Monitoring Ocean Health and Marine Ecosystems in a Changing Climate

Climate change is driving change in the ocean. Increasing temperatures, melting glaciers, more frequent extreme weather events, and increasing levels of atmospheric carbon dioxide have led to sea level rise and to a warmer, more acidic ocean. These conditions cause stress not only to marine organisms, including seafood species, but also to coastal communities.

As the effects of climate change worsens, concern has grown that warmer, more acidic waters could affect the growth and health of corals, fish, and other species and the way pollutants affect food chains, which impacts seafood safety. Therefore, monitoring and assessing ocean change are key to designing policies to ensure the resilience of marine ecosystems and coastal communities.

Innovative experimental radiotracer applications are used to analyse the effect of ocean acidification on calcifying marine organisms and to study the uptake of heavy metals by marine organisms and radioligand receptor binding assay methods are applied to identify and monitor biotoxins in seafood.

For more than ten years, the IAEA has worked with the Kuwait Institute for Scientific Research (KISR) to develop and apply nuclear techniques for monitoring the impact of climate change on marine ecosystems.

KISR is using radioligand receptor binding assays to analyse the increasing occurrence of toxic algae and their biotoxins, partly caused by climate change, and the impact on seafood. As the ocean becomes warmer and more acidic, marine organisms become less resistant to additional stressors, like pollutants. Using nuclear techniques, researchers can determine the uptake rates of such pollutants. Radiotracer methods also help us to experimentally assess the responses and thresholds of organisms to various stressors.

There are concerns that warmer and more acidic waters might cause marine life to

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absorb more pollutants, and they could accumulate in seafood. With IAEA support, KISR has used radiotracers to discover that the polonium in crustaceans has not increased, although the uptake by fodder phytoplankton had increased. Research on other metals, like copper and mercury, is ongoing.

Studies conducted with shrimp, an important food source for many fish species, showed that although ocean acidification did not affect the size of the shrimp, it increased the amount of food the shrimp need to survive. Shrimp were observed to adapt over successive generations to increasingly acidic water.

A key scientific hub in the Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology (ARASIA) region, KISR has been officially designated as an IAEA Collaborating Centre that provides support to neighbouring countries in coastal and marine science. It is also part of the IAEA Ocean Acidification International Coordination Centre's network. At COP28, IAEA and KISR will launch a joint research project to support ocean health using KISR's new medium-sized research vessel 'AlMustakshif' ("The Explorer") as a critical tool for monitoring the impact of ocean acidification, marine microplastic pollution, emerging contaminants such as 'forever chemicals' and radioactive pollution in the Gulf and the Mediterranean Sea, and beyond. This joint research and capacity building will contribute to the understanding of possible impacts on marine environments and help inform climate change policymaking.

The Science

Artificial radiotracers are substances that are 'labelled' with radioactive material to track the substances' movements. Naturally occurring radionuclides in the ocean, such as polonium, lead or tritium, are also used as radiotracers.

The presence of radiotracers and the rate of their decay can help scientists track the movement of contaminants in the ocean, their uptake by organisms and their accumulation in the food chain.

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