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Risks of invasion of alien marine species driven by global shipping

New research has identified global hot spots of invasion risk by marine species transported in the ballast water of shipping. Treating this water before discarding it could reduce the risk of invasions by as much as 82%, the researchers predict.

The movement of marine organisms outside their natural ranges can have seriously damaging effects on native ecosystems. Increased trade and transport at sea now means that many marine regions are being invaded by several new species every year. Such biological invasions often occur as a result of the water taken on board as ballast to stabilise ships, which can contain aquatic species. When new cargo is loaded at ports along the ship's journey, the ballast water is pumped out and the organisms are released in the surrounding water.

Using an updated database on shipping traffic researchers have been able to analyse the volume, frequency, origin and destination of cargo ships around the world. The data, recorded during 2007 and 2008, represent movements of 67% of the global shipping fleet ships and the majority of large ships at sea. The resulting network included 32,511 ships, which made 2,892,523 voyages, calling at 1,469 ports. Ballast water discharge volumes were provided by the National Ballast Information Clearinghouse. The water temperature and salinity at each port were also recorded.

The results show that high invasion risks were concentrated in a small number of busy ports; the majority of ports were at low risk of receiving new organisms via ballast water. The hot spots are mainly located in South East Asia, the Middle East and the USA, with Singapore, the Suez Canal (Egypt), Hong Kong and the Panama Canal most likely to be invaded.

As well as shipping intensity, the water temperature and salinity of the original port from where the ballast water was taken also played an important role in invasion risk. The results predict that the greatest risk of new introductions occurs at distances of approximately 8,000-10,000 km between the source and recipient sites. Over longer distances, the organisms are less likely to survive the journey.

The researchers also investigated mitigation strategies, such as treating ballast water at each port, for example, with filters, chemicals or radiation. They estimated that if 'treatment effort' (the percentage of species eradicated by a single treatment) was 25%, invasion risk would be reduced by 56%. This rises to 82% if treatment effort reaches 50%.

The authors conclude that understanding invasion risks and developing successful mitigation strategies is especially important in the light of future global warming, which may open Arctic passages to shipping and therefore increase the risk of invasion into new areas by alien species.

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