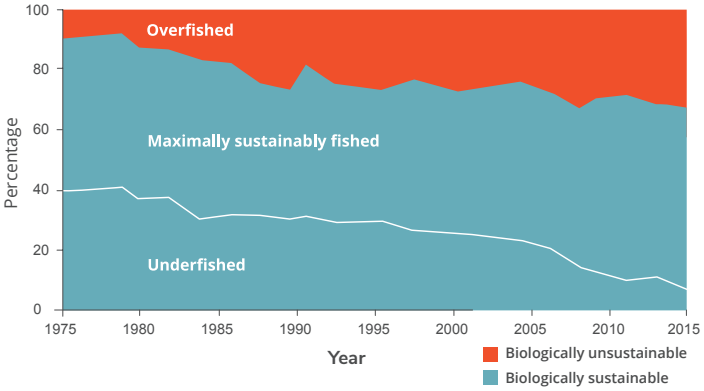
It is easy to forget the Earth is fundamentally a blue planet: the ocean covers 71% of the surface area of the Earth. The ecological and economic assets provided by the ocean are staggering. If compared to the top 10 economies in the world, the ocean would rank seventh, yielding an annual value of goods and services of USD 2.5 trillion. But research shows that the ocean is now at greater risk now than at any other time in recorded history.

This primer features an overview of major threats facing the marine environment. While the list is presented by category, most of these threats are not siloed but interact in combined and detrimental ways.

Overfishing

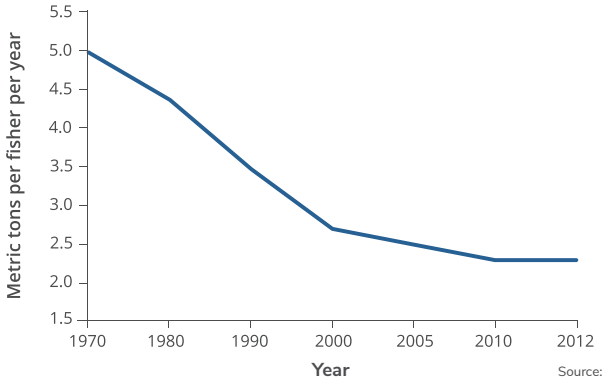
Overfishing is the largest direct threat to marine ecosystems. A majority of global fisheries (over 80% of assessed stocks) are fully fished or overfished today (Fig. 1). An excess of boats chasing too few fish has been problematic for decades; current fishing fleets are estimated to be 250% larger than what is sustainable. The estimated catch per fisher has declined by more than 50% since 1970 (Fig. 2). This problem has been exacerbated by global subsidies, estimated to be at least USD 20 billion annually—an amount equal to roughly 25% of the value of global catch.

Fig. 1 Global trends in state of the world's marine fish stocks, 1974–2015



Source: FAO, 2018.

Fig. 2 Average catch per fisher per year



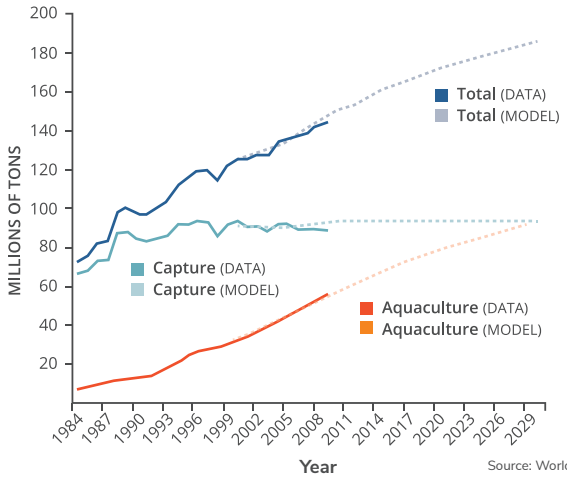
Source: PNAS, 2017.

Aside from legal overfishing, illegal fishing is a driving factor in the overexploitation of wild stocks. The global losses stemming from illegal, unreported, and unregulated (IUU) fishing are estimated between USD 10 billion-23.5 billion annually (representing between 11-26 million tonnes of catch).

Aquaculture

Aquaculture can present an opportunity for meeting future protein demands of a rapidly growing global population, if sustainability considerations are prioritized. However, not all aquaculture is created equally. The sector faces its own constraints and challenges, including a reliance on wild-caught fish to feed captive fish, degradation of coastal habitats for expansion, disease outbreaks to wild fish populations, and pollution from antibiotic use. Given the plateaued growth of wild capture fisheries in recent years, aquaculture is likely to make up an increasingly important component of global seafood production in the coming decades.

Fig. 3 Global fish production: data and projections, 1984–2030



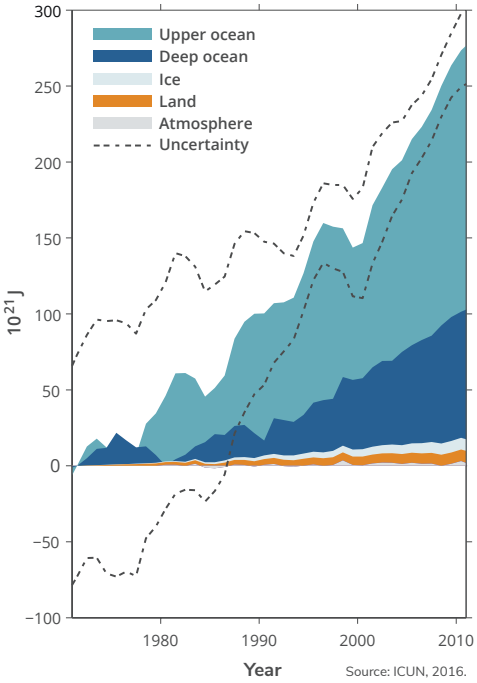
Source: World Bank, 2013.

Worldwide, fisheries provide 3.2 billion people with around 20% of their average intake of animal protein. In some countries—particularly in Small Island Developing States—fish make up over 50% of per capita protein intake. If production practices are sustainable, there is strong potential for wild capture fisheries and aquaculture to contribute to food security for a global population expected to reach 9.8 billion by 2050.

Climate change and ocean acidification

The fundamental chemistry of the ocean is changing at a rate unprecedented in human history. The ocean plays a key role as a global climate regulator: it has absorbed 93% of excess heat trapped by GHG emissions since the 1970s (Fig. 4). As a result of climate change, the ocean is experiencing major changes in several environmental conditions, including salinity, pH, oxygen levels, and circulation. The increased uptake of carbon dioxide is acidifying ocean waters. At current rates, ocean pH may drop another 120% by 2100, creating a more acidic ocean than seen in the past 20 million years. Ocean acidification impacts will cascade throughout the marine food chain in potentially catastrophic ways. This could possibly devastate not only marine populations but also human populations, particularly those with the least resilience to adapt in terms of livelihoods and food security.

Fig. 4 Energy accumulation by the Earth's climate system



Pollution, eutrophication, and hypoxia

No area of the ocean is completely untouched by human activity, as demonstrated by marine debris, which has been found everywhere from the once-pristine Arctic Ocean to remote, uninhabited South Pacific atolls. Chemical alterations—including pollution, eutrophication, and hypoxia—taking an unquantified, but demonstrably negative, toll on the marine environment.

The most common form of pollution entering the marine environment is large-scale nutrient runoff associated with eutrophication (i.e., excess of nutrients), and subsequent hypoxia (i.e., oxygen deficiency) events, known as "dead zones." Sources of nutrient pollution vary significantly by region: in the U.S. and the E.U., agricultural sources (commercial fertilizers and animal manure) are the primary sources of nutrient pollution in waterways. In South America, Asia, and Africa, urban wastewater is often a leading source of nutrient pollution. Each of these sources presents unique threats to public health and the natural environment.

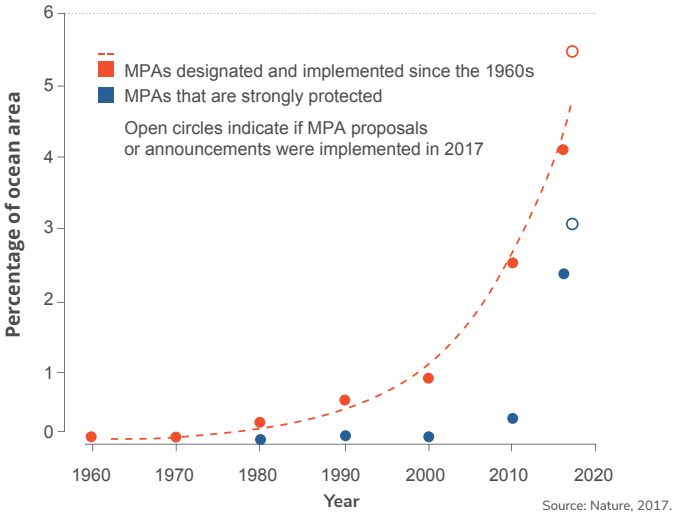
Plastic debris accounts for the largest portion of marine litter in the ocean by volume, with an estimated 8 million tonnes of plastic waste entering the marine environment annually from land-based sources. Plastic production has increased dramatically in recent decades: from 14 million tonnes in 1964 to 310 million tonnes in 2014. This figure is expected to double again over the next 20 years. Plastics have infiltrated the marine food chain, with particular implications for public health given the contamination of fish and shellfish. "Ghost gear"—abandoned, lost and discarded fishing gear—is a form of plastic pollution which traditionally receives less attention but presents a serious threat to marine species and ecosystems. The FAO estimates that 640,000–800,000 tons of ghost gear is discarded in the ocean annually. This litter, which can trap and kill marine life, has risen substantially in recent years and can take up to 600 years to decompose.

Habitat loss

Aside from fishing- and climate-related impacts, coastal development and associated habitat loss has been the most obvious threat to the nearshore environment. Draining wetlands, clearing mangrove habitat, filling in estuaries, and hardening shorelines all affect the complex biological interactions between nearshore and offshore habitats.

Due to these stressors, the critical ecological functions of these habitats continue to decline at alarming rates. An estimated 50% of salt marshes, 35% of mangroves, and 29% of seagrasses have been either lost or degraded worldwide. Between 30–60% of the world's corals have disappeared. With warm-water corals particularly vulnerable to the impacts of climate change, 90% of coral reefs are projected to disappear by 2050 at the current rate of temperature rise.

Fig. 5 Growth of marine protected areas



Marine protected areas (MPAs) are often positioned as a solution for addressing fishing pressure, protecting biodiversity, and restoring damaged ecosystems. Global coverage of MPAs has grown exponentially at a rate of more than 8% per year since 1960 (Fig. 5). While MPAs can provide important ecological and economic benefits, recent research has highlighted that many areas are underperforming due to limited funding and staff capacity for implementation and enforcement. The past decade in particular has seen a rise of large MPAs in remote areas of the ocean, raising concern that governments are racing to reach national coverage targets, while overlooking nearshore environments that tend to face higher resource user conflicts.