What are European green crabs eating in Willapa Bay?

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European green crab (*Carcinus maenas*) was first found in Willapa Bay in 1998. For two decades following their discovery, green crabs were only periodically detectible. Since around 2017, however, they have achieved greater densities in the bay than ever previously observed. This unfolding invasion has raised concern that green crabs could already be threatening the harvest of clams, oysters and Dungeness crabs, reducing the productivity of Willapa Bay's renowned shellfish beds. Green crabs have the potential to dramatically alter the ecology of the estuary, generating ripple effects through a food web that links to migratory shorebirds and waterfowl, salmon, and humans.

With funding from the Washington Department of Fish and Wildlife, Willapa Bay Oyster Reserve Research Program, this project evaluated the diet of green crabs collected across Willapa Bay, including crabs captured on actively cultured Manila clam (*Ruditapes philippinarum*) beds.

Methods

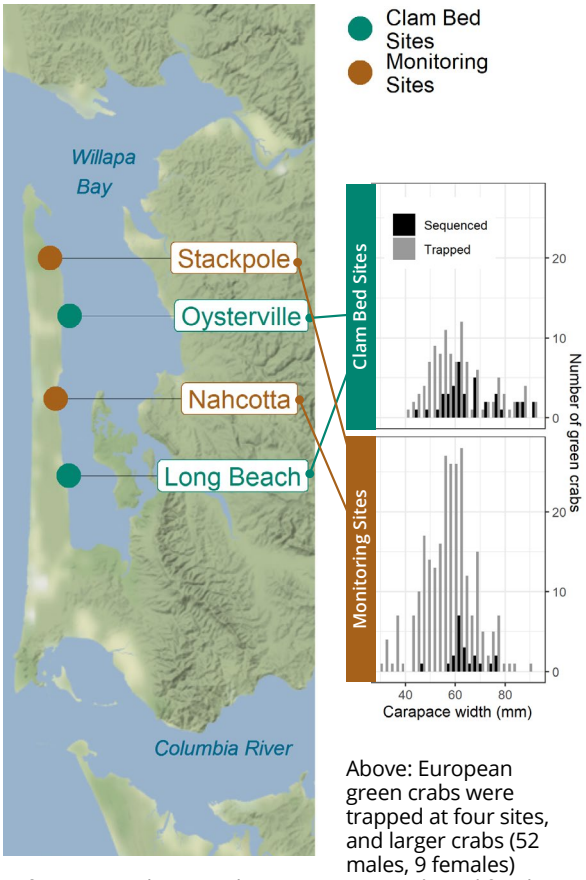
In spring and summer 2021, Washington Sea Grant Crab Team and partners collected European green crabs from four sites in Willapa Bay: two sites with Manila clam beds, and two long-term monitoring sites at sloughs without active aquaculture. From this sample, 61 larger, primarily male crabs were selected for diet analysis. It was assumed that these individuals were more capable of eating Manila clams because of the greater crushing strength of their claws.

To determine what these crabs had been eating, diet analysis was conducted using the DNA left behind by food items in a crab's stomach. This DNA-based method involves extracting DNA from crab stomach contents, and sequencing short regions of the DNA known as "barcodes." The barcodes can then be matched to a large database of potential prey species, allowing the simultaneous identification of different food items. Because crabs crush and grind their food, DNA-based diet analysis can be more sensitive than visual methods when identifying the broad range of prey that green crab may feed on.

Green crabs have a wide diet, including fish, insects, and algae. The most common invertebrates in their stomachs were

- hairy shore crab
- sand shrimp
- amphipods
- softshell clam

Left: Green crab stomach contents after drying



Above: European green crabs were trapped at four sites, and larger crabs (52 males, 9 females) were selected for diet analysis.

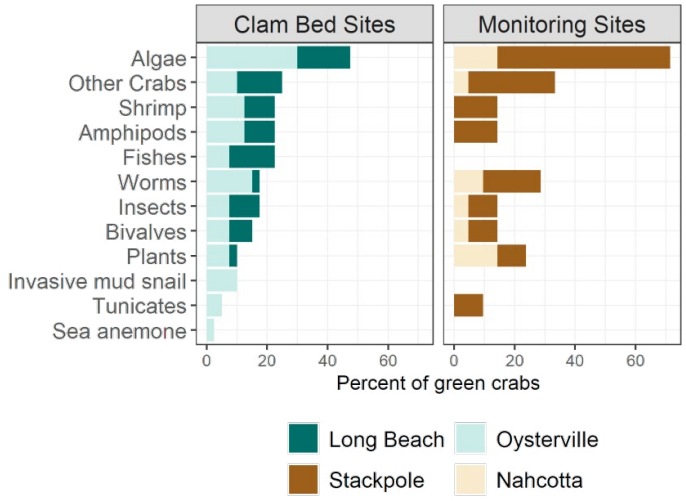
Results

Green crabs have a diverse, omnivorous diet. 54 unique food items were identified from the stomach contents of the 61 crabs, ranging from marine *polychaete* worms to smaller benthic fish. These items may have been consumed through active predation, scavenging, or incidental ingestion (if the food item was attached to, or inside of, the targeted prey the crab consumed). A relatively high number of green crabs consumed the following "top" species:

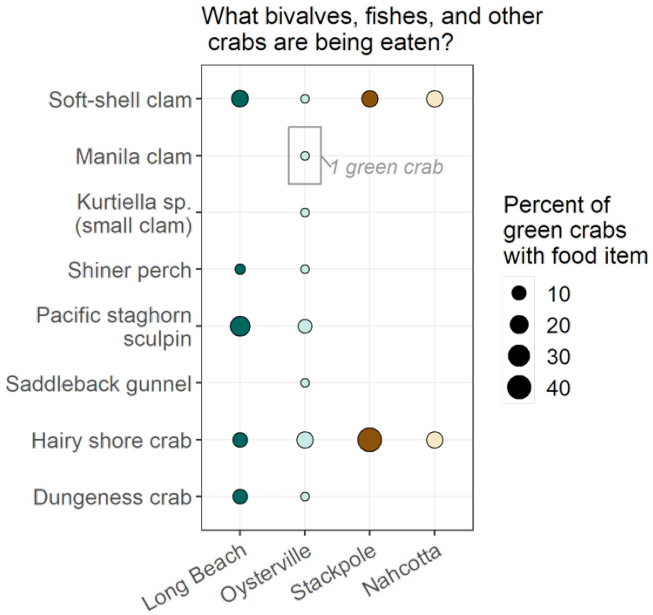
A relatively high number of green crabs consumed the following "top" species:

- 20% ate hairy shore crab (*Hemigrapsus oregonensis*)
- 20% ate sand shrimp (*Crangon spp.*)
- 13% ate red algae (*Neoporphyra sp.*)

Green crabs ate both native and other non-native species. Non-native food items included both soft-shell and Manila clams, as well as the invasive mud snail *Batillaria attramentaria* and several amphipod crustaceans.



Only one crab ate Manila clam out of the 61 crabs analyzed. This suggests that larger, male crabs were not eating very many Manila clams (*Ruditapes phillipinarum*) during the spring or summer months. By contrast, the soft-shell clam (*Mya arenaria*) was found in the stomach contents of 11% of green crabs analyzed. Although three green crab stomachs contained Dungeness crab (*Cancer magister*) DNA, these green crabs had co-occurred in traps with Dungeness crab; consumption may have occurred as a result of being enclosed in the same trap, even though evidence of predation was not observed. DNA from Zosteraceae, a family of marine plants that includes surfgrasses (*Phyllospadix* spp.) and eelgrasses (*Zostera* spp.) was also detected among stomach contents. However, more research is needed to determine what our results mean for specific species of these two important habitat-forming groups in Willapa Bay.



For more information visit: *wsg.uw.edu/crabteam* or *https://wdfw.wa.gov/species-habitats/invasive/carcinus-maenas;*
The published paper is available online: Fisher et al. 2024 PLoS ONE *doi.org/10.1371/journal.pone.0302518*

Willapa-Grays Harbor Oyster Growers Association

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