

Input to SG report on oceans and the law of the sea – the role of seafood in global food security

Executive Summary

Global climate change is expected to alter terrestrial inputs to the sea, the production of organic matter in the ocean, marine ecosystem composition and trophic interactions. As a result, the chemical composition of the organic matter may change with unknown consequences for global fish stocks and food security. The combined effect of marine contamination and ocean acidification can reduce the productivity and economic value of species through direct toxic impacts on their viability or their reproductive capacity and ultimately adversely affect international trade in these valuable commodities. Enhancing knowledge on the biology and ecology species of ecological and economic importance is essential to promote sustainable exploitation of wild resources or optimize aquaculture production.

Nuclear and isotopic techniques provide powerful tools to investigate the environmental and biological processes responsible for the bioaccumulation and food-chain transfer of radionuclides, metals, organic contaminants, and bio-contaminants such as harmful algal bloom (HAB) toxins in seafood and the potential effects of ocean acidification on their generation. Isotopes are valuable proxies of marine species population health.

The International Atomic Energy Agency (IAEA) provides, *inter alia*, support to its Member States to establish nuclear and isotope-based tools and techniques to monitor and assess threats to global seafood stocks and public health resulting from climate change and various pollutants. It develops and applies nuclear and isotopic techniques to assist in the management of the coastal ecosystems, i.e. to identify sources of pollutants, their transport pathways and impact and ultimately their metabolism and fate in the environment or sediments. This work is also supported by remote sensing products and modelling the dispersion of radiotracers and pollutants in selected coastal environments in cooperation with organisations applying these tools.

Since early 2013, the “Ocean Acidification International Coordination Centre (OA-ICC)”, coordinated by the IAEA Environment Laboratories in Monaco with the goal to serve all ocean acidification actors (scientific community, policymakers, media, and the general public) by facilitating, promoting and communicating a number of global activities on ocean acidification has been fully operational (<http://www.iaea.org/ocean-acidification/>).

In the framework of several Regional Seas Conventions and Action Plans, the IAEA is a key player and partner to build capacity on the analysis of hazardous pollutants in the marine environment, to strengthen data quality assurance of Member States’ analytical laboratories involved in the respective marine pollution monitoring programmes and to provide technical reports related to seafood safety with respect to the presence of radioactive materials in the oceans.

The International Atomic Energy Agency (IAEA) provides, *inter alia*, support to its Member States to establish nuclear and isotope-based tools and techniques to monitor and assess threats to global seafood stocks and public health resulting from climate change and various pollutants. This includes building capacity in areas such as ocean acidification, harmful algal blooms (HABs), and the presence of heavy metals and persistent organic pollutants in marine biota. This support is provided by the IAEA Environment Laboratories in Monaco as well as through the IAEA Technical Cooperation Programme.

The IAEA is a key player and partner with regard to several Regional Seas Conventions and Action Plans, such as the Barcelona Convention (Mediterranean Action Plan), the Black Sea Commission (Black Sea Environment Programme, BSEP) and the Kuwait Convention (Regional Organisation for the Protection of the Marine Environment of the Gulf, ROPME), to build capacity on the analysis of

hazardous pollutants in the marine environment and to strengthen data quality assurance of Member States' analytical laboratories involved in the respective marine pollution monitoring programmes. It also co-operates with the regional sea conventions i.e. the "Oslo and Paris Conventions for the protection of the marine environment of the North-East Atlantic" (OSPAR) and the "Baltic Marine Environment Protection Commission" also known as the "Helsinki Commission" (HELCOM), with regard to radioactive substances.

Climate change

Global climate change is expected to alter terrestrial inputs to the sea, the production of organic matter in the ocean, marine ecosystem composition and trophic interactions, the ice forming and melting dynamic as well as the release of methane from permafrost areas in the Arctic, accelerating the greenhouse effect. As a result, the chemical composition of the organic matter may change accordingly with unknown consequences for global fish stocks and food security. In this respect, the IAEA studies biomarker indicators and their isotope composition in order to characterize the organic material and trace the trophic interactions through the food chains. They are used as tracers of sedimentary organic matter to explore complex ecosystems with respect to source apportionment, trophic interactions, elucidation of pathways and transformation processes of the organic carbon. These approaches are essential to provide evidence for ecosystem changes and the necessary background for establishing policies to adapt to climate change.

Nuclear and stable isotopic techniques are particularly valuable in assessing the effects of ocean acidification on marine organisms in conjunction with increasing water temperatures and co-contaminants in their environment. Because of the global extent of ocean acidification, this information is useful when coupled with valuation techniques to assess the scale of its socio-economic significance for Member States. The IAEA has initiated a four-year coordinated research project (CRP) focused on key ocean ecosystems south of 30°N latitude. The overall objective of the project is to evaluate potential biological and socio-economic impacts of ocean acidification, and the implications for sustainable food security for the coastal population. The CRP targets productive coastal boundary currents, tropical coral reef habitat, and semi-enclosed seas. The CRP supports the transfer of new knowledge to a network of developing Member States, and will promote institutional capacity for research and training in ocean acidification regionally.

In response to recommendations from the scientific and end user communities, and the increasing concern of IAEA Members States, the project "Ocean Acidification International Coordination Centre (OA-ICC)", was launched during the Rio+20 UN Conference and became fully operational in early 2013. The project is coordinated by the IAEA Environment Laboratories in Monaco with the goal to serve all ocean acidification (OA) actors (scientific community, policymakers, media, and the general public) by facilitating, promoting and communicating a number of global activities on ocean acidification. These include the establishment of an international observing network, the use of joint platforms and facilities, collaboration between natural, social and economic sciences, exchange of students and scientists, joint experiments, definition of best practices, online bibliographic database, data management, capacity building, dissemination of information and outreach activities. A wide range of information on ocean acidification activities for different audiences can be found on the OA-ICC website (<http://www.iaea.org/ocean-acidification/>). In addition, through its news stream, the OA-ICC provides an extensive report on ocean acidification related scientific literature and media articles on a daily basis to all its registered followers (free subscription at <http://news-oceanacidification-icc.org/>). To respond to the multi-disciplinary nature of ocean acidification, the IAEA is also expanding its support for collaborations among international researchers on the effects of rising acidity of ocean water. Through biennial international multi-disciplinary workshops, scientists meet to discuss the topic "Bridging the Gap between Ocean Acidification Impacts and Economic Valuation." The goal is to generate interdisciplinary recommendations to policymakers on the emerging issue of ocean acidification (<http://www.iaea.org/ocean-acidification/download/ebook-ECONOMICS%20OF%20OCEAN%20ACIDIFICATION.pdf>).

Coastal Pollution and Seafood Safety

The increasing needs for production and trade in the fisheries industries will require greater production from coastal and oceanic aquaculture industries as well as harvesting from wild fisheries. Through their bioaccumulation to levels that may adversely affect human health, marine pollutants can adversely affect international trade in these valuable commodities, particularly from the Least Developing Countries and Small Islands Developing States depending heavily on their marine resources. The combined effect of marine contamination and ocean acidification can also reduce the productivity and economic value of these species through direct toxic impacts on their viability or their reproductive capacity and the enhancement of their capacity to accumulate pollutants. Enhancing knowledge on the biology and ecology species of ecological and economic importance is essential to promote sustainable exploitation of wild resources or optimize aquaculture production. Nuclear and isotopic techniques provide powerful tools to investigate the environmental and biological processes responsible for the bioaccumulation and food-chain transfer of radionuclides, metals, organic contaminants, and bio-contaminants such as harmful algal bloom (HAB) toxins in seafood and the potential effects of ocean acidification on their generation. As well, isotopes are valuable proxies of marine species population health. These data are relevant to management decisions in areas such as fisheries closures/re-openings, choice of aquaculture species and the geographical seating of aquaculture facilities. They can also support risk-based assessments of contaminants in seafood by expert groups such as the Joint FAO/WHO Expert Committee on Food Additives.

The IAEA is developing and applying nuclear and isotopic techniques to assist in the management of the coastal ecosystems, i.e. to identify sources of pollutants, their transport pathways and impact and ultimately their metabolism and fate in the environment or sediments. This work is also supported by remote sensing products and modelling the dispersion of radiotracers and pollutants in selected coastal environments in cooperation with organisations applying these tools. The general objectives of this field of activities are to improve the understanding of the anthropogenic impacts on coastal ecosystems and to investigate land-ocean interconnection and transport mechanisms across this boundary effecting coastal environments. Among others it is planned to better understand the linkage between HABs and nutrient supply from land and submarine groundwater discharge (SGD), to develop qualitative and quantitative models describing the sources of nutrients causing HABs, and to link it to relevant aspects of seafood safety and security.

The IAEA enhances the capabilities of Member States to achieve goals set out under Agenda 21 and serves as a clearing house for radioactive contaminants in the environment within the framework of the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (GPA). The IAEA also provides advice to the Joint Group of Experts on the Scientific Aspects of Marine Environment Protection (GESAMP) on the transfer, behaviour and fate of natural and artificial radionuclides in the marine environment. Under the IAEA Action Plan on Protection of the Environment from the Effects of Ionising Radiation, information on the bioaccumulation and tissue distributions of radionuclides in candidate marine organisms is required to estimate resultant radiation doses. Numerous land-based industrial, mining, domestic and agricultural activities result in substantial input of radionuclides and potentially toxic metals and organic pollutants into coastal and marine waters. These various types of contaminants can be bio-accumulated along the food chain, and may have direct or indirect deleterious effects on coastal ecosystems. Radiotracer and other nuclear techniques provide unique insights into the bioavailability and fate of various toxic compounds occurring at trace levels, particularly with regard to climate change scenarios of increasing temperature and acidity of marine waters. These data are also used to identify suitable bio-indicator species to be used in bio-monitoring programmes in Member States. The general objective of this field of activities is to enhance the capability of Member States to develop and apply nuclear-based techniques for assessing the bioavailability, contaminant pathways, behaviour and fate of radionuclides, trace metals and organic contaminants originating from land-based sources in the marine environments.

Marine radioactivity and its impact on global seafood supplies

In 2013 the IAEA has prepared updates of two technical reports related to seafood safety with respect to the presence of radioactive materials in the oceans:

The report “Determining the Suitability of Materials for Disposal at Sea Under the London Convention and London Protocol: A Radiological Assessment Procedure” contains a radiological assessment procedure to determine, if materials that are candidate for dumping at sea, contain radionuclide levels which can be considered de minimis, e.g. that the radiological impact to humans and the environment due to the input of these materials in the ocean waters can be considered negligible. The radiological assessment includes the consideration of seafood in the human food-chain as well as the impact to representative organisms of marine flora and fauna, using for this purpose the concepts and criteria defined by the International Commission of Radiation Protection (ICRP) and included the IAEA related Safety Standards. This work by the IAEA was done at the request of the Contracting Parties of the Convention on the Prevention of Marine Pollution by dumping of wastes and Other Matter (the London Convention 1972). The updated procedure was endorsed in October 2013 by the Contracting Parties of this Convention. This report is currently in the process of publication by the IAEA and will be included in the International Maritime Organization (IMO) Guidelines on the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter.

The second report prepared by the IAEA in cooperation with IMO is an update of the inventory of radioactive materials at sea resulting from historical marine dumping activities, accidents and losses at sea. The process of updating this inventory concluded in December 2013; a report titled “Inventory of Waste Disposals, Accidents and Losses at Sea Involving Radioactive Materials” is in the publication process by the IAEA. This report, prepared at the request of the Contracting Parties of the London Convention 1972, is intended to be used as an information base to assess the impact of radionuclide sources in the marine environment.

To enable Member States in the region to evaluate the extent and the possible impact of the releases of radioactivity from the Fukushima Daiichi nuclear power plant into the marine environment and make scientific assessments of the data, the IAEA is carrying out a regional technical cooperation project together with Asian and Pacific countries with the title “Marine benchmark study on the possible impact of the Fukushima radioactive releases in the Asia-Pacific Region”. This project will enhance regional mechanisms and competency of the Member States in the monitoring and assessment of the possible impact and consequences of uncontrolled releases of radioactivity into the marine environment following a nuclear event.

Further information: <http://www.iaea.org/newscenter/news/2012/radioactiverelease.html>

<http://www.iaea.org/newscenter/news/2011/tcmarine.html>

http://www.iaea.org/technicalcooperation/Regions/Asia-and-the-Pacific/News/09102013_Palau_postFukushima.html

In November 2013, the IAEA, through its Environment Laboratories started collaboration with Japanese authorities on sea area monitoring. The IAEA will assist Japanese laboratories to improve their performance in analysing marine samples including marine food by means of Proficiency Tests and sample exchange by interlaboratory comparisons, thus increasing the reliability and the level of confidence of the Japanese monitoring results in a transparent manner to ensure safety of marine food in relation to radioactive substances.