WWF

REPORT

INT

2015

THIS REPORT HAS BEEN PRODUCED IN COLLABORATION WITH:

ZSL
LET'S WORK FOR WILDLIFE

Living Blue Planet Report

Species, habitats and human well-being

WWF
WWF is one of the world's largest and most experienced independent conservation organizations, with over 5 million supporters and a global network active in more than 100 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

Zoological Society of London
Founded in 1826, the Zoological Society of London (ZSL) is an international scientific, conservation and educational organization. Its mission is to achieve and promote the worldwide conservation of animals and their habitats. ZSL runs ZSL London Zoo and ZSL Whipsnade Zoo; carries out scientific research in the Institute of Zoology; and is actively involved in field conservation worldwide. The ZSL manages the *Living Planet Index*® in a collaborative partnership with WWF.

WWF International
Avenue du Mont-Blanc
1196 Gland, Switzerland
www.panda.org

Institute of Zoology
Zoological Society of London
Regent's Park,London NW1 4RY, UK
www.zsl.org/indicators
www.livingplanetindex.org

Design by: millerdesign.co.uk
Cover photograph: © naturepl.com / David Fleetham / WWF

Living Planet Report
WWF's *Living Planet Report*, released every two years, is a leading science-based analysis on the health of our planet and the impact of human activity upon it. The *Living Planet Report 2014* detailed alarming declines in biodiversity, showing species populations falling by half between 1970 and 2010. It also showed that humanity, particularly in developed nations, continues to make unsustainable demands on nature.

This special edition takes a deeper look into these findings, and their implications, for the marine realm. Data on marine ecosystems and human impacts upon them is limited, reflecting the lack of attention the ocean has received to date. Nevertheless, the trends shown here present a compelling case for action to restore our ocean to health.

ISBN 978-2-940529-24-7

This report has been printed on FSC certified paper.
Printed at NCP SA and Cavin SA, Switzerland

CONTENTS

NEARLY 3 BILLION PEOPLE RELY ON FISH AS A MAJOR SOURCE OF PROTEIN. OVERALL, FISHERIES AND AQUACULTURE ASSURE THE LIVELIHOODS OF 10–12 PER CENT OF THE WORLD'S POPULATION. 60 PER CENT OF THE WORLD'S POPULATION LIVES WITHIN 100KM OF THE COAST. MARINE VERTEBRATE POPULATIONS DECLINED 49 PER CENT BETWEEN 1970 AND 2012. POPULATIONS OF FISH SPECIES UTILIZED BY HUMANS HAVE FALLEN BY HALF, WITH SOME OF THE MOST IMPORTANT SPECIES EXPERIENCING EVEN GREATER DECLINES. AROUND ONE IN FOUR SPECIES OF SHARKS, RAYS AND SKATES IS NOW THREATENED WITH EXTINCTION, DUE PRIMARILY TO OVERFISHING. TROPICAL REEFS HAVE LOST MORE THAN HALF THEIR REEF-BUILDING CORALS OVER THE LAST 30 YEARS. WORLDWIDE, NEARLY 20 PER CENT OF MANGROVE COVER WAS LOST BETWEEN 1980 AND 2005. 29 PER CENT OF MARINE FISHERIES ARE OVERFISHED. IF CURRENT RATES OF TEMPERATURE RISE CONTINUE, THE OCEAN WILL BECOME TOO WARM FOR CORAL REEFS BY 2050. SEABED MINING LICENCES COVER 1.2 MILLION SQUARE KILOMETRES OF OCEAN FLOOR. MORE THAN 5 TRILLION PLASTIC PIECES WEIGHING OVER 250,000 TONNES ARE IN THE SEA. OXYGEN-DEPLETED DEAD ZONES ARE GROWING AS A RESULT OF NUTRIENT RUN-OFF. THE OCEAN GENERATES ECONOMIC BENEFITS WORTH AT LEAST US$2.5 TRILLION PER YEAR. JUST 3.4 PER CENT OF THE OCEAN IS PROTECTED, AND ONLY PART OF THIS IS EFFECTIVELY MANAGED. INCREASING MARINE PROTECTED AREA COVERAGE TO 30 PER CENT COULD GENERATE UP TO US$920 BILLION BETWEEN 2015 AND 2050.

Marco Lambertini
Director General,
WWF International

OUR LIVING BLUE PLANET

Our ocean – that seemingly infinitely bountiful, ever awe-inspiring blue that defines our planet from space – is in crisis.

When I wrote the foreword to the 2014 edition of WWF's *Living Planet Report*, I said it was not for the faint-hearted. This edition – a deep dive into the health of marine species and the habitats on which they depend – is equally if not more sobering.

The marine Living Planet Index (LPI) presented here is roughly in line with the global LPI, which shows a 52 per cent decline in vertebrate populations since 1970. That alone should set off alarm bells. But it's what's hidden in the overall marine LPI that foretells an impending social and economic crisis.

When we look at the fish species most directly tied to human well-being – the fish that constitute up to 60 per cent of protein intake in coastal countries, supporting millions of small-scale fishers as well as a global multibillion-dollar industry – we see populations in a nosedive. The habitats they depend on, such as coral reefs, mangroves and seagrasses, are equally threatened.

The trends shown in this report present a compelling case for action to restore our ocean to health.

The picture is now clearer than ever: humanity is collectively mismanaging the ocean to the brink of collapse. Considering the ocean's vital role in our economies and its essential contribution to food security – particularly for poor, coastal communities – that's simply unacceptable. Could the economic implications of the collapse of the ocean's ecosystems trigger the next global recession or undermine the progress we have made on eradicating poverty?

Solutions exist: smart fishing practices that eliminate bycatch, waste and overfishing; getting rid of harmful subsidies and unregulated fishing; protecting key habitats and a large enough portion of the ocean to enable the regeneration of its living resources while conserving iconic species and inspirational places; cutting CO_2 emissions that threaten a potentially catastrophic acidification of the ocean. And the ocean has another great advantage: it is a dynamic, interconnected global ecosystem that can bounce back relatively quickly if the pressures are dealt with effectively.

WWF reports on the state of the planet's health every two years. But we decided we needed to amplify the warning siren for the ocean this year, because the situation is urgent and the moment to act is at hand. The global community has prioritized a healthy ocean in the post-2015 sustainable development agenda. These commitments must be backed by tangible investment in restoring and sustainably managing marine resources.

The pace of change in the ocean tells us there's no time to waste. These changes are happening in our lifetime. We can and we must correct course now.

CHAPTER ONE: THE STATE OF OUR BLUE PLANET

On Mali Island in Fiji, Alumita Camari expertly handles a freshly caught live (and aggressive) mud-crab from the mangroves. Mita, as she's commonly known, is considered the best mud-crab harvester in her village. A single mother, she relies on fishing to provide for herself and her daughter.

Life in Fiji has always been shaped by the ocean. The Pacific island nation is home to the Great Sea Reef, known locally as Cakaulevu. Over 200km in length, it's the world's third longest barrier reef system after Australia's Great Barrier Reef and the Mesoamerican Reef off the Caribbean coast of Central America.

The reef and associated ecosystems like mangroves are fundamental to the country's economy and people's way of life. They provide food, attract hundreds of thousands of tourists each year, and protect coastal areas from storms.

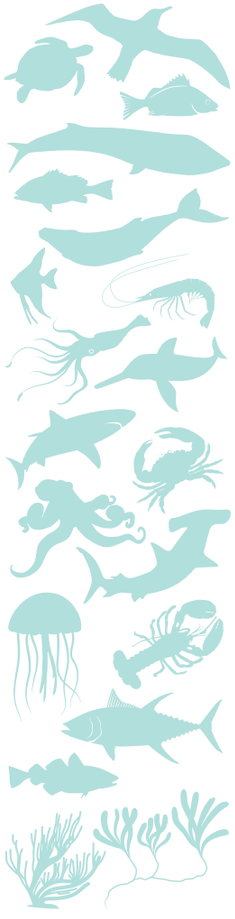
But coral reefs and other marine ecosystems are declining all over the world. Populations of marine species are falling, while habitats are being destroyed and degraded. The incredible marine biodiversity of our blue planet, and the diverse coastal cultures that have evolved upon it, face an uncertain future.

The marine Living Planet Index

The *Living Planet Report 2014* highlighted the alarming state of the natural world upon which our societies and economies depend. The Living Planet Index (LPI), which measures trends in 10,380 populations of 3,038 vertebrate species, declined 52 per cent between 1970 and 2010. In other words, population sizes of mammals, birds, reptiles, amphibians and fish fell by half on average in just 40 years. Humanity continues to make unsustainable demands on nature, threatening our long-term well-being and prosperity. As ecosystems decline, meeting the basic needs of a growing human population will become an even greater challenge.

The LPI for marine populations, compiled for this report, shows a decline of 49 per cent between 1970 and 2012 (Figure 1). This is based on trends in 5,829 populations of 1,234 mammal, bird, reptile and fish species. With many more species and locations included, the marine LPI in this report is almost twice as large as it was in the *Living Planet Report 2014*, giving an even clearer picture of ocean health — and the decline is even greater than previously described. The period from 1970 through to the mid-1980s experienced the steepest decline, after which there was some stability – but more recently, population numbers have been falling again. The global index masks considerable variation in different regions: numbers have been increasing (from previously depleted levels) in northern latitudes, but falling in tropical and subtropical regions.

This chapter dives deeper into this data. Because the marine environment has not been comprehensively monitored, there are gaps in the data for some regions. The Zoological Society of London (ZSL) has created indices for a number of ecosystems and species types where we have sufficient robust data available from published reports, journal articles and fisheries researchers.



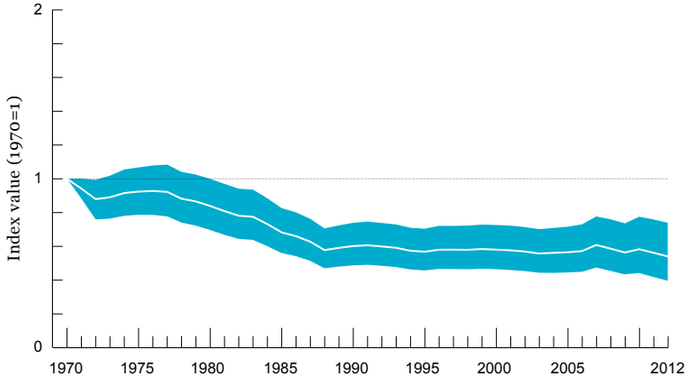


Figure 1: The global marine LPI shows a decline of 49 per cent between 1970 and 2012. *This is based on trends in 5,829 populations of 1,234 species (WWF-ZSL, 2015).*

Key

Marine Living Planet Index

Confidence limits

Fish

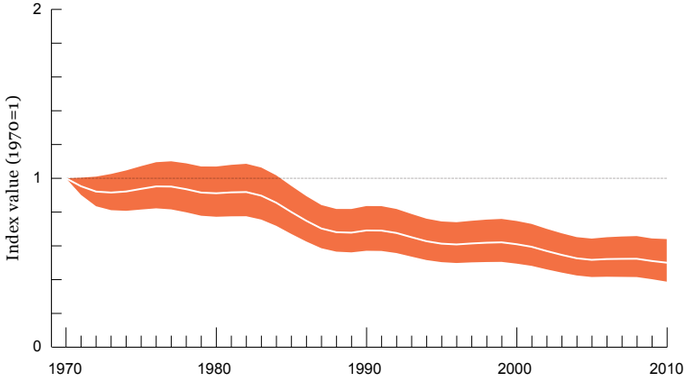
Of the marine fish in the LPI (930 species), 1,463 populations (492 species) are recorded as utilized, whether for local subsistence or commercial use. The index for all utilized fish species indicates a 50 per cent reduction in population numbers globally between 1970 and 2010 (Figure 2). Of the utilized fish populations, data sources for 459 contain information on threats. Exploitation is identified as the main threat in the vast majority of cases; other threats listed include habitat degradation/loss and climate change impacts.

Figure 2: The utilized fish index declined 50 per cent between 1970 and 2010 *(WWF-ZSL, 2015).*

Key

Utilized fish index

Confidence limits



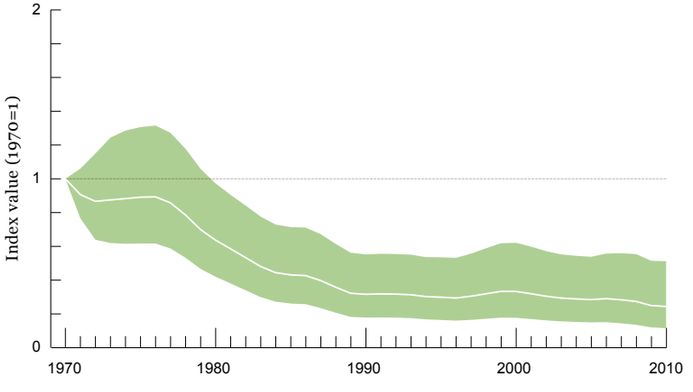
For fish species of importance for regional economies, livelihoods and food, the decline may be even more dramatic. This can be seen in the case of Scrombidae, the family of mackerels, tunas and bonitos. An index for Scrombidae, based on data from 58 populations of 17 species, shows a decline of 74 per cent between 1970 and 2010 (Figure 3). While the most rapid decline is between 1976 and 1990, there is currently no sign of overall recovery at a global level.

Figure 3: The index for Scrombidae (tuna, mackerel, bonito) declined 74 per cent between 1970 and 2010 *(WWF-ZSL, 2015).*

Key

Scrombidae index

Confidence limits



Other species

The decline observed in fish populations holds true for other marine species. As marine ecosystems are closely interconnected, these declines can affect marine food webs and alter ocean ecosystem functioning (McCauley et al., 2015). While the IUCN Red List shows a growing number of threatened marine species, only a small fraction of known marine species have been evaluated – and in many case there is insufficient data to conduct an adequate assessment (Figure 4). Further research and monitoring is urgently needed into fish species and marine invertebrates, in particular, to determine threat levels.

We have selected three species groups as indicators of the current level of stress on biodiversity and marine ecosystem health: sea cucumbers (one of the few invertebrate species groups to have been monitored in some detail); sharks and rays, which include many threatened species but also many data gaps; and marine turtles, where species' critically endangered status has helped spur conservation action.

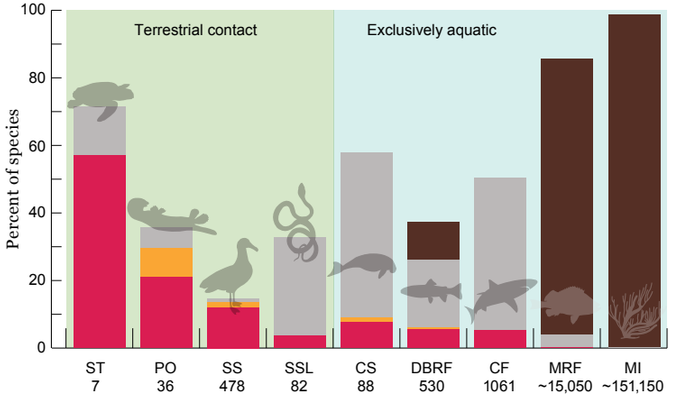


Figure 4: Threatened marine species, as chronicled by the IUCN Red List.
Threat categories include "extinct" (orange), "endangered" (red; IUCN categories "critically endangered" + "endangered"), "data deficient" (light grey), and "unreviewed" (brown). Groups that contact land during some portion of their life history (green) are distinguished from species that do not (light blue). The total number of species estimated in each group is listed below the graph (McCauley et al.,2015).

Key

- Unreviewed
- Data deficient
- Extinct
- Endangered

Species groupings
ST Sea turtles
PO Pinnipeds and marine mustelids
SS Seabirds and shorebirds
SSL sea snakes and marine lizards
CS Cetaceans and sirenians
DBRF Diadromous/ brackish ray-finned fishes
CF Cartilaginous fishes
MRF Exclusively marine ray-finned fishes
MI Marine invertebrates

Sea cucumbers

Sea cucumbers are distributed globally, and harvested and traded in more than 70 countries (Purcell et al., 2012). They play a vital role in the ecosystem, regulating water quality, turning over sediment, recycling nutrients, and as prey for commercial species such as crustaceans. They are also prized as a luxury food item, particularly in Asia. Globally, sea cucumber fisheries have expanded massively in the last 25 years (Figure 5). Many populations have been overfished, causing knock-on effects in the ecosystem. Some areas without sea cucumbers have become uninhabitable for other organisms; sea cucumbers turn over sand by feeding on organic matter mixed within it, and the nutrients they excrete can be taken up again by algae and corals (Mulcrone, 2005).

In the Galapagos, sea cucumber populations declined 98 per cent between 1993, when the first legal fishery opened, and 2004 (Shepherd et al., 2004). Similarly, populations fell 94 per cent between 1998 and 2001 in the Egyptian Red Sea due to over-exploitation (Lawrence et al., 2005). Despite the introduction of a fishing ban in 2003, populations decreased by another 45 per cent between 2002 and 2007 (Ahmed and Lawrence, 2007). Some commercial species are returning to their earlier overfished areas, but there is no evidence of stock recovery.

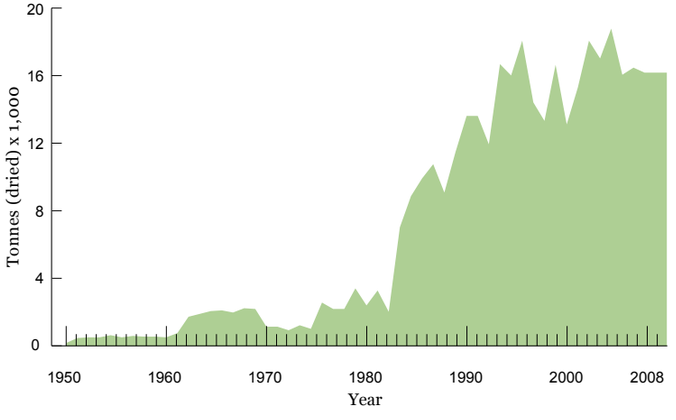


Figure 5: Global sea cucumber harvest, based on FAO data *(Purcell et al., 2013).*

Key

- Global sea cucumber harvest

Improved governance of sea cucumber fisheries is vital. Management measures need to take account of sea cucumber stocks, the ecosystems they are part of, and the socio-economic drivers of exploitation (Purcell et al., 2013).

Sharks and rays

Sharks and rays are fished across the open ocean and the coastlines of the world, as the main target or as secondary catch or bycatch (Dulvy et al., 2014). Globally, catches of sharks, rays and related species such as skates rose more than threefold from the 1950s to a high in 2003 and have been falling since (Dulvy et al., 2014). This decrease is not so much a result of improved management, but of the decline in populations (Davidson et al., 2015). As most catches of sharks and rays are unregulated, total catch could be three to four times greater than reported (Clarke et al., 2006; Worm et al., 2013).

Around one in four species of sharks, rays and skates is now threatened with extinction, due primarily to overfishing (Dulvy et al., 2014). Sharks and their relatives include some of the latest maturing and slowest reproducing of all vertebrates (Cortés, 2000): these species are especially vulnerable to overexploitation.

Many shark species are apex predators; others are filter feeders or carnivores of a lower trophic level. While the effects of falling shark numbers are still being studied, there is widespread concern about the damage to ecosystem health. Research has shown that the loss of apex predators nearly always results in further marine ecosystem degradation (Estes et al., 2011).

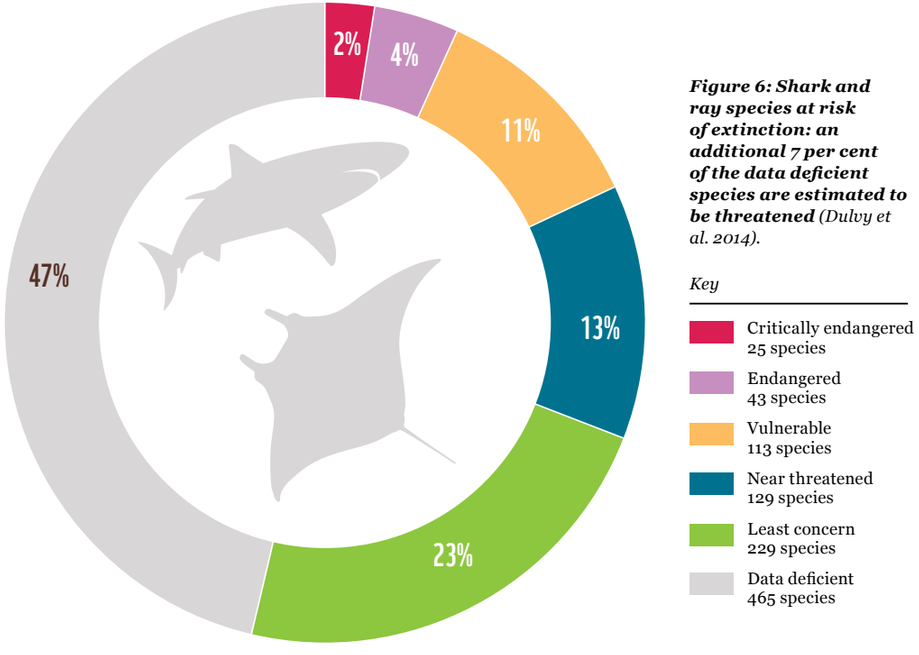


Figure 6: Shark and ray species at risk of extinction: an additional 7 per cent of the data deficient species are estimated to be threatened *(Dulvy et al. 2014).*

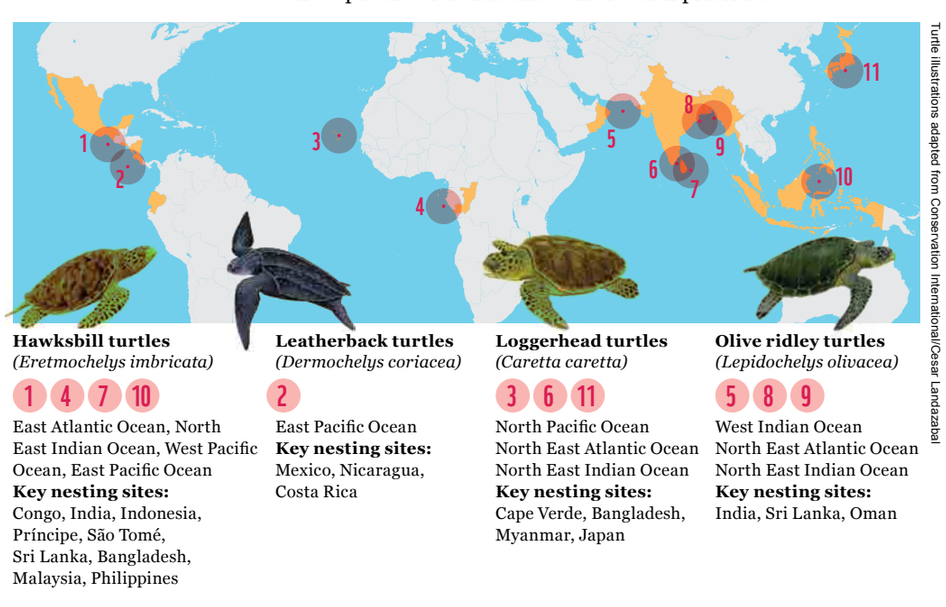
Marine turtles

Marine turtles are spread throughout virtually all tropical and sub-tropical waters. They often migrate thousands of kilometres from feeding grounds to nesting sites, and occupy differing habitats as hatchlings, juveniles and adults. They also face varying pressures from human consumption, bycatch in fisheries, climate change, marine debris, loss of nesting beaches and myriad other hazards.

This makes assessing the status of marine turtles challenging. Currently, the IUCN Red List classifies four turtle species as endangered or critically endangered – hawksbill, Kemp's ridley, green and loggerhead — while olive ridley and leatherback are vulnerable, and flatbacks are data deficient. However, this global viewpoint masks significant regional disparities. The IUCN Marine Turtle Specialist Group (MTSG) has recently developed a new approach, which focuses on regional management units (RMUs) (Wallace et al., 2010).

In 2013, the status of leatherback turtles was reassessed using this system. Of the seven subpopulations or RMUs, four were assessed as critically endangered, including those in the Eastern Pacific that have declined by 97 per cent in the past three generations, and two as data deficient; however, the North West Atlantic population is now rated least concern after decades of conservation efforts. These regional statistics provide a far more realistic view of the status of leatherbacks than a single global listing. Other species are now being reassessed on a regional basis, which will give a more accurate picture of trends and conservation priorities.

Figure 7: The 11 most endangered subpopulations identified by the MTSG, overlaying threats and known trends for each RMU.



Turtle illustrations adapted from Conservation International/Cesar Landazabal

Habitats

While human exploitation is identified as the major cause of the declines in marine species, habitat loss and degradation are also major threats. The following section looks at trends in three key marine ecosystems: coral reefs, seagrass and mangroves. It also looks at the status of deep-sea habitats in the North Atlantic and polar ecosystems in the Antarctic.

Coral reefs

Coral reefs provide some of the most biologically rich, productive and economically valuable ecosystems on Earth. Over 25 per cent of all marine species live in coral reefs, and yet they cover less than 0.1 per cent of the ocean, about half the area of France (Spalding et al., 2001).

Globally, around 850 million people live within 100km of a coral reef and directly benefit from the economic, social and cultural services it provides (Burke et al., 2011). Reefs support many economically important fish species, providing food for hundreds of millions of people. They also protect the coast from storms and erosion, and generate jobs and income from fishing, tourism and recreation.

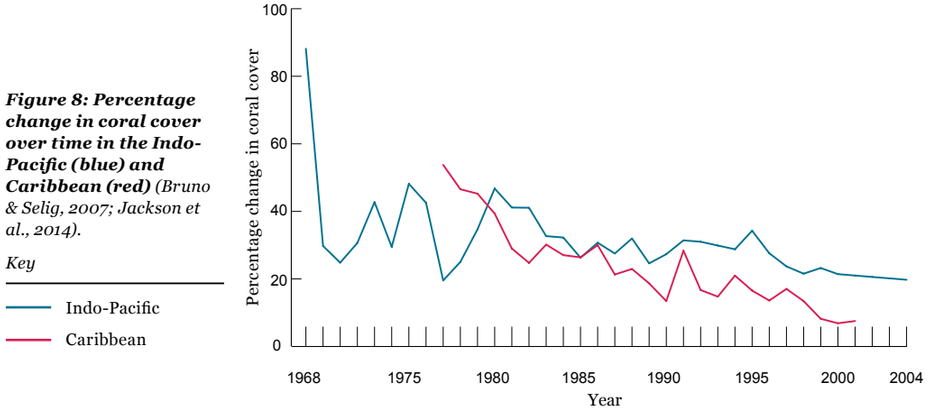
Three-quarters of the world's coral reefs are currently threatened (Burke et al., 2011). Pressures include increased fishing, poor water quality from coastal agriculture, deforestation, coastal development and shipping, as well as rising ocean temperatures and acidity brought on by global warming. At current projected levels of warming and acidification, coral reefs could be lost altogether by 2050 (Hoegh-Guldberg et al., 2015).

Recent studies indicate that tropical reefs have lost more than half their reef-building corals over the last 30 years (Hoegh-Guldberg et al., 2015). Figure 8 shows an overall large decline in coral cover in the Indo-Pacific and the Caribbean since the 1970s. This degradation threatens both the reefs and the communities and economies they sustain.

>25%

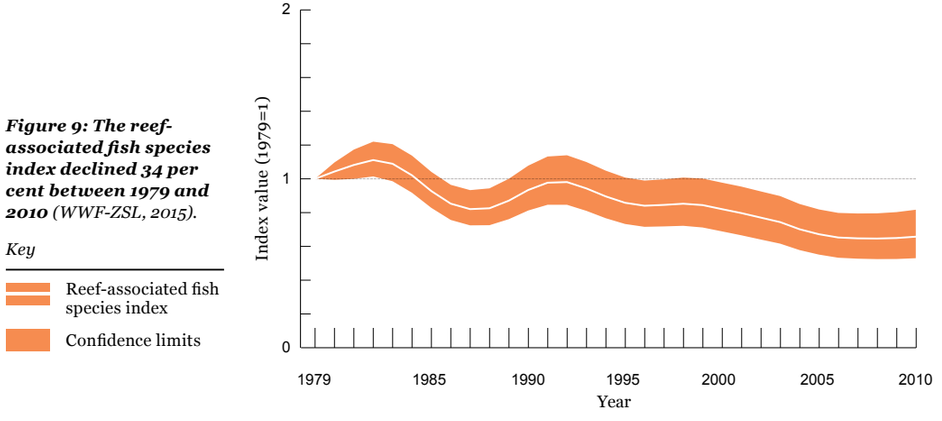
Over 25 per cent of all marine species live in coral reefs, yet they cover an area about half the size of France

Figure 8: Percentage change in coral cover over time in the Indo-Pacific (blue) and Caribbean (red) *(Bruno & Selig, 2007; Jackson et al., 2014).*



Of the 930 fish species in the LPI database, 352 are classified as "reef associated" (living and feeding on or near coral reefs), comprising 2,501 populations. The index for reef-associated fish species declined 34 per cent between 1979 and 2010 (Figure 9). Many reef-associated fish such as the various species of groupers are important food sources both commercially and for local subsistence. While overexploitation was listed as the primary threat to the majority of populations, habitat degradation and loss, climate change and invasive species were also identified as significant threats.

Figure 9: The reef-associated fish species index declined 34 per cent between 1979 and 2010 *(WWF-ZSL, 2015).*



Seagrass

Seagrass meadows provide a range of ecosystem services, from catching sediment and stabilizing the seabed (Gillis et al., 2014) to providing grazing for dugongs, manatees and green turtles, and critical habitat for commercially important fish species (Orth et al., 2006). They also store vast amounts of carbon: Fourqurean et al. (2012) estimate that seagrass meadows store 83,000 tonnes of carbon per square kilometre, more than twice as much as a typical terrestrial forest.

Seagrass coverage worldwide has declined by about 30 per cent over the last century. Waycott et al. (2009) carried out a global assessment of 215 studies to determine the status of seagrass habitats. A total of 1,128 observations from around the world between 1879 and 2006 were included in their assessment, which indicated a mean decline in seagrass area of 1.5 per cent per year, adding up to a total of 3,370km² lost in 127 years on those sites (Figure 10).

Extrapolating these figures to a global scale suggests that more than 51,000km² of seagrass meadows have been lost since 1879, a total of 29 per cent of seagrass area. The current global estimate of seagrass coverage is 177,000km² (Waycott et al., 2009).

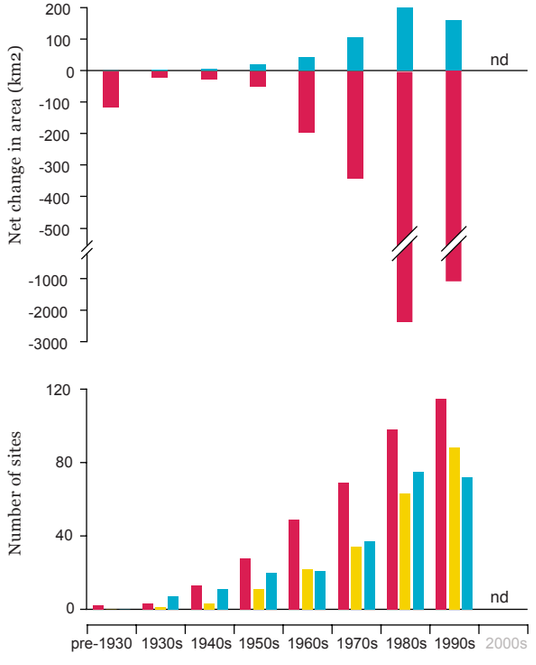


Figure 10: Net area of seagrass gain and loss per decade in study sites *(Waycott et al., 2009).*

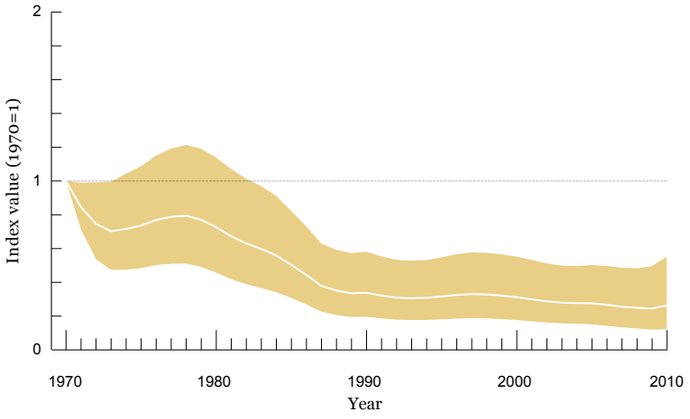
Key

- Decreasing
- No detectable change
- Increasing

Figure 11: The index for fish in seagrass habitats shows a decline of over 70 per cent between 1970 and 2010 *(WWF-ZSL, 2015).*

Key

- Seagrass-associated fish index
- Confidence limits



ZSL calculated an index for fish populations found in seagrass habitats, based on data on 350 populations of 232 species. This shows a dramatic decline of over 70 per cent between 1970 and 2010 (Figure 11). LPI data sources identify exploitation as the main threat to populations in seagrass habitats, followed by habitat degradation/change; the threat of pollution appears to be higher within seagrass habitats than in the indices for fish and coral reefs discussed above (WWF-ZSL, 2015).

Mangroves

Mangroves are known to exist in 123 countries, though just five (Indonesia, Australia, Brazil, Nigeria and Mexico) account for almost half (45.7 per cent) of the total global mangrove area (Spalding et al., 2010). They provide spawning grounds, nurseries, nutrients and shelter for many species, including fish, reptiles, amphibians, mammals and birds (Nagelkerken et al. 2008). They also provide a variety of benefits to human populations, including provisioning services (firewood, timber, fisheries, other forest products), regulating services (coastal protection, carbon sequestration, buffering seagrass beds from terrestrial sediment/nutrient loads), and cultural services (recreation, ecotourism, spiritual) (UNEP, 2014).

Worldwide, nearly 20 per cent of mangrove cover was lost between 1980 (18,794,000 hectares) and 2005 (15,231,000 hectares), equal to nearly 3.6 million hectares (Figure 12). The primary cause of this loss was the conversion of mangrove areas to different uses such as aquaculture, agriculture, infrastructure and tourism, as a result of increasingly high human population pressure in coastal areas (FAO, 2007).

Between 1980 and 1990, the global annual rate of net mangrove loss was 1.04 per cent. This fell to 0.66 per cent between 2000 and 2005 (FAO, 2007). Many governments are increasingly recognizing the importance of mangroves, which has resulted in better protection, management and restoration. Legal protection, natural regeneration and planting programmes have enabled places such as Cuba, Puerto Rico and the Sundarbans Reserved Forest of Bangladesh to increase their mangrove cover (FAO, 2007).

The importance of mangroves to fish populations is undoubted: numerous species rely on them as nurseries, for example. However, there is not enough data to develop an index for mangrove-associated species. More research is needed to understand the relation between these populations and the condition of the mangroves.

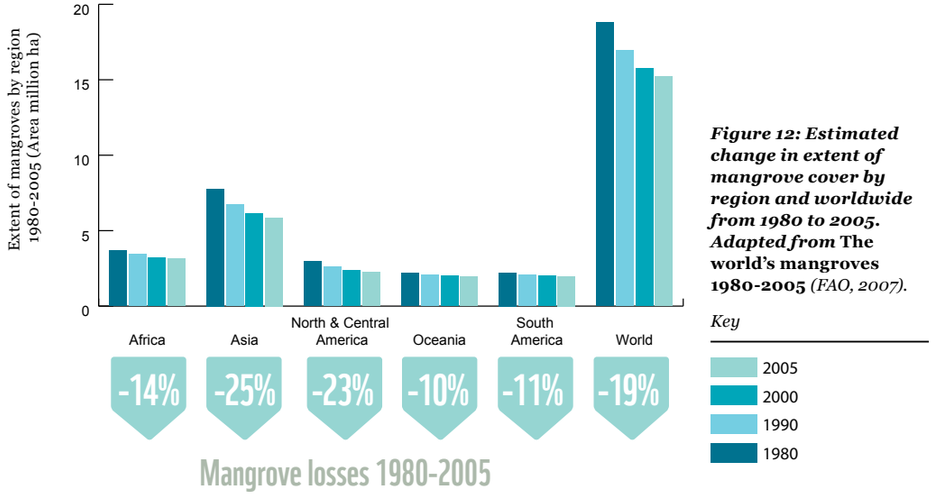
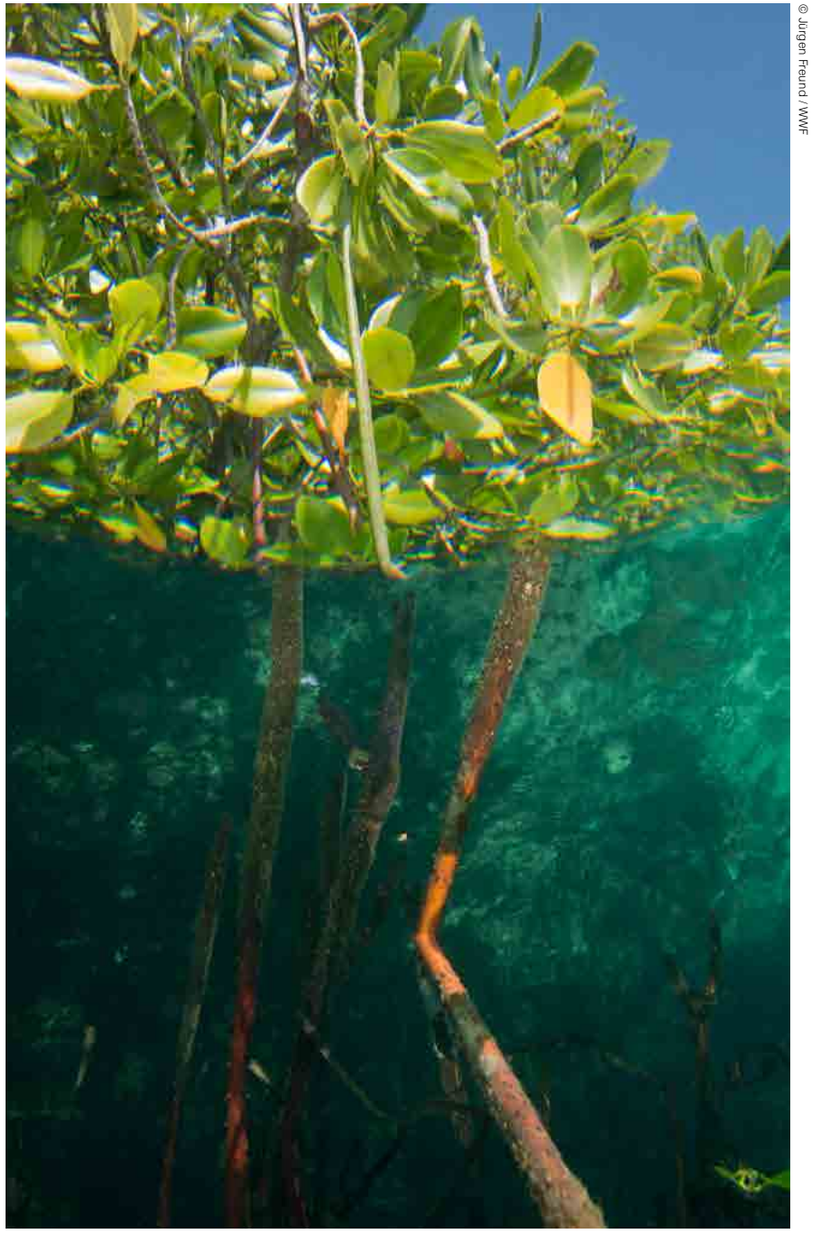


***Figure 12: Estimated change in extent of mangrove cover by region and worldwide from 1980 to 2005. Adapted from* The world's mangroves 1980-2005** *(FAO, 2007).*



© Jürgen Freund / WWF

Mangroves provide spawning grounds and nurseries for fish, protect coastlines and store carbon — but a fifth of global mangrove area was lost between 1980 and 2005.

Deep-sea habitats: North Atlantic Ocean

Important marine ecosystems are not confined to the tropics. Deep-sea habitats such as seamounts, deep-water corals and polar habitats are also an integral part of our ocean system. Data for these habitats is limited, but there is evidence that they are facing enormous pressure and change.

The North Atlantic Ocean is one of the world's richest marine areas. Whales and turtles travel through its waters, and seals and seabirds as well as many commercially important fish find shelter, nursery and feeding grounds in the region. The North Atlantic also hosts diverse and productive habitats, such as cold-water coral reefs and hydrothermal vents. Due to its wealth of habitats and resources, the North Atlantic makes a crucial contribution to the economy and social well-being of many coastal communities and countries in western Europe.

The index for deep-sea fish populations for the North Atlantic (Figure 13) is based on 77 populations of 25 species, and indicates a 72 per cent decline over the last 40 years. In the last two decades the index is more or less stable, but not showing signs of recovery.

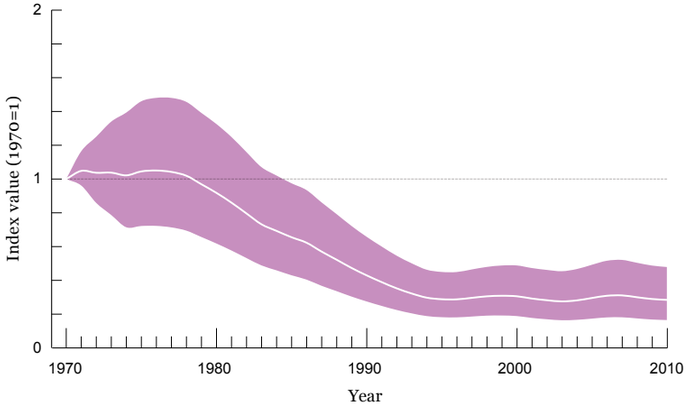


Figure 13: The deep-sea fish index for the North Atlantic shows an overall downward trend *(WWF-ZSL, 2015).*

Key

- Deep-sea fish index
- Confidence limits

The North Atlantic contains a number of vulnerable marine ecosystems – groups of species, communities or habitats that, based on the physical and biological features they possess, are deemed vulnerable to impacts from fishing activities, particularly practices such as bottom trawling (FAO, 2009). The use of bottom-touching gear and overfishing of target stocks in these vulnerable areas damages the marine resources and ecosystems.

Polar habitats: Southern Ocean

Despite its remoteness, the rich marine life of the Southern Ocean has experienced some of the sharpest recorded declines in fish populations (WWF, 2014). Limited data means it is not possible to develop a reliable overall index for the Southern Ocean. However, a massive decrease in population numbers of some commercially targeted fish species can be observed in the late 1970s, following increased fisheries activity in the region (Figure 14) (CCAMLR, 2013b). Illegal, unregulated or unreported (IUU) fishing is a particular concern in the Southern Ocean (Osterblom and Bodin, 2012; CCAMLR, 2013a).

Unsustainable levels of fishing have been largely curtailed since the establishment of the international Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) in 1982 (Figure 16). The Ross Sea toothfish, for example, is now managed to a target of 50 per cent of the original stock biomass (Figure 15). This is a conservative limit that enables productive commercial exploitation while minimzing the risk of stocks becoming depleted. CCAMLR has adopted an ecosystem-based management system, and has also substantially reduced levels of IUU fishing and seabird bycatch.

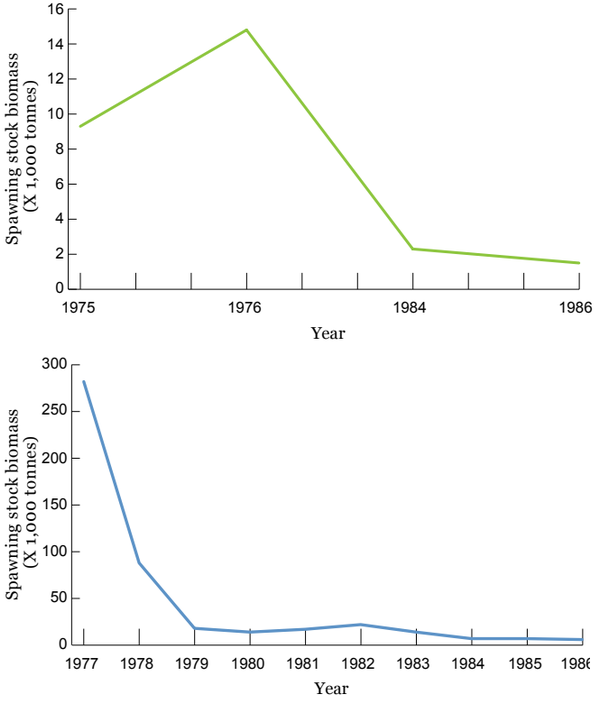


Figure 14: Population trends in two commercial fish species from the Southern Ocean – marbled rock cod and mackerel ice fish – show sharp declines in the 1970s *(CCAMLR, 2013b; Duhamel et al., 2011).*

Key

- Marbled rock cod (South Orkney Islands)
- Mackerel icefish (South Orkney Islands)

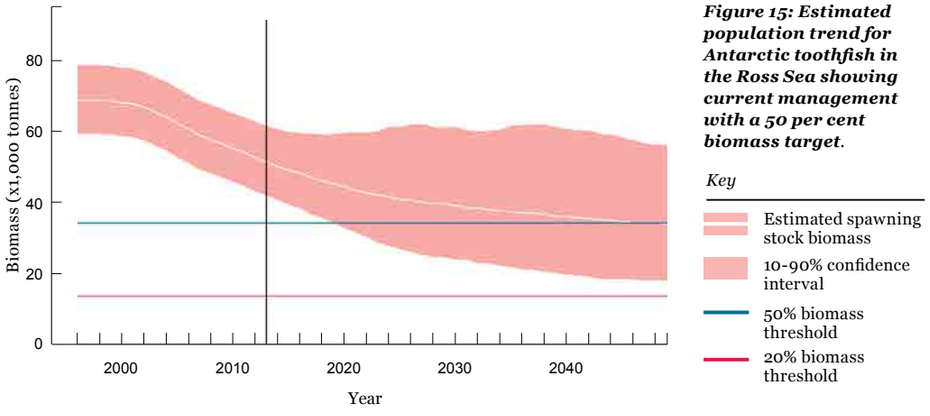


Figure 15: Estimated population trend for Antarctic toothfish in the Ross Sea showing current management with a 50 per cent biomass target.

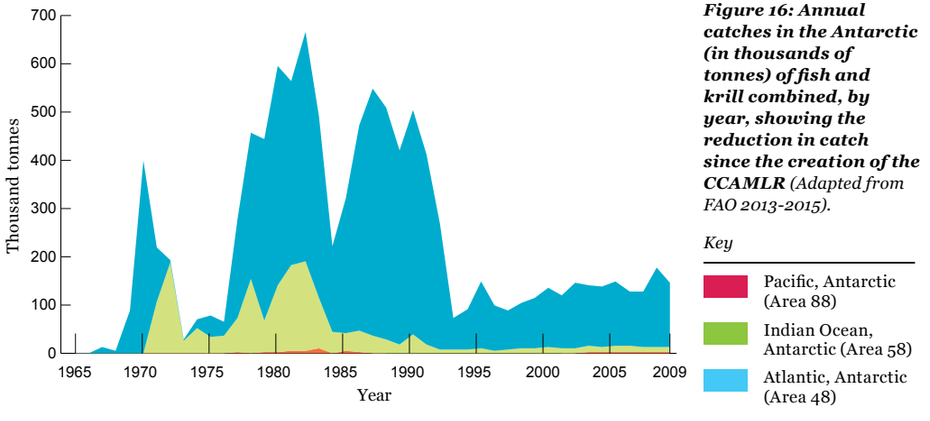


Figure 16: Annual catches in the Antarctic (in thousands of tonnes) of fish and krill combined, by year, showing the reduction in catch since the creation of the CCAMLR *(Adapted from FAO 2013-2015).*

Antarctic krill

Antarctic krill (*Euphausia superba*) is central to the food chain in the Southern Ocean. Many types of species including whales, penguins and fish are reliant on krill as a food source. The abundance of krill is heavily influenced by environmental conditions, such as the availability of phytoplankton in the summer and the extent of sea ice in winter (CCAMLR, 2015). Although estimates are subject to large uncertainties, the density of krill appears to have declined in the 1980s in the Southwest Atlantic Ocean, where most of the fishing now occurs (Figure 17).

This is the part of the Southern Ocean that has warmed most in recent years (Gille, 2002). The Antarctic Peninsula is one of the fastest warming areas on the planet (Turner et al., 2009).

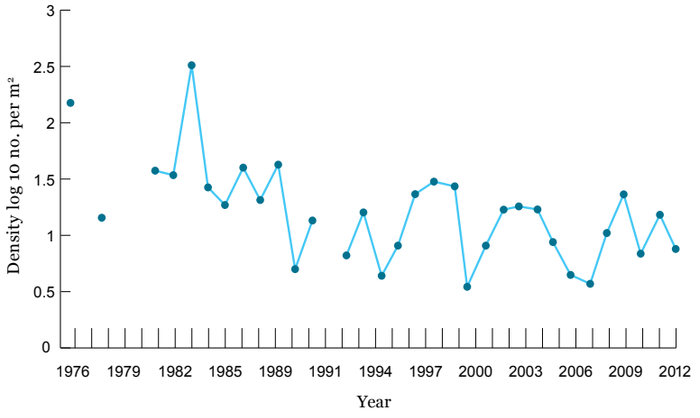


Figure 17: Antarctic krill postlarval abundance (number per m²) within 10°E to 90°W *(Atkinson et al., 2014).*

The associated decline in winter sea ice extent is thought to be a factor in krill decline. Over coming years, ocean acidification and warming waters will have an impact on these species (Kawaguchi et al., 2013; Hill et al., 2013). There is concern about the impact that declines in krill will have on the food web of the Southern Ocean.

Krill is targeted by industrial fishing boats, and processed into feed for aquaculture and livestock or omega-3 food supplements. The total reported krill catch in 2013/14 was around 294,000 tonnes, the highest reported catch since 1991. Interest in krill fishing continues to rise.

CCAMLR regulates the fishery within an interim trigger level of 620,000 tonnes, around 1 per cent of the krill biomass in the fished area.

Climate change and krill

Krill are vulnerable to impacts associated with climate change:

- Sea ice provides shelter for Antarctic krill during the winter. The ice also acts as habitat for algae, which the krill feed on (ACE, 2009).
- Krill are a coldwater species and grow fastest in cold water — any warming can slow down or stop growth (Hill et al., 2013).
- Increased global CO_2 levels in the atmosphere have increased the amount of CO_2 absorbed by the ocean, resulting in seawater that is more acidic. This is a major threat to krill because it can damage their exoskeleton and may cause substantial declines in Southern Ocean krill populations over the next 100 years (Kawaguchi et al., 2013).

CHAPTER TWO: OUR OCEAN UNDER PRESSURE

On Robben Island in South Africa's Western Cape, a jackass penguin covered with oil from a tanker spill cuts a lonely figure. Oil spills can be devastating to seabirds and other marine life – and as offshore oil extraction and shipping expand, the risk is likely to increase.

From oil and industrial shipping to fishing and pollution, coastal development to climate change, human activities are having a huge impact on the marine environment.

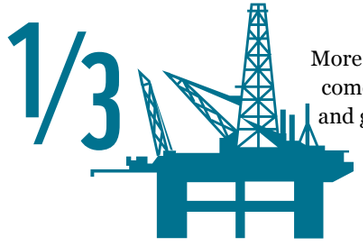
Our ocean under pressure

For centuries, people have regarded the ocean as an inexhaustible source of food and a convenient dumping ground, too vast to be affected by anything we do. But in the space of just a few decades, it has become increasingly clear that the ocean has limits and that in many important parts of our seas the sustainability thresholds have been well and truly breached. The data presented in Chapter 1 gives us a snapshot of an ocean in trouble: populations of marine species have fallen dramatically and vast areas of vital habitats have been degraded and destroyed, with implications that we are only just beginning to comprehend.

Driving all these trends are human actions: from overfishing and extractive industries, to coastal development and pollution, to the greenhouse-gas emissions causing ocean acidification and sea temperature rise. While these pressures are described separately over the following pages, they also have a cumulative impact: for example, an ecosystem degraded by pollution and fragmented by development is likely to be slower to recover from the effects of overfishing and less resilient to the impacts of climate change.

Average per capita fish consumption globally increased from 9.9kg in the 1960s to 19.2kg in 2012 (FAO 2014b).

29% of global fish stocks are over exploited (FAO 2014).



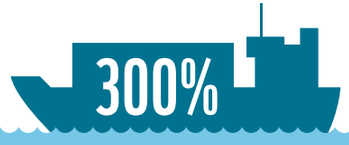
1/3

More than a third of oil and gas comes from offshore sources, and growing demand is fuelling interest in deep-sea deposits (Maribus, 2014).

80% of all tourism is based near the sea (Honey and Krantz, 2007).

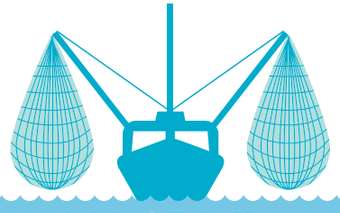
+2 billion

The global population is expected to grow by another 2 billion to reach 9.6 billion people by 2050 – with a concentration in coastal urban areas (FAO 2014a).



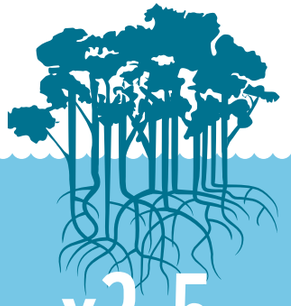
300%

Ship traffic has quadrupled over the past two decades, with the largest growth in the Indian Ocean and the Western Pacific Seas (Tournadre, 2014).



US$14-35 billion

Subsidies that encourage overfishing, mostly in developed countries, are worth an estimated US$14-35 billion – even though the global fishing fleet is 2-3 times larger than the ocean can sustainably support (Sumaila et al., 2010, 2013; Nellemann et al., 2008).



x3-5

Deforestation of the planet's mangroves is exceeding average global forest loss by a rate of three to five times (UNEP, 2014).

A moderate-sized cruise ship on a one week voyage generates

795,000 litres of sewage

3.8 million litres of grey water

500 litres of hazardous waste

95,000 litres of oily bilge water

8 tonnes of garbage

based on 2,200 passengers and 800 crew (Copeland, 2008).

50% DESTROYED

Half the world's corals and a third of all seagrasses have been lost (Hoegh-Guldberg et al., 2015).

3-5°C ocean warming by 2100

At current rates of temperature rise, coral reefs will disappear by 2050 (Hoegh-Guldberg et al., 2007; IPCC, 2013).

8 million tonnes of plastic waste is dumped in the ocean each year – or

15 large garbage bags for every metre of coastline. That number is set to double by 2025 (Jambeck et al., 2015).

Overfishing

"The cod fishery, the herring fishery, the pilchard fishery, the mackerel fishery, and probably all the great sea fisheries, are inexhaustible," declared Thomas Henry Huxley at a fisheries exhibition in London in 1883. *"That is to say, that nothing we do seriously affects the number of the fish."*

He could not have been more wrong. Today, the world's fish stocks are under considerable pressure, with 29 per cent classified as overfished and a further 61 per cent as fully exploited, with no ability to produce greater harvests (FAO 2014b). This is a big problem for future global food security. Overfishing not only affects the balance and interaction of life in the ocean, but also the social and economic well-being of the coastal communities that depend on fish for their way of life.

A growing world demand for fish, overcapacity – partly driven by fishing subsidies estimated at up to US$35 billion per year, equivalent to around a fifth of the industry's overall revenue (Sumaila et al., 2013) – and the lack of new or alternative opportunities are all contributing to a "race to fish". This is depleting many coastal fisheries and causing fishing fleets to look further and fish deeper into international waters. New species and areas are being targeted as traditional stocks become exhausted. Figure 19 shows the huge expansion in heavily fished areas: only the deepest and most inaccessible parts of the ocean are yet to feel pressure from fisheries.

More fish are being caught at greater depths than ever before (Figure 18). Around 40 per cent of the world's fishing grounds are now in waters deeper than 200m and many deep-water species are likely to be overexploited (Roberts, 2002). Only a few decades ago it was virtually impossible to fish deeper than 500m: now, with technological improvements in vessels, gear and fish-finding equipment, bottom trawling is occurring at depths of up to 2,000m (UNEP, 2006, Ramirez-Llodra et al., 2011). Most deep-sea fisheries considered unsustainable (Norse et al., 2012) have started to target fish populations that are low in productivity, with long lifespans, slow growth and late maturity (Morato et al., 2006). This leads to rapid declines in the population (Devine et al., 2006) and even slower recovery once the stock has collapsed (Baker et al., 2009).

As a result of this growing pressure, the number of fish stocks that are overfished and fully fished has increased, while less than 10 per cent of fisheries have any capacity for expansion (Figure 20). Yet this huge increase in fishing effort does not mean we are catching more fish: the total weight of fish landed in marine capture fisheries in 2012 was 79.7 million tonnes, compared to 80.7 million tonnes

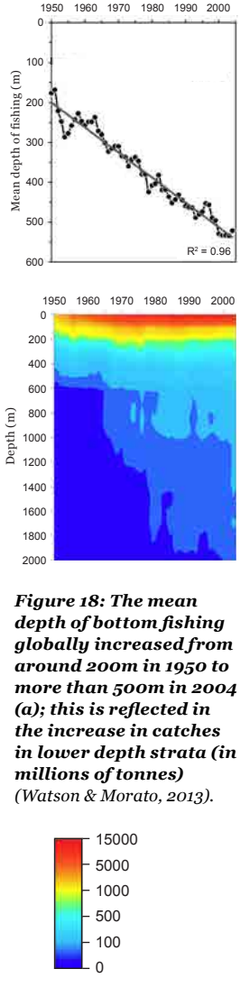
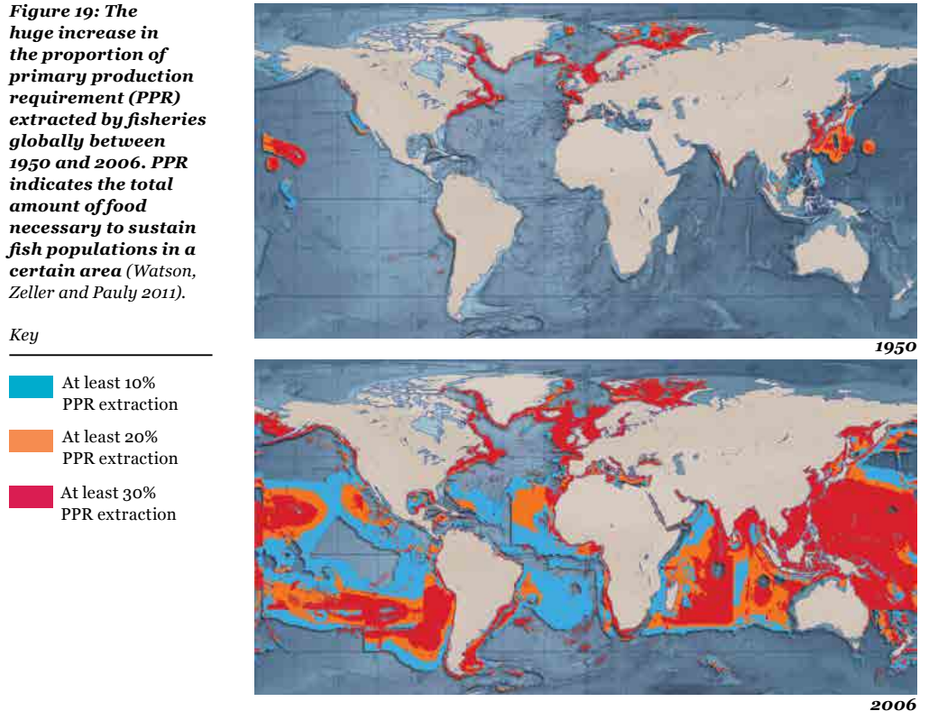


Figure 18: The mean depth of bottom fishing globally increased from around 200m in 1950 to more than 500m in 2004 (a); this is reflected in the increase in catches in lower depth strata (in millions of tonnes) *(Watson & Morato, 2013).*

Figure 19: The huge increase in the proportion of primary production requirement (PPR) extracted by fisheries globally between 1950 and 2006. PPR indicates the total amount of food necessary to sustain fish populations in a certain area *(Watson, Zeller and Pauly 2011).*



in 2007 (FAO, 2014b). For some species, the increased fishing pressure has had an adverse effect, as seen in the overall decline in the utilized fish species index presented in Chapter 1, and the even steeper 74 per cent decline in the Scrombridae group.

Small-scale fisheries are not immune to overcapacity, overfishing or destructive fishing practices. In some cases, the activities of the small-scale fleets themselves have been a root cause of depletion and environmental degradation. In many other cases, the difficulties faced by small-scale fleets have been compounded (or even initially caused) by the arrival of industrial-scale fleets in their traditional waters. These factors are not exclusive to small-scale fisheries. In many developing countries, fisheries continue to have open access with no effective controls on the quantities of fish harvested or the techniques used. Lack of political will, data deficiencies and inadequate financial and human resources are often blamed for weak governance and management (CSR, 2006; FAO and OECD, 2015).

The fisheries sector is often a buffer for populations marginalized by conflicts, climate events, poverty or unemployment

which makes it politically difficult to restrain access to resources, placing vulnerable populations in even more precarious situations.

At a global scale, IUU fishing has escalated over the last two decades. IUU fishing is estimated to take 11-26 million tonnes of fish each year, adding to the pressures on stocks (Agnew et al., 2009). This represents 12-28.5 per cent of global capture fisheries production (FAO 2014b).

Overfishing is also closely tied to bycatch, which causes the needless loss of billions of fish, along with marine turtles, whales and dolphins, seabirds and other species. Global bycatch levels (excluding IUU fishing) are estimated at 7.3 million tonnes (Kelleher, 2005).

While overfishing is a global problem, it is by no means uniform and there is evidence that effective management can successfully rebuild stocks. However, addressing the drivers of overfishing throughout the vast majority of coastal waters and the high seas remains an urgent challenge.

Newfoundland, in Canada, provides a sobering example of what happens to communities when populations are fished to commercial extinction. For centuries, the cod stocks of the Grand Banks seemed inexhaustible. In the early 1990s, the fishing and fish-processing industry employed 110,000 people. But in 1992 the cod fishery collapsed and 40,000 people lost their jobs, including 10,000 fishermen. Today the cod stock, although showing signs of recovery, remains well below pre-collapse levels.

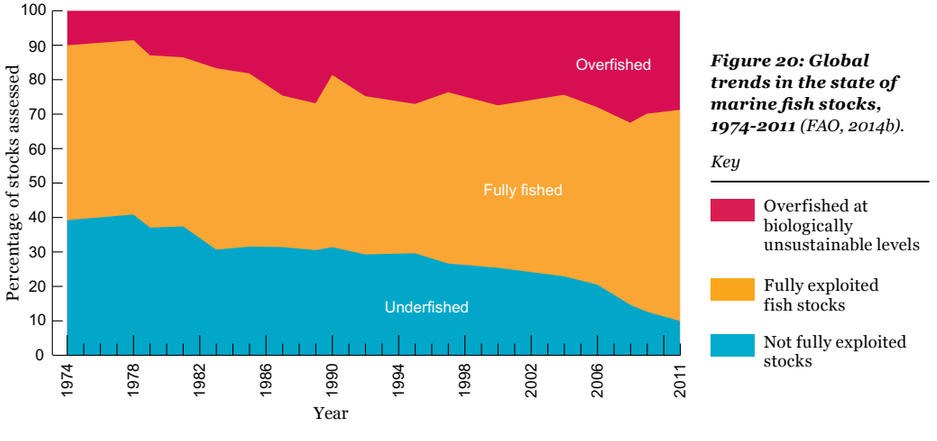


Figure 20: Global trends in the state of marine fish stocks, 1974-2011 *(FAO, 2014b).*

Key

- Overfished at biologically unsustainable levels
- Fully exploited fish stocks
- Not fully exploited stocks

Aquaculture

"With the world's population predicted to increase to 9 billion people by 2050 – particularly in areas that have high rates of food insecurity – aquaculture, if responsibly developed and practised, can make a significant contribution to global food security and economic growth."
Árni M. Mathiesen, Assistant Director-General of FAO Fisheries and Aquaculture Department

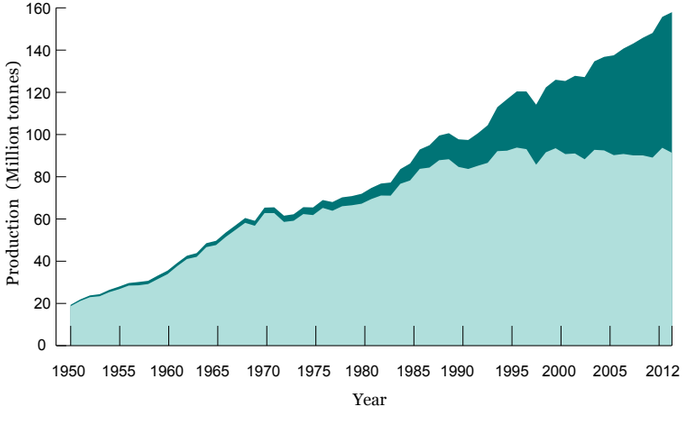
Over the past three decades, global aquaculture has grown on average at 8.6 per cent each year. Fish farming has enabled seafood consumption to continue to increase even as marine fisheries production has flat-lined. It now supplies 58 per cent of the fish we eat, has kept the overall price of fish down, and made protein and improved nutrition more accessible to communities around the world. Around 90 per cent of the world's 18.9 million fish farmers are small-scale producers from developing countries (FAO, 2014a; FAO, 2014b).

But farming fish is not always a sustainable alternative. In many countries, aquaculture production has depleted key ecosystems like mangroves, polluted aquatic environments and potentially reduced climate change resilience for coastal communities. Poor management, a lack of capacity and access to technical knowledge, or irresponsible practices have also led to large-scale disease outbreaks, such as early mortality syndrome for shrimp in Asia (FAO, 2013).

Figure 21: The continued increase in seafood production in the last 30 years is almost entirely due to aquaculture *(FAO, 2014b).*

Key

- Aquaculture production
- Capture production



© Adam Oswell / WWF-Greater Mekong

Prawn farms in Vietnam

Aquaculture, and in particular shrimp farming, is a key economic sector in Vietnam. It creates many jobs and generates substantial income for the country. But shrimp farming is coming at a cost to the environment. Both small-scale and large-scale shrimp farms have destroyed mangrove forests, polluted groundwater and coastal estuaries, and increased salination on agricultural land. Intensive farming methods have also introduced pathogens, leading to major shrimp disease outbreaks that result in significant economic losses.

One way to reduce these negative impacts is through certification schemes, such as the Aquaculture Stewardship Council (ASC). Businesses that join the ASC commit to a better way of producing farmed seafood with less impact on the environment, stronger protection of biodiversity and water resources, higher standards of animal health and better working conditions. Through ASC certification, shrimp farms aim to measurably reduce adverse impacts on the environment and communities by preserving wetlands and mangroves, addressing the transfer of viruses and disease, improving water quality, feeding responsibly and addressing biodiversity issues.

WWF is helping small-scale shrimp farmers in Vietnam to implement better management practices that reduce negative environmental impacts and will help them achieve ASC certification.

Tourism

9.8%

Global GDP generated by tourism and related activities

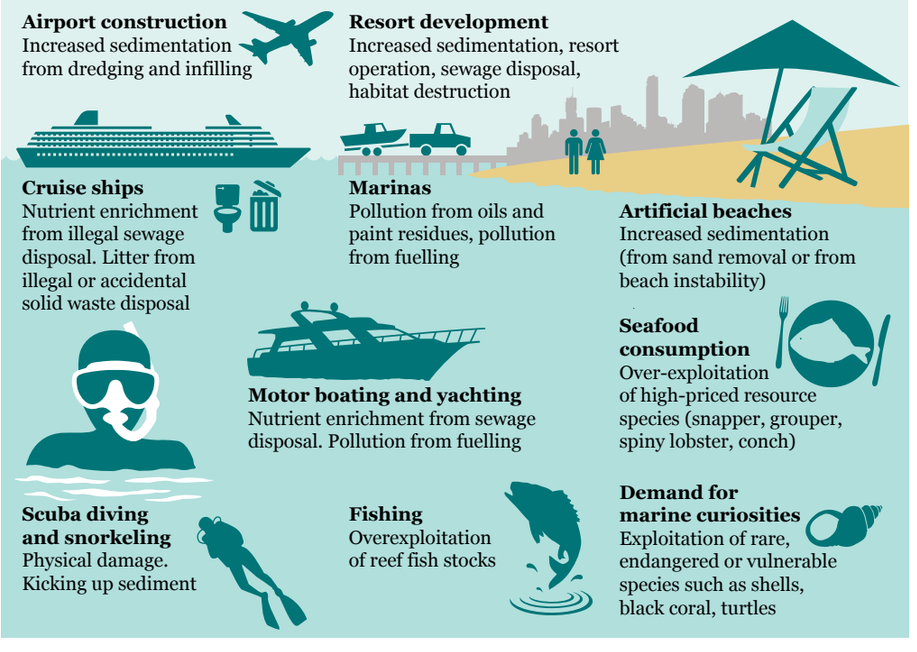
Tourism is one of the largest and fastest-growing industries in the world. Coastal and marine tourism is one of its most important sectors and a major component of thriving coastal communities. This growth, however, can bring with it major environmental, cultural, social and economic implications. Careful attention needs to be paid to these impacts.

Globally, tourism and related economic activities generate 9.8 per cent of GDP and employ 277 million people, or 1 in every 11 jobs (WTTC, 2013). The sector continues to grow fast, especially in some of the world's least developed countries.

Although tourism can be an opportunity for sustainable development, poorly planned development of hotels and resorts in coastal areas can result in habitat destruction, pollution, and other negative impacts on local communities as well as biodiversity.

The increased popularity of cruise ships can also adversely affect the marine environment. Carrying up to 6,000 passengers and 2,000 crew, these enormous floating towns are a major source of marine pollution through the dumping of garbage and untreated sewage at sea, and the release of other shipping-related pollutants (Copeland, 2008).

Figure 22:
The impacts of tourism on marine health



Galapagos: infrastructure and tourism

In a little over three decades, the Galapagos has been transformed from “worthless Clinker Islands” into one of the world’s most famous ecotourism destinations. Over 1.5 million visitors have experienced the unique natural wonders of Galapagos. Tourism accounts for half the local economy, and brings in US$418 million a year to the economy of Ecuador. Improvements in local transportation, communication, infrastructure, health, and socio-economic well-being are directly attributed to the tourism industry (Epler, 2007).

Tourist revenue is also essential for conserving the islands’ fragile ecosystems. However, the rapid increase in visitors from 40,000 in 1990 to more than 145,000 in 2006 and a restructuring of the tourism sector in favour of larger cruise ships have placed increasing pressure on the archipelago (Epler, 2007). Rapid development and ever-increasing infrastructure needs, along with higher demand for imported goods and fossil fuels, the introduction of invasive species, immigration and waste threaten the land and waters of the Galapagos.

WWF is working with the public sector and local tourism businesses to design and implement a new ecotourism model that both supports conservation and improves people’s livelihoods.

© James W. Thorsell / WWF

Climate change and the ocean: Key risks

Loss of coral reefs due to warming and acidification → reduced biodiversity, fisheries production and coastal protection

Shift in distribution of fish and invertebrates due to warming waters → decreased catches in tropical regions

Extreme weather events and reduced ecological resilience → coastal inundation and habitat loss

Rising sea levels → threats to low-lying coastal areas

Loss of livelihoods, coastal settlements, infrastructure, ecosystem services and economic stability

Climate change

The ocean regulates our climate and drives the weather determining rainfall, droughts and floods. Ocean waters also absorb vast amounts of CO_2, helping to mitigate human-caused global warming and climate change. Indeed, in the last 200 years, the ocean has absorbed around a third of the CO_2 produced by human activities and has absorbed over 90 per cent of the extra heat trapped by the rising concentrations of atmospheric greenhouse gases (Gattuso et al., 2015).

Impacts on key marine and coastal organisms, ecosystems, and services are already detectable, and several will face a high risk of impacts well before 2100, even under the low-emissions scenario (Gattuso et al. , 2015). By absorbing CO_2, the ocean is becoming more acidic – now occurring at a rate that is faster than any other period in the past 65 million years. Warming and acidifying oceans amplify the impact of other pressures from overfishing, habitat destruction and pollution. For example, the increased acidity of the ocean reduces the ability of coral reefs to re-establish themselves (“bounce back”) from disturbances such as bleaching, cyclones and crown-of-thorns starfish outbreaks (Hoegh-Guldberg et al., 2015). If current rates of temperature rise continue, the ocean will become too warm for coral reefs by 2050 (Hoegh-Guldberg et al., 2007). This would mean a major disruption to at least 25 per cent of the biodiversity in the ocean, as well as the loss of productive fisheries and significant impacts on industries such as tourism. The loss of reefs as a barrier would increase the exposure of coastal areas to waves and storm systems.

Coastal systems and low-lying areas are also increasingly experiencing adverse impacts from sea level rise – submergence, coastal flooding, and coastal erosion. The loss of coastal ecosystems such as mangroves and seagrass beds increases vulnerability of coastlines and people to the impacts of climate change. Many low-lying developing countries and small island states are expected to face severe impacts that, in many cases, could result in displacement of people, damage to ecosystems, and adaptation costs amounting to several percentage points of GDP (IPCC, 2014).

Climate change in the Arctic

With only 4 million people spread over more than 32 million square kilometres, the Arctic remains largely untouched by direct human impacts. But the effects of global climate change have led to an unprecedented state of flux. Evidence indicates that Arctic summer temperatures today are higher than at any time in the past 2,000 years (Kaufman et al., 2009).

The most drastic result of continued warming is the ongoing shrinking, in extent, thickness, and volume, of summer sea ice. The Arctic Ocean is projected to become nearly ice-free in summer within this century, likely within the next 30 to 40 years (Overland and Wang, 2013).

Life in the Arctic Ocean is highly adapted to the presence of ice. On and around the ice, polar bears hunt, seals give birth, walrus rest and feed, and whales feed and hide from predators. But these are just the more visible parts of a whole ecosystem driven by pulses of nutrients mediated by the ebb and flow of sea ice (Eamer et al., 2013). A change in the timing of nutrient pulses can spell difficulty for both endemic and migratory species. Millions of migratory birds rely on the pulse of life in the Arctic spring.

The Arctic Ocean will also likely be particularly prone to an increase in acidity levels. This is a problem for shell-forming sea life such as zooplankton, an important part of the Arctic food web. A recent study by the National Oceanic and Atmospheric Administration modelled the future of US Arctic waters, and concluded that within decades, "the diverse ecosystems that support some of the largest commercial and subsistence fisheries in the world may be under tremendous pressure" (Mathis et al., 2015).

Changes in the Arctic are significant to people locally and globally. The Arctic Ocean and surrounding seas produce more than 10 per cent of global marine fisheries catch by weight – more than 7 million tonnes per year. The Survey of Living Conditions in the Arctic (Poppel et al., 2007), which covered indigenous households in Alaska, Greenland, Canada and Chukotka, found that two-thirds of households obtained at least half their food from traditional resources. Diminishing resources could produce economic and cultural hardship, and push Arctic peoples to increasingly look to new industries for support – potentially putting further pressure on this crucial ecosystem.

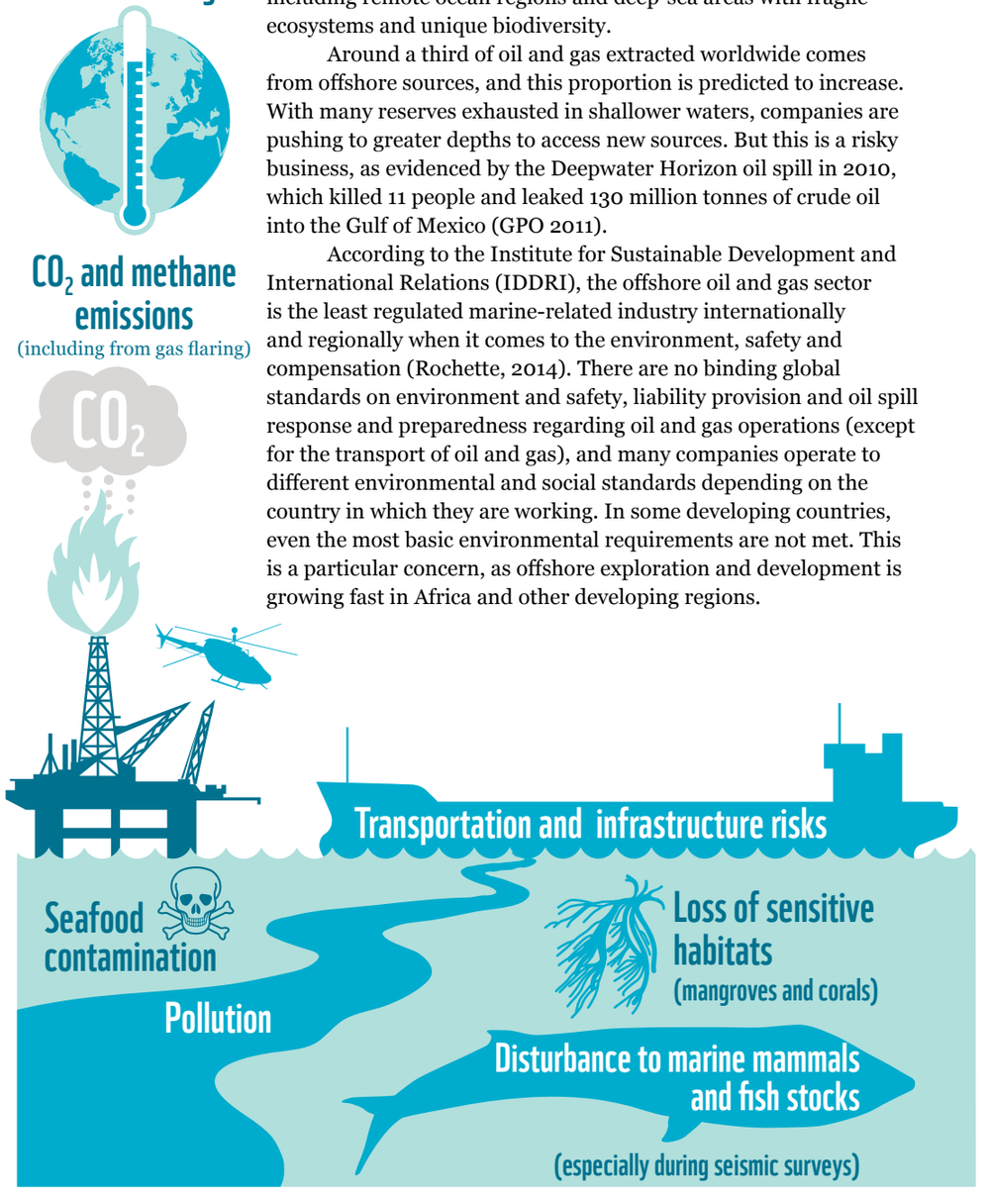
The Arctic Ocean is likely to become nearly ice-free in summer within the next 30 to 40 years

Extractives

To meet our ever-increasing demands for fossil fuels and mineral resources, extractive industries are moving into new areas – including remote ocean regions and deep-sea areas with fragile ecosystems and unique biodiversity.

Around a third of oil and gas extracted worldwide comes from offshore sources, and this proportion is predicted to increase. With many reserves exhausted in shallower waters, companies are pushing to greater depths to access new sources. But this is a risky business, as evidenced by the Deepwater Horizon oil spill in 2010, which killed 11 people and leaked 130 million tonnes of crude oil into the Gulf of Mexico (GPO 2011).

According to the Institute for Sustainable Development and International Relations (IDDRI), the offshore oil and gas sector is the least regulated marine-related industry internationally and regionally when it comes to the environment, safety and compensation (Rochette, 2014). There are no binding global standards on environment and safety, liability provision and oil spill response and preparedness regarding oil and gas operations (except for the transport of oil and gas), and many companies operate to different environmental and social standards depending on the country in which they are working. In some developing countries, even the most basic environmental requirements are not met. This is a particular concern, as offshore exploration and development is growing fast in Africa and other developing regions.



Oil and gas in the Arctic

Oil and gas is the most widely discussed and most controversial resource development sector in the Arctic. According to the United States Geological Survey (Bird et al., 2008) the Arctic contains an estimated 90 billion barrels of oil and 30 per cent of the world's undiscovered natural gas. Much of the undiscovered gas is in Russian territory, while the oil is thought to be mostly offshore of Alaska, Canada and Greenland.

Offshore oil development is especially controversial. Shell has encountered major difficulties (technical, regulatory and reputational) in its efforts to drill in Alaskan waters, and exploratory drilling in Greenland's Baffin Bay drew concern from Canadian Arctic residents. A few of the sector's major players are not at present actively involved in oil and gas projects in the high Arctic due to substantial risks and the absence of key technologies and infrastructure to ensure safe operations as well as reasonable economic returns.

There are no proven effective methods of cleaning up oil spills in ice, especially mobile ice. Even without ice, the effects of a spill in Arctic conditions will linger for decades. Oil from the Exxon Valdez spill in Alaska still pollutes beaches, more than 25 years later.

While industrial development is expanding in the Arctic, serious challenges make its consequences unclear. There are few reliable technologies designed to work in Arctic conditions; infrastructure is very limited; very few strategic environmental assessments have been done, and knowledge of Arctic ecosystem dynamics is weak; there are next to no regional Arctic-specific environmental standards in the oil and gas industry; no consistent standardized liability regimes in particular linked to environmental risk; and there is still no comprehensive regional or international governance regime for ecosystem-based management. Finally, the Arctic requires a comprehensive and representative network of marine protected areas to build and protect resilience in a region expected to experience wrenching climate change.

Mining

Mining impacts on marine environments are not a new phenomenon. Marine and coastal zones have been damaged by mining activity since the dawn of the industrial revolution. Some coastal areas have been used as repositories for coal discards and metal mine tailings for centuries, both directly dumped offshore or via river courses that were used, in effect, as industrial drains. Such was the extent of this impact over the years that the accumulated wastes are now periodically dredged to reclaim the minerals lost by the inefficient technologies of earlier centuries. Thankfully many of these practices have now long been outlawed, though some near-shore coastal zones continue to struggle to recover.

There is also growing interest in the deep ocean, the largest biome on Earth, as an untapped source of both precious and semi-precious metals, and mineral deposits. With advances in technology and in anticipation of rising demand and prices, extracting this mineral wealth is drawing commercial interest and raising conservation concerns. While no commercial deep-sea mining operations have occurred to date, the International Seabed Authority has issued licences covering 1.2 million square kilometres of ocean floor in areas beyond national jurisdiction in the Pacific, Atlantic and the Southern Indian Ocean (Shukman, 2014).

The impacts from this type of mining are unclear, limited by the lack of knowledge about deep-sea biodiversity and ecosystem complexity, but as huge areas of seabed have been licensed the scale could be unprecedented. Understanding and knowing how to manage these impacts, if indeed the impacts can be acceptably managed at all, and avoiding development in areas with unacceptable risk will be key in avoiding the damage of the past.

Land-based pollution

Pollution on land has a huge impact at sea, threatening ecosystems, impacting human health, damaging livelihoods and spoiling our enjoyment of beaches. Land-based sources are responsible for around 80 per cent of all marine pollution (UN, 2004).

Poor water quality and sediment are the most serious pollution threats to many coastal and marine environments in populated areas (UN WWAP, 2014), with sewage being the greatest contributor. In many parts of the world, sewage flows untreated, or under-treated, into the ocean. According to the fourth UN World Water Development Report, only 20 per cent of globally produced wastewater receives proper treatment (UNESCO, 2012).

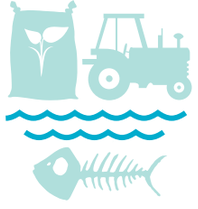
Until the 1970s, dumping rubbish in the ocean had been an accepted practice for centuries. Marine debris can travel immense distances: it creates navigation hazards, smothers coral reefs, transports invasive species and negatively affects tourism. It also injures and kills wildlife; at least 17 per cent of species affected by entanglement and ingestion of marine debris are listed as threatened or near threatened on the IUCN Red List. It also may pose a threat to human health (Gall and Thompson, 2014).

Plastic debris is of particular concern due to its abundance and its persistence in the environment. There are estimated to be over 5 trillion plastic pieces weighing over 250,000 tonnes afloat at sea (Eriksen et al., 2014). We are only just beginning to understand the level and impact of microplastics – tiny plastic particles of which around 35,500 tonnes are estimated to be floating in our ocean (Eriksen et al., 2014). Many more organisms ingest small plastic particles than previously thought, and these work their way up the food chain (Cole, 2013; Lusher et al., 2013).

Meanwhile, fertilizer run-off from farms and residential lawns causes eutrophication – the flourishing of algal blooms that deplete the water's dissolved oxygen and suffocate marine life (Rabalais, 2002; Selman et al., 2008). Eutrophication has created enormous "dead zones" in several parts of the world, including the Gulf of Mexico and Baltic Sea, reducing species diversity (Smith and Schindler, 2009) and sometimes leading to toxic algal blooms known as red tides (Anderson et al., 2008; Rabalais, 2002). Dead zones are growing in both magnitude and geographical extent (Selman et al., 2008).

Toxic wastes from industries continue to be discharged into our major water bodies, through deliberate illegal dumping or through run-off from land-based activities. Almost every marine organism, from the tiniest plankton to whales and polar bears, is contaminated with man-made chemicals, such as pesticides and chemicals used in common consumer products (Garcia-Hernandez et al., 2007; Dorneles et al., 2013; Seltenrich, 2015).

With at least 60 per cent of the world's population living within 100km of the coast and the global population growing, marine pollution from land-based activities is likely to worsen. Given the transboundary nature of marine pollution, protection of our ocean from land-based activities requires urgent international cooperation.



Land-based sources are responsible for 80% of marine pollution

Great Barrier Reef: Boosting resilience

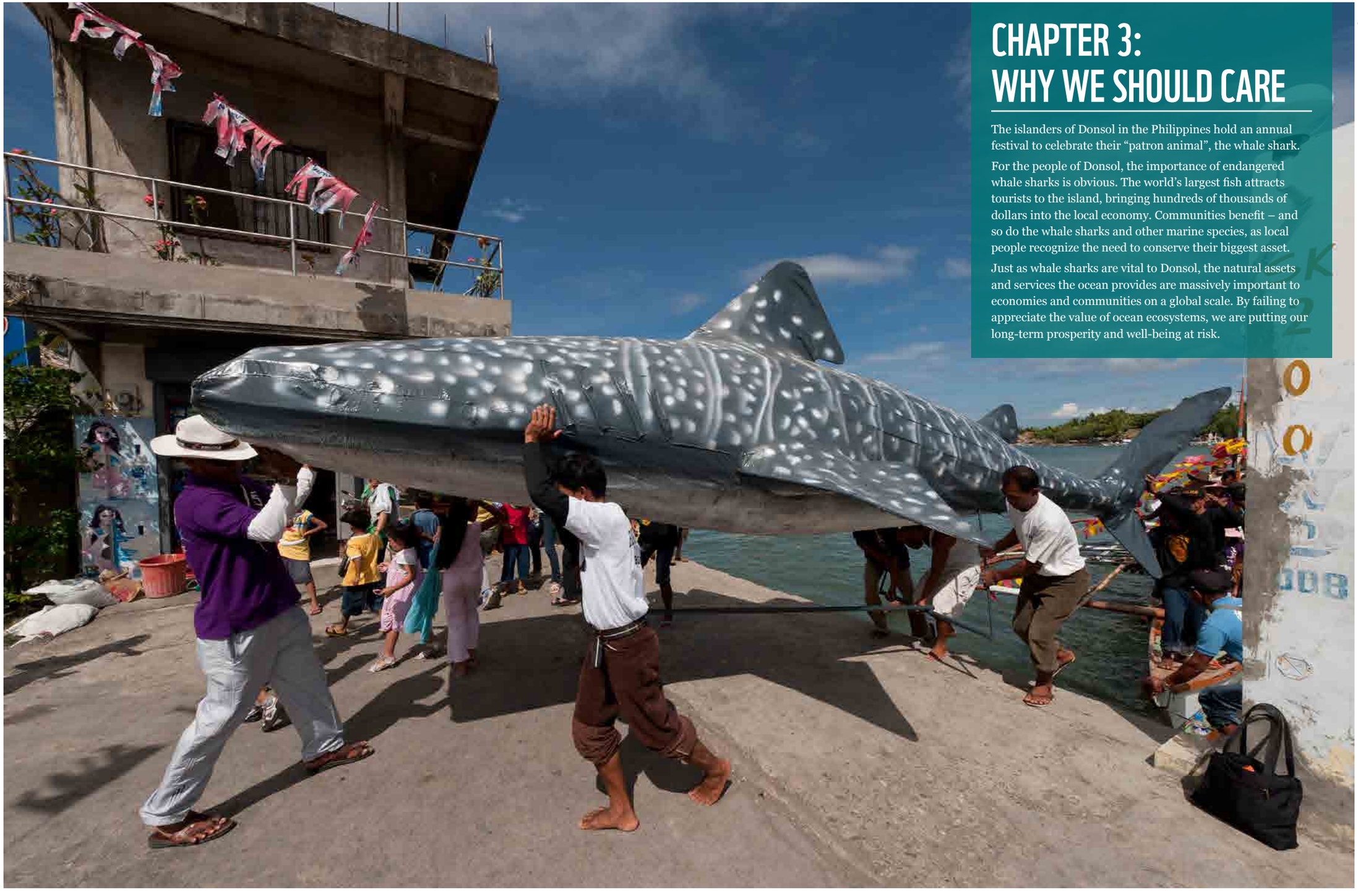
Over the past 30 years, Australia's Great Barrier Reef has lost more than half of its coral cover. The Great Barrier Reef Marine Park Authority warns that climate change is the most serious long-term threat to the reef (GBRMPA, 2014). Building its resilience by reducing other pressures is an urgent priority.

More than 40 per cent of coral loss has been caused by outbreaks of the coral-eating crown-of-thorns starfish, which are fuelled by nutrient run-off from farms (De'ath et al., 2012). WWF is working with farmers, governments and companies to cut pollution so coral can recover.

One key initiative is Project Catalyst, which brings together sugarcane growers, The Coca-Cola Foundation, government agencies and WWF to test and implement new practices that reduce run-off and erosion and improve farm productivity. Nearly 100 Queensland farmers are involved in the project, with impressive results. But to get the cuts to pollution necessary for the Great Barrier Reef's survival, this work needs to be scaled up across all the catchments that run into the reef's waters – encompassing millions of hectares and thousands of farms.

In recent years, WWF has campaigned against plans for massive new industrial developments along the reef's coasts which could have allowed up to 100 million tonnes of dredge spoil to be dumped within its waters. Incredible public support for the reef has resulted in a ban on dumping dredge spoil from new developments in the reef's World Heritage Site area. Industrial development still poses many significant threats to the reef including increasing shipping traffic, dredging and dumping for port maintenance and coastal habitat destruction. WWF will keep driving for change to reduce these threats to ensure the best possible future for the reef.

© James Morgan / WWF



CHAPTER 3: WHY WE SHOULD CARE

The islanders of Donsol in the Philippines hold an annual festival to celebrate their "patron animal", the whale shark.

For the people of Donsol, the importance of endangered whale sharks is obvious. The world's largest fish attracts tourists to the island, bringing hundreds of thousands of dollars into the local economy. Communities benefit – and so do the whale sharks and other marine species, as local people recognize the need to conserve their biggest asset.

Just as whale sharks are vital to Donsol, the natural assets and services the ocean provides are massively important to economies and communities on a global scale. By failing to appreciate the value of ocean ecosystems, we are putting our long-term prosperity and well-being at risk.

Why we should care

"Both everyday experience and scientific research show that the gravest effects of all attacks on the environment are suffered by the poorest. For example, the depletion of fishing reserves especially hurts small fishing communities without the means to replace those resources; water pollution particularly affects the poor who cannot buy bottled water; and rises in the sea level mainly affect impoverished coastal populations who have nowhere else to go." Encyclical Letter - Laudato Si' - of the Holy Father Francis on Care of our Common Home.

The ocean is fundamental to life on Earth, underpinning economies and businesses, and sustaining the livelihoods and well-being of billions of people worldwide. Yet as Chapter 1 has shown, many ocean ecosystems are in serious decline – while the pressures outlined in Chapter 2 continue to intensify. We are rapidly running down our ocean – the natural assets like coral reefs, mangroves and the species they contain – and the wealth of goods and services that it provides. Overfishing, pollution, tourism, shipping, extractive industries and now climate change are not only threatening the health of marine habitats and species, but also our fundamental life-support system. People's health, way of life and security is at risk.

From coral reefs and mangroves to migratory fish stocks, the ocean is rich in natural capital. These natural assets provide a range of goods and services on which we all ultimately depend (Figure 23). The ocean benefits us directly, providing food, raw materials, energy, medicines and other products. Nearly 3 billion people rely on marine and freshwater fish as a major source of animal protein, getting almost 20 per cent of their dietary intake from this source (FAO, 2014b) and around 10-12 per cent of the world's population depends on fishing and aquaculture as a livelihood (HLPE, 2014). The ocean is also enormously important for recreation and tourism, and is of great cultural and spiritual importance to coastal communities around the world. It's also crucial to international transport and shipping.

The ocean also benefits humans indirectly. It regulates our global climate and weather, produces half the oxygen we breathe and absorbs almost a third of anthropogenic CO_2 emissions (IPCC, 2013). Coastal habitats protect coastal communities and cities from storms and erosion, and filter land-based pollution and nutrients.

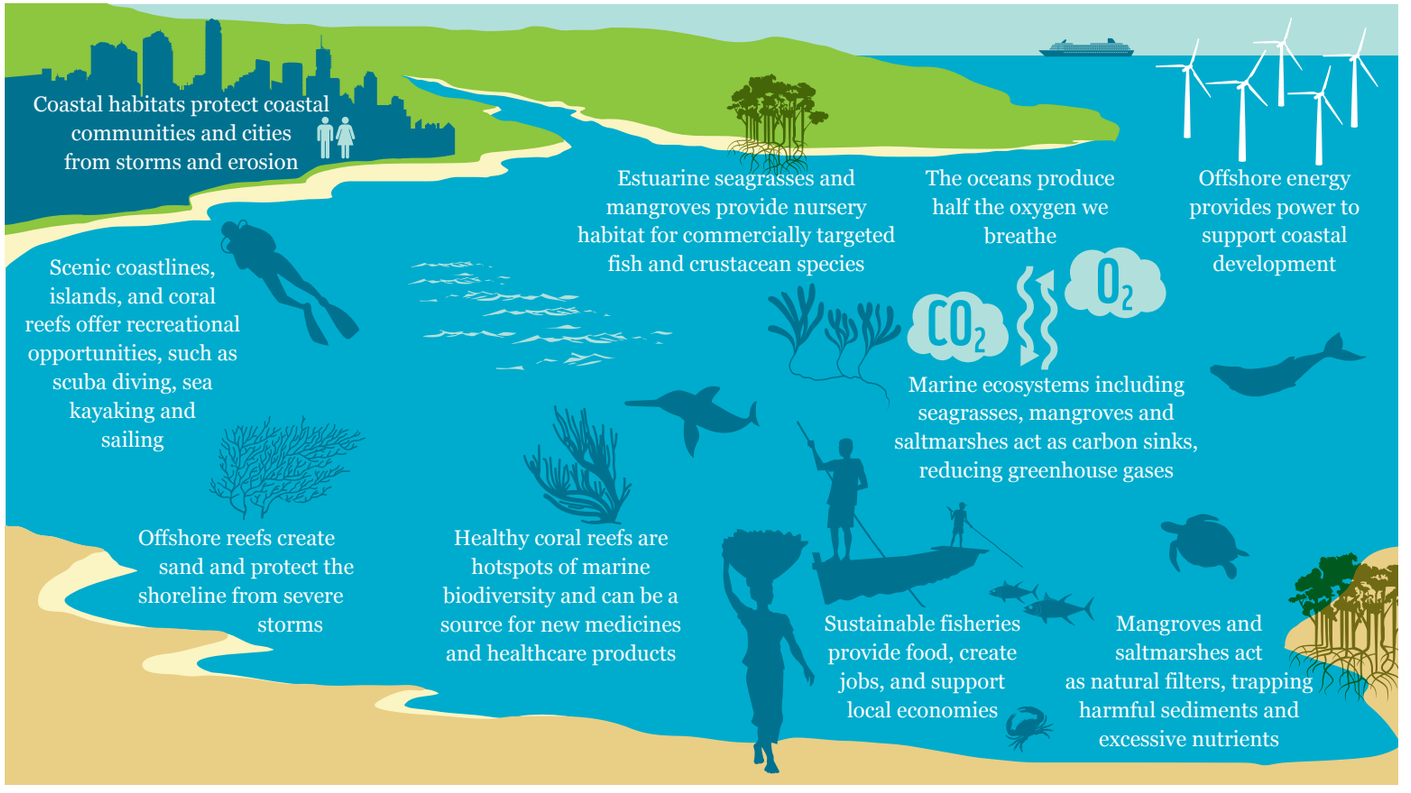


Figure 23: Ecosystem goods and services provided by the ocean *(UNEP 2011).*

Marine natural capital: the Coral Triangle

Nowhere on Earth is richer in marine natural capital than the Coral Triangle, which covers a vast area of ocean spanning Indonesia, Malaysia, the Philippines, Papua New Guinea, Solomon Islands and Timor-Leste.

One-third of the inhabitants of the Coral Triangle – more than 120 million people – depend directly on local marine and coastal resources for their income, livelihoods and food security, and fish is a major source of protein in local diets (ADB 2014). Fisheries exports from Coral Triangle countries in 2011 amounted to 1.7 million tonnes, worth nearly US$5.2 billion (FAO FIGIS, 2011). The region also produces almost 30 per cent of the total global tuna catch (WCPFC, 2014; IOTC, 2015), with an export value estimated at close to US$1 billion (FAO FIGIS, 2011). A lucrative trade in coral reef fish caught and sold live for human consumption generates an annual value of US$1 billion (Muldoon, 2015).

The region also attracts tens of millions of visitors every year. The Pacific Asia Travel Association estimates nature-based tourism in Coral Triangle countries is worth US$12 billion annually, with earnings shared by travel operators, tour guides, hotels, diving operations and countless other businesses (Pet-Soede et al., 2011).

Socio-economic implications of ocean decline

As the preceding chapters have highlighted, the ocean is being re-engineered as a result of human activity. Many marine and coastal ecosystems are under such stress and degradation that they are now past the point where they can replenish themselves and continue to provide us with the same level of benefits. This is generating increased risks and costs to human well-being and economies around the world.

The ocean's once abundant fisheries are increasingly unable to feed and provide livelihoods for the world's rapidly expanding population. In 2008, the FAO estimated that global fish stocks were contributing some US$50 billion less every year than they would if well managed and fished sustainably (Arnason et al., 2008). Poor coastal communities who rely most directly on the ocean for food and livelihoods are particularly vulnerable – and often unfairly disadvantaged. In West Africa, for example, small-scale local vessels find themselves competing for dwindling fish stocks with giant (and heavily subsidized) super-trawlers from EU countries.

In West Africa, small-scale local vessels are competing for dwindling fish stocks with heavily subsidized super-trawlers from EU countries

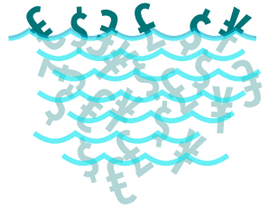
Ocean degradation is also increasingly threatening sustainable tourism in many destinations. Tourism is especially dependent on the condition of habitats such as coral reefs, and reef degradation has a direct economic impact on people whose livelihoods rely on reef-related tourism.

Coasts denuded of protective habitats are increasingly exposed to risks associated with rising seas and extreme weather events. A UN report reveals that global mangrove deforestation is resulting in economic losses of up to US$42 billion annually (UNEP, 2014).

With the global population projected to increase beyond 9 billion people by 2050, the demand for ocean resources will persist and intensify, placing further pressure on natural systems. Climate change and associated ocean warming and acidification are exacerbating these risks.

Invisibility of nature's value: a major cause of ocean decline

Despite our dependence on ocean ecosystems, their contribution is routinely taken for granted. Many of the benefits they provide do not have an explicit market value, providing little incentive for decision-makers to account for the impacts of overuse or degradation, for example when deciding how to manage a fishery or where to build a new port. The value of many of nature's services is often appreciated only when they are lost (MEA, 2005).



Understanding the value of ocean ecosystems is a crucial first step in their recovery. Governments, intergovernmental agencies, businesses and financial institutions are increasingly seeing the economic sense in managing the ocean more sustainably. In 2010, for example, the 193 member states of the Convention on Biological Diversity (CBD) agreed on new biodiversity targets which include "the need to incorporate values of biodiversity into national accounting and reporting systems". The same year, the United Nations Environment Programme (UNEP) launched the TEEB (The Economics of Ecosystems and Biodiversity) for Oceans and Coasts initiative to incorporate values of oceans and coasts in decision-making.

Tools and approaches such as natural capital accounting (NCA) and ecosystem service valuation (ESV) are increasingly used and accepted globally. NCA helps governments and companies to track the status of natural capital assets and the benefits they provide over time, while ESV is used to assess, quantify or estimate the monetary value of benefits provided by nature. The information these tools provide can help decision-makers to develop policies, target investment and manage ocean resources more effectively.

Valuing the ocean: an example

The Boston Consulting Group in collaboration with the Global Change Institute and WWF recently estimated that the ocean generates economic benefits worth at least US$2.5 trillion per year. The total value of the ocean's underpinning assets is at least US$24 trillion (Hoegh-Guldberg et al., 2015). Underpinning the value estimates are direct outputs (e.g. fishing), services enabled (e.g. tourism, education), trade and transportation (coastal and oceanic shipping) and adjacent benefits (e.g. carbon sequestration, biotechnology)(BCG, 2015). More than two-thirds of this value relies on healthy ocean conditions.

However, the values highlighted are considered to be vast underestimates. The study did not attempt to assess the value of less well understood ecosystems such as seamounts and deep-sea habitats. Moreover, the study did not consider the role the ocean plays in atmospheric regulation, carbon storage and planetary temperature control – nor its incalculable spiritual and cultural values.

The ocean is, of course, infinitely valuable: without it, life on Earth simply could not exist. It also has an intrinsic value, irrespective of human perceptions. Valuation tools are not about putting a price tag on our ocean assets so they can be commoditized, but about enabling decision-makers to make smarter choices so present and future generations can continue to enjoy the benefits of a healthy ocean.

Ocean infrastructure: cost-effective protection to coasts from flooding and erosion

The combination of severe storms, high population densities, degraded natural habitats and climate change is putting property and life at increasing risk around the world (IPCC, 2007). In the US, about 16 per cent of the immediate coastline (within 1km of the shore) is classified as "high hazard" area. These coastlines are home to 1.3 million people and US$300 billion worth of residential property. Sea level rise is predicted to increase the amount of highly threatened people and property by 30-60 per cent by 2100. A recent study found that 147-216 million people – more than a quarter of them in China – live on land that will be below sea level or regular flood levels by the end of the century (Strauss and Kulp, 2014).

The traditional response to these coastal hazards has been to construct levees and seawalls. But these are expensive to build and maintain and often have consequences for the benefits that natural systems provide to people (Jones et al., 2012).

Recently, interest has increased in "green infrastructure", such as restoration of coastal habitats – wetlands, coastal forests, mangroves, seagrass meadows, coral and oyster reefs. The aim is to protect people and property while improving quality of life by maintaining the full suite of benefits these ecosystems provide.

In 2013, the Natural Capital Project (a partnership between WWF, The Nature Conservancy, University of Minnesota and Stanford University) mapped the entire US coast to identify where green infrastructure has the greatest potential for reducing risk from coastal hazards (Arkema et al., 2013). On a national scale, the number of people most exposed to future hazards can be halved if existing coastal habitats remain fully intact. Regionally, coastal habitats defend the greatest number of people and total property value in Florida, New York and California.

In other parts of the world, coastal defence planning has slowly begun to incorporate ecosystems alongside physical structures. Many poor coastal communities in countries like the Philippines, Indonesia and small island developing states face grave risks of hurricanes, tsunamis and sea level rise. These communities largely depend on fishing for their food and income: if their fisheries are in poor health, it is hard for them to bounce back from disaster. Multi-stakeholder efforts in these countries are combining community-based and large-scale initiatives to restore natural habitats, to both strengthen fisheries and help buffer coastal communities from floods and storms.

147-216 million people live on land that will be below sea level or regular flood levels by the end of the century

An ocean of opportunity

Ocean ecosystems are renewable assets which, if maintained in a healthy state, would continue to provide goods and services in perpetuity. Substantial economic and social gains could be realized by protecting and improving them, and from using them sustainably and equitably to:

- **Enhance food security, health and well-being**. Improved and equitable access to food and raw materials from a healthy ocean would improve quality of life for hundreds of millions of people, as well as generating substantial savings from averted healthcare and social costs.
- **Deliver more secure and cost-effective public services.** Ocean ecosystems are a core part of a nation's infrastructure portfolio, and should be invested in accordingly. Protecting and improving them to secure service supply would generate multibillion-dollar savings (through reduced need for man-made alternatives and avoided socio-economic costs).
- **Build more resilient economies and businesses.** Improved access to a sustainable supply of raw materials would insulate economies, businesses and supply chains from resource shocks, price volatility and disaster risks.
- **Generate economic growth where it is needed,** including through new businesses and job creation in coastal areas (for example in fisheries and tourism) – areas that often suffer from a lack of economic opportunities.

Marine protected areas could help to reduce poverty, increase food security, create employment and protect coastal communities

Protecting our ocean makes economic sense

Marine protected areas (MPAs) that effectively protect critical habitats, species and ecological functions are an essential tool for ensuring ocean ecosystems can deliver services and benefits to current and future generations. Brander et al. (2015) show that well-managed MPAs could help to reduce poverty, increase food security, create employment and protect coastal communities. They modelled a range of scenarios to examine the net benefits of expanding MPAs. Increasing MPA coverage to 30 per cent of marine and coastal areas could generate between US$490 billion and US$920 billion by 2050 and 150,000-180,000 full-time jobs in MPA management over the 2015-2050 period.

CHAPTER 4: TURNING THE TIDE

"Working with scientists and park managers really helped me understand the benefits of fishing regulations," says Michele Iaia. *"Today, my income is protected and I am less worried about our community's future."*

Michele is a fisherman in Torre Guaceto in Italy, a traditional fishing site and a marine protected area (MPA) since 1991. In 2000, fishing was banned in the entire MPA, leading to conflicts and high levels of illegal fishing. Five years later, a portion of the zone was reopened. The fishermen, with support from scientists and MPA staff, were invited to develop their own sustainable fishing solutions. One of these included a project to market species of low commercial value, in collaboration with the Slow Food association. Fishermen have improved their income, and now play an active part in the management of the MPA.

Blue planet solutions

As the preceding chapters make clear, marine and coastal ecosystems are in serious trouble, and the pressures upon them continue to mount. If we don't reverse these trends, the implications will be profound – for the security, well-being and way of life of hundreds of millions of people, for local and global economies, and for the future generations who inherit this blue planet.

The picture in this report is bleak – yet there are signs of hope. It's not too late to save our seas: opportunities and solutions exist for governments, business and industry, and civil society to rise to the challenge and work together to secure a living ocean for all. WWF's One Planet Perspective (Figure 24) provides a framework for preserving and managing our ocean resources within ecological limits. It highlights the need to preserve our natural marine capital, produce resources like seafood and energy in a better way, and consume these resources more wisely. And it outlines two essential enabling conditions – redirecting financial flows to support these priorities, and equitable resource governance that ensures our ocean is looked after for the benefit of all.

This chapter introduces examples of how, all over the world, the One Planet Perspective is being put into practice – and of how marine ecosystems, and the people who depend on them, are benefiting. We need to see solutions like these rolled out on a far greater scale – urgently.

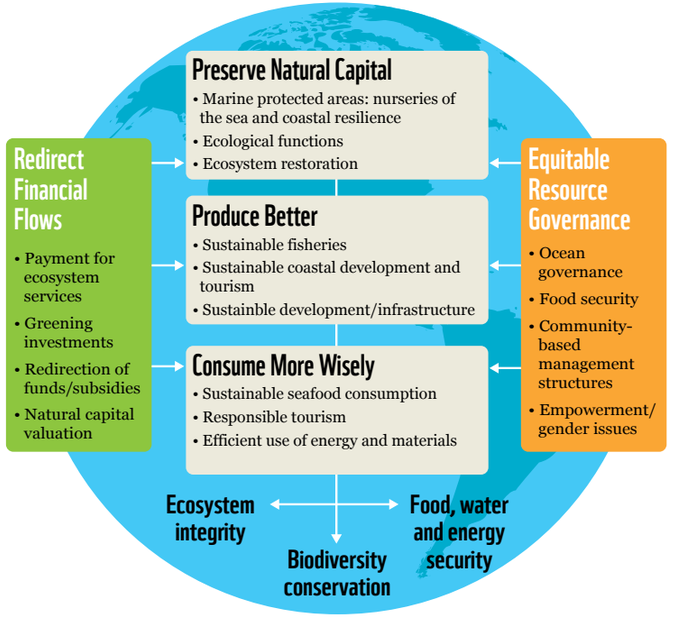


Figure 24: WWF's One Planet Perspective provides a framework for making better choices for the marine environment.

Using circle hooks like this one in place of traditional long-line hooks can reduce the accidental catching of non-target species such as marine turtles by as much as 80 per cent. WWF is working with thousands of long-line tuna fishermen to promote better fishing methods that reduce impacts on the marine environment and support the industry's long-term sustainability.

Blue economy from a One Planet Perspective

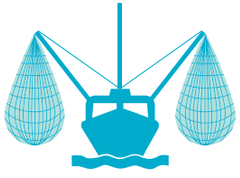
The One Planet Perspective shows how we can halt the depletion of the ocean, restore damaged ecosystems, and manage, use and share the ocean's resources within the planet's finite capacity. These are also the ingredients for a sustainable blue economy.

Preserve natural capital: Marine natural capital should be built into national accounting, and the importance of ecosystem services and natural assets should be considered in every decision that affects the marine environment.

To date, the total ocean area under some form of protection is only 3.4 per cent: concerted action is needed to reach the Aichi Target, agreed under the CBD, to protect at least 10 per cent of coastal and marine areas by 2020. WWF is working with governments, partners and local communities around the world to establish effectively and equitably managed, ecologically representative and well-connected networks of MPAs.

Produce better: Almost 10 per cent of wild-caught seafood globally now comes from fisheries certified by the Marine Stewardship Council (MSC). This ensures stocks are being managed sustainably, and that impacts on marine ecosystems and species are minimized. In addition, an increasing number of fish farms are implementing the standards of the Aquaculture Stewardship Council (ASC). WWF and partners also work with fisheries, including communities where certification is not an option, to improve fishing practices. Better management in fisheries is vital for reversing the alarming decline in utilized fish species and rebuilding fish stocks to ecologically sustainable harvest levels.

Meanwhile, shifting away from fossil fuels will reduce the impacts of oil and gas sector development – and of climate change – on the marine environment.



Consume more wisely: Demand from consumers and retailers for more responsibly produced seafood has encouraged producers to commit to ASC and MSC certification. Consumer choices can also influence service industries such as tourism to operate in more responsible ways that benefit marine ecosystems and coastal communities.

Redirect financial flows: There is a compelling economic case for investing in preserving and restoring marine natural capital and sustainable production, yet investment patterns and harmful subsidies continue to promote overfishing and unsustainable exploitation. NCA and ESV tools, as described in the previous chapter, can help support wiser investment choices.

One alternative model is WWF's Financial Instrument for the Recovery of Marine Ecosystems (FIRME). Which facilitates loans for conservation measures and social support necessary to put a fishery on a sustainable footing, to be repaid through profits from increased future yields. User fees for marine protected areas and tourism levies that are put back into conservation are also examples of how finance can be redirected to enhance the value of our ocean assets.

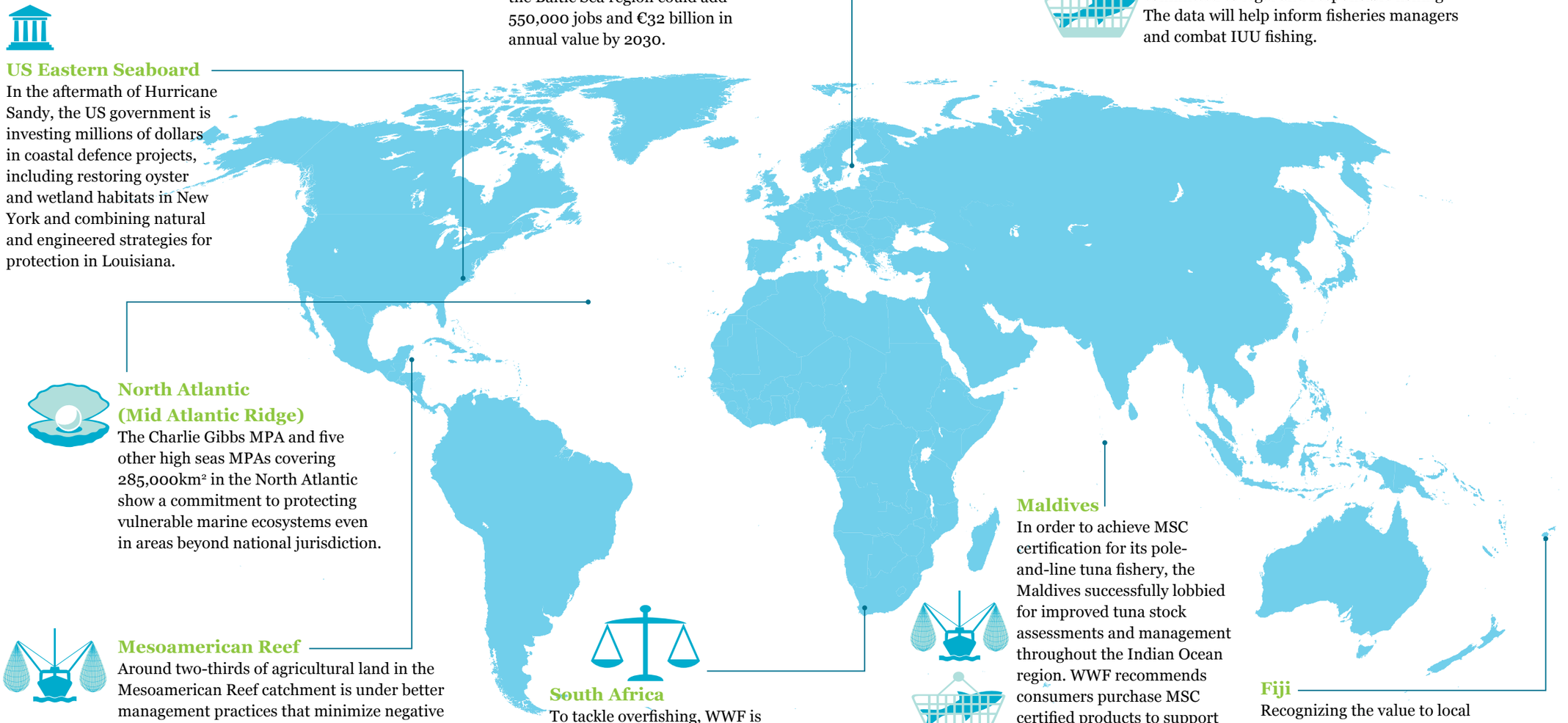
WWF wants to see a "Blue Alliance" of nations as well as concerned organizations and businesses to drive action to restore our ocean to health. This would include raising and accessing funds to invest in restoring habitats, reforming fisheries (including small-scale fisheries), reducing pollution, and building resilience to climate change.

Equitable resource governance: Ocean protection and restoration is not just a matter for government; communities and responsible businesses must be engaged as well. Solutions must involve holistic thinking that includes natural, social and economic needs and limits.

WWF is working with communities to develop rights-based, ecosystem-centred management systems, enabling them to sustainably manage their marine resources and ensure their long-term food and livelihood security. Gender issues often also need to be addressed with regard to access to resources and benefits.

The One Planet Perspective in action

Read more at ocean.panda.org



Baltic

A more integrated approach to managing marine resources in the Baltic Sea region could add 550,000 jobs and €32 billion in annual value by 2030.

seeOcean explorer

TransparentSea.org, launched in 2015 by WWF and navama, is a digital platform where fishing boats worldwide can register and share their satellite data to prove they are committed to legal and responsible fishing. The data will help inform fisheries managers and combat IUU fishing.

US Eastern Seaboard

In the aftermath of Hurricane Sandy, the US government is investing millions of dollars in coastal defence projects, including restoring oyster and wetland habitats in New York and combining natural and engineered strategies for protection in Louisiana.

North Atlantic (Mid Atlantic Ridge)

The Charlie Gibbs MPA and five other high seas MPAs covering 285,000km² in the North Atlantic show a commitment to protecting vulnerable marine ecosystems even in areas beyond national jurisdiction.

Mesoamerican Reef

Around two-thirds of agricultural land in the Mesoamerican Reef catchment is under better management practices that minimize negative impacts on the reef. Pesticide toxicity has been cut by 68 per cent, fertilizer and water use by more than 30 per cent, and soil erosion by a third.

South Africa

To tackle overfishing, WWF is supporting around 80 small-scale rock lobster and line fishers on Kogelberg coast to organize into community cooperatives and sell directly into higher-value markets.

Maldives

In order to achieve MSC certification for its pole-and-line tuna fishery, the Maldives successfully lobbied for improved tuna stock assessments and management throughout the Indian Ocean region. WWF recommends consumers purchase MSC certified products to support sustainable fisheries.

Fiji

Recognizing the value to local development of divers coming to see sharks, communities in Fiji have stopped shark fishing in a 30-mile “shark corridor”. Shark tourism contributed US$42.2 million to the country’s economy in 2010 (Vianna et al., 2011).

The Coral Triangle

An ambitious initiative spanning six countries aims to preserve the region's unparalleled marine riches for the benefit of its current and future inhabitants.

Home to three-quarters of all known coral species, six of the world's seven species of marine turtles, 27 marine mammal species and 3,000 species of fish, the Coral Triangle is the world's centre of marine life. Yet over the last 40 years, over 40 per cent of the region's coral reefs and mangroves have disappeared (Hoegh-Guldberg et al., 2009). More than 85 per cent of its remaining reefs are threatened, with nearly 45 per cent at high or very high threat levels (Burke et al., 2011). Local threats, driven by population growth and economic development, include coastal development, pollution and damage from agriculture, shipping and oil and gas installations, and unsustainable and destructive fishing. These are compounded by global stressors, including warming sea temperatures and ocean acidification.

Recognizing the importance of preserving their region's hugely valuable natural capital, the six Coral Triangle countries came together in 2009 to establish the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF). The initiative, strongly supported by WWF and other development partners, has produced groundbreaking collaborative action plans to sustainably manage the region for future generations. Key areas of focus include managing priority seascapes and MPA networks, applying ecosystem-based approaches to fisheries management, addressing climate change, and protecting threatened species.

Preserve natural capital: The initiative has helped to catalyse ambitious projects such as the Tun Mustapha Park, a vast MPA encompassing almost 1 million hectares and 50 islands off Sabah, Malaysia. The park contains a globally significant mix of coral reefs, mangroves and seagrasses and is an important migratory passage for fish, turtles and marine mammals. But it also supports the livelihoods of 80,000 people, with approximately 100 tonnes of fish – valued at US$200,000 – caught each day.

Tun Mustapha Park marks a shift away from small, strictly protected areas to a large area encompassing different sustainable uses. Importantly, it will be managed in collaboration with local communities. Community-based natural resource management is a key tool for conserving and sustainably using marine resources while improving livelihoods in the Coral Triangle.

80,000

At almost a million hectares, the Tun Mustapha Park contains a globally significant mix of coral reefs, mangroves and seagrasses and supports the livelihoods of 80,000 people.

US$200,000

Approximately 100 tonnes of fish, valued at US$200,000 are caught in the park each day.

Figure 25. Map of the Coral Triangle *(The Coral Triangle Atlas; UNEP-WCMC, WorldFish Center, WRI, TNC 2010).*

Key

Coral Triangle scientific boundary

CTI-CFF implementeation area boundary

Equitable resource governance: Women make up half of all seafood workers globally (FAO, 2014b), and addressing the position of women in fisheries is fundamental to tackling the root causes of poverty and environmental degradation. In the Solomon Islands, women's empowerment has been central to a project which aims to improve the lives of coastal communities on the island of Ghizo. The project, supported by WWF-Australia and funded by the Australian Department of Foreign Affairs and Trade and John West Australia, has included launching inshore fish aggregating devices or "rafters". These floating devices attract fish, provide alternative fishing areas and contribute to reducing fishing effort on the reefs.

The sale of fish caught at the rafters contributes to local women's savings clubs, part of a micro-savings and loans scheme set up with seed money from John West Australia. The women are able to take out loans to help fund small businesses. In just 18 months, the scheme grew rapidly to seven savings clubs, with more than 650 members, and the women had saved over SBD$172,000 (US$21,400). Their investment into the project is helping to ensure sustainable management of local marine resources.

Redirecting financial flows: The CTI-CFF has leveraged nearly a quarter of a billion dollars in finance from donors including the Asian Development Bank, the Global Environment Facility, USAID and the Australian government (Abraham, 2015). This in turn has encouraged investment from private sector companies operating in the region into sustainable fishing and tourism projects.

Catching less to catch more

Along the coast of Mozambique, local fishers are seeing the benefits of no-take zones and MPAs.

Primera e Segundas is a chain of 10 pristine coral islands stretching 150km along the coast of northern Mozambique. It's one of the most important places for sea turtle reproduction in the western Indian Ocean, as well as home to migrating whales, dolphins and seabirds. The area is also crucial for Mozambique's economy, and part of the world's largest wild prawn fishery.

However, this globally important marine environment has been pushed to the point of collapse through industrial and artisanal overfishing, compounded by the increasing impacts of climate change. In the city of Moma, which has a population of around 300,000, four out of five people eat fish daily, and in over half the households at least one man or boy actively fishes. Many of the more than 15,000 fishermen use harmful practices, like using mosquito nets which catch even the smallest fish.

WWF and CARE are working with poor communities in the region to support development and conservation. In 2010, the CARE-WWF Alliance helped set up two no-take zones, where no fishing is allowed. Local communities are closely involved in managing and monitoring these sanctuaries, and are already seeing the benefits as the number and diversity of fish has increased dramatically. After four years, the biomass caught in surveys within the sanctuaries was 50.761kg compared to 4.454kg for the same area outside, and there were three to four times as many species (Mualeque, 2014). This leads to increased catches for local fishers as these fish spread to other areas. As a result of these positive effects, the Mozambique Fisheries Research Institute has recommended that no-take zones be established in other parts of the country.

+300%

After four years, there were three to four times as many species within the sanctuaries

Valuing nature in coastal management

Belize's new coastal development plan takes full account of the huge value of natural ecosystems.

The beauty and diversity of Belize's coastal ecosystems draw tourists from around the globe. More than 40 per cent of the country's population live and work along the coast and depend on these ecosystems for their livelihoods.

Belize's coastal and ocean ecosystems provide services worth up to US$559 million per year – equivalent to 43 per cent of GDP in 2007 (Cooper et al., 2009). These include support for commercial fisheries, tourism and protection from erosion and storm surges. But too often, the benefits of natural ecosystems such as coral reefs and mangroves are overlooked in coastal investment and policy decisions.

In 2010, Belize's Coastal Zone Management Authority and Institute began to develop the country's first national Integrated Coastal Zone Management Plan, in partnership with WWF and the Natural Capital Project (NatCap). The plan replaces ad hoc development decisions with informed, long-term management. It provides science-based evidence to help resolve conflicts between competing interests and minimize the risks to natural habitats from human activities. It was developed through close consultation with the public and different industries at local and national level.

To understand the implications of different development scenarios, the team used NatCap's InVEST (Integrated Valuation of Ecosystem Services and Trade-offs) software, designed to help incorporate the value of ecosystem services into decision-making. For instance, by looking at how coastal development in a particular area will affect key ecosystems, it's possible to weigh up the expected gains in tourist revenue against the potential loss in income for lobster fishers and the increased vulnerability to storms.

By balancing conservation with current and future development needs, the plan could boost revenue from lobster fishing by US$2.5 million, increase the functional area of coral reefs, mangroves and seagrass by up to 25 per cent, and double the value of these ecosystems for protecting the coast by 2025. In short, it will help the people of Belize plot a wiser course for managing the incredibly valuable resources their ocean and coast provide.

THE NEXT WAVE

In 1972, the US space agency NASA released the first image of the full, sunlit sphere of the Earth. Humanity had never seen our planet – our shared home – from that perspective, and the image left an indelible impression.

More than 40 years later, just as we were finalizing this report, NASA released the second such image – not a composite stitched together to create one picture, but a single shutter snap of Earth taken from a million miles away.

By now, of course, the image is familiar. But it still has the power to make us pause and reflect. There are no borders on this globe. We're all connected, and we're totally dependent on this fragile planet suspended in the vast blackness of space.

This blue planet. If you ever doubted the primacy of the ocean in shaping the life on Earth, just look at this image. If you ever doubted the link between ocean and climate, this image shows they are inextricably interwoven.

Alongside awe and humility, this new image fills me with a renewed sense of urgency. Because while the Earth from space in 2015 looks about like it did in 1972, we know that our planet has changed substantially and perhaps irrevocably in the intervening four decades. As this report describes, the marine Living Planet Index has declined by 49 per cent since 1970. That's not just the loss of some fish and some turtles. That's the unravelling of the fabric of an ecosystem that sustains life on Earth.

This year, world leaders are meeting to discuss two global agreements that could have profound implications for the future of the ocean. In September, international heads of state and government will agree a set of Sustainable Development Goals (SDGs). Goal 14 of the SDGs focuses specifically on the ocean. The targets must translate into action to address the issues outlined in this report, including habitat destruction, overfishing, illegal fishing and marine pollution, and the commitments must be backed by significant investment and implementation strategies.

At the end of 2015, governments will meet in Paris to try to reach a binding and universal agreement on tackling climate change. This is of the utmost importance, as current international commitments fall far short of the action we need to stop levels of warming and acidification that would prove catastrophic to ocean ecosystems and the people who depend upon them.

While it's easy to get lost in the complexity of these issues, when we step back and consider what's really at stake, it becomes clear that inaction is not an option.

© Phil Dickie / WWF

John Tanzer, Director, WWF International Marine Programme

© NASA

REFERENCES

Abraham, A. 2015. Stocktake of CTI-CFF Programs and Projects: Strategic Review of Progress and Future Direction. Financial Resources Working Group, CTI-CFF, Interim Regional Secretariat.

ACE. 2009. *Position Analysis: Changes to Antarctic sea ice: impacts*. Antarctic Climate & Ecosystems Cooperative Research Centre, Hobart, Australia.

Agnew, D.J., Pearce, J., Pramod, G., Peatman, T., Watson, R., Beddington, J.R. and T.J. Pitcher. 2009. Estimating the Worldwide Extent of Illegal Fishing. *PLoS ONE* 4(2): e4570. doi:10.1371/journal.pone.0004570

Ahmed, M.I. and Lawrence, A.J. 2007. The status of commercial sea cucumbers from Egypt's northern Red Sea Coast. SPC Beche de Mer Information Bulletin 26.

Anderson, D.M., Burkholder, J.M., Cochlan, W.P., Glibert, P.M., Gobler, C.J., Heil, C.A., Kudela, R.M., Parsons, M.L., Rensel, J.E.J., Townsend, D.W., Trainer, V.L., and G.A. Vargo. 2008. Harmful algal blooms and eutrophication: examining linkages from selected coastal regions of the United States. *Harmful Algae* 8: 39–53.

Arkema, K., Guannel, G., Verutes, G., Wood, S., Guerry, A., Ruckelshaus, M., Kareiva, P., Lacayo, M. and J. Silver. 2013. Coastal habitats shield people and property from sea-level rise and storms. *Nature Climate Change* 3: 913-918.

Arnason, R., Kelleher, K. and R. Willmann. 2008. *The Sunken Billions: The Economic Justification for Fisheries Reform*. Joint publication of the World Bank and the FAO. ISBN 978-0-8213-7790-1.

ADB. 2014. *Regional state of the Coral Triangle—Coral Triangle marine resources: Their status, economies, and management*. Asian Development Bank, Philippines.

Atkinson, A., Hill, S., Barange, M., Pakhomov, E., Raubenheimer, D., Schmidt, K., Simpson, S. and C. Reiss. 2014. Sardine cycles, krill declines, and locust plagues: revisiting 'wasp-waist' food webs *Trends in Ecology & Evolution* 29(6): 309-316.

Baker, K.D., Devine, J.A. and R.L. Haedrich. 2009. Deep-sea fishes in Canada's Atlantic: population declines and predicted recovery times. *Environmental Biology of Fishes*. 85, pp.79–88.

BCG. 2013. *Turning adversity into opportunity: A business plan for the Baltic Sea*. Boston Consulting Group, Stockholm, Sweden.

BCG. 2015. *BCG Economic Valuation: methodology and sources. Reviving the Ocean Economy: the case for action*. Boston Consulting Group, Global Change Institute and WWF International. Gland, Switzerland.

Bird, K.J., Charpentier, R.R., Gautier, D.L., Houseknecht, D.W., Klett, T.R., Pitman, J.K., Moore, T.E., Schenk, C.J., Tennyson, M.E. and C.J. Wandrey. 2008, Circum-Arctic resource appraisal; estimates of undiscovered oil and gas north of the Arctic Circle. US Geological Survey Fact Sheet 2008-3049.

Burke, L., Reytar, K., Spalding, M. and A. Perry. 2011. *Reefs at Risk Revisited*. World Resources Institute, Washington DC, USA.

Brander, L., Baulcomb, C., van der Lelij, J. A. C., Eppink, F., McVittie, A., Nijsten, L. and P. van Beukering. 2015. *The human benefits generated by expanding Marine Protected Areas*. VU University, Amsterdam, The Netherlands.

Bruno, J. F. and Selig, E. R. 2007. Regional decline of coral cover in the Indo-Pacific: timing, extent, and subregional comparisons. *PloS ONE* 2(8): e711.

Bryant, D., Burke, L., McManus, J. and M. Spalding. 1998. *Reefs at Risk: A Map-Based Indicator of Threats to the World's Coral Reefs*. World Resources Institute, International Center for Living Aquatic Resources Management, World Conservation Monitoring Centre, and United Nations Environment Programme.

CCAMLR. 2013a. Illegal, unreported and unregulated (IUU) [online]. Convention on the Conservation of Antarctic Marine Living Resources. Available from: www.ccamlr.org/en/compliance/illegal-unreported-and-unregulated-iuu-fishing [accessed 26 June 2015].

CCAMLR. 2013b. Fishery Report 2013: Champsocephalus gunnari Heard Island (Division 58.5.2) and Fishery Report 2013: Champsocephalus gunnari South Georgia (Subarea 48.3) [online]. Available from: www.ccamlr.org/en/fisheries/icefish-fisheries [accessed 21 July 2015].

CCAMLR. 2015. How is climate change/ocean acidification predicted to impact krill abundance and distribution? Available from: www.ccamlr.org/en/fisheries/krill-%E2%80%93-biology-ecology-and-fishing

Clarke, S.C.. McAllister, M.K., Milner-Gulland, E.J., Kirkwood, G.P., Michielsens, C.G.J., Agnew D.J., Pikitch, E.K., Nakano, H. and M.S. Shivji. 2006. Global estimates of shark catches using trade records from commercial markets. *Ecology Letters* 9: 1115-1126.

Cole, M. 2013. Microplastic ingestion by zooplankton. Environmental Science and Technology 47: 6646–6655.

Cooper E., Burke L., and N. Bood. 2009. Coastal Capital: Belize. The economic contribution of Belize's coral reefs and mangroves. WRI working Paper. World Resources Institute, Washington, DC. 53p.

Copeland, C. 2008. Cruise Ship Pollution: Background, Laws and Regulations, and Key Issues. Congressional Research Service (Report #RL32450), Washington DC, USA.

Cortés, E. 2000. Life history patterns and correlations in sharks. *Reviews in Fisheries Science* 8: 299–344.

CRS. 2006. Fisheries Opportunities Assessment. University of Rhode Island and Florida International University.

Davidson, L.N.K., Krawchuk, M.A. and N.K Dulvy. 2015. Why have global shark and ray landings declined: improved management or overfishing? *Fish & Fisheries* doi: 10.1111/faf.12119.

De'ath, G., Fabricius, K.E., Sweatman, H. and M. Puotinen. 2012. The 27-year decline of the coral cover on the Great Barrier Reef and its causes. *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* 109(44):17995–17999.

Devine, J.A., Baker, K.D. and R.L. Haedrich. 2006. Fisheries: deep-sea fishes qualify as endangered. *Nature* 439: 29.

Dorneles, P.R., Sanz, P., Eppe, G., Azevedo, A.F., Bertozzi, C.P., Martínez, M.A., Secchi, E.R., Barbosa, L.A., Cremer, M., Alonso, M.B., Torres, J.P., Lailson-Brito, J., Malm, O., Eljarrat, E., Barceló, D. and K. Das. 2013. High accumulation of PCDD, PCDF, and PCB congeners in marine mammals from Brazil: A serious PCB problem. *Science of the Total Environment* 463-464: 309-318.

Duhamel, G., Pruvost, P., Bertignac, M., Gasco, N., and M. Hautecoeu. 2011. Major fishery events in Kerguelen Islands: Notothenia rossii, Champsocephalus gunnari, Dissostichus eleginoides – current distribution and status of stocks. In: Duhamel, G. and Welsford, D. (Eds). *The Kerguelen Plateau Marine Ecosystem and Fisheries*. Société Française d'ichtyologie. Available at: www.ccamlr.org/en/ws-mpa-11/p04 [accessed 21 July 2015].

Dulvy, N.K., Fowler, S.L., Musick, J.A., Cavanagh, R.D., Kyne, P.M., Harrison, L.R., Carlson, J.K., Davidson, L.N.K., Fordham, S.V., Francis, M.P., Pollock, C.M., Simpfendorfer, C.A., Burgess, G.H., Carpenter, K.E., Compagno, L.J.V., Ebert, D.A., Gibson, C., Heupel, M.R., Livingstone, S.R., Sanciangco, J.C., Stevens, J.D., Valenti, S and W.T. White. 2014. Extinction risk and conservation of the world's sharks and rays. *eLife* 3: e00590.

Eamer, J., Donaldson, G.M., Gaston, A.J., Kosobokova, K.N., Lárusson, K.F., Melnikov, I.A., Reist, J.D., Richardson, E., Staples, L., and C.H. von Quillfeldt. 2013. *Life linked to ice: A guide to sea-ice-associated biodiversity in this time of rapid change*. CAFF Assessment Series No. 10. Conservation of Arctic Flora and Fauna, Iceland. ISBN: 978-9935-431-25-7.

Epler, B. 2007. *Tourism, the Economy, Population Growth, and Conservation in Galapagos*. Charles Darwin Foundation, Galapagos Islands, Ecuador.

Eriksen, M., Lebreton, L.C.M., Carson, H.S., Thiel, M., Moore, C.J., Borerro, J.C., Galgani, F.,Ryan, P.G. and J. Reisser. 2014. Plastic Pollution in the World's Oceans: More than 5 Trillion Plastic Pieces Weighing over 250,000 Tons Afloat at Sea. *PLoS ONE* 9(12): e111913. doi:10.1371/journal.pone.0111913.

Estes, J.A., Terborgh, J., Brashares, J.S.,Power, M.E., Berger, J., Bond, W.J., Carpenter, S.R., Essington, T.E., Holt, R.D., Jackson, J.B.C., Marquis, R.J., Oksanen, L., Oksanen, T., Paine, R.T., Pikitch, E.K., Ripple, W.J., Sandin, S.A., Scheffer, M., Schoener, T.W., Shurin, J.B., Sinclair, A.R.E., Soulé, M.E., Virtanen, R., and D.A. Wardle. 2011.Trophic Downgrading of Planet Earth. *Science* 333 (6040): 301-306.

Soulé, M.E., Virtanen, R., and D.A. Wardle. 2011.Trophic Downgrading of Planet Earth. *Science* 333 (6040): 301-306.

FAO. 2007. *The world's mangroves 1980-2005*. FAO Forestry paper 153. Food and Agriculture Organization, Rome, Italy.

FAO. 2009. *International Guidelines for the Management of Deep-sea Fisheries in the High Seas*. Food and Agriculture Organization, Rome, Italy.

FAO. 2013. Report of the FAO/MARD Technical Workshop on Early Mortality Syndrome (EMS) or Acute Hepatopancreatic Necrosis Syndrome (AHPND) of Cultured Shrimp (under TCP/VIE/3304). Hanoi, Viet Nam, 25–27 June 2013. FAO Fisheries and Aquaculture Report No. 1053. Rome, Italy.

FAO 2013-2015. FAO Fisheries Department (FAO- FI). Review of the state of world marine fishery resources 2011. Marine resources - Southern Ocean. FIRMS Reports. In: Fisheries and Resources Monitoring System (FIRMS) [online]. firms.fao.org/firms/resource/10528/en [accessed 23 June 2015].

FAO. 2014a. *FAO yearbook: Fishery and Aquaculture Statistics 2012*. Food and Agriculture Organization, Rome, Italy.

FAO. 2014b. *The State of World Fisheries and Aquaculture*. Fisheries and Aquaculture Department, Food and Agriculture Organization, Rome, Italy.

FAO FIGIS. 2011. Fisheries data [online]. Available from: www.fao.org/fishery/figis/en [accessed 29 June 2015].

FAO and OECD. 2015. Fishing for Development. FAO Proceedings 36, Paris, France.

Fourqurean, J., Duarte, C., Kennedy, H., Marbà, N., Holmer, M., Mateo, M.A., Apostolaki, E., Kendrick, G., Krause-Jensen, D., McGlathery, K. and O. Serrano. 2012. Seagrass ecosystems as a globally significant carbon stock. *Nature Geoscience* 5: 505–509.

GBRMPA. 2014. Great Barrier Reef Outlook Report 2014. Great Barrier Reef Marine Park Authority, Townsville, Australia.

Gall, S.C. and Thompson, R.C. 2014. The impact of debris on marine life. *Marine Pollution Bulletin* 92(1-2): 170–179.

García-Hernández, J., Cadena-Cárdenas, L., Betancourt-Lozano, M., García-De-La-Parra, L.M., García-Rico, L. and F. Márquez-Farías. 2007. Total mercury content found in edible tissues of top predator fish from the Gulf of California, Mexico. *Toxicological & Environmental Chemistry* 89(3).

Gattuso, J.-P., Magnan, A., Billé, R., Cheung, W.W.L., Howes, E.L., Joos, F., Allemand, D., Bopp, L., Cooley, S.R., Eakin, C.M., Hoegh-Guldberg, O., Kelly, R.P., Pörtner, H.-O., Rogers, A.D., Baxter, J.M., Laffoley, D., Osborn, D., Rankovic, A., Rochette, J., Sumaila, U.R., Treyer, S. and C. Turley. 2015. Contrasting futures for ocean and society from different anthropogenic CO_2 emissions scenarios. *Science* 349 (6243): aac4722 [DOI:10.1126/science.aac4722].

Global Ocean Commission (GOC), 2014. *From Decline to Recovery: A rescue package for the global Ocean*. Available from: www.globaloceancommission.org/wp-content/uploads/GOC_Report_20_6.FINAL_.spreads.pdf

Gille, S.T. 2002. Warming of the Southern Ocean Since the 1950s. *Science* 295 (5558): 1275-1277.

Gillis, L.G., Bouma, T.J., Jones, C.G., van Katwijk, M.M., Nagelkerken, I., Jeuken, C.J.L., Herman, P.M.J. and A.D. Ziegler. 2014. Potential for landscape-scale positive interactions among tropical marine ecosystems. *Marine Ecology Progress Series* 503: 289-303.

GPO. 2011. Deep Water: The Gulf Oil Disaster and the Future of Offshore Drilling: Report to the President. National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling.

Hill, S.L., Phillips, T. and A. Atkinson. 2013. Potential Climate Change Effects on the Habitat of Antarctic Krill in the Weddell Quadrant of the Southern Ocean. *PLoS ONE* 8(8).

HLPE. 2014. *Sustainable fisheries and aquaculture for food security and nutrition*. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security. Rome, Italy.

Hoegh-Guldberg1, O., Mumby, P. J., Hooten, A. J., Steneck, R. S., Greenfield, P., Gomez, E., Harvell, C.D., Sale, P.F., Edwards, A.J., Caldeira, K., Knowlton, N., Eakin, C.M., Iglesias-Prieto, R., Muthiga, N., Bradbury, R.H., Dubi, A. and M.E. Hatziolos. 2007. Coral Reefs Under Rapid Climate Change and Ocean Acidification, *Science* Vol. 318 no. 5857 pp. 1737-1742

Hoegh-Guldberg, O., Hoegh-Guldberg, H., Veron, J.E.N., Green, A., Gomez, E. D., Lough, J., King, M., Ambariyanto, Hansen, L., Cinner, J., Dews, G., Russ, G., Schuttenberg, H. Z., Peñaflor, E.L., Eakin, C. M., Christensen, T. R. L., Abbey, M., Areki, F., Kosaka, R. A., Tewfik, A. and J. Oliver. 2009. *The Coral Triangle and Climate Change: Ecosystems, People and Societies at Risk*. WWF-Australia, Brisbane, 276 pp.

Hoegh-Guldberg, O. et al. 2013. *Indispensable Ocean: Aligning Ocean Health and Human Well-being*. Guidance from the Blue Ribbon Panel to the Global Partnership for Oceans.

Hoegh-Guldberg, O. et al. 2015. *Reviving the Ocean Economy: the case for action*. WWF International, Gland, Switzerland.

Holy Father Francis. 2015. Encyclical Letter - Laudato Si' - of the Holy Father Francis on Care of our Common Home. Available from: w2.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html

Honey, M. and Krantz, D. 2007. Global Trends in Coastal Tourism, Center on Ecotourism and Sustainable Development. Prepared for WWF. Available from: www.responsibletravel.org/resources/documents/reports/Global_Trends_in_Coastal_Tourism_by_CESD_Jan_08_LR.pdf

Igulu, M.M., Nagelkerken, I., Dorenbosch, M., Grol, M.G.G., Harbone, A.R., Kimire, I.A., Mumby, P.J., Olds, A.D. and Y.D. Mgaya. 2014.

IOTC. 2015. Data querying service [online]. Indian Ocean Tuna Commission. Available from: www.iotc.org/iotc-online-data-querying-service

IPCC. 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, , M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 976pp.

IPCC. 2013. *Climate Change 2013: The Physical Science Basis*. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York, NY, USA. 1535pp.

IPCC. 2014. Summary for policymakers. In: Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D.,Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R. and L.L. White (eds.) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change,* pp.1-32. Cambridge University Press, Cambridge, UK and New York, NY, USA.

Jackson, J.B.C., Donovan, M.K., Cramer, K.L. and V.V. Lam (eds.). 2014. *Status and Trends of Caribbean Coral Reefs: 1970-2012*. Global Coral Reef Monitoring Network, IUCN, Gland, Switzerland.

Jambeck, R., Geyer, R., Wilcox, C., Siegler, T., Perryman, M., Andrady, A., Narayan, R. and K. Law. 2015. Plastic waste inputs from land into the ocean. *Science* 347 (6223): 768-771.

Jones, H.P., D. Hole, and E.S. Zavaleta. 2012 Harnessing nature to help people adapt to climate change. Nature Climate Change 2(7):504-509.

Kaufman, D.S., Schneider, D.P., McKay, N.P., Ammann, C.M., Bradley, R.S., Briffa, K.R., Miller, G.H., Otto-Bliesner, B.L., Overpeck, J.T. and B.M. Vinther. 2009. Recent warming reverses long-term Arctic cooling. *Science* 325(5945): 1236-1239.

Kawaguchi, S., Ishida, A., King, R., Raymond, B., Waller, N., Constable, A., Nicol, S., Wakita, M. and A. Ishimatsu. 2013. Risk maps for Antarctic krill under projected Southern Ocean acidification. *Nature Climate Change* 3: 843–847.

Kelleher, K. 2005. Discards in the World's Marine Fisheries; an Update. FAO Fisheries Technical Paper 470. Food and Agriculture Organization, Rome, Italy.

Lawrence, A. J., Ahmed, M., Hanafy, M., Gabr, H., Ibrahim, A. and A.A.F.A. Gab-Alla. 2005. Status of the sea cucumber fishery in the Red Sea – the Egyptian experience. FAO Fisheries Technical Paper, 79-90, Food and Agriculture Organization, Rome, Italy.

Lusher, A., McHugh, M. and R. Thompson. 2013. Occurrence of microplastics in the gastrointestinal tract of pelagic and demersal fish from the English Channel. *Marine Pollution Bulletin* 67: 94–99.

Maribus. 2014. *World Ocean Review 3: Living with oceans: Marine Resources - Opportunities and Risks*. maribus gGmbH, Hamburg, Germany. Available from: worldoceanreview.com/wp-content/downloads/wor3/WOR3_english.pdf

Mathis, J.T., Cross, J.N., Evans, W. and S.C. Doney. 2015. Ocean acidification in the surface waters of the Pacific-Arctic boundary regions. *Oceanography* 28(2):122–135.

McCauley, D.J., Pinsky, M.L., Palumbi, S.R., Estes, J.A., Joyce, F.H. and R.R. Warner. 2015. Marine defaunation: Animal loss in the global ocean. *Science* 347(6219) doi: 10.1126/science.1255641.

MEA. 2005. *Living Beyond Our Means: Natural Assets And Human Well-being*. Millennium Ecosystem Assessment Board.

Millennium Ecosystem Assessment. 2003. *Ecosystems and Human Well-being: A Framework for Assessment*. Island Press, Washington DC, USA.

Morato, T., Cheung, W.W.L. and T.J. Pitcher. 2006. Vulnerability of seamount fish to fishing: fuzzy analysis of life history attributes. *Journal of Fish Biology* 68: 209–221.

Mualeque, D. 2014. Viabilidade biológica dos santuários de Corane e Tapua, distrito de Moma, provincial de Nampula, Moçambique. *Revista de Investigação Pesqueira* 36: 23-39.
Muldoon, G. 2015. Unpublished data. WWF Coral Triangle Programme.
Mulcrone, R. 2005. Holothuroidea [online]. *Animal Diversity Web*. Available at: animaldiversity.org/accounts/Holothuroidea [accessed 22 May 2015].
Nellemann, C., Hain, S. and J. Alder (eds). 2008. *In Dead Water – Merging of Climate Change with Pollution, Over-Harvest, and Infestations in the World's Fishing Grounds*. United Nations Environment Programme, GRID-Arendal, Norway.
Nagelkerken, I., Blaber, S.J.M., Bouillon, S., Green, P., Haywood, M., Kirton, L.G., Meynecke, J.-O., Pawlik, J., Penrose, H.M., Sasekumar, A. and P.J. Somerfield. 2008. The habitat function of mangroves for terrestrial and marine fauna: a review. *Aquatic Botany* 89: 155-185.
Norse, E., Brooke, S., Cheung, W., Clark, M.R., Ekeland, I., Froese, R., Gjerde, K.M., Haedrich, R.L., Heppell, S.S., Morato, T., Morgan, L.E., Pauly, D., Sumaila, R. and R. Watson. 2012. Sustainability of deep-sea fisheries. *Marine Policy* 36: 307–320.
Orth, R., Carruthers, T., Dennison, W., Duarte, C., Fourqurean, J., Heck Jr., K., Hughes, A.R., Kendrick, G., Kenworthy, W.J., Olyarnik, S., Short, F., Waycott, M. and S. Williams. 2006. A Global Crisis for Seagrass Ecosystems. *BioScience* 56 (12): 987-996.
Österblom, H. and Bodin, Ö. 2012. Global Cooperation among Diverse Organizations to Reduce Illegal Fishing in the Southern Ocean. *Conservation Biology* 26: 638–648.
Overland, J. E. and Wang, M. 2013. When will the summer Arctic be nearly sea ice free? *Geophysical Research Letters* 40(10): 2097-2101.
Pet-Soede, L. Tabunakawai, K. and M.A. Dunais. 2011. *The Coral Triangle* photobook. ADB and WWF.
Poppel, B., Kruse, J., Duhaime, G. and L. Abryutina. 2007. *SLiCA Results*. Institute of Social and Economic Research, University of Alaska, Anchorage, US.
Purcell, S., Samyn, Y. and C. Conand. 2012. *Commercially important sea cucumbers of the world*.
Purcell, S. W., Mercier, A., Conand, C., Hamel, J. F., Toral-Granda, M. V., Lovatelli, A. and S. Uthicke. 2013. Sea cucumber fisheries: global analysis of stocks, management measures and drivers of overfishing. *Fish and Fisheries* 14(1): 34-59.
Rabalais, N.N. 2002. Nitrogen in Aquatic Ecosystems. *Ambio* 31(2): 102–112.
Ramirez-Llodra, E., Tyler, P.A., Baker, M.C., Bergstad, O.A., Clark, M.R., Escobar, E. and C.L. Van Dover. 2011. Man and the Last Great Wilderness: Human Impact on the Deep Sea. *PLoS ONE* 6(8): e22588. doi:10.1371/journal.pone.0022588.
Roberts, C. 2002.Deep impact: the rising toll of fishing in the deep sea. *TRENDS in Ecology & Evolution* 17(5):242-245.
Rochette, J. 2014. International regulation of offshore oil and gas activities: time to head over the parapet. IDDRI Policy Brief No 06/14 Feb 2014. Available from: www.iddri.org/Publications/Collections/Syntheses/PB0614_JR_offshore_EN.pdf
Selman, M., Greenhalgh, S., Diaz, R. and Z. Sugg. 2008. Eutrophication and Hypoxia in Coastal Areas: A Global Assessment of the State of Knowledge. Water Quality: Eutrophication and Hypoxia Policy Note Series No.1. World Resources Institute, Washington DC, USA.
Seltenrich, N. 2015. New Link in the Food Chain? Marine Plastic Pollution and Seafood Safety. *Environmental Health Perspectives* 123(2): A34–A41. doi:10.1289/ehp.123-A34.
Shepherd, S. A., Martinez, P., Toral-Granda, M. V. and G.J. Edgar. 2004. The Galápagos sea cucumber fishery: management improves as stocks decline. *Environmental Conservation* 31(02): 102-110.
Shukman, D. 2014. Deep sea mining: licences issued. BBC. Available from: www.bbc.com/news/science-environment-28442640
Smith, V. H. and Schindler, D. W. 2009. Eutrophication science: where do we go from here? *Trends in Ecology & Evolution* 24: 201–207. doi:10.1016/J.TREE.2008.11.009.
Spalding, M., Ravilious, C. and E. Green. 2001. *World Atlas of Coral Reefs*. University of California Press, Berkeley, CA, USA and UNEP/WCMC. ISBN 0520232550.
Spalding, M., Kainuma, M. and L. Collins. 2010. *World Atlas of Mangroves*. Earthscan.
Strauss, B. and Kulp, S. 2014. *Flooding risk from climate change, country by country, research report by Climate Central*. Available from: www.climatecentral.org/news/new-analysis-global-exposure-to-sea-level-rise-flooding-18066.
Sumaila, U., Khan, A., Dyck, A., Watson, R., Munro, G., Tydemers, P. and D. Pauly. 2010. A bottom-up re-estimation of fishing subsidies. *Journal of Bioeconomics* 12: 201-225.

Sumaila, U.R., Lam, V., Le Manach, F., Swartz, W. and D. Pauly. 2013. *Global Fisheries Subsidies*. European Parliament Directorate-General For Internal Policies, Brussels.
Tournadre, J. 2014. Anthropogenic pressure on the open ocean: The growth of ship traffic revealed by altimeter data analysis. *Geophysical Research Letters* 41: 7924–7932, doi:10.1002/2014GL061786.
Turner, J., Bindschadler, R.A., Convey, P., Di Prisco, G., Fahrbach, E., Gutt, J., Hodgson, D.A., Mayewski, P.A. and C.P. Summerhayes. 2009. Antarctic Climate Change and the Environment. SCAR, Cambridge, UK. ACE. 2009. Position Analysis: Changes to Antarctic sea ice: impacts. Antarctic Climate & Ecosystems Cooperative Research Centre, Hobart, Australia.
UN General Assembly 2004 Oceans and the Law of the Sea, Report of the Secretary-General of 18 August 2004, A/59/62/Add.1, 29, para. 97.
UNESCO. 2012. Managing water under uncertainty and risk. The United Nations World Water Development Report 4. United Nations Educational, Scientific and Cultural Organization, Paris, France.
UNEP. 2006. *Ecosystems and Biodiversity in Deep Waters and High Seas*. UNEP Regional Seas Reports and Studies No. 178. United Nations Environment Programme/International Union for the Conservation of Nature, Switzerland. ISBN: 92-807-2734-6.
UNEP. 2011. Taking Steps Toward Marine and Coastal Ecosystem-Based Management - An Introductory Guide. UNEP Regional Seas Reports and Studies No. 189.
UNEP TEEB. 2012. *Why Value the Oceans? A Discussion Paper*. UNEP/GRID-Arendal, Duke University's Nicholas Institute for Environmental Policy Solutions, UNEP-TEEB Office and the UNEP Regional Seas Programme.
UNEP. 2014. *The Importance of Mangroves to People: A Call to Action*. van Bochove, J., Sullivan, E. and T. Nakamura (eds). UNEP, World Conservation Monitoring Centre, Cambridge, UK.
UNEP-WCMC, WorldFish Centre, WRI, TNC. 2010. Global distribution of warm-water coral reefs, compiled from multiple sources including the Millennium Coral Reef Mapping Project. UNEP World Conservation Monitoring Centre, Cambridge, UK. Available from: data.unep-wcmc.org/datasets/1
UN WWAP. 2014. Water and Ecosystems [online]. United Nations World Water Assessment Programme. Available from www.unesco.org/new/en/natural-sciences/environment/water/wwap/facts-and-figures/ecosystems [accessed 22 June 2015].
Vianna, G.M.S., Meeuwig, J.J., Pannell, D., Sykes, H. and M.G. Meekan. 2011. *The socio-economic value of the shark-diving industry in Fiji*. Australian Institute of Marine Science. University of Western Australia, Perth, Australia.
Wallace, B.P., Di Matteo, A.D., Hurley B.J., Finkbeiner. E.M., Bolten, A.B., Chaloupka, M.Y., et al. 2010. Regional Management Units for Marine Turtles: A Novel Framework for Prioritizing Conservation and Research across Multiple Scales. *PLoS ONE* 5(12): e15465. doi:10.1371/journal.pone.0015465.
Watson, R.A. and Morato, T. 2013. Fishing down the deep: Accounting for within-species changes in depth of fishing. *Fisheries Research* 140: 63–65.
Watson R., Zeller, D., and D. Pauly. 2011. Spatial expansion of EU and non -EU fishing fleets into the global ocean, 1950 to the present. Report commissioned by WWF-Netherlands. Available at www.seaaroundus.org/doc/publications/books-and-reports/2011/Watson-et-al-EU-fleet-expansion.pdf
Waycott, M., Duarte, C.M., Carruthers, T.J.B., Orth, R.J., Dennison, W.C., Olyarnik, S., Calladine, A., Fourqurean, J.W., Heck, Jr, K.L., Hughes, A.R., Kendrick, G.A., Kenworthy, W.J., Short, F.T. and S.L. Williams. 2009. Accelerating loss of seagrasses across the globe threatens coastal ecosystems. *Proceedings of the National Academy of Sciences of the United States of America*, 106 (30): 12377-12381.
WCPFC. 2014. WCPFC Tuna Fishery Yearbook 2013. Western and Central Pacific Fisheries Commission. Available from: www.wcpfc.int/statistical-bulletins
Worm, B., Davis, B., Kettemer, L, Ward-Paige, C.A., Chapman, D., Heithaus, M.R., Kessel, S.T. and S.H. Gruber. 2013. Global catches, exploitation rates, and rebuilding options for sharks. *Marine Policy* 40: 194-204.
WTTC. 2015. Travel and Tourism: Economic Impact 2014. World Travel and Tourism Council. Available from: www.wttc.org/-/media/files/reports/economic%20impact%20research/economic%20impact%202015%20summary_web.pdf
WWF. 2014. *Living Planet Report 2014: species and spaces, people and places* [McLellan, R., Iyengar, L., Jeffries, B. and N. Oerlemans (Eds)]. WWF, Gland, Switzerland.
WWF-ZSL. 2015. The Living Planet Index database. WWF and the Zoological Society of London. Downloaded 3 March 2015. www.livingplanetindex.org

WWF NETWORK OFFICES

WWF Offices*

Armenia
Azerbaijan
Australia
Austria
Belgium
Belize
Bhutan
Bolivia
Brazil
Bulgaria
Cambodia
Cameroon
Canada
Central African Republic
Chile
China
Colombia
Croatia
D.R. of Congo
Denmark
Ecuador
Finland
Fiji
France
French Guyana
Gabon
Georgia
Germany
Greece
Guatemala
Guyana
Honduras
Hong Kong
Hungary
India
Indonesia
Italy
Japan
Kenya
Laos
Madagascar
Malaysia
Mexico
Mongolia
Mozambique
Myanmar
Namibia
Nepal
Netherlands
New Zealand
Norway
Pakistan
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Poland
Republic of South Korea
Romania
Russia
Singapore
Solomon Islands
South Africa
Spain
Suriname
Sweden
Switzerland
Tanzania
Thailand
Tunisia
Turkey
Uganda
United Arab Emirates
United Kingdom
United States of America
Vietnam
Zambia
Zimbabwe

WWF Associates

Fundación Vida Silvestre (Argentina)
Pasaules Dabas Fonds (Latvia)
Nigerian Conservation Foundation (Nigeria)

***As at July 2015**

Publication details

Published in August 2015 by WWF – World Wide Fund for Nature (Formerly World Wildlife Fund), Gland, Switzerland ("WWF").

Recommended citation:
WWF. 2015. *Living Blue Planet Report. Species, habitats and human well-being.* [Tanzer, J., Phua, C., Lawrence, A., Gonzales, A., Roxburgh, T. and P. Gamblin (Eds)]. WWF, Gland, Switzerland.

Contributors
Editor-in-Chief: John Tanzer
Lead Editors: Carol Phua, Barney Jeffries, Anissa Lawrence, Aimee Gonzales, Paul Gamblin, Toby Roxburgh
Editorial Team: Stephanie Verbeek, Gretchen Lyons, Paolo Mangahas, Valerie Burgener, May Guerraoui

Zoological Society of London
Louise McRae, Mahboobeh Shirkhorshidi, Ellie Trezise, Charlie Howarth, Helen Muller, Robin Freeman
Bryan P. Wallace (Stratus Consulting, USA)
Nicolas J. Pilcher (Marine Research Foundation, Malaysia)

WWF
David Aplin, Katie Arkema, Hugo Arnal, Gemma Quilez Badia, Jessica Battle, Nadia Bood, Ian Campbell, Nerissa Chao, Andy Cornish, Daniella Diz, Phil Freeman, Domingos Gove, Piers Hart, Jon Hobbs, Robecca Jumin, A. G. Klei, Jochem Lamp, Richard Leck, Aimee Leslie, Angela Lim, Gilly Llewellyn, Stephan Lutter, Emily McKenzie, Chantal Menard, Pauli Merriman, Alissa Moen, Geoffrey Muldoon, Rab Nawaz, Ludo Nijsten, Maria Amalia Porta, Tinh Huynh Quoc, Harifidy Olivier Ralison, Mary Rokonadravu, Liza Rosen, Melissa Sanfourche, Shannon Seeto, Vilisite Tamani, Clive Tesar, Ottilia Thoreson, Dwi Aryo Tjiptohandono, Cristina Torres, Simon Walmsley, Pablo Xavier Guerrero Verduga, Edith Verhoestraete, Bob Zuur

With special thanks for review and support to:
Ivan Nagelkerken (University of Adelaide, Australia)
Ove Hoegh-Guldberg (University of Queensland, Australia)
Lorenzo Álvarez-Filip (Universidad Nacional Autónoma de México, Mexico)
Angus Atkinson (Plymouth Marine Laboratory, UK)
Amy Rosenthal (MacArthur Foundation)

WWF: Natascha Zwaal, Louise Heaps, Giuseppe Di Carlo, Piers Hart, Jackie Thomas, Mkhululi Silandela, John Duncan, Sally Bailey, Carel Drijver, Brad Ack

LIVING BLUE PLANET REPORT

100% RECYCLED

SPECIES

Populations of fish species used by humans have fallen by half.

HUMAN WELL-BEING

Marine and freshwater fisheries are a major source of protein for 2.9 billion people.

HABITATS

Tropical reefs have lost more than half their reef-building corals over the last 30 years.

NATURAL CAPITAL

The ocean generates economic benefits worth at least US$2.5 trillion per year.

WWF

Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

ocean.panda.org