Zoogeography

Lesson 7

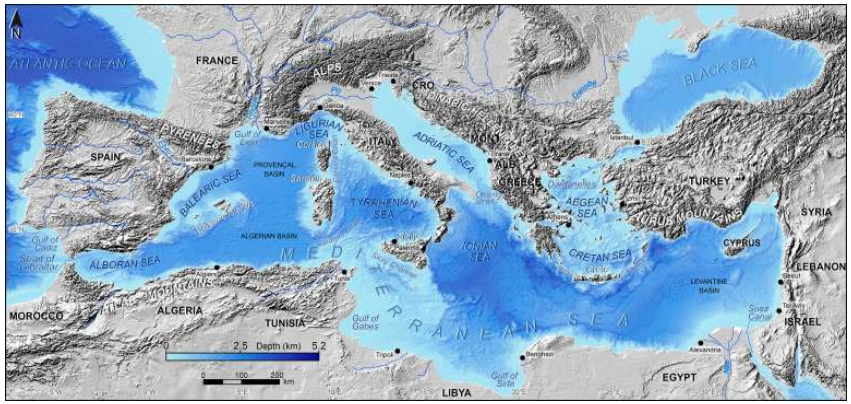
Intro and Recup

- the current distribution of landmasses and seas is the result of the movements of the continental masses (movements that originated in the Palaeozoic Era), which continue to this day.

- the consequences of these movements are especially evident along the coasts where, under the pressure of ‘clods’, very steep mountain ranges and abyssal trenches have formed at the edges of the continents.

- the waters of the oceans penetrate more or less deeply into the continental masses with inland seas and Mediterranean seas

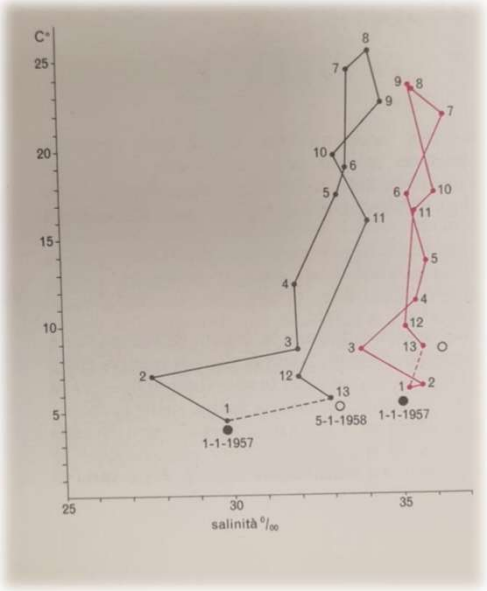
- e.g. Mediterranean sea and Carribean sea (American Mediterranean sea)

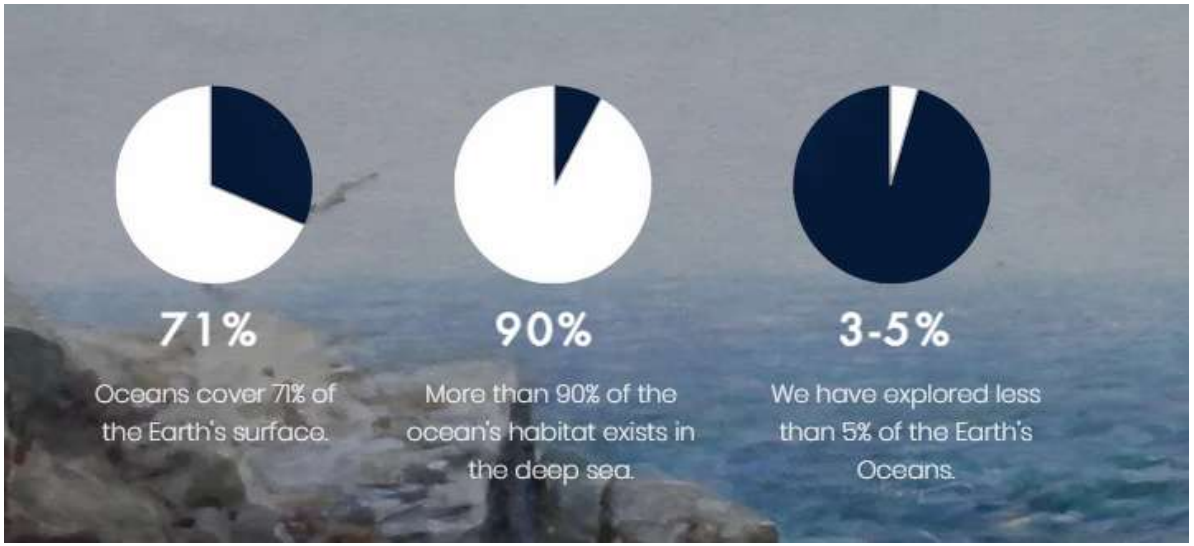


- other seas are those located on the continental shelf, and therefore have a limited depth, such as the Adriatic sea

Salinity and temperature have a considerable influence on the distribution of marine organisms.

Species that are able to tolerate wide variations in temperature are called **eurytherms**, while those adapted to live within narrow temperature ranges are called **stenotherms**. Similarly for salinity, we speak of **euryhaline** or **stenohaline** species.





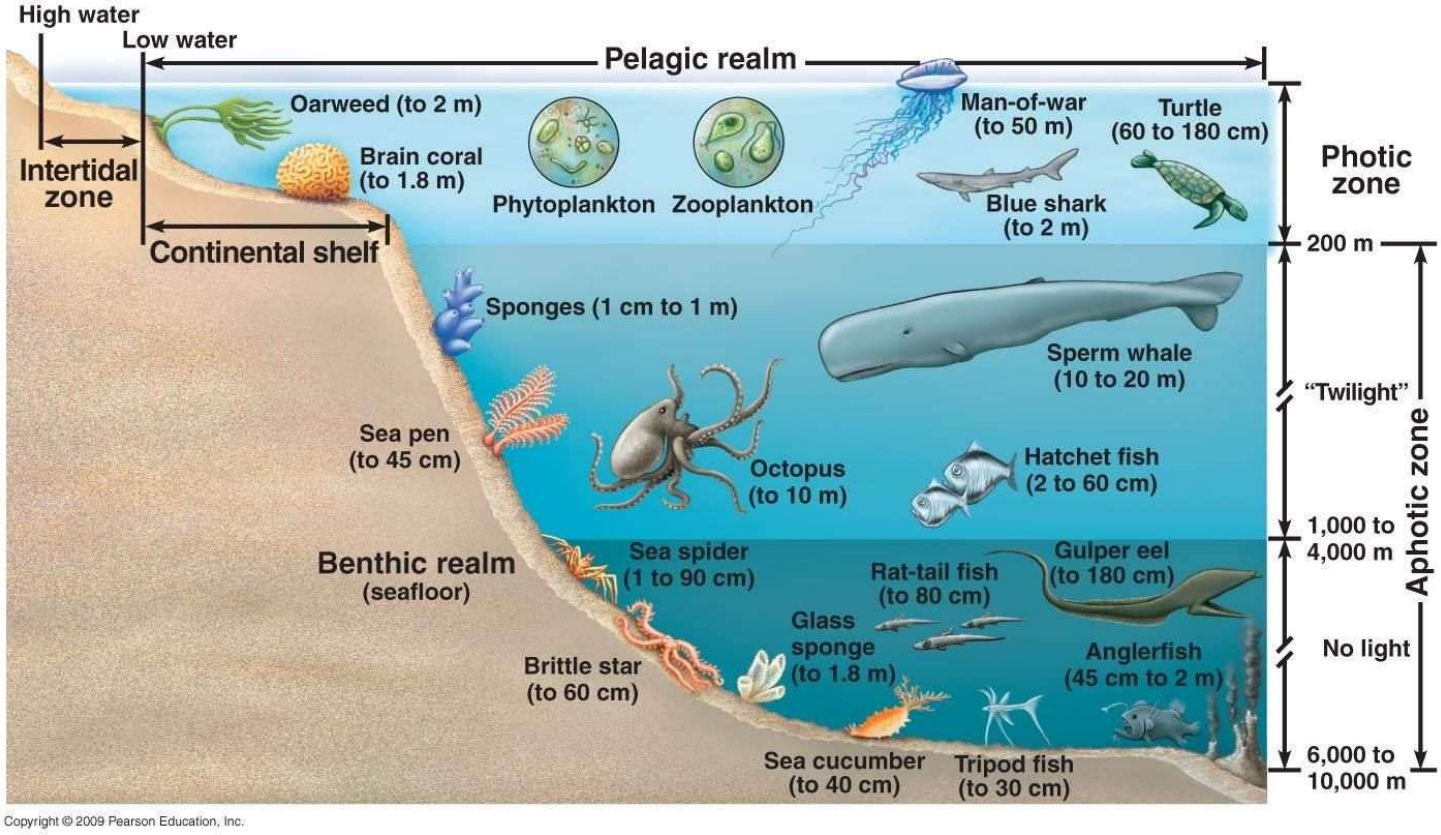
https://www.youtube.com/watch?v=9FqwhW0B3tY

Marine ecosystems – ocean zones

Several broad categories (although there is some disagreement)

Marine ecosystems

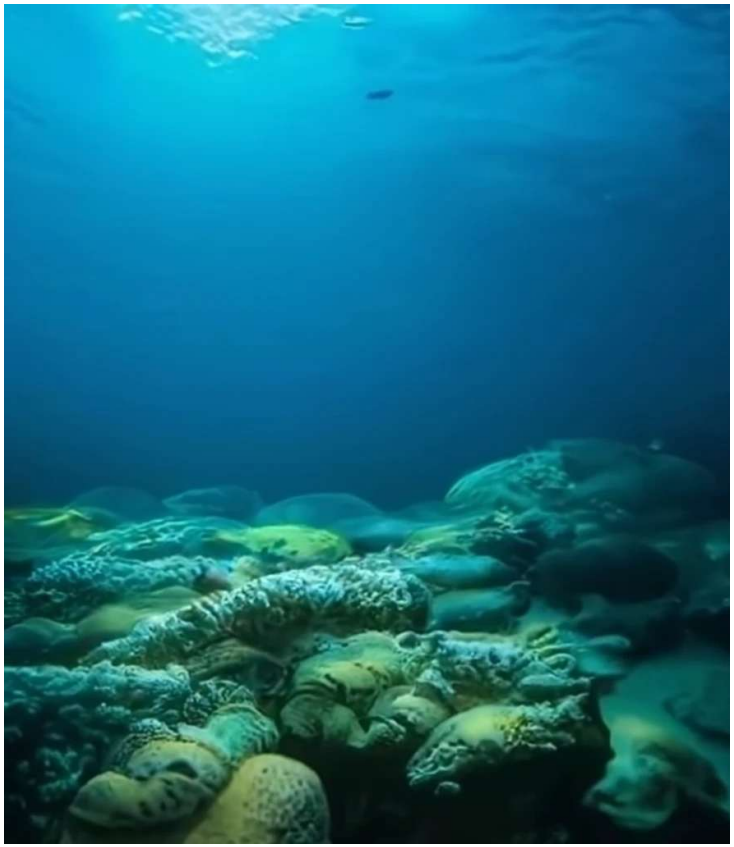
1- estuaries ✓
2- salt marshes ✓
3- mangrove forests ✓
4- coral reefs,
5- the open ocean, and
6- the deep-sea ocean



The sunlight zone - Epipelagic Zone 0 - 200m

- The sunlight zone is the only zone in the ocean where photosynthesis is able to provide sufficient energy to support communities of life.

Below 200m, we will find no plant life at all.



Coral reef

Did you know?

Coral reefs make up less than 0.1% of the ocean but contain 25% of marine species.

- Coral reefs are natural underwater limestone structures made by small creatures called polyps.

- A bit farther out into the tropical sea are coral reefs, euphotic-zone ecosystems built from the exoskeleton secreted by coral polyps. These exoskeletons form complex structures that shelter many different organisms.

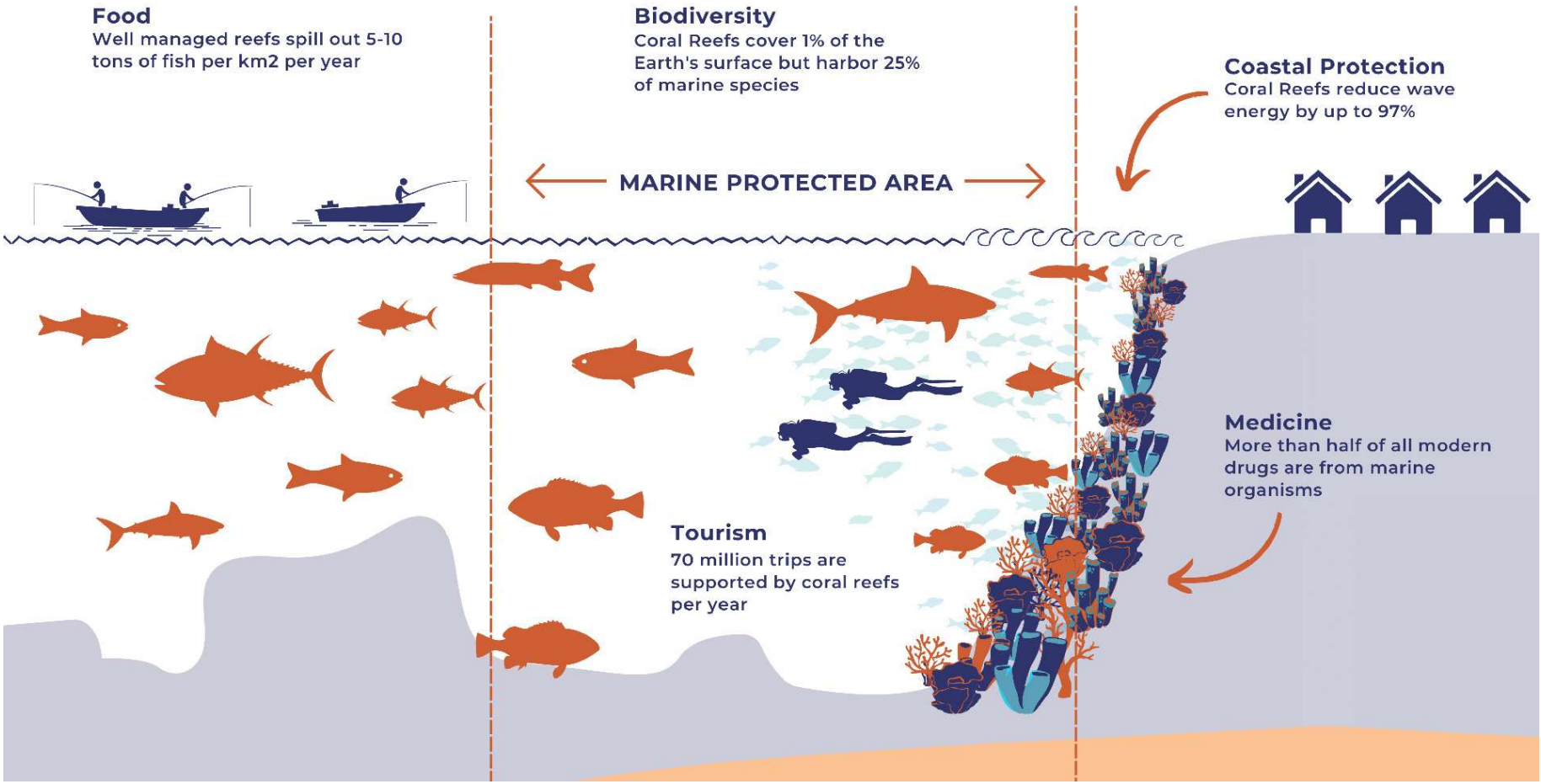
Coral reef

- Coral reefs are extremely diverse ecosystems that host sponges, crustaceans, mollusks, fish, turtles, sharks, dolphins, and many more creatures. By some counts, **coral reefs can account for a quarter of all ocean species**.

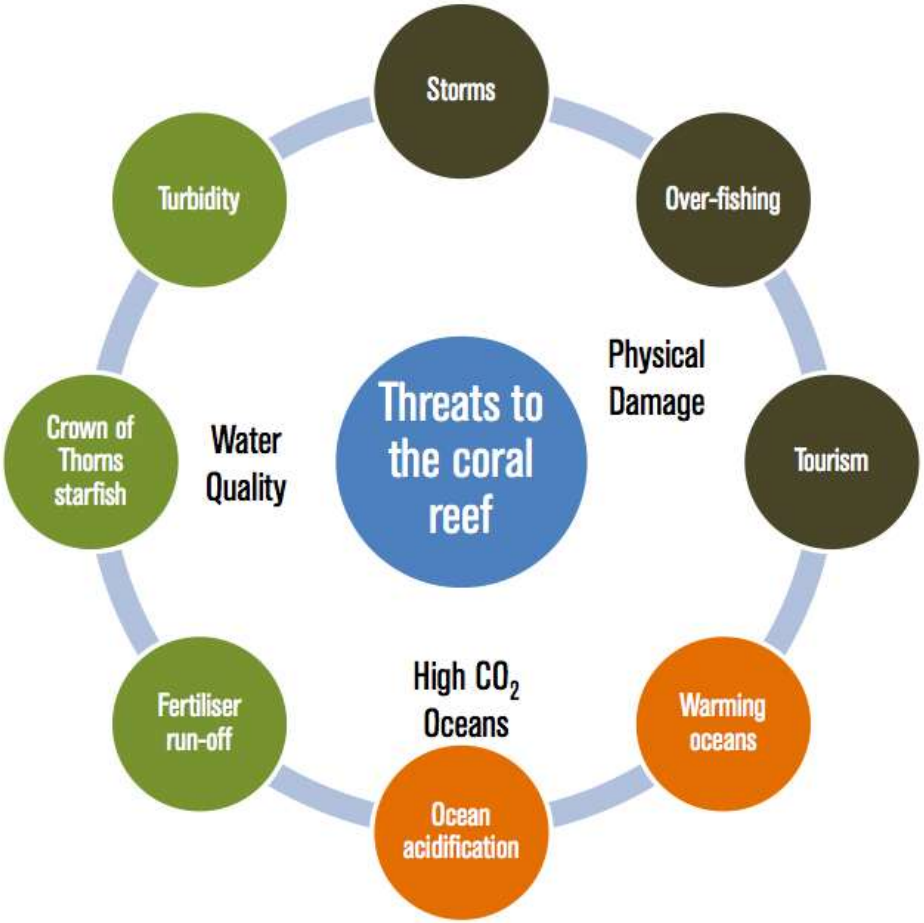
- They're the ocean version of an apartment block – they provide homes for many different living things.

They have been compared to rainforests because of their biodiversity, importance to humans and the role they play in helping to limit the damage caused by climate change.

The importance of coral reef ecosystems

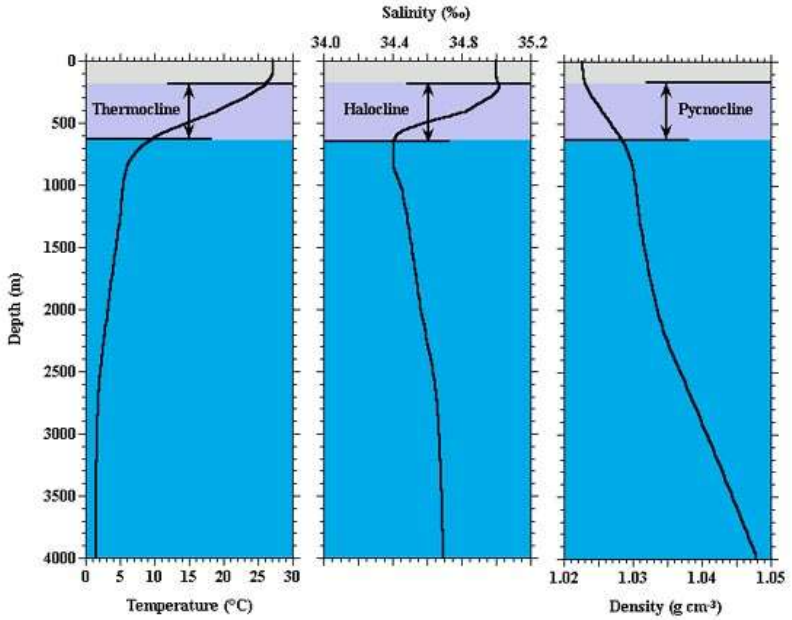


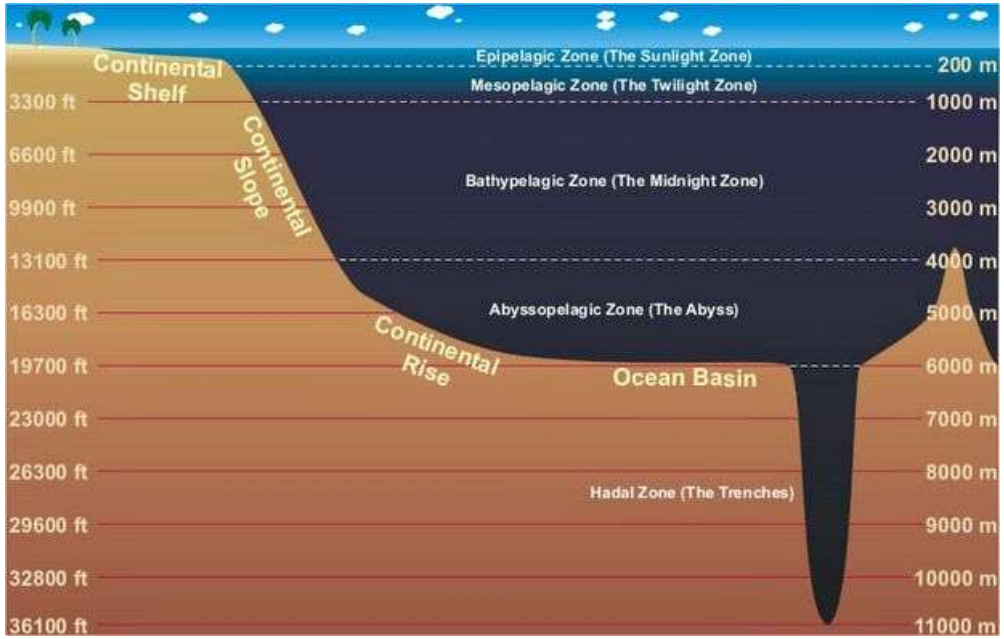
Coral reef threats



The open ocean

- Beyond the coral reefs lies the open ocean.
- At the surface of the ocean, the **euphotic zone**, the ecosystem receives plenty of light and oxygen, is fairly warm, and supports many photosynthetic organisms. Many of the organisms that we associate with marine ecosystems, such as whales, dolphins, octopi, and sharks, live in the open ocean.





- https://www.bioexplorer.net/ocean-animal-adaptations.html/
- **Camouflage:** To survive in the well-lit, exposed habitat of the open ocean, many types of animals have evolved a form of camouflage called countershading (e.g. sharks, rays, dolphins, and whales). These animals are darker on their top side and lighter on their under side (e.g. great white shark, Fig. 7). This makes them more difficult to spot from above (they blend in with the darker deep water below them), or from below (they blend in with the clearer shallow water above them).
- https://manoa.hawaii.edu/sealearning/survival-of-the-fittest#:~:text=To%20survive%20in%20the%20well,7).

- But amidst the productive frenzy of the shallow open ocean, animals excrete, and die, and moult, creating a trickle of organic material that begins to sink downwards. A nutrient-rich supply of food, known as marine snow. And so, we enter the isolated deep.

- With no sunlight, photosynthesis cannot occur below 200 metres in the Twilight Zone. There are no plants here to fulfil the role of nutrient producers. There is only marine snow, bringing down the leftovers from above. It might be enough to sustain an abundance of detrivores, or small filter feeders like sponges, but this alone is not enough to support a complex biological community.

- And yet, the deep sea is complex in its biodiversity. So if the energy is not coming from the sun, where is it coming from?

The deep sea (below 200 m)

- As the depth of the ocean increases, it gets darker, colder, and with less available oxygen. Organisms living in deep-sea ecosystems within the **dysphotic and aphotic zones** have unusual adaptations that help them survive in these challenging environments. Some organisms have extremely **large mouths** that allow them to catch whatever nutrients fall from shallower ocean depths. Others have adapted to get their **energy via chemosynthesis** of chemicals from hydrothermal vents.



The Food Web of the Deep Sea

At first look, the depths of the ocean may appear barren, lifeless, and silent. The lonely expanse rolls out into a long horizon, while the great abyss plummets ever-downwards into darkness. Communities of life are solitary. They seem isolated from other habitats in the deep. But there is more going on here…

- At the bottom of every food web, whether it is terrestrial or marine, there must be a source of nutrients. There must be organisms capable of synthesising organic molecules from energy.

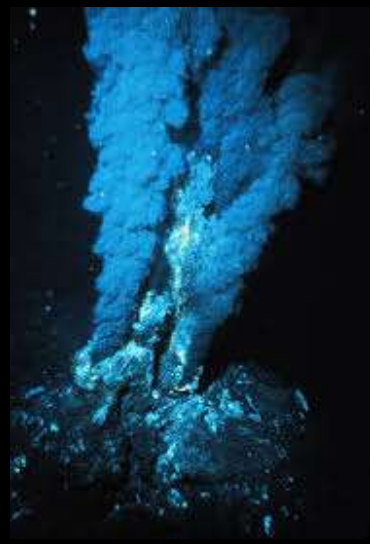
- Photosynthesising organisms that use energy from sunlight to convert carbon dioxide into oxygen and chemical energy stored as glucose (Photoautotrophs)

- Herbivores, or primary consumers, such as zooplankton or turtles and manatees, feed primarily on the plants and phytoplankton.

- The herbivores become food themselves for secondary consumers, which make up the top two levels of the food web. Carnivores, and top predators.

Chemosynthesis
PRIMARY PRODUCTION IN THE DEPTHS

- there are **hot upwellings** of dissolved chemicals and minerals that form towering chimney structures on the sea-floor, and release heated minerals from deep within Earth into the ocean. The chemicals expelled within the superheated vent fluid would be toxic to us humans. But to the life here, they are vital, containing nutrients that bacteria are able to convert to energy in a process that mirrors the conversion of sunlight during photosynthesis.



- In place of Photoautotrophs, we find Chemoautotrophs. In place of plants and plankton, there is bacteria. In place of photosynthesis, chemosynthesis. The bacteria are the primary producers, a major source of nutrients for the deep sea ecosystem.

The Mesopelagic zone (200-1000 m)

700m

1.8 m (6 ft)

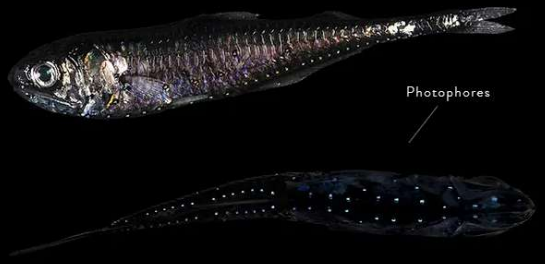
COELACANTH

700m (2,300ft)

The coelacanth was thought to have gone extinct 65 million years ago, during the great extinction that wiped out the dinosaurs. They were rediscovered in 1939.

COUNTER-ILLUMINATION

Many organisms in the Twilight Zone, including this lanternfish, use counter-illumination to blend in with the ambient light in order to avoid predators.



- The light from the sun diminishes to a faint glow. There is not enough sunlight here to support photosynthesis in plants or microorganisms.

SUNFISH

580m (1,900ft)

The wonderfully weird Mola mola is the world's largest bony fish. To move its large, cumbersome body, it wiggles its large fins and steers with the crest-like clavus at its back.

1.8 m (6 ft)

https://www.naturalworldfacts.com/the-deep-sea-zones

ATOLLA JELLYFISH

The vivid colours of the Atolla jellyfish are actually protective. because most deep sea creatures see blue light, the deep red hue makes them practically invisible.

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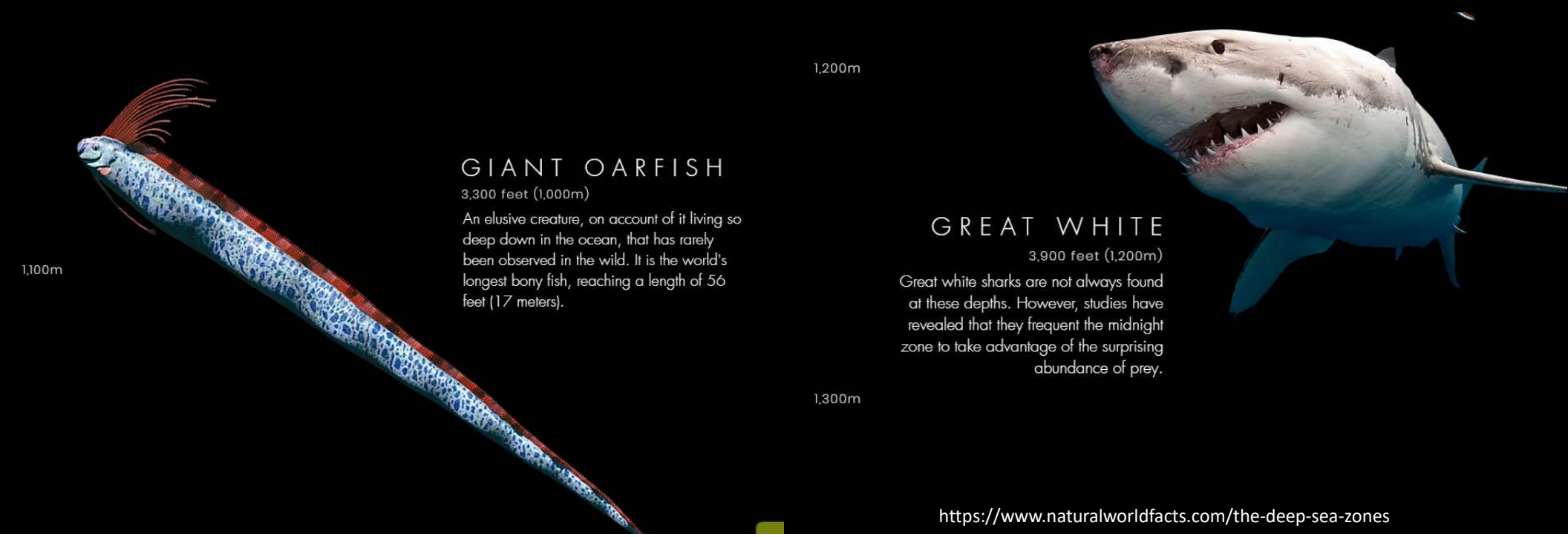
The midnight zone
Bathypelagic Zone 1000 - 4,000m

With no light, there is no growth of plants or phytoplankton - all animals are thus predators or scavengers.



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1,500m

The Deep Sea Anglerfish attracts prey using a bioluminescent lure.

1,600m

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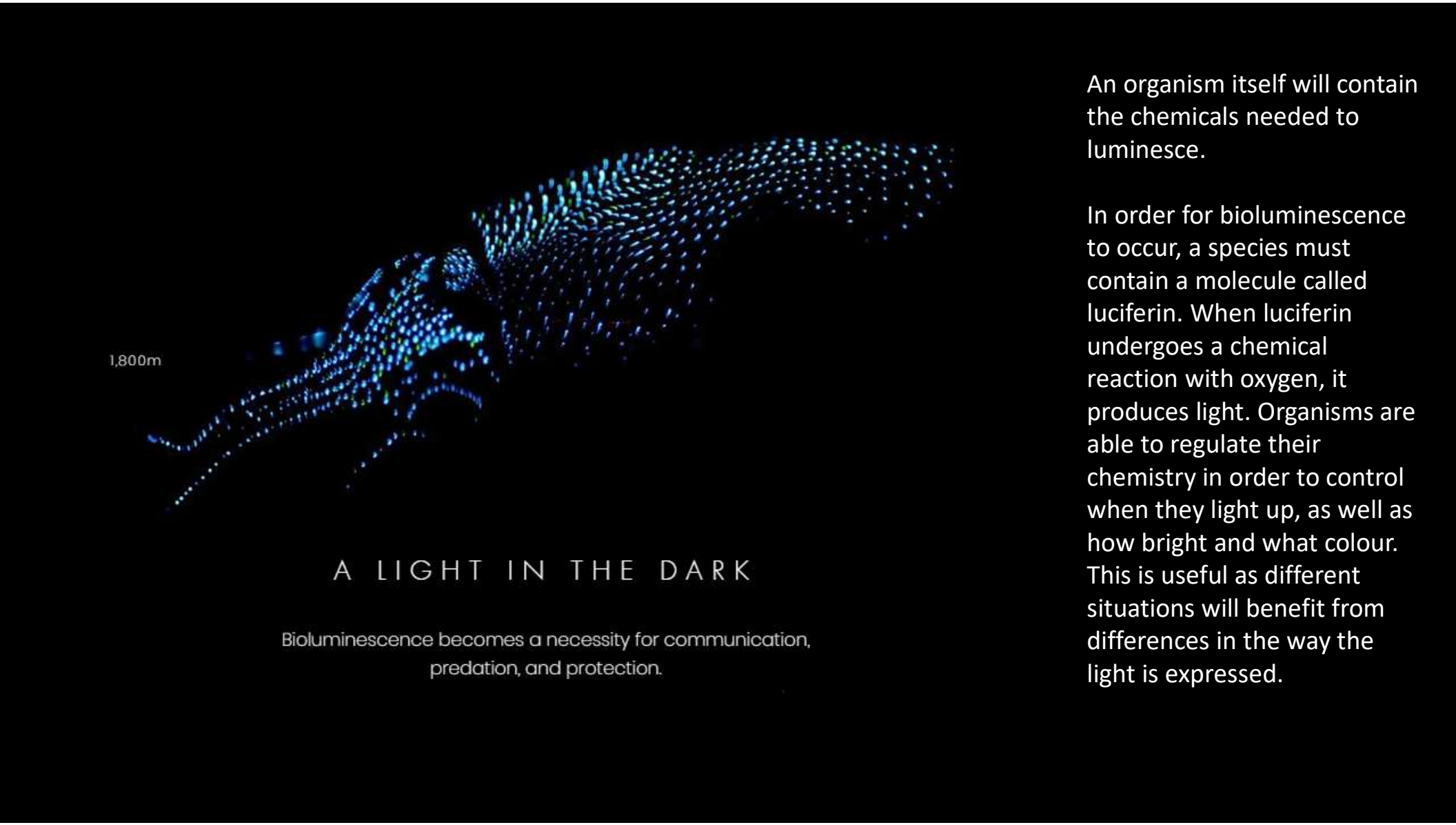


An organism itself will contain the chemicals needed to luminesce.

In order for bioluminescence to occur, a species must contain a molecule called luciferin. When luciferin undergoes a chemical reaction with oxygen, it produces light. Organisms are able to regulate their chemistry in order to control when they light up, as well as how bright and what colour. This is useful as different situations will benefit from differences in the way the light is expressed.

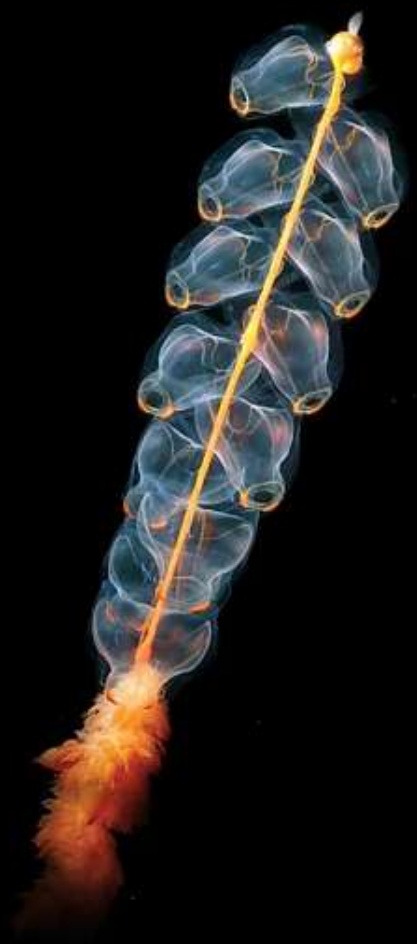
1,900m

SIPHONOPHORES

7,550 feet (2,300m)

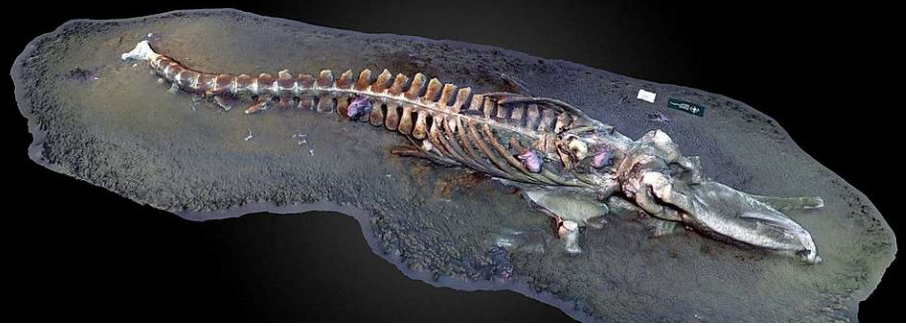
Though they may look like single organisms, these drifting translucent blobs are actually colonies made up of thousands of tiny zooids. The zooids specialise to fulfil a specific role in the colony, meaning each kind of zooid relies on the others in order to survive. It is a bioluminescent vessel of life, drifting in the deep sea.

2,000m



Pelagic scavengers that obtain energy from Whale-fall communities

Occasionally, amidst the constant trickle of marine snow from above, something larger will sink to the deep sea. A sunken whale carcass - known as a ‘whale-fall’ - that can support a complex biological community for up to 50 years.



2,300m

2,400m

SLEEPER SHARK

7,200 feet (2,200m)

The Greenland or sleeper shark is the most eery-looking deep sea wonder. With blind white eyes, and rough dark skin, they truly look like living fossils. They outlive all other vertebrates on Earth, with lifespans close to 500 years.

2,500m

THE CHIMAERA

8,500 feet (2,600m)

2,600m

Also known as ghost sharks, these deep sea fish demonstrate that the deeper you go, the weirder life becomes. With fins like bird wings, a large head, and dead-looking eyes, they exhibit a truly unique morphology that dates back 300 million years.

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A sperm whale can dive down more than 2,000 meters and can stay submerged for up to an hour.

It is a skill that they must acquire in order to hunt their prey, deep-dwelling squid.

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3,200m

GLASS SQUID

3,300m

Ctenophores beat their shimmering hair-like cilia to move around.

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This is the average depth of the oceans. But in some places, it goes deeper.

3,700m

3,800m

THE 'UNSINKABLE'

On the 14th April, 1912, the Titanic sank to its final resting place at a depth of 3,800 meters.

3,900m

Patagonian Toothfish have antifreeze proteins in their tissues.

Beneath the Midnight Zone lies an even stranger realm of darkness and silence.

The Abyss

Abyssopelagic Zone (4000-6000 m)

4,100m

Temperatures are near freezing, and very few animals can survive the extreme pressure here.

4,200m

ATOLLA JELLYFISH

Look familiar? This jellyfish swims in a range from 1,000m deep at the bottom of the Twilight Zone, to up to 4,000 metres in the Abyss.

4,400m

THE SEA PIG

4,500m

Sea pigs have five to seven pairs of enlarged tube feet. These "walking legs" are hydraulically operated appendages that can be inflated and deflated to move around.

4,600m

MEGAMOUTH

15,000 feet (4,600m)

4,700m

Megamouths spend most of their lives in the dark of the Abyss, only returning to the surface at night to feed. They are filter feeders, and in order to survive in the deep where food is scarce, they grow to enormous sizes in order to become more efficient. This is known as deep sea gigantism.

5,000m

The aptly named Fangtooth has been found as deep as 5,000m.

https://www.naturalworldfacts.com/the-deep-sea-zones

Much of the life that dwells in the Abyss is Benthic or Demersal, meaning they live on or near the sea-floor. Many are well-adapted for such a lifestyle.

5,400m

FACELESS FISH

5,500m

This species of cusk eel has made evolutionary sacrifices in order to survive the Abyss. Its face is buried deep beneath the skin, making its eyes virtually useless.

TRIPOD FISH

The Tripod fish uses elongated pelvic and lower caudal fin rays to stand on the sea floor like a tripod. It waits motionless until it detects potential prey with its extended pectoral fins.

These fins then direct the food towards its huge mouth. This method of hunting uses very little energy and is ideal for a predator on the desert of the deep ocean.

https://www.naturalworldfacts.com/the-deep-sea-zones