Life Underwater: How Climate Change Affects Marine Life

There is a strong relationship between climate and the conditions for life underwater. As the earth's climate changes, so does water temperature, ocean currents, and sea levels. These changes directly impact all life underwater, from plankton at the bottom of the marine food chain to the largest mammals in the oceans.

As long as we continue to emit greenhouse gases into the atmosphere, we are putting more and more stress on life underwater. This, in turn, will have serious consequences for humans. Many of us depend on the oceans for our food and livelihoods.

Why is life Underwater Important?

Principally, the aim of SDG 14 (Life Under Water) is to make our use of the world's ocean, seas and marine resources sustainable. It is also to conserve our marine resources against further damage.

Oceans, seas, and other marine environments are essential for human wellbeing. Globally, those environments are vital for social and economic development. Currently, over 3 billion people depend on marine and coastal biodiversity to live.

Unfortunately, when fish stocks collapse from overfishing they can take decades to recover. In turn, this threatens livelihoods, communities and food security. Consequently, fish prices increase and seafood becomes less available.

Source: A Guide to SDG Interactions: From Science to Implementation

Moreover, human health is negatively affected by ocean acidification, plastic pollution, and chemical pollution (Falkenberg LJ et al, 2020). Toxic chemicals in microplastics accumulate in fish and shellfish. When consumed, the toxins can cause health complications. So, when humans eat seafood from this environment they are directly affected.

How does Climate change impact Life Underwater?

SDG 13 identifies the major consequences that Climate Change will have for oceans and coastlines. Global warming affects all marine life and, in turn, all the human communities that depend on it.

Today, marine life is suffering stress like never before. Our oceans are growing warmer, more acidic and less oxygenated. Emissions from human activity are

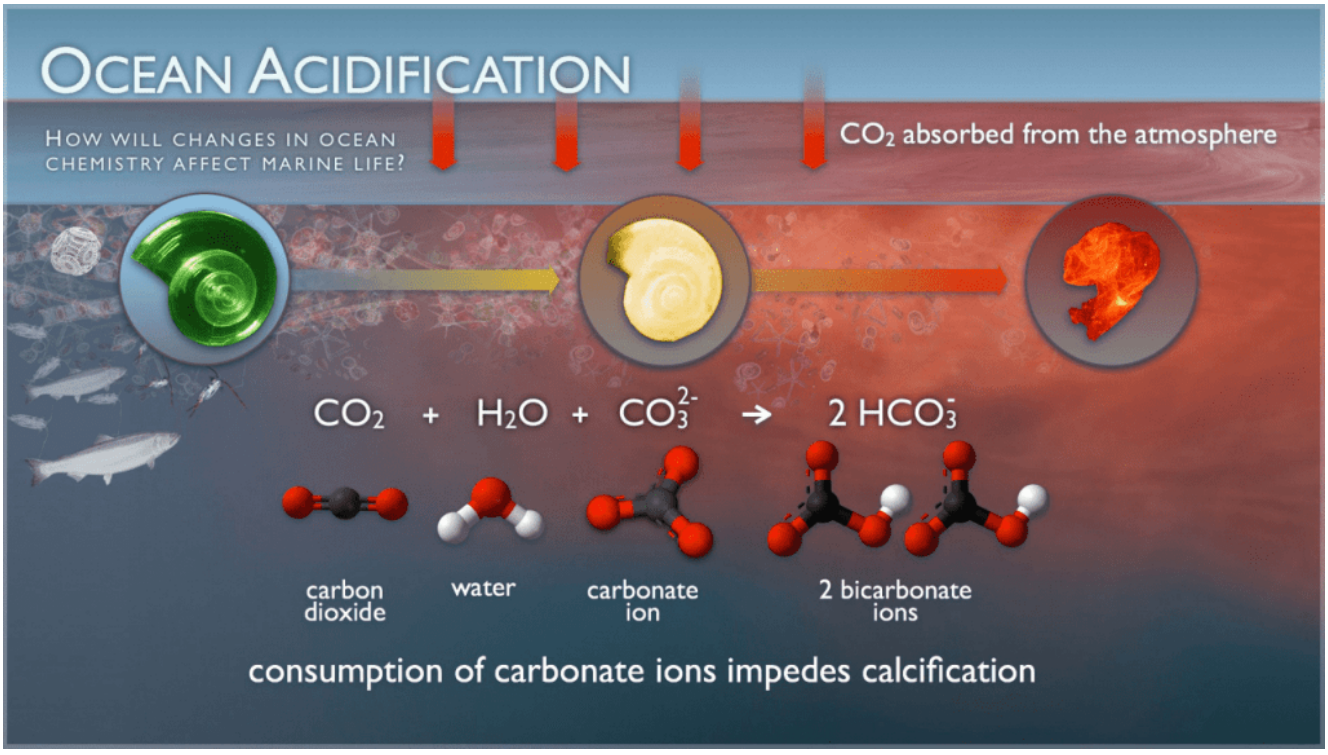
having profound effects on marine life. Many species are struggling to adapt to the changing conditions. Some are already facing extinction.

Acidification and Deoxygenation destroying oceans

The ocean is a large carbon 'sink'. It has absorbed approximately 25% of all carbon dioxide emissions since the Industrial Revolution. However, this has caused the oceans to become 30% more acidic.

The process of ocean acidification is as follows:

1. Oceans absorb carbon dioxide
2. Water and carbon dioxide form H_2CO_3 (a weak acid)
3. The weak acid dissociates (breaks) into hydrogen ions (H^+) and bicarbonate ions (HCO_3^-)
4. With increased hydrogen ions the pH decreases, and oceans become more acidic



Process of ocean acidification that occurs as the ocean absorbs carbon.
Source: National Oceanic and Atmospheric Administration

Ocean acidification causes many problems that negatively affect marine species

and humans. Examples of negative effects include:

- Altering marine food chains and supply to humans
- Decreasing storm protection from reefs
- Calcifying organisms become vulnerable to dissolution

Oceans also absorb 93% of the excess heat produced by greenhouse gases. Unfortunately, this increases ocean temperatures. Warmer oceans hold less oxygen, which affects their ability to support marine life.

Sea Level Rise

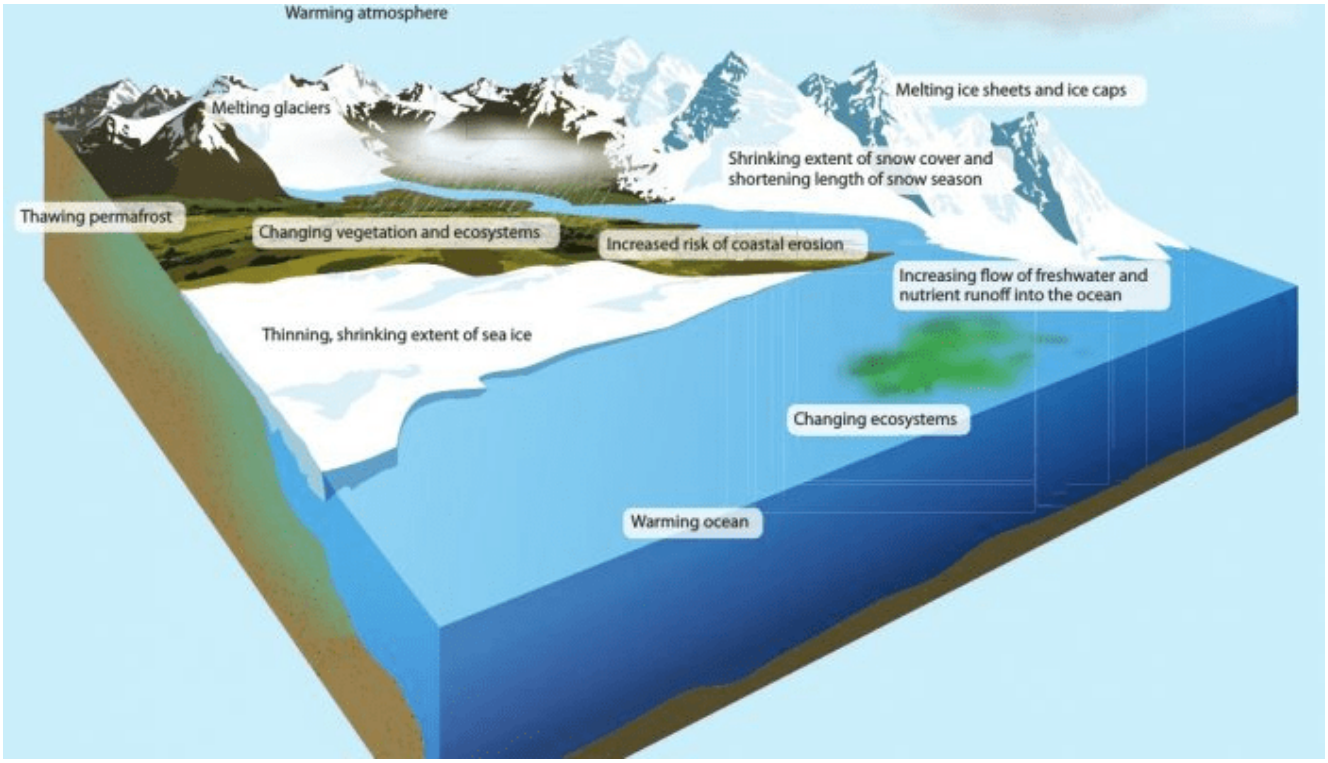
The global sea level rises approximately 2.0 millimeters every year. It has risen a total of 10.0 – 25.0 centimeters over the course of the twentieth century.

Sea level rise causes coastal erosion. The erosion of coast lines harms marine life by causing the dispersion and migration of shallow marine and intertidal habitats. Furthermore, higher sea levels cause fragmentation of light underwater which affects the availability of light to support marine ecosystems.

There are two factors that contribute to rising sea levels: melting glaciers and thermal expansion.

Melting Glaciers

The rise in global temperatures is causing glaciers to melt. Glaciers hold the majority of the Earth's fresh water. However, as they melt, ocean surface temperatures cool and salinity levels decline.



Climate change impacts on melting glaciers and its consequent effect on other variables.
Source: Blogs of the European Geoscience Union

Thermal Expansion

Oceans absorb the additional heat that is trapped in the atmosphere from greenhouse gasses. In total, oceans trap 90% of the earth's heat. As that heat is absorbed, ocean temperatures increase and water expands. This causes sea levels to rise.

In turn, rising sea levels impact marine ecosystems in a variety of ways, including habitats and the salinisation level of soils. This has a significant effect on the level of biodiversity under water.

Plastic Pollution

Plastic pollution poses many direct threats to marine life. However, as it breaks down it creates another source of greenhouse gas emissions in the form of microplastics.

Microplastics contribute even more greenhouse emissions into the ocean, negatively affecting marine species.

Washed-up microplastics on a beach. These microplastics can be anywhere between five microns and one millimeter in size.
Source: Plastic Facts
Marine species also ingest microplastics, which directly affects humans when those species are eaten.

Oceans Naturally mitigate climate change

Whilst oceans have the ability to absorb carbon, the process causes acidification and other impacts which lead to dire consequences for marine life. However, there are other ways that oceans can absorb it.

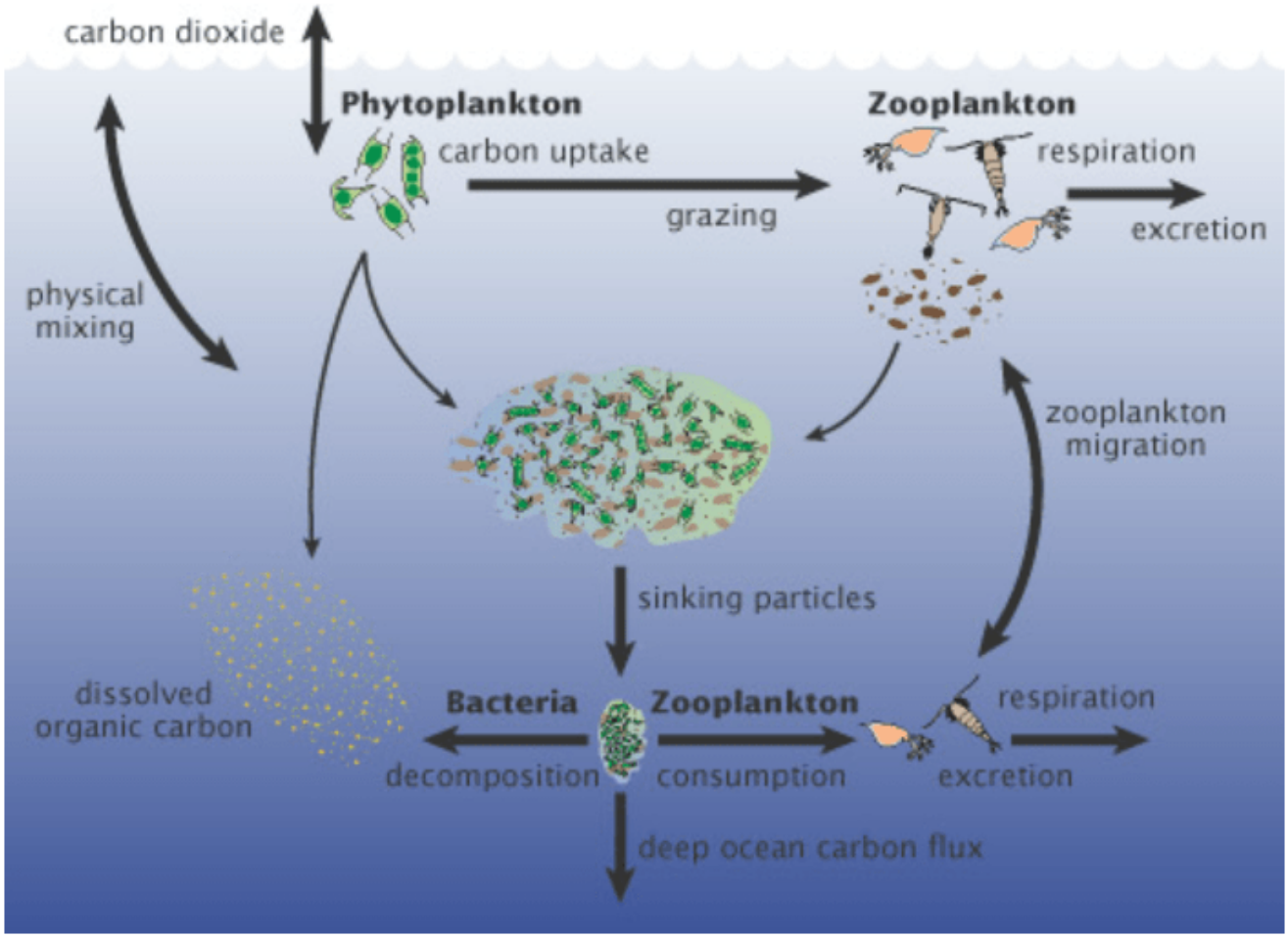
Mangroves

Mangroves have the ability to store massive amounts of carbon in their soil. The soil Mangoes grow in allows them to capture a lot of carbon and store it for long periods of time. Their ability to store carbon is significantly greater than even that of tropical forests.

Unfortunately, mangroves are threatened by rising sea levels. Mangrove trees' lower trunks and roots survive under water while their leaves and upper trunk rely on contact with the air. As the sea levels rise, mangroves are essentially subject to drowning.

Phyotoplankton

Phytoplankton is the main reason the ocean is considered a carbon sink. Carbon dioxide is absorbed through phytoplankton via photosynthesis.



The carbon cycle via phytoplankton in oceans. **Source:** NASA: Earth Observatory
When phytoplankton die the carbon is transferred either to the deep ocean or to the ocean surface.

However, the ability for phytoplankton to act as a carbon sink is also threatened by rising sea levels. With light fragmentation, caused by rising sea levels, light cannot reach phytoplankton and photosynthesis cannot occur.

Call to action

Life underwater is amazing. It's so vastly different from life on land, and there's so much to explore. Yet, life underwater is also very delicate. Climate change is a major stressor for our lands. Equally, it is hazardous for all marine ecosystems.

So, this is THRIVE's CALL TO ACTION!

Firstly, Check your labels: Look for the Marine Stewardship Council (MSC) and Aquaculture Stewardship Council (ASC) labels to ensure your seafood is sustainable. These labels mean your fish can be traced back to sustainably managed fisheries and farms.

Also, Stop using single use plastics: This includes takeout packaging, non-reusable water bottles, plastic bags, and straws. If every American sipped out of just five fewer straws per year, we could keep more than 1.5 billion straws out of landfill.

Volunteer at beach clean ups: Beach clean ups raise awareness about marine debris and pollution.

Use less water: This prevents excess wastewater that would runoff into the ocean along with its contaminants.

Finally, Stop the use of pesticides: Especially if you live by a river or coastal area. Pesticides will runoff into streams which eventually leads to oceans causing much harm to ocean biodiversity as well as human health.

Join the conversation at THRIVE this month as we discuss Life on Land and Life Under Water. Check out our podcasts, blogs, and webinars! At THRIVE we believe that there is no sustainable business in an unsustainable world. Check us out for more.

References

Falkenberg LJ, Bellerby RGJ, Connell SD, Fleming LE, Maycock B, Russell BD, Sullivan FJ, Dupont S. Ocean Acidification and Human Health. Int J Environ Res Public Health. 2020 Jun 24;17(12):4563. doi: 10.3390/ijerph17124563. PMID: 32599924; PMCID: PMC7344635.