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Plastics can concentrate toxic pollutants, endangering marine ecosystems

Plastic debris is a serious environmental concern, as a physical pollutant as well as a chemical pollutant when it breaks down in the marine environment. A new study has now shown that plastics can also concentrate other pollutants, with significantly higher concentrations of toxic pollutants adhering to soft, rubbery plastics, rather than hard, glassy plastics.

Marine species, including fish and birds, are known to ingest particles of plastic debris in the ocean. If animals consume plastic particles that bind other chemical pollutants, there is an added risk for greater accumulation of toxins in the food chain via anthropogenic debris. In addition, the combination of the chemical constituents of plastics and the pollutants that adhere to them may introduce a complex mixture and multiply any toxic effect to marine organisms.

This is the first study that has examined variation in the affinity of pollutants to different kinds of plastic outside a laboratory setting. The researchers deployed samples of pellets of five common types of plastic at five locations throughout San Diego Bay in the USA, for collection at the end of five time periods: one, three, six, nine and 12 months (250 total samples). At the end of each time period, samples were retrieved and tested to determine the quantities of two common kinds of pollutants (polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) that had adhered to the pellets.

The relative difference in adherence of PCBs and PAHs among the five plastic types was consistent over space and time. Throughout the 12 months of the experiment, the 'rubber-like' plastics, such as high-density polyethylene, polypropylene, and low-density polyethylene, consistently attracted concentrations of pollutants ten times greater than the 'glass-like' polyvinyl chloride (PVC) and polyethylene terephthalate (PET).

The authors caution that the results they found may not extend to other classes of pollutants and advise that further research is needed to establish how other pollutants interact with different plastic types.

Although the findings reinforce results from previous laboratory experiments, the researchers stress that conditions in the marine environment are very different from a controlled laboratory setting. Concentrations of pollutants in the ocean change over time depending on sources and environmental changes, e.g. temperature. Plastic debris remains in the marine environment for an unknown period of time, moves with currents, and slowly degrades under the action of light. As it breaks down, surface area increases, which could lead to a greater accumulation of chemical pollutants over time. Plastic debris may therefore pose a greater toxic threat to the food chain the longer it remains at sea.

While global manufacture of plastics increases and policy enforcement remains weak, the quantity of plastic debris in the oceans is likely to increase. The results of this study suggest that certain types of plastic may be 'safer' for marine life than others, but they also reinforce the message that action is needed to remove plastic debris from the oceans, and stricter controls are required to limit new sources of plastic pollution.