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Determining the prey consumption, preferences, and potential for dietary overlap between invasive European green crabs and native graceful crabs in the Salish Sea

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Abstract

The global success of the invasive European green crab (*Carcinus maenas*) is due, in part, to its broad diet, with over 140 different genera consumed worldwide[1]. However, very little of this information comes directly from the Salish Sea. Additionally, almost nothing is known about the diet of graceful crab (*Metacarcinus gracilis*), a common, co-occurring native species which may compete with green crabs. This study is the first to document the types of locally available prey consumed by both crab species, their prey preferences, and potential for competition. Crabs were allowed to forage individually on a range of common intertidal invertebrates in appropriate substrate at natural prey densities. As expected, green crabs readily consumed a wide variety of prey, especially bivalves. Although graceful crabs did prey on most species, including those with hard shells, they were less effective predators overall (i.e., significantly lower proportional consumption). These results support the hypothesis that while these two crab species may compete for some shared prey resources, more work should be done to understand the potential impacts of invasive green crabs on intertidal invertebrate populations in the Salish Sea.

Introduction

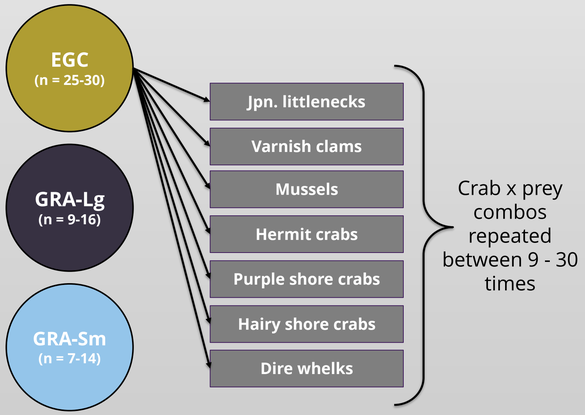
Although European green crab (EGC) are well-documented as highly effective predators on a range of intertidal species in lab settings[1-3], how this translates to actual impacts on prey populations in British Columbia (BC) is unknown. This pilot study was the first in a series of experiments intended to fill this crucial knowledge gap by looking at two questions:

1. **Are green crabs more likely to successfully consume certain types of prey?**
2. **Are green crabs be competing for shared prey with a co-existing native graceful crabs?**

Photo credit: I.M. Côté (2015)

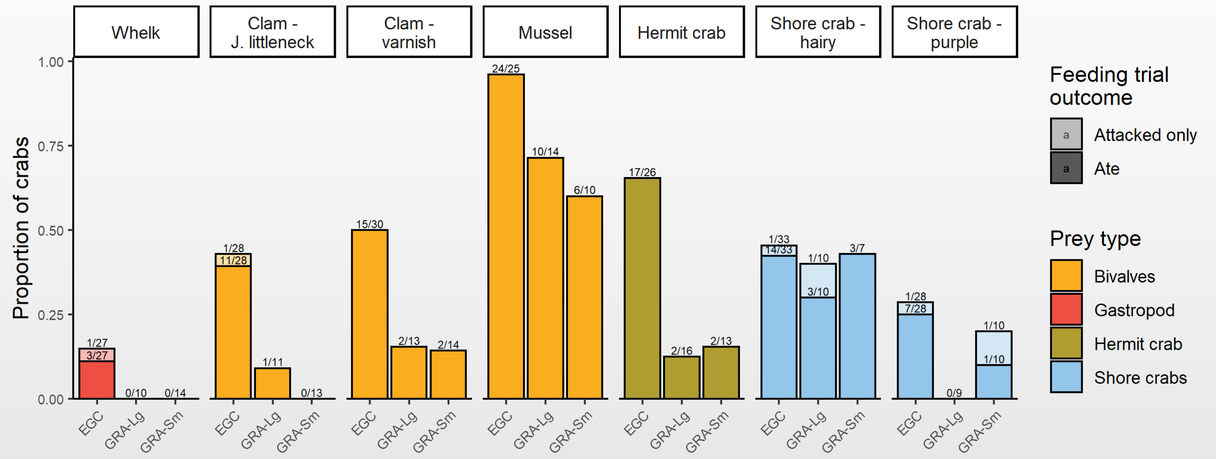
Materials & Methods

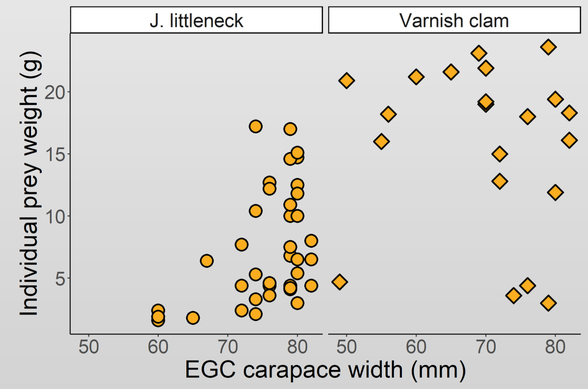
A recirculating seawater system was constructed at the Centre for Shellfish Research at Vancouver Island University (VIU). EGC (carapace width range: 49 – 82 mm) and graceful (GRA) crabs (large (Lg): 70 – 106 mm; small (Sm): 51 – 66 mm) were held in three separate tanks until undergoing a 48 hour fast and feeding trial.



Each day, a single crab was placed in one of 10 feeding trial bins (~0.25 m^2), with either sand or cobble substrate, and a single prey species (n = 7 prey species). Experimental prey densities were based on natural densities. Crabs were allowed to forage freely for 4 hours, after which the remaining prey were counted and weighed, and injuries (failed predation attempts) noted.

Each combination of crab type (i.e., EGC, GRA-Lg, or GRA-Sm) and prey species was repeated up to 30 times. Crabs were re-used or replaced as needed. However, no individual crab was exposed to the same prey species twice.





Results

EGC ate all prey species offered, while GRA consumed all prey types except dire whelks (*Lirabuccinum dirum*). However, GRA only demonstrated proportionally similar consumption rates as EGC when foraging on mussels and shore crabs. Both EGC and GRA were marginally more successful when preying on hairy shore crabs (*H. oregonensis*) than purple shore crabs (*H. nudus*). This may be partially a consequence of substrate, as hairy shore crab trials occurred over sand and purple shore crab trials occurred over cobble.

For EGC, we observed the expected positive relationship between crab size and prey weight for Japanese littleneck clams (*Ruditapes philippinarum*), with an apparent upper limit of 18-20 g, but not for varnish clams (*Nuttallia obscurata*).

Conclusion

Although almost nothing is known about the diet of GRA, it has been speculated that they prefer soft-bodied prey[4]. Our observations from this pilot study support this, as GRA clearly preferred prey species with the thinnest shells. In comparison, EGC readily attacked most prey offered, as expected of a generalist predator. Given their reputation as highly effective bivalve predators, the large proportion of shore crabs both attacked and eaten by EGC was unexpected, although aligns with observations of significant declines in shore crab abundances after the arrival of EGC in California[6]. If GRA and EGC do compete for prey[5], particularly in soft-sediment environments where the two species most commonly co-occur, it is therefore most likely for hairy shore crab.

The results of this pilot study suggest several avenues for future research. In particular, the possible impacts of EGC on shore crabs and their competitive interactions with GRA.

Acknowledgements

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