Marine biodiversity and ecosystem services

Key findings from the Global Assessment of the Intergovernmental Platform for Biodiversity and Ecosystem Services

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Key findings on marine biodiversity and ecosystem services are presented in this testimony, based on the global assessment on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES). I will start by a broad brush picture of the current status of marine biodiversity, depict why it is essential to our livelihoods, then expand on what futures we can anticipate and finally present pathways and actionable options to counter biodiversity loss and improve our dependent quality of life.

Marine biodiversity is declining at unprecedented rates

The scientific evidence is unequivocal – **marine biodiversity has been impacted at unprecedented rates** by direct human activities (mainly in the form of fishing, coastal development and pollution) and by climate change (mainly in the form of ocean warming, ocean acidification, sea level rise, extreme events), jeopardizing major ecosystem services to human societies and increasing inequities. Almost 33% of reef forming corals, sharks and shark relatives, and >33% marine mammals are threatened with extinction. In the last decade, 66 per cent of the ocean area has been experiencing increasing cumulative impacts, and only 3% of the ocean is now described as free from human pressure. **Globally, fishing exploitation has had the largest negative impacts on marine biodiversity and habitats in the past 50 years, while climate change impacts have been accelerating**. Global food fish consumption has increased markedly during the last six decades outpacing population growth (3.2 % per year vs 1.6 % from 1961 to 2016) and exceeded that of meat from all terrestrial animals combined (2.8%), with per capita fish consumption increasing from 9.0 kg in 1961 to 20.3 kg in 2016. The expansion in demand has been driven by a combination of population growth, rising incomes, urbanization, and globalization of fish markets. In response, fishing effort has continued to increase but global catches have been stagnating for almost 30 years. This is a clear sign of global overexploitation. In 2016, 93% of fish stocks were classified as overexploited or fully exploited with severe impacts on non-target species and habitats. Global fish catches have been sustained by expanding fisheries geographically and fishing in deeper waters. Today, industrial fishing, concentrated in a few countries and corporations, covers at least 55 per cent of the oceans, largely concentrated in the northeast Atlantic, the northwest Pacific and upwelling regions off South America and West Africa. Along the coastlines, **sea use changes** (including **coastal development, aquaculture)** bring challenges to coastal ecosystems in addition to fishing and climate change. Coastal populations are increasing disproportionately relative to the global population increase. Many of emerging cities are on the coast and their growth will add to the 75% of the world's mega-cities which are already coastally located. Over 2.6 billion people live on or near the coast, many in developing countries where dependence on coastal resources may be high and demand for multiple benefits such as food, coastal protection and income, will continue to grow as human populations expand. The most productive and diverse coastal ecosystems are henceforth threatened: seagrass meadows have decreased in extent by over 10 per cent per decade from 1970-2000, mangroves cover has declined by 38% between 1996-2010, live coral cover on reefs has nearly halved in the past 150 years, the decline dramatically accelerating over the past 2-3 decades due to increased water temperature and ocean acidification interacting with and further exacerbating other drivers of loss (fishing, pollution). **Pollution** from land sources is a major driver of negative impacts on nature. Marine plastic pollution in particular has increased tenfold since 1980, affecting at least 267 species, including 86 % of marine turtles, 44 % of seabirds and 43 % of marine mammals. Plastic microparticles and nanoparticles are entering marine food webs and can potentially harm humans' health. Coastal waters have the highest levels of metals and persistent organic pollutants from industrial discharges and agricultural runoff, poisoning coastal fish harvests. Excessive or inappropriate application of fertilizers can lead to large nitrogen and phosphorus runoff from agricultural fields, causing eutrophication in coastal waters and subsequent aerobic microbial decomposition, that is responsible for the development of hypoxic zones (« dead zones ») covering a total area of more than 245,000 km2 as early as 2008 (the equivalent of UK area). The dynamics of ocean and airborne transport of pollutants mean that the harm from inputs of plastics, persistent organic pollutants, and heavy metals is felt worldwide, and includes consequences for human health.

Healthy marine ecosystems are essential to our livelihoods

The dramatic loss of biodiversity imperils human societies as **oceans are essential to life and provide major ecosystem services**. Marine phytoplankton produce about half of the global O_2. The ocean supports fisheries and aquaculture activities and produced on average 104.3 million tons per year of fish and invertebrates from 2009-2014, which represented approximately 17% of the animal protein consumed by humans globally, but this share can be 50 % or higher in some small island developing states, as well as in Bangladesh, Cambodia, Gambia, Ghana, Indonesia, Sierra Leone and Sri Lanka. In 2016, fisheries and aquaculture production directly employed about 60 million people. Oceans also support rapid socioeconomic development and growth of human population on coastlines, with increasingly intensive, multiple uses leading to heavily degraded habitats. Coastal marine ecosystems are among the most productive systems globally, and their loss and deterioration reduce their ability to protect shorelines, and the people and species that live there, from storms, as well as their ability to provide sustainable livelihoods. Urbanization and coastal development can also restrict the capacity of coastal ecosystems to adapt to rising sea levels e.g. through the “coastal squeeze”. **The ocean is central to regulating the Earth's climate**. The ocean absorbs around 25% of the anthropogenic emissions of CO_2 by biogenic sequestration (channeled through phytoplankton, and coastal wetlands vegetation) or by dissolution in the ocean water mass, leading to ocean acidification with a decrease in surface seawater pH of 0.1 units since the beginning of the industrial era. The ocean also absorbs 93% of the Earth's excess heat energy, resulting in sea warming of 0.11°C per decade in the upper 75m of the ocean between 1971 and 2010.

Future scenarios for marine biodiversity

Globally, none of the current human-induced pressures are projected to decrease in the future, they even intensify in business-as-usual scenarios (BAU).
In the last decade, biodiversity science has made considerable progress in building integrated models and scenarios that link multiple drivers of global change to ecosystem functioning from the physics, through biogeochemistry, plankton up to fish biodiversity and fisheries. These models and scenarios provide decision-makers with visions for the future, and exploration of actionable management, economic, policy options for the future of our oceans.

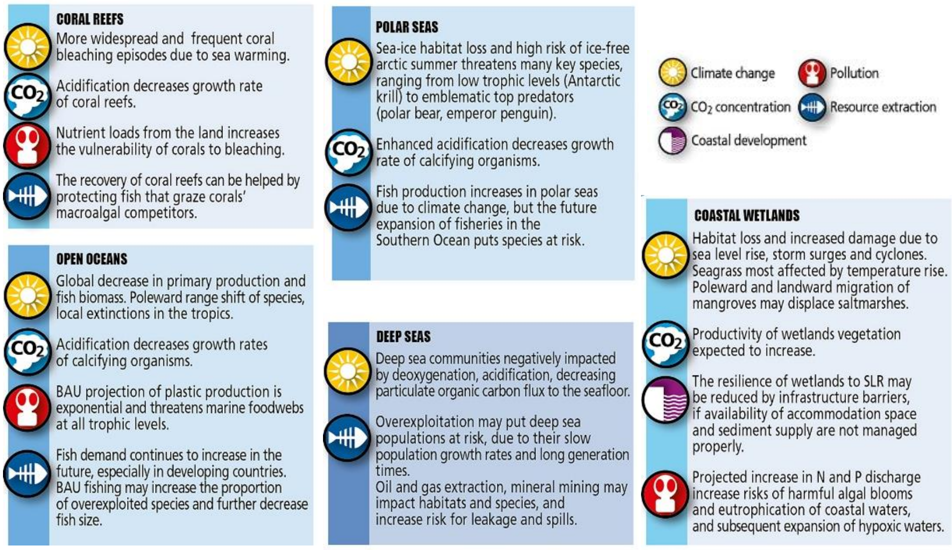

Figure 1: Examples of future projected impacts of major drivers of change on marine biodiversity and ecosystems. BAU: Business as usual future scenario. SLR: sea level rise. N: nitrogen, P: phosphorus.

Our future oceans and our dependent livelihoods will strongly depend on the amount of green house gases emitted today and in the coming decades. **Mean sea surface temperature is projected to increase** by +2.7°C in 2090-2099 as compared to 1990-1999 (or ca. 3.7°C above pre-industrial level) for the high emission scenario (RCP8.5, also considered as a "business as usual" scenario), whereas the warming is limited to +0.71°C for the more stringent RCP2.6 emission scenario (or ca. 1.7°C above pre-industrial level). At the regional scale, stronger warming occurs in the tropics, in the North Pacific and in the Arctic Ocean, with the sea surface warming more than +4°C at the end of the 21st century under RCP8.5. As global temperatures rise, so does the **mean sea level** due primarily to the thermal expansion of ocean water and by melting of glaciers, ice caps and ice sheets. Under the high emission scenario (RCP8.5), sea level rise (SLR) is projected to reach 52-131 cm by 2100 relative to year 2000. A broadly uniform decrease of the **mean sea surface pH** of -0.33 pH units by the 2090s relative to the 1990s is predicted under high emission scenario (RCP8.5), which will severely impact the growth of shells or skeletons of many calcifying marine organisms. Models also project **decreasing global ocean oxygen** due to climate change. The mechanisms at play are a reduction of oxygen solubility due to ocean warming and the combination of increased stratification and reduced ventilation that prevents the penetration of oxygen into the deep ocean. Deoxygenation will continue over the 21st century irrespective of the future scenario, with decreases of global O2 of -1.8% and -3.45% under RCP2.6 and RCP8.5, respectively, with a stronger drop for the North Pacific, the North Atlantic, and the Southern Ocean.

Future climate change will hence alter marine habitats and modify biogeochemical cycles, producing more hostile conditions and threatening vulnerable ecosystems and species with low adaptive capacity. By the end of the century, climate change is projected to decrease net primary production (by ca. 3.5% under the low greenhouse gas emissions scenario, RCP2.6 and up to 9% in the high emissions scenario, RCP8.5), and secondary production up to fish (by 3% to 23% under RCP2.6 and RCP8.5, respectively), as well as top predator. Fish populations and catch potential are projected to move poleward due to ocean warming with a mean latitudinal range shift of 15.5 km to 25.6 km per decade to 2050 (under RCP2.6 and RCP8.5, respectively), leading to high extirpation rates of biomass and local species extinctions in the tropics. However, that does not necessarily imply an increase in biodiversity in the polar seas, because of the rapid rate of sea ice retreat and the enhanced ocean acidification of cold waters in the Arctic and Southern Oceans. Along coastlines, the upsurge in extreme climatic events and sea level rise is expected to cause increased fragmentation and loss of habitats. Climate change is projected to become increasingly important as a direct driver of changes in nature and its contributions to people in the next decades. Scenarios project mostly adverse climate change effects on biodiversity and ecosystem functioning, which worsen with incremental global warming. **They show that limiting global warming to well below 2°C plays a critical role in reducing adverse impacts on nature and its contributions to people. For example,** coral reefs are particularly vulnerable to climate change and are projected to decline to 10-30 % of former cover at 1.5°C warming and to less than 1 % at 2°C warming.

Adding to future climate change and potentially amplifying negative impacts on marine ecosystems, direct human-mediated pressures will intensify in business-as-usual scenarios.

Diverse forms of pollution (excessive nutrient loads, toxic contaminants, persistent organic pollutants, plastics, solid waste) will likely continue to pervade marine ecosystems in the future, constituting additional threats to living organisms. The oceans are sinks for landborne and airborne inputs of persistent pollutants which can both travel great distances in the near-surface water masses of the open ocean, and sink into the deeper ocean. In coastal oceanic waters, increasing nutrient loads in combination with sea warming will likely stimulate eutrophication and increase the extent of oxygen minimum zones. If current plastic production and waste management trends continue, about 12,000 Mt of plastic waste will accumulate in the environment by 2050, particularly in oceans.

An increase in the today most impacting driver, fisheries exploitation, is projected in business-as-usual scenarios, as a response to increasing demand for fish and seafood resulting from human population growth (projected to reach ca. 9.8 billion people in 2050) and increasing average income that allows for augmenting the proportion of fish in the diet. Relative to climate change impacts, scenarios project that the choice of fisheries management and market regulation measures can have the strongest impacts on the future status of marine fish populations. Recent scientific studies show that business-as-usual fisheries management would increase the proportion of overexploited populations by 20% in 2050. In contrast, a scenario where long-term economic benefits are optimized (without subsidies), such as through rights-based fisheries management, the majority of exploited fish populations (98%) recover to a healthy status, with a median time of recovery of about 10 years. Likewise, it was shown that reforming fisheries by adopting an optimal harvest policy that maximizes long-term economic benefits (without subsidies) and that adapts its management strategy to climate-induced changes in fish biomass and spatial distribution could offset the detrimental impacts of climate change on fish biomass and catch under most greenhouse gas emission scenarios, except the worse case business-as-usual scenario (RCP8.5).

Future options for sustainable fisheries

Ensuring sustainable food production from the oceans while protecting biodiversity entails policy action to apply sustainable ecosystem approaches to fisheries management, spatial planning (including the implementation and expansion of marine protected areas) and, more broadly, to address drivers such as climate change and pollution. Transformative changes are needed at different levels, with four key leverage points:

1) **Ensuring sustainable exploitation and best fisheries practices.** In 2016, only 7% of fish stocks are underexploited. This small portion of fish stocks offers little scope for expanding fisheries in the future, especially since they are often of low commercial and nutritional interest. The only option to sustain the increasing demand in seafood is to rebuild the overexploited stocks by reducing fishing effort, which would both restore biodiversity and increase fisheries yield by 2050. However, Nations are not making progress towards the achievement of Aichi

Target 6 of the Convention on Biological Diversity (CBD), and the UN Sustainable Development Goal 14.4. The persistence of a high proportion of overfished stocks is an area of great concern. It is urgent to take actions today, because rebuilding fish stocks requires time, usually two to three times species' life span. In this regard, it is important to enhance capacity-building for the adoption of best fisheries management practices; adopt measures to promote conservation financing and corporate social responsibility; develop new legal and binding instruments; implement and enforce global agreements for responsible fisheries; and urgently take all steps necessary to prevent, deter and eliminate Illegal, Unreported and Unregulated fishing (IUU) which made up 33% of the world's total catch in 2011, and is the highest off the coast of West Africa and in the Southwest Atlantic.

2) **Halting harmful subsidies**. Economic incentives that hide environmental and social costs generally have favoured expanding economic activity, often accompanied by environmental harm, over conservation and sustainable production. Harmful subsidies are often associated with overexploitation of natural resources, as well as inefficient production and waste management. In fisheries, subsidies to increase and maintain capacity, which in turn often lead to degradation of nature, constitute perhaps a majority of the tens of US$ billions spent on subsidies. Vested interests may oppose the removal of subsidies or the introduction of other policies. However, policy reforms to deal with such causes of environmental harm offer the potential to both conserve nature and provide economic benefits.

3) **Expanding and effectively managing the current network of marine protected areas**. Marine protected areas (MPAs) have demonstrated success in both biodiversity conservation and improved local quality of life when managed effectively and can be further expanded through larger or more interconnected protected areas or new protected areas in currently under-represented regions and key biodiversity areas. The Aichi Target 11 of the CBD is one of the very few targets registering progress of Parties towards achievement *"By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes."*. As of 2019, MPAs coverage represents 7.6% of the Ocean. However, this number hides a more complex reality. Although fishing has been shown to be the main impacting driver in the last 50 years, only 2.2% of the ocean is in strongly protected no-take marine reserves (https://protectedplanet.net/marine). A stronger synergy of actions developed between this target 11 and target 6 of the CBD is essential for achieving truly sustainable management of fisheries exploitation. In addition, to meet the Sustainable Development Goals and achieve the 2050 Vision for Biodiversity, future targets are likely to be more effective if they take into account the impacts of climate change. For example, climate change is projected to greatly increase the number of species under threat, with fewer species expanding their ranges or experiencing more suitable climatic conditions than the number of species experiencing range contraction or less suitable conditions. The impacts of climate change on the effectiveness of marine protected areas calls for the re-evaluation of conservation objectives, but there are currently few protected areas whose objectives and management take climate change into account.

4) **Addressing inequalities, especially regarding income and food subsistence for local communities and small-scale artisanal fisheries. Relocating seafood production appears as one of the main leverage points.** Distant areas of the world are increasingly connected as consumption, production, and governance decisions increasingly influence seafood flows across the world, generating aggregate economic gains while shifting economic and environmental costs. With the rise of per capita consumption of seafood, developed and emerging countries have contained fishing impacts in their national waters often by importing seafood mainly from

developing countries or by translocating their fishing pressure through acquisition of fishing rights in foreign waters, mainly in developing countries. As a result, the largest share of global catches is produced in developing countries (71% in 2016) and least developed countries have suffered the highest biodiversity degradation. Fish is one of the most traded food commodities in the world with 35% of fisheries production exported, of which 59% in volume come from developing countries. The European Union represents the largest single market for fish and fish products, followed by the United States of America and Japan. In 2016, their combined imports accounted for about 64 % of total import value of fish and fish products. For local communities, reduced, declining and unequal access to marine resources may, in a complex interaction with other factors be a source of conflict. Adding to the risk of overfishing, tropical regions face critical challenges due to interactions with climate change (with fish stocks projected to move polewards), and intense coastal development. Equitable share of fish resources is a ubiquitous challenge worldwide that often translates into the competition between industrial fisheries and small-scale artisanal fisheries. Smaller artisanal fisheries account for over 90% of the commercial fishers, as well as nearly half (46%) of the total global fish catch, yet the rest of global fish production is quite concentrated, within a few countries and a few corporations, while funds channelled through tax havens support most vessels implicated in illegal, unreported and unregulated fishing. It is therefore critical to spur well managed small-scale fisheries, using selective and non-destructive gears to promote employment, lower fossil fuel consumptions, and reduce fisheries footprint on the oceans.