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Popular Article

Effect of Radioactivity on Marine Organisms

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Introduction

The outdated assumption that protection from ionizing radiation for humans extends to all nonhuman biota is no longer accepted. It's now crucial to verify the radiological protection status of animals and plants, with established dose rate thresholds unlikely to harm flora and fauna. Projects like ERICA suggest a benchmark of 10 mGy/h at the ecosystem level, supported by UNSCEAR's findings. Planned exposure situations generally don't harm marine biota, except for a few localized hot spots. Past accidents near the sea, like Chernobyl, had minimal impact on marine life due to the long distances involved. As of now, no major accident has caused significant effects on marine biota. Interest in radiation's impact on marine life surged after the Fukushima accident in 2011, the only major nuclear incident to directly affect a coastal area. Assessing its impact remains challenging due to evolving circumstances and the ongoing human tragedy. Publishing a radiological assessment of Fukushima's ecosystem is premature given the situation's gravity, but it may occur in the future. Instead, this article focuses on factors affecting the transfer of radionuclides into the marine environment.

Current understanding of Marine fate

When radioactive wastewater, containing various radionuclides like 134Cs, 137Cs, 131I, Pu, and Am, leaks into the sea, it doesn't disperse infinitely. Some of the released material disperses, but the rest accumulates in the seabed due to sorption and scavenging. Radionuclides in

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sediments can migrate and undergo decay, but some will eventually be remobilized, particularly Cs compared to Pu and Am. Physical, chemical, and biological processes contribute to this remobilization. Consequently, the long-term bioavailability of radionuclides persists, potentially impacting distant marine biota.

Potential impacts to Marine life and Food chains

Marine biota actively participates in the distribution of radionuclides, often overlooked. Biogenic particles like zooplankton faecal pellets can scavenge and sink radionuclides, forming distinct subsurface maxima. This mechanism facilitated the rapid transport of Chernobyl radioactivity to depths in the Mediterranean. Fukushima's releases, occurring in a productive, complex ocean area, could similarly be affected by currents. Radionuclides may concentrate biologically, with evidence for I, Cs, Pu, and Am in marine species. Depending on speciation, Cs accumulate in fish, while Pu and Am tend to accumulate in benthic crustaceans and molluscs. Iodine exhibits a unique affinity for mollusc structures. Post-accident, efforts focus on mitigating human impact, followed by radiological monitoring of seawater and seafood if there are sea discharges. Careful selection of marine sampling sites is crucial for obtaining representative data. Sampling surface water shortly after an accident may underestimate radionuclide levels due to higher subsurface concentrations. Water sampling should consider local tides and currents, ideally using hydrodynamic modelling for short-term radioactivity spread prediction. Sampling bio-indicator species, considering their biological uptake rates and elimination times, is important. Understanding the biological half-lives of relevant radionuclides in local organisms is also essential for accurate assessment.

Relative sensitivity of Different groups of organisms to radiation

Group	(r) Dose which caused		"Latent" period
	50% mortality	100% mortality	
Algae	8,000–100,000	25,000– 600,000	45 days
Protozoa	10,000–300,000	18,000–1,250,000	45 min.–40 days
Molluscs	5,000– 20,000	10,000– 50,000	3 weeks–2 years
Crustaceans ..	500– 90,000	5,000– 80,000	5 days–80 days
Fish	600– 3,000	370– 20,000	14–460 days
Insects [1]			

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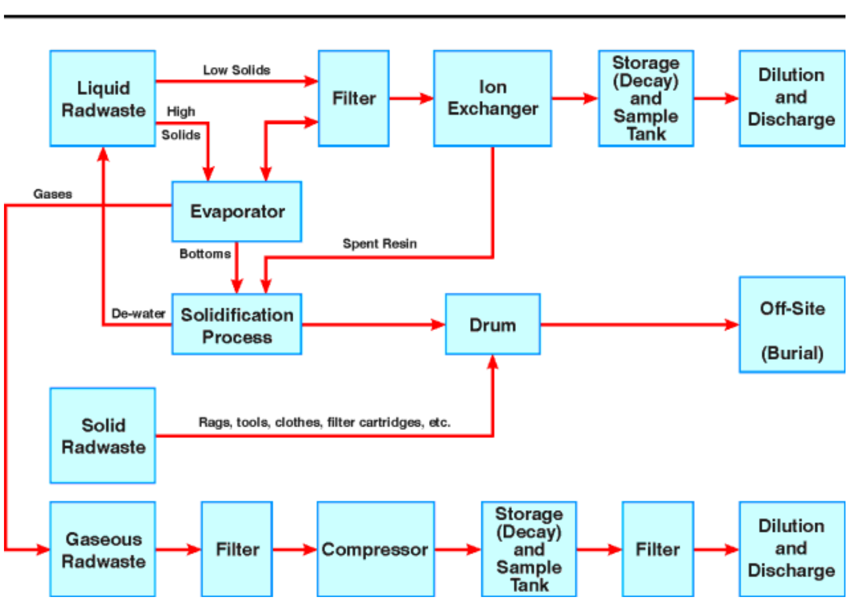
Assessing Ecological Risks

An accidental release situation could lead to a non-continuous source term where irregular pulses of radioactivity enter the marine environment. In a highly dynamic situation, ambient concentrations could vary rapidly, whereas biological half-lives are protracted. Equilibrium between the biota and the medium may not be reached during the period of intensive short-term radiation following the accident, where the most severe damage to species is likely to occur. Conservative screening approaches based on equilibrium concentration factors may therefore be inadequate. Such a situation calls for the use of dynamic radiological assessment models that are capable of calculating time-integrated doses for a pulsed release of radioactivity. Fortunately, several tools have already been developed and tested for such purposes. A measure of accident risk in the marine environment can be obtained in the first instance by comparing dose rates for fish, crustaceans, and molluscs with the screening dose of 10 mGy/h. Knowledge of what effects may be expected in marine biota at higher dose rates is very sparse. As an example, radiation effects (on reproductive capacity) in plaice are reported for dose rates of 100 to 1500 mGy/h, whereas for polychaete worms, the first radiation effects (also on reproductive capacity) are observed between 5000 and 10 000mGy/h, according to the radiation effects database for the ERICA tool. Little is known regarding long-term effects to entire populations, a limitation that is unlikely to be resolved shortly.

Radwaste Handling System



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Nuclear Waste Management in India:

1. Radioactive waste management facilities have been set up at Trombay, Tarapore, Rawatbhata, Kalpakkam, Narora, Kakrapara, Hyderabad and Jaduguda
2. Air-cooled solid storage and surveillance facility in Tarapore.
3. Incineration of solid radioactive waste at Kalpakkam.
4. Deep geological repository in Kalpakkam

Scientists discovered that when the green algae first absorb strontium90, calcium, and barium from water, the strontium and barium form crystals inside of each algae cell. The crystals remain inside the cells, but the algae filter out and excrete calcium and other minerals that may be present. The strontium is then isolated, and thus able to be treated.

Conclusion

Accidental radiological releases present significant challenges in assessing their impact on marine ecosystems. These challenges include limited data from past accidents, uncertainty about radiation's effects on interconnected marine populations, and the dynamic nature of releases coupled with marine environment complexity. Additionally, public and societal concerns over even minor contamination of the marine food chain further complicate matters. In the aftermath of a nuclear accident, there will be limited quantitative information to assess environmental contamination. Understanding these immediate and long-term challenges requires a full grasp of the radiological situation, emphasizing early efforts to aid people while planning future investigations.

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