Centre for Marine Living Resources and Ecology (CMLRE) under Ministry of Earth Sciences (MoES) Publishes Report on Ecological Impact of the ELSA 3 Shipwreck in the Arabian Sea

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1. The Centre for Marine Living Resources and Ecology (CMLRE), Ministry of Earth Sciences, undertook a dedicated scientific investigation to assess the ecological consequences of the ELSA 3 shipwreck that occurred off the south-eastern Arabian Sea. The research cruise on-board FORV Sagar Sampada was carried out from 2nd to 12th June 2025, covering 23 sampling locations between Kochi and Kanyakumari, with closer observations near the wreck site. The shipwreck was located at coordinates 09°18.76'N and 76°08.22'E, at a depth of 54 meters. According to official reports, ELSA 3 was carrying 367 tonnes of furnace oil and 84 tonnes of low-sulphur diesel at the time of sinking, raising concerns of large-scale ecological impacts.

2. During the initial surveys, an oil slick extending over nearly two square miles was clearly visible around the wreck site, and the chemical analysis confirmed the presence of petroleum-derived pollutants at elevated levels. Under the prevailing calm sea conditions, these pollutants tended to concentrate more at mid-depths, while the surface was appeared with a thin oil film. When the site was revisited, however, the distribution pattern changed, with higher concentrations observed at the surface and reduced levels at depth. This shift highlighted how oceanic turbulence and mixing play a key role in redistributing oil-derived pollutants through the water column.

3. Analysis of PAH (Polyaromatic hydrocarbons) fractions revealed the presence of compounds such as naphthalene, fluorene, anthracene, phenanthrene, fluoranthene, and pyrene. The elevated levels of naphthalene, which normally indicate human-induced contamination, strongly suggest leakage from the wreck's fuel compartments. In addition, higher concentrations of trace metals commonly associated with petroleum, including nickel, lead, copper, and vanadium, were detected in both water and sediments near the site. These findings confirm that the wreck has become a local source of hydrocarbon and heavy-metal pollution.

4. The biological impacts of the spill were evident across multiple levels of the ecosystem. Zooplankton, which form the base of the marine food chain, were found to contain high levels of petroleum-derived pollutants. All major PAH fractions were detected in both surface and deeper samples, confirming bioaccumulation and raising concerns about the transfer of these pollutants through the food web to fish and ultimately to humans. The impact on early life stages of fish was particularly alarming, as this period coincides with the southwest monsoon season, which is critical for spawning and recruitment of many commercially important species in the eastern Arabian Sea. Large numbers of fish eggs and larvae collected from the affected area showed signs of decay, suggesting possible mortality linked to oil exposure during this vulnerable stage.

5. On the seafloor, benthic organisms showed clear signs of ecological stress. Sensitive species declined sharply within days of the incident, leaving behind only pollution-tolerant worms and bivalves. This shift indicates acute disturbance of the seabed, with potential long-term consequences for sediment

health and fisheries habitats.

6. Microbial studies further highlighted the ecological impact. Metagenomic analysis of water samples revealed a rich and diverse bacterial community near the wreck site, including several hydrocarbon-degrading bacteria such as *Neptunomonas acidivorans, Halomonas tabrizica,* and *Acinetobacter baumannii*. While their abundance points to natural bioremediation potential, it also reflects the heavy hydrocarbon contamination present around the wreck.

7. The observed impacts were strongly shaped by oceanographic conditions during the survey. The region experienced south-westerly winds and southward surface currents. Despite this turbulence and mixing, oil remained concentrated near the wreck even after eight days, suggesting continued leakage from unsealed compartments.

8. Visible impacts extended to higher marine fauna as well. A Brown Noddy seabird (*Anous stolidus*) was observed taking prolonged shelter on the wreck, repeatedly preening its feathers, a typical behavioural response to oil contamination of plumage. Such incidents point towards the vulnerability of marine birds and higher organisms in the vicinity of the spill.

9. The findings from the scientific assessment confirm that the sinking of ELSA 3 has led to significant ecological disruption in the south-eastern Arabian Sea, affecting water quality, plankton, benthos, fish eggs and larvae, and higher marine life. The persistence of oil even after several days, despite prevailing turbulence and current flows, highlights the risk of continued leakage. The study underscores the urgent need for sealing of the wreck's fuel compartments and long-term monitoring of the impacted region to safeguard marine ecosystems and fisheries resources.

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