

Is Fukushima wastewater release safe? What the science says

Radiation in the water will be diluted to almost-background levels, but some researchers are not sure this will be sufficient to mitigate the risks.

Despite the concerns of several nations and international groups, Japan is pressing ahead with plans to release into the Pacific Ocean water contaminated by the 2011 meltdown of the Fukushima Daiichi nuclear power plant. Sometime this year, Japan will start a 30-year process of slowly releasing treated water stored in tanks at the site into the ocean through a pipeline extending one kilometre from the coast. But just how safe is the water to the marine environment and humans across the Pacific region?

How is the water contaminated?

Several explosions occurred at the power station after a devastating earthquake and subsequent tsunami damaged the coastal plant, overheating the reactor cores. Since then, more than 1.3 million cubic metres of seawater have been sprayed onto the damaged cores to keep them from overheating, contaminating the water with 64 radioactive elements, known as radionuclides. Of greatest concern are those that could pose a threat to human health: carbon-14, iodine-131, caesium-137, strontium-90, cobalt-60 and hydrogen-3, also known as tritium.

Some of the radionuclides have a relatively short half-life and will already have decayed in the 12 years since the disaster. But others take longer to decay; carbon-14, for example, has a half-life of more than 5,000 years.

How is the water being treated?

The contaminated water has been collected, treated to reduce the radioactive content and stored in more than 1,000 tanks at the site. The power-station operator, Tokyo Electric Power Company (TEPCO), has used what it describes as an advanced liquid-processing system (ALPS) to treat the water. TEPCO says the water undergoes five processing stages of co-sedimentation, adsorption and physical filtration.

The ALPS process removes enough of 62 of the 64 radionuclides to bring their concentration below Japan's 2022 regulatory limits for water to be discharged into the environment. These limits are based on

recommendations from the International Commission on Radiological Protection.

But that process does not remove carbon-14 and tritium, so the treated water needs to be diluted. TEPCO says that the resulting concentration of tritium is around 1,500 becquerels (a measure of the radioactivity of a substance) per litre — around one-seventh of the World Health Organization's guidelines for tritium in drinking water. The company suggests that the concentration of tritium will drop to background ocean levels within a few kilometres of the discharge site. The carbon-14 in the tanks is currently at concentrations of around 2% of the upper limit set by regulations, TEPCO says, and this will reduce further with the seawater's dilution.

Jim Smith, an environmental scientist at the University of Portsmouth, UK, says the risk this poses to nations around the Pacific Ocean will probably be negligible. "I always hesitate to say zero, but close to zero," he says. "The nearest Pacific island is about 2,000 kilometres away." He argues that a greater risk is posed by keeping the treated water on-site. "The risk of another earthquake or a typhoon causing a leak of a tank is higher."

Will radioactivity be concentrated in fish?

Nations such as South Korea have expressed concern that the treated water could have unexplored impacts on the ocean

environment, and a delegation from the country visited the Fukushima site in May.

Last year, the US National Association of Marine Laboratories in Herndon, Virginia, also voiced its opposition to the planned release, saying that there was "a lack of adequate and accurate scientific data supporting Japan's assertion of safety". The Philippine government has also called for Japan to reconsider its plan to release the water into the Pacific.

"Have the people promoting this ... demonstrated to our satisfaction that it will be safe for ocean health and human health?" asks Robert Richmond, a biologist at the University of Hawaii at Manoa. "The answer is 'no'."

Richmond is one of five scientists on a panel advising the Pacific Islands Forum, an intergovernmental organization made up of 18 Pacific nations, including Australia, Fiji and Papua New Guinea. The panel was convened to advise on whether the release of the treated water from Fukushima was safe both for the ocean and for those who depend on it. Richmond says that the panel has reviewed all the data provided by TEPCO and the Japanese government, and visited the Fukushima site, but that there are still some unanswered questions about tritium and carbon-14.

Tritium is a β -radiation emitter — albeit a weak one — meaning that it emits ionizing radiation that can damage DNA. "If you eat something that's radioactively contaminated



A TEPCO representative measures radiation levels around the treated water storage tanks.

KIMIMASA MAYAMA/AFP VIA GETTY

with β -emitters, your cells inside are being exposed,” says Richmond.

TEPCO says fishing is not routinely conducted in an area within 3 kilometres of where the pipeline will discharge the water. But Richmond is concerned the tritium could concentrate in the food web as larger organisms eat smaller contaminated ones. “The very chemistry of dilution is undercut by the biology of the ocean,” Richmond says.

Shigeyoshi Otsuka, an oceanographer and marine chemist at the Atmospheric and Ocean Research Institute of the University of Tokyo says that the organically bound form of tritium could accumulate in fish and marine organisms. “I think it is important to evaluate the long-term environmental impact of these radionuclides,” Otsuka says.

A spokesperson for TEPCO said that the company has raised marine organisms in seawater containing ALPS-treated water. “The tritium concentrations in the bodies of marine organisms reach equilibrium after a certain period of time and do not exceed the concentrations in the living environment,” the spokesperson said. Tritium concentrations then decrease once the organism is returned to untreated seawater.

TEPCO will continue to compare the health of organisms reared in diluted treated water with those reared in seawater.

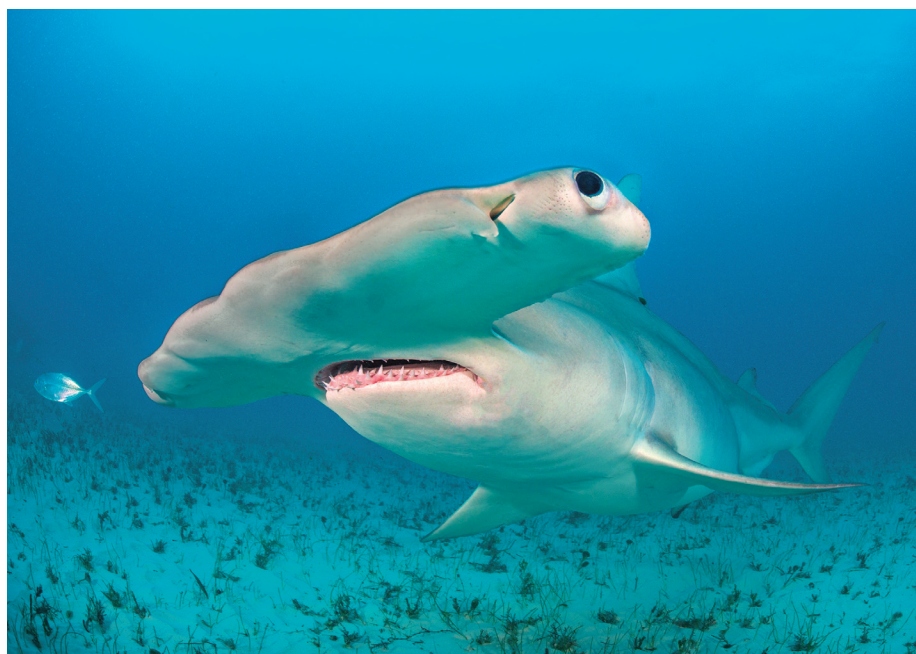
Has this been done before?

Smith points out that releasing tritium-contaminated water is common for nuclear power plants. He says that, in the United Kingdom, both the Heysham nuclear power station and the Sellafield nuclear-fuel-processing plant in release between 400 and 2,000 terabecquerels of tritium into the ocean each year.

Otsuka says that this is also the case in Japan: “More than 50 terabecquerel of tritium was discharged annually from each nuclear power plant in regular operation before the accident,” he says. TEPCO says that less than 22 terabecquerels of tritium will be released from the pipeline each year.

The International Atomic Energy Agency, which has been supervising the clean-up and management of Fukushima, is expected to release a final report on the site and the plan for the wastewater soon.

By Bianca Nogrady



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Hammerhead sharks (*Sphyrna mokarran*) are critically endangered.

BATTLES OVER FUNDING THREATEN GLOBAL EFFORT TO SAVE SPECIES

In the wake of last year’s historic biodiversity deal, nations are arguing over how to finance conservation.

By Natasha Gilbert

Disputes over how to finance conservation of the world’s plants and animals have resurfaced between countries – threatening their ability to meet goals laid out in a historic plan signed late last year, sources have told *Nature*.

At the COP15 biodiversity summit in Canada in December, more than 190 countries agreed to the Kunming-Montreal Global Biodiversity Framework, a deal including targets such as nations protecting and restoring 30% of the world’s land and seas by 2030. To ensure that all countries – particularly low- and middle-income nations (LMICs) – can meet these targets, those that signed the deal agreed to establish a trust fund by the end of this year and that, by 2030, wealthy nations should collectively be contributing US\$30 billion per year.

Several times during those negotiations, however, arguments erupted and threatened to derail the deal. Those disputes are now rearing their heads again.

During COP15, LMICs that are rich in biodiversity called for a new, independent fund

for species conservation. The current fund, run by the Global Environment Facility (GEF) within the World Bank in Washington DC, is difficult to access and slow to distribute funds, LMIC representatives said.

“We need real money from donor countries.”

But high-income nations, including some in the European Union, disagreed, and eventually it was decided that a newly established fund would be run by the GEF – although the deal set out provisions to continue discussions about an independent biodiversity fund.

This week, the GEF is set to start the process of establishing the biodiversity trust fund. But fissures have appeared that threaten to delay the proceedings, according to sources involved in the discussions, who asked not to be named to maintain diplomacy.

At the meeting, GEF council members – including representatives from 14 high-income