

Research and Monitoring of Makah Intertidal, Nearshore, and Coastal Ecosystems

By Adrienne Akmajian, Marine Ecologist



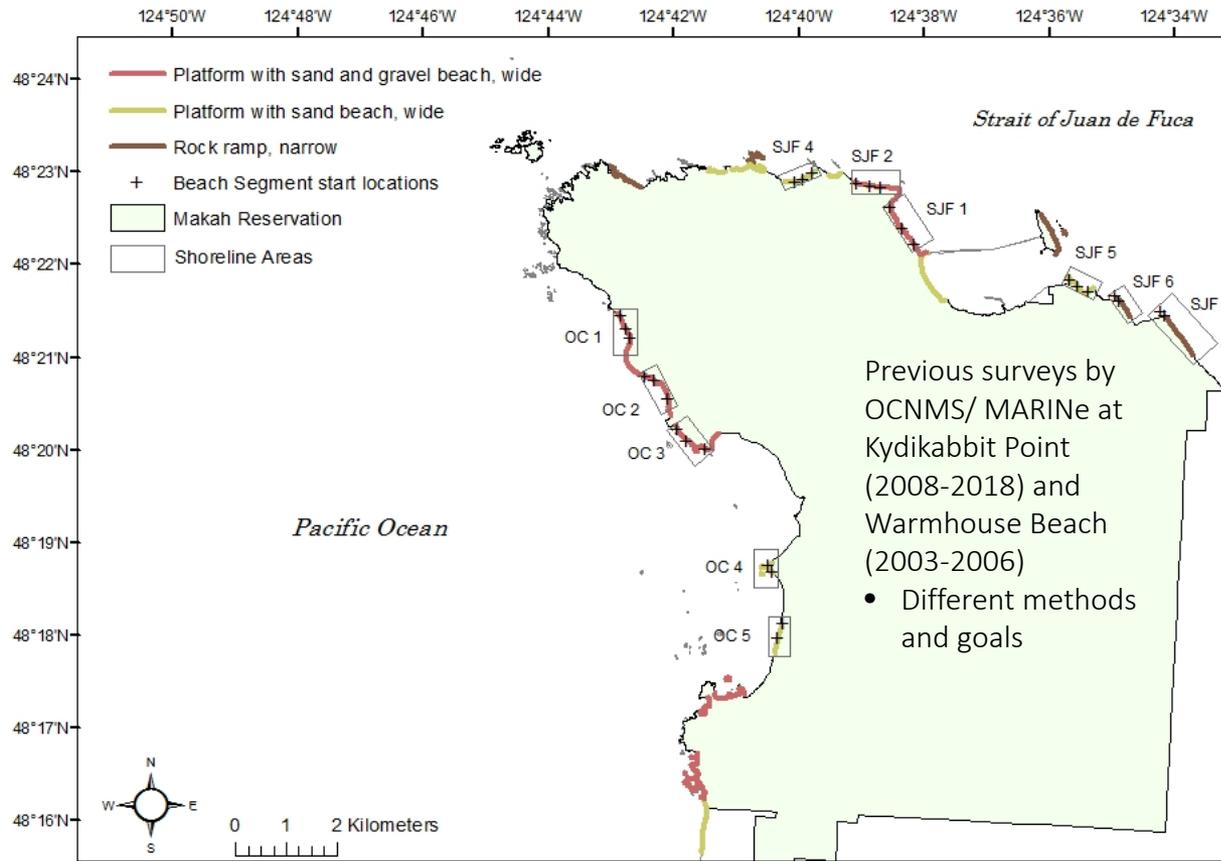
Program Overview

- Grant funded, started 2016
- Intertidal surveys to establish baseline data
- Olive snails and sea stars
- Algal toxin monitoring in fish and whales
- European green crab
- New projects - Indicators



Photo: Tiffany Royal, NWIFC

Rocky Intertidal



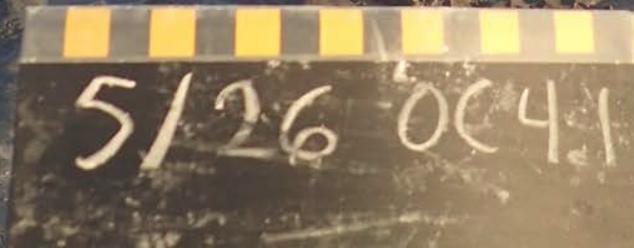
Rocky Intertidal

Our goals:

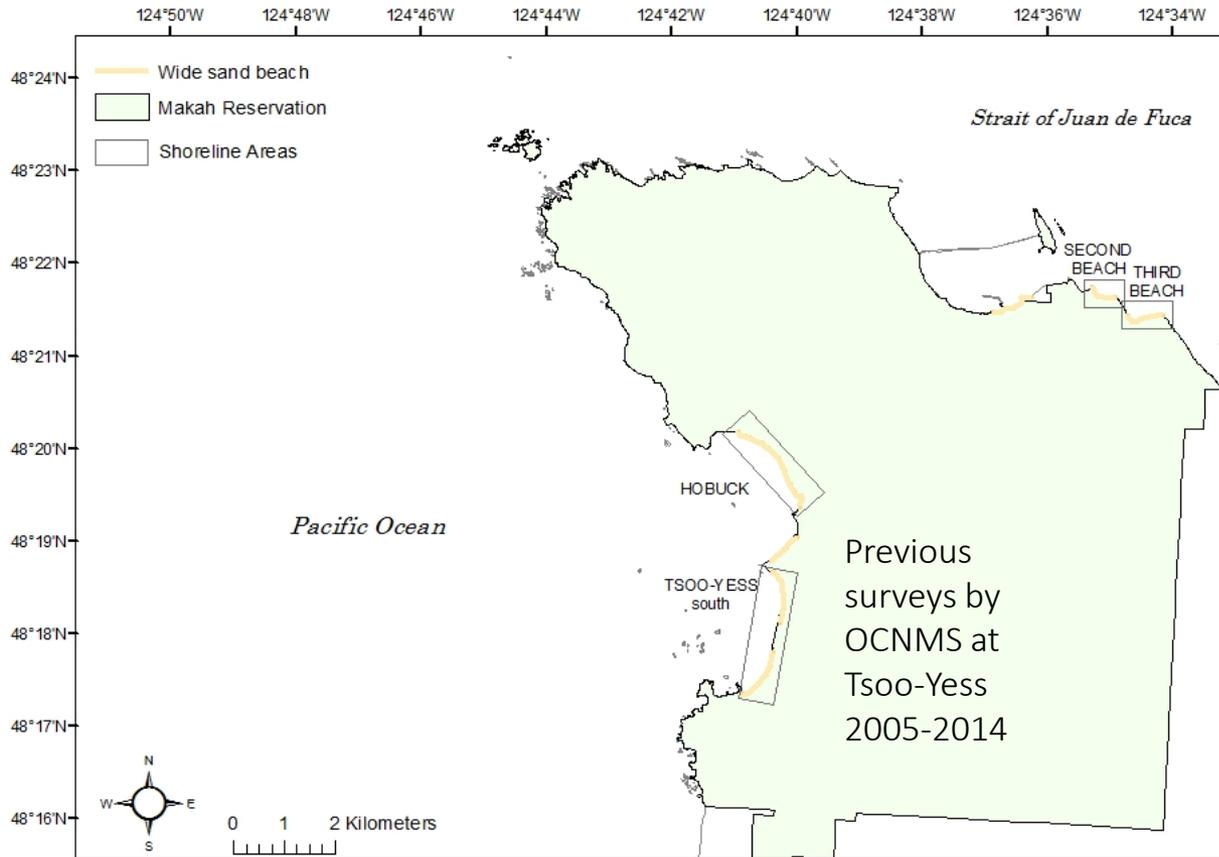
- Comprehensive baseline data on species presence and abundance
- Future surveys to look at changes over time, due to climate change
- Incorporate into the Tribe's Marine Spatial Plan and Oil Spill Response

A few results...

- Invertebrates: 76 genus or species + 10 higher taxa
- Algae: 57 genus or species + 8 higher taxa



Sandy Intertidal



Sandy Intertidal

- Baseline for beach productivity
 - Food for shorebirds and nearshore fish
- Identified unexpected (to us) species
- Detected a difference in diversity/abundance by:
 - Area (outer coast vs. Strait)
 - Month (May vs. June)
- Hope to continue surveys, compare to shorebirds, changes in beach profile, other factors



Top left: weevil beetle (*Emphyastes fucicola*)

Top right: dune beetle (*Coelus ciliatus*)

Bottom left: pictured rove beetle (*Thinopinus pictus*)

Bottom right: unidentified beetle, Staphylinid family

Olive Snails

- Abundance surveys since 2009
- Concern about sustainable harvest
- Mass mortality event in 2014, hundreds of thousands dead
 - Investigated several hypotheses
 - Used OCNMS mooring data from Makah Bay
 - Not able to determine definitive cause
- Conducted surveys in 2014-2018 to document recovery
- In 2018, surveyed additional beaches
- New funding to continue surveys, look at health indicators including parasites

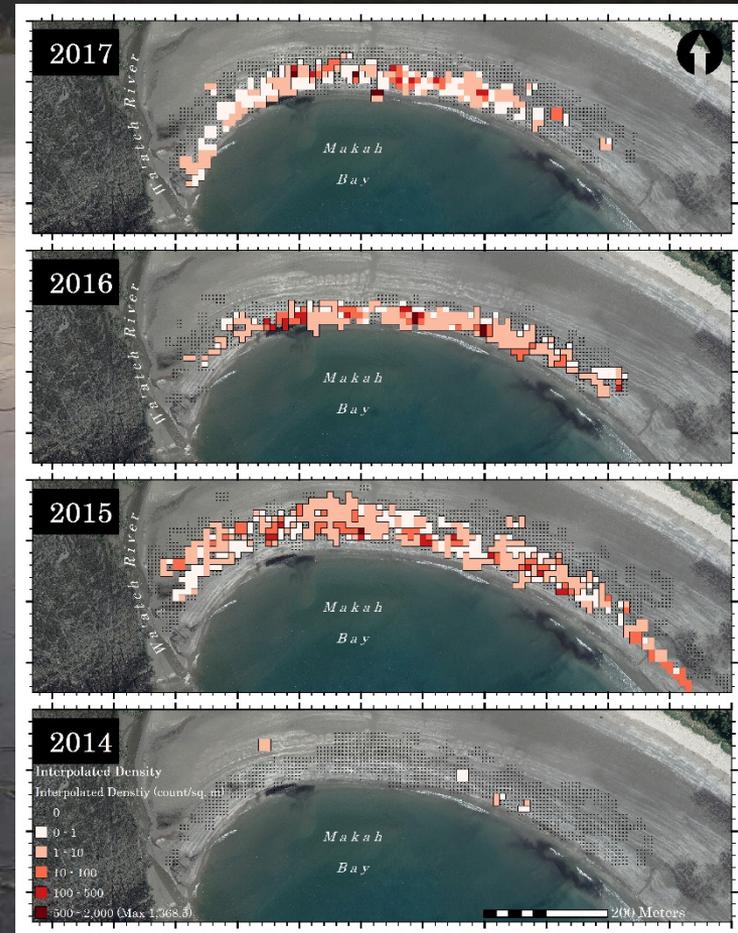
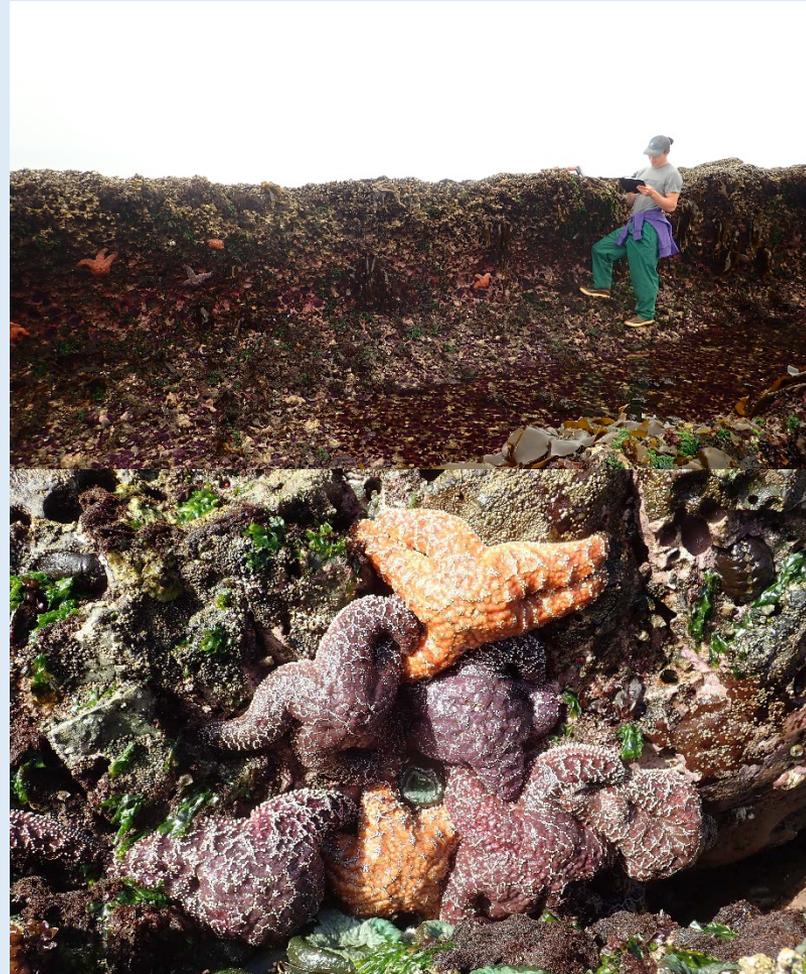


Image from Akmajian et al. 2018

Sea Stars

- First time establishing dedicated sea star plots, monitoring sea stars, urchins, and chitons
- Looking for abundance, size class, and also health indicators (wasting)
- Suitable locations on the outer coast and in the Strait
 - Tsoo-Yess Beach
 - Third Beach
- Hope to continue as long-term monitoring



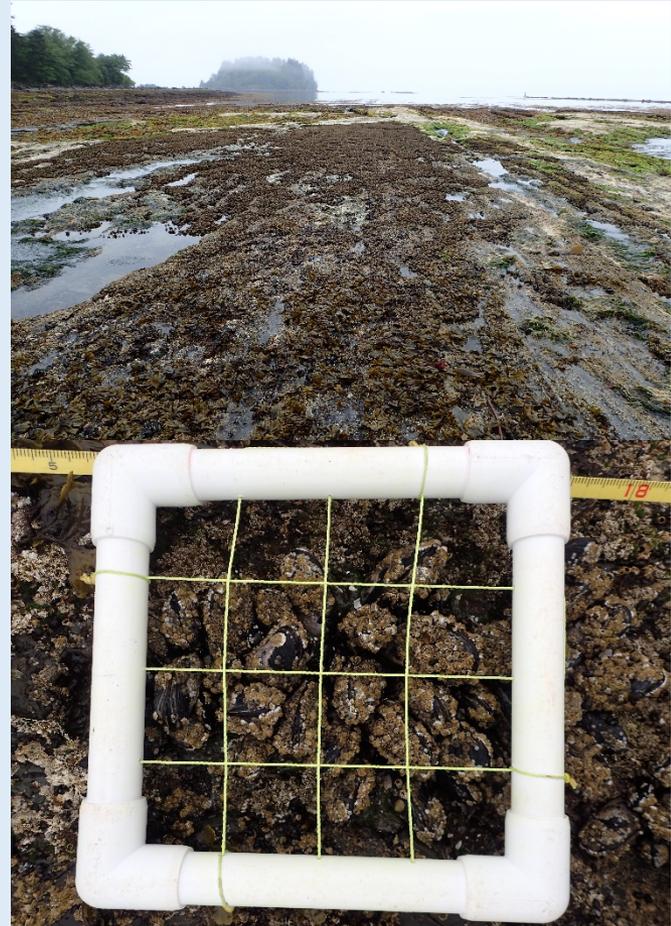
Algal Toxins in Fish and Whales

- Two-year funding from Washington Sea Grant
- Looking for domoic acid and saxitoxin in fish, gray whales, and their prey
- Seven fish species from tribal commercial fisherman – yellowtail rockfish, walleye pollock, petrale sole, arrowtooth flounder, dogfish, skate, chinook salmon
- Scat from gray whales and prey tows near feeding whales
- Running ELISA analyses in-house!



New Projects

- New funding to look more at indicators of nearshore, intertidal, and coastal systems
- Mussel and eelgrass beds, olive snails
- Continuing European green crab trapping and monitoring
- Gray whales/ prey and harbor seals
- Working with GIS department to map ecological data

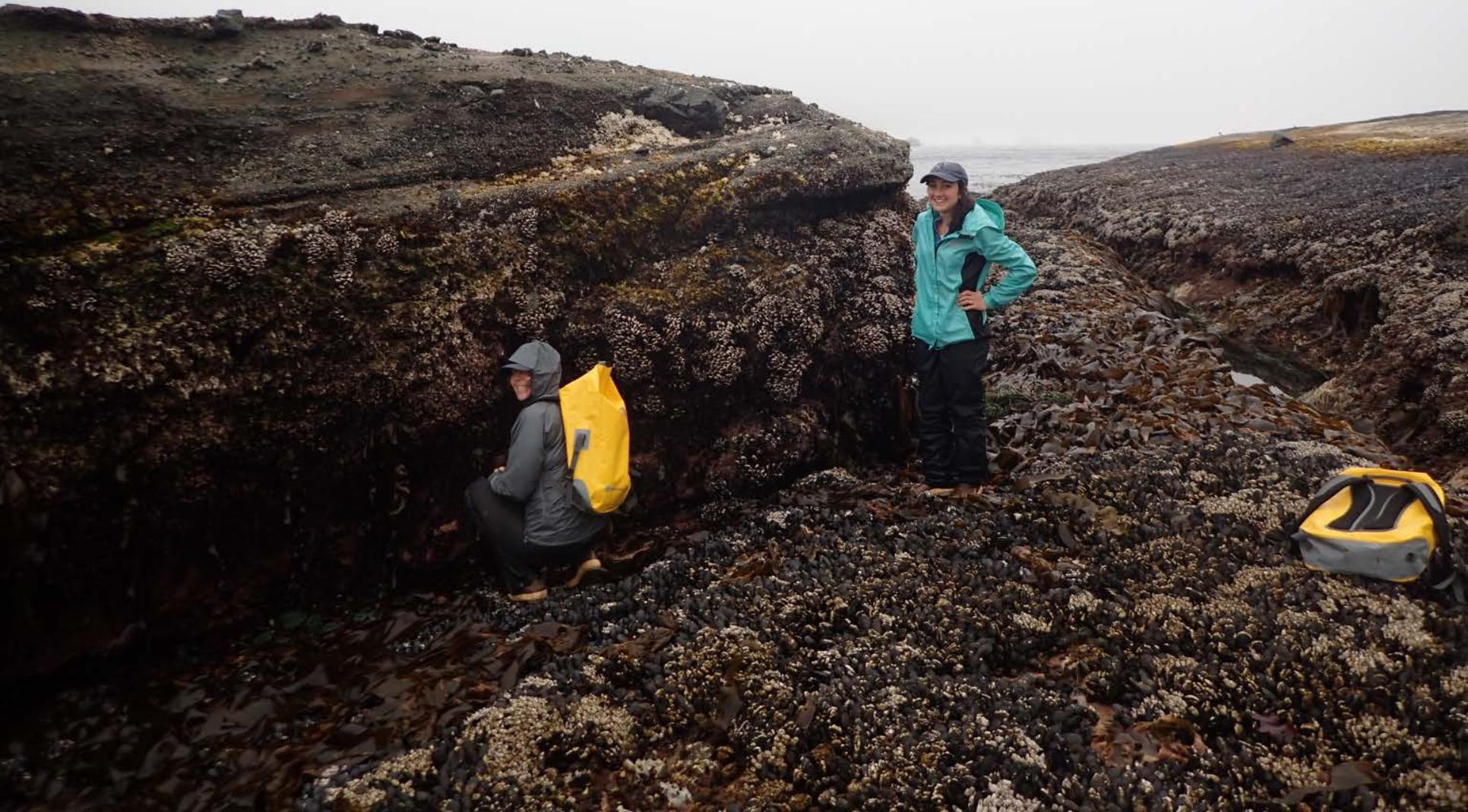


Relationship to OCNMS

- Overlap in some of data being collected and interests
- Mooring data is very valuable!
- Would like data on pH (OA), could partner with OCNMS
- Other data of subtidal work adjacent to our intertidal
- Outreach to Neah Bay community – science seminars?



Questions?



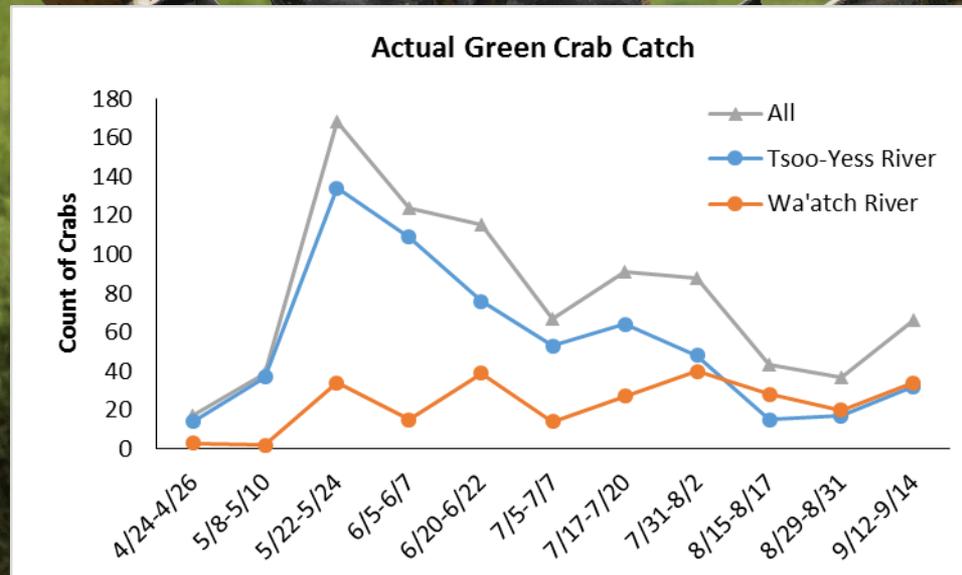
European Green Crab on the Olympic Coast



The Punch Line

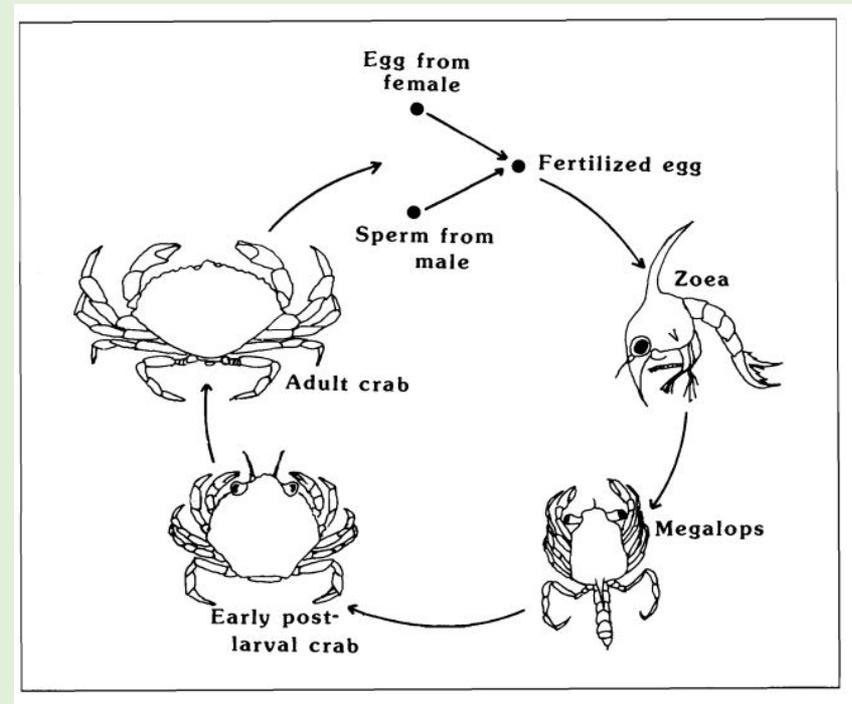
Since starting trapping in April 2018, we have deployed ~2000 traps catching a total of...

968 European green crabs!



Life Cycle

- Larvae must develop in open ocean, may remain in marine waters >80 days
- Potential to disperse long distances, especially under certain oceanographic conditions
 - Up to 50 km/day during 1998 El Nino
- Adults live 4-7 years, males larger reaching up to 100 mm max
- Mating when female has just molted, male may attach to female before
- After molt will deposit spermatophors
- Spawn twice per year, producing up to 185,000 eggs per clutch

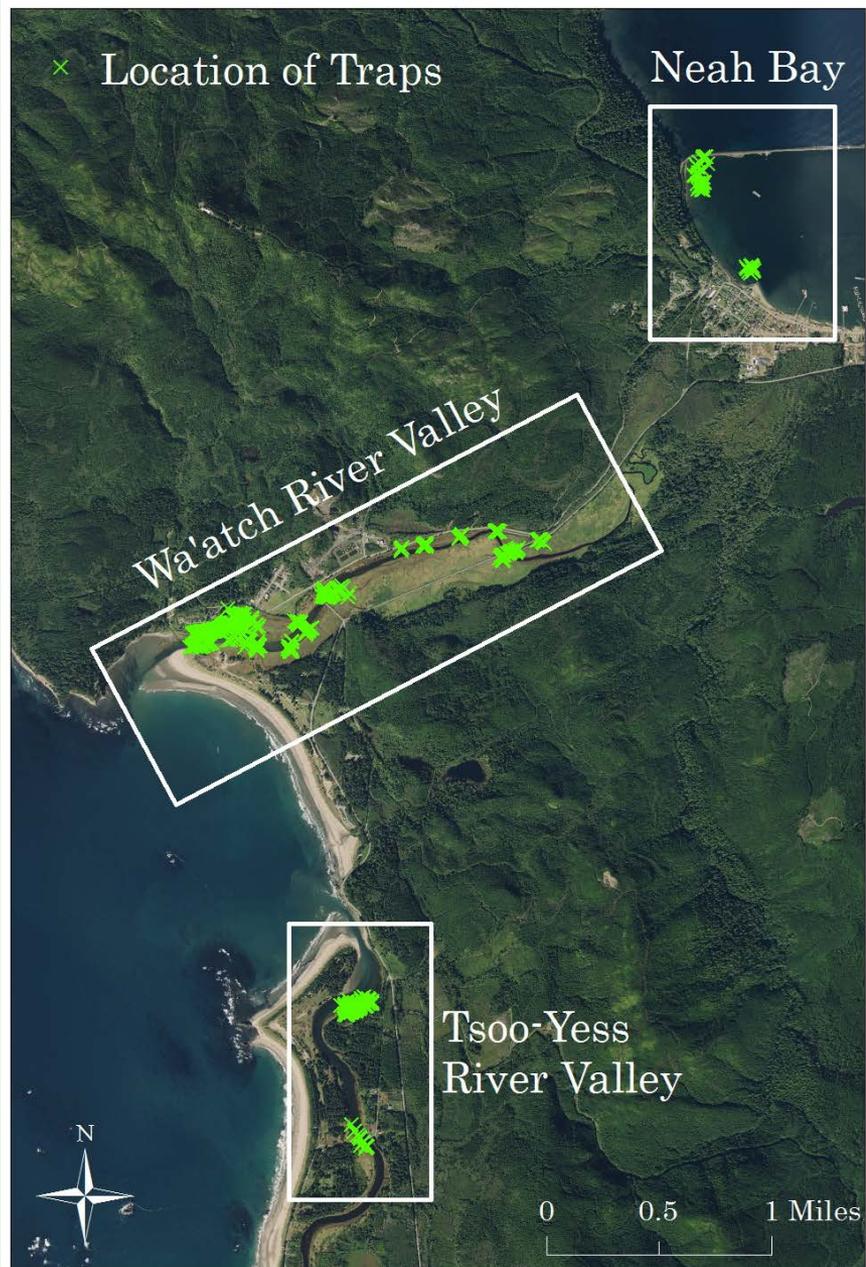


Dungeness crab life cycle from Pauley et al. 1999

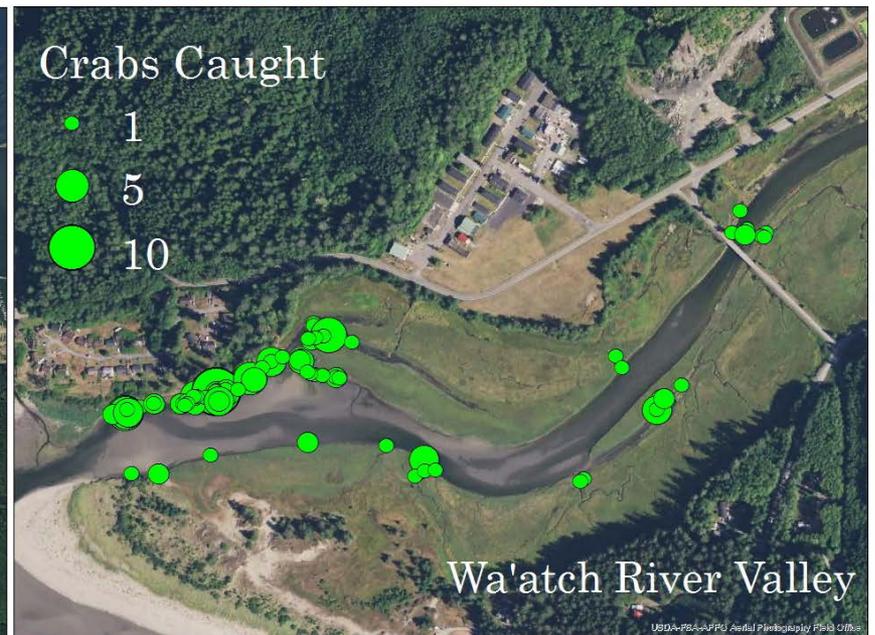
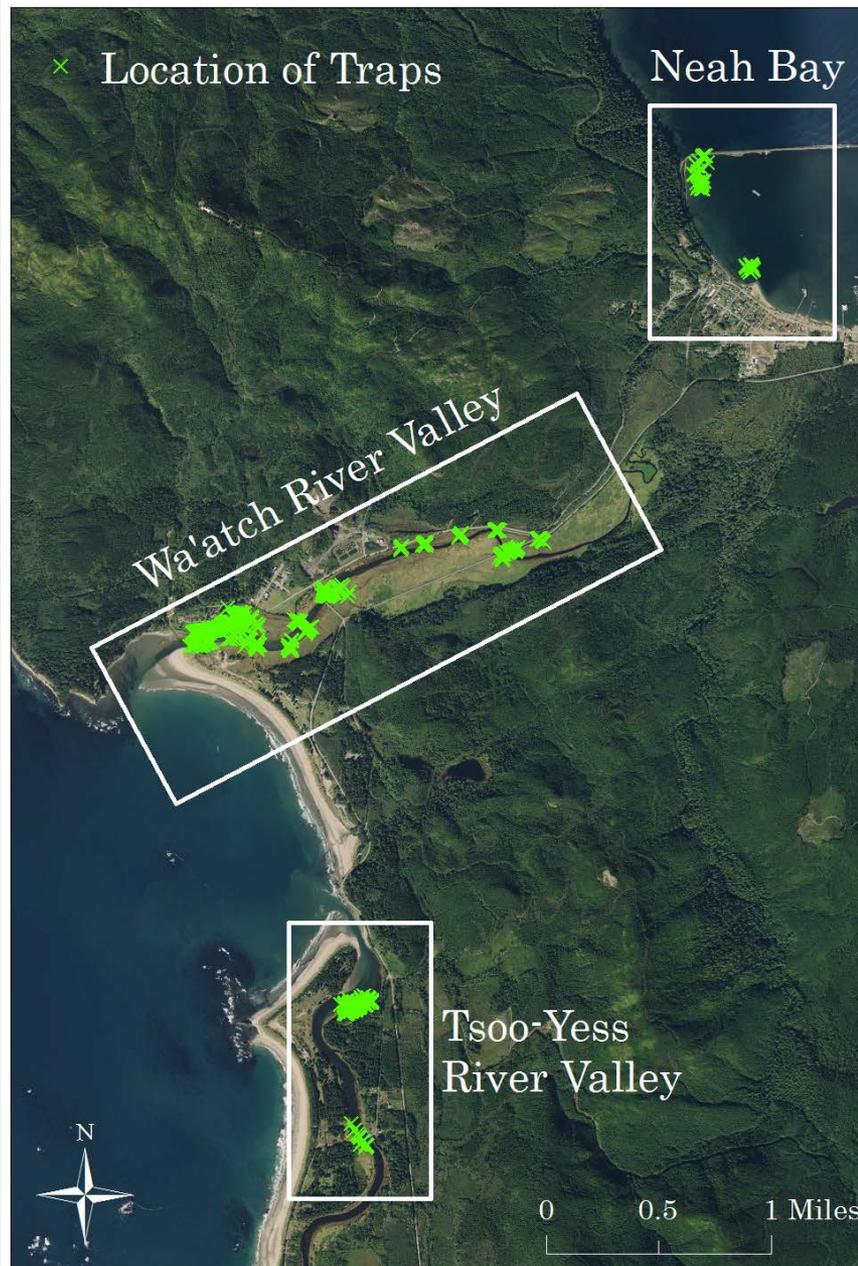
2018 Trapping

- Funding to purchase equipment
- Traps set every other week from April – September
- Two primary trap types, crayfish (Fukui) and minnow (modified)
- Set in the lower Wa'atch River, lower Tsoo-Yess River, and nearshore of Neah Bay
- Collecting data on all species caught – native crabs and fish
- Data on individual green crabs
- Also collected/ documented molts

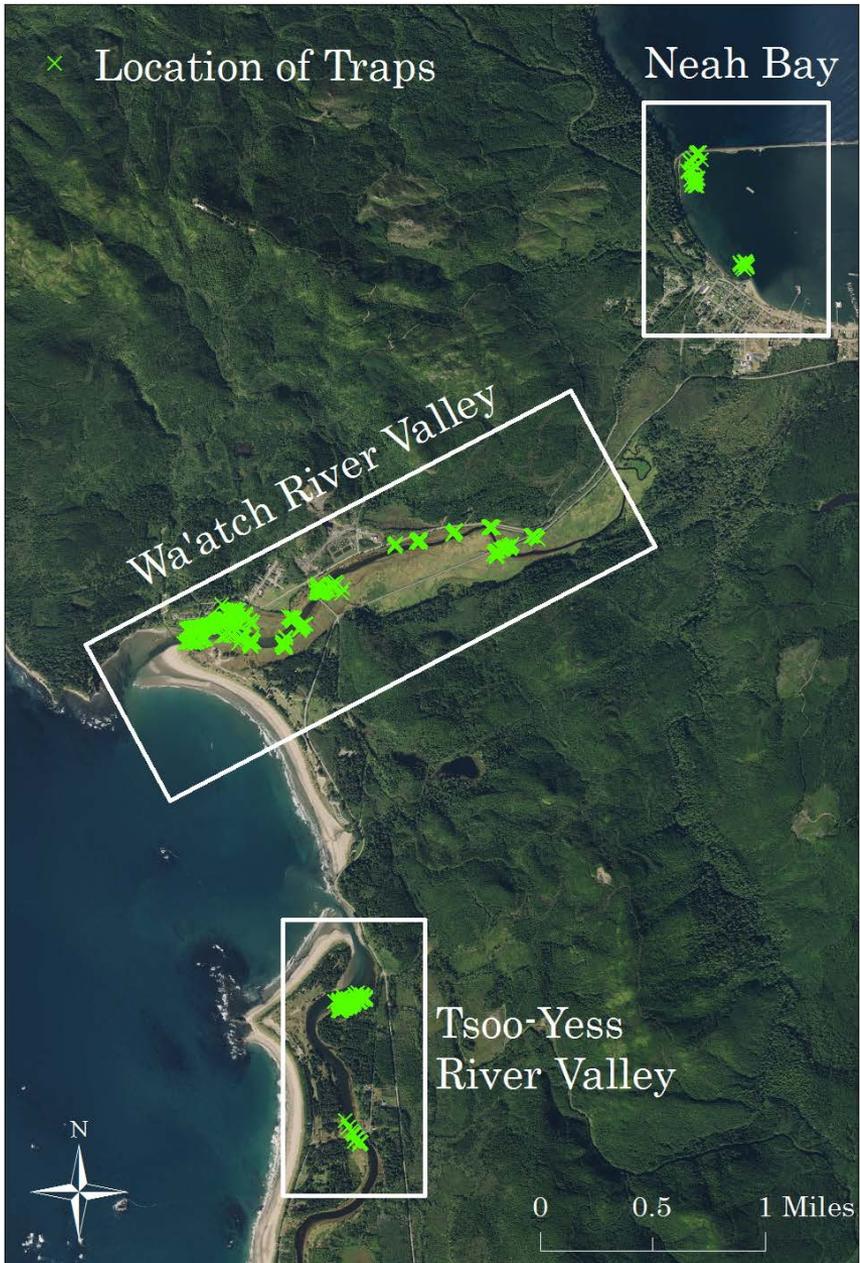




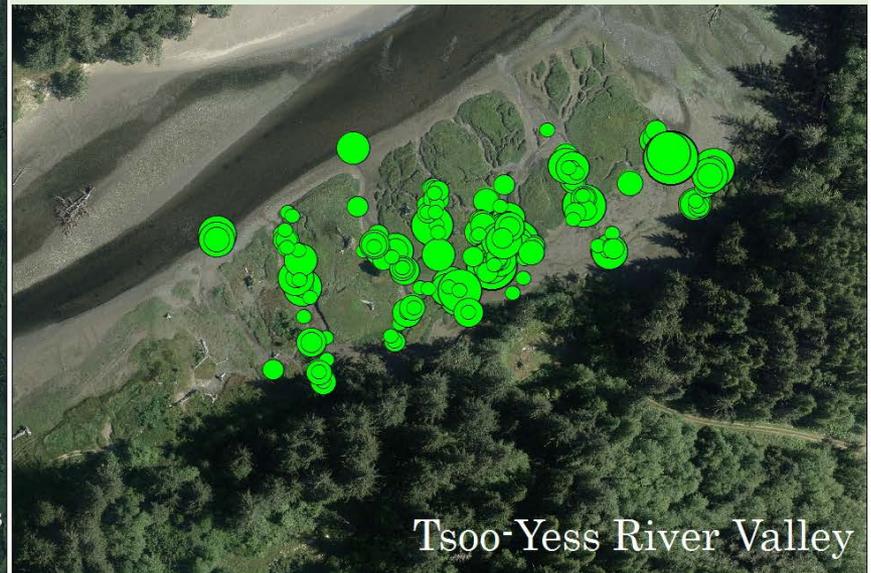
- Preferred habitat is muddy, soft bottomed, undercut banks
 - Can inhabit mud, salt marsh, sea grass beds, rocky intertidal
- Tolerant of wide range of temperature and salinity
- Most successful in protected coastal and estuarine habitats
- Found from high tide down to 5-6 m
- Offshore overwintering migration out of estuaries to deeper, warmer coastal waters
 - May vary by age, sex, and even salinity of the water

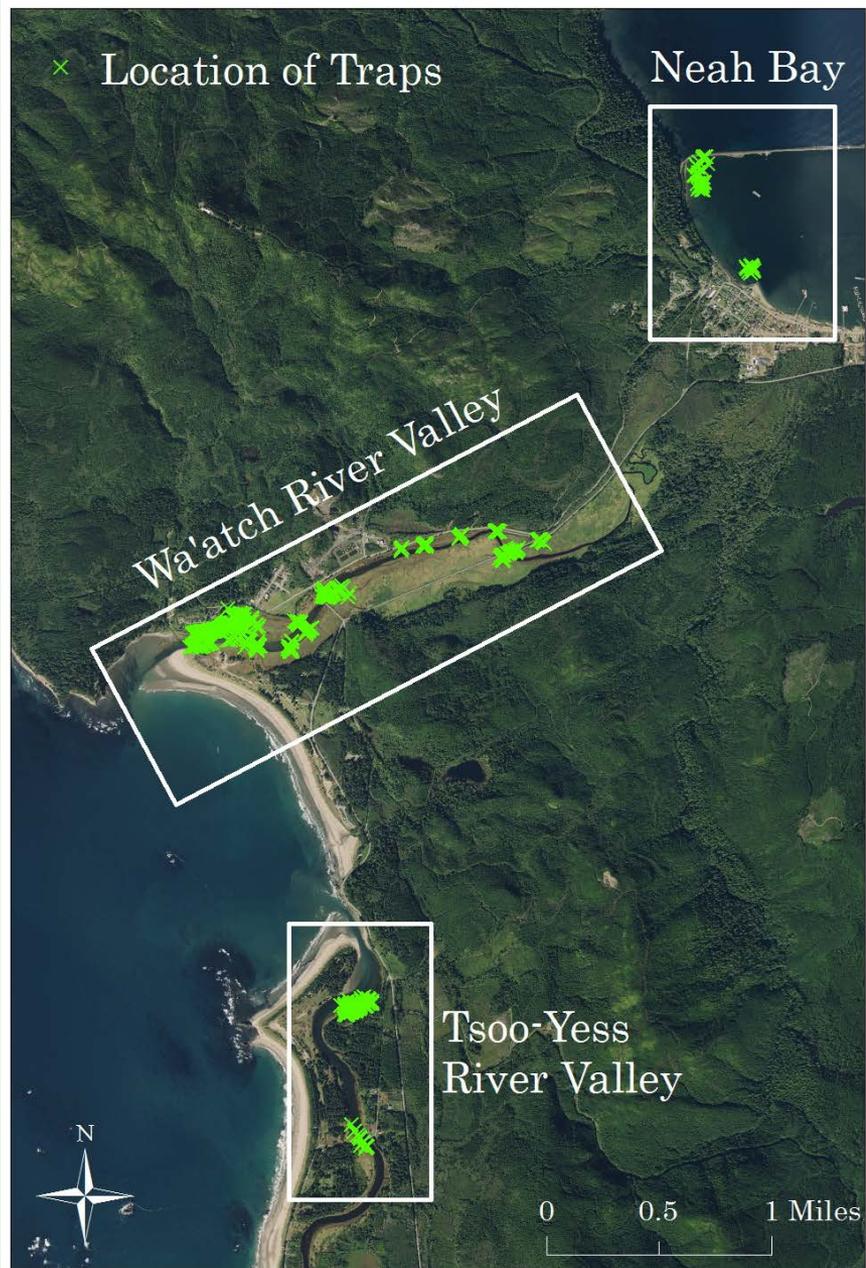


- 328 total green crabs, 255 male, 73 female
- Average of 58 mm carapace width, range from 14 – 89 mm
- Crabs caught primarily in lower river mile
- Two crabs found in rocky intertidal at Wa'atch Point
- Salinity is fairly high, particularly in tide pools and side channels



- “Hotspot” for green crab
- 640 total green crabs, 452 male, 188 female
- Average 50 mm in carapace width, range from 12 – 90 mm
- Primary area is salt marsh habitat, steep banks and tidepools
- Have caught crabs up to the bridge
- Salinity is lower than the Wa’atch River, especially in main channel, but stays high in back pools





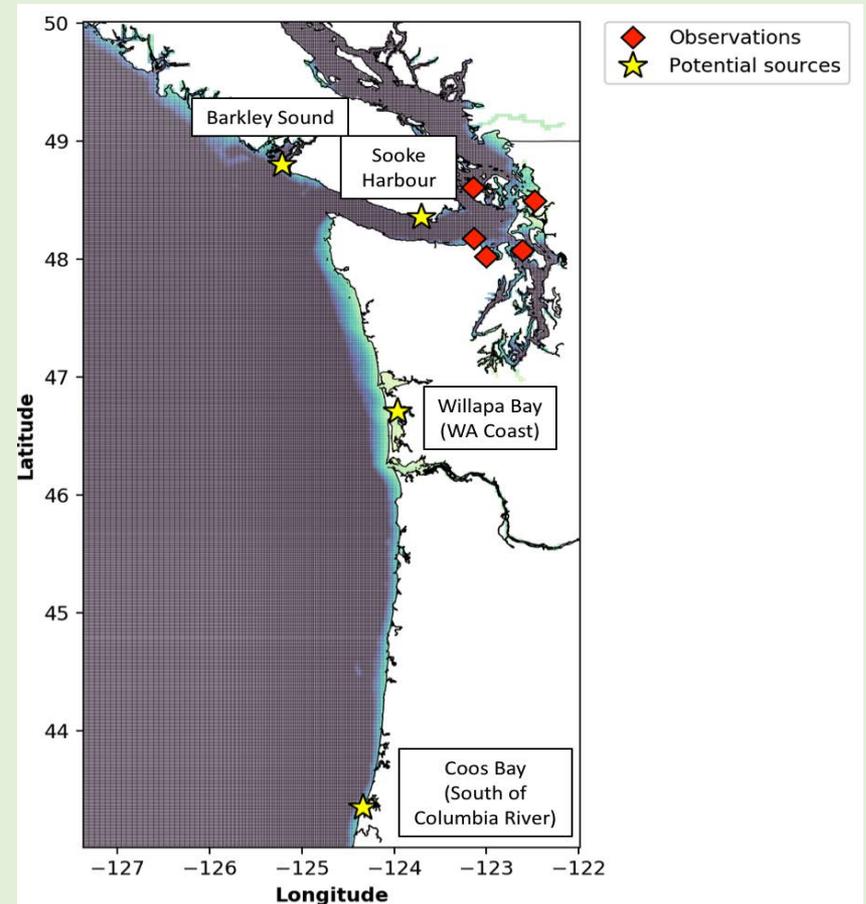
Neah Bay

- No green crabs caught
- Have found 6 molts
- Likely that green crabs are in the Bay
 - Not “typical” habitat, but similar to what they see in BC
 - Trap locations?
 - Predators (red rock crabs)?



Where are they coming from, where will they go?

- Populations in Willapa Bay, Grays Harbor, Barkely Sound, Sooke, and further south in OR and CA
- Genomic work (WHOI) and oceanographic modelling (UW) to look at how green crabs get into Salish Sea and where green crabs caught are from
- In genetic study, one crab from Makah Bay was from Sooke, rest from “outer coast”
- In oceanographic modelling, normal conditions crabs would come from outside in, backward flow conditions could move from inside (Sooke) out



Further Analysis

- Subset of crabs from this season will be sent to WHOI for genomic analysis
- Have officially received funding for trapping in 2019!
- New areas to preempt spread
- Salinity and temperature
- Health indicators – missing limbs, body damage, barnacle growth, etc.
- Different baiting techniques or traps



Bottom Line...

- Need to develop a long-term management strategy for the Tribe
 - Will continue to work with partners such as WDFW, WSG, and USFWS
- This is a coast wide problem!
 - Marine dispersal of larvae
 - Dispersal enhanced by El Niño conditions
 - In high abundance, may utilize “non-preferred” habitats
- Molts – an easy, noninvasive way to start looking for green crab
 - Outreach to OCNMS visitors?
 - Molts have been reported by the public on Hobuck Beach and Tsoo-Yess beach



Questions?

