

POLLUTION EFFECTS ON OCEANS AND MARINE LIFE



Marine pollutants are more easily defined by impact: any substance introduced into the oceans that has undesired effects.
(photo: iStockphoto)

In addition to ocean acidification, our seas and their wildlife are facing a grave threat from the increased dumping and release of toxic pollutants into the marine environment. What are these pollutants and how do they affect the seas? How is the IAEA involved with monitoring these pollutants?

Which pollutants are affecting the seas?

Defining what a pollutant is can be challenging since the term applies to many substances in addition to toxic industrial by-products. Marine pollutants are more easily defined by impact: any substance introduced into the oceans that has undesired effects. This broad definition includes heavy metals, such as lead and mercury, and synthetic organic compounds like chlorinated pesticides, flame retardants

and polychlorinated biphenyls (PCBs), but also some of life's building blocks, such as nitrogen and phosphorous compounds. These pollutants can enter our oceans through illegal direct dumping of toxic industrial waste, or through harder-to-control natural processes such as wind, rain runoff and polluted rivers. Through careful monitoring and strict regulations governments hope to control the harmful pollutants that enter the seas.

How do heavy metals affect organisms?

Although heavy metals like lead and mercury can kill an organism if a significant quantity is ingested in a short period of time, most heavy metal poisoning affects sea life by generally reducing organisms' longevity and their 'recruitment', or the organisms' ability

to produce surviving offspring. Shortened life spans and reduced recruitment in key organisms significantly weakens the ecosystem, making it more vulnerable to other threats such as overfishing, climate change or ocean acidification. Degradation of the marine environment is often attributed to the combination of these stressors rather than any single cause.

How do nitrogen and phosphorous compounds affect organisms?

Essential in supporting plants' life and growth, the natural elements nitrogen and phosphorous are key components of fertilizers. When too much fertilizer is applied to fields, rainwater can wash excess nitrogen and phosphorous into river systems and onwards to the sea. There, these nutrients can cause phytoplankton populations to explode, an event called a population 'bloom'. Toxic algal blooms can then transfer toxins to fish that in turn can be consumed as seafood. Sometimes this overfeeding, or 'eutrophication', can boost the population of some species to the detriment of others.

Increased algal blooms can produce oxygen deficiencies in areas due to decomposition of the planktonic biomass, and create so called 'dead zones', anaerobic zones where normal sea life cannot survive.

Where do pollutants go?

When organisms ingest and retain more pollutants and toxins than they can excrete, 'bioaccumulation' occurs. Through the food chain, pollutant concentrations tend to increase in the bodies of top predators (biomagnification). Humans, at the top of the food chain, run a great risk of accumulating high concentrations of pollutants in their body tissues. Research conducted on top predators in the marine environment (large fish, seals and seabirds) helps us in understanding the biomagnification process and to assess seafood safety.

How can nuclear techniques mitigate pollution?

Domestic wastewater and the solids it produces after treatment can be dangerous to human health and the environment if not managed properly. At the same time, wastewater solids contain valuable organic matter and nutrients, which can enrich soil and may emerge as important resources provided

they can be adequately treated to avoid risks and are used safely in accordance with good practice.

Sewage sludge can now be treated with gamma rays from a cobalt-60 source or with an electron accelerator, which can kill the pathogenic (disease-causing) agents in the sludge, such as bacteria, fungi or viruses. This nuclear application will enable the release of sludge into the environment in a safe manner. A pilot plant for sludge gamma irradiation is operating in India. The process yields pathogen-free, dried sludge that can be beneficially used as manure in agriculture. The field trials performed in Baroda confirmed that the manure enhances crop yield and improves soil conditions

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How does the IAEA help?

The IAEA helps its Member States use nuclear technologies to monitor pollution on land and in the sea. The IAEA Environment Laboratories use radioisotopes to track and trace the sources of pollutants and in that way help countries control their environmental impact. For example, the IAEA supported a study of the effects of trace amounts of cadmium (a toxic metal) on local fish and shellfish in Chile¹. Experiments were designed to use the radiotracer cadmium-109 to measure how quickly the cadmium in mussels was released in order to understand the bioaccumulation of this hazardous metal.

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¹Investigations of marine ecotoxicological impacts using nuclear-based techniques. www.iaea.org/monaco/page.php?page=2221