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POLICY BRIEF

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Sustainable Development Goal 14 on the ocean

Some insights on fisheries subsidies, noise and plastics

OVERVIEW

The importance of the ocean for sustainable development has been firmly acknowledged in the 2030 Agenda for Sustainable Development through Sustainable Development Goal 14. During a workshop organized by the *Ocean University Initiative* for the French Ministry of Ecological Transition on May 29, 2019 in Brest, some of these goals, notably to manage and combat the negative effects of fisheries subsidies, noise and plastic pollution, were analyzed, enabling the identification of areas for future research detailed in this policy brief. Some research topics are particularly important. Firstly, the implementation of target 14.6 on harmful fishing subsidies requires applied research into the economic, ecological and social impacts of public policies. Secondly, there is a strong need for harmonized measures to assess the impact of noise on marine fauna (invertebrates and vertebrates). Thirdly, marine pollution reduction target 14.1 should initially focus on plastic packaging, which accounts for almost half of the world's marine plastic waste.

Plastic pollution (photo © Jasmin Sessler)

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**Affiliated organizations on May 29, 2019, at the time of the workshop.*

Harmful fisheries subsidies

What fisheries subsidies are harmful to biodiversity?

It has been demonstrated that all policies aimed at supporting production means, for example subsidies for the construction of vessels or fuel tax exemptions, lead to increased fishing effort and reduce biodiversity (figure 1). Fuel subsidies, in particular, encourage trawling practices with abrasion effects. All subsidies supporting access to foreign waters as well as support for the development of infrastructure like ports and harbors also result in increased fishing effort and reduced biodiversity. According to a study carried out by Sumaïla in 2016, subsidies to the fishing sector amounted to US$35 billion worldwide in 2009, of which 22% were fuel subsidies. In France, the *Conseil d'analyse stratégique* has estimated that 55% of the fisheries subsidies paid in 2008 were detrimental to biodiversity.

Are there fisheries subsidies whose impact on biodiversity is yet undetermined?

The effects on biodiversity of subsidies aimed at supporting fishers' revenues, reducing capacities, promoting sales or supporting coastal communities are yet undetermined. Reported data on harmful fisheries subsidies are therefore debatable. In 2008, the French Ministry of Agriculture, Food and Fisheries estimated harmful fisheries subsidies at €351 million, but this figure is more than three times higher once seafarers' social protection and fiscal policies such as tax exemptions on fuels, tax reliefs on profits, VAT exemptions and tax exemptions on investments in French overseas territories are included.
Also debatable are subsidies for the construction of fishing vessels. Whereas for ship owners such subsidies are necessary to upgrade the technical, environmental and safety performance of their vessels, they can also lead to additional fishing effort as a result of the modernization of the fleet. Moreover, these subsidies often have a negative impact on the number of jobs.

Should subsidies be systematically granted to the fishing industry, knowing that, thanks to more effective regulation, it is still possible to generate profits?

Two proposals are made as regards subsidies for the construction of fishing vessels. Firstly, there is no ground for systematically subsidizing ship building as today's business model generates enough profits to upgrade the fleet without public support. Secondly, as a quid pro quo for investment aids, agreements to reduce the fishing effort should be signed to compensate for the increase in the

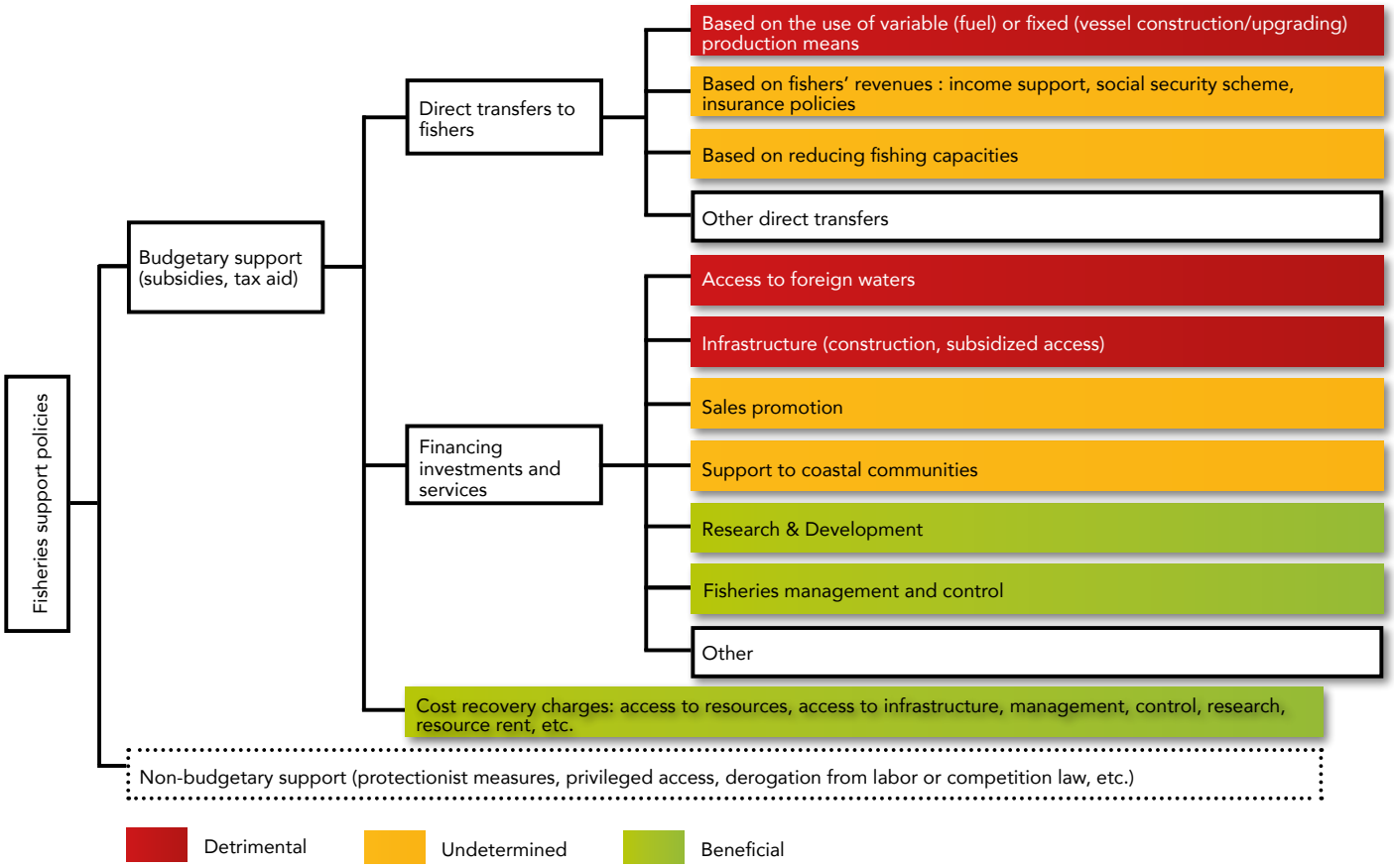

Figure 1. Typology of fisheries subsidies based on their impacts on sustainability
(Fabienne Daures, Ifremer, based on the OECD Review of Fisheries 2017 and Sumaila et al., 2016 and 2010)

fishing capacity of upgraded vessels. For the national government, this would involve deploying additional means of controls. This would also require that each vessel be fitted with a position tracking system and maintain it activated.

In Europe, the subsidies granted for the construction of new vessels in the 1980s have had a negative impact on biodiversity over several decades. Since the 1990s, the Common Fisheries Policy (CFP) has successively implemented policies aimed to reduce the fishing effort, to regulate it, and then to stop all vessel-construction subsidies. To date, these policies have brought around 50% of fish stocks in the European Union close to maximum sustainable yield. In this way, fishers' revenues are therefore maximized without compromising the reproduction process. But there is currently talk of reintroducing subsidies for vessel construction in the European Union. Since 2018, the European Commission has authorized state aid to finance the renewal of fishing fleets in the outermost regions. The results in terms of reduced fishing effort and economic yields could be compromised.

Do we have scientific data on all fish stocks in the EU?

It would be desirable to know the state of the stock for each species, in order to implement appropriate actions if necessary. However, scientific advice on the status of stocks in France is lacking, especially with regard to the Mediterranean and overseas territories. Historical data on fish stocks and scientific expertise to assess them are often lacking.

Ocean noise

Can invertebrates be impacted by ocean noise?

As is the case for marine mammals and fish, ocean noise can negatively impact a wide range of invertebrates, including jellyfish, octopuses and shrimps (figure 2).
Noise could have a major impact on the recruitment of benthic invertebrate populations (Lillis *et al.*, 2014). Fishers from Saint-Brieuc Bay in France have expressed concerns about the impact of building a wind farm on the animals they harvest. Indeed, due to the ground-attachment technique, the installation

Bio-economic assessment of the Gulf of Biscay sole fishery

A bio-economic model has been applied to the Gulf of Biscay sole fishery to investigate different quota management systems from a multi-criteria perspective. This model simulates various management scenarios, including the co-management system currently in place, a fleet decommissioning scheme and the introduction of quota transferability, highlighting trade-offs between social, economic and ecological impacts depending on the desired objectives (table 1). This type of analysis is particularly relevant in countries where small-scale artisanal fishing provides about three-quarters of jobs in the fishing sector.

Table 1. Ecological, economic and social impacts of fisheries (Bellanger et al., 2018, Canadian Journal of Fisheries and Aquatic Sciences 75:10).

		Indicator	Transition phase (2017)		Long-term impacts (2025)	
			Decommissioning scheme	ITQ	Decommissioning scheme	ITQ
ECOLOGICAL IMPACTS	Impacts on habitats	Fishing effort (h/year)	-10%	36%	-10%	33%
		Trawling energy effort (kWh)	-16%	53%	-15%	52%
	Carbon footprint	Fuel consumption (L/year)	-11%	41%	-11%	38%
	Stock status	SSB sole (t)	0%	0%	0%	-8%
		SSB Nephrops (t)	0%	-3%	5%	-9%
		Landing sole (t)	0%	11%	0%	2%
ECONOMIC IMPACTS	Profits	Gross operating Surplus (€)	15%	60%	7%	27%
	Economic efficiency	Cumulative net present value of Net Profit (€)			6%	33%
	Economic viability	Gross operating Surplus > 0 (% vessels)	7%	6%	2%	2%
	Economic inequality	Theil index applied to gross value of landings	-7%	23%	-5%	25%
SOCIAL IMPACTS	Employment	Crew* hours at sea (h/year)	-10%	23%	-10%	18%
	Acceptability	Average yearly wage per crew (€/year)	13%	41%	13%	34%
		Average hourly wage (€/h)	8%	-4%	10%	-4%
		Time at sea (h/year)	7%	35%	6%	30%
		Wage inequality	-12%	94%	-5%	97%

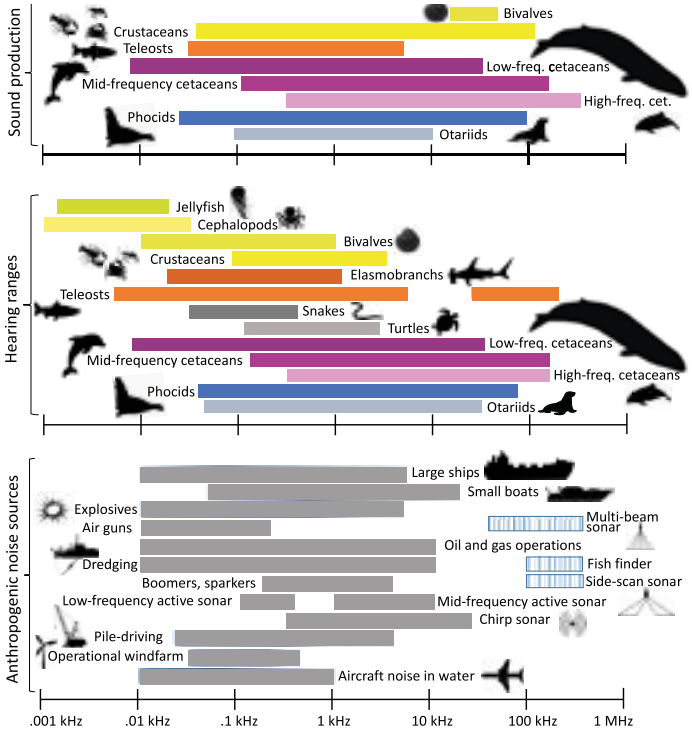

Figure 2. Human-induced sound production and hearing frequency ranges of marine animals (redrawn by Sébastien Hervé, UBO, after Duarte et al., 2021, Science, 371).

of wind turbines to seabed generates very intense noise. According to results from LIA BeBEST, this type of noise has a negative impact on the growth and settlement of scallops. However, conclusions on the impact of noise cannot be generalized as they will depend on the species, its degree of maturity and the ecosystem. For example, it has been reported that submitting mussel larvae seeking to settle on seafloor substrates to the same intensity of noise as that generated by aquaculture boats increases settlement by almost 70%.

Could an acoustic threshold be agreed on to avoid disturbing marine animals' communication and behavior?

Although the U.S. National Oceanic and Atmospheric Administration has defined acoustic thresholds for limiting the physiological impact of noise, including immediate mortality, as well as a zone of influence for cetaceans and some fish species, to date there is no globally accepted threshold for invertebrates. Neither is there an agreed threshold for avoiding disturbing intraspecific communications, or for avoiding altering the behavior of marine benthic invertebrates. Yet this type of nuisance could have long-term effects on populations of large crustaceans, for example. Lobsters make noises with their antennae to avoid fighting with each other (figure 3). If this communication is hindered, it could lead to daily clashes.

Did you know that we lack information to carry out impact assessments?

To carry out impact assessments, it is essential to take *in situ* measurements during construction campaigns, to reproduce the noise generated in laboratory conditions. For example, the nuisance caused by pile driving during wind farm construction. These laboratory tests are often necessary because of the difficulty of measuring them *in situ*. What is needed is a standardized noise measurement method, as well as a data bank of raw data from impact studies, including measurement protocols, pile diameters and environmental factors such as bottom hardness and bathymetry.

What ocean noise indicators would be the most relevant?

In 2008, the EU adopted the Marine Strategy Framework Directive (MSFD) which recognizes 11 indicators of ecological status including impulsive noise sources, such as pile driving, explosions and seismic surveys, as well as continuous sources such as maritime traffic.These criteria should be monitored at the regional level and indicate the percentage of the population affected, the geographical area impacted and the evolution in time. Given model uncertainties and the lack of knowledge about the effects on marine animals' communications, defining non-deterioration thresholds would be relevant, especially for continuous noise (figure 4).

While legislation on underwater noise is being tightened, each country applies different rules depending on its activities at sea and the species in the vicinity. When carrying out seismic surveys, Ifremer, the French institute for ocean science, works on seismic campaigns based on thresholds defined by the US National Oceanic and Atmospheric Administration for limiting the physiological impact of noise on cetaceans. Some countries make activities at sea subject

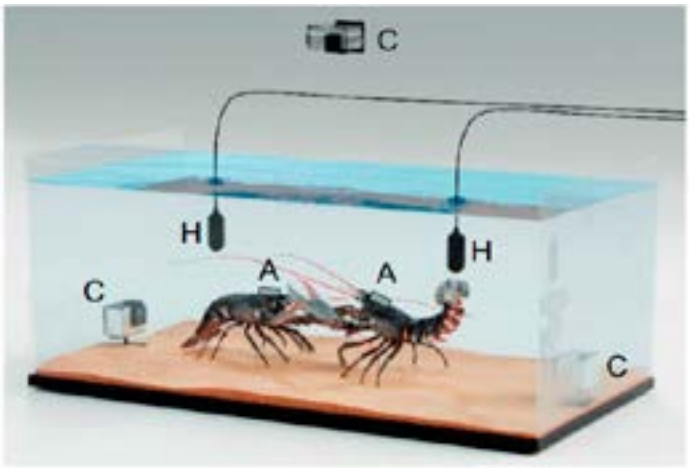

Figure 3. Lobsters make noises to avoid fighting (experiment with European male lobsters, CNRS, LIA BeBEST/LEMAR).

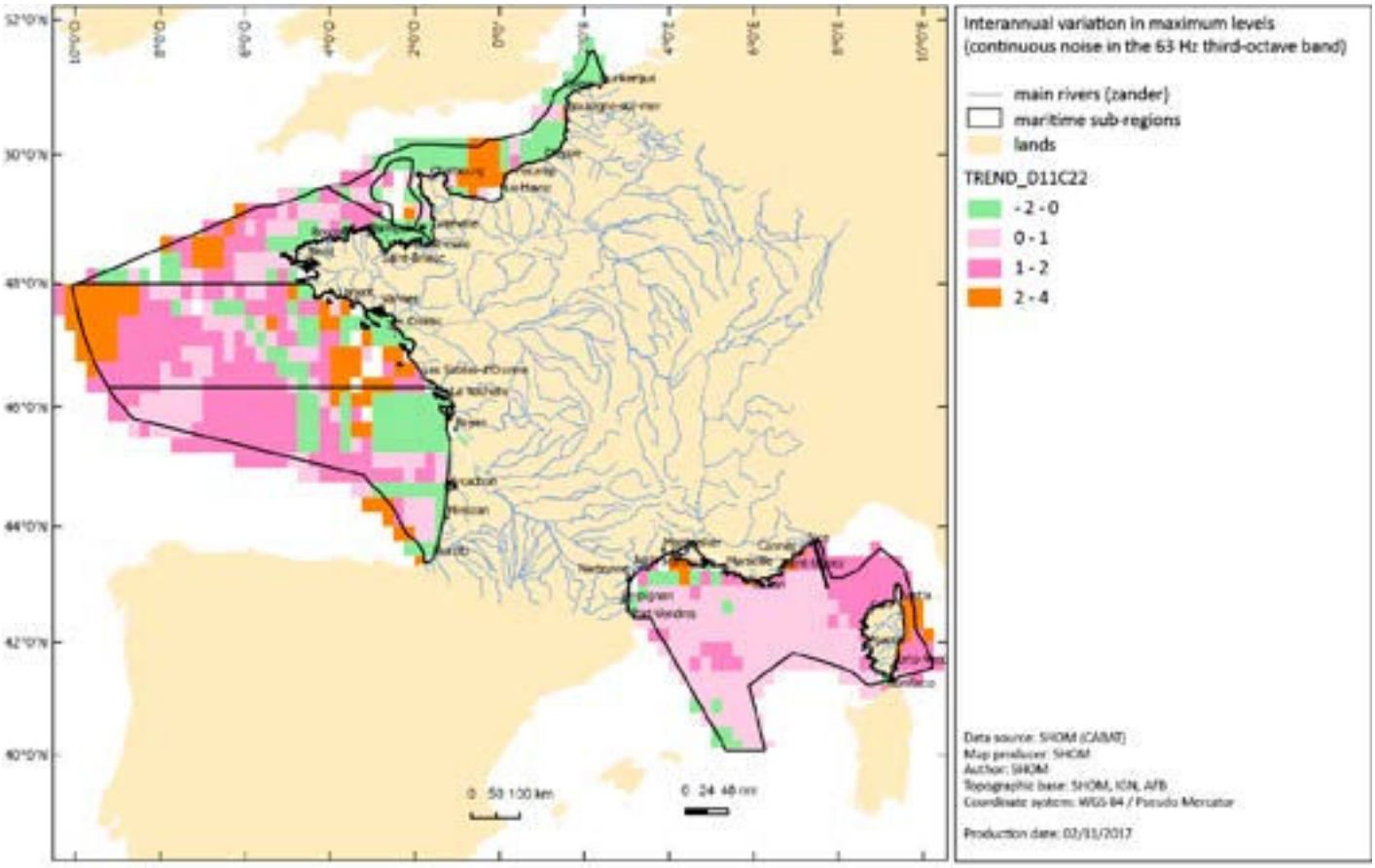

Figure 4. Evolution of continuous noise at 125 Hz between 2012 and 2016 (Kinda et al., 2017, Marine pollution bulletin, 124(1)).

to impact assessments. Others limit the noise level of these activities, adopt seasonal and/or geographical restrictions or impose mitigation measures. However, there is no legally binding text on ocean noise at the global level. For example, there are no legal restraints on ocean noise emitted by freighters and tankers, which account for 80% of all shipping trade worldwide. Ships entering the English Channel, however, emit noise that is audible within a 50 km range.

Plastics in the ocean

Do "plastic continents" really exist?

There is reportedly 250 million tons of plastic in the ocean today. Each year, 4 to 12 million tons of plastic end up in the ocean, projected to increase tenfold by 2025. About 80% of this waste comes from the land, with the remaining 20% mainly from fishing nets. Some plastics also come from the 10,000 or so containers that fall into the sea each year. It has been calculated that each square kilometer of ocean holds up to 3 kg of plastic. But this does not mean that "plastic continents" exist. There may be as much as 3.5 kilograms of plastic per square kilometer.

Do we know where plastic debris can be found in the ocean?

Plastic debris can be found near coasts and out at sea, on the surface of water, in the water column, on the sea floor and in organisms that have ingested them. Studies of ocean currents and, to a lesser extent, samples taken on the surface of the ocean, show that particulate matter accumulates in five large areas called gyres: the Northern Pacific, the Northern Atlantic (the Sargasso Sea), the Southern Atlantic, the South Indian Ocean and the South Pacific (figures 5 and 6). In fact, we mainly have surface data from the Northern Pacific and Northern Atlantic gyres. The activity of these oceanic vortexes, which are "swirling" areas with "exit" pathways, is not well understood. Moreover, we have very little information about surface plastics in the north of the Indian Ocean, and globally about the concentration of plastics in the water column, on the sea floor and in the organisms that have ingested them. Tara Expeditions proposes to monitor the concentration of plastics in the water column by studying samples of phytoplankton.

Why should spatial and oceanic communities work together?

It is not yet possible to observe plastic density below the surface using satellite observations, but current and wave data can be used to build models of the long-

term dispersion of plastics from their main sources of emission, i.e. river mouths and coastal areas, based on the population density near coasts and economic indicators. The results of these models still need to be validated by ground truth data collected by floating objects and aerial or submarine drones equipped with sensors. Promising results have already been obtained from aerial drones in measuring the surface area of the Great Pacific garbage patch, which is twice the size of France. Would it also be possible to use data collected by ships equipped with radar systems? This would involve combining approximate yet global spatial data with highly accurate, zone-specific oceanic data collected *in situ*. Spatial and oceanic communities would need to work together to harmonize their approaches, methods, ways of collecting data and currently divergent expectations. The Intergovernmental Oceanographic Commission and the World Meteorological Organization could act as a model, as both organizations work in close collaboration on climate issues.

Did you know that 92% of marine plastic litter is composed of microplastics?

Macroplastics, those measuring over 20 cm, are only the tip of the iceberg. Most plastic debris measures less than 5 mm, half the average size of a fingernail. Although it has been demonstrated that micro-plastics can carry harmful pathogens, their role in the transmission of diseases is as yet unknown. A study published by Joleah B. Lamb in 2018 showed that plastics increase the risk of coral diseases from 4 to 89%. And we have almost no data on nanoplastics, those measuring less than one micro-millimeter.

What indicators would be the most relevant for plastics in the ocean?

A distinction needs to be made between indispensable or high added-value plastics (e.g. in the health sector), those we use over a long time (e.g. in cars), and others. Indicators should focus on short-life, low added-value plastics, like packaging which accounts for 45% of plastic waste. It is important to highlight that biodegradable plastics must not systematically be considered to be safe as they may be associated with faster dispersion. Moreover, some biodegradable plastics only biodegrade in industrial conditions. In the ocean, they pose the same problems as conventional plastic. Finally, the number of times products made of alternative materials, like cotton or paper, should be used to obtain a more favorable ecological footprint should also be evaluated.

What initiatives exist to reduce plastic debris in the ocean?

Since the 1990s, a series of initiatives and international networks have emerged to tackle the issue of plastic debris in the ocean (table 2). In the science-society category, thousands of initiatives have been launched at various scales by actors like The Nature Conservancy, WWF, Greenpeace, Surfrider or Oceana. To develop solutions and reduce this type of pollution, the dialogue between public authorities, NGOs and the private sector must be reinforced. And all these various initiatives must work together in an open system.

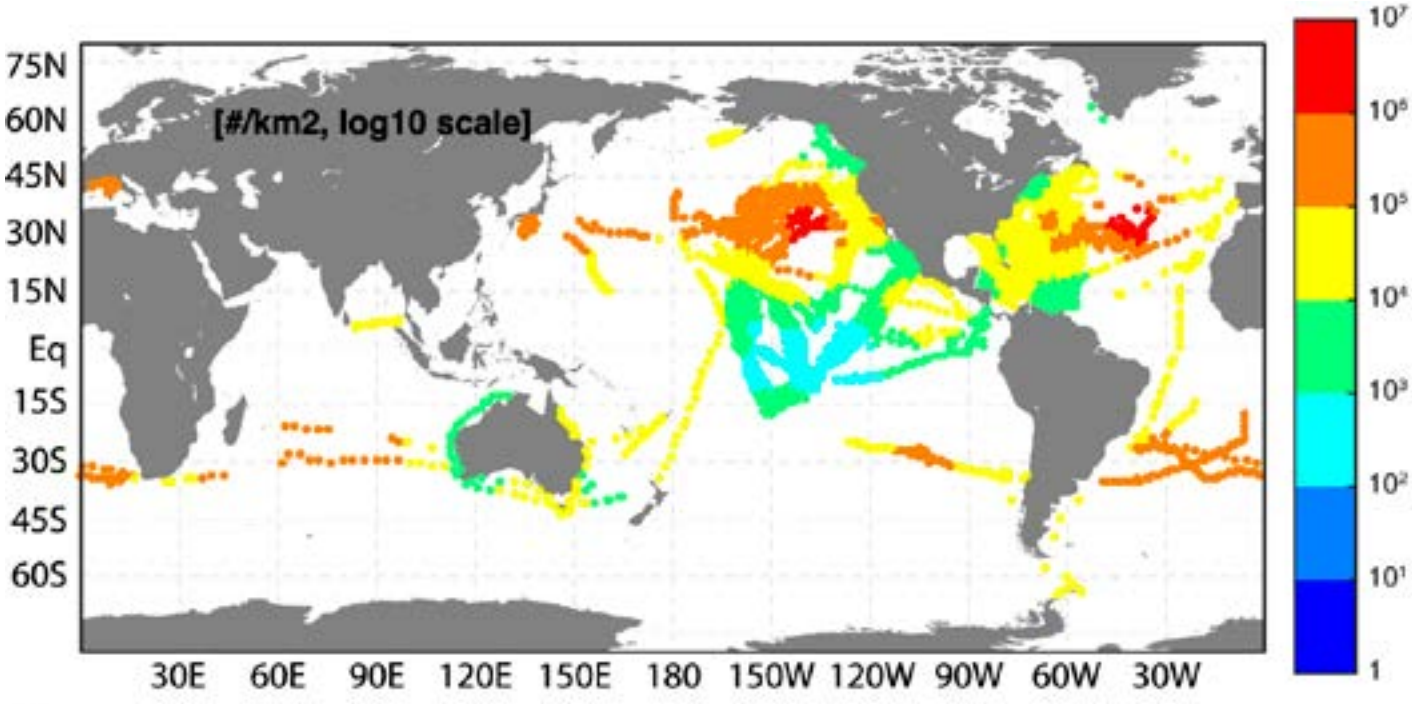

Figure 5. Evaluation of the concentration of microplastics based on surface observations (Van Sebille et al., 2015, Environmental Research Letters 10)

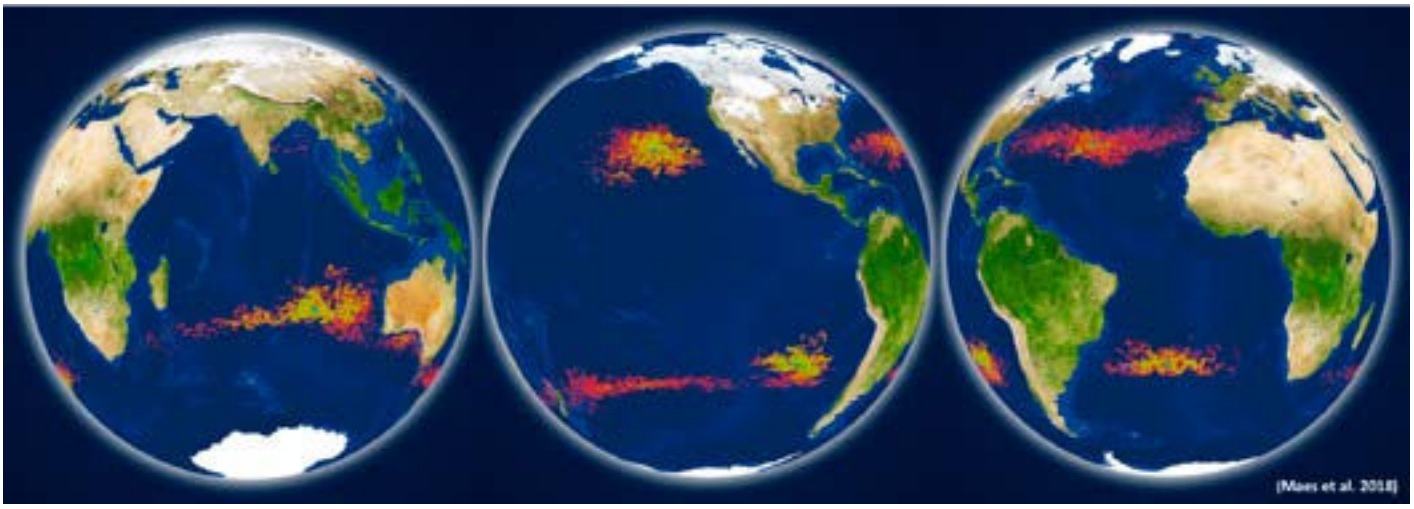

Figure 6. State of scientific knowledge on the concentration of plastic in the ocean based on models (Maes et al., 2018, Geophysical Research Letters 45)

In the research area

Technical group on marine litter, European Commission
See: Harm caused by marine litter (2016)

The European Chemicals Agency
See: Restriction proposal for intentionally added microplastics (2019)

Global Partnership on Marine Litter, UN Environment

SCOR 153 working group: Floating Litter and its Oceanic Transport Analysis and Modeling

Convention for the Protection of the Marine Environment of the North-East Atlantic or OSPAR Convention
See: Regional action plan for marine litter (2017)

GESAMP (Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection)
See: Sources, fate and effects of microplastics in the marine environment: a global assessment (2015)

Zero Plastic working group
See: White paper (2019)

In the science-society area

- The Plastic Tide
- Microplastics Project
- Watershed Litter Monitoring
- Coastal Observation and Seabird Survey Team
- Plastic Pirates
- Community PlasticWatch
- The Litter Project
- Open Litter Map
- Litter-Free Digital Journal
- Coordinated Litter Assessment Project
- Plastic Bank
- Let's do it world
- Global Microplastics Project
- Plastic Soup Surfer
- The Sea Cleaners
- Global Microplastics Initiative
- Riverwatch: Microplastics Monitoring
- ...

Table 2. International initiatives and networks (Juan Baztan, University of Versailles Saint-Quentin)

TOPICS FOR FUTURE RESEARCH

Harmful fisheries subsidies

What lessons can be drawn for implementation of target 14.6 of SDG14? (i) continue to build a common database of fisheries subsidies using standardized methods, like the questionnaire developed by the OECD; (ii) monitor how fisheries respond to changes in public policies, especially in the Mediterranean and in French overseas territories, where information about fish stocks is lacking; (iii) develop public research on the impacts of public policies by characterizing the situation of fisheries and analyzing the economic, social and environmental impacts of fisheries subsidies based on different scenarios.

Ocean noise

The impacts of ocean noise on marine fauna: (i) understand the impacts of ocean noise on the communication and behavior of marine animals; (ii) analyze the long-term effects at the level of populations; (iii) map the habitats and species present on sites of interest, a costly and constantly evolving task; (iv) start analyzing the various activities at sea sufficiently in advance to meet the needs of impact assessments, as it can take years to monitor lifecycles. As regards invertebrates, biological responses in terms of physiology (stress, mortality), the effects on development (reproduction, growth, lifecycle) and behavior as well as modes of perception (electrophysiology) need to be characterized.

***In situ* measurements during underwater work campaigns:** (i) develop a standardized method for measuring ocean noise with the participation of experts from the International Standardization Organization's working group; (ii) make *in situ* impact assessments carried out by States available in a databank.

Plastics in the ocean

Location of plastics: (i) develop ways to observe the surface of the ocean (*in situ* sampling and satellite/airborne/drone data) through national and international initiatives; (ii) develop water column observation systems with sediment traps in areas of interest; (iii) develop ways of mapping plastics on the sea floor; (iv) understand the lifecycle of plastics in the marine environment, from the surface to the seabed; (v) identify and model the fate of plastics throughout the oceans from their sources of emission, which involves integrating the correct physical processes of turbulent dispersion.

The impacts of micro- and nanoplastics on the ecosystems: (i) understand the role of microplastics in the transfer of harmful pathogens; (ii) assess the toxicity of micro- and nanoplastics using realistic, multi-scale approaches: realistic chronic impact assessments (How much plastic in a liter of ocean water? How to acquire data on the water column and on plastic debris smaller than microplastics?); integrate the ecosystem dimension and the toxicity of sources (develop decision-making tools; eco-safety of future biosourced and biodegradable polymers).

SOURCES AND FURTHER READING

Harmful fisheries subsidies

Sumaila, R. et al. (2016) Global fisheries subsidies: An updated estimate. Marine Policy 69: 189-193.

Sumaila, R. et al. (2020) Illicit trade in marine fish catch and its effects on ecosystems and people worldwide. Sci Adv. 26;6(9):eaaz3801.

OECD, 2017. OECD Review of Fisheries (2017) General Survey of Fisheries Policies. TAD/FI(2017)14/FINAL. Paris: OECD publishing.

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Maximenko, N., et al. (2019) Toward the integrated marine debris observing system. Front. Mar. Sci., 6, 447.

van Sebille, E., et al. (2020) The physical oceanography of the transport of floating marine debris, Environ. Res. Lett., 15, 023003.

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The Ocean University Initiative was initiated by the local authorities in Brittany. It is implemented by the University of Brest (UBO) with the aim of creating the conditions for establishing in France of an institute of the United Nations University dedicated to the ocean and the coasts, and with the means to carry out pioneering work in three areas: research, training and communication.

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