

# CLAMS & SHRIMP & WHALES, OH MY! UTILIZING INVASIVE VARNISH CLAMS IN PUGET SOUND

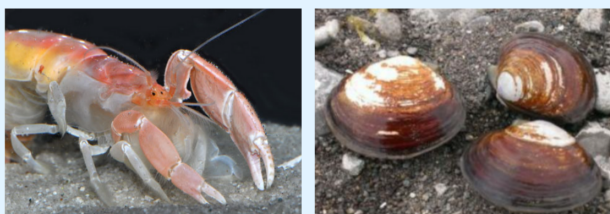
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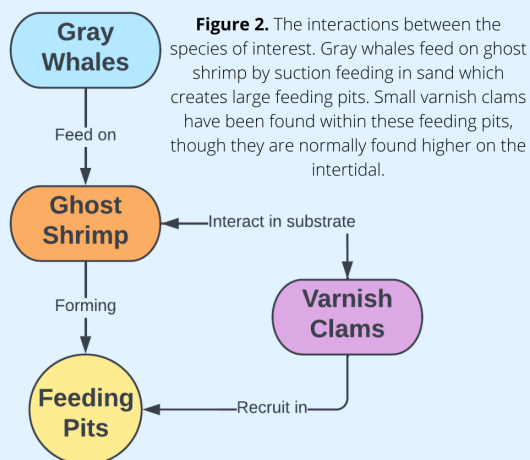
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## Background

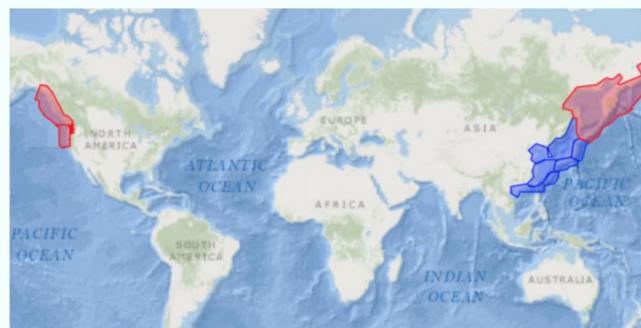
- Purple varnish clams (*Nuttallia obscurata*) are a non-native species in the Pacific Northwest.
- There is interest in harvesting varnish clams for food or aquaculture feed, and adjacent ghost shrimp (*Neotrypaea californiensis*) for bait.
- Ghost shrimp are a source of prey for gray whales that seasonally come into Puget Sound.
- It's important to develop methods for appropriately surveying clam and shrimp populations, not much is known about varnish clam population dynamics.



**Figure 1.** Ghost shrimp (left) and varnish clams (right). Ghost shrimp are bioturbators that alter sediment attributes and can negatively impact shellfish by loosening sand, causing shellfish to sink and suffocate. Varnish clams are a very successful invasive species that live high on the intertidal and are tolerant to changes in heat and salinity.



**Figure 2.** The interactions between the species of interest. Gray whales feed on ghost shrimp by suction feeding in sand which creates large feeding pits. Small varnish clams have been found within these feeding pits, though they are normally found higher on the intertidal.



**Figure 3.** Map showing the native (blue) and nonnative (red) range of varnish clams. Taken from the Smithsonian's National Estuarine and Marine Exotic Species Information System (NEMESIS) database. Varnish clams arrived in Puget Sound in the 1990s.

## Question

How do we assess varnish clam and sand shrimp populations in areas harvested by people and gray whales?

## Internship/Methods

For my internship I worked with NOAA, conducting literature reviews and helping develop a study design by looking into online sources and scholarly papers to learn more about the species of interest and intertidal study design. We also spoke with the Tulalip Tribe's shellfish biologist to learn more about their harvest plan and gain insight into harvest methods.

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## Findings

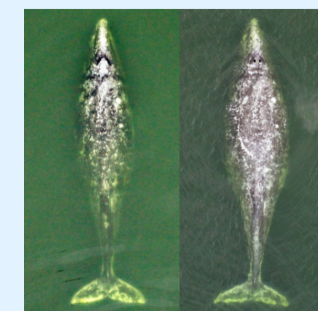
- The Tulalip Tribe plans on harvesting large areas on their beaches for varnish clams and ghost shrimp. This creates an opportunity to study harvest effects on their populations.

### Study Methods & Future Research

- Yearly monitoring is necessary. Only the size and number of clams needs to be recorded, size can be used to estimate age and age of standing stock.
- The study design should reflect all possible dynamics on the beach, we cannot control where grey whales may bite into the sand.
- Sampling methods depend on the size of the harvest area and study area. For example, PVC pipe sampling is sufficient for the size of whale feeding pits.
- There should be control sites off of the Tulalip Reservation in other areas of North Puget Sound.

## Broader Significance

- It has been suggested that global warming may create more favorable conditions for varnish clams, who knows how population dynamics may change in the future.
- There's recently been a gray whale die off and the whales have also started coming into Puget Sound earlier than normal to feed on ghost shrimp. Monitoring ghost shrimp populations may be more important in the future.



**Figure 4.** Aerial images of a gray whale known as Earhart taken 19 days apart. Before (left) and after (right) feeding on ghost shrimp. Photos taken in Northern Puget Sound by Holly Fearnbach and John Durban in May 2020.