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COMMITTEE ON FISHERIES

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MICROPLASTICS IN FISHERIES AND AQUACULTURE: A SUMMARY[1] OF FAO'S STUDY

I. BACKGROUND AND SCOPE OF THE FAO STUDY

1. FAO carried out an assessment study[2] on "Microplastics in fisheries and aquaculture: occurrence and impacts", with the support from UNEP, and, in particular with Norwegian funding, and building on efforts by GESAMP[3]. The two main concerns of the FAO study were to assess the potential impact of microplastics on food safety and consumers' perception, and to understand the potential consequences on fish productivity as physiological processes are likely to be affected by microplastics (because of their occurrence and of the presence of additives and contaminants contained in the plastic).

2. This report focuses on the present state of knowledge on the occurrence and effects of microplastics (i.e. plastic particles less than 5 mm in their longest dimension) on aquatic organisms, especially commercially important species, as well as the possible implications for seafood safety and security. The widespread use of plastic materials in the fisheries and aquaculture sectors, and the sources of microplastic contamination, particularly those derived from fisheries and aquaculture activities, are also covered.

3. The study benefited from the input of a range of international experts in the fields of ecology of marine microplastics pollution, fisheries and aquaculture, and seafood safety risk assessment,

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[1] This summary has been adapted from the executive summary of the FAO study.
[2] Lusher, A.L.; Hollman, P.C.H.; Mendoza-Hill, J.J. 2017. Microplastics in fisheries and aquaculture: status of knowledge on their occurrence and implications for aquatic organisms and food safety. FAO Fisheries and Aquaculture Technical Paper. No. 615. Rome, Italy. http://www.fao.org/3/a-i7677e.pdf
[3] GESAMP (The Joint IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP Group of Experts on the Scientific Aspects of Marine Environmental Protection) produced two assessment reports on the sources, fate and impacts of microplastics in the marine environment.
http://www.gesamp.org/data/gesamp/files/file_element/0c50c023936f7ffd16506be330b43c56/rs93e.pdf
http://www.gesamp.org/data/gesamp/files/media/Publications/Reports_and_studies_90/gallery_2230/object_2500_large.pdf

modelling and management. The report is intended for a wide audience including fisheries scientists and managers, health authorities, fisheries and aquaculture associations, environmental and fisheries ministries, regional fisheries bodies and regional seas organizations.

4. Production of fishery and aquaculture has increased approximately eightfold since FAO started to compile data from member countries in 1950. The increased production of fisheries and aquaculture products has resulted in greater global per capita consumption, significantly contributing to food security, nutrition, income, trade, poverty reduction and socio-economic development in many parts of the world.

5. Consumption of fish and fisheries products have well known health benefits due to their unique nutritional composition, but in some cases fish accumulate significant levels of contaminants from the environment, resulting in some fish products being potentially harmful depending on the amount consumed. Emerging food safety concerns such as the presence of microplastics in seafood should not be seen in isolation, but in the context of the health benefits derived from seafood consumption.

II. CONTEXT

6. Plastic production has been increasing exponentially since the early 1950s and it reached 322 million tonnes in 2015 (this figure does not include synthetic fibres which accounted for an additional 61 million tonnes in 2015). Market demand for plastic products is expected to continue to increase and projections indicate production levels may reach around 600 million tonnes by 2025 and to exceed one billion tonnes by 2050.

7. Plastic is a catch-all term used to describe a range of polymer materials that are moulded under specific temperature and pressure, and have different properties depending on the requirements of the end product. Plastic polymers are highly diversified with around twenty distinct groups, as product requirements and applications evolve so will the types of plastic materials. Depending on the desired properties of the final product, the polymers can be mixed with different additives to enhance their performance, such as plasticizers, antioxidants, flame retardants, ultraviolet stabilizers, lubricants and colourants. The most common additives used in the fabrication processes are phthalates, bisphenol A (BPA), nonylphenol (NP) and flame retardants (FRs).

8. Microplastics are usually defined as plastic items which measure less than 5 mm in their longest dimension, and this definition includes also nanoplastics which are particles less than 100 nanometres (nm) in their longest dimension. Plastic items may be manufactured within this size range (primary micro- and nanoplastics) or result from the degradation and fragmentation of larger plastic items (secondary micro- and nanoplastics).

9. Microplastics and larger macroplastic items are associated with a mixture of chemicals added during manufacturing (such as, plasticizers, antioxidants, flame retardants, ultraviolet stabilizers, lubricants and colourants) or accumulated from the surrounding environment (such as, persistent, bioaccumulative and toxic substances (PBTs), including Persistent Organic Pollutants (POPs).

III. PLASTICS USED IN FISHERIES AND AQUACULTURE

10. The development of fisheries and aquaculture has relied heavily on plastic use. Ropes and netting made from synthetic fibres offer greater strength and durability at a lesser weight when compared to natural fibres. Plastic materials are used in boat construction (including painting and anti-fouling coats), boat maintenance, fishing gears (gill nets, trawl nets, dredge nets, traps, floats, lures, hook and lines), fish hold insulation and fish crates. In aquaculture plastic materials are used for ropes, floats, fish crates and boxes, fish cages, pond lining, fish feeders and fish tanks. Mariculture structures (primarily made of plastics) are kept afloat by buoyant plastics (often Expanded polystyrene (EPS) or plastic buoys) and held in place with lines and ropes (mostly non-buoyant plastic lines). Plastic materials also are used for seafood packaging and transportation.

11. As for the overall contribution from the fisheries and aquaculture sector, it is considered that abandoned, lost or otherwise discarded fishing gears (ALDFG) are the main source of plastic waste into the marine environment, but there is substantial spatial variability in their distribution and abundance. At present there are no current global estimates of the contribution of fisheries and aquaculture to total plastic waste in aquatic environments.

IV. MICROPLASTICS EVERYWHERE

12. Microplastics have been documented in many habitats of inland waters, the open-ocean and enclosed seas, including beaches, surface waters, the water column and the deep seafloor. In oceans, the small size and low density of microplastics contributes to their widespread transport across large distances particularly by ocean currents. Oceanic transport can move buoyant microplastics to distant shorelines or entrained particles can accumulate in central ocean regions. In areas of coastal mariculture and fishing, these activities may be responsible for the presence of microplastics, whereas the sources of microplastics in offshore fishing grounds may be harder to interpret because of the influence of oceanic distribution.

V. MICROPLASTICS AFFECTING AQUATIC LIFE

13. The ubiquitous presence of microplastics raises concerns regarding interaction with biota and potential contamination of the human food supply. This concern has led to a number of exposure and toxicological studies under laboratory conditions. These studies have confirmed that a diverse array of aquatic organisms, across trophic levels, can ingest microplastics. This includes protists, annelids, echinoderms, cnidaria, amphipods, decapods, isopods, molluscs and fish. Also, trophic transfer of microplastics has been observed in several studies under laboratory conditions. However, it is not likely that trophic transfer of microplastics will lead to accumulation, because most microplastics will not translocate into the tissues of their hosts. Metabolic and negative physiological responses from microplastic ingestion in aquatic organisms have only been observed under laboratory conditions after exposure to very high levels.

14. Observations of microplastic uptake by wildlife have been reported in a range of habitats, including the sea surface, water column, benthos, estuaries, beaches and aquaculture. Over 220 different species have been found to ingest microplastic debris in natura. Excluding birds, turtles and mammals, 55 percent are species (invertebrates to fish) of commercial importance, such as: mussels, oysters, clams, Brown shrimp, Norway lobster, anchovies, sardines, Atlantic herring, Atlantic and chub mackerels, scads, Blue whiting, Atlantic cod, common carp and Acoupa weakfish among others. At present there is no direct evidence of trophic transfer of microplastics in wild populations. Additionally, field observations show no evidence of negative effects from microplastic ingestion at the population or community levels in aquatic organisms.

VI. MICROPLASTICS AND SEAFOOD SAFETY

15. Microplastics have been found in various types of human food (e.g. in beer, honey and table salt) and the majority of the reports have studied their occurrence in seafood. Thus, seafood appears to be the most understood source of microplastics to humans. At present, there are no data on the occurrence of nanoplastics in foods because analytical methods to identify nanoplastics remain to be developed.

16. Adverse human health effects from ingestion of micro- and nanoplastics in seafood may be caused by the plastic particles themselves, or by additives and adhered contaminants, such as persistent, bioaccumulative, and toxic substances (PBTs). Human intake of microplastics from seafood (i.e. mussels) has been estimated to equal anywhere from 1 particle per day to 30 particles per day depending on seafood consumption habits and exposure of organisms to microplastics. In microplastic exposed aquatic organisms, the digestive tract contains the largest quantities of microplastics.

However, seafood innards are normally discarded before human consumption, except for bivalves, certain crustaceans and some species of small fish.

17. As an example, a worst case estimate of exposure to microplastics, after the consumption of 250g of mussels per day per person[4], would represent 9 µg of plastics. Based on this estimate and considering the highest concentrations of additives or contaminants reported in plastics and complete release from the microplastics upon ingestion, the microplastics present in seafood will have a negligible effect on the exposure to PBTs and additives, contributing an extremely small fraction of the total dietary intake of these compounds.

VII. KEY FINDINGS

18. Plastic contamination of aquatic environments will continue to increase, resulting in growing amounts of micro- and nanoplastics in these environments. There is some basic knowledge on the occurrence of microplastics in aquatic environments, organisms and seafood, but details are still lacking. Gaps in the occurrence of microplastics include details on entry rates and global distribution in aquatic environments and organisms, their distribution in the water column, and the specific contribution of the fisheries and aquaculture sectors to microplastic contamination. Trophic transfer of microplastics will not lead to accumulation in seafood, and associated PBTs and additives have a negligible effect on the total human dietary intake of these compounds. In contrast, basic knowledge on nanoplastics is still lacking. Data on nanoplastics are essential, because there is concern that nanoplastics may have a high biological impact.

19. Plastic contamination in the oceans and inland waters is a serious problem affecting not only the aquatic environment but also humans. Consumers should be aware that according to the current state of knowledge on the toxicity of microplastics, the risk associated with the consumption of fishery and aquaculture products contaminated with microplastics is negligible and their benefits are known to be numerous. Nonetheless, preventive and corrective measures should be taken at international, governmental and consumer levels to evaluate the toxicity of common polymers, to reduce plastic use and encourage the use of alternative materials, recycling and the adoption of sustainable practices in using plastics and managing plastic pollution.

VIII. POLICY-RELEVANT RECOMMENDATIONS

20. The FAO study on microplastics in fisheries and aquaculture includes a set of recommendations. These were developed by the expert group for the consideration of stakeholders, including policy makers, decision makers, government authorities, fisheries, aquaculture, and seafood industry and retailers, civil society and private sector organizations, consumers, academics and researchers, as concerned with, and interested in the occurrence and impacts of microplastics on fisheries and aquaculture resources, associated seafood safety and human health aspects:

1) Recognize that occurrence and potential impacts of microplastics in fisheries and aquaculture deserve to be studied.

2) Consider applying environmental risk assessment approaches to potential microplastic contamination impacts on fisheries resources and aquaculture operations.

3) Recognize potential impacts of microplastics on seafood quality and safety.

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[4] The consumption figure (250g of mussels per day per person) is taken from the Joint FAO/WHO Chronic Individual Food Consumption Database - Summary Statistics (CIFOCOSS) of 2017. This differs from the 225 g of mussels per day per person that was taken by the European Food Safety Authority (EFSA) as the worse exposure scenario, as described in the FAO microplastics study. This translates in a difference of 2 µg of plastics more ingested through mussel consumption per day per person, which however does not reflect any difference in the exposure assessment conclusions.

4) Recognize that data and knowledge gaps exist for risks of small microplastics (less than 150 µm) and nanoplastics in seafood.

5) Adopt food safety risk analysis frameworks (i) to evaluate risks to consumers of seafood contaminated with microplastics and (ii) to determine decisions and measures to ensure effective consumer protection and viable seafood trade.

6) Facilitate and promote improved cost-effective and well-targeted monitoring of microplastics in the environment, biota and seafood products (market sampling) and promote capacity building and implementation of best practices in monitoring and the review of (i) microplastics contamination of seafood and (ii) microplastics contamination effects on fish resources.

7) Select the most appropriate approaches for monitoring microplastic contamination levels in commercial fish resources and contamination impacts on fish and fisheries products.

8) Strengthen and harmonize analytical methods used for detection and quantification of microplastics and nanoplastics, and ensure appropriate risk-based interpretation of results.

9) Communicate actively and adequately about hazards and risk management of microplastic contamination of seafood to the general public, food safety and consumer protection authorities, fisheries and aquaculture agencies as well as to the seafood industry.

10) Promote cooperation between national and regional authorities, industry and stakeholders concerned with effects of microplastic and nanoplastic contamination and pollution impacts in fisheries, aquaculture and seafood supply chains.

11) Raise awareness in the appropriate authorities (central, regional and municipal), sectors (industry, transport, etc.) and consumers of microplastic issues (impacts, sources and mitigation), and links to industry practices and other sources.

12) Recognize responsibilities of contributors to microplastic contamination including fisheries and aquaculture as well as other sources such as industry, sewage, transport, etc.

13) Raise awareness of fisheries and aquaculture sector stakeholders on the importance of managing plastic-based gears, equipment use and inputs and preventing loss or release of microplastic-generating gears.

14) With a view to reducing and avoiding impacts on fisheries, aquaculture and seafood supplies and consumers, other sectors contributing to microplastic pollution should consider addressing the following selection of recommendations (UNEP, 2016[5]) that were developed for the 2016 United Nations Environment Assembly (UNEA-2), such as:

    i. Ensure effective efforts of reduction of release of microplastics and associated contamination impacts;

    ii. Strengthen the implementation and enforcement of existing international and regional frameworks;

[5] UNEP. 2016. Marine plastic debris and microplastics – Global lessons and research to inspire action and guide policy change. United Nations Environment Programme, Nairobi. ISBN No: 978-92-807-3580-6. https://wedocs.unep.org/rest/bitstreams/11700/retrieve

iii. Quantify the relative contributions of all critical land-based and sea-based sources and investigate pathways of marine litter, including macrolitter and microlitter;

iv. Prioritize actions for marine litter mitigation, including the identification of hotspots and the examination of future scenarios, by the use of best available technologies;

v. Develop cost-effective monitoring and assessment strategies with regard to marine litter at all levels, taking into account existing programmes at the regional level, and particularly, promote harmonization and standardization of methods, establish monitoring programmes for marine litter, report on actions they have taken in order to prevent, reduce and control marine littering, and strengthen international cooperation for data and information exchange;

vi. Promote willing and informed stakeholder participation in marine litter prevention and reduction strategies and policies;

vii. Develop global and regional marine litter indicators to guide the prioritization of targeted interventions;

viii. Support efforts to promote a lifecycle approach to plastic products, including the consideration of the degradation of different polymers and the rate of fragmentation (in the marine environment); and

ix Strengthen education and awareness measures on marine litter.

15) International organizations (such as FAO, UNEP, IOC, WHO, others) as well as regional organizations (regional fisheries organizations, regional seas programmes, others) should collaborate on microplastic and nanoplastic contamination of aquatic environments and potential impacts on food safety and fishery and aquaculture resources. Advisory Bodies such as GESAMP should work on specific aspects of contamination of the environment with microplastics and nanoplastics.