



Tiny Crabs, Big Impacts: Long-Term Monitoring for Healthy Dungeness Crab Populations (Grades 6-8)

Introduction



Dungeness Crab in Washington

- Most profitable fishery in WA State
 - Co-Managed by State and Treaty tribes
- Cultural Importance
 - Tribal harvest and recreational fishing
- Ecological Role
 - Key predator (adult) and prey (juveniles) - food for salmon and rockfish



Photos: Jim Gibson

Presentation Notes

➤ Recent declines in adult Dungeness crab populations throughout Puget Sound prompted the formation of the Pacific Crab Research Group (PCRG) in late 2018, led by treaty tribes and supported by state and federal agency biologists, university scientists and non-profit organizations to provide science-based information for adaptive planning and management of this species.

Impacts of climate change, including warming temperatures and low pH, are among the stressors reducing the survival of juvenile Dungeness crab that are very vulnerable to changing ocean conditions. Reduced survival of juvenile crab in a single year has a direct effect on the number of healthy adult Dungeness crab in the following years.

Dungeness crab are considered a key stone species, critical for the health and function of the Puget Sound ecosystem. The Dungeness crab fishery in Washington is valued at \$12.5M: an essential commercial, recreational and tribal shellfishery for the overall health, wellbeing and resilience of our local communities.

This important shellfishery is co-managed by Washington state treaty tribes and state biologists. These experts determine each year where, when and to what extent crab can be fished in Puget Sound. By collaboratively monitoring this species, shellfish managers will be able to ensure we get to keep fishing and eating tasty Dungeness crab for many years to come!



Tiny Crabs, Big Impacts: Long-Term Monitoring for Healthy Dungeness Crab Populations (Grades 6-8)

Background Information

Biology and Ecology of Dungeness Crab

- *Cancer magister*
 - Order Decapoda - 10 legs!
- Chelipeds = claws
- Carapace = shell, size determines age
- Live for about 8-13 years
 - Harvest size at 4 years, 6¼" shell width
- Molt shells when grow too large



Photos top to bottom: ODFW



HABITAT

PREDATORS

Photos L-R: SF Chronicle, Scott Groth/ODFW, Vancouver Aquarium, WDFW

Presentation Notes

➤ Dungeness crab (*Cancer magister*) are **decapods** (*deca-poda*), meaning 10 thoracic pairs of legs. Other common decapods include shrimp and lobster.

Crabs have two large **chelipeds**, or claws and four pairs of walking legs. Chelipeds are used for defense and tearing food. In *C. magister*, chelipeds have white tips.

The body or shell of the crab is called the **carapace** and is made of chitin, protein and calcium carbonate.

Crabs grow through the process of **molting**, or “shedding” their outer shell.

Carapace (shell) width is an indicator of age and determines **legal size** or harvestable size of crabs: 6¼” in Puget Sound and 6” on the Pacific coast. Age at harvest size is typically four years. *C. magister* can grow over 10” in carapace width and live between 8-13 years.

➤ Range: Alaska to Santa Barbara, California

Habitat: Intertidal shell habitats (e.g. oyster beds) are important for juveniles. Typically found in gravel/rocky habitat covered with algae and eelgrass.

Feeding: **Omnivores** - opportunistic foragers on bivalves, fish, shrimp, other crabs, algae

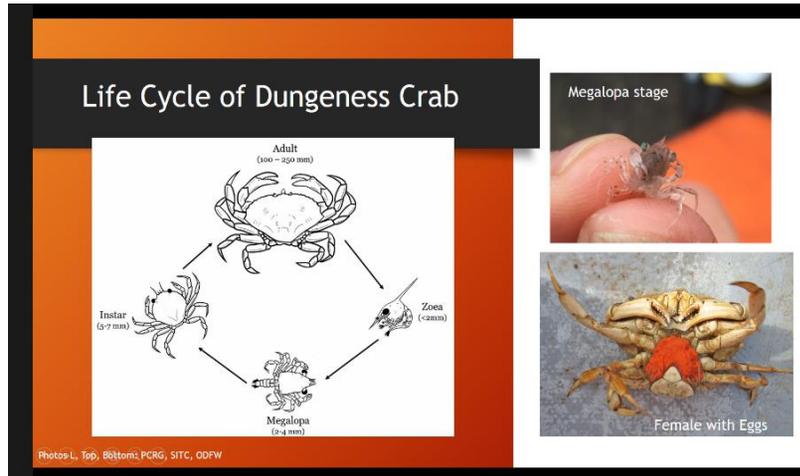
Juveniles fed on by flounder, sole, sculpin, invasive European green crab. **Megalopae**, an early planktonic life stage, preyed on by salmonids and rockfish.

Adults have few predators: Lingcod, cabezon, wolf eels, sea otters and us!



Tiny Crabs, Big Impacts: Long-Term Monitoring for Healthy Dungeness Crab Populations (Grades 6-8)

Background Information



Presentation Notes

➤ Females have ~1.5-2.5 million eggs, carried under their abdomen for several months before hatching in February or March.

Eggs hatch into **zoa** - planktonic larvae, drift for ~80 days in open waters winter to spring.

Megalopae: zoea molt into this pelagic stage and move to nearshore estuarine environments in the late spring, occurring through summer.

Instars: megalopae molt into this stage, finally looking like a small crab, they settle on the sediment bottom. Instars continue to grow and molt throughout the year.

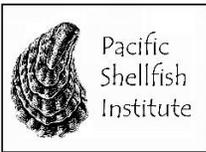
Juvenile stage: considered the first 1-2 years, molting up to 6 times per year. Juveniles prefer shallow estuarine habitat with rocky/shell debris and eelgrass for protection.

Adult stage: at 3 years juveniles become adults and migrate to deeper waters to forage and mate. Males mate with newly molted females.

Resources: Oregon Dept. of Fish and Wildlife (ODFW)

<https://www.dfw.state.or.us/mrp/shellfish/crab/lifehistory.asp>

➤ Photos: (Left) Megalopae caught in the South Sound light trap. Right: *C. magister* instar just molted from megalopal stage, note dark pigmentation on carapace. (Photo credits: A. Brownlee, K. Houle)



Tiny Crabs, Big Impacts: Long-Term Monitoring for Healthy Dungeness Crab Populations (Grades 6-8)

Larval Crab Research – Light Trapping

Threats to Population

- Fishing Pressure
 - Daily limits set during seasons, “3S system”
 - Catch record card required in Puget Sound Fishing areas
- Climate Change
 - Ocean warming and acidification
 - Low dissolved oxygen (hypoxia)
- Vulnerability of larvae to disease
- Human Development
 - Dredging- sedimentation
 - Pesticides and other pollutants




Photo: Top: <https://www.seattlemag.com/article/ocean-acidification-global-warmings-doppelganger>; Bottom: Swinovich

Pacific Northwest Crab Research Group

- Diverse group of researchers:
 - State and Tribal Co-managers
 - Federal Agencies
 - Academics
 - Non-profit Organizations (ex. PSI)
- Formed 2018
- Support sustainable fishing and healthy Dungeness crab populations in PNW
- Long-term monitoring in Puget Sound



PNWCRG Partner Organizations

- ▲ Jameson Skiklan Tribe
- ▲ Lummi Nation
- ▲ NOAA/NMFS
- ▲ Nisqually Tribe & DNR Aquatic Reserves
- ▲ Port Gamble Skiklan Tribe
- ▲ Puget Sound Restoration Fund
- ▲ Puyallup Tribe
- ▲ Quileute Tribe
- ▲ Skokanish Tribe
- ▲ Squamish Tribe
- ▲ Swinomish Indian Tribal Community
- ▲ Tlulip Tribe
- ▲ University of Washington

Presentation Notes

➤ Historical fishing pressure – shifting toward ecosystem-based management approach to maintain healthy populations

Climate Change

- Ocean warming and acidification - damage to carapace and sensory structures (Bednarsek *et al.* 2020)
- **Hypoxia** - Low dissolved oxygen (Scholnick and Haynes 2012, Froehlich *et al.* 2017)

Vulnerability of larvae to disease

Human Development

- Dredging- sedimentation
- Pesticides and other pollutants

➤ Pacific Northwest Crab Research Group (PCRGR) - working to address critical data gaps for the promotion and support of sustainable management and harvest of Dungeness crab

Light Trap Monitoring - long term study developed by PCRGR members to monitor juvenile Dungeness crab populations in Puget Sound, Washington

Modeled after Dr. Alan Shanks study in Coos Bay, Oregon

Larval crab abundance can help predict adult crab biomass 4-years later



Tiny Crabs, Big Impacts: Long-Term Monitoring for Healthy Dungeness Crab Populations (Grades 6-8)

Larval Crab Research – Light Trap Monitoring

Light Trap Monitoring Project

WHY?

- Recent declines of Dungeness crab in Puget Sound
- South Sound fishery closed since 2018
- Young crab are most vulnerable to stress in the environment
- Cause of declines still unknown...



Light Trap Monitoring Project

- Light traps deployed off docks and piers around Puget Sound to capture larval crab
 - Collect data April through September
- Megalopae swim to surface at night to feed
- Attracted to light of trap (phototaxis)!
- Other species attracted too...



Video: Megalopae in light trap - PCRG- Swinomish

Presentation Notes

➤ Follow Links to videos hosted on the PSI YouTube channel:

Light Trap, How it works by Margaret Homerding (Nisqually Shellfish Biologist) - <https://youtu.be/YuxnhSroChM>

Light Trap at Night (Boston Harbor Marina) - <https://youtu.be/7PfsyYskkBM>



Tiny Crabs, Big Impacts: Long-Term Monitoring for Healthy Dungeness Crab Populations (Grades 6-8)

Larval Crab Research – Light Trap Monitoring

Take Home Messages

- Dungeness crab of all ages are important parts of our ecosystem
- Washington communities rely on Dungeness crab for their livelihood, food, culture and fun!
- Cause of recent declines in Puget Sound unknown...
- Climate change negatively impacts Dungeness crab
- Scientists are working together to learn more so we can keep fishing Dungeness crab sustainably in WA!



Photo: Jamestown S'Klallam

Quick Quiz!

1. Name one reason Dungeness are important in Washington?
2. Where can we find Dungeness?
3. Who preys upon Dungeness?
4. What are some threats to the population?
5. What year did the South Sound Dungeness fishery close?
6. Why are we using the light traps?
7. Can you name other species found in the light trap?



Presentation Notes



Answers to Quiz:

1. Keystone species, valuable fishery, cultural importance
2. Coastal and estuarine waters, shallow/nearshore (juveniles) – deeper subtidal (adults)
3. (Adult crabs) Humans, sea otters, lingcod, wolf eel, etc./ (Juvenile stages) flounder, sole, sculpin, salmonids, rockfish, etc.
4. Overharvest, environmental stress/climate change - OA, warming, hypoxia, disease, pollution, development
5. 2018 – currently closed (2021)
6. Tracking larval stages to predict future adult populations
7. Many other species! See previous slides...