eDNA a useful tool for early detection of invasive green crab

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A European green crab found in Willapa Bay, Washington, in 2016. Credit: P. Sean McDonald/University of Washington

European green crabs feast on shellfish, destroy marsh habitats by burrowing in the mud and obliterate valuable seagrass beds. The invasive species also reproduces quickly, making it a nightmare for wildlife managers seeking to control its spread in Washington's marine waters.

Last month, Gov. Jay Inslee issued an emergency order in response to more than 70,000 crabs caught on Lummi Nation land as well as dramatic increases in crab populations on Washington's outer coast and other locations in Puget Sound in recent years.

As the green crab invasion in the state worsens, a new analysis method developed by University of Washington and Washington Sea Grant scientists could help contain future invasions and prevent new outbreaks using water testing and genetic analysis. The results, published online Feb. 6 in the journal *Ecological Applications*, show that the DNA-based technique works as well in detecting the presence of green crabs as setting traps to catch the live animals, which is a more laborious process. Results suggest these two methods could complement each other as approaches to learn where the species' range is expanding.

The new method relies on genetic material in the environment, known as eDNA, that is found in the water after organisms move through. Scientists can collect a bottle of water from a location, extract DNA from the water and discern which species were present recently in that area.

"We have limited resources to be able to combat this problem, and it's important to think about how to allocate those resources efficiently and effectively," said lead author Abigail Keller, who completed the work as a master's student in the UW School of Marine and Environmental Affairs. "Knowing the best situations for using eDNA to detect invasive green crabs is important, and that's what our study tried to tackle."

The research team relied on data collected over three months in 2020 from green crab traps in 20 locations throughout Puget Sound and the outer coast. Trapping at these locations was done by a large number of partners participating in statewide efforts to monitor and control European green crab, including multiple tribes, Washington Department of Fish and Wildlife—the state lead for green crab management—Washington Sea Grant's Crab Team, and other state and federal agencies.

For this study, the researchers visited each location and collected water samples, then ran genetic analyses to detect both the presence and quantity of European green crab in each location. In this way they could validate the eDNA data with the actual presence and numbers of crabs. They found that using eDNA to detect the presence and abundance of the species was as sensitive as trapping and counting live crabs.

This is significant, the researchers said, because eDNA as a detection method is new, and it hasn't always been clear how to interpret eDNA detections in past scenarios. This study shows how conventional monitoring methods—in this case, trapping and counting crabs—can be combined with eDNA techniques to more effectively find and control invasive species outbreaks.

"Here's a really well-validated example of how to use eDNA in the real world. To me that's really exciting," said co-author Ryan Kelly, a UW associate professor in the School of Marine and Environmental Affairs. "There are lots of invasive species, and many imperiled and endangered species that are hard to monitor, so this is one significant way forward on all of those fronts."

The study also evaluates when eDNA would add value in monitoring for invasive crabs, and when conventional trapping and counting still make the most sense. For example, taking water samples and testing for green crab DNA in remote locations—or in areas where outbreaks haven't yet been identified—could save time and resources instead of deploying traps. Alternatively, eDNA probably wouldn't be helpful in locations where large numbers of green crabs are already living and where community scientists and managers are already trapping and controlling those populations, the researchers explained.

European green crab captured at Lagoon Point (Whidbey Island), Washington, in 2018. Credit: Emily Grason/Washington Sea Grant

"From a management perspective, the value of this tool just really comes to life in places that are more remote or have a lot of shoreline to cover, like Alaska, where green crabs haven't yet been detected," said co-author Emily Grason, a marine ecologist who leads the Washington Sea Grant Crab Team. "I see eDNA as another tool in the toolkit, and we can imagine scenarios where it can be used alongside trapping, especially as an early detection method."

Finding these crabs soon after they have occupied a new location is important for controlling the population and protecting native habitats. Managers could get ahead of new invasions by testing water from multiple locations, and then follow up with more water testing, on-the-ground monitoring and trapping if green crab DNA is detected.

The paper identified green crab DNA in one location where the species hasn't yet been captured, near Vashon Island. The research team followed up a year later with intensive trapping and retested the water; no green crabs or additional green crab DNA were found. The researchers think the earlier positive sample likely was picking up green crab larvae, which weren't present in that location a year later. Notably, the effort represented an important test case for how eDNA and traditional trapping can be implemented together for green crab management.

"The reason we pursued this project in the beginning is that early detection of green crabs is difficult—it's like finding a needle in a haystack," said co-author P. Sean McDonald, a UW associate teaching professor in environmental studies and aquatic and fishery sciences and the UW principal investigator for Crab Team research. "So if adding eDNA to our toolkit helps us detect those needles, then that's great to have at our disposal."

More information: Abigail G. Keller et al, Tracking an invasion front with environmental DNA, *Ecological Applications* (2022). DOI:

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