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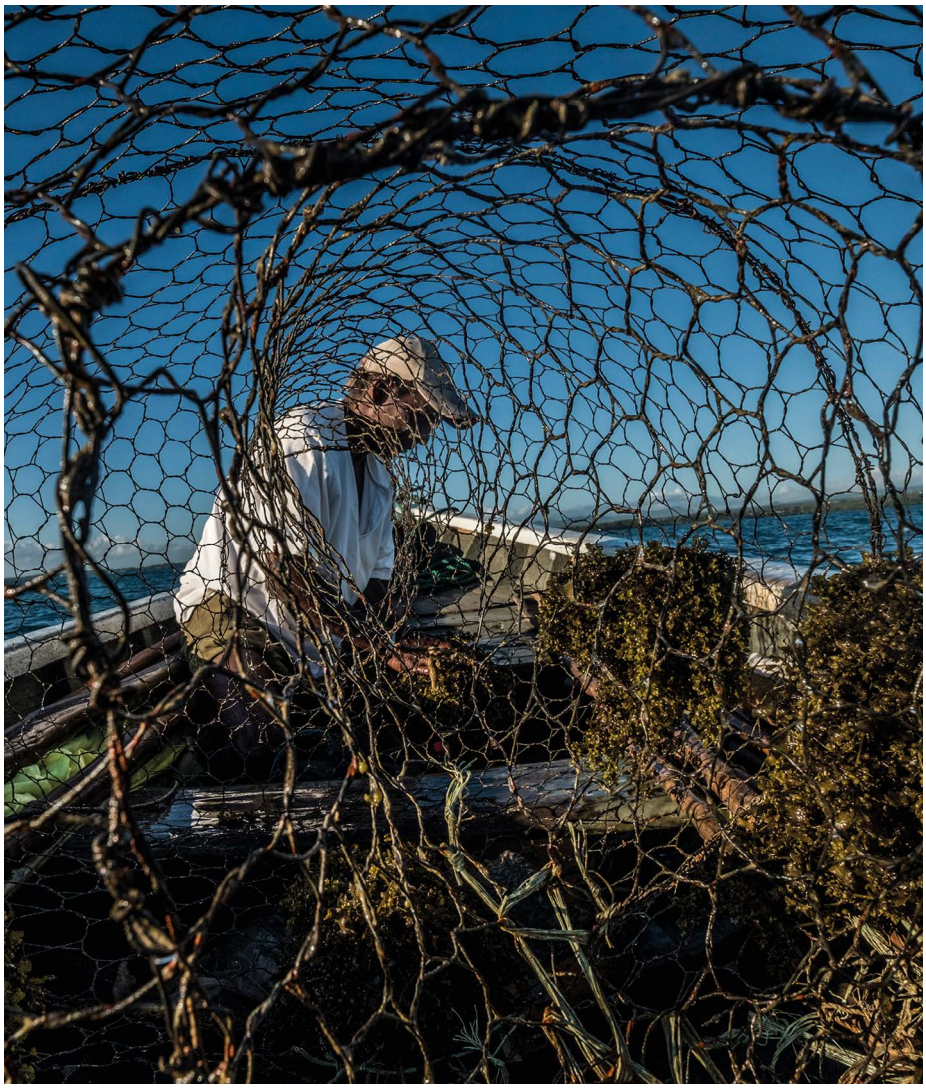


A fisher in Mauritius adds bait to a wire fish trap.

TOMMY TRENCHARD/PANOS

Five priorities for a sustainable ocean economy

Jane Lubchenco, Peter Haugan & Mari Elka Pangestu

Unleash the ocean's potential to boost economies sustainably while addressing climate change, food security and biodiversity.

Ocean ecosystems are under threat. They also hold solutions. Climate change is increasing sea levels and making the ocean warmer, more acidic and depleted in oxygen. The ocean has absorbed around 90% of the excess heat trapped by greenhouse-gas emissions and one-third of the carbon dioxide emitted by human activities since the 1980s (ref. 1).

Excessive and destructive fishing threaten ocean habitats and biodiversity, from coastal margins to open waters and the deep sea[2]. Unsustainable development along coastlines is destroying coral reefs, seagrass beds, saltmarshes and mangrove forests. These house biodiversity, sequester carbon, provide nurseries for fish and buffer coasts against storm surges (go.nature.com/3m4trjd). Plastics and nutrients washed from the land are also killing wildlife (go.nature.com/3t4ffpa). All of these threats erode the capacity of the ocean to provide nutritious food, jobs, medicines and pharmaceuticals as well as regulate the climate. Women, poor people, Indigenous communities and young people are most affected.

For much too long, the ocean has been out of sight, out of mind and out of luck. Attention has been scant – from governments, funding agencies, financial institutions, food-security organizations and the climate-mitigation community. Nations usually manage their waters sector by sector, or issue by issue. The resulting hodgepodge of policies fails to consider collective impacts.

Countries are agreed on what needs to happen – use marine resources responsibly and equitably and manage them sustainably, avoiding overfishing, pollution and habitat destruction. Our knowledge about the ocean is deep. But political action to deliver a healthy ocean has been lacking. Until now.

In September 2018, 14 nations, led by Norway and Palau, commissioned a major science-based review of ocean threats and opportunities as a baseline for resetting policies. Today, this High Level Panel for a Sustainable Ocean Economy (the Ocean Panel) publishes its conclusions[3] and commitments[4].

The reports highlight what stands to be gained by 2050 by taking a holistic approach to the ocean, by asking what it can deliver, and for whom. They find that a healthy ocean could, with 30% of it protected effectively, deliver the following: 20% of the carbon emission reductions needed to achieve the Paris climate agreement's warming limit of 1.5 °C above pre-industrial levels; 40 times more renewable energy than was generated in 2018 (see go.nature.com/3767y3b); 6 times

more sustainable seafood[5]; 12 million jobs; and US$15.5 trillion in net economic benefits (go.nature.com/366fnf2). These outcomes are not guaranteed. They require new policies, practices and collaborations.

As co-chairs of the expert group of scientists convened by the Ocean Panel, here we highlight five priority areas for policy action.

Hidden crisis

The Ocean Panel is an ad hoc group focused on the seas that is made up of serving world leaders with direct authority to trigger, amplify and accelerate action worldwide. Co-chaired by Norway and Palau, the panel comprises Australia, Canada, Chile, Fiji, Ghana, Indonesia, Jamaica, Japan, Kenya, Mexico, Namibia and Portugal, with support from the United Nations Secretary-General's Special Envoy for the Ocean. Collectively, these leaders manage nearly 40% of the world's coastlines and nearly 30% of its exclusive economic zones, 20% of the world's fisheries and 20% of the world's shipping fleets.

At the panel's invitation, we chaired an expert group (go.nature.com/2vdsutz) of more than 75 scientists chosen for their knowledge, experience and diversity of perspectives. We also worked with a larger group of scientists and policy or legal experts, totalling more than 250 people from 48 countries or regions, to produce syntheses of knowledge and options for action on topics identified by the Ocean Panel (go.nature.com/3nnowty and go.nature.com/2j8c51b). The 19 syntheses ranged from food[5], energy and mineral production (go.nature.com/3m9jdod), genetic resources[6] and conservation[6] (go.nature.com/376dapp) to climate change (go.nature.com/3m52poz), technology[7], equity (go.nature.com/378hjjy), illegal fishing[8], crime[9] and ocean accounting[10] (go.nature.com/39gpims).

A parallel group of more than 135 organizations, called the Advisory Network (go.nature.com/39dsz8v), included representatives from industry, financial institutions and civil society. Participants coalesced as Action Coalitions around areas of shared interest — for example, renewable ocean energy, sustainable seafood or ocean accounting.

Five priorities

Investing in the following five areas, the reports found, would address global challenges, create jobs and boost economies, while protecting people and the planet.

Manage seafood production sustainably. Currently, fish, crustaceans and molluscs provide only 17% of edible meat[5]. More protein and essential nutrients will be needed to feed the world's rising population, expected to reach almost 10 billion by 2050.

Land-based agriculture is hard to expand, because doing so would exacerbate climate change, biodiversity loss and water scarcity. Sustainable fisheries and mariculture together, however, might deliver 36–74% higher yields by 2050, meeting 12–25% of the extra meat needed[5].

Aquaculture has greatest potential for expansion, notably un-fed seafoods such as molluscs, including oysters, clams and mussels, which obtain their food by filter feeding. Currently, most mariculture (around 75%) requires feed, typically fishmeal and fish oil. Such production of fed bony fish could be increased somewhat[5]. But there are ecological limits to how much fish and feed could be caught without depleting stocks.

> **"Ocean-based options might deliver as much as one-fifth of total emissions reductions."**

Policy reforms are needed[11]. And Ocean Panel leaders commit to restoring wild fish stocks, catching them at sustainable levels and expanding sustainable mariculture by 2030. They pledge to eliminate illegal, unreported and unregulated fishing and prohibit harmful fisheries subsidies. They will implement science-based plans to rebuild depleted stocks, develop climate-ready fisheries (go.nature.com/3m52poz) and strengthen international Regional Fisheries Management Organizations. Policies to minimize environmental impacts and accelerate sustainable practices will be introduced for mariculture. Seafood businesses in the Advisory Network are highly supportive.

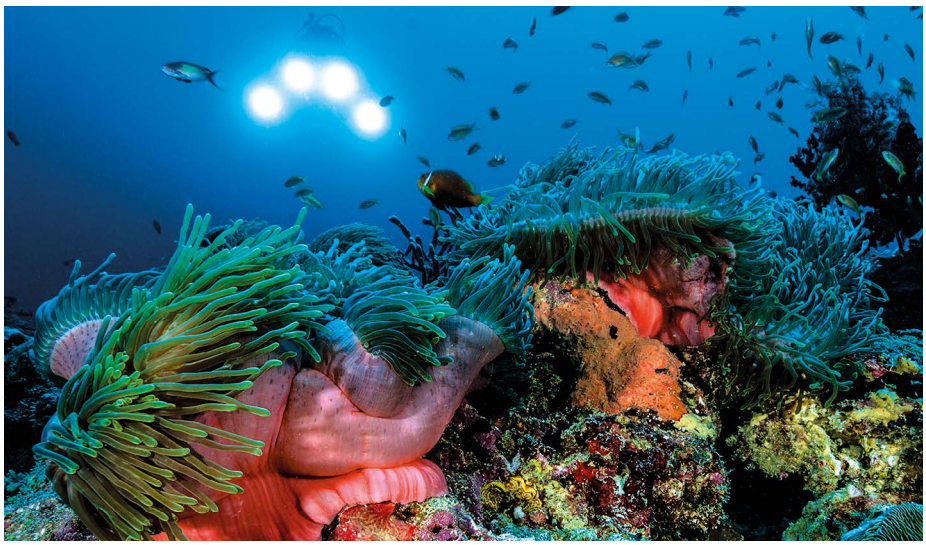
Mitigate climate change. Around the world, climate change is wreaking havoc on weather patterns, producing more powerful hurricanes, floods and storm surges. Warmer waters are eating away at the bases of Antarctic glaciers and killing coral reefs[1]. Greenhouse-gas emissions need to be reduced sharply. But most mitigation options focus on the land — clean wind and solar energy, for example, or increasing the efficiency of transportation, buildings and appliances. More consideration needs to be given to the ocean.

The panel's reports suggest that ocean-based options might deliver as much as one-fifth of the total emissions reductions needed to limit warming to the Paris goal of 1.5°C by 2050 (11.8 gigatonnes of CO_2 equivalents ($GtCO_2e$) annually). The numbers are tentative and based on maximum contributions from five sectors: renewable energy (5.4 $GtCO_2e$), transport (1.8 $GtCO_2e$), coastal and marine ecosystems (1.4 $GtCO_2e$), food (1.2 $GtCO_2e$) and carbon storage in the seabed (2 $GtCO_2e$) (go.nature.com/3767y3b; see also ref. 12). Although carbon storage needs further study, three other opportunities warrant immediate action.

Ocean-based renewables offer varied options for power generation — wind, wave, tidal, current, thermal and solar — suitable for different places. Ocean Panel leaders pledge to invest in research, development and demonstration projects to make these technologies cost-competitive, accessible to all and environmentally sustainable. They will work with industry to address environmental impacts and market impediments to deployment.

Decarbonizing shipping is sorely needed. More than 90% of global goods move across the seas. But ships use heavy fuel oils that release soot and sulfur as well as CO_2 — amounting to 18% of some air pollutants and 3% of greenhouse-gas emissions. Panel leaders agree to set national targets and strategies to decarbonize vessels and develop and adopt technologies for producing and storing new zero-emission fuels. They will incentivize low-carbon ports to support clean shipping, and strengthen regulations within the International Maritime Organization. These include minimizing the transfer of aquatic invasive species by ships, reducing engine noise and banning the use of heavy fuel oil in the Arctic.

'Blue carbon' ecosystems of mangroves, seagrass beds and salt marshes store carbon at up to ten times the rate of terrestrial ecosystems. Much of that ends up in the atmosphere if these ecosystems are damaged or destroyed. Although they cover only 1.5% of the area of land forests, degraded blue-carbon ecosystems release 8% of the total emissions from these and terrestrial deforestation combined. Between 20% and 50% of these ecosystems have already been lost. Ocean Panel leaders pledge to halt that decline and improve the extent and condition of these ecosystems. Successful restoration of 3,000 hectares of seagrass beds in Virginia lagoons along the US eastern seaboard has resulted in sequestration of about 3,000 tonnes of carbon per year, for example[13].



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A reef in the Maldives displays a wealth of biodiversity.

Stem biodiversity loss. The diversity of plants, animals and microbes that inhabit ocean ecosystems, from the deep sea to estuaries and from the tropics to the poles, is the main reason the ocean delivers so many benefits. That biodiversity is being lost. In 2019, an international assessment of biodiversity[2] identified overharvesting as the biggest single threat.

Effective marine protected areas (MPAs) are the most powerful tool to stop this loss. Fishing and other damaging activities are banned within them (go.nature.com/3ma76rf). But they take time to implement. They require planning, design, funding, compliance and enforcement. Only 2.6% of the global ocean is in fully or highly protected classes of MPAs (https://mpatlas.org). Many scientific analyses have concluded that at least 30% of the ocean globally should be covered to protect biodiversity (see, for example, ref. 14). The Ocean Panel supports that goal by 2030.

Seize opportunity for economic recovery. Ocean workers and sectors have been largely absent from economic stimulus packages in response to the COVID-19 pandemic. Yet a 'blue recovery' effort holds great potential for jump-starting economies.

The Ocean Panel highlights five opportune areas for economic investment (go.nature.com/3otqsdp). First, restore coastal and marine ecosystems to create jobs and enhance tourism, fisheries and carbon sequestration. After the 2008–09 crisis, for instance, every $1 million invested in coastal restoration in the United States created an average of 17 jobs, or more than twice those created per dollar spent on road construction and fossil-fuel exploration and extraction combined[15].

Second, extend sewage and wastewater infrastructure to create jobs and improve health, tourism and water quality. Over the past 30 years, wastewater and sewage run-off has cost the global economy $200 billion to $800 billion per year (go.nature.com/2kjdthr).

Third, invest in sustainable, community-led, non-fed mariculture such as shellfish, especially in developing and emerging economies. This would enhance local livelihoods and diversify economies while producing food and other products.

Fourth, catalyse incentives to encourage zero-emission marine transport. This would create jobs, accelerate a transition to lower carbon emissions, promote efficiency gains and help to minimize stranded assets in the maritime shipping sector, such as existing ships that burn dirty fuels. Decarbonizing shipping could yield a benefit of between $1 trillion and $9 trillion over 30 years[16].

Fifth, investing in ocean-based renewable energy could deliver climate benefits, reduce local and global pollution, and build energy security. Projections suggest that this could be a $1-trillion industry that has the potential to deliver up to one million full-time jobs by 2050 (go.nature.com/3otqsdp).

Manage the ocean holistically. Patchy management cuts across all areas mentioned. For example, plans for a new port or tidal energy project might not consider the destruction of blue-carbon ecosystems or the impacts of shipping on fish.

Tools for ecosystem-based management and integrated ocean management exist[17]. These consider a suite of current or anticipated activities, how they might coexist successfully and what combination can operate without serious harm. It is a major undertaking: all stakeholders must be involved (go.nature.com/378hjjy), data and maps must be assembled, probable impacts identified and interactions considered. Success requires clear goals, funding and an inclusive process.

Achieving the three main goals of the Ocean Panel — to protect effectively, produce sustainably and prosper equitably — will require being smarter about ocean uses, seeking greater efficiencies, using leapfrogging technologies[7] and seeking ongoing scientific guidance (https://en.unesco.org/ocean-decade). It also requires heeding lessons from other transitions[18], acting with precaution (for example, in deep-sea mining[19]) and paying closer attention to the welfare of all people (go.nature.com/3nukkzf) and to the health of ecosystems.

Ultimately, the High Level Panel for a Sustainable Ocean Economy commits member nations to manage all of their ocean area sustainably by 2025. Other coastal and ocean states should join this effort, so that by 2030, all waters under national jurisdiction are sustainably managed. If guided by science and mindful of equity, sustainable management of national waters could be a boon for people, nature and the economy[20].

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