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Pollutants at India's biggest ship recycling yard, including heavy metals and petroleum hydrocarbons, quantified

A study of the pollution caused by ship scrapping in Alang, India, shows significantly higher levels of heavy metal and petroleum hydrocarbons in sediment and seawater, compared to a control site. The researchers also found reduced populations of zooplankton — a critical food source for marine biota — and increased numbers of pathogenic bacteria.

The beaches in Alang, on the western coast of India, have become the world's largest 'graveyard' for ships that have come to the end of their useful lives. The Alang shipbreaking yard, established in 1982, now recycles hundreds of ships every year and employs tens of thousands of people.

Alongside the employment opportunities and notable contribution to the steel industry it provides, the industry has also polluted the region with substances including petroleum, asbestos, paint, glass wool and plastics — many of which are persistent and harmful to humans and the environment. In addition, workers and local people have been known to dump domestic waste on the shore, leading to high concentrations of nutrients and bacteria.

To get a better understanding of the pollution problem along the Alang coast, this study quantified a number of pollutants. As a control site, the researchers used Piram, a nearby island that is in a more pristine condition and serves as a nesting site for endangered species, including turtles.

In total, the researchers took samples from four sites: two control sites (near shore and 10 km from the shore of Piram) and two sites at Alang (again, near shore and 10 km away). They collected seawater and sediment and analysed a number of parameters, including chemical and biological values (e.g. pH, oxygen levels and nutrient content), heavy metal concentrations, chlorophyll-*a* levels (chlorophyll used in oxygenic photosynthesis — therefore an indicator of productivity), petroleum hydrocarbons, and numbers of bacteria, phytoplankton and zooplankton.

Concentrations of heavy metals, including iron, manganese, cobalt, copper, zinc, lead, cadmium, nickel and mercury, were significantly higher at the near shore station of Alang compared to the control site. The least-enriched metal was nickel, which was 25% higher at Alang than at the control site, while mercury was an astounding 15 500% higher at Alang than at the control.

Concentrations of petroleum hydrocarbons were 16 973% higher at Alang than at the control, and 53 900% higher at the near shore site of Alang than 10 km away. However, levels of chlorophyll-*a* were at much lower concentrations at Alang compared to at the control, and in some cases below detection.

Zooplankton showed considerable reductions in growth (up to 66%) at Alang compared to the control, but phytoplankton counts were slightly raised at Alang. Interestingly, the higher number of phytoplankton observed at Alang was not matched by an increase in chlorophyll-*a* levels (as expected, as chlorophyll-*a* is a measure of phytoplankton biomass).

The researchers therefore conclude that dead phytoplankton cells were likely included in the count, obscuring the fact that heavy metals and petrol reduced the productivity of phytoplankton in the region. The authors note that relationships between numbers of phytoplankton and chlorophyll concentration vary and depend on many factors, including turbidity (cloudiness or haziness of water depending on the number of individual microscopic particles) and tidal range.

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Ship Recycling: Reducing Human and Environmental Impacts

Source: Tewari, A., Joshi, H., Trivedi, R., Sravankumar, V., Raghunathan, C., Khambhaty, Y., Kotiwar, O. & Mandal, S. (2001). The Effect of Ship Scrapping Industry and its Associated Wastes on the Biomass Production and Biodiversity of Biota in *in situ* Condition at Alang. *Marine Pollution Bulletin*. 42(6): 461-468. DOI: 10.1016/S0025-326X(00)00185-5.

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The total number of bacteria was 605% higher at Alang than the control site. Numbers of individual bacteria, including some pathogenic strains, were also higher; *E. Coli* and *E. Faecalis* were 349% and 394% higher at Alang than at the control, respectively. Coastal regions with high metal content and low salinity are thought to be less toxic to bacteria, which may explain why bacteria survived at higher levels in the seawater of Alang. Other factors include anthropogenic activities contributing bacteria to coastal seawater, including nearby latrines.

Such high bacterial content could pose health risks. According to the EU Bathing Water Directive, coastal waters should contain no more than 500 units of *E. Coli* per 100 ml (and ideally no more than 250 ml). At Alang, the researchers found over 1500 per 100 ml.

This study reveals how pollution caused by ship recycling and the surrounding industrial development can change local ecosystems — increasing numbers of potentially harmful bacteria and reducing ecologically important organisms, such as zooplankton. The researchers hope their findings inform protective regulations at Alang and at similar sites worldwide.

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