

Researchers find steep decline in invasive crab population

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Charles Epifanio holding native mud crabs, which have made a resurgence in Delaware as an invasive species of crabs unexpectedly declined over the past decade. Credit: Bob Bowden

Delaware's native mud crabs were on the verge of being completely edged out by invasive Asian shore crabs 10 years ago. Today, new research shows that the tables have unexpectedly turned.

"I was shocked," said Charles Epifanio, a scientist in the University of

Delaware's College of Earth, Ocean, and Environment whose lab started researching Asian shore crabs with support from Delaware Sea Grant a few years after they first appeared in Delaware Bay in 1988. "When this crab arrived here and took over the rocky intertidal habitat, it was remarkable. It wasn't gradual. It exploded."

By 2001, two of the three [native species](#) of mud crabs in that habitat were gone, replaced by Asian shore crabs. The invaders established such a stronghold that researchers assumed the trend would continue and did not resume population counts until a follow-up project by a summer intern in 2011 to see whether there were any changes.

"At first, I thought she had it wrong," Epifanio said about the intern's work.

He was so surprised by the mud crab resurgence that he went back out with the student to double-check her technique. Then, to rule out the chance that 2011 was an anomaly, Epifanio and graduate student Corey Schab repeated the experiments in 2012 and 2013 with similar outcomes.

Indeed, just as abruptly as they arrived, the invasive crabs started dwindling. In 2001, invasive Asian shore crabs made up 75 percent of the crabs found in rocky habitat near the mouth of Delaware Bay. Today, they represent only 25 percent.

Epifanio's lab documented this boom-and-bust phenomenon in the recent *Journal of Shellfish Research* in an article titled, "Return of the Native: Historical Comparison of Invasive and Indigenous Crab Populations Near the Mouth of Delaware Bay." Such a shift isn't unique to Asian shore crabs or Delaware Bay. In fact, it is just one more question that adds to the mystery of how these invasives even got started to begin with.

The invasive boom

Adult Asian crabs seemed to come out of nowhere, piquing scientific curiosity since their arrival 26 years ago.

"It was really interesting because when we sampled for crab larvae, we could find almost no invasive larvae," said Susan Park, Virginia Sea Grant assistant director for research, whose Ph.D. work with Epifanio in the late 1990s became the baseline data for the new report.

One might expect that low larvae numbers mean the population isn't going to grow, but Park said, "When you come back and sample for adults and juveniles, it is mostly invasives."

This signaled to Park that, for the Asian shore crabs, survival might not be a numbers game. Even though only a few larvae made it to adulthood, those few adults survived better than the natives, leading to a population boom.

To add to the mystery, somehow these invasive crabs started appearing all along the East Coast, from Maine to North Carolina.

"The question was, 'How?' because these crabs don't swim like fish," said Park.

Larvae are too small to swim against currents. Instead, they move around by positioning themselves to catch and ride different currents. Mud crab larvae stay in the same habitat during their lifecycle by moving up and down in the water column. When tide comes in, they move up toward the surface where the water pushes them toward shore. When it goes out, they sink to the bottom so they don't get pulled out.

Not all crabs stay in place for their entire life cycle. Some, like blue

crab, spend their life near the water's surface and get blown away from land as larvae. In the fall, after the larvae have developed offshore, they rely on weather events to push them current back toward shore. If storms don't come, there may be fewer crabs in the next year.

Even if Asian crabs rode currents away from shore, it wouldn't explain how they went from Delaware to Maine. Prevailing Atlantic currents along the coast move southward. The currents that move north are farther away from the coast. For a crab to go north, something has to push it east, far enough offshore to catch that current and then something else would have to push it westward again to move it back toward land.

"Basically, it's almost an accident for things to go north," says Park, but if a couple of Asian shore crabs did get accidentally transported north toward Maine, it would only take a couple of survivors to kick off an invasion.

When her research concluded in 2001, the invasive crabs seemed on the verge of a complete takeover.

Then, they didn't.

The invasive bust

Why the Asian shore crab went from boom to bust is the new mystery. Although he doesn't know what caused the shift in population, Epifanio says such an abrupt population change isn't unheard of.

"When you have any two native species that are competing with each other, a lot of times there will be switches," he said.

One decade one will be more common than the other, and then they flip-

flop. These species produce millions of progeny each year, so an increase even of just 1 percent can result in a huge number. Anecdotally, Epifanio has observed this phenomenon many times with fish in Delaware Bay: there was once a big weakfish population, then a decline; same with striped bass.

"If it happens with native species, why wouldn't it happen with invasive species once they're established?" he said.

Although Epifanio is nearing retirement, and his lab is no longer active, he is considering continuing field studies through the National Science Foundation's Research Experience for Undergraduates program to investigate some of the potential causes for the population decline. He hopes to do a more quantitative study to see if there is a connection between sediment and habitat and population shifts. Disease and parasites could also be worth examining, he said.

For Epifanio, documenting observations like this change in population points to the need for long-term monitoring efforts. Typically, once an invasive undergoes that initial population boom, research stops.

"We often close the book," Epifanio said. "What we're saying here is, if we come back a decade later, maybe they're not there any more."

More information: "Return of the Native: Historical Comparison of Invasive and Indigenous Crab Populations Near the Mouth of Delaware Bay." Corey M. Schab, Susan Park, Lisa A. Waidner, and Charles E. Epifanio. *Journal of Shellfish Research* 2013 32 (3), 751-758.
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