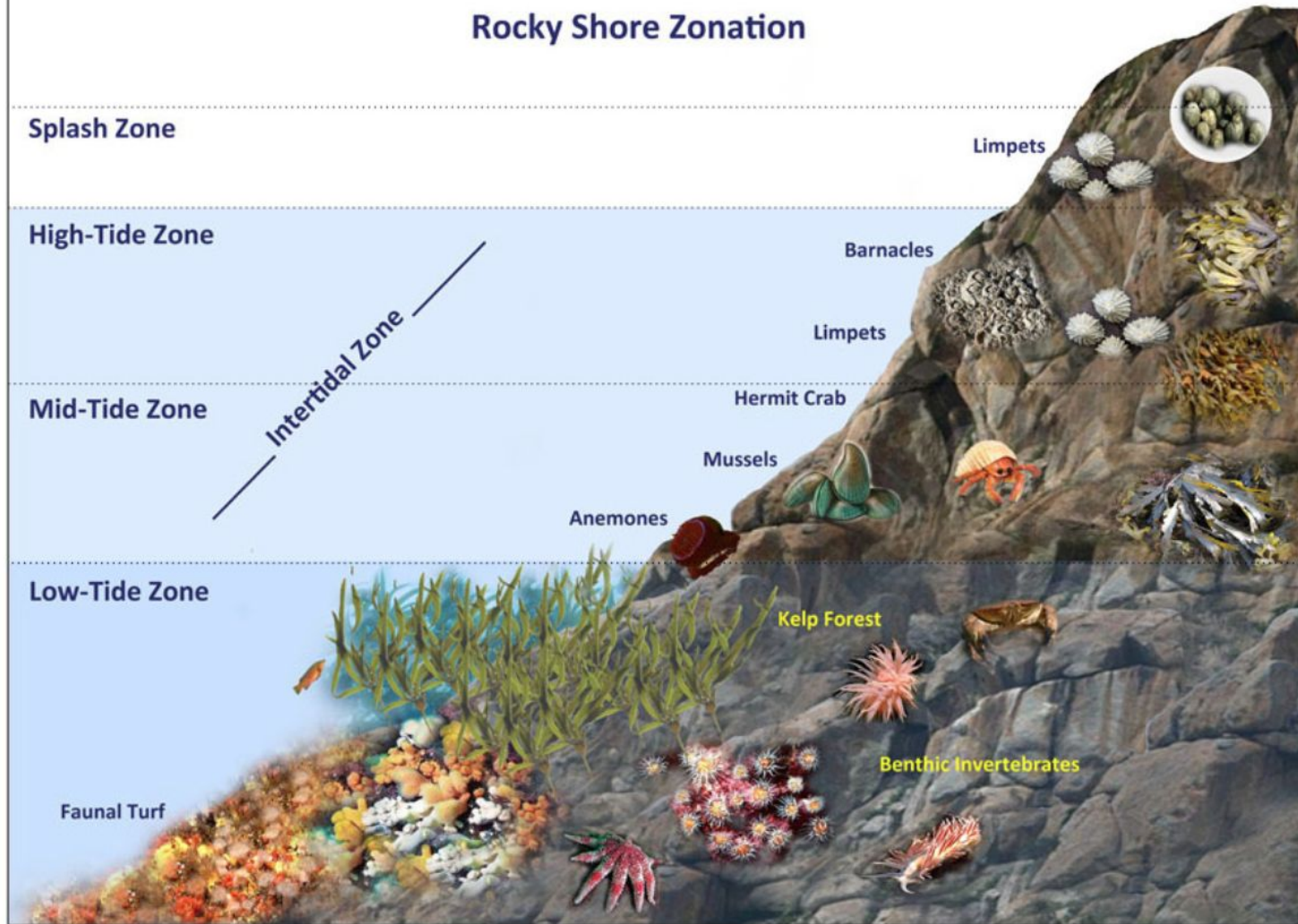
Low-Tide Zone

Kelp Forest

Benthic Invertebrates

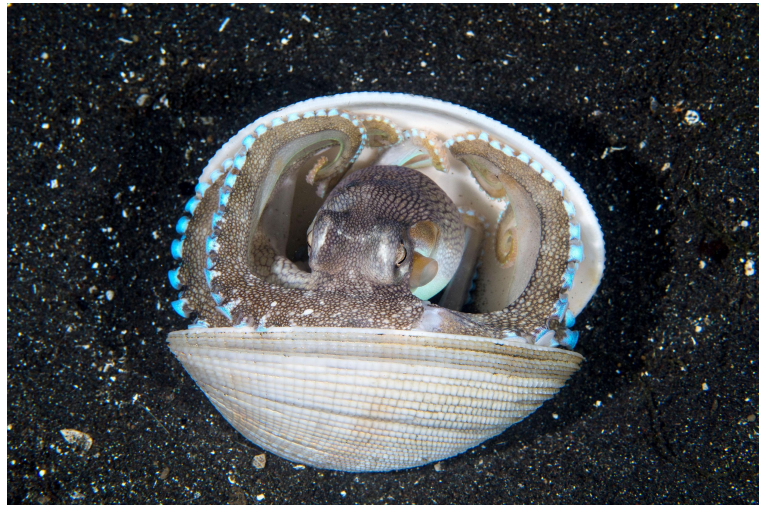
Faunal Turf

Intertidal Zone









What are Mud Flats?

Mudflats or mud flats, also known as tidal flats, are coastal wetlands that form in intertidal areas where sediments have been deposited by tides or rivers

A recent global analysis suggested they are as extensive globally as mangroves

They are found in sheltered areas such as bays, bayous, lagoons, and estuaries

Salinity: 0-34 ppt Influenced by weather / climate

pH: 6.9 - 7.5 but can be as high as 9.5

Mud Flat

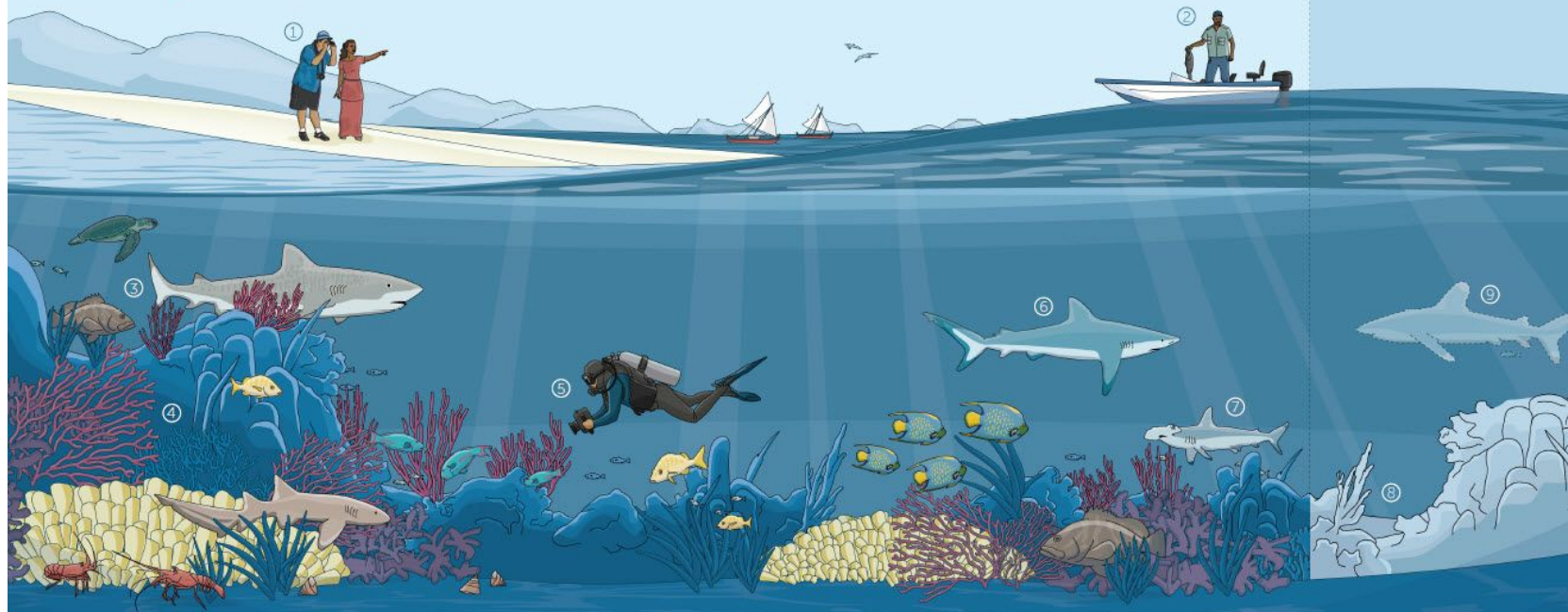
Average Temperature: 10°C to 25°C or 50°F to 77°F but at times colder temperatures may freeze the top layer of mud when exposed

Found along intertidal zones near coastlines, often in sheltered areas such as bays, lagoons, estuaries, etc

Characteristics: Dominated by mud, crustaceans, mollusks, filter-feeders, and shore birds.

NPP - Comparatively Low, but algae supports a wide range of nutrients for its invertebrates and birds

The Importance of Sharks to Islands



1 Healthy reefs drive economies

Healthy reefs are also vital to tourism. They attract divers, snorkelers, recreational fishers, and other visitors from overseas.

2 Reefs protect us and provide for us

Coral reefs help protect coastal communities and infrastructure from the impacts of wave action and storms. They also provide shelter, breeding areas, nurseries, and food for shellfish, invertebrates, and fish. The waters surrounding reefs are a significant source of protein for over a billion people globally.

3 Top predator in the food web

Sharks help maintain the health of marine life in the ocean, including populations of commercially important fish species. Like wolves and other top predators on land, sharks play an important role in the ecosystem and should gain similar protections.

4 Healthy reefs need sharks

Science now shows that sharks help maintain the health of coral reefs.²

5 Sharks are worth more alive than dead

An individual reef shark is estimated to have a lifetime value of US\$1.9 million to the tourism industry.³ In contrast, the value of a dead shark is estimated at about US\$108.

6 More like whales than fish

Unlike other fish, sharks grow slowly, mature late, and produce few young over long lifetimes. As a result, they are at high risk of overexploitation and slow to recover from depletion.

7 Not just fins

Approximately 100 million sharks are killed every year in commercial fisheries.⁴ Products include fins, meat, skins, liver oil, and jaws.

8 The danger of not knowing

The loss of sharks in our oceans can lead to unpredictable consequences, including the possible collapse of important fisheries and the loss of corals and other marine habitats.

9 Threatened with extinction

Nearly 30 percent of known shark species fully assessed by scientists are threatened with extinction. Another 26 percent are nearing threatened status.⁵