Environment

Objective

To enhance the capacity for understanding environmental dynamics, and the identification and mitigation of problems in the marine and terrestrial environments caused by radioactive and nonradioactive pollutants using nuclear techniques.

Application of Isotopes to Understand the Impact of Ocean Acidification on Organisms

In the future, the acidification of the ocean due to carbon dioxide accumulation in seawater is expected to dramatically reduce the calcification and physiology of many marine organisms. Moreover, changes in ocean carbonate chemistry and decreasing pH will alter the chemical speciation of trace elements and modify their bioavailability to marine biota. In this connection, radioisotope analysis provides valuable data for understanding the mechanisms of toxicity in marine organisms and for assessing the risk of contaminant levels in seafood for human consumption. In 2011, such experimental studies at the Agency identified contrasting interactions among contaminants and species, resulting from combined chemical and biological effects caused by climate change.

Isotope techniques facilitate our understanding of carbon driven effects on marine organisms and reduce the uncertainty that exists concerning biological outcomes of changing ocean chemistry. Data collected by the Agency in 2011 highlighted how ocean warming synergistically increases the effect of ocean acidification on the calcification capacity of most species studied. However, not all organisms display the same response to environmental changes, and results obtained in the Agency's laboratories helped identify tolerant organisms that could be considered as key species for adaptation of ecosystems and for maintenance of associated ecosystemic research in the future. The results of these studies are essential for the production of accurate models of effects on fisheries and estimates of the socioeconomic impacts of ocean acidification.

Building the Technical Capacity of Regional Laboratories for Assessing Marine Pollution

In 2011, three new marine certified reference materials for radionuclides, trace elements and organic contaminants were produced according to ISO Guides 34 and 35. They were distributed to Member States to be used in national and regional laboratories for quality control, validation of analytical methods, and assessment of data quality and methods development.

The Agency provided technical support for the quality assurance of data for UNEP's Programme for the Assessment and Control of Pollution in the Mediterranean Region (MED POL) by completing two interlaboratory comparisons and two analytical performance studies, and by conducting two training courses on analytical techniques and basic metrological principles for the determination of organic contaminants and trace elements. Four methods for the determination of trace elements and organic contaminants in marine samples were also revised and provided to MED POL laboratories.

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With the aim of improving quality assurance and management of laboratories in Member States, the Agency organized three proficiency tests for the determination of radionuclides, trace elements and organic contaminants for the Regional Organization for the Protection of the Marine Environment (ROPME). A proficiency test for radionuclides was also organized for the Contracting Parties to the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention). In addition, the Agency conducted three worldwide interlaboratory quality assurance comparisons for radionuclides, trace elements and methyl mercury in the marine environment. Over 120 laboratories participated in these comparisons.

FIG. 1. An example of an HAB (left). (Photograph courtesy of B. Suarez.) The radiobinding assay technique permits the detection of HAB outbreaks at an early stage (right).

The Agency implemented 28 technical cooperation projects to assist over 40 Member States in Africa, the Middle East, the Asia–Pacific region, and Latin America and the Caribbean in developing or improving national technical capacity for marine pollution studies and environmental quality assessment. The Agency also provided support to develop tools and techniques for assessing levels of organic and inorganic contaminants, radionuclides and stable isotopes in the marine environment, and for setting up sustainable regional monitoring programmes. Member States received assistance in generating data on contaminants in seafood, and in assessing the relevance of using experimentally derived and field based data for establishing regulatory threshold levels of contaminants in seafood. Five technical cooperation projects and one CRP focused on the assessment of harmful algal blooms (HABs), toxin concentrations in the environment and toxin transfer to human consumers. In related work, the Agency and its international counterparts in Member States, including the IAEA Collaborating Centre in the Philippines, used nuclear techniques to develop and refine a radioassay technique that detects and warns more quickly and precisely of an HAB outbreak, thus saving lives and protecting fisheries (Fig. 1).

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The Agency's Contributions to Climate Change Studies

Climate change is a major challenge for the Earth's future. The world's oceans absorb over 25% of the increasing carbon dioxide emissions released into the atmosphere by human activities. Global warming will further accelerate carbon dioxide release from natural sources into the atmosphere. Recent research has provided evidence that rising levels of carbon dioxide are causing acidification of ocean water. Nuclear and isotopic methods are major tools to study climate change effects on the environment. The Agency is playing a significant role in addressing these issues.

One example of the Agency's work is its collaboration with researchers around the world to study how the rising acidity of ocean water disrupts the ecophysiology of organisms that are of high economic value or that provide the foundation of the marine food chain, as well as of the corals that serve as coastal protection and act as an essential habitat for countless marine species. The Agency also supported studies that combined laboratory experiments (as described above) using radioisotopes

and work in the field that focused on carbon dioxide vents that naturally decrease seawater pH. These studies help demonstrate and validate contrasts in tolerance among species to changing environmental conditions.

Recognizing that an interdisciplinary approach is necessary for climate change studies, the Agency facilitated discussions and collaboration between experts in geochemistry, biology, fisheries and economics. The aim is to build connections between the different disciplines and to target priority support for Member States dependent upon marine resources in a time of rapid environmental change.

As part of its collaboration in the Malina project, jointly organized by Canada, France and the USA to assess the impact of climate change in the coastal Arctic Sea, the Agency carried out experiments on the identification of the terrestrial, marine and bacterial sources of carbon and the processes of transport and degradation in the water column of the Beaufort Sea off the Mackenzie River delta (Fig. 2). This work involves the assessment of particle export from surface waters and water mass exchanges between shelf and offshore areas, as well as downward particle flux at several depths and in several areas. The data generated will assist field observations monitoring the complex and rapidly changing Arctic environment and increase the information available to climate change modellers.

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FIG. 2. As part of the Malina project, the Agency carried out experiments to measure natural radionuclides in the Arctic Sea.