

Melting Arctic ice will make way for more ships and more species invasions

A new study shows immense increases in shipping are likely over the North Pole and Arctic Ocean in the coming years, alerting scientists who study invasive species.

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The rare ships that have ventured through the harsh, icebound Arctic Ocean require reinforced hulls and ice-breaking bows that allow them to plow through dense ice as much as two meters deep, and face hazardous conditions in remote locations for long periods of time. Arctic sea ice now is melting so rapidly each summer due to global warming, however, that ships without ice-breaking hulls will be able to cross previously inaccessible parts of the Arctic Ocean by 2050. And light-weight ships equipped to cut through one meter of ice will be able to travel over the North Pole regularly in late summer, according to [a new study published March 4 in Proceedings of the National Academy of Sciences Plus](#).

That's good news for economic development because it offers many new and faster routes from east to west, shaving 40 percent off transportation time and fuel costs compared with shipments via the Suez Canal. But the geographic extent of trade routes across the Arctic is worrisome for scientists who study invasive species.

Ships traveling regularly in the Northwest Passage, beyond the Northern Sea Route and through the central Arctic Ocean, will likely bring new invaders to the Arctic as well as to northern ports. Mosquitoes and forest beetles are expected to survive hidden in cargo, for example. Hearty marine organisms, such as mussels and barnacles, will likely tag along as larvae in ballast tanks or in niche areas on vessel hulls. When new species flourish in a new environment they can become harmful, damaging local ecosystems and threatening native plants and animals, much as the Japanese vine known as kudzu has overrun the southern U.S. Economic costs associated with new pests have been significant—for example, the influx of zebra mussels into the Great Lakes has been estimated at \$1 billion annually.

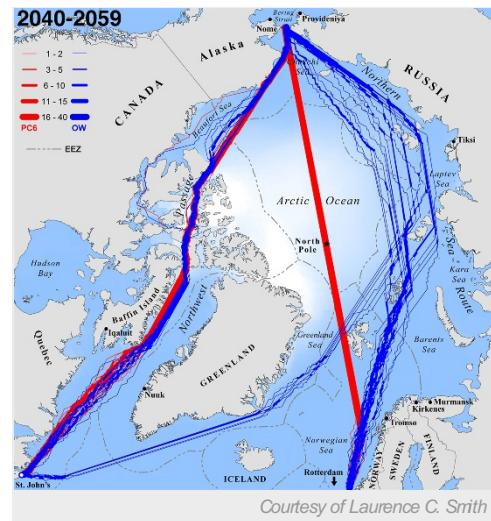
"The temptation for many new ships to enter [the Arctic] will be huge," says University of California, Los Angeles, geographer Laurence Smith, lead author of the new study. Arctic shipping already has grown by leaps and bounds in just the past few years. In 2012, which set a record for lowest sea ice extent, a total of 46 ships—the most ever—traversed the Arctic Ocean. Thirty-four ships made the passage in 2011 whereas just four had done so the year before. For context, 19,000 ships pass through the Suez Canal annually.

Sea ice has long been a barrier to shipping across the Arctic Ocean as well as to species. Already, shipping is by far the most common pathway for marine invasive species, responsible for 69 percent of species introductions to marine areas, followed by aquaculture at 41 percent (non-native species can have more than one pathway of introduction, meaning some double counting.) The most common transport method is ships' ballast water. Organisms can also hitch a ride in nooks and crannies on a ship's hull, known as hull fouling. And organisms such as forest pests and mosquitoes can survive long trips in pallets and in cargo such as tires.

"Invasive species are one of those things that once the genie is out of the bottle, it's hard to put her back in," says climate scientist Jessica Hellmann of the University of Notre Dame who was not involved with this study. Hellmann studies the impact of climate change on invasive species and ecological systems. As Arctic ice melts, new ports will be connected and shorter passages between existing ports will lead to new opportunities for invasive species to spread, she says.

Cold storage

Mario Tamburri, a marine scientist and director of the Maritime Environment Resource Center at the University of Maryland Center for Environmental Science, has been researching survivorship and reproduction of organisms likely to be transported by ships by



mimicking the conditions of shipping traffic. New colder, shorter routes afforded by the retreat of ice help invaders, such as mussels, barnacles and crabs, on a biological level, Tamburri says. Cold water slows metabolism of organisms, which can sustain themselves in low food conditions. "It's like putting your groceries on ice," he says.

Shorter routes also mean more organisms either attached to the hull or in ballast water are now more likely to survive the journey. Previously, the high heat and lack of light of longer trips outside the Arctic killed them off. "When ships now transport goods through the Panama Canal, for instance, through warm water and freshwater, natural barriers to invasive species are built into the shipping routes," Tamburri says. "In the Arctic, those barriers go away."

Ballast water and bivalves

Murmansk, Russia, a leading global port and the largest city north of the Arctic Circle, is one area that ice-free routes will likely open up further this summer. As more ships exchange ballast water for cargo, native species in places like Murmansk can quickly lose out against new species that have no checks and balances, such as marine species like bivalves that can be dispersed by larvae in ballast water as well as cold-water adapted adults, including green crabs.

Lewis Ziska, a plant physiologist with the U.S. Department of Agriculture's Agricultural Research Service, says that once introduced, a new species can outcompete everything that has evolved over millennia. Although some nonnative species are innocuous, others thrive because there have no predators. Nothing controls them in the natural system, and they are better at filtering food out of the water than their native cousins. "Invasives use up the lion's share of resources, and whatever biodiversity that was there falls apart," Ziska says.



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When new interlopers take hold, one or two tend to become very well suited for that environment and dominate it. The natural biodiversity diminishes, Ziska says. Scientists are beginning to catalogue and classify native and nonnative species at ports near oil facilities in Alaska. No large obvious invasions by marine traffic have occurred yet in the high latitude environment but Ziska and others scientists say no one can be sure. Scientists are only now beginning to look closely.

"We weren't expecting the Arctic to change this quickly," Ziska notes, adding that the implications for not only human traffic but also for biology are worrisome. "It's basically opening up the entire Arctic region as a huge playground for invasive species. New things, new biological organisms are going into the area where they have never been seen before. The consequences of that are, quite frankly, are completely unknown."

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