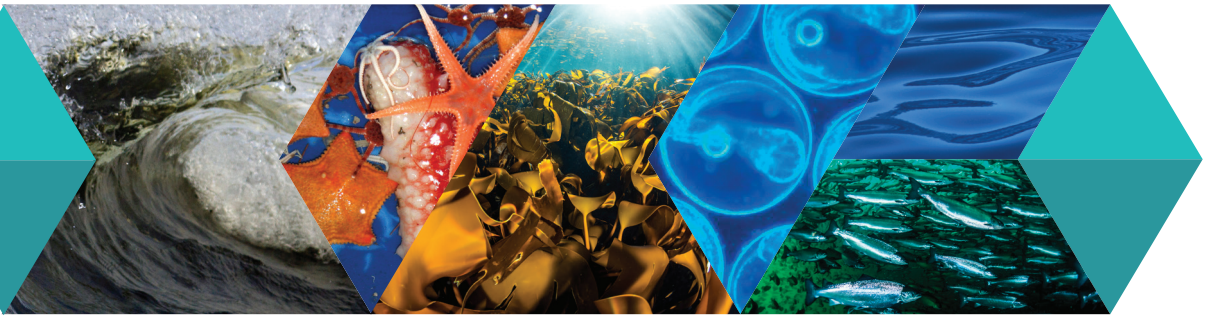


Report from the Science for Ocean Action conference

Bergen 20–21 November 2018

Foreword

On 20-21 November 2018, 150 invited ocean experts from more than 50 countries met to discuss critical science-based actions in response to the problems facing the oceans. The conference, announced by Prime Minister Erna Solberg at the G7 meeting in June 2018 in Canada, was hosted by the Institute of Marine Research (IMR). The conference addressed five areas of serious concern, aiming to make a contribution towards achieving the UN Sustainable Development Goals.

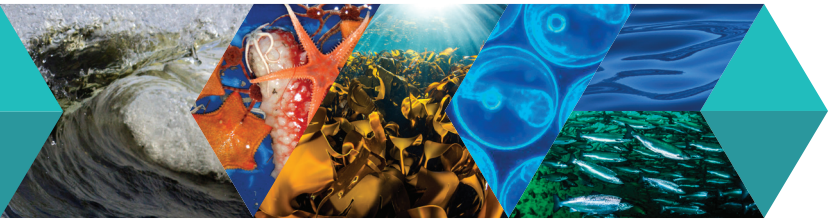
This report summarizes the action points proposed and refined by the experts at the conference. The report will feed into the work of Prime Minister Erna Solberg's international High Level Panel for a Sustainable Ocean Economy. This panel, announced early 2018 at World Economic Forum, will work over the next two years to produce recommendations on how we can reconcile conservation and sustainable use of the oceans and its resources. **Political will is essential to coordinate and act for "The ocean we need for the future we want."** [1]

The action points address the requirement for knowledge-development, and marine monitoring programs, as well as the importance of ocean and coastal governance. Such a concerted effort is vital for a balanced ocean based economic development with an increased food production whilst simultaneously protecting the marine environment and its biodiversity.

I would sincerely like to thank all the 150 participants who all had special duties during the conference: senior adviser Kari Østervold Toft and her IMR-team in planning and executing the conference: the PhD students and postdocs at IMR who summarized the action points from the round table discussions. The report was drafted by Professor Alf Haakon Hoel at IMR and the Arctic University of Norway, and edited by the research directors at IMR and myself.

Professor Sissel Rogne
Director

[1] The name of the UN decade ocean science for sustainable development, coordinated by UNESCO´s Intergovernmental Oceanographic Commission, IOC.



Context and introduction

In January 2018, Norwegian Prime Minister Erna Solberg launched the High Level Panel on a Sustainable Ocean Economy.[2] The panel, comprising 12 heads of state, will present its report in 2020 and thus set the global ambition and recommendations for how governments, the private sector, and civil society can create an ocean economy that contributes to achieving the Sustainable Development Goals (SDGs). The conference Science for Ocean Actions provides input from the scientific community to the work of the High Level Panel. Over 150 experts from more than 50 countries, representing a number of international organizations, participated in the meeting that took place in Bergen 20–21 November 2018.[3] This report summarizes the main findings from the conference **Science for Ocean Actions** in a "summary for policy-makers" format of proposed ocean actions.

Humankind depends on the continued capacity of the ocean to provide essential ecosystem services such as – but not limited to – stabilizing the global climate, act as a major carbon sink, provide safe and healthy seafood, as a source for marine bioprospecting, and for us all to enjoy the various pleasures of clean and rich oceans. However, the ocean is currently under heavy stress due to the effect of climate change and acidification related to high global CO_2 emissions, and pollution. Increasing ocean temperatures lead to more extreme weather, sea level rise, coral bleaching, shifts in species distributions, disturbance of fine-tuned ecological interactions, and in some areas low oxygen content or toxic algal blooms. Ocean acidification will in the longer run threaten organisms that make structures of calcium carbonate, such as corals and bivalves.

The Sustainable Development Goals (SDGs) and the UN Decade of Ocean Science for Sustainable Development were the two starting points for the conference.

The SDGs, adopted by the UN General Assembly in 2015, recognizes the limits of the natural environment and lays out the ambitions for sustainable development in 17 areas of action in the period up to 2030. While ocean issues are addressed specifically in SDG 14 "Life below Water," and call for actions in nine designated areas, the 17 SDGs should be taken as a whole when considering ocean actions. Healthy oceans are important for achieving many of the SDGs, including SDG 2 "Zero Hunger" on nutrition or SDG 13 on "Climate Action". [4]

The Decade of Ocean Science for Sustainable Development (2021–2030) was proclaimed by the UN General Assembly in 2017. Scientific understanding of the ocean's responses to pressures and management action is fundamental for sustainable development. The Decade will address gaps in our scientific capacity and contribute to achieving the SDGs, by transforming knowledge systems to support sustainable development. Scientific understanding of the ocean's responses to pressures and management action is fundamental for sustainable development. Ocean observations and research are also essential to predict the consequences of change, design regulations and guide adaptation. The IOC of UNESCO will coordinate the Decade's preparatory process, inviting the global ocean community to plan for the next ten years in ocean science and technology.[5]

[2] More information about the High Level Panel here: http://oceanpanel.org
[3] The keynote presentations and the panel discussions were recorded and are available at https://scienceforoceanactions.imr.no
[4] https://www.un.org/sustainabledevelopment/
[5] https://en.unesco.org/ocean-decade

Panel 1.

IMPACTS OF CLIMATE CHANGE ON MARINE ECOSYSTEMS

The reports of the Intergovernmental Panel on Climate Change (IPCC) have addressed how the oceans are affected by increasing CO_2 levels, with the main message being that the oceans are warming. In a business as usual scenario, the oceans will continue to warm, with global surface temperatures set to increase up to 4 °C by the end of the century (Fig. 1). It is commonly agreed up on that in order to avoid serious impacts on ecosystems and the communities that depend on them, warming will need to be contained within 2 degrees above preindustrial levels. This requires substantial reductions in current levels of emissions of climate gases.

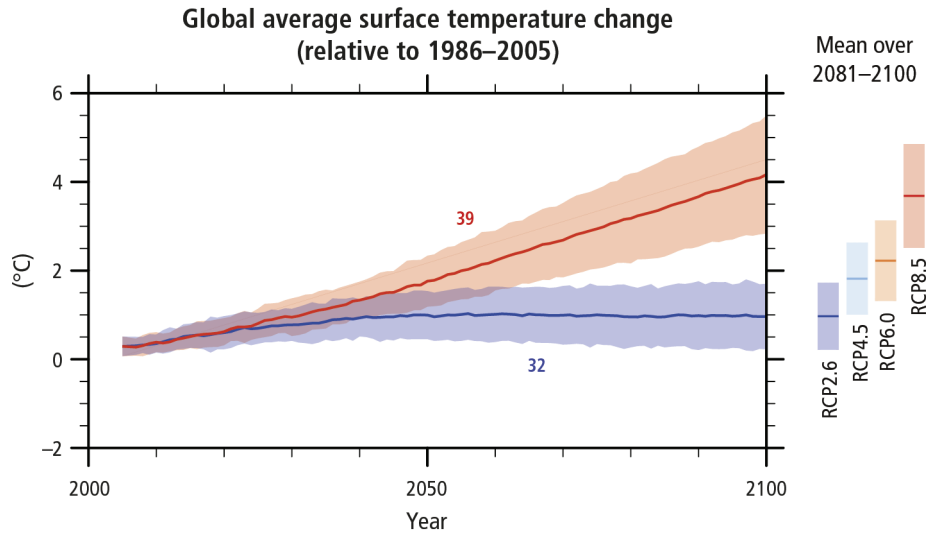


Figure 1: *From IPCC 5 Assessment Report. https://www.ipcc.ch/report/ar5/syr/synthesis-report/*

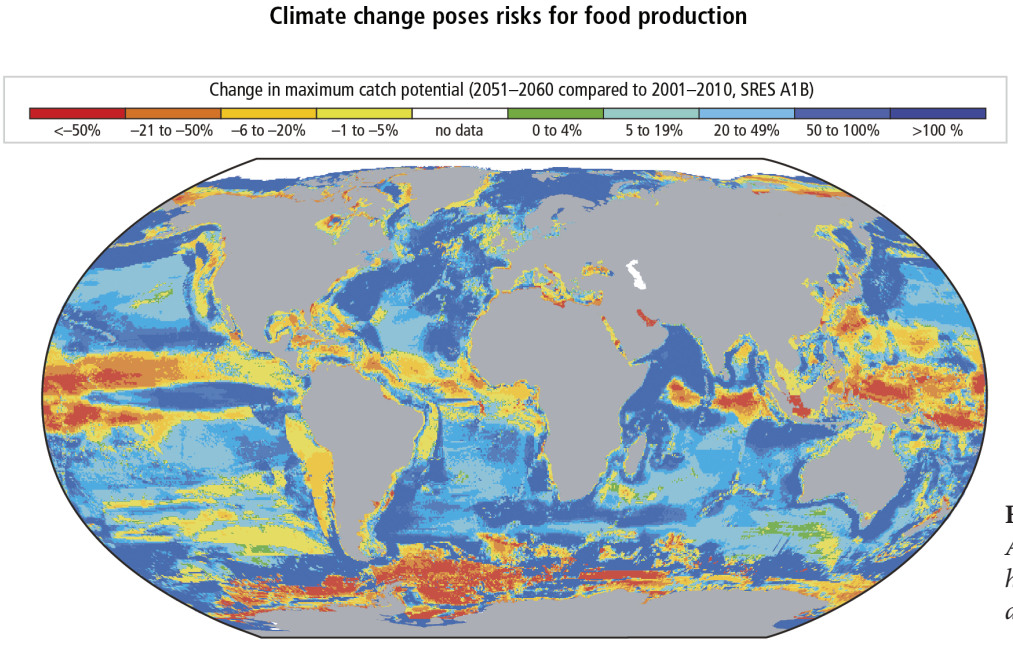


Figure 2: *From IPCC 5 Assessment Report. https://www.ipcc.ch/report/ar5/syr/synthesis-report/*

The fifth assessment report of the IPCC (2014) provides a comprehensive review of the effects of climate change on marine ecosystems and their resources.[6] Changes in oxygen uptake and in primary production, shifting distributions of marine species, increased uptake of CO_2 and impacts for calcifying organisms, changes in water cycles, and increased storm frequencies are among the observed impacts of increased CO_2 on marine ecosystems today. The IPCC has commissioned a special report on the ocean and cryosphere in a changing climate that will be published in 2019. The production of this report offers new opportunities for underlining the role of the ocean in climate evolution, in mitigating climate change through CO_2 uptake, possibilities for further uptake by coastal blue carbon actions as well as other remediation options.

In addition to increasing the visibility and attention to the role of the ocean in climate, there is a need to bring climate aspects fully into the ocean agenda at UN level and beyond. Initial efforts towards that has begun.[7]

These ocean climate changes have implications for fisheries and their management, raising questions about adaptation to change, according to the UN Food and Agriculture Organization FAO.[8] Studies of cumulative effects are critical. E.g. ocean acidification may have impacts that come in addition to temperature effects on species and ecosystems.

Figure 2 shows potential changes in catch potential for fish later this century, with reductions in tropical regions and increases in temperate regions, which entails risks for food production.

Action points relating to impacts of climate change on marine ecosystems:

- Reform regional management systems to deal with shifting distribution of resources.
- Share information, involve stakeholders, and develop close links between science and policy in order to find and implement solutions to reduce impacts of climate change.
- Ocean observations and scientific analyses have to address complex situations where impacts are combined: For example, coral reefs may first be weakened by storms and then affected by bleaching events.
- Local solutions that have other benefits in addition to reducing impacts of climate change, e.g. coastal restoration of mangroves, should be deployed immediately.
- Highlight the role of the ocean and ocean science in follow-up of the *United Nations Framework Convention on Climate Change (UNFCCC).*
- UNFCCC efforts should include blue carbon and coastal livelihoods, in addition to marine renewable energy and low emission ocean transport.
- Monitoring programs are required to collect the information needed for ecosystem-based management should be strengthened, taking the effects of climate change into account.
- Address the large differences between regions in terms of availability of scientific information and develop sophistication of models for ecosystem-based management.
- Strengthen actions to reduce the pressure on ecosystems in the coastal zone. Information of such actions can be useful not only locally but also to create involvement, engagement and support to actions on the regional and global level.

[6] https://www.ipcc.ch/report/ar5/syr/
[7] https://en.unesco.org/ocean-climate-conference
[8] The State of World Fisheries and Aquaculture. http://www.fao.org/3/i9540en/I9540EN.pdf See pp 130-138

Panel 2.
OCEAN HEALTH

Ideally a healthy marine ecosystem is clean from pollution and have a balanced food web structure and is well functioning. Marine pollution and marine litter pose major threats to biodiversity, ecosystem function and services, as well as seafood safety. Although a range of pollutants have been banned under various international agreements, many persistent pollutants will remain for a long time in the ecosystems, and therefore have long-lasting effects. In addition, replacement of toxic chemicals may also have severe negative impacts that have not yet been discovered.

The amount of plastic litter, including micro- and nano-plastic, are increasing rapidly in the marine environment, affecting marine organisms. The overall consequences are yet largely unknown. It is estimated that more than 10 million tons of plastic waste ends up in the oceans annually, mostly via rivers in East and Southeast Asia.

Another threat to ocean health stems from society's use of antibiotics. Antimicrobial drugs are widely used in human medicine, in agriculture, and in some cases also in aquaculture. Such drugs may end up in the oceans with unknown ecological and human health impacts. Moreover, excess discharges of inorganic nutrients and organic material can lead to eutrophication, and/or hypoxic conditions, algal blooms, and other ecosystem changes that may have a negative impact on biodiversity, fisheries or aquaculture.

These threats may also interact. The level of pollution may become increasingly adverse in response to the effects of

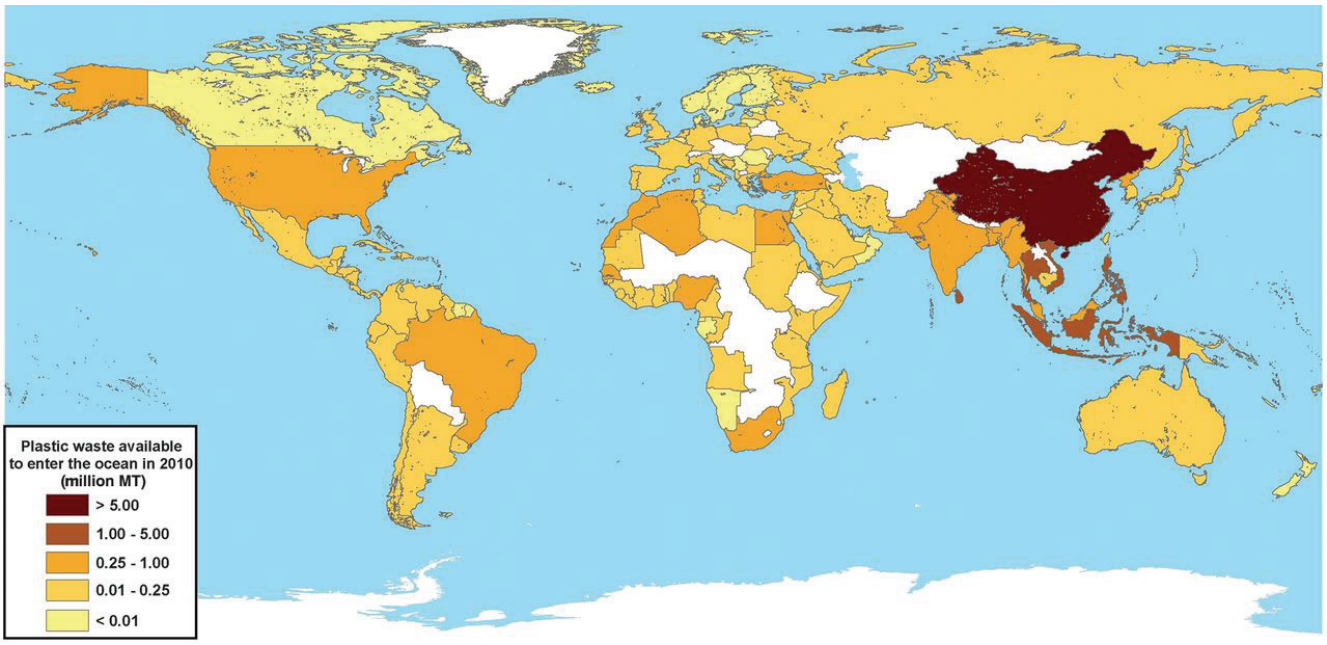


Figure 3: *Countries shaded according to estimated mass of mismanaged plastic waste. Source: Jambeck et al 2015.*[9]

[9] Jambeck, J. Et al., 2015: Plastic waste inputs from land into the ocean. Science Vol. 347, Issue 6223, pp

climate change. Extreme weather and rising sea levels may remobilize pollutants buried in coastal areas near the shore, and consequently result in the release of more plastic litter, more persistent organic pollutants and heavy metals in coastal waters, and in turn become available for bioaccumulation and/or synergistic impact on marine life. Increased temperatures combined with eutrophication may lead to more severe algal blooms, increased prevalence of toxic algae, and changes in the microbial ecosystem with unknown consequences.

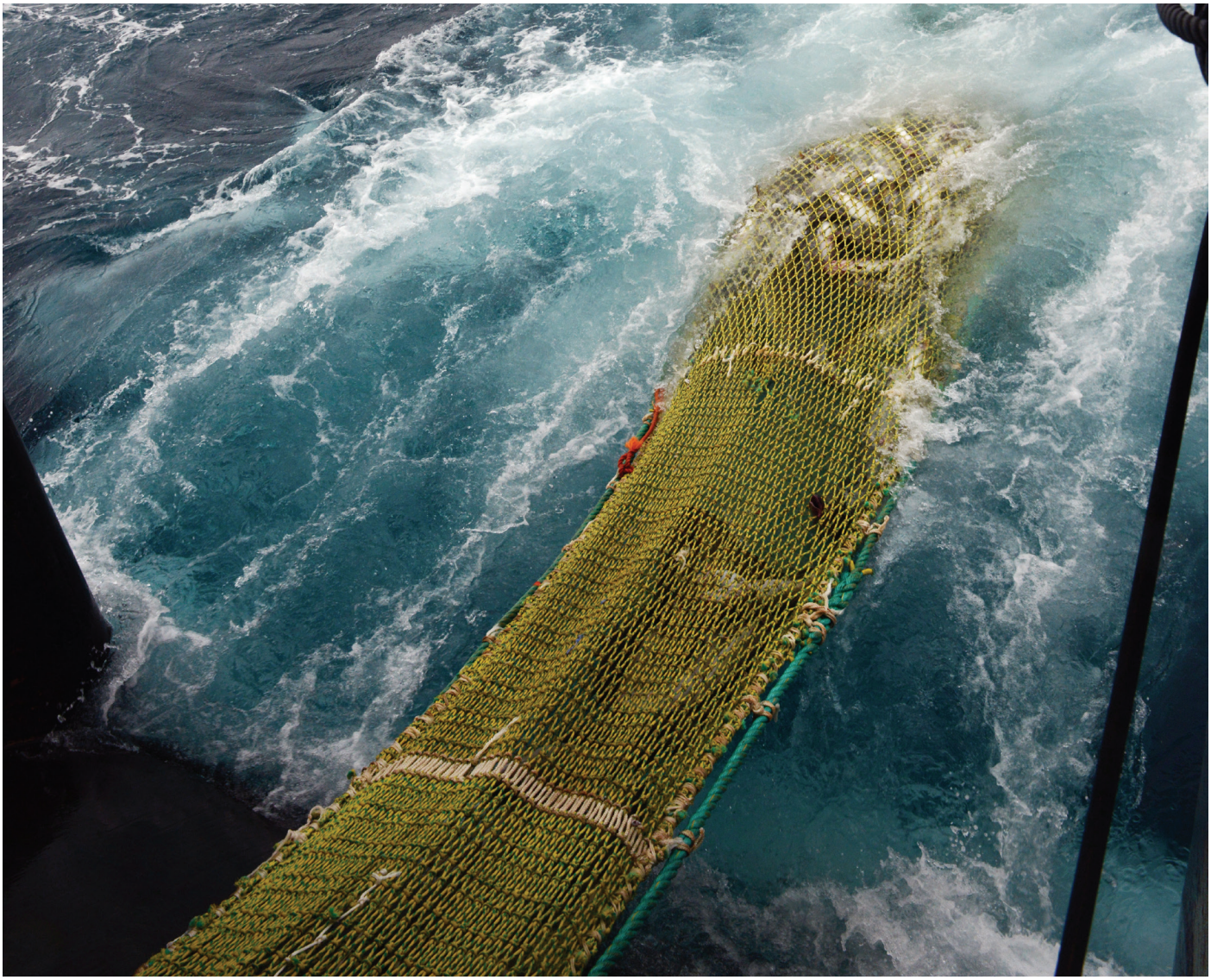
It should, however, be noted that impacts of the different environmental stressors vary greatly, both locally and regionally. Thus, ocean health varies from region to region. For that reason, some of the actions needed to preserve, restore or even enhance ocean health and ocean ecosystem services may operate at a local or regional level. Where impacts are on a global scale they must be addressed accordingly.

Action points on ocean health:

- It is essential to monitor the marine environment in order to provide data for assessing the status of various pollutants. Such monitoring forms a critical basis for action. Monitoring can e.g. take place at the level of the so called Large Marine Ecosystems (LMEs).
- Stop the flow of plastic from land-based sources into rivers and the ocean.
- The introduction of pollutants in the marine environment should be stopped, or substantially reduced as fast as possible, in order to improve seafood security and safety, as well as to reduce stress on marine ecosystems.
- Pollutants should be backtracked to their sources and replaced with safer alternatives.
- If possible, those responsible for pollution should be held accountable.
- The main part of methylmercury inArctic marine mammals is anthropogenic. Implementation of the Minamata Convention on Mercury should be internationally supported and encouraged.
- At the international level, the Stockholm Convention[10] on traditional and emerging persistent organic pollutants (POPs) should be supported. At the national level it is important to trace leaks in existing repositories.
- Pollution of the oceans have major ramifications – and it is critical to educate industry, politicians and the general public on the wide-ranging impacts of pollution on marine ecosystem functions and sea food production and safety.

[10] Stockholm Convention on Persistent Organic Pollutants is an international environmental treaty, signed in 2001 and effective from May 2004, that aims to eliminate or restrict the production and use of persistent organic pollutants (POPs). http://chm.pops.int/

Panel 3.
THE STATE OF FISHERIES RESOURCES



The world marine capture fisheries and aquaculture production has grown tremendously over the last century, bringing the human per capita consumption of seafood to around 20 kg/year. Fish and shellfish are critically important in providing animal protein to the world, accounting for 17% of the global consumption of these essential nutrients.[11] Total aquaculture production is now at about the same level as marine capture fisheries, and about one third of the production takes place in the sea. About 60 million people works in the fisheries and aquaculture industries.

Two thirds of the world's marine fisheries occur on fish stocks that are fished within biologically sustainable levels.[12] Overfishing is increasing over time, and about one third of the world's fish stocks are now overfished, according to the FAO.

The Law of the Sea, the UN Fish Stocks Agreement, and the FAO code of conduct for responsible fisheries lay the foundation for a sustainable fishing industry. It is estimated that rebuilding overfished stocks to sustainable levels may

[11] FAO State of World Fisheries and Aquaculture. http://www.fao.org/3/i9540en/I9540EN.pdf
[12] According to the FAO´s 2018 State of World Fisheries and Aquaculture (page 39), this means that a sustainable stock is at or above the level associated with Maximum Sustainable Yield (MSY).

increase production by more than 16 million tons annually.[13] In addition to losses from inadequate management, it is estimated that Illegal, Unregulated and Unreported (IUU) fishing amounts to somewhere between 11 and 26 million tons of fish annually.[14] Also, large amounts of fish are discarded, and it is estimated that postharvest losses – losses between landing and consumption – and discards combined amounts to some 35% of global catches, corresponding to about 30 million tons annually.[15]

In other words, there is considerable potential to increase the amount of marine fish available for human consumption by reducing Illegal, Unreported, Unregulated (IUU) fishing, improving management and reducing post-harvest losses. A number of countries have demonstrated that a transition to more sustainable fisheries is indeed feasible, relying on investments in science, sound regulatory frameworks and enforcement of regulations.

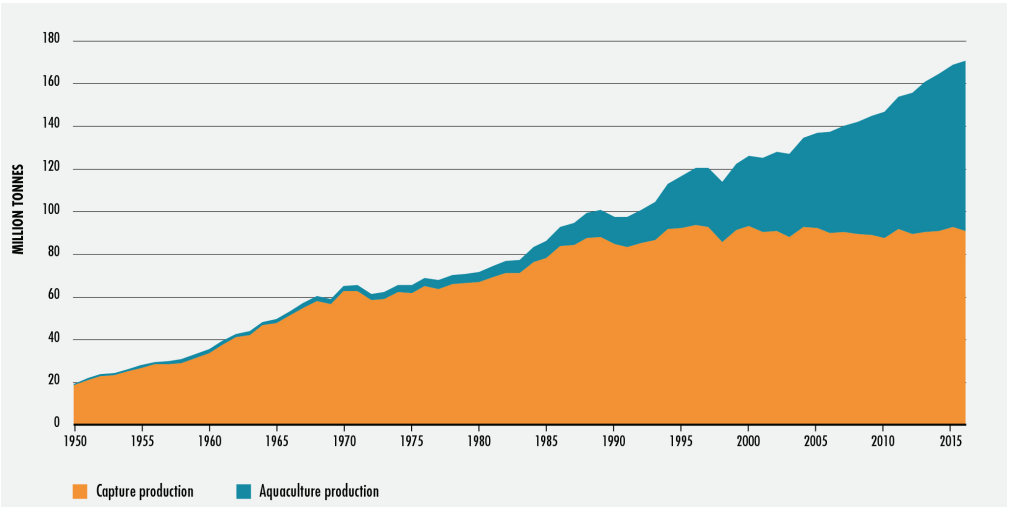


Figure 4: *World capture fisheries and aquaculture production.*
Source: FAO State of World Fisheries and Aquaculture (SOFIA). http://www.fao.org/state-of-fisheries-aquaculture/en/

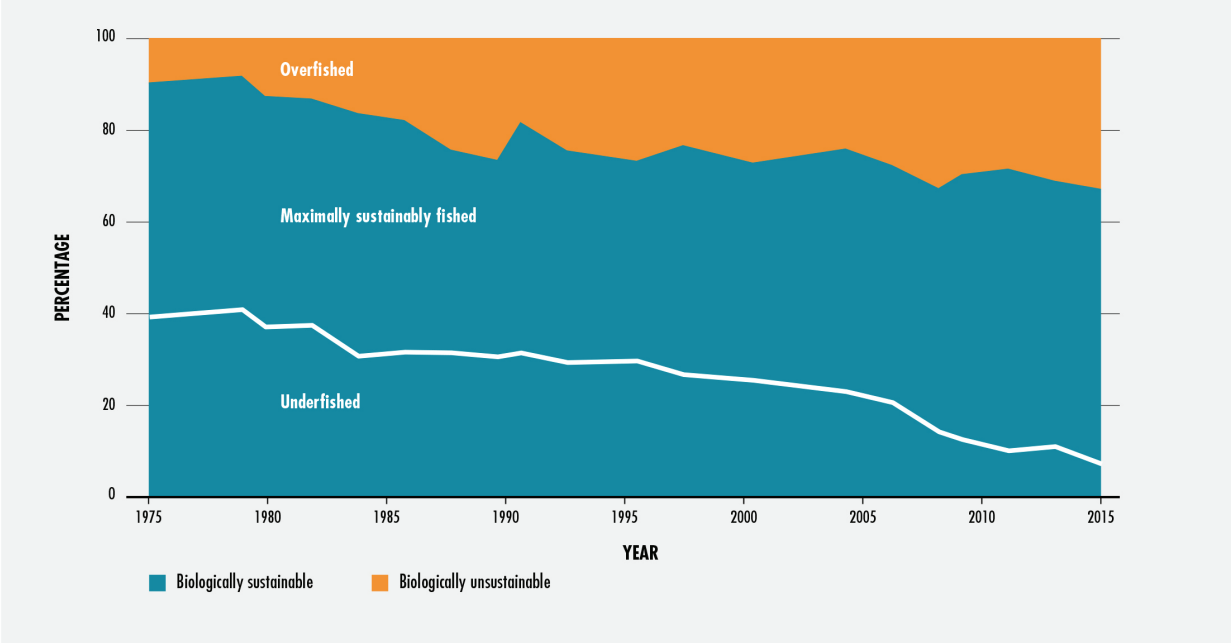
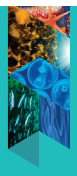


Figure 5: *Global trends in the state of the world´s marine fish stocks.*
Source: FAO State of World Fisheries and Aquaculture (SOFIA). http://www.fao.org/state-of-fisheries-aquaculture/en/

[13] Ye et al 2013, in FAO 2018 p 45
[14] Agnew et al 2009
[15] FAO State of World Fisheries and Aquaculture (2018) pages 50, 152



Action points to strengthen the management of fisheries, reduce waste and increase sustainable harvest from the sea:

- Ensure collection of adequate data from the fisheries.
- Strengthen international collaboration in science and data collection, control and collaboration in management of fisheries.
- Recognise and engage regional expertise to co-create balanced and evidence-based assessment of status, threats and opportunities to marine ecosystems. Use these expositions to guide a more rational priority for monitoring, assessment and management.
- Advance understanding and operationalisation of ecosystem-based fishery management and maximum sustainable yield concepts and their application in single species, mixed, multispecies and emerging fisheries.
- Improve understanding of the effects natural variability and human impacts have on marine biodiversity and ecosystem functioning.
- Explore if wild capture of mesopelagic fishes, krill and other zooplankton can contribute to increased sustainable harvest of marine fat and protein and a reduced environmental footprint associated with the global food production.
- Assess the wider role of seafood production in society, including resilience of the food system, interactions between food systems in the sea and on land, and how consumer's expectations influence practices in aquaculture and fishing.
- Establish dialogue between the fishing industry and policy makers with the aim of reducing waste in fisheries to zero.
- Establish research and innovation programs to stimulate industries and new markets for feed and chemicals.
- Empower regional fisheries management organizations to enhance regional enforcement of fisheries management in the high seas.
- Take effective action against IUU fisheries by establishing mechanisms that encourage compliance with fisheries regulations, the Code of Conduct for Responsible Fisheries and punish criminal activities.
- Where they do not already exist, develop and encourage measures ensuring that retailers take responsibility for not trading restricted sizes and species of fish.
- Establish measures to reduce discards and postharvest losses.
- Undertake capacity development to strengthen national policy and legal frameworks, monitoring, control, surveillance and enforcement capacity, and catch documentation schemes, cfr. the FAO Voluntary Guidelines for Catch Documentation Schemes.[16]
- Strengthen regional fisheries management organizations to ensure sufficient regional capacity in scientific advice, management, regulation and enforcement.

[16] http://www.fao.org/3/a-i8076e.pdf

Panel 4.
SUSTAINABLE AQUACULTURE

The total, global aquaculture production of food is now at about the same level as capture fisheries (cfr. figure 4), around 80 million tons annually. One third of the total production, about 28 million tons, takes place in the sea.[17] Aquaculture is the fastest growing food sector world-wide, growing at 5.8 per cent per year in the 2000–2016 period, according to the FAO.[18] About 20 million people works in aquaculture. China is by far the largest producer, producing more than all other countries combined.

Figure 6 shows the extremely rapid growth of aquaculture, from less than 20 million tons in 1990 to around 80 million tons now (120 million tons if aquatic plants are included). Finfish in freshwater is by far the largest category. About 600 species are now farmed in commercial aquaculture.

Marine aquaculture consists of three main categories: Finfish (6,6 million tons in 2016): crustacea (5 million tons): and molluscs (17 million tons). An important distinction is fed species versus unfed species, the former requiring substantial inputs of feed partly based on marine species. About one third of the total production is unfed species that rely on organisms in the environment for their feed. Polyculture where fed and unfed species are grown together is encouraged in aquaculture development.[19]

While aquaculture has taken place for 4000 years, industrial scale aquaculture started in the 1970s and is today the only food producing method capable of growing at required scales and speeds to meet the demand for aquatic foods over the next decades. The future growth of marine aquaculture has to address issues related to environmental impact, use of ocean space, and fish health and welfare. These are challenges that have limited the development of aquaculture in many countries.

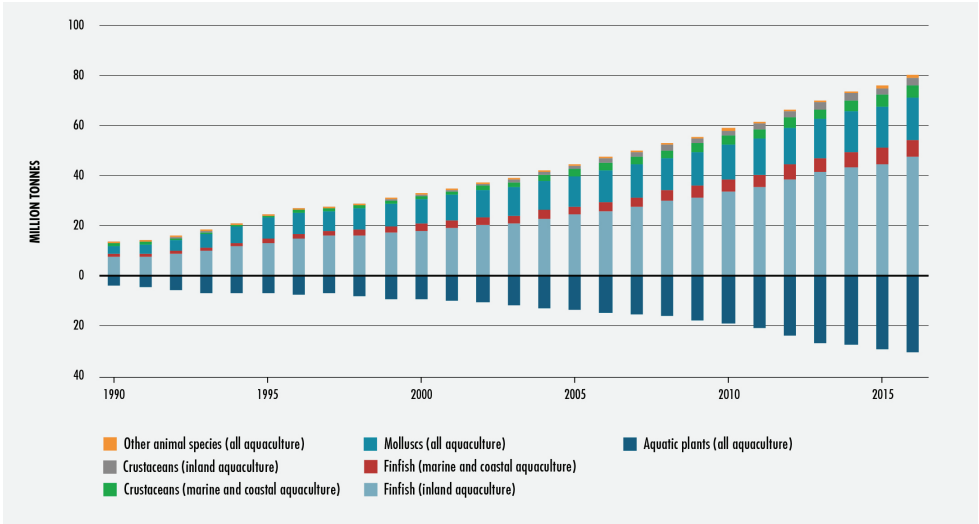


Figure 6: *World aquaculture production of food fish and aquatic plants (freshwater and marine).*
Source: FAO State of World Fisheries and Aquaculture, 2018, p. 17.

[17] FAO State of World Fisheries and Aquaculture, page 4
[18] See previous footnote
[19] FAO State of World Fisheries and Aquaculture 2018

Action points for future growth in aquaculture:

Science and monitoring:

- Establish research and monitoring programs to ensure that aquaculture production innovations incorporate and serve sustainability goals.
- Improve efforts towards the development of ecosystem carrying capacity estimates and monitoring to ensure environmentally sustainable aquaculture development.
- The knowledge based on costal ecosystems needs to be substantially extended, to ensure that various marine aquaculture activities are developed in a sustainable manner.
- More effort is needed to develop lower food chain aquaculture, in particular in marine systems e.g. algae and shellfish farming.
- Develop comprehensive understanding of the biological requirements of relevant fish species, to ensure high productivity as well as welfare and health in aquaculture systems. *This includes:*
    - Understanding the genetics of aquaculture organisms, and the interplay between genetics and the environment, in order to implement efficient breeding programs and to develop production systems adapted to the biological needs of each species.
    - Knowledge on relevant disease organisms and their interplay with the host, in order to prevent diseases and develop efficient vaccines.
    - Further develop the knowledge of each farmed aquaculture species' unique nutrient requirements and biology to ensure optimal diets based on a variety of feed resources.
- Develop and implement research-based fish welfare indicators for established and new aquaculture species, especially when new farming technology is developed.
- Intensify the search and knowledge development for sustainable feed resources for aquaculture organisms. *This includes:*
    - o Exploring the potential for more diverse feed resources, including use of bioreactors and sustainable marine feed ingredients e.g. macro algae or mesopelagic fishes, and use of biproduct and by-catch not directly suitable for direct human use.
    - o Fish feed resources should be a part of a circular bio-economy, preferably utilizing resources that are not directly suitable as food for humans.
    - o Exploring new ways of producing sources of important fatty acids such as long-chain omega-3 fatty acids, for use in aquaculture feeds, e.g. by microalgae production.

Management:

- Aquaculture development need a strong knowledge-based governance platform to meet the global marine food production that ensure sustainability, animal welfare and health.
- Suitable areas for marine aquaculture should be identified as a part of extended marine/coastal spatial planning, based on robust understanding of the biodiversity in the ecosystem and regarding various human activities and in the context of climate changes.
- Foster integrated aquaculture planning by interaction with local and regional stakeholders, taking into consideration the linkages between social, economic and ecological systems for sustainable growth and development and adaptation to local and regional opportunities and challenges.
- Explore and utilize ongoing technology diversification in e.g. salmon aquaculture, in a global perspective, on-shore and off-shore. For example, off-shore farming technology may open for fish farming and other marine culture productions in new ocean areas unfit for traditional net pens.
- Control regimes must be established to ensure that regulations and standards are respected in aquaculture operations, supported by appropriate monitoring programs, e.g. on environmental impacts, animal health and welfare, as well as therapeutics and other substances used.

Capacity development:

Wealthy countries, in a rapidly expanding and globally-connected world, should contribute to develop sustainable food production practices that are relevant to less developed regions.

Panel 5.

THE IMPORTANCE OF SEAFOOD FOR HUMAN NUTRITION

Malnutrition is one of the largest health and development challenges of our time, affecting at least one in three people in the world today. This includes 815 million people who are chronically undernourished [20] and 1.9 billion adults who are overweight or obese.[21] Undernutrition includes being underweight for age, too short for age (stunted), too thin relative to height (wasted) and functionally deficient due to micronutrient malnutrition (lack of vitamins and minerals).

The growth in capture fisheries and aquaculture in the last decades has significantly improved the world's access to nutritious food. According to the FAO, the consumption of fish has doubled from 9 kg per capita in 1960 to about 20 kg per capita now.[22] The growth has been driven by increased production as well as a host of other factors, such as reduced waste, better distribution and increased demand. The consumption of fish varies considerably between countries, from below 10 kg / capita in Africa, Latin America and near East, to above 21 kg / capita in Asia, Europe and North America. Fish now provides around 16% of the animal protein consumption on average globally.

An important aspect of seafood production is that its climate footprint is very limited compared to land-based animals. Fish is efficient in converting feed into high quality protein. In comparison to land-based animals, most of the fish can be utilized for food or food products.

Fish has a critically important role in global food security and nutrition, contributing essential nutrients, especially micronutrients, that are important to combat malnutrition. Hunger, and particularly hidden hunger, results from

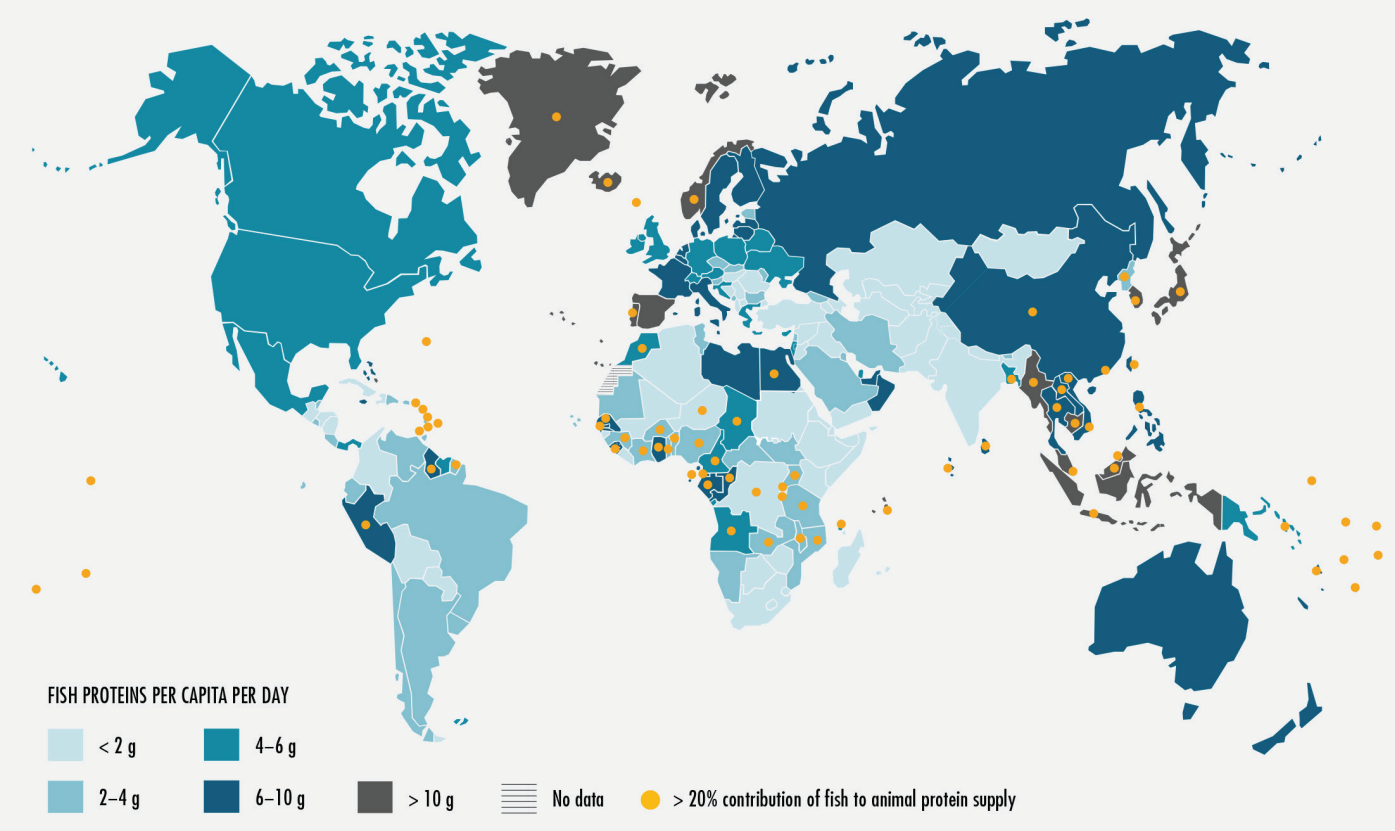


Figure 7: *Contribution of fish to animal protein supply. Source: FAO State of World Fisheries and Aquaculture 2018.*

[20] Food and Agriculture Organization of the United Nations, International Fund for Agricultural Development, United Nations Children's Fund, World Food Program, World Health Organization. The State of Food Security and Nutrition in the World 2017. Building resilience for peace and food security. Rome: Food and Agriculture Organization of the United Nations; 2017.

[21] UNCD Risk factor collaboration. Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 19.2 million participants. The Lancet. 2016; 387: 1377-1396.

[22] FAO State of World Fisheries and Aquaculture 2018, p. 69.

deficiencies of micronutrients. Hidden hunger is hard to identify because energy needs are met while one or several micronutrients are lacking, thereby causing huge health burdens often with complex symptoms and reduced cognitive abilities. Among children under 5 years of age, 151 million (22.2%) are stunted (low height for age) whilst at the same time 38 million (5.6%) are either overweight or obese.[23] The most abundant problem globally is lack of iron causing anemia, lack of iodine causing cretinism and reduced cognitive abilities, and lack of vitamin A causing blindness. Also, a challenge in the context of nutrition and health is too low intake of vitamins D and B_{12}, high quality protein, and marine lipids like the long-chain omega-3 fatty acids. Seafood is a rich source of these essential nutrients and is important to solve these challenges. Proper nutrition is particularly important for pregnant women and younger children as fish contains nutrients that are essential for e.g. neurological development.

In some areas fish is exposed to pollution. Regimes to control contaminants should be in place so that only safe food reaches the markets. Only then can the positive effects of eating fish outweigh potential negative effects of contamination.[24] Adherence to and implementation of international conventions are important to reduce pollution levels and thereby provide more safe seafood.

In terms of animal protein intake, fish is particularly important in developing countries, where the least developed countries (LDCs) have about one quarter of their protein intake from fish.[25]

Undernutrition remains a significant problem in many parts of the world – many lack the food they need for a healthy life.[26] More than 800 million people are chronically undernourished. Seafood is a rich source of essential nutrients and is an important part of a healthy diet. Proper nutrition is particularly important for pregnant women and younger children as fish contains nutrients that are essential for e.g. neurological development. There is a need to better integrate fish into national food security and nutrition strategies, which are often dominated by agriculture.[27]

This is a major theme in the UN Decade on Action on Nutrition (2016-2025) led by the FAO and the World Health Organization (WHO). There is a need to better integrate fish into national food security and nutrition strategies, which are often dominated by agriculture.[28]

It is important to take advantage of the newly established *Global Action Network for Sustainable Food from the Oceans and Inland Waters for Food Security and Nutrition* under the UN Decade of Action on Nutrition[29] led by the World

[23] United Nations Children's Fund (UNICEF), World Health Organization, International Bank for Reconstruction and Development/The World Bank. Levels and trends in child malnutrition: key findings of the 2018 Edition of the Joint Child Malnutrition Estimates. Geneva: World Health Organization; 2018.
[24] FAO/WHO 2011. Report of the Joint FAO/WHO Expert Consultation on the Risks and Benefits of Fish Consumption, Rome, 25–29 January 2010. Rome, Food and Agriculture Organization of the United Nations; Geneva, World Health Organization, 50 pp.
[25] FAO 2018, p. 71.
[26] FAO et al 2017: The State of Food Security and Nutrition in the World 2017.
[27] High Level Panel of Experts on Food Security and Nutrition: Sustainable Fisheries and Aquaculture for Food Security and Nutrition. FAO and World Committee on Food Security 2014, Rome. http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE_S_and_R/HLPE_2014_Sustainable_Fisheries_and_Aquaculture_Summary_EN.pdf.
[28] High Level Panel of Experts on Food Security and Nutrition: Sustainable Fisheries and Aquaculture for Food Security and Nutrition. FAO and World Committee on Food Security 2014, Rome. http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE_S_and_R/HLPE_2014_Sustainable_Fisheries_and_Aquaculture_Summary_EN.pdf.
[29] https://nettsteder.regjeringen.no/foodfromtheocean/files/2018/07/Concept-Document.pdf.

Health Organization (WHO) and FAO offering a unique opportunity to all countries and stakeholders to unite around a common framework and to increase the visibility, coordination, efficiency and effectiveness of nutrition action at all levels across the world.[30] The commitments need to be SMART, i.e. specific, measurable, achievable, relevant and time-bound.

In order to ensure nutritious and safe seafood, reduction of pollution of the seas and increased support towards conventions such as the Stockholm Convention[31] and the Minamata Convention[32] are important. In addition, more data are warranted on the contents of nutrients and contaminants (unwanted substances) of seafood on the markets. Such data should be open access to enable the global community to learn and use the data in policymaking ensuring improved nutrition. Other important factors include better utilization of the whole seafood, reducing waste, supporting initiatives on circular economy and developing innovative and healthy marine food products important for the first 1,000 days of life since this period is critical for the health later in life. Moreover, there is a need for more research into long term human intervention trials on seafood diets in order to evaluate their mechanisms of action in a risk benefit perspective.

Action points to strengthen seafood/fish in nutrition strategies:

- Ensure fish consumption as an integral part of national food and nutrition policies. Focus on the importance of fish to combat nutrient deficiencies and taking advantage of global opportunities such as the Decade of Action on Nutrition to obtain several of the SDGs.
- Improve the efficiency of fish value chains to reduce losses and waste, in an effort to improve access and affordability to all.
- Invest in analyses of nutrient content and food safety aspects of common fish species, fish products and new resources reaching the food-value chain, and make the data open access.
- Include fish in research strategies to elucidate the efficiency of fish to combat malnutrition.
- Invest in the development of well-liked, affordable, nutritious, safe, ready-to-eat, easy-to-use fish products for the first 1,000 days of life.
- Develop food products from underutilized marine species (herring, shellfish, mussels, algae etc.).
    - o Make use of algae and marine yeast as cell factories to produce high value food ingredients.
    - o Tailor marine food products to the preferences of different population groups (elderly, children, women).
    - o Facilitating the protein shift from red (meat) to blue by providing evidence based blue alternatives.
    - o Take the innovative food products to the market.
- Identify a long-term innovation and research agenda which can contribute to aquaculture, fisheries and nutritional policies on national and international level, promote sustainable and nutritious marine foods, and put pressure on the manufacturers to produce more sustainable and healthier alternatives.
- For aquaculture products highlight the effect of decontamination of feed ingredients, e.g. marine oil used as feed in fish farming. This will be an effort to reclaim the pollutants released to the oceans and to decrease human exposures.

[30] World Health Organization, Food and Agriculture Organization of the United Nations. Driving commitment for nutrition within the UN Decade of Action on Nutrition: policy brief. Geneva: World Health Organization; 2018 (WHO/NMH/NHD/17.11).

[31] Stockholm Convention on Persistent Organic Pollutants is an international environmental treaty, signed in 2001 and effective from May 2004, that aims to eliminate or restrict the production and use of persistent organic pollutants (POPs) http://chm.pops.int/.

[32] http://www.mercuryconvention.org/.

Future sustainable use of ocean biological resources

The major take-home message from the conference is that although science is critical to the achievement of the ocean-related SDGs, it is even more important that the knowledge generated is used in policymaking and followed up by making decisions. The United Nations Decade of Ocean Science for Sustainable Development (2021-2030) is important for basic as well as applied research. The Global Ocean Science Report (2017),[33] provides a comprehensive account of the status of global marine science and a basis for further actions to strengthen the contributions of marine science to the 2030 agenda. The work to plan for the United Nations Decade of Ocean Science for Sustainable Development has started and will need political engagement and enthusiasm.

It is of vital importance that international agreements are implemented. The Law of the Sea Convention and associated agreements such as the UN Fish Stocks agreement provides the legal foundation for the governance of the oceans, including the scientific aspects. The Convention is considered the "constitution of the oceans" and it is widely accepted with 169 parties. It recognizes the need for a legal order for the seas and oceans.[34] The implementation of the Law of the Sea Convention and its implementing agreements such as the UN Fish Stocks Agreement (1995) are subject to annual review by the UN General Assembly. In this respect, marine science plays an important role and there are a number of on-going processes under UN General Assembly auspices where the science – policy interface is vital. A regular process to assess the status of the world oceans, delivering its first Global Integrated Marine Assessment in 2015, is important in this respect.

Further; IPCC's recommendations must be followed. Understanding climate change and its effects on the oceans and marine ecosystems are of paramount importance, as ocean health, fisheries, aquaculture and nutritional aspects are affected in significant ways by increased temperature and CO_2 levels.

Ocean health needs to be carefully monitored. While pollution levels vary from region to region, more efforts are needed to reduce introduction of contaminants into the oceans.

With respect to marine litter, and plastics in particular, it is essential to stop litter entering the ocean in the first place by having adequate waste handling systems.

There is considerable scope for increasing the availability of marine seafood. Improved management to reduce IUU fishing and fisheries crime will provide millions of tons more seafood for human consumption. Bringing overexploited fish stocks back to sustainable levels, introduction of rights-based management measures where appropriate, adoption of balanced harvesting and developing new fisheries, will sustain fish stocks that can be harvested for centuries and allow robust investments in new infrastructure and technologies. Also, reduction of discards and better post-harvest practices can significantly increase the supply of fish.

With respect to aquaculture, the fastest growing food-producing sector today, the key issue is to resolve problems relating to the environmental footprint while at the same time providing for further growth. This calls for science-based actions to address feed issues, pollution, fish health, and multiple uses and stakeholders in the coastal zone. Marine, or coastal spatial planning is of essence in this regard for sustainable aquaculture.

The role of seafood in providing nutrition is essential, in particular in the developing world and for younger children. The overall messages in this area is that seafood can contribute to reform food systems, provide healthy diets and should become an integral part of food and nutrition policies. Also, seafood can combat malnutrition and is important for children particularly in the first 1,000 days of life, and for pregnant women.

Improved communication between scientists and policymakers is essential. Mechanisms for this exists both at the global level in the UN (for example the Regular Process producing the World Ocean Assessment), and in the UN specialized agencies such as the FAO, as well as at the regional level such as the International Council for the Exploration of the Sea (ICES) and the North Pacific Marine Science Organization (PICES). In regions where cooperation in marine science is not well established, Large Marine Ecosystems can be a platform for organizing scientific information.

A particular concern is the need to build science based management, and capacity for control mechanisms in fisheries and food safety in developing countries. In many countries the very foundation for the management of the oceans, the scientific understanding of marine ecosystems and the data about the resources are insufficient or lacking. The United Nations Decade of Ocean Science for Sustainable Development provides an opportunity to address this problem in a comprehensive way.

[33] https://en.unesco.org/gosr
[34] https://www.un.org/regularprocess/