Harmful algal blooms: nuclear techniques help reduce toxicity, prevent health impact

By Sarah Jones-Couture and Miklos Gaspar

IAEA researchers taking samples for toxin analysis using the Receptor Binding Assay technique.
(Photo: IAEA)

"The impact of foodborne illnesses is of the same magnitude as illnesses like malaria and tuberculosis. More work is needed to gather data and develop methodologies so States can address this issue."

— Angelika Tritscher, Coordinator, Department of Food Safety and Zoonoses, World Health Organization (WHO)

The geographical range and intensity of harmful algae blooms (HABs) have been increasing over the last decade, a change linked to global warming. An increasing number of countries are turning to nuclear science in order to identify and measure these blooms and the biotoxins they produce, and then – armed with the data – establish appropriate policies and countermeasures to control their impact more effectively.

Each year, HABs are responsible for the poisoning of thousands of people worldwide through consumption of contaminated seafood and inhalation of toxins. "Faced with the apparent increase in frequency, geographical distribution and intensity of such blooms, addressing them on a global scale has become urgent," said Marie-Yasmine Dechraoui Bottein, a research scientist at the IAEA Environment Laboratories in Monaco.

Microscopic algae at the base of the marine food chain provide nutrients for marine organisms and are responsible for producing more than half the earth's oxygen supply. However, factors such as the surface water temperature, the circulation of wind and water, the natural movement of nutrient-rich waters towards the surface or the accumulation of agricultural run-off into

Ocean acidification

Another impact of climate change on oceans is ocean acidification – an important area of research at the IAEA.

The increased amount of carbon dioxide in the atmosphere means more carbon dioxide in the oceans – making the ocean more acidic and threatening oceanic habitats. The IAEA works with Member States to use nuclear techniques to measure ocean acidification – which in turn will allow policy-makers to introduce measures to control it.

Nuclear and isotopic techniques are powerful tools for studying ocean acidification and have contributed widely to investigating past changes in ocean acidity and potential impacts on marine organisms. Researchers at the IAEA Environment Laboratories use calcium-45 to examine the growth rates in calcifying organisms such as corals, mussels and other molluscs, whose skeletons and shells are composed of calcium carbonate. Tracers are also used to determine how ocean acidification is affecting the physiology of marine organisms, as well as the impact of a combination of stressors, such as ocean acidification, increases in temperature and contaminants.

the sea can trigger algal blooms, which can sometimes include toxic species.

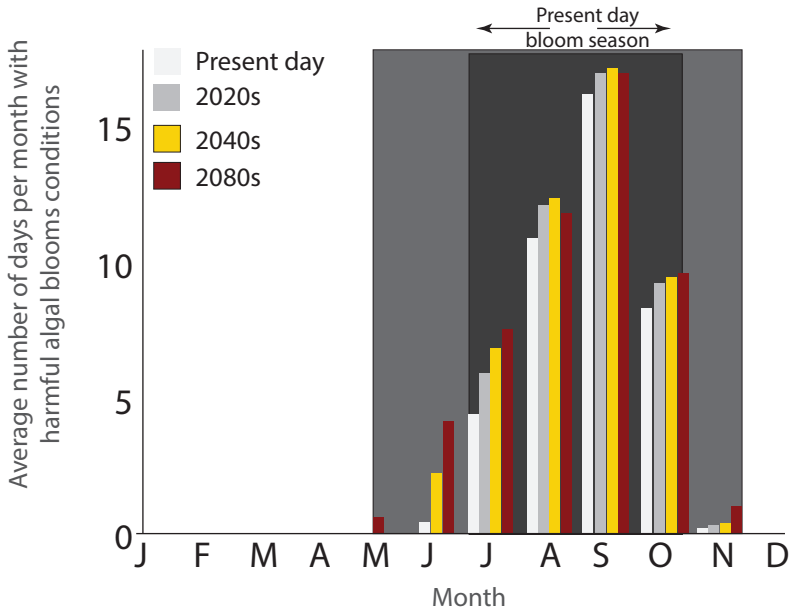
Although strategies to control the impact of planktonic toxic HABs, which float in the water, are well defined, there remain gaps in the scientific understanding of those on the ocean floor, known as benthic species. Environmental changes linked to climate change could make matters worse in tropical areas, as dead coral reefs constitute good habitats for macroalgae, said Clemence Gatti, a research scientist at the Louis Malardé Institute in French Polynesia. With the increasing number of corals dying, a proliferation in benthic HABs and associated health risks are likely. Likewise, with temperatures increasing globally, tropical toxic species thrive in expanded areas of the subtropics and temperate seas and oceans.

One of the most common illnesses is ciguatera fish poisoning — a non-bacterial seafood intoxication caused by ingesting fish that has been contaminated by ciguatera toxin from benthic HABs. Ciguatera, previously limited to tropical and subtropical regions, has now spread to Europe's coastal waters.

"It is a complex disease, still poorly understood," Gatti said. "It can express itself through 175 different symptoms that can last for months or even decades, which makes its diagnosis and management a challenge for physicians."

The IAEA is working with scientists from around the world to develop the capacity to accurately detect toxins in the environment and seafood, so that they can implement countermeasures such as fishery closures and bans on eating seafood when there is an elevated risk of poisoning (see The Science box).

Projected changes to the harmful algal bloom season in a future warmer climate



Source: phys.org

Angelika Tritscher, coordinator in the Department of Food Safety and Zoonoses at the World Health Organization (WHO), emphasized that "the impact of foodborne illnesses is of the same magnitude as illnesses like malaria and tuberculosis." She added that "more work is needed to gather data and develop methodologies so States can address this issue."

The IAEA will continue working with other United Nations agencies to address the emerging risks caused by HABs. "A better assessment of risks associated with HABs will help reduce their impact on human health, the economy and society at large," said Dechraoui Bottein. "This will contribute to the achievement of the Sustainable Development Goals."

THE SCIENCE

Measuring biotoxins in seafood

The IAEA works with experts in Member States to develop the capacity to detect and measure biotoxins in seafood. By using nuclear and isotopic techniques, researchers can accurately measure biotoxins and study the way they are transferred from organism to organism, making their way up the food chain and potentially reaching our plates.

The radioligand receptor binding assay (RBA) is one of the nuclear techniques used. It is based on the specific interaction between the toxins and the receptor they bind (pharmacological target), in which a radiolabelled toxin competes for a limited number of receptor binding sites with the toxin in the sample being analysed, allowing quantification of the toxicity of the sample.