

IN DEEP WATER – THE CONCERNING IMPACTS OF CLIMATE CHANGE ON OCEANS

Estimated read time:  9 min





KEY TAKEAWAYS

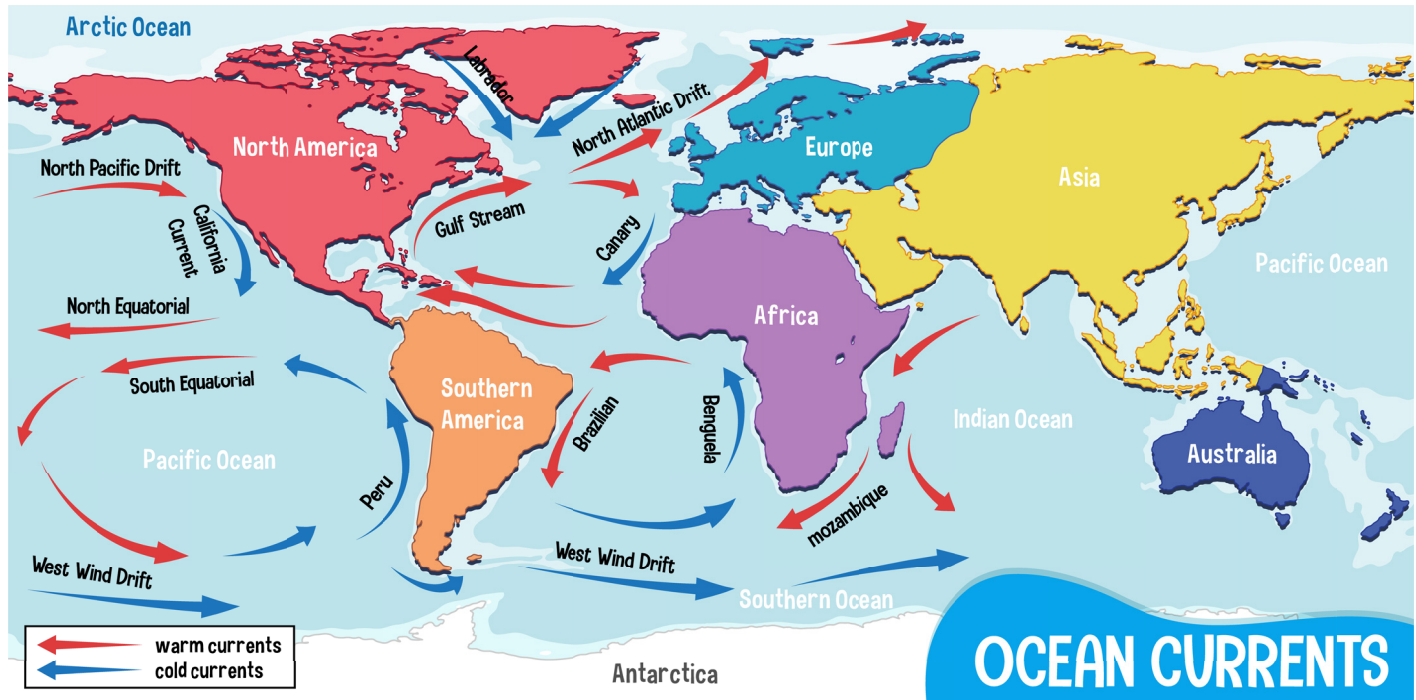
In recent years, global warming has been jeopardising the health and stability of the seas.

The changing climate has been impacting currents, disrupting aquatic habitats, affecting ocean oxygen stores and causing sea level rise.

Addressing the rate of climate change through emissions reduction is imperative, but a degree of adaptation will be equally necessary to ensure resilience.

The picture of our planet as seen from space once prompted author Arthur C. Clarke to declare: “How inappropriate to call this planet ‘Earth’ when it is quite clearly ‘Ocean’.” **More than 70%** of our planet’s surface lies underwater, and life as we know it is inextricably bound to the sea. Oceans are home to complex and diverse ecosystems; they help feed us; they facilitate intercontinental transportation; and they support millions of livelihoods across the globe. They also play an indispensable role in the regulation of climate and weather.





In recent years however, global warming has been jeopardising the health and stability of the seas, with dire implications for aquatic ecosystems and associated industries, coastal communities, and even global weather patterns.

SO, HOW EXACTLY IS CLIMATE CHANGE IMPACTING THE OCEAN, WHAT DOES IT MEAN FOR HUMANITY, AND WHAT CAN WE DO ABOUT IT?

IMPACT ON CURRENTS

Ocean currents are generated by surface winds, gravity, differentials in temperature and salinity. By enabling the lateral movement of water across the ocean and the vertical circulation of water through its depths, currents deliver invaluable services.

The majority of solar radiation that reaches the Earth is absorbed by oceans, with more sunlight hitting tropical latitudes than

the polar regions because of the spherical shape of the planet. The movement of ocean currents mimics a conveyor belt that helps carry heat from the warmer waters near the equator to the temperate regions. Ocean temperatures in turn impact precipitation patterns and shape regional climates. Without this conveyor belt redistributing heat energy around the globe, temperatures would be far more extreme and certain places would be uninhabitable.¹

CONCERNINGLY, IN RECENT YEARS, CLIMATE CHANGE HAS BEEN LINKED TO A WEAKENING OF GLOBAL CURRENTS.

Melting ice and greater precipitation in some regions have dumped more freshwater into the ocean. Usually, the sinking of higher-density cold and salty water near the poles helps power currents, as warmer, 'lighter' water is pulled poleward to take its place. However, climate-driven inflows of freshwater are interfering

with ocean salinity and water density, disrupting the cyclical overturning of water, and slowing currents.



WHAT THIS MEANS IS HEAT ENERGY FROM THE SUN IS NOT BEING AS EFFECTIVELY DISTRIBUTED AROUND THE WORLD, WITH KNOCK-ON EFFECTS ON WEATHER.

The 2015 European heatwave has been linked to an anomalous 'cold blob' – an isolated region in the subpolar North Atlantic that experienced record cold ocean temperatures that year.² Weaker Atlantic currents have also been implicated in projections of drought increases in the Sahel.³

¹<https://oceanexplorer.noaa.gov/facts/climate.html>

²<https://os.copernicus.org/articles/18/953/2022/>

³<https://www.carbonbrief.org/atlantic-conveyor-belt-has-slowed-15-per-cent-since-mid-twentieth-century/>



Little Tobago, Northeast Coast Tobago
Copyright© Underwater Earth, Maritime Ocean Collection

That said, it is hard to forecast with certainty how ocean currents will behave as climate change intensifies, because of the complexity of the system. Precipitation patterns – notoriously difficult to predict – will both influence and be influenced by

currents; plate tectonics can change the surface of the ocean floor and redirect flows; atmospheric warming could decrease the temperature gradients between latitudes and upset the physics behind the conveyor belt.

WHAT IS CLEAR, HOWEVER, IS THAT THE GLOBAL SYSTEM OF CURRENTS IS CHANGING, AND THE EFFECTS WILL BE FELT AROUND THE WORLD.

IMPACT ON OCEAN LIFE

Deoxygenation

The churning of the ocean through the action of currents has another significant function. Gases and nutrients that are vital to marine flora and fauna are circulated from the surface layers of the ocean to deeper strata, and vice versa, through 'downwelling' and 'upwelling' currents. Downwelling is particularly important for moving oxygen dissolved from the atmosphere through to organisms in deeper waters.

Climate change is hampering this process. The ocean is getting warmer in certain regions due to rising atmospheric temperatures. Warmer water can hold less soluble oxygen and is more buoyant, leading to less vertical mixing of shallow and deep water. Both these factors — along with pollution from agricultural runoff and sewage — contribute to deoxygenation of the ocean.

STUDIES HAVE FOUND THAT THE OCEAN HAS LOST **2%** OF ITS OXYGEN INVENTORY FROM 1960 TO 2010, AND THE NUMBER OF LOW-OXYGEN REGIONS IS EXPANDING GLOBALLY.⁴

Increased ocean temperatures also change how quickly organisms metabolise and respire, which increases consumption of marine oxygen.⁵ This means demand is higher and supply is lower.

In coastal waters, climate change is also driving deoxygenation by creating more ideal conditions for the proliferation of algal blooms. Nutrients washed into the ocean from farmlands and human settlements can lead to overgrowth of algae in



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surface waters, which eventually die and decay, consuming oxygen in the process and suffocating life in lower layers.

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and have triggered mass crustacean 'walkouts' – where tonnes of lobsters and crayfish have literally walked out of the sea to escape low oxygen conditions.⁶

The warming of coastal waters is projected to make such algal blooms and marine deaths more common.

⁴<https://www.carbonbrief.org/guest-post-how-global-warming-is-causing-ocean-oxygen-levels-to-fall/>

⁵Ibid

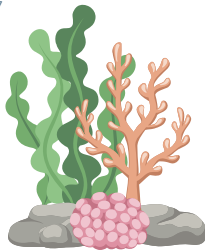
⁶<https://www.timeslive.co.za/news/sci-tech/2022-03-04-in-pics-dramatic-images-of-cape-rock-lobster-walkout-after-red-tide-on-west-coast/>

Coral bleaching

Coral reefs are biodiverse ecosystems that are found in tropical and semi-tropical waters. Thousands of aquatic species depend on reefs for shelter, spawning grounds and food.

IN FACT, APPROXIMATELY **25 PERCENT** OF ALL MARINE LIFE, INCLUDING FISH, DEPEND ON CORAL REEFS AT SOME POINT DURING THEIR LIFE CYCLES.⁷

REEFS SUPPORT FISHERIES, ECONOMIES AND FOOD SUPPLY CHAINS IN MANY COUNTRIES, AND AS WE KNOW IN THE CARIBBEAN, THEY ARE LUCRATIVE TOURIST ATTRACTIONS.

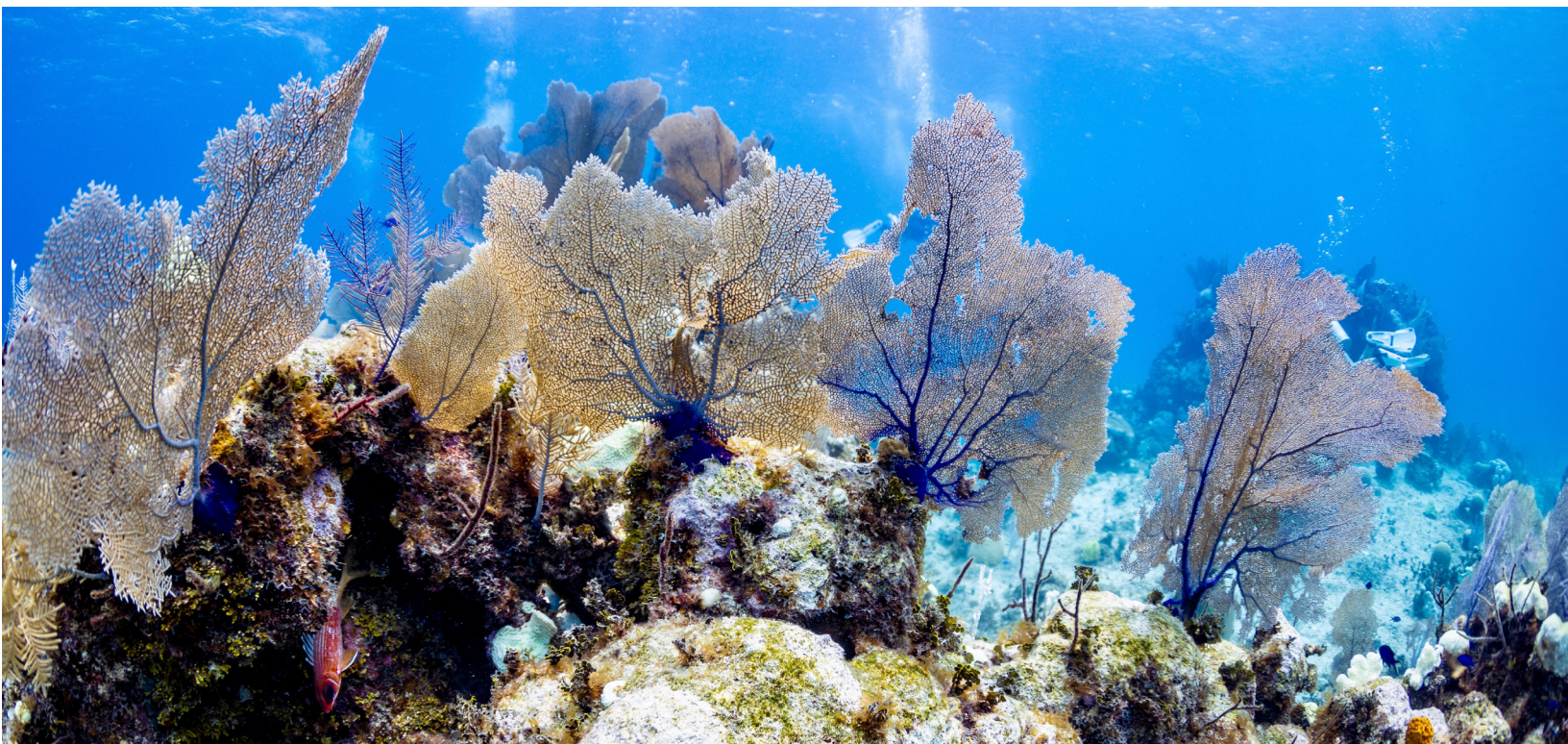


Additionally, reefs serve as natural seawalls, protecting coastal communities from waves and storm surges.⁸

Among the threats facing coral reefs today, climate change is a critical one. Higher ocean temperatures are causing coral bleaching, or the expulsion of the algae that give corals their colour. Bleaching can cause corals to eventually die.

THE UNITED NATIONS ENVIRONMENTAL PROGRAMME REPORTED THAT BETWEEN 2009 AND 2018, THE WORLD LOST ABOUT 14 PER CENT OF THE CORAL ON ITS CORAL REEFS.⁹

The outcome is a cascade of impacts on the species that depend on them. When breeding grounds and habitats are destroyed, fish and crustacean populations are impacted, as are the animals that feed on them. Fisheries deteriorate and fishing industries are affected. Coastal areas become more vulnerable to the ocean. In countries where reefs are tourist draws, bleaching can undercut revenues. These are all imminent risks facing the Caribbean, with the National Oceanic and Atmospheric Administration (NOAA) predicting severe coral bleaching throughout the region from July to October 2023.¹⁰



⁷<https://www.fisheries.noaa.gov/feature-story/how-are-fisheries-and-coral-reefs-connected#:~:text=Overfishing%20Threatens%20Reefs&text=Fish%20need%20healthy%20coral%20reefs,to%20the%20death%20of%20corals>.

⁸<https://www.worldwildlife.org/pages/everything-you-need-to-know-about-coral-bleaching-and-how-we-can-stop-it>

⁹<https://www.unep.org/news-and-stories/press-release/rising-sea-surface-temperatures-driving-loss-14-percent-corals-2009#:~:text=release%20Nature%20Action-,Rising%20sea%20surface%20temperatures%20driving%20the%20loss,percent%20of%20corals%20since%202009&text=Nairobi%2C%205%20October%202021%20%2D%20The,the%20world's%20coral%20since%202009>.

¹⁰<https://newsday.co.tt/2023/07/06/caribbean-coral-reefs-at-high-risk-in-2023/>

Disrupted polar habitats

As in tropical waters, life in polar regions is similarly threatened by global warming. In one tragically ironic example, in late 2022, warmer temperatures led thousands of penguins in the Antarctic to freeze to death.¹¹ The event was linked to the loss of sea ice, which the emperor penguins used as a breeding ground and platform to raise their young. The rapid melting and breakup of a sea ice shelf meant an estimated 10,000 chicks fell into the ocean before they developed the waterproof feathers to swim in the frigid ocean.

AT THE NORTH POLE, LOSS OF SEA ICE HAS AFFECTED SEALS IN THE SAME WAY, AND THE POLAR BEARS THAT RELY ON THEM FOR FOOD SUFFER IN TURN. BESIDES LOSING HUNTING GROUNDS AND EASY PREY WITH THE MELTING OF SEA ICE, BEARS ALSO LOSE 'OVERLAND' TRAVELLING ROUTES, MATING DENS AND REFUGE FOR REST.¹²

Land-based animals aren't the only ones affected by the loss of sea ice. In the Southern Ocean, krill – tiny crustaceans that form the basis of almost every Antarctic food chain

– feed on algae found under the surface of sea ice.¹³ A loss of ice therefore reduces the food source for these creatures.

ACCORDING TO RECENT RESEARCH, KRILL POPULATIONS ARE PROJECTED TO DECLINE BY ABOUT 30% THIS CENTURY DUE TO A COMBINATION OF HUMAN-DRIVEN CLIMATE CHANGE AND NATURAL CLIMATE VARIABILITY.¹⁴

This will put competitive pressure on all species dependent on krill for their own sustenance.



¹¹<https://www.bbc.com/news/science-environment-66492767>

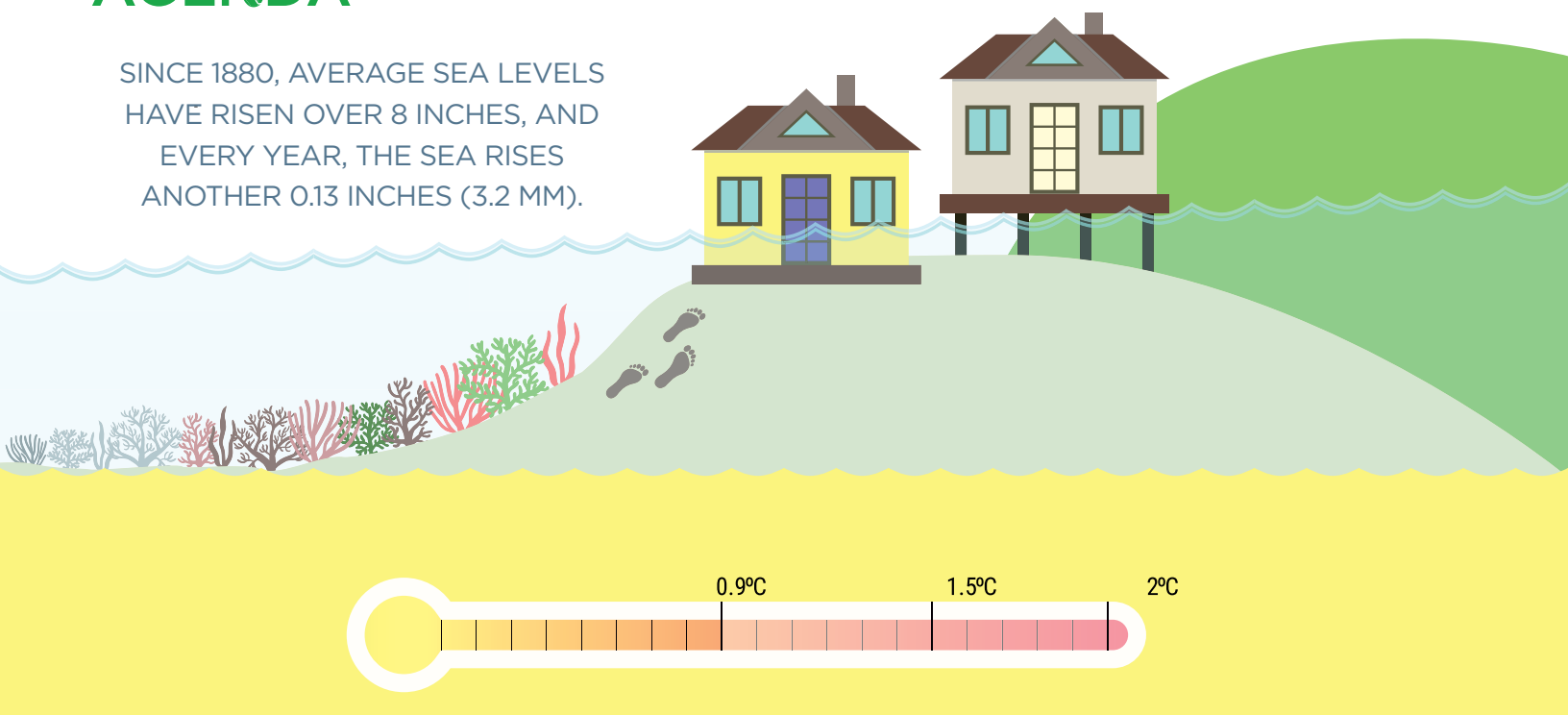
¹²<https://www.worldwildlife.org/pages/polar-bears-and-climate-change>

¹³<https://discoveringantarctica.org.uk/climate-change/impacts-of-climate-change/>

¹⁴<https://www.colorado.edu/today/2021/06/15/human-driven-climate-change-only-half-picture-krill-key-species-southern-ocean>

ON THE GREEN AGENDA

SINCE 1880, AVERAGE SEA LEVELS HAVE RISEN OVER 8 INCHES, AND EVERY YEAR, THE SEA RISES ANOTHER 0.13 INCHES (3.2 MM).



Impact on sea level

Perhaps the most commonly cited and most easily observed impact of climate change on oceans is the rise in sea levels. According to NASA, “sea level rise is caused primarily by two factors related to global warming: the added water from melting ice sheets and glaciers, and the expansion of seawater as it warms.”¹⁵

SINCE 1880, AVERAGE SEA LEVELS HAVE RISEN OVER 8 INCHES, AND EVERY YEAR, THE SEA RISES ANOTHER 0.13 INCHES (3.2 MM). HOWEVER, THE RATE OF RISE IS ACCELERATING, AND RESEARCH PUBLISHED IN FEBRUARY 2022 PROJECTS THAT LEVELS WILL RISE BY A FOOT BY 2050.¹⁶

This is alarming news for the millions of people who live in coastal settlements around the world, and particularly for small island developing states with limited geographical room to escape encroaching seas. In the Caribbean, many nations have built critical infrastructure on reclaimed land, such as at the waterfront and port area of Port of Spain in Trinidad and Tobago.¹⁷ This makes such areas highly vulnerable to rising sea levels, and the concomitant destruction of property, habitats and livelihoods.

Additional impacts include destructive erosion, wetland flooding, and aquifer and agricultural soil contamination with salt. In some territories, services such as Internet access can also be impacted, as communications infrastructure lies in the path of rising seas.¹⁸

Adaptation and mitigation

Given humanity's dependence on and proximity to the sea, it is clear that climate change impacts on the ocean are a global concern. Addressing the rate of climate change through emissions reduction is of course the most urgent imperative, but a degree of adaptation will be equally necessary to ensure resilience. To protect against sea level rise, proper planning will be vital. Coastal settlements will need to consider appropriate coastal protection, and will need to be equipped with resilient transportation networks, proper drainage and innovative architecture to help with water catchment as well as elevation of homes and buildings above projected water levels.

¹⁵<https://climate.nasa.gov/vital-signs/sea-level/#:~:text=Global%20sea%20levels%20are%20rising,of%20seawater%20as%20it%20warms.>

¹⁶<https://www.nationalgeographic.com/environment/article/sea-level-rise-1>

¹⁷<https://repositorio.cepal.org/server/api/core/bitstreams/c94d4b38-7867-4049-b500-e2ca09f21e1e/content>

¹⁸<https://www.nationalgeographic.com/environment/article/sea-level-rise-1>



Green infrastructure solutions such as mangroves and other coastal vegetation can help buffer against storm surges and rising tides

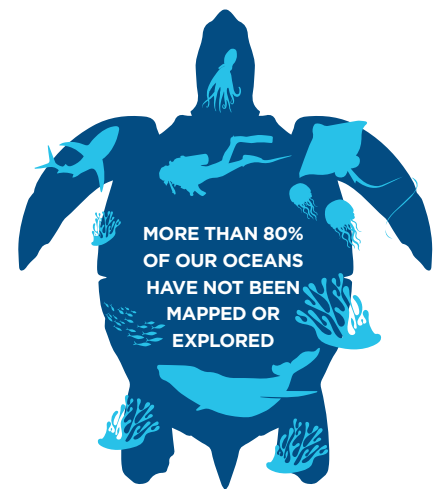
Green infrastructure solutions such as mangroves and other coastal vegetation can also help buffer against storm surges and rising tides. In addition, where feasible, due consideration should be given to relocating critical infrastructure and even at-risk settlements to higher ground further inland. Where this is impractical, early warning systems can help provide a measure of protection against damage and even loss of life from coastal flooding events.

In light of the impacts on marine life and sensitive habitats, fishing industries and tourism can be adversely affected. Economies dependent on these industries must

seek to sustainably manage their natural marine resources and invest in protection and rehabilitation where possible. Compounding stressors such as pollution and destructive fishing must be reduced to prevent further damage.

Most importantly, we need to constantly monitor our oceans to register any significant changes likely to have an impact on humans.

THE FACT THAT MORE THAN 80% OF OUR OCEANS HAVE NOT BEEN MAPPED OR EXPLORED MAKES THIS A DIFFICULT TASK, BUT IT IS A CRITICAL AREA FOR RESEARCH.



Understanding how our oceans are changing is the necessary first step to managing the fallout. ■