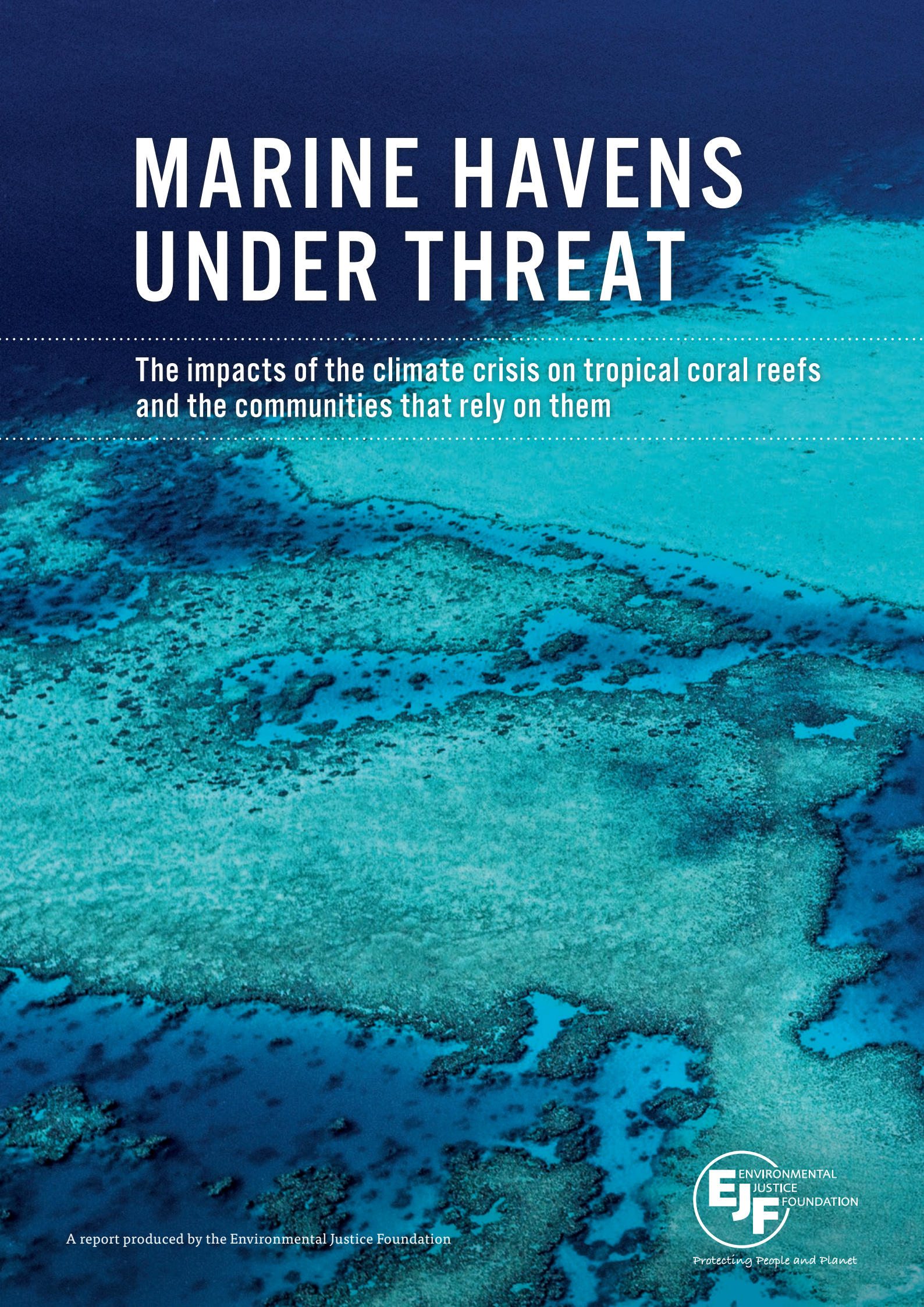
MARINE HAVENS UNDER THREAT

The impacts of the climate crisis on tropical coral reefs and the communities that rely on them



A report produced by the Environmental Justice Foundation

ENVIRONMENTAL JUSTICE FOUNDATION

Protecting People and Planet

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The Environmental Justice Foundation (EJF) is a UK-based environmental and human rights charity registered in England and Wales (1088128).

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This document should be cited as: EJF (2020)

Marine havens under threat: The impacts of the climate crisis on tropical coral reefs and the communities that rely on them.

Cover picture credit:
Gaby Barathieu / Coral Reef Image Bank

OUR MISSION

Protecting People and Planet

EJF believes environmental security is a human right.

EJF strives to:

- Protect the natural environment and the people and wildlife that depend upon it by linking environmental security, human rights and social need
- Create and implement solutions where they are needed most – training local people and communities who are directly affected to investigate, expose and combat environmental degradation and associated human rights abuses
- Provide training in the latest video technologies, research and advocacy skills to document both the problems and solutions, working through the media to create public and political platforms for constructive change
- Raise international awareness of the issues our partners are working locally to resolve

Our Oceans Campaign

EJF's Oceans Campaign aims to protect the marine environment, its biodiversity and the livelihoods dependent upon it. We are working to eradicate illegal, unreported and unregulated fishing and to create full transparency and traceability within seafood supply chains and markets. We conduct detailed investigations into illegal, unsustainable and unethical practices and actively promote improvements to policy making, corporate governance and management of fisheries along with consumer activism and market-driven solutions.

EJF is working to secure sustainable, legal and ethical seafood.

Our ambition is to secure truly sustainable, well-managed fisheries and with this the conservation of marine biodiversity and ecosystems and the protection of human rights.

EJF believes that there must be greater equity in global fisheries to ensure developing countries and vulnerable communities are given fair access and support to sustainably manage their natural marine resources and the right to work in the seafood industry without suffering labour and human rights abuses.

We believe in working collaboratively with all stakeholders to achieve these goals.

For further information visit **www.ejfoundation.org**

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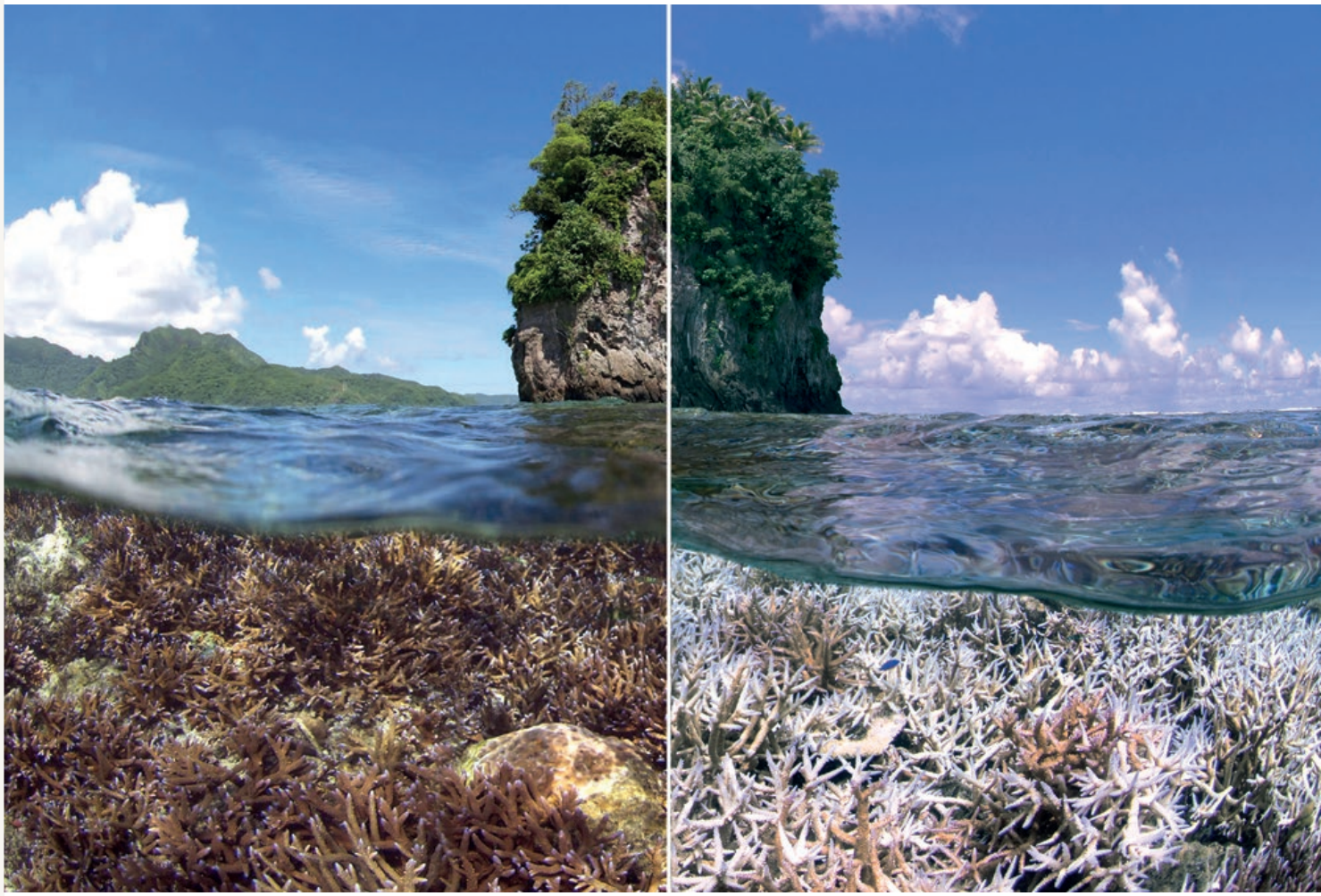


Credit: The Ocean Agency / XL Catlin Seaview Survey

EXECUTIVE SUMMARY

Coral reefs comprise one of the richest ecosystems on the planet, supporting an estimated quarter of all marine species and rivalling rainforests in terms of diversity of wildlife.[1/2]

Yet, they are under imminent risk of destruction. In their latest Special Report, the Intergovernmental Panel on Climate Change listed coral reefs as one of the most threatened ecosystems on Earth.

The IPCC estimates that global warming of just two degrees would result in the death of 99% of corals, and the loss of this habitat would have devastating impacts on marine wildlife across interconnected ecosystems.[3] Species of fish, dolphins, sharks and already endangered sea turtles would be widely affected. It would also prove catastrophic for the estimated 275 million people living in coastal communities who depend directly on coral reef ecosystems for food, income and storm protection.[4]

EJF urges decision-makers to take immediate action to protect these ecosystems and the communities that rely on them. To do this, we must urgently increase the ambition and scale of action to decarbonise the global economy and effectively address the climate crisis, while simultaneously eradicating pollution and illegal and damaging fishing practices. This report focuses on climate change as the primary long-term threat to coral reefs, but it is clear that both unsustainable fishing and pollution are serious near-term threats that must not be neglected.

If the combined threats of climate change, pollution and overfishing facing coral reefs are not fully addressed, the future of a significant proportion of marine biodiversity, and those that rely on it, will be critically threatened.

EJF RECOMMENDATIONS

Saving coral reefs means ending the climate crisis, therefore:

- All countries must rapidly and fully implement the global climate change agreement established in Paris in December 2015, raising their emission reduction pledges over time, keeping the global temperature below 1.5°C above pre-industrial levels.

- A full transition to zero carbon by all major industrialised economies is needed by 2030. That means reducing emissions across every part of every industry and ensuring a reliable supply of truly renewable energy. A clear set of policies is required to facilitate long-term investment and innovation in solar, wind, wave, and geo-thermal energy.

- The EU should initiate the creation of a high-profile, fully resourced, inter-agency taskforce to coordinate the work of the multiple bodies in the Commission, including (but not limited to) Environment, Climate Action, Migration and Humanitarian Affairs, International Cooperation and Development as well as the High Representative of the Union for Foreign Affairs and Security Policy. This will drive a more effective, integrated approach towards wider international responses to climate change.

- The devastating implications for fundamental human rights and economic prosperity of our failure to roll-back global heating must be made central to national, regional and global economic policy and decision making – to help facilitate this, a UN special rapporteur on human rights, economic well-being and climate change should be immediately established, fully resourced and charged with developing recommendations for action, reporting by 2021.

To ensure that corals survive the climate change that is irreversible:

- Illegal and unsustainable fishing must be stopped. One key way states can achieve this is by increasing transparency in the industry by following EJF's Charter for Transparency.[5]

- Fishing practices that destroy reefs must be banned worldwide and such bans must be effectively enforced.

- Marine protected areas must offer true protection, with clear restrictions and effective conservation aims, such that they provide an effective and much-needed haven for corals, fish and other wildlife.

- Marine protected areas must be expanded so that they cover at least 30% of the oceans.

- Coral-harming pollution, from agricultural run-off to sewage and plastics, must be curbed. In many locations tackling such problems will have other positive effects for coastal communities, such as improved sanitation as a result of better sewage treatment.

- In all deliberations and future negotiations, all stakeholders must be included, with special reference to local communities.

Credit: Hannes Klostermann / Coral Reef Image Bank

INTRODUCTION

Coral reefs cover approximately 0.1% of the ocean and are one of the oldest ecosystems in the world; with fossils dating as far back as 500 million years.[6/7] They support hundreds of thousands of animal and plant species[8], totalling a quarter of all marine species.[9]

These include hard and soft corals, fish, sponges, crustaceans, molluscs, sea turtles, sharks and dolphins.[10] They are often of critical importance to coastal and island communities as a source of food, income and physical protection against storm damage; making them of crucial importance to both people and planet.[11]

The structural basis of reefs is neither rocks nor plants, but layers of calcium carbonate. This compound is produced by coral polyps, soft-bodied marine organisms, to form their individual protective skeletons. This eventually forms the structure of entire reefs in a process known as calcification.[12] Coral polyps live in symbiosis with zooxanthellae, an alga which supplies them with energy and nutrients and gives them their vibrant colour.[13]

Coral reefs exist in a delicate balance of conditions: temperature, salinity, nitrate and phosphate concentration, carbonate saturation and light availability[14] must all be right, and these can be influenced by a range of external factors. Globally, coral reefs tend to be found in tropical or semi-tropical latitudes, where temperatures range from 23 – 29°C,[15] and in shallow waters, where there is sufficient sunlight available for photosynthesis.[16]

Approximately 850 million people live within 100 km of coral reefs and at least 275 million of them directly depend on reefs for their livelihoods and sustenance.[17] Dependence on reefs is particularly common in small island developing states, countries in the Coral Triangle (see box: *The Coral Triangle*), and coastal populations in developing countries; who are left increasingly vulnerable as reefs degrade under climate change.[18]

More than 75% of all coral reefs on the planet are currently threatened by a combination of stressors including climate change, overfishing and destructive fishing, coastal development, pollution and damage.[19] As they deteriorate, fish populations disappear, reefs provide less storm protection, they are less attractive to tourists and they no longer contribute to the formation of sandy beaches, another protective barrier for coastlines and attraction for tourists.[20] Overfishing and pollution are serious immediate threats to many reefs; however, climate change is now the primary concern and will cause irreversible damage to reefs worldwide.[21] The stark warning from the IPCC is that 70-90% of corals would be lost in a 1.5°C world and 99% at 2°C.[22]

Credit: Image courtesy of Expedition to the Deep Slope 2007, NOAA-OE

Deep-water reefs

While tropical coral reefs are typically found up to 150m, cold deep-water reefs can be found at 2000m or lower. Deep-water reefs are biologically distinct as they do not rely on the availability of light and as such will be affected by climate change in different ways.[23]

It has been suggested that deep-water reefs could provide a refuge for shallow-water coral ecosystems under changing oceanic conditions.[24] However, not only are deep water reefs vulnerable to disturbances themselves, but there are concerns about the suitability and ability of most coral larvae to migrate to deep water reefs. Only 25% of total coral biodiversity – the 'depth-generalist' species – would be suited to deep water reefs.[25] Deep-water reefs may act as a refuge for some shallow corals, but it is not an ecosystem-wide phenomenon.[26/27] Deep reefs are unable to act in a refuge capacity for the vast majority of species from shallow reefs.[28]

Research surrounding the impact of climate change on deep reefs is limited as they are difficult to access.[29] Furthermore, shallow, warm-water reefs tend to be of more direct importance to humans as they are closer to settlements. This report therefore focuses on warm-water, tropical reefs.

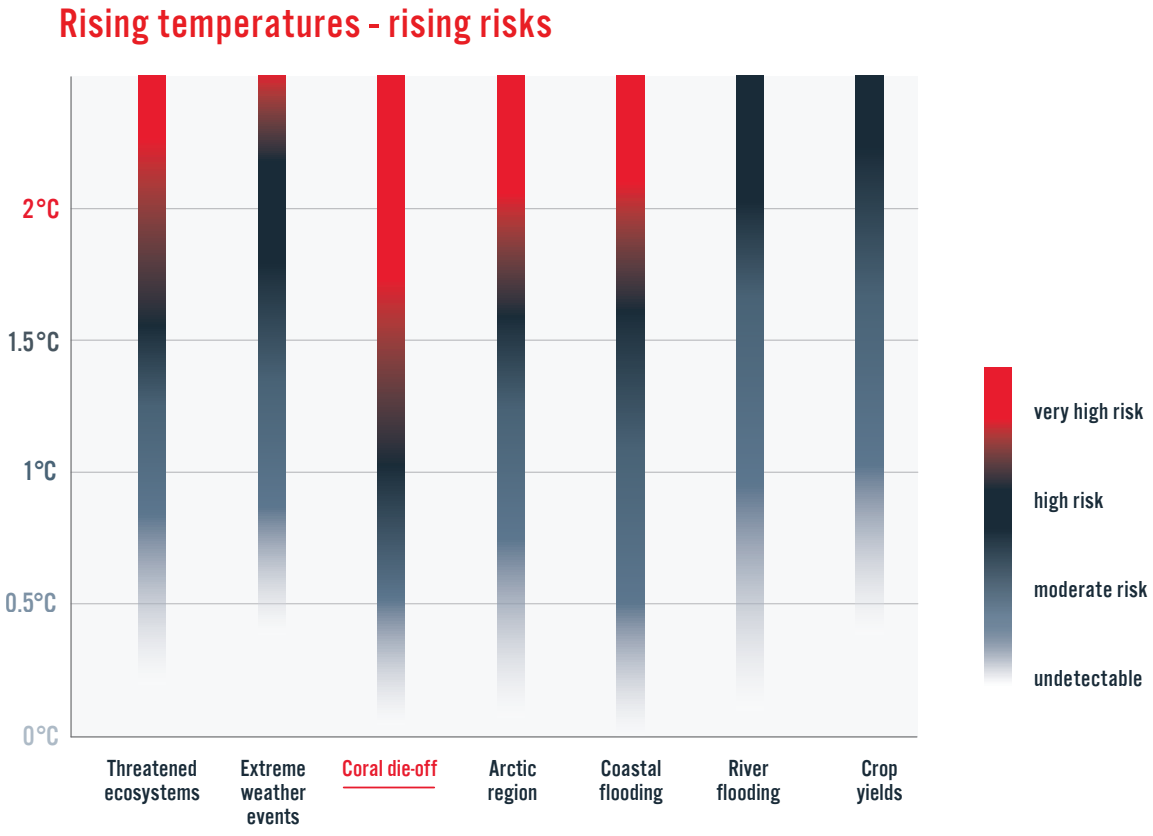
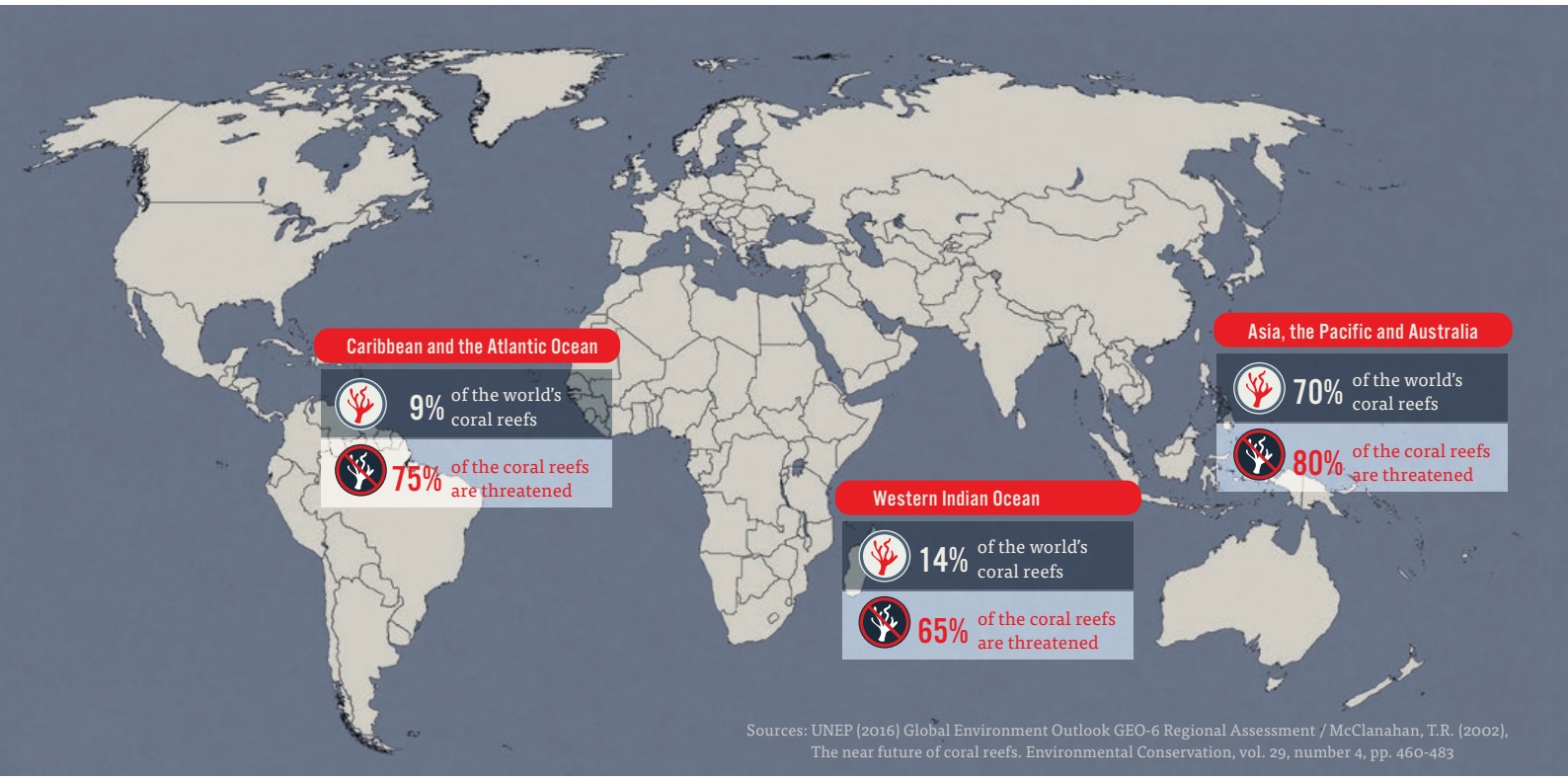


Figure 1: Adapted from - Assessment of level of risk in various spheres affected by climate change. Source: IPCC, 2018



Sources: UNEP (2016) Global Environment Outlook GEO-6 Regional Assessment / McClanahan, T.R. (2002), The near future of coral reefs. Environmental Conservation, vol. 29, number 4, pp. 460-483

The Coral Triangle

The Coral Triangle covers 647 million hectares of land and sea in South-east Asia and houses the highest concentration of marine species on the planet, including 76% of known species of coral, 2,500 species of reef fish and many endangered animals such as blue whales.[30] Because of this immense biodiversity and richness, it is often referred to as 'the Amazon of the Seas'.[31]

130 million of those who live within the Coral Triangle rely directly on their coastal and marine resources[32], yet 90% of its coral reefs are currently at risk.[33/34]

CORALS UNDER THREAT

Coral bleaching: when corals are stressed by changes in conditions such as temperature, light or nutrients, they expel the symbiotic algae living in their tissues, causing them to turn completely white.[35]

The climate crisis is a severe threat to coral reefs. As the global temperature rises, reefs will be put at risk from warming oceans, higher frequency cyclones, increased precipitation, sea level rise, rising acidification and changing ocean circulation.[36] These factors alter the delicate balance of conditions necessary for tropical coral reefs to function, causing bleaching and destruction of reefs. In many cases, this damage is irreversible.

Urgent action on climate change

The climate crisis obviously extends far beyond coral reefs, and is already affecting the entirety of the Earth's ecosystem, and all those living within it.

A full transition to zero carbon by all major industrialised economies is needed by 2030. That means reducing emissions across every part of every industry and ensuring a reliable supply of truly renewable energy. A clear set of policies is required to facilitate long-term investment and innovation in solar, wind, wave, and geo-thermal energy. This move to carbon-free electricity will need effective storage systems and grids designed for high volume of variable renewable power. This must be achieved without relying on unsustainable measures such as nuclear power or driving deforestation or food insecurity by growing food-based bio-fuels.

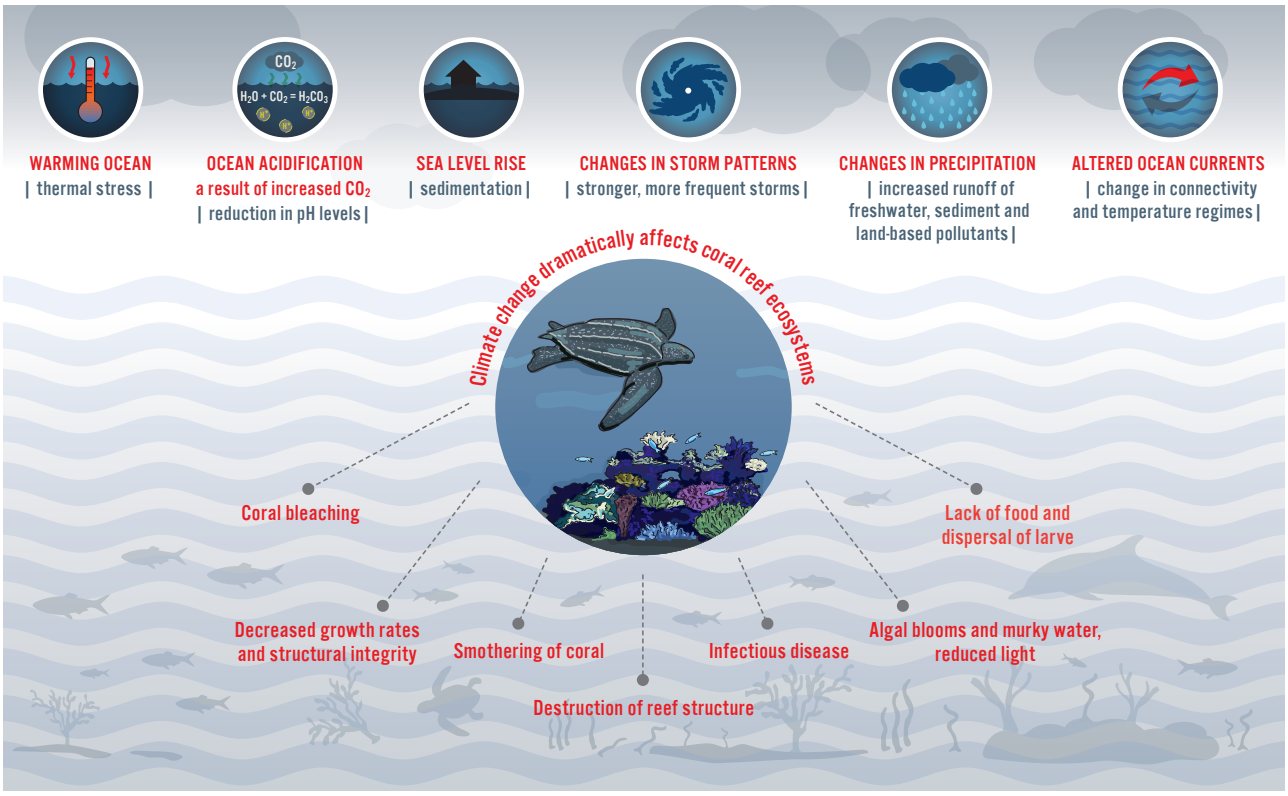


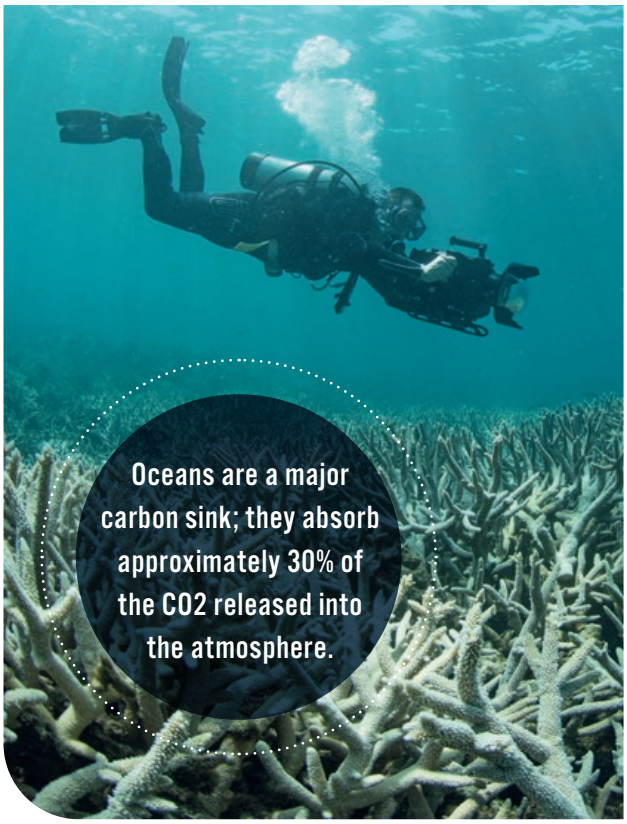
Figure 2: Adapted from - Threats to coral reefs: climate change[37]

Acidification

Along with forests, oceans are a major carbon sink; they absorb approximately 30% of the CO_2 released into the atmosphere[38], helping to mitigate global warming. As atmospheric CO_2 rises, more is absorbed by the ocean; however, this also causes it to become more acidic. In the past century, the average acidity of the oceans has increased by 26%.[39]

Normally, reef-building corals use naturally occurring carbonate in the oceans to form their calcium carbonate skeletons.[40] As the ocean acidifies, less carbonate is available for this process. Along with impacting reef growth, this causes existing coral skeletons to become brittle and more vulnerable to damage from storms.[41]

Along with affecting living corals, acidification will cause the calcium carbonate in the sediments that support the reef to dissolve, an issue that is likely to increase notably by the end of the century.[42/43] Reefs with less structural integrity have been found to attract fewer new corals, and therefore may struggle to rebuild after loss of carbonate.[44]



Credit: The Ocean Agency / XL Catlin Seaview Survey / Richard Vevers

Coral soundscapes in danger

Coral reefs have a distinct soundscape which is vital in attracting young fish to safe, suitable habitats and guides fish who have left the reef back to their home. However, degraded reefs are unable to perform this important ecological function.

Soundscapes from recently degraded reefs are significantly quieter and attract 40% fewer juvenile fish when compared to healthy reefs, research has shown.[45]

The soundscape effect is likely to cause negative impacts on reef resilience, as healthy fish populations are essential in helping reefs to recover from storm damage and bleaching.[46]

This is prevalent in the Great Barrier Reef, where the 'reef orchestra' is being silenced as it degrades and corals deteriorate.[47] As a result of recurrent bleaching events and repeated cyclones, the wildlife that used to live in the reef has begun to disappear, along with the multitude of sounds they make.[48]

Soundscapes from recently degraded reefs are significantly quieter and attract 40% fewer juvenile fish.

Credit: Lindsey Kramer/ USFWS

Rising temperatures

Alongside ocean acidification, the major impact of the climate crisis on coral reefs is rising temperature. While corals are affected by both excessively warm and cold temperatures outside their narrow range, the majority of tropical reefs are closer to their upper thermal limits, meaning they are particularly vulnerable to higher temperatures.[49] Warming causes a breakdown of the symbiotic relationship between coral and the photosynthetic algae, starving the coral of nutrients.[50] As the algae die off, corals lose their colour in what is known as a 'bleaching' event.[51]

Even if global warming is kept to under 2°C, most reefs will still experience mass bleaching, in part because of the complexity and geographical variation of oceanic temperature changes.[52] For example, in 2016 the Great Barrier Reef suffered 'a catastrophic die-off' of 30% of its coral, under extremely high temperatures experienced in the summer heatwave.[53] These extreme heatwave events are increasingly common under the climate crisis.

In certain conditions, some corals are able to recover from bleaching events, particularly in deep water reefs.[54] However, this relies on optimum recovery conditions, where reefs are repopulated by coral larvae. In reality, these conditions are rare. Repeated bleaching events, ocean acidification, intense storms, pollution and overfishing are all increasingly common and severely hamper reef recovery.

On average across the Great Barrier Reef, the recovery rate of corals from bleaching events has declined by 84% between 1992-2010.[55] Unfortunately, this scenario is now common; massive bleaching events have overwhelmed the capacity of reefs to bounce back. While corals need approximately 10-15 years to naturally recover, massive bleaching events now occur on average every 6 years.[56]

Extreme weather and disease

Under future global warming scenarios, the intensity of tropical cyclones is likely to increase significantly.[61] Strong winds and wave action can damage or destroy reefs.[62] Reefs often provide protection to coastal communities, absorbing energy from storm waves before they reach the shore, which reduces casualties, damage and subsequent reconstruction costs.[63] The natural ability of reefs to recover from storm damage has suffered under repeated and increasingly intense storms. Coastal communities are not only losing a major source of food and income but also a vital line of defence against extreme weather.

More intense rainfall under the climate crisis will also cause larger volumes of surface runoff, which transfers nutrients and sediments to the ocean. When these sediments settle on reefs, they smother corals, blocking the light.[64] The same effect occurs when algal blooms form due to excess concentrations of nutrients.[65]

Climate change has also been linked to the spread of infectious diseases[66] and the expansion of invasive species – such as sponges or lionfish – which can survive in harsher conditions than corals and other reef wildlife.[67]

Overfishing and pollution

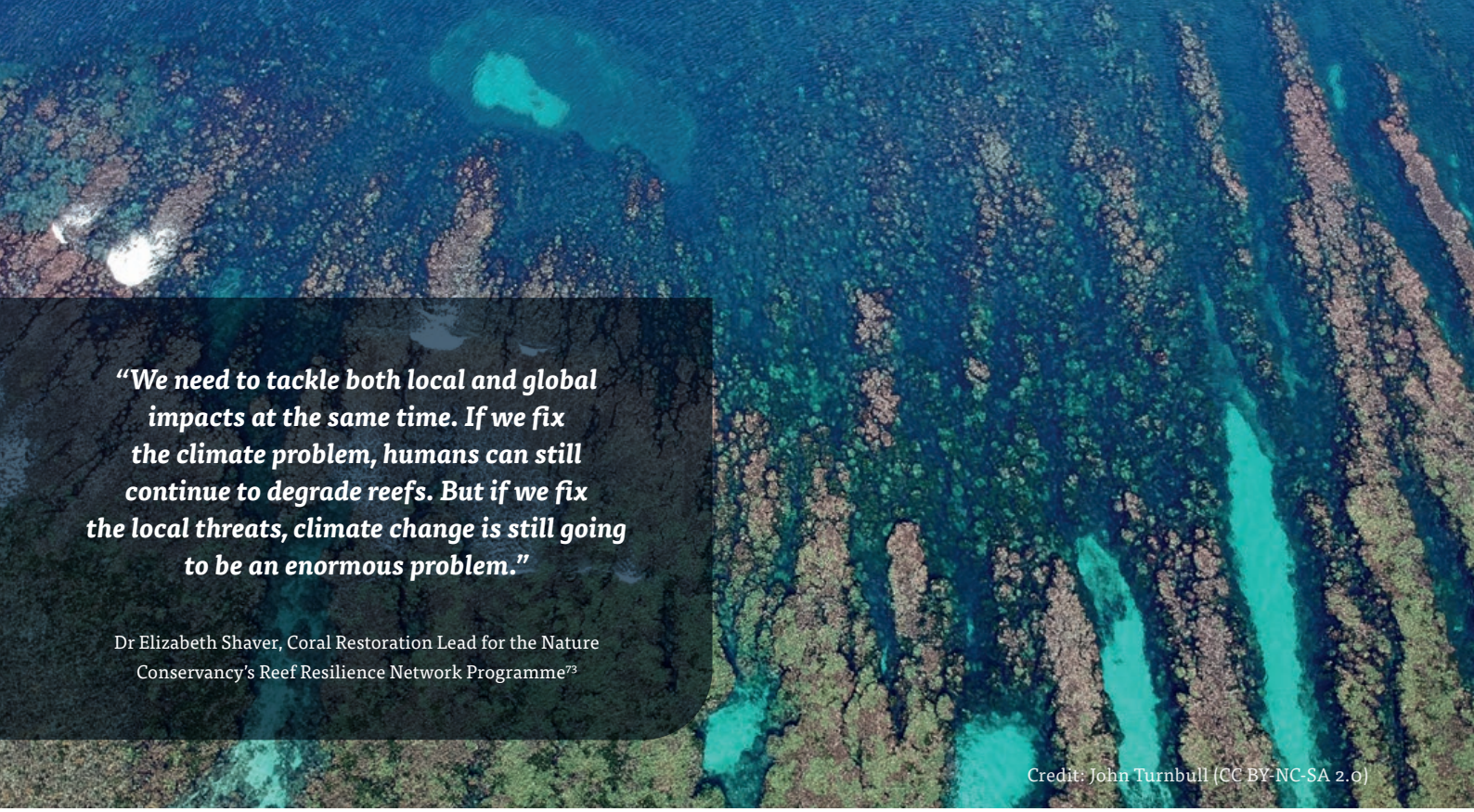
Climate change is an existential threat to coral reefs, but they are also faced with other anthropogenic stressors. Currently, overfishing is considered to be the greatest immediate threat for at least 55% of the world's coral reefs.[68]

By 2050, Pacific reef fish populations are projected to decrease by 20%.[69] Fish are an important part of coral reef ecosystems, as they consume algae which would otherwise smother the reef, disrupting coral growth and making it inhospitable for new coral larvae.[70/71/72]

In 2016 the reef lost 30% of its coral to bleaching.

The Great Barrier Reef

The Great Barrier Reef is the Earth's largest living structure, approximately the size of Italy.[57] For 500,000 years it has been home to an astonishingly diverse array of wildlife, and in more recent times, has played an important role in Indigenous culture and modern Australia's economy.[58] However, this unique ecosystem is under serious threat as the climate crisis escalates. In 2016 the reef lost 30% of its coral to bleaching[59], and its recovery rate from bleaching events has declined by 84% between 1992-2010.[60]



"We need to tackle both local and global impacts at the same time. If we fix the climate problem, humans can still continue to degrade reefs. But if we fix the local threats, climate change is still going to be an enormous problem."

Dr Elizabeth Shaver, Coral Restoration Lead for the Nature Conservancy's Reef Resilience Network Programme[73]

LOSS OF MARINE WILDLIFE

As well as overfishing, destructive fishing practices can leave corals more vulnerable to pollution and climate change. Bottom trawling is especially damaging and tends to have high bycatch of key species such as sea turtles.[74] Dynamite fishing is often used in reef waters and is directly damaging to reef structure, as well as severely depleting fish populations.[75]

Pollution is an additional concern for coral reefs.[76] Sediments, agricultural fertilisers and pesticides, plastics, sewage and other pollution from human activities inland can damage coral reefs. Sediments, often topsoil washed from fields, physically smother corals, whereas nutrient pollution in the form of fertiliser or sewage can also lead to smothering by encouraging the growth of harmful algae. Plastic pollution is also a serious problem, and recent research has shown that the likelihood of corals succumbing to disease increases from 4% to 89% when they are in contact with plastic.[77]

Pollution is becoming an increasing concern as coastal settlements expand, especially where there are poor or non-existent waste disposal strategies.

These factors are vital for coral reef conservation, however, even if addressed they cannot eliminate the threat of the climate crisis. A study of the 2016 mass coral reef bleaching event found that variations in water quality and fishing pressure between reefs were independent of the severity of bleaching events.[78] This suggests that local conservation efforts against pollution and overfishing will be of little help if unchecked climate change continues.

Tropical coral reefs support an estimated quarter of all marine species: hundreds of thousands of animal and plant species, who rely on the reef for food, shelter and a safe place to live and reproduce.[79/80] These complex ecosystems include hard and soft corals, sponges, crustaceans, molluscs, fish, sea turtles, sharks, dolphins and much more – including 'foundation' and 'keystone' species such as corals and sea turtles.[81] The Great Barrier Reef alone has over 600 different species of coral polyps.[82]

Sharks are the apex predators of the reef ecosystem. Species such as the White-tip Reef Shark, Grey Reef Shark and Tiger Shark are prevalent across Pacific, Indian and Coral Triangle reefs.[83] They feed primarily on reef species such as octopuses, crustaceans and a variety of reef fishes, and use reefs as safe nursery grounds for their young.[84] They even provide food and habitat for fish species that eat their parasites.[85] Yet despite their key role in maintaining a healthy ecosystem, their populations are poorly managed, even on the Great Barrier Reef.[86]

Many fish species rely exclusively on coral reefs; such as Butterflyfish, whose larvae settle only on live coral colonies[87] and who rely on coral polyps for 80% of their diet.[88] The loss of 99% of their sole habitat – which the IPCC predicts will occur at 2°C of global heating – would be devastating, not only for Butterflyfish but a multitude of other species heavily dependent on reefs.[89]

There are many clear links between the health of coral cover and marine life[90]; for example, over an eight-year period, loss of coral cover led to declines in 75% of reef fish populations in Papua New Guinea.[91]

In reefs suffering such massive biodiversity losses, even the remaining, more resilient, fish species are still at risk of losing their function in the local environment and seeking other habitats, leaving reefs unable to fully recover from disturbances.[92]

Maintaining coral biodiversity is key to reef survival; reefs rich in coral species attract more fish and other marine life and are better placed to recover from storm damage, bleaching, pollution, disease and predator outbreaks.[93] Increasingly, however, reefs are damaged too frequently for corals to recover. For example, after months of particularly warm ocean temperatures in 2015, 55% of corals in inshore reefs in the Red Sea experienced bleaching; after this episode, only the strongest corals survived, and fish populations dropped significantly.[94]

If coral reefs continue to face the combined threats of climate change, pollution and overfishing, the future of marine biodiversity will be in doubt. Overall, 32.8% of 704 reef-building coral species are already at high risk of extinction.[95] If a third of all species that construct reefs are threatened, what does the future hold for the quarter of all marine species that depend on them?

A single hammerhead shark can generate up to US$1.6 million throughout its life from eco-tourism revenue, research in Costa Rica has shown.[96]
– UN Environment Programme

THREATS TO PEOPLE

Healthy coral reefs have long been an essential source of food, employment, income and storm protection for coastal communities. According to the UN, an estimated 850 million people around the world live within 100 km of coral reefs and at least 275 million depend on them for their livelihoods and sustenance.[97] And this number is increasing; in Asia and the Pacific alone, 325 million more people are expected to live in coastal zones by 2025.[98]

Feeding coastal communities

Reefs are a crucial food source for many coastal communities. In developing countries, coral reefs contribute approximately a quarter of the total annual fish catch, feeding 1 billion people in Asia alone.[99] Six million fishers–over a quarter of the world's small-scale fishers–harvest from coral reefs.[100]

In the USA, over 50% of all federally managed fisheries species depend on coral reefs for part of their life cycle.[101] The annual dockside value of commercial US fisheries from coral reefs is over $100 million.[102]

Reefs are the main source of animal protein for the populations of many isolated islands, especially those with limited resources and trade opportunities.[103] The threat to food security is particularly pressing for the populations of small island developing states because of their lack of land.

In fact, many coastal communities would have limited capacity to adapt to a world without 99% of its reefs.[104] Low-lying coastal settlements and small island developing states are particularly vulnerable to the ripple effects of reef degradation. These communities often experience some of the combined stresses of high population density, territorial isolation, limited sources of income, and a lack of other natural resources.

In the Persian Gulf, 19 million people live within 30 km of a coral reef, however, 85% of reefs in this area are currently threatened[105] and a 30% decrease in fish catch potential is expected by 2090.[106]

THE ECONOMIC VALUE OF CORAL REEFS

Tourism and recreation = $9.6 billion
Coastal protection = $9.0 billion
Fisheries = $5.7 billion
Wildlife = $5.5 billion[107]

A note of caution: Valuing biodiversity in this way is of course subjective, how do we put a value on a species' intrinsic right to exist?

Boosting the economy

Coral reefs also provide opportunities for employment and income generation. Both fishing and tourism are highly dependent on the health of the reef. Tourism relies on the attractiveness of reefs – namely their healthiness, which generates the spectacular colours, and the abundance of marine life.[108]

Damage to coral reefs and the resultant decline in fish stocks jeopardises the livelihoods of millions of people around the world.[109]

Small island developing states can be particularly dependent on coral reef tourism such as scuba diving and snorkelling. In Bonaire, more than half of the 74,000 visitors it received in 2007 were divers.[110] Even in larger economies such as the USA and Australia, where reef tourism makes up a much smaller part of the economy, it still generates billions of US dollars in income every year.[111] In a study of 108 countries and territories with coral reefs, at least 94 benefitted from reef tourism, and in 23 of these, it accounts for more than 15% of GDP.[112] For large and small economies alike, the loss of reef tourism would be significant.

For states with low average income and access to inshore coral reefs, employment in the fishing industry is often particularly attractive because of low start-up costs and the relative ease of accessing reef fish without need for high-tech equipment.[113] Many jobs depend on sustainable reef fisheries; there are an estimated six million reef fishers worldwide and over a quarter of the world's small-scale fishers work on coral reefs.[114]

In addition, for many countries, seafood exports from coral reef fisheries are important to the economy. For example, spiny lobsters represent a major source of export income for the Caribbean, and are the main fishery for 24 Caribbean countries.[115]

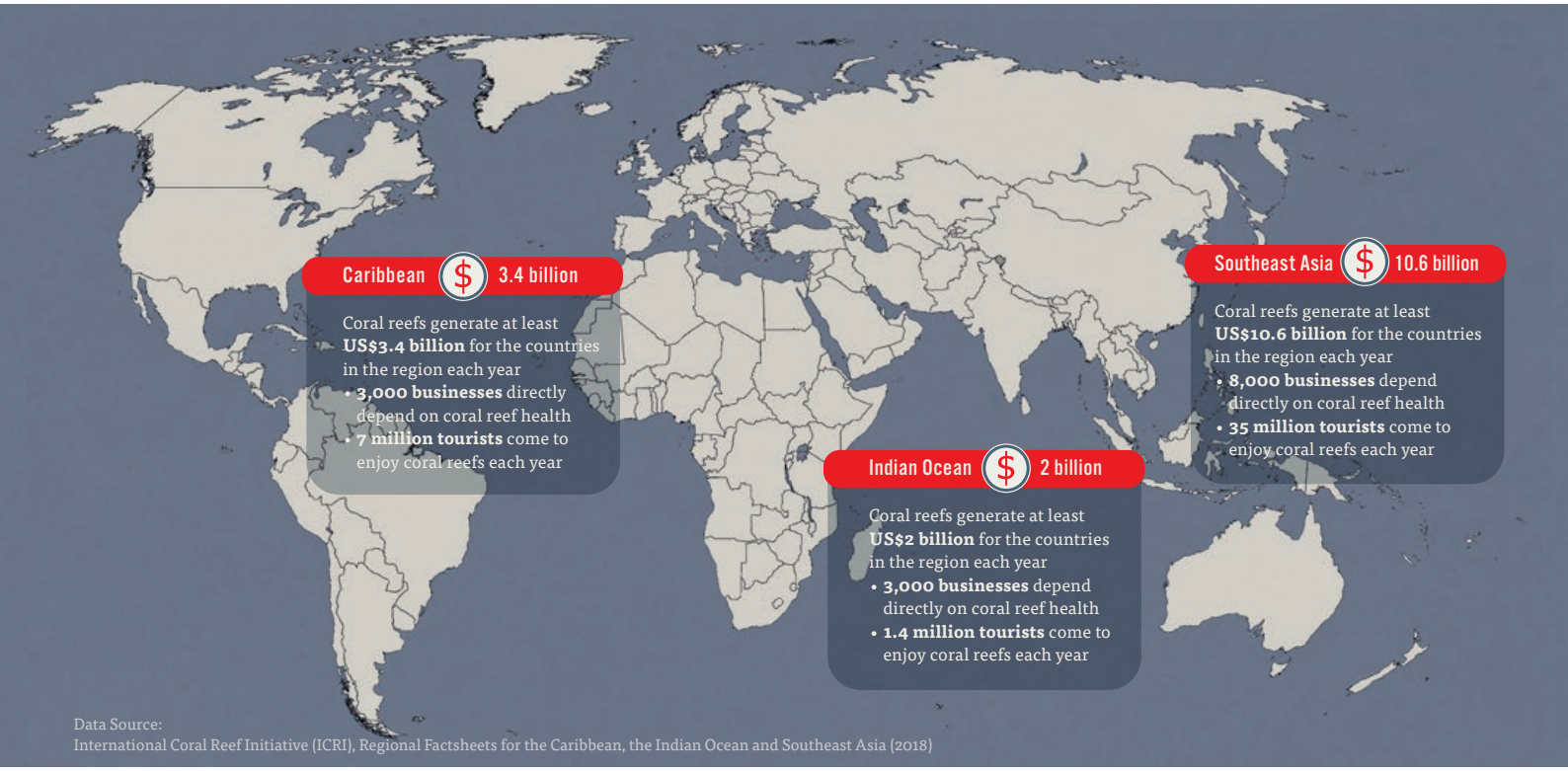
Damage to coral reefs and the resultant decline in fish stocks are jeopardising the livelihoods of millions of people around the world. For island communities who rely heavily on fishing and tourism with few alternatives, the rate at which climate change is damaging coral reefs may surpass their capacity to adapt.

Protecting the coastline

Another vital function of coral reefs is to provide physical protection from wave action, storms and erosion for coastal communities around the world. More than 150,000 km of shoreline in 100 countries and territories receives some protection from coral reefs, through reduction of wave energy and associated damages.[116] On the east African coast alone, approximately 3-4 million people benefit from this shoreline protection.[117]

Coral reefs can absorb 70-90% of wave energy, forming a natural protective barrier.[118] Not only does this ensure a safer, more stable way of life for communities, but also prevents the substantial costs that would be incurred from building hard coastal defences and repairing storm damage.

INCOME GENERATION BY CORAL REEFS



Data Source:
International Coral Reef Initiative (ICRI), Regional Factsheets for the Caribbean, the Indian Ocean and Southeast Asia (2018)

A further concern is that sea level rise will drown coral reefs, exposing coasts to wave action against which they were previously protected. On most reefs, growth rate is not sufficient to keep up with projected sea level rise.[119]

The economic impact of flood damages incurred by the loss of coral reefs is significant. With the loss of only one metre in reef height, annual financial damages from flooding would double and damages from storms would triple.[120] Over a period of just 100 years, the cost of flood damage would increase by 91%.[121]

Communities built on low lying atolls, such as Pacific islands Kiribati and Tuvalu, are particularly at risk. Kiribati is one of nine nations identified by the World Resources Institute as both highly dependent on threatened coral reefs and as having a low capacity to adapt.[122] Seventeen people from the Pacific have already made refugee claims in New Zealand based on climate change, none of which have been successful as there is no international protection for climate refugees.[123] The World Bank has suggested increasing labour mobility from at-risk Pacific islands to Australia and New Zealand, to prevent a forced mass-migration of climate refugees as sea levels rise.[124]

Finally, corals and other reef species have been the source of vital medicines used to treat cancer, Alzheimer's and bacterial infections, among many other conditions.[125] Losing this important habitat means losing a potential source of new treatments. Ultimately, if left unchecked, the loss of coral reefs will have a devastating impact on the livelihoods of millions of people around the world.

PROTECTING CORAL REEFS

To protect coral reefs, we must tackle the climate crisis and free the reefs from the pressures of pollution and unsustainable fishing. As discussed elsewhere in this report (see box: *Urgent action on climate change*), the climate crisis can only be solved through sincere international cooperation. Governments must step up to fulfil their vital role in facilitating an effective and fair framework for action.

To ensure that coral reefs survive the climate change that cannot be prevented, conservation programmes must enhance their resilience. All coral reefs have a natural degree of resilience, which can be condensed into six essential indicators: (1) resistant coral species, (2) coral diversity, (3) herbivore diversity, (4) prevalence of coral disease, (5) macroalgae cover and (5) recruitment.[126] Reefs that are more diverse in coral and herbivore species tend to be more resistant to outbreaks of disease, and those with good recruitment of coral larvae are more able to repopulate after storm damage and bleaching.[127]

> To protect coral reefs, we must tackle the climate crisis and free the reefs from the pressures of pollution and unsustainable fishing.

Marine Protected Areas

Marine Protected Areas (MPAs), although not a complete solution to reef protection, can improve resilience and allow threatened species to reproduce and recover in a safe area.[128]

Properly managed MPAs can boost fish populations in nearby areas, ensuring that people who depend on them for food and income can prosper.[129/130/131] Conservation initiatives can also provide alternative employment opportunities for local communities.[132] In this way, MPAs benefit both coastal communities and marine wildlife.

Currently, however, just 27% of coral reefs are encompassed by the world's MPAs[133] and there is significant variation in their effectiveness. International enforceable guidelines on exactly what constitutes an MPA still lack clarity and it is at each country's discretion which conservation measures they implement. Their level of protection varies substantially: in fact, only 3.6% of declared MPAs have been implemented, and only 2% are fully protected.[134] While it is encouraging that the number of MPAs are increasing, is vital that they are properly managed.

Successful MPAs tend to have nature conservation as their primary objective, are regulated by clear boundaries, legally recognised and have distinct and unambiguous management goals.[135]

MPAs have been particularly successful in Latin American and Caribbean countries: Brazil, Mexico, Chile and Colombia.[136] In 2018, the creation of an MPA encompassing the Revillagigedo archipelago in Mexico not only protected the species living within its waters but also helped maintain key routes for migratory species to the Clipperton Atoll, Galapagos Islands and Cocos Island.[137] These networks of MPAs are able to achieve ecological and social aims that single MPAs cannot, and thus it is important to consider the connectivity of MPAs when they are designated.[138]

MPAs, reef rehabilitation measures and other efforts to reduce pollution and overfishing are an important component of overall management strategies, yet merely delay coral reef decay unless climate change is addressed. A multi-faceted strategy simultaneously targeting climate change, overfishing and pollution is needed; while at the same time building resilience through promoting biodiversity.

Only 3.6% of declared MPAs have been implemented, and only 2% are fully protected.

The traditional conservation practice of Gwala: Giving nature a rest

Gwala could be a solution to help preserve the 40,000 square kilometres of coral reefs.

Papua New Guinea has abundant natural resources – wood, minerals, oil, gas and fish. Exploitation through logging, mining and commercial fishing were common in the latter half of the 20th century and land ownership laws were altered in order to maximise capital gain from fossil fuels in particular.[139/140]

Since then, there has been a cultural shift to reassert local ownership of resources, in response to the effects of climate change. Sea level rise forced several villages to move further inland and corals underwent severe bleaching, resulting in declines in fish populations and scarce seafood.[141] In recognising the link between sustainable resource use and climate change, some islands in Papua New Guinea have returned to the traditional practice of Gwala; setting aside a reef or forest area to allow the ecosystem to recover.[142]

"The essential goal [of Gwala] is to set aside your space to rest. Although it is always done to let resources recover, it may be practised for several reasons; there might not be enough resources and they need to replenish so [communities] can eat, or it might be for cultural reasons: to celebrate an important event, or to honour someone who has passed away.

After Gwala was re-implemented, islanders noticed the improvement in the size of the reef and the availability of fish. With healthier reefs, fish come closer to the shore, making it easier for coastal communities to find food in bad weather.

A community in Wiyaloki Island set aside some of its maritime space through Gwala. They were famous for their clam garden [traditional intertidal rock structures used to farm clams]. When the most recent El Niño happened in the Western Pacific, it meant a lot of their neighbours were having serious food security issues, as they were not able to go out at sea or to get food from their gardens.

People from the Wiyaloki community were able to feed their neighbours by offering them clams. Because they had set clam gardens aside, they were replenished. As a result, Wiyaloki helped other communities start their own clam gardens by giving a couple of their clams. That could not have happened without Gwala."

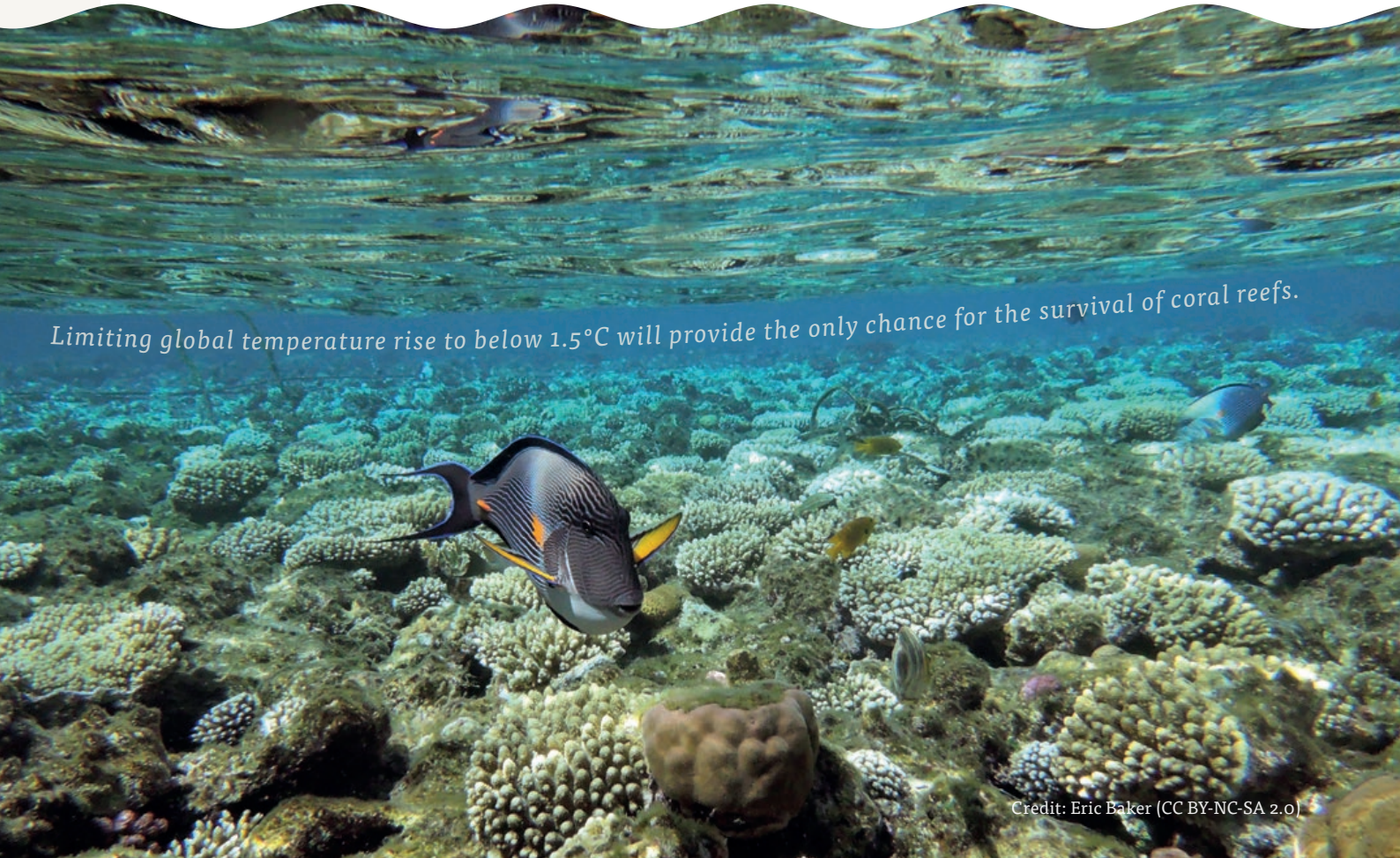
Niquole Esters, director of the Coral Triangle Initiative at Conservation International[143]

Following success in certain areas of Papua New Guinea, the practice of Gwala is spreading across the archipelago to an increasing number of islands.[144] If properly implemented, Gwala could be a solution to help preserve the 40,000 square kilometres of coral reefs spread throughout Papua New Guinea.[145]

CONCLUSION

Saving coral reefs and the vital protection, livelihoods and food security they provide to coastal communities means ending the climate crisis. Limiting global temperature rise to below 1.5°C will provide the only chance for the survival of coral reefs.

However, conservation efforts to end destructive fishing practices and pollution are also vital, since these are also very real threats to the world's reefs. Effective management and protection for wildlife will build resilience against the climate change that we will not be able to avert.



Limiting global temperature rise to below 1.5°C will provide the only chance for the survival of coral reefs.

EJF RECOMMENDATIONS

Saving coral reefs means ending the climate crisis, therefore:

- All countries must urgently and fully implement the global climate change agreement established in Paris in December 2015, raising their emission reduction pledges over time keeping the global temperature level below 1.5°C above pre-industrial levels.
- A full transition to zero carbon by all major industrialised economies is needed by 2030. That means reducing emissions across every part of every industry and ensuring a reliable supply of truly renewable energy. A clear set of policies is required to facilitate long-term investment and innovation in solar, wind, wave, and geo-thermal energy.
- The EU should initiate the creation of a high-profile, fully resourced, inter-agency taskforce to coordinate the work of the multiple bodies in the Commission, including (but not limited to) Environment, Climate Action, Migration and Humanitarian Affairs, International Cooperation and Development as well as the High Representative of the Union for Foreign Affairs and Security Policy, in order to drive a more effective, integrated approach towards wider international responses to climate change.
- The devastating implications for fundamental human rights and economic prosperity of our failure to roll-back global heating must be made central to national, regional and global economic policy and decision making – to help facilitate this, a UN special rapporteur on human rights, economic well-being and climate change should be immediately established, fully resourced and charged with developing recommendations for action, reporting by 2021.

To ensure that corals survive the climate change that is irreversible:

- Illegal and unsustainable fishing must be stopped. One key way states can achieve this is by increasing transparency in the industry by following EJF's Charter for Transparency.[146]
- Fishing practices that destroy reefs must be banned worldwide and such bans must be effectively enforced.
- Marine protected areas must offer true protection, with clear restrictions and effective conservation aims, such that they provide an effective and much-needed haven for corals, fish and other wildlife.
- Marine protected areas must be expanded so that they cover at least 30% of the oceans.
- Coral-harming pollution, from agricultural run-off to sewage and plastics, must be curbed. In many locations tackling such problems will have other positive effects for coastal communities, such as improved sanitation as a result of better sewage treatment.
- In all deliberations and future negotiations, all stakeholders must be included, with special reference to local communities.

Marine protected areas must be expanded so that they cover at least 30% of the oceans.

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