

Puget Sound Dungeness Crab

The Biology, the Fisheries, and Harvest Impacts



Beach Watchers Class 2022

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Washington Department of Fish and Wildlife
Crustacean Project



The background of the slide is a close-up photograph of several crabs, likely coconut crabs, with their characteristic large, segmented legs and dark, textured carapaces. The crabs are positioned in a way that they appear to be moving or interacting with each other. The image is slightly blurred, giving it a sense of motion and depth. The overall color palette is dominated by the browns and greys of the crabs' shells and legs, with some lighter, yellowish-brown tones on their limbs.

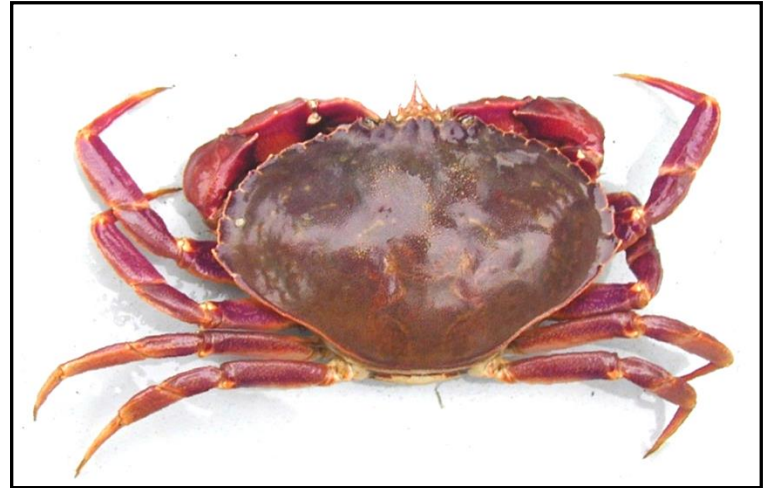
Outline

- Life History, Reproduction and Growth
- Crab Fishery Management Strategy
- Co-Management & Resource Allocation
- Harvest History
- Reducing Derelict Gear and its impacts
- Recent Trends and ongoing research

CRABS IN PUGET SOUND



Red Rock crab
Cancer productus



Graceful crab
Metacarcinus gracilis (*Cancer gracilis*)



Southern Tanner crab
Chionoecetes bairdi



Brown Box crab
Lopholithodes foraminatus

CRABS IN PUGET SOUND



Northern kelp crab,
Pugettia producta



Purple shore crab,
Hemigrapsus nudus



European Green crab,
Carcinus maenas



Helmet crab,
Telmessus cheiragonus

Dungeness Crab

Metacarcinus magister (*Cancer magister*)



Dungeness Crab Biology and Life History

Dungeness Crab Facts

- Range from Pribilof Islands, AK to Santa Barbara, CA
- Up to a carapace width of 254 mm (10 inches), but in Puget Sound the largest crab has been 225 mm (8.9 inches)
- Age: Maximum 8-9 years
- They prefer sandy bottom habitat and depths less than 350 ft.
- Feeds on clams, crustaceans (including each other), fishes, and “crab bait”. Bottom scavengers.
- Adult crabs are prey for octopi, wolf eels, cabazon, sea otters, etc.
- Larvae and juveniles are prey for salmon, flatfish, sculpins, other crabs, sea stars, birds, whales, etc.

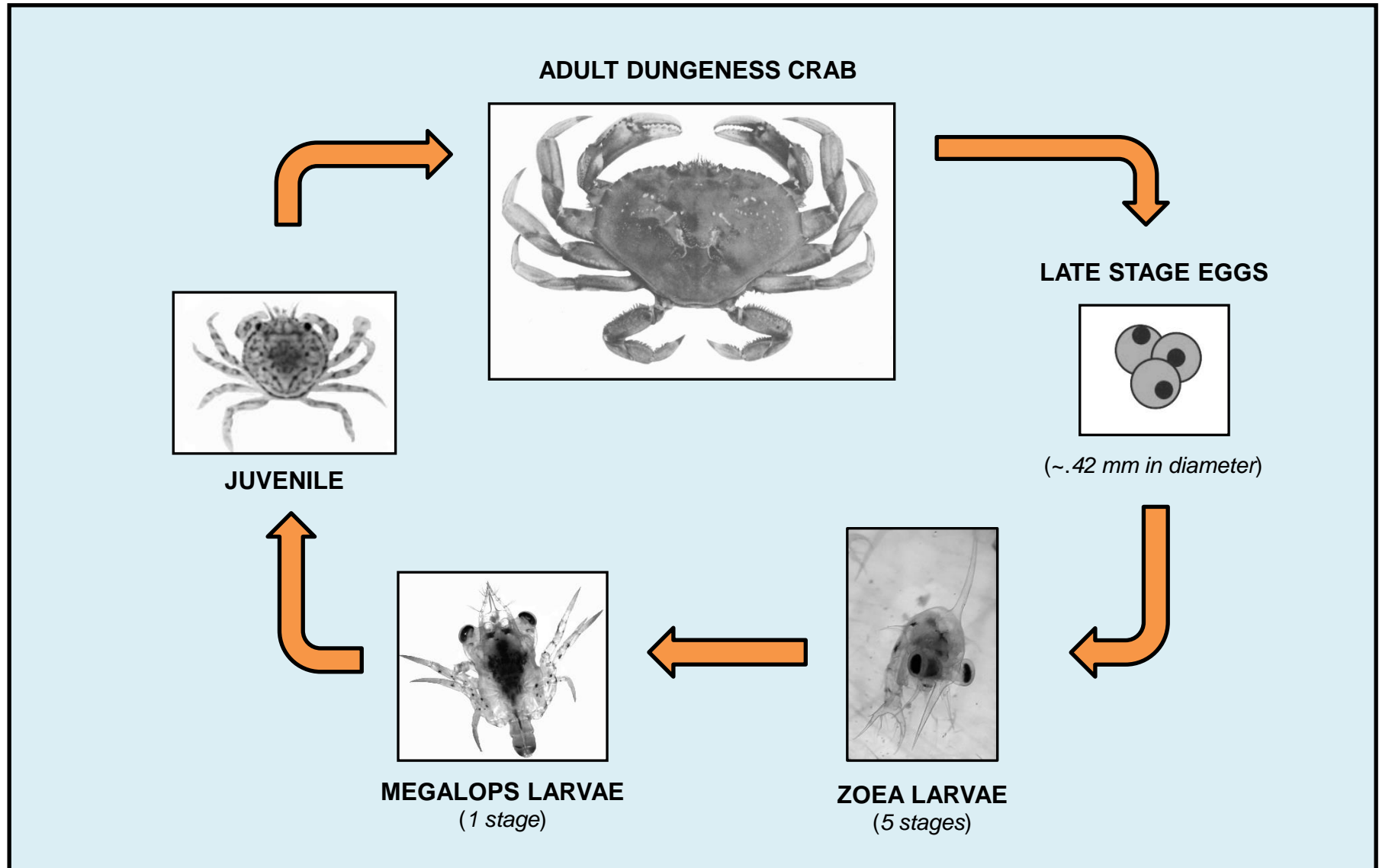


Dungeness Crab Facts (cont.)

- **Mating occurs between hard shell males and soft shell females primarily in late spring/early summer in shallow waters**
- **Females extrude eggs primarily from Sept. to Nov.**
- **Eggs are hatched from January thru April and planktonic larvae develop for 90 -110 days. 5 zoea stages and 1 megalops**
- **Puget Sound crab settle as cohorts. The larvae are derived from populations on the WA Coast and from within Puget Sound**
- **Sexual maturity reached ~ age 2 years. Males enter fishery ~4 years and grow ~1 inch of carapace width prior to recruiting to the fishery**
- **Weight increases 65% at recruitment molt. Average weight of a 6 ¼" to 6 ½" crab is between 1.5 and 1.7 pounds**



Dungeness Crab Life Cycle



About 90 to 110 days from hatching to settlement



Dungeness crabs locked in a mating embrace in the intertidal zone

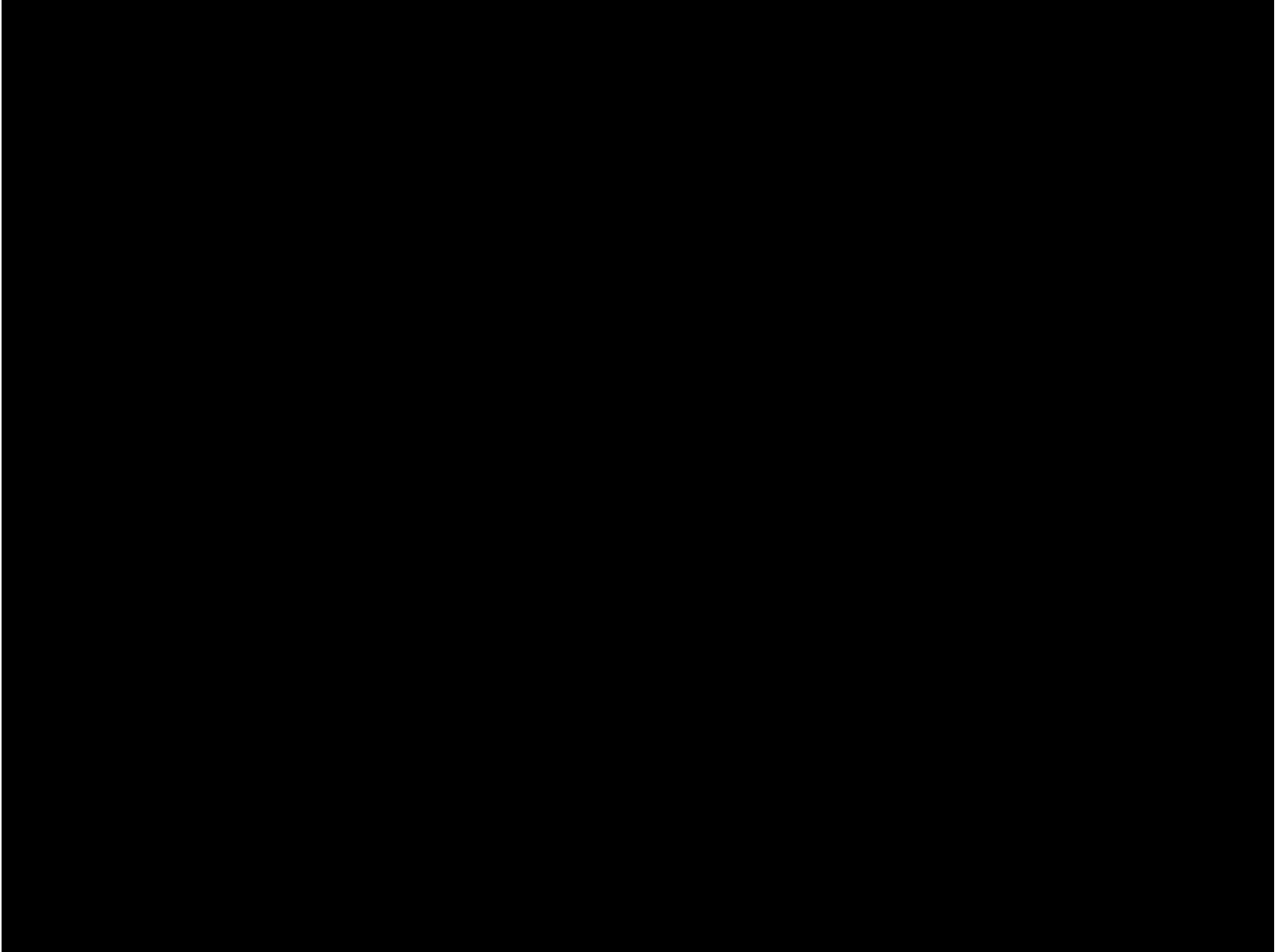


Eggs on a female Dungeness crab

1 to 2 million eggs per brood

5 million eggs over lifespan

Video - Dungeness crab larvae and juveniles



**Molted shells of
Dungeness crab “zoea”
(larvae)**



Crab Zoea Stranding Event

Edmonds, April 2017



Crab *Megalops* Molting Event

Mutiny Bay, June 1997



Planktonic larvae settle to the bottom and transition to juvenile crab

Megalops Larvae



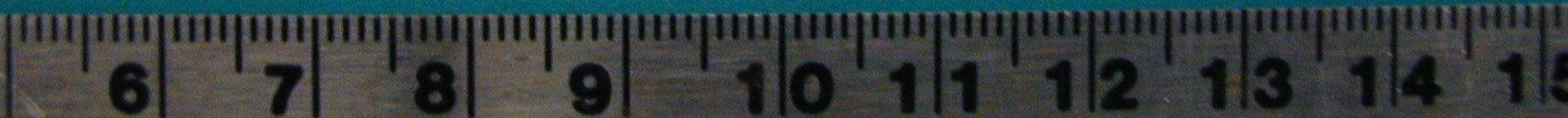
First Instar



Second Instars



Third Instar



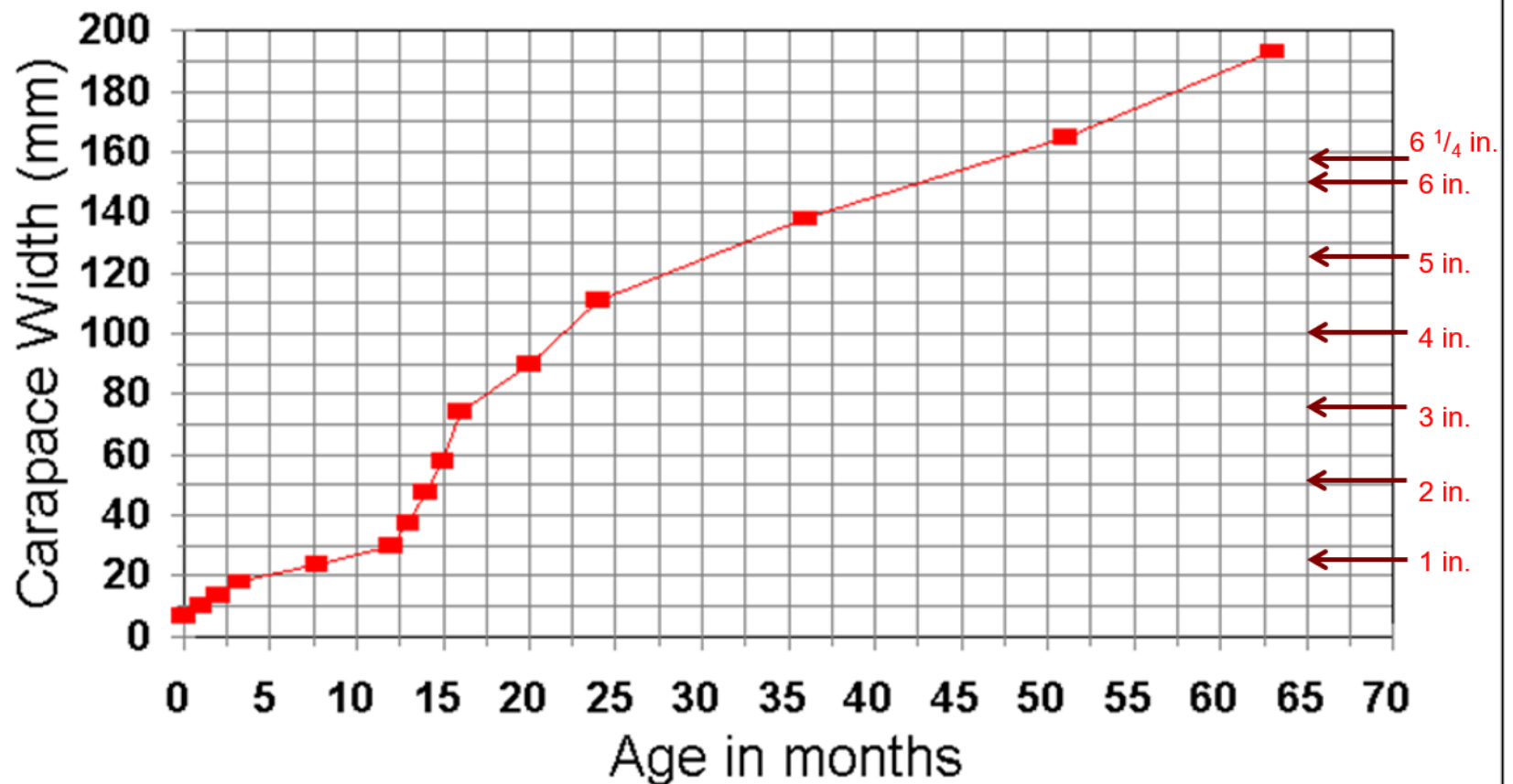
Approx. 13 Instar stages, 15 to 50 days between molts

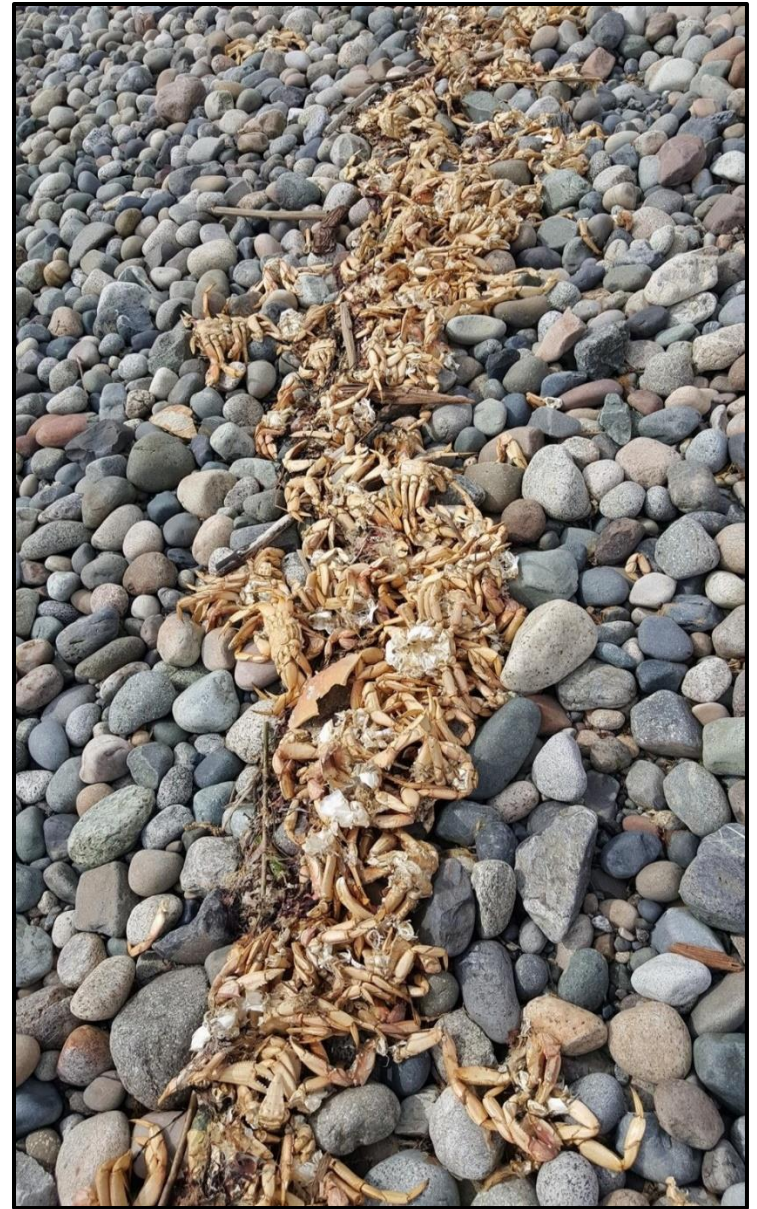
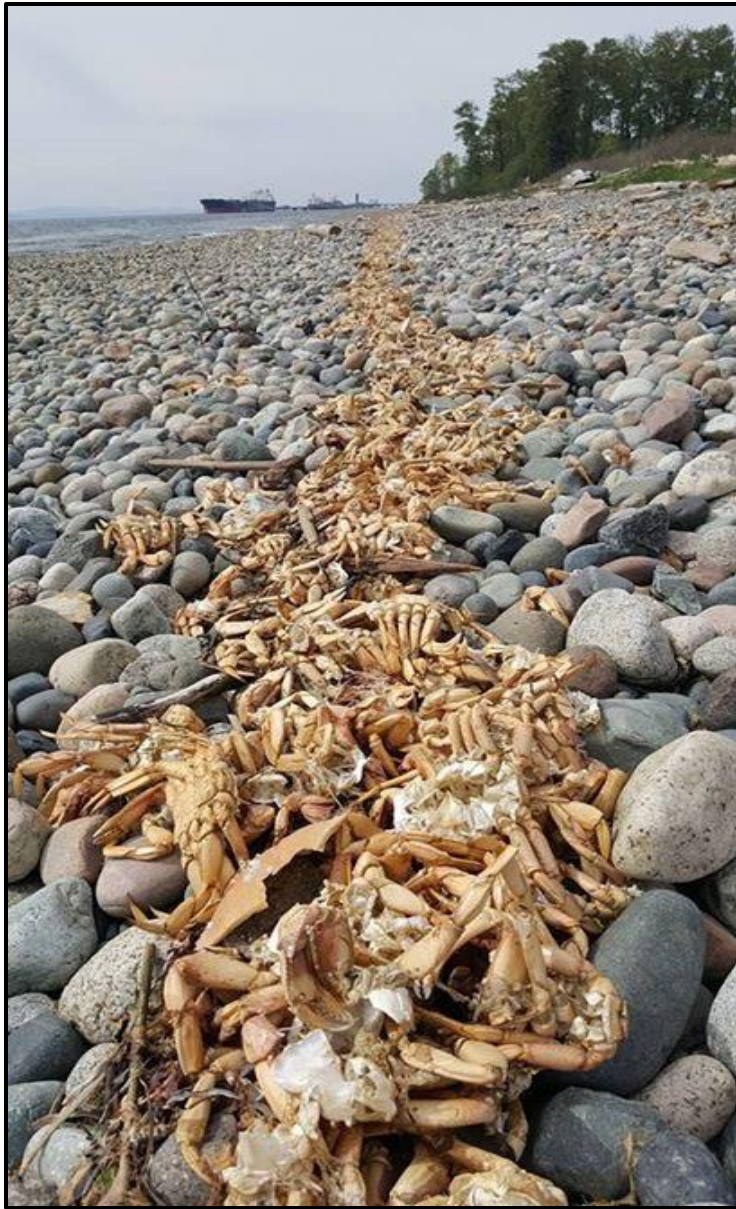
Video - Dungeness crab molting



Dungeness Crab Growth

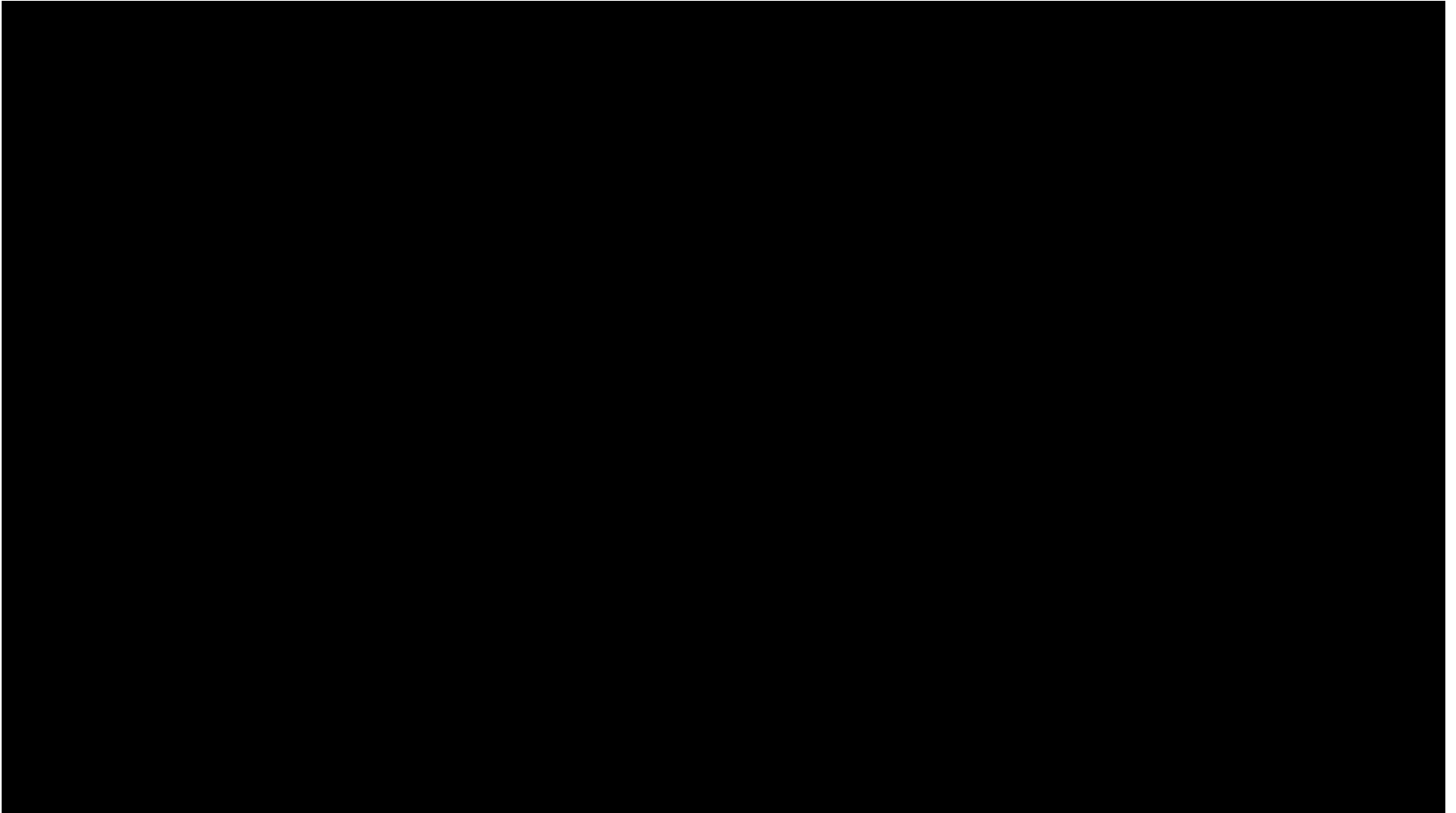
Queen Charlottes crab (males)



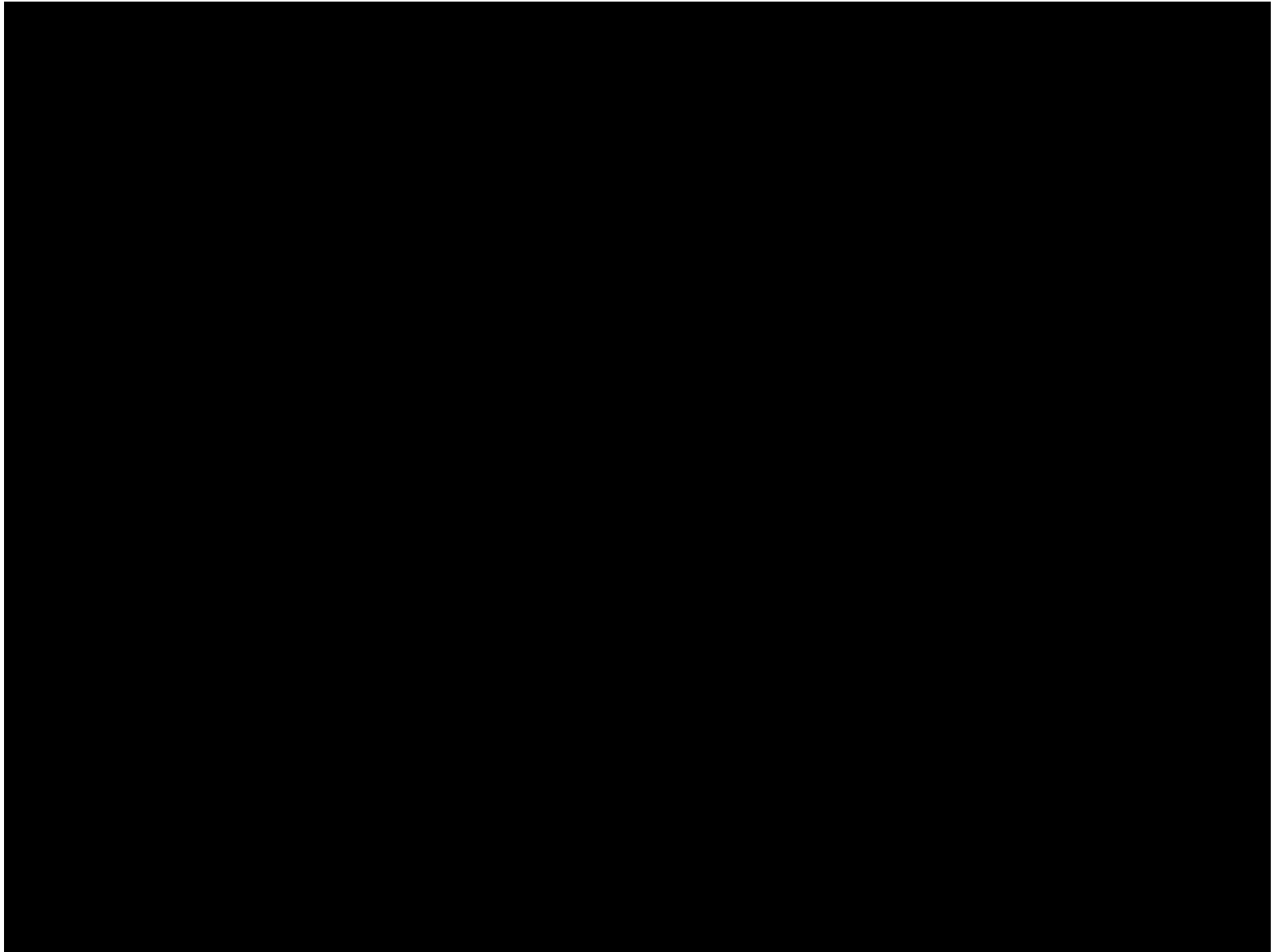


Whatcom County, between Sandy Pt. and Cherry Pt., April 2016

Video - Dungeness crabs foraging, Seaside Oregon



Video -Dungeness crab feeding on steelhead

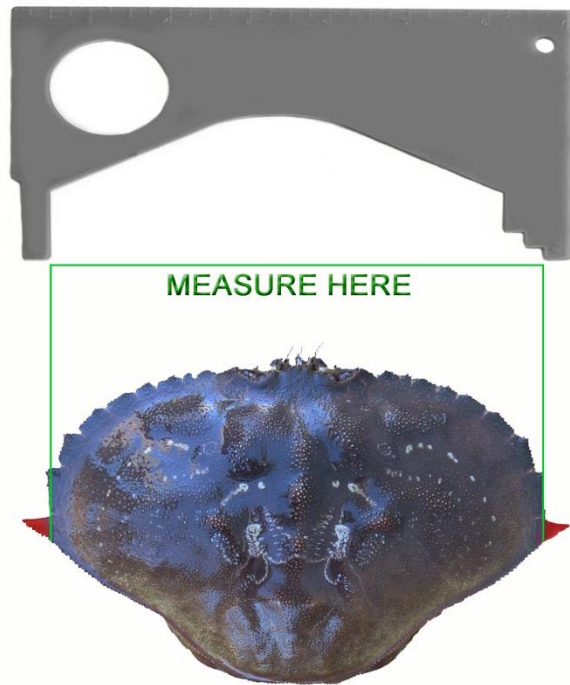


Dungeness Crab Fishery Management

COAST WIDE “3-S” MANAGEMENT STRATEGY

- Minimum **S**ize limits
- Harvest ONLY male **S**ex
- The **S**eason is established to minimize the harvest and handling of soft shell crab

¹Size Limit



**DO NOT INCLUDE THE LAST SET
OF POINTS WHEN MEASURING SIZE**



DO NOT use any bill to measure.
These are typically less than 6 ¹/₈ inches long.

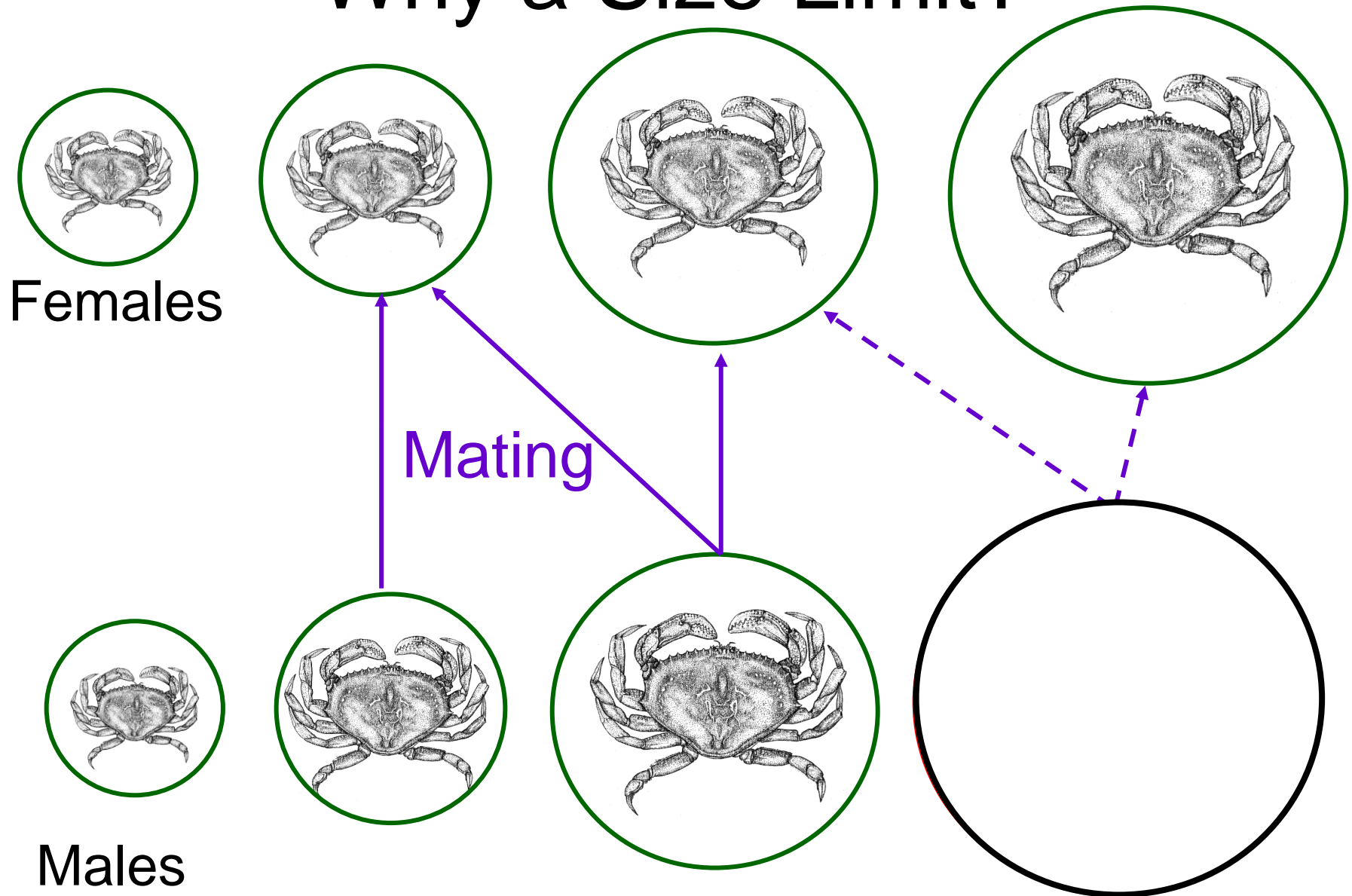


DO NOT use a tape to measure.
These bend and are inaccurate when conforming to the curve of the carapace.

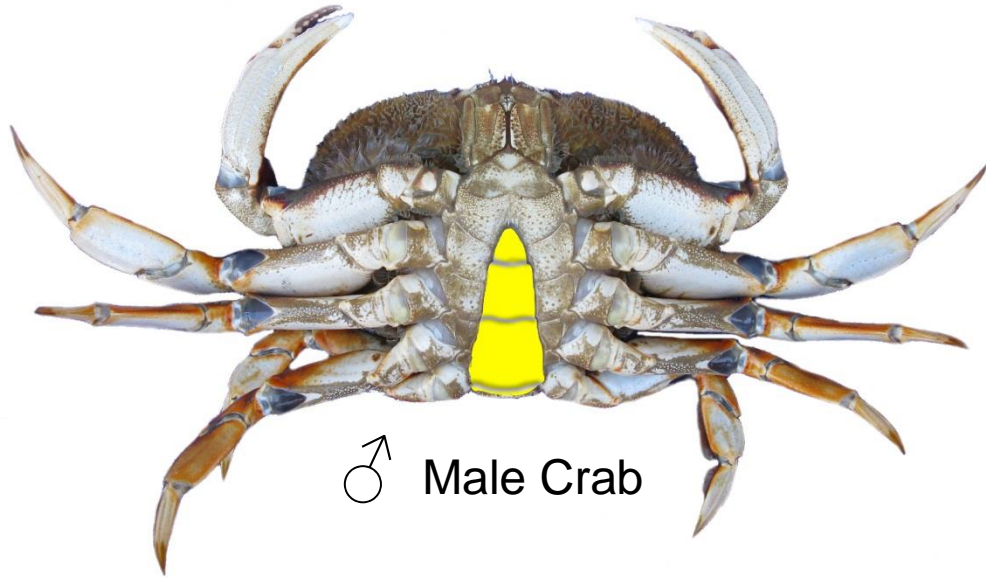
- Minimum size depends on area harvesting
 - Puget Sound $\geq 6 \frac{1}{4}$ inches**
 - WA Coast ≥ 6 inches**
 - Columbia River $\geq 5 \frac{3}{4}$ inches**
- Measure the crab *inside the last set of points on the shell.*
- Use an approved crab gauge to measure
Do Not Use:
 - Dollar Bills
 - Measuring Tapes
 - Rulers



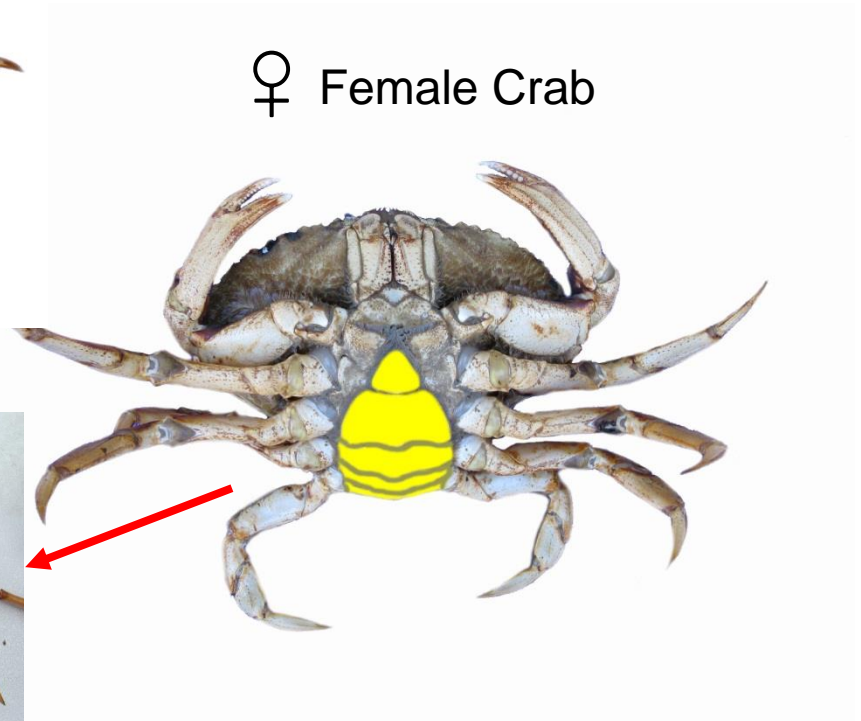
Why a Size Limit?



Male ²Sex ONLY ♂ ♀



♂ Male Crab



♀ Female Crab

³Season Structure

1. Seasons are planned to avoid the **Molting Period**.
2. Recently molted **Soft Shell** crab have NOT grown into their new shell.
 - Low meat yield per crab
 - Meat quality is poor
 - Handling mortality is high for soft crab



How do I determine if a crab is **Soft Shell?**





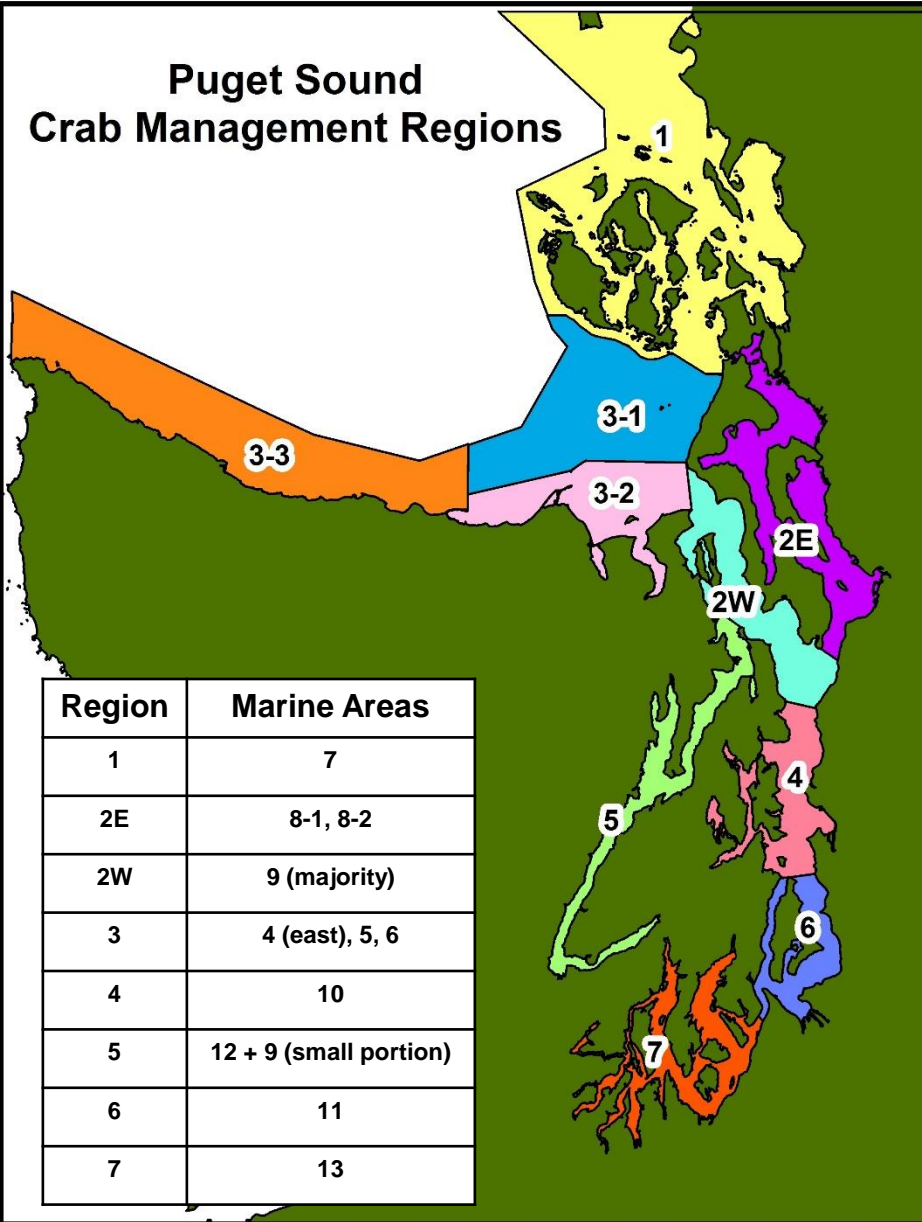
Characteristics of a Recently Molted Soft Shell Crab

- **Clean Carapace**
- **Leg hairs are blonde**
- **Crab seems light in weight for it's size**
- **Underside of crab is beige**
- **Leg membranes “balloon” when leg is compressed**



Puget Sound Crab Fishery Management

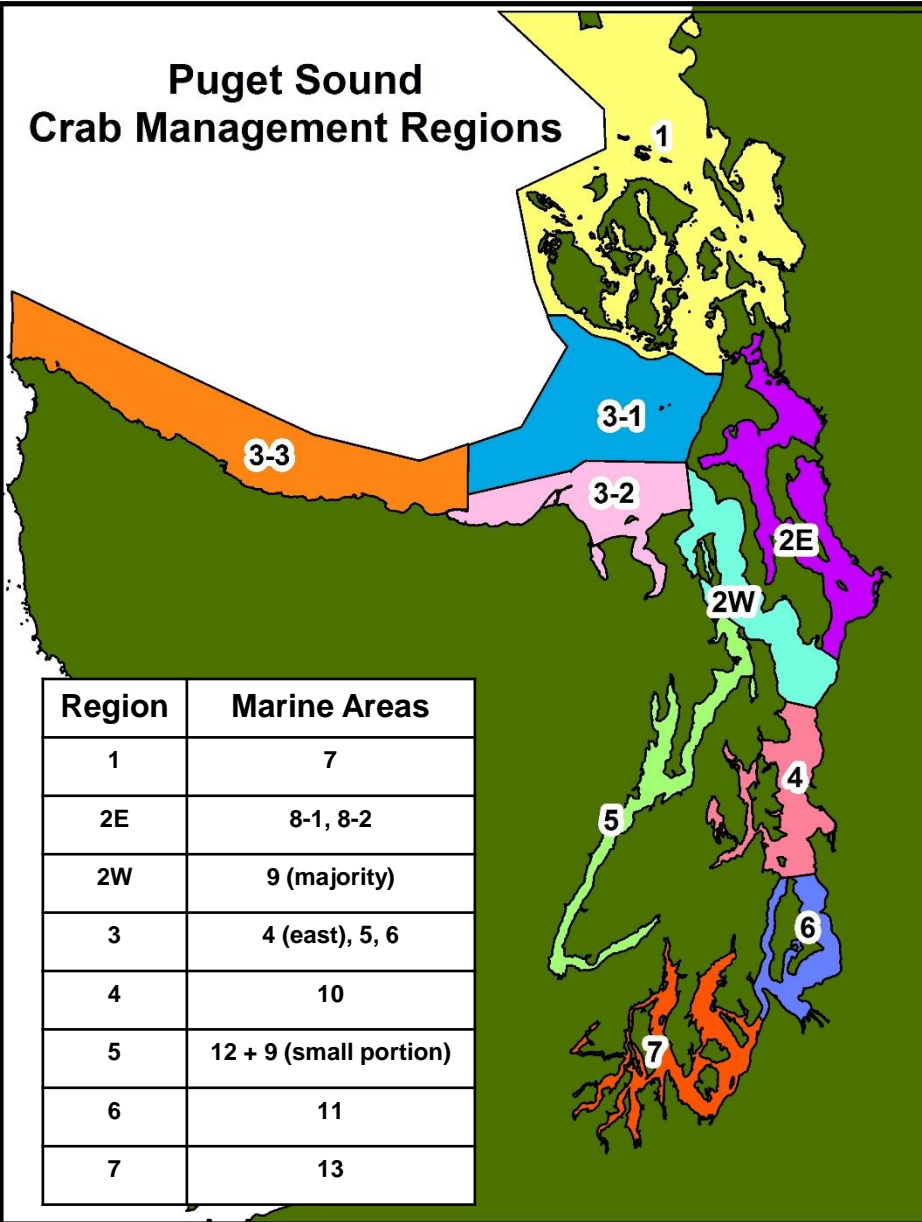
**Puget Sound
Crab Management Regions**



- Treaty fisheries can occur in all Regions
- Region specific annual harvest quotas are set pre-season to increase stability and predictability in fisheries
- Regional State/Tribal harvest shares are established annually through co-management agreements.

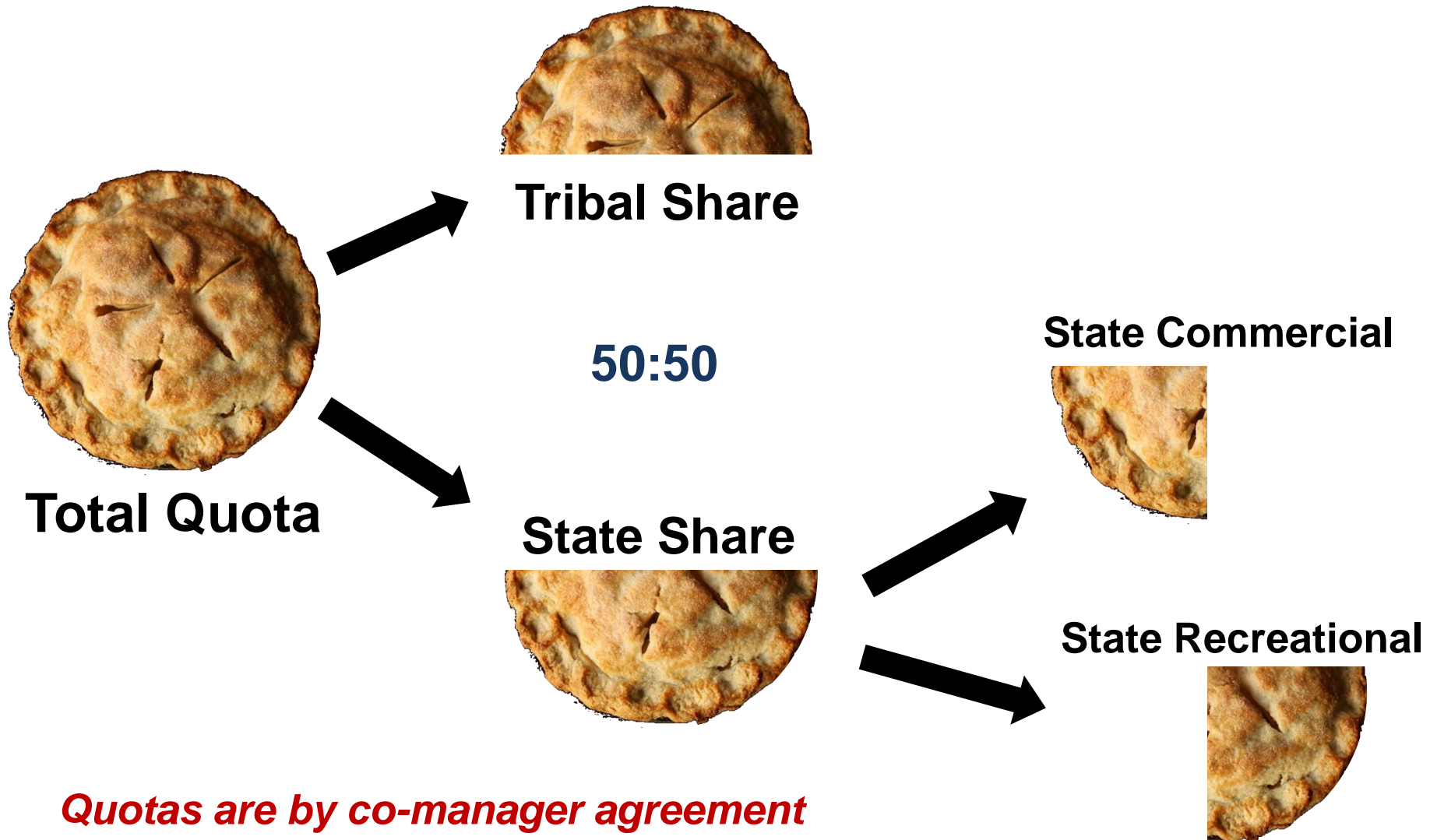
Puget Sound Crab Fishery Management

Puget Sound
Crab Management Regions



- **8** management regions (Region 3 subdivided)
- Regions **1**, **2E**, **2W**, and **3** have State commercial and recreational
- Regions **4**, **5**, **6** and **7** are State recreational only
- Recreational Marine Areas are designated differently but mostly align with the Regional structure
- **June** through **May** management period with soft shell closures during spring and early summer months

How is the resource allocated to the various user groups?

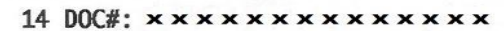


Treaty Fishery



- **17 Treaty Nations**
- **14 Treaty Nations participate in the Puget Sound crab fishery**
- **Approximately 800 to 1,000 crabbers**
- **Commercial, subsistence and ceremonial fisheries**
- **Commercial landings are accounted for using required Treaty Fish Tickets (FT's). Commercial landings account for >95% of the Treaty harvest.**
- **All commercial wholesale dealers MUST complete and submit FT's for every purchase**
- **Fish Ticket data is entered into the TOCAS database (NWIFC)**
- **Additionally, copies of these Fish Tickets are entered into the WDFW WAFT database**
- **Data can be drawn from TOCAS regularly for in-season landings updates**

- **> 200,000 to 243,000 Crab Endorsements sold each year since 2007**
- **Landings estimate generated from Catch Record Card system (CRC)**
- **CRC's are required to be submitted within one month of the end of the season (Summer/Winter)**
- **\$10 penalty for non-compliance**



14 DOC#: xxxxxxxxxxxxxxxx

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State Recreational Fishery

- Recently, 46% of CRCs reported (Summer)
- Recently, 50% of CRCs reported (Winter)
- Almost 1/3 of our fishers are NEW each year
- 41% of the returned cards show ZERO landings
- 31% of the returned cards have 1 or 2 trips
- Creel surveys (aka, boat ramp interviews) are completed to generate an estimate of unreported catch. EUC is added onto the landings projected from the CRC estimates for the final recreational landings

14 DOC#: xxxxxxxxxx



SUMMER Puget Sound Dungeness Crab Catch Record Card
Valid from July 01, 2014 to September 02, 2014
Use WINTER card after September 02, 2014

NOTICE: Card must be returned or information reported on the Internet even if no crab were kept.
See reporting option 1 and 2 below

\$10.00 Penalty for not returning card or Internet reporting by October 01, 2014

Name: **Dudley DoRight**

Wild ID: **X X X X - X X X - X X X**

Residence: **Mill Creek, WA 98012**

Dealer ID:1323

Issue Date:07/10/2014

Report Crab Catch

Option 1

Return card to address below by October 01, 2014

Return To: WDFW Fish / CRC Office
600 Capitol Way N
Olympia WA 98501-1091

Option 2

Report catch card information on the Internet between
September 03-October 01, 2014 at fishhunt.dfw.wa.gov

Season opening dates, closures, and restrictions are available in the 2014-2015 Sport Fishing Rules pamphlet, on the toll-free shellfish rule change hotline 1-(866) 880-5431, and on the Internet at wdfw.wa.gov

Use ballpoint pen only. Do not use a felt tipped pen. Immediately upon retaining a Dungeness crab, you are required to record your catch by completing the record below. Failure to do so is a violation of WAC 220-56-175

SUMMER

14 DOC#: xxxxxxxxxxxxxxxx

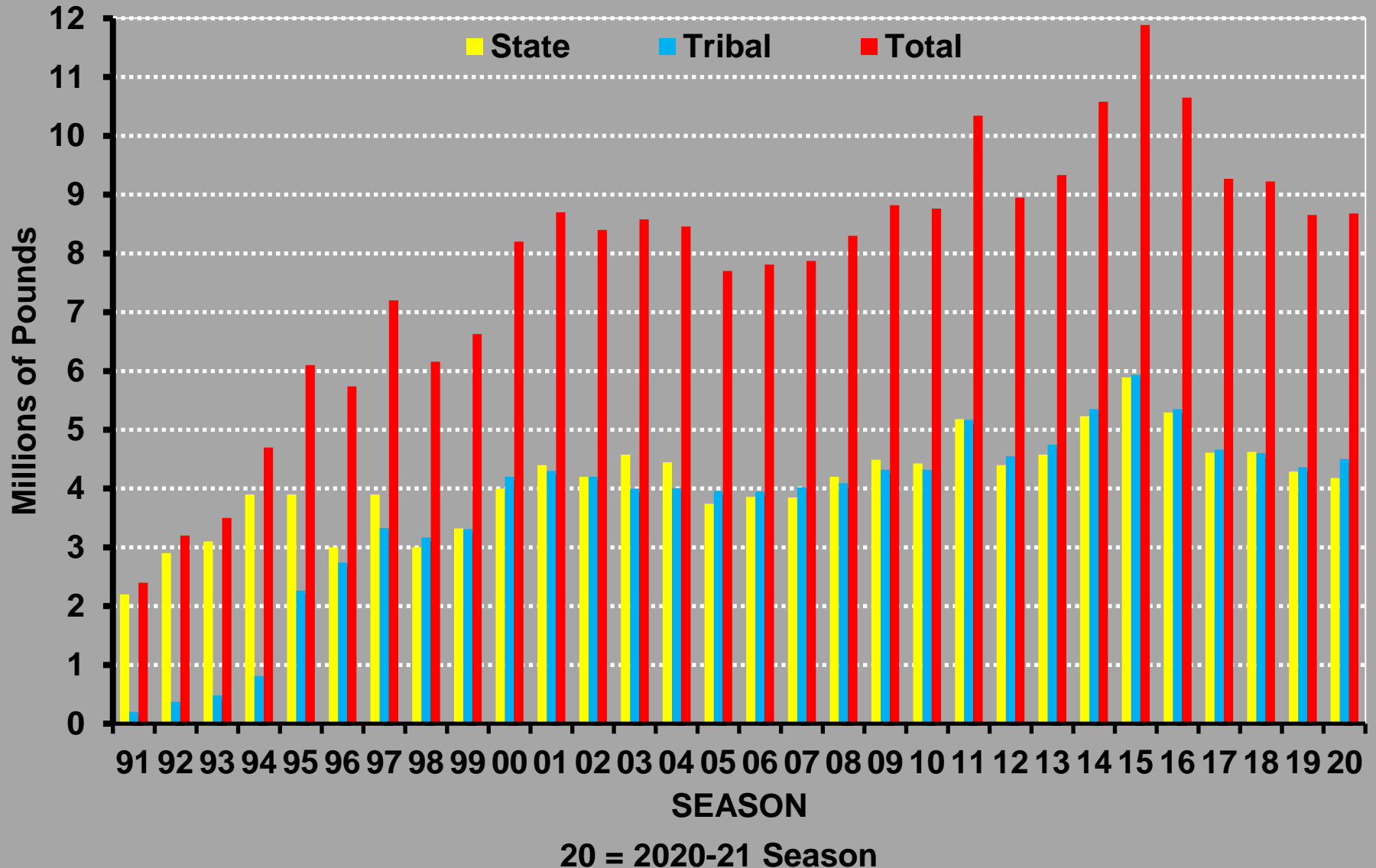
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State Commercial Fishery

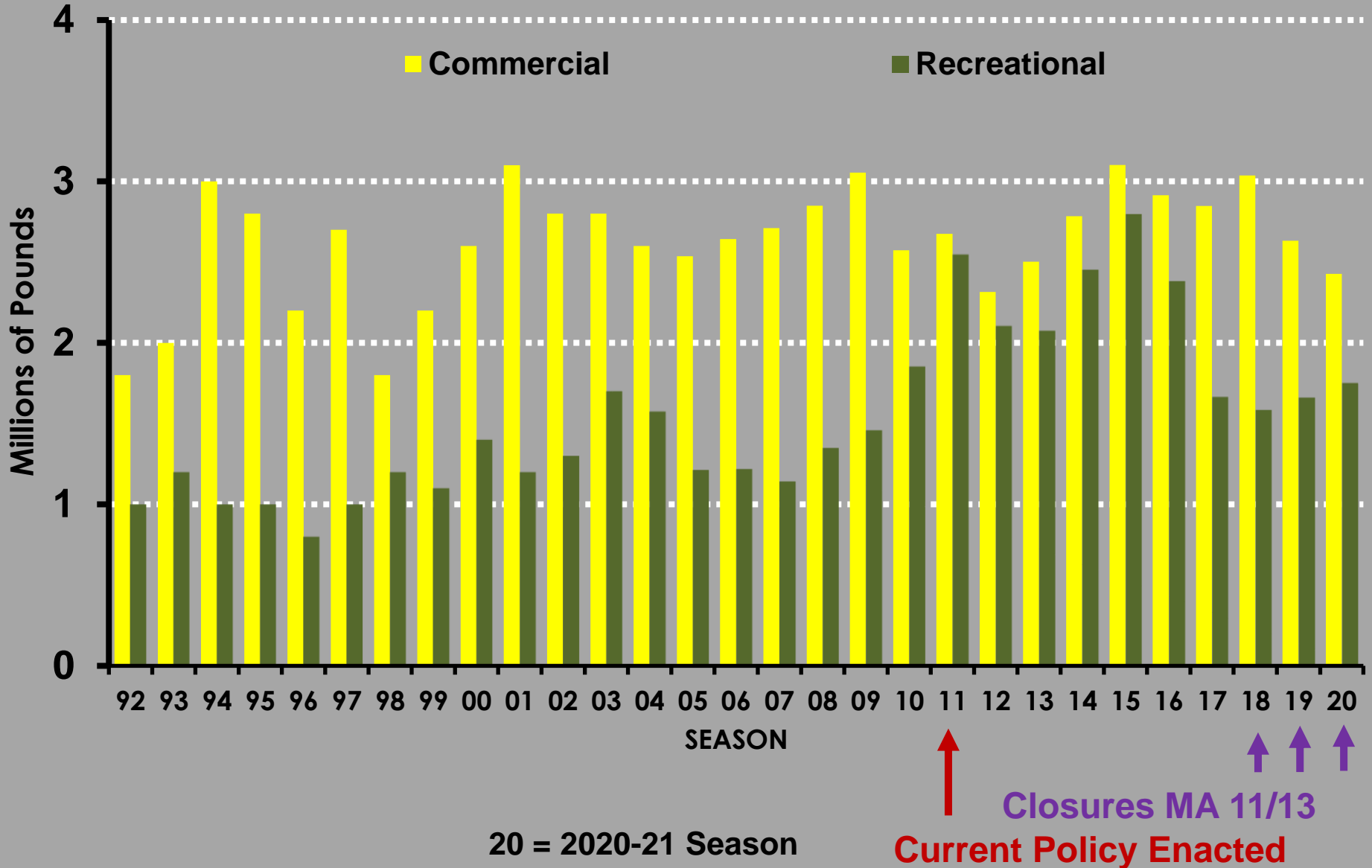
- 249 Licenses (*limited entry*)
- 132 License owners (*most have 1 or 2 licenses*)
- Maximum of 100 pots per license
- Maximum of 3 licenses per boat
- Commercial landings are accounted for using required State Fish Receiving Tickets (FRT's)
- All commercial wholesale dealers **MUST** complete and submit FRT's on every purchase
- Additionally, all wholesale dealers **MUST** file a Quick Report by 10am the day following a purchase
- Data from the Quick Reports allows for nearly “Real Time” Management
- State Fish Tickets are entered into the WDFW WAFT database
- Data can be drawn from WAFT regularly for in-season landings updates



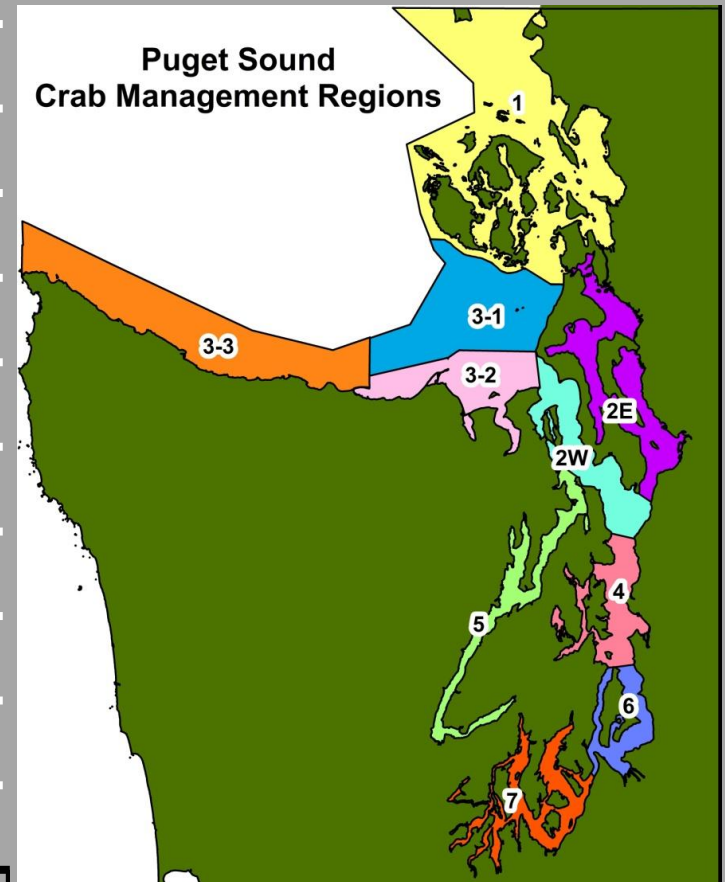
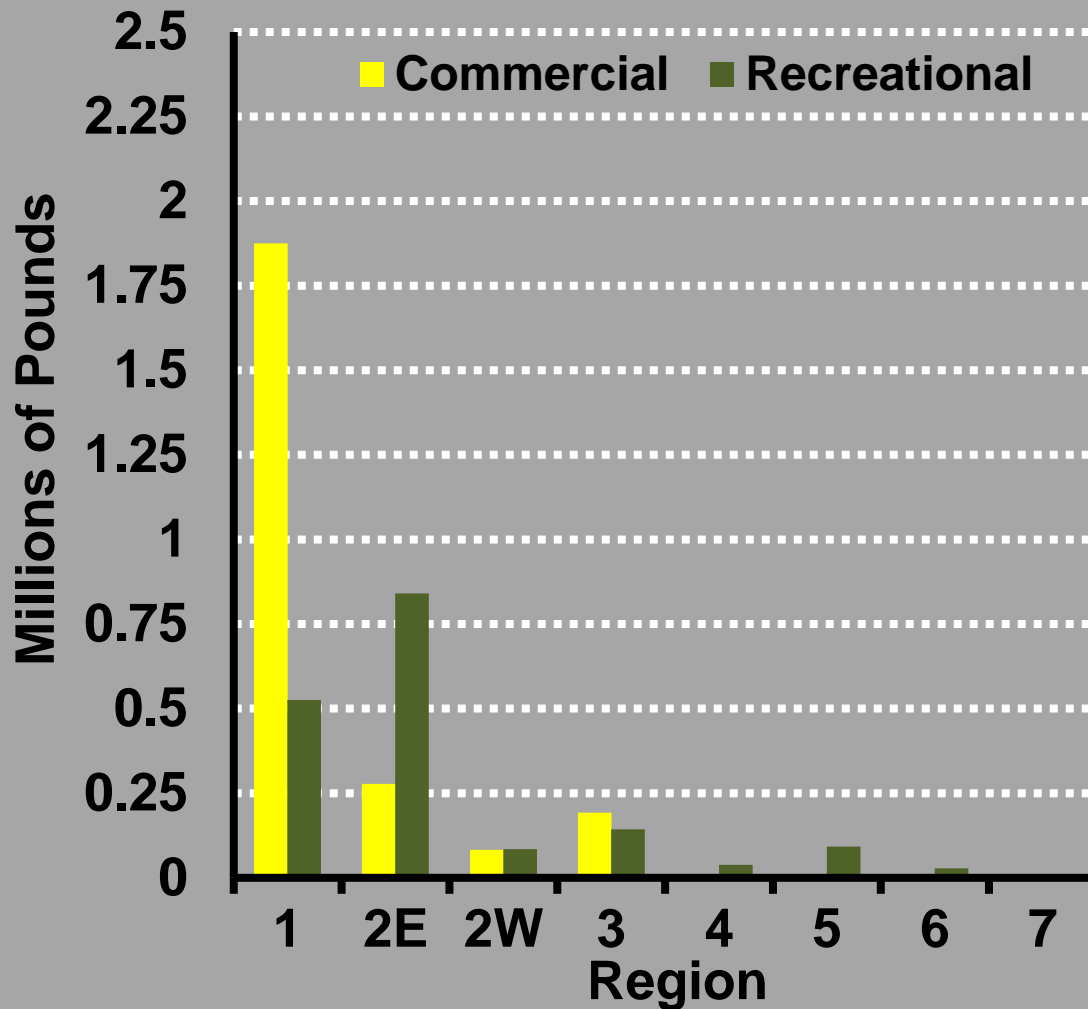
State and Tribal Dungeness Crab Harvests, from Puget Sound (1991-2020)



Dungeness Crab Harvests for State Fisheries in Puget Sound (1991-2020)



2020-21 Dungeness Crab Harvest for State Fisheries by Region



Crabbing Equipment

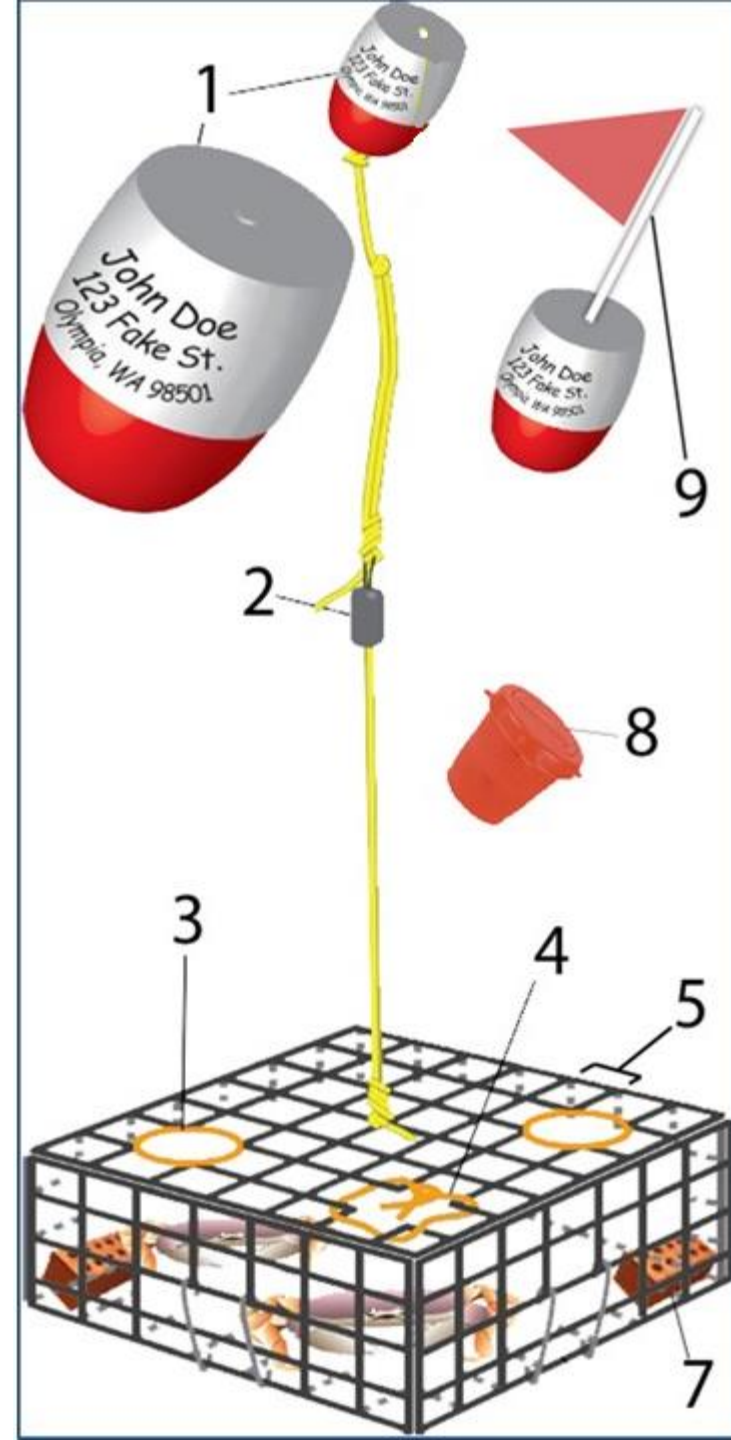


Requirements for legal traps

1. Properly marked buoy with full name and mailing address, completely legible. Recreational crab buoys must be red and white.
2. Use sinking line, or add weight to buoyant line so none floats on surface of water. Have at least 25 to 30% more line than the “high tide” depth where the pot is being set.
3. Two escape rings 4 ¼ inch diameter in upper half of pot so smaller crabs can escape.
4. A biodegradable device (escape cord) comprised of 100% *natural fiber cord* that will degrade over time. Degradation must leave a 3 inch by 5 inch opening to allow captured crabs to escape if your trap is lost. See four escape cord configurations below.
5. A minimum mesh size of 1 ½ inches on the trap.
6. A total trap volume of 13 cubic feet or less. (*Not labeled in graphic*)

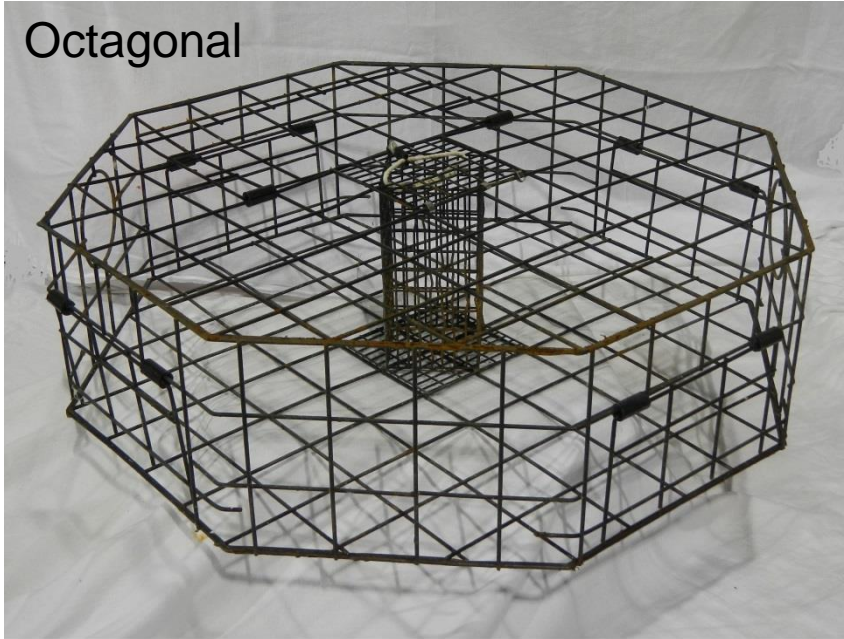
Also recommended for traps

7. Adding weight to your trap is advised strongly for lighter designs to prevent currents from sweeping them away.
8. Rugged bait containers to keep the bait inside the trap where it belongs.
9. Flags and staffs on buoys are optional. These are often used to identify your trap visually when in a large group of traps. A staff can also make retrieving the buoy easier.

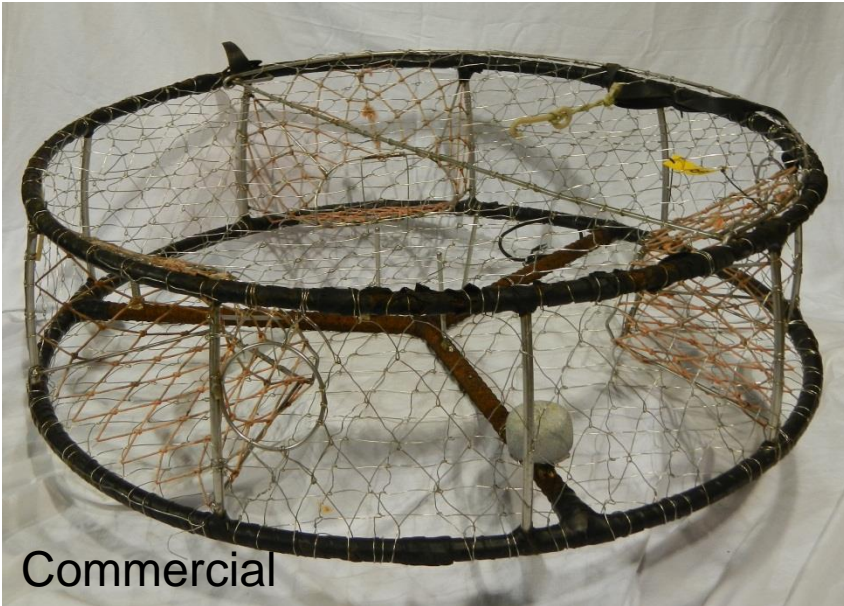
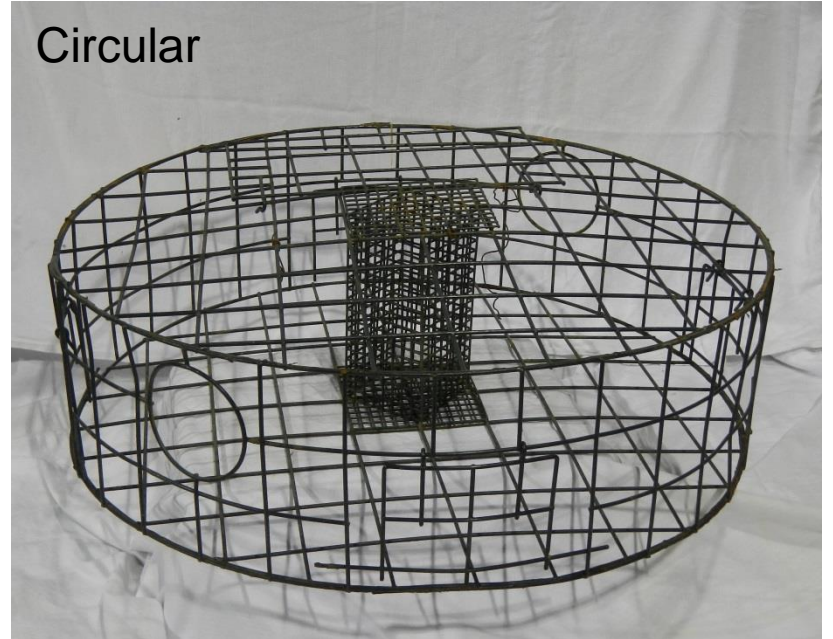


CRAB POT DESIGNS

Octagonal



Circular



Commercial



Rectangular

Derelict Traps – Prevention and Removal



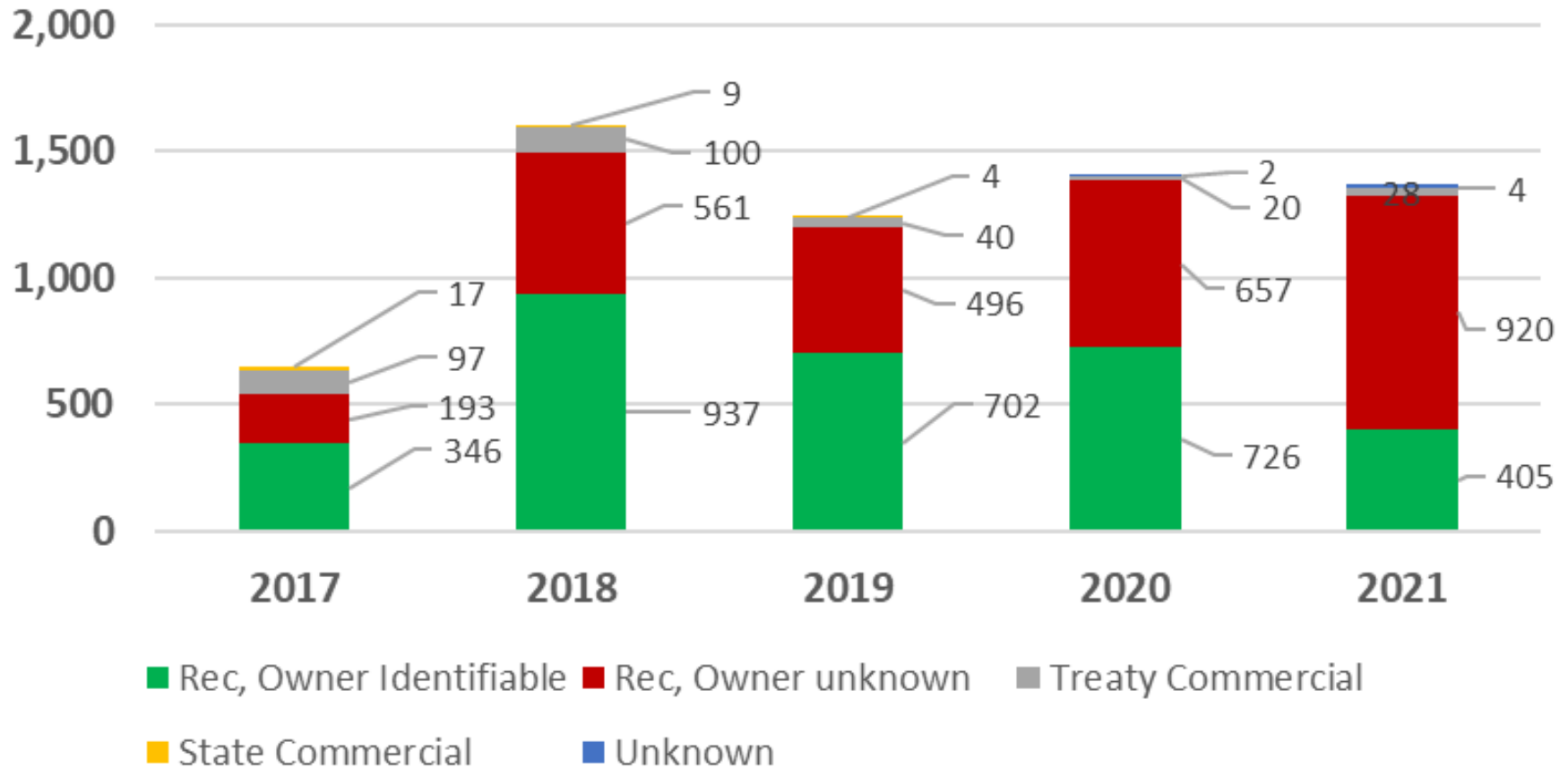
How do traps become derelict?

- Traps are set too deep*
- Sediment deposition prevents retrieval*
- Buoys and lines struck by vessels/barges/log rafts*
- Buoys and lines tangle in woody debris or kelp*
- Owners forget where they placed them*
- Tidal currents pull buoys down and/or drag traps away*
- Snagging on undersea boulders or reefs*
- Knots or line connections fail*
- Ice floes drag traps away
- Malicious sabotage or cutting off buoys

Preventing derelict gear and impacts

- *Educate crabbers to prevent lost traps*
- Regular sweeps to remove lost traps (buoyed and unbuoyed)
- Properly label gear
- Use required escape cord
- Use correct length and type of line
- Weight traps appropriately
- Attach buoys properly
- Know hazards in your area
- Mark trap locations with GPS
- When possible, stay near traps

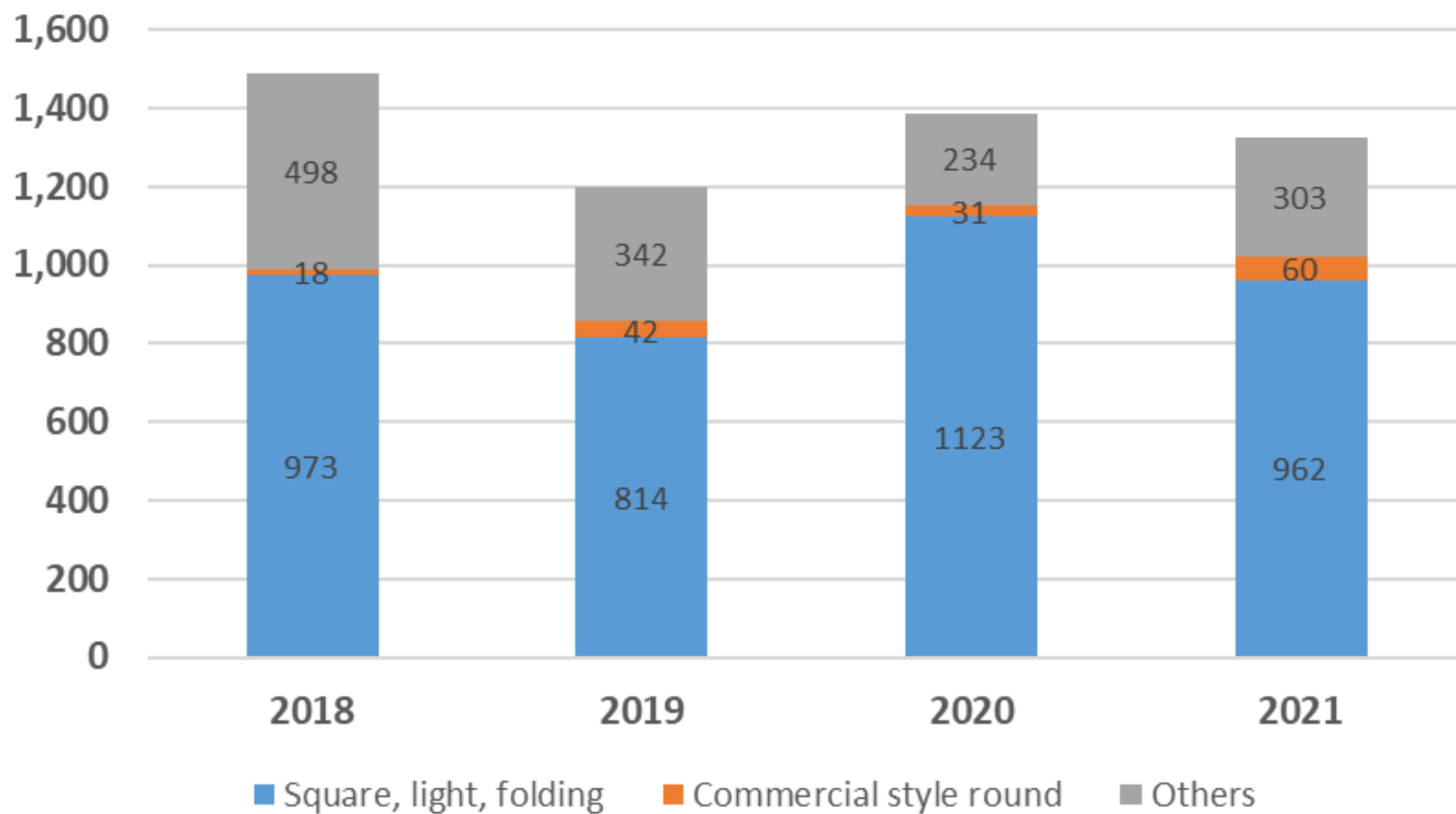
All traps removed by WDFW sweeps 2017-2021



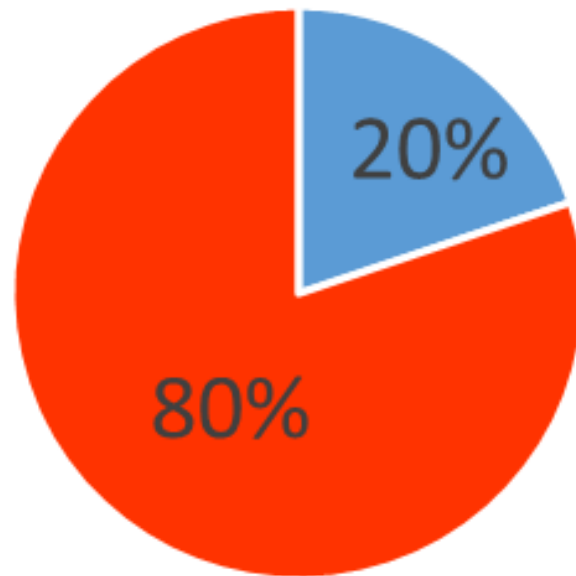
*This reflects summer gear sweep efforts through 10/1 each season.
Criteria for "owner identifiable" is the legal definition in 2021.*

Recreational traps removed by WDFW sweeps

Gear Type by Year



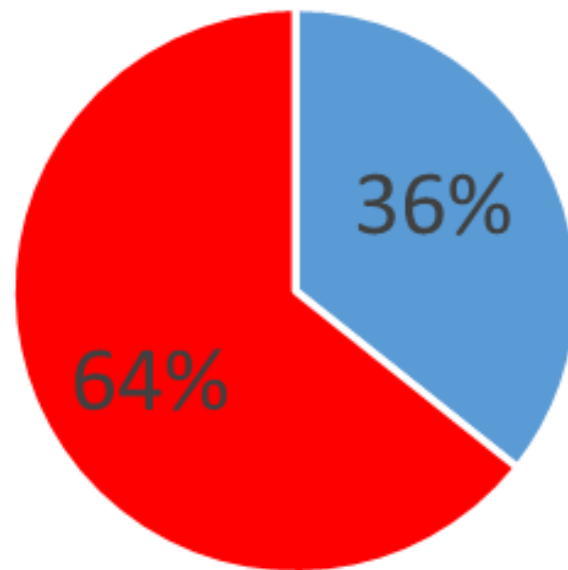
2021 WDFW trap removals
Buoys attached incorrectly



■ Buoys attached correctly

■ Buoys attached incorrectly

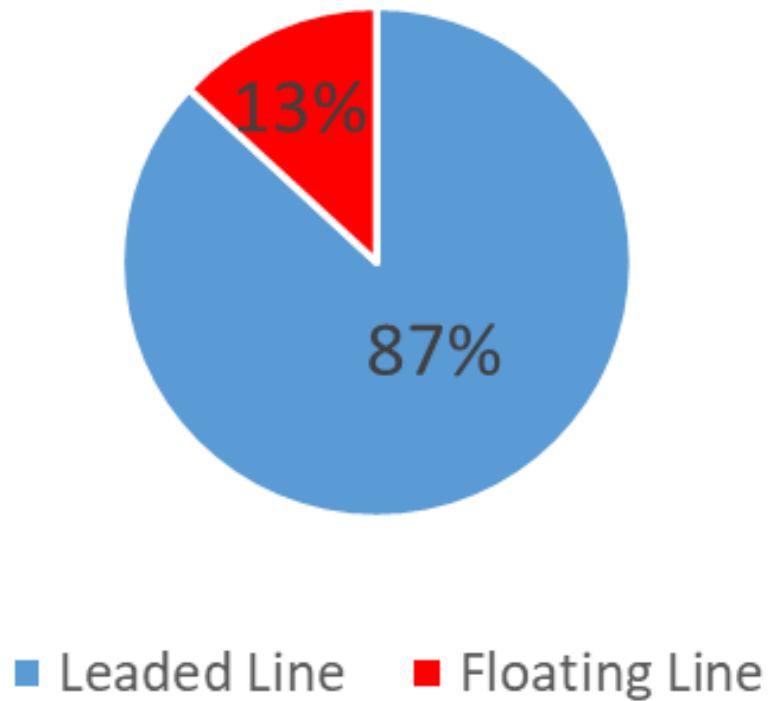
2021 WDFW trap removals
Unweighted traps



■ Weighted ■ Not Weighted

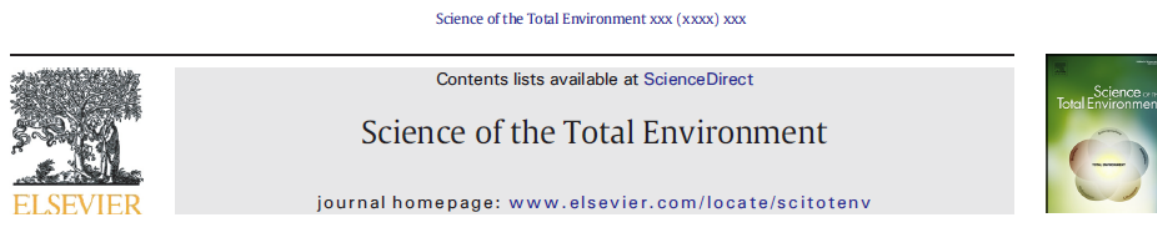
2021 WDFW trap removals

Use of floating line



Current Research

So many questions and so few answers...

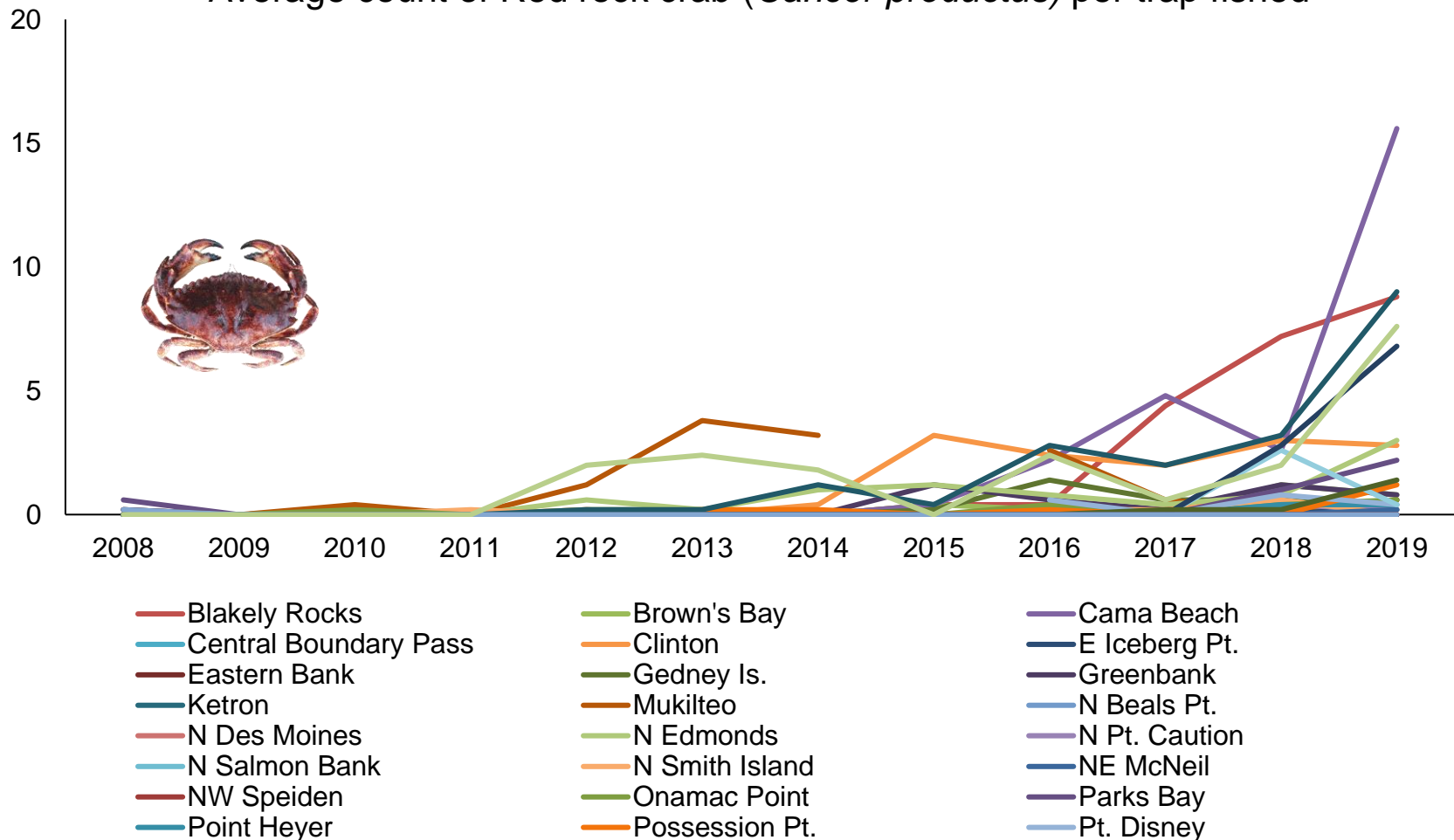


Exoskeleton dissolution with mechanoreceptor damage in larval
Dungeness crab related to severity of present-day ocean acidification
vertical gradients

Nina Bednaršek ^{a,*}, Richard A. Feely ^b, Marcus W. Beck ^c, Simone R. Alin ^b, Samantha A. Siedlecki ^d, Piero Calosi ^e,
Emily L. Norton ^f, Casey Saenger ^f, Jasna Štrus ^g, Dana Greeley ^b, Nikolay P. Nezlin ^a,
Miranda Roethler ^a, John I. Spicer ^h

Researchers and managers are becoming aware of the need
to link **ecosystem scale** processes to **fishery management**

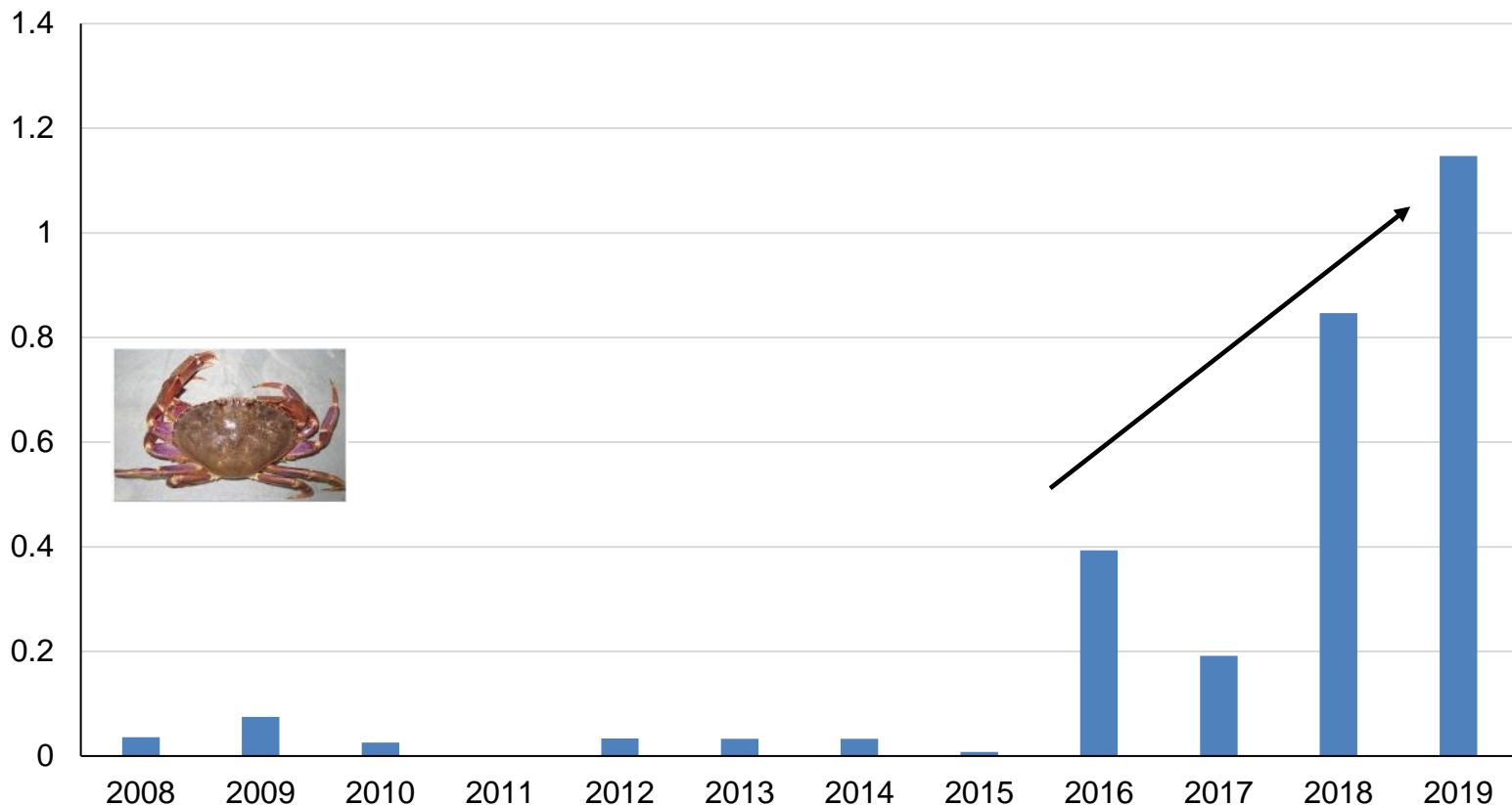
- *Shifts in species composition*



***Potential* Climate Change Indicators**

- Shifts in species composition

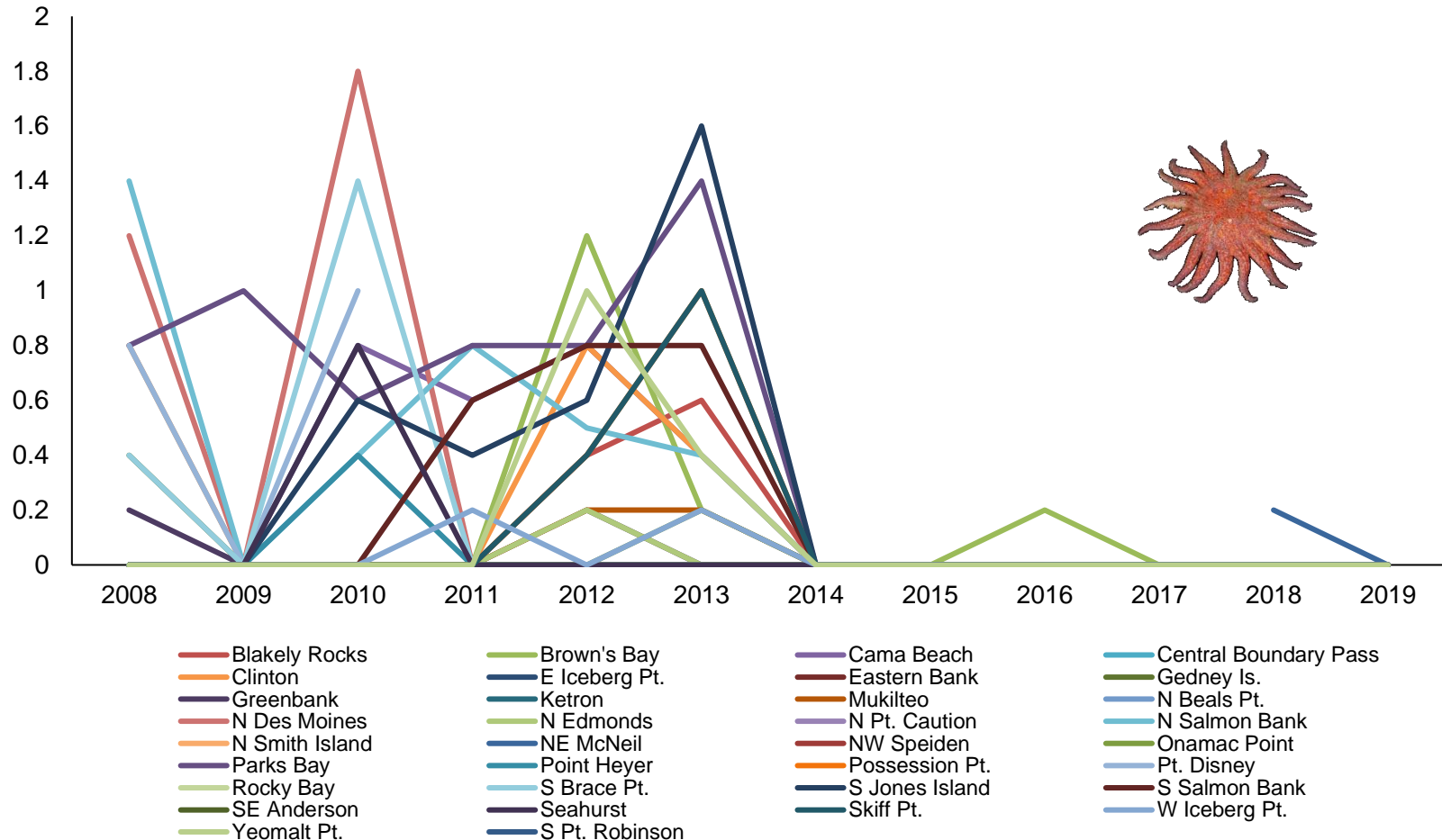
WDFW Post-season Shrimp Test Fishing Data
Average count of Graceful crab (*Cancer gracilis*) per trap fished



Potential Climate Change Indicators

- Shifts in species composition

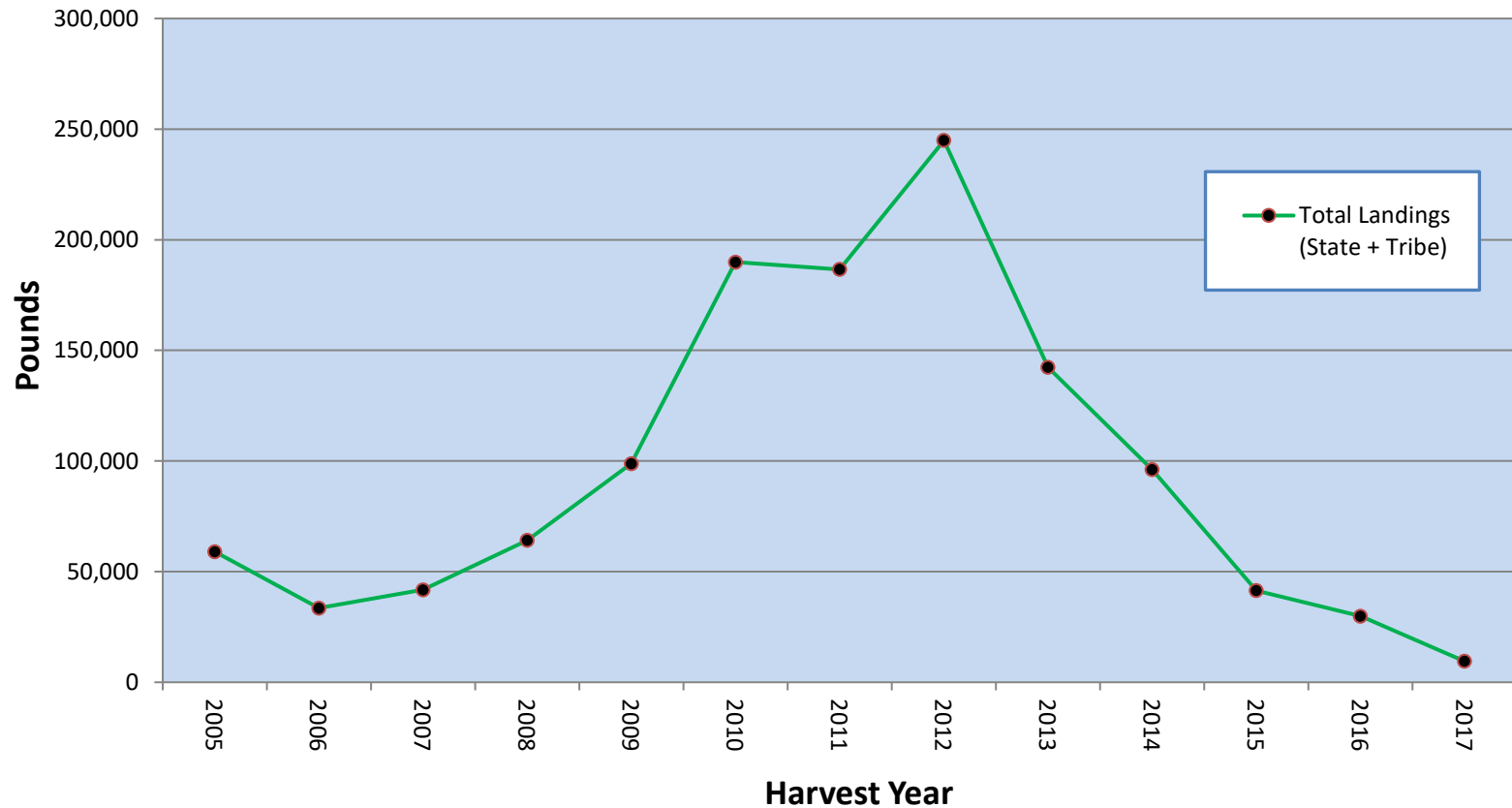
WDFW Post-season Shrimp Test Fishing Data
Average count of Sunstars (*Pycnopodia helianthoides*) per trap fished



Recent State and Treaty Dungeness Crab Landings

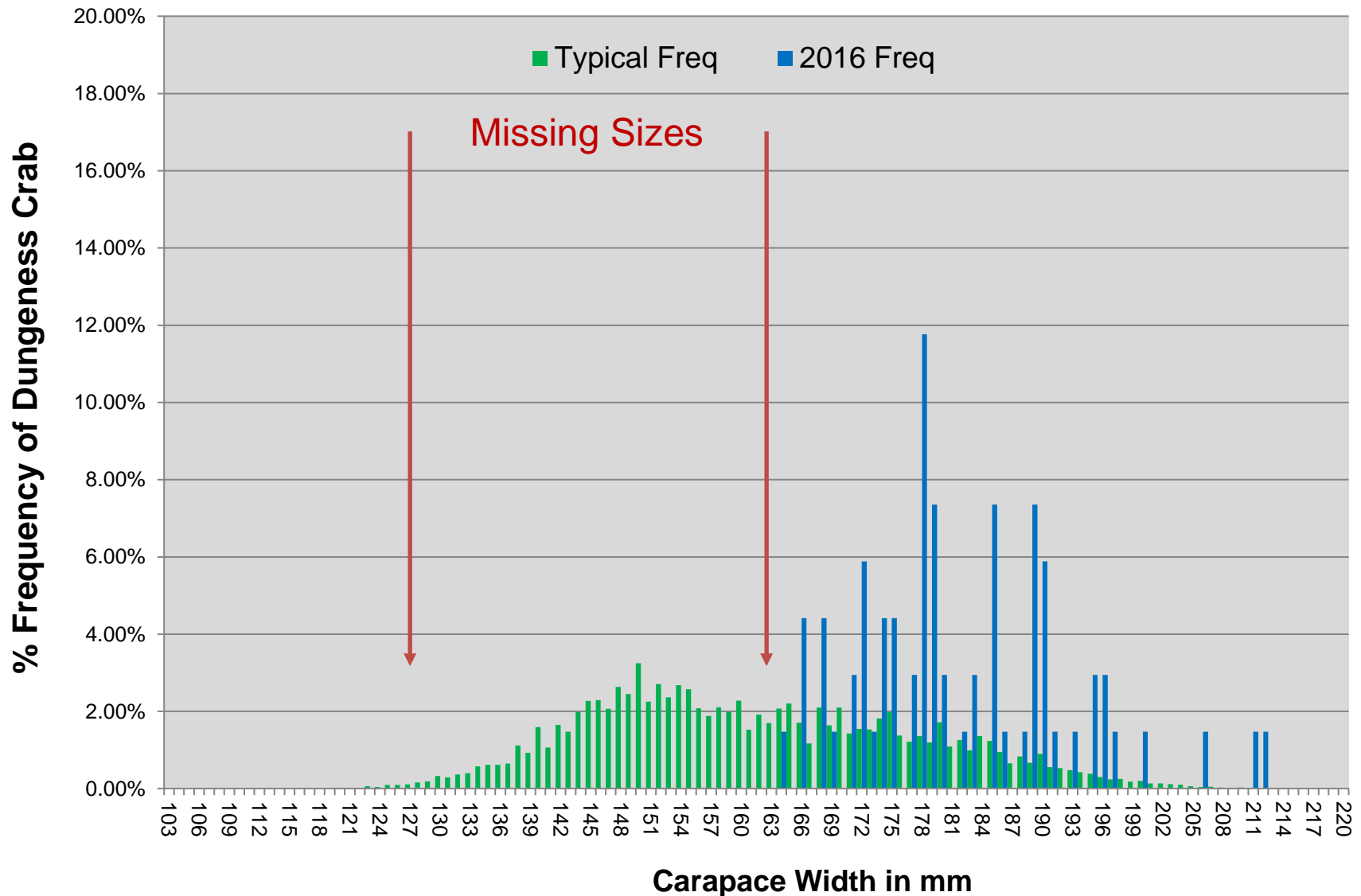
Marine Area 13 Combined State & Tribal Dungeness Crab Landings

(Jan 1, 2005 to Dec 31, 2018)



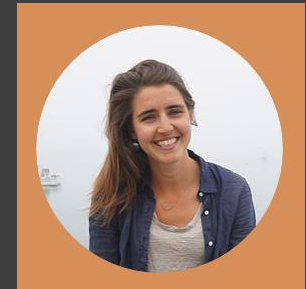
Comparison of “typical” Dungeness size distribution to 2016 crab population in MA 13

(*n=34,109 for “typical” MA 8 crabs from 1999-2016*) (*n=68 for MA 13 crabs in 2016*)





Pacific Northwest Crab Research Group



Emily Buckner

PCRG Program Coordinator || WSG Hershman Fellow
pnwcrab@gmail.com

<https://www.pnwcrab.com/>

What is the Pacific Northwest Crab Research Group (PCRG)?

- Diverse group of over 70 crab researchers and managers
 - State and tribal co-managers
 - Federal agencies
 - Academia
 - Non-profit organizations

Mission statement:

To promote and support sustainable Dungeness crab populations in the Pacific Northwest

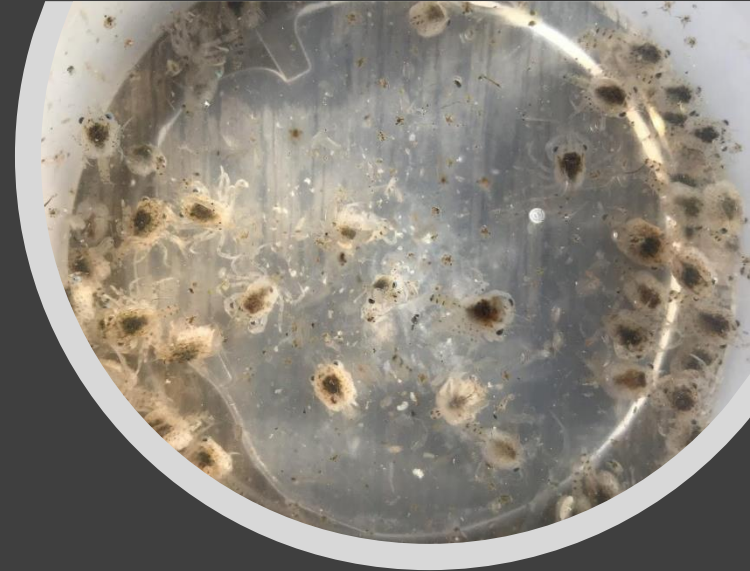


A snapshot of involvement in PCRG



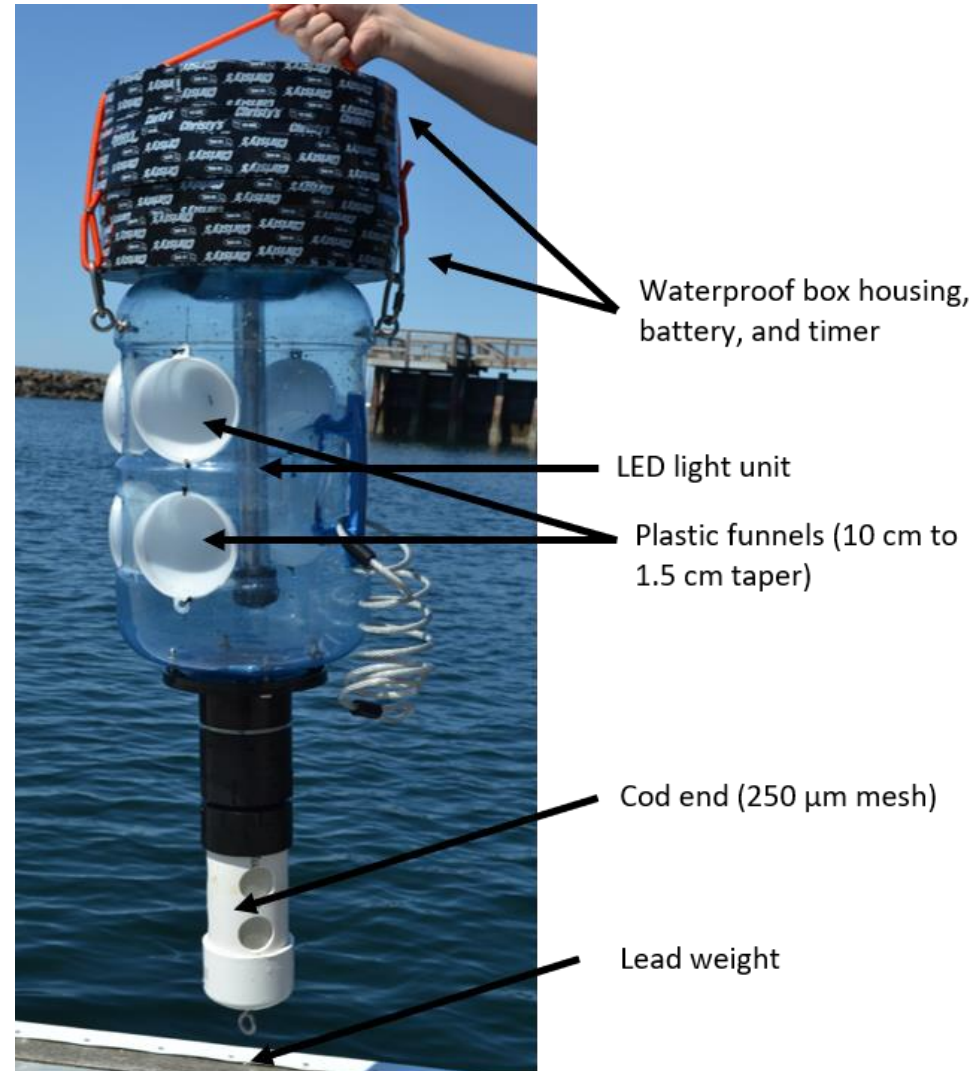
Light Trap Study Background

- Megalopae are the pre-settlement stage of crab and are free-swimming in the water column
- Light traps have *semi-accurately predicted relative abundance of adult populations in Coos Bay, OR.
- There are two cohorts of Dungeness crab in inland WA waters → “early and late cohorts”.
 - We know very little about when they come in, where they are, when exactly they settle and where, and by what path they come into the inland waters.



What is a light trap?

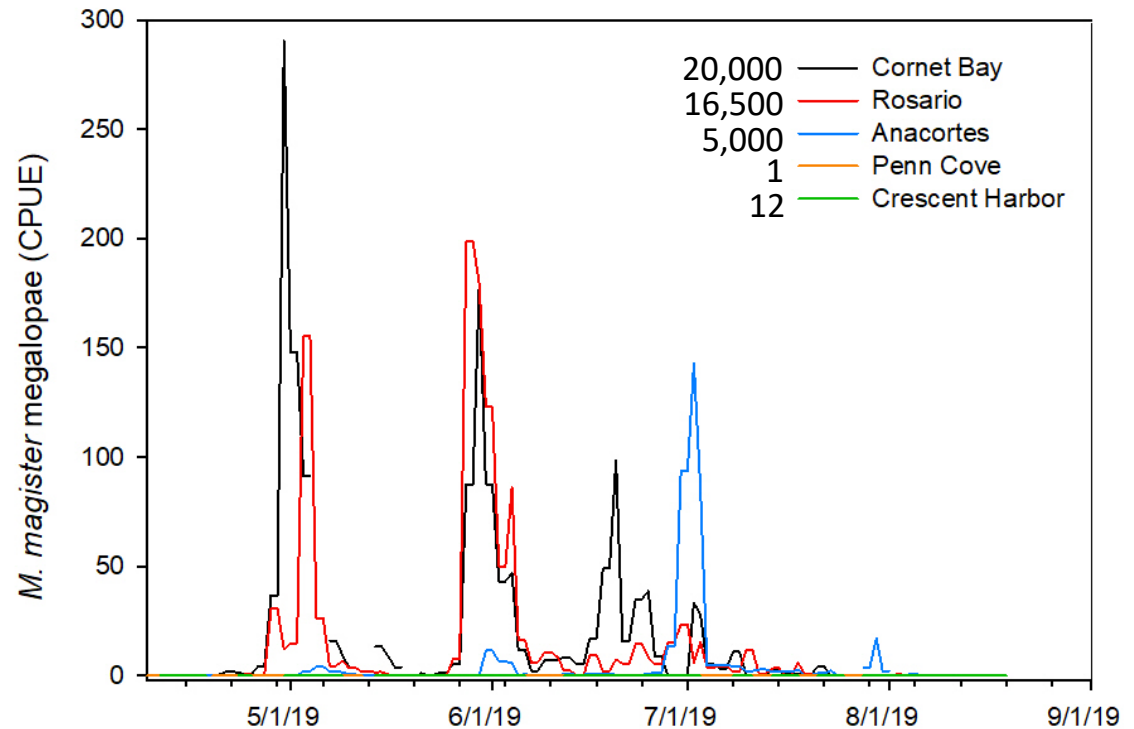
- Standard design is a 5 gallon jug like this→
- How it works
 - Megalopae are free-swimming in the water column and have positive phototaxis (really catches anything attracted to light that is smaller than 1.5 cm)
 - Timer turns it on at dusk and off at dawn



Light Trap Results: Dungeness Crab

2019

- Peak pulses at end of April & start of June
- 1 caught in Penn Cove and 12 in Crescent Harbor
- Cornet Bay caught the most, followed by Rosario





Puget Sound Zooplankton

Julie Keister

Amanda Winans, BethElLee Herrmann, and numerous partners.



Puget Sound Zooplankton Monitoring Program

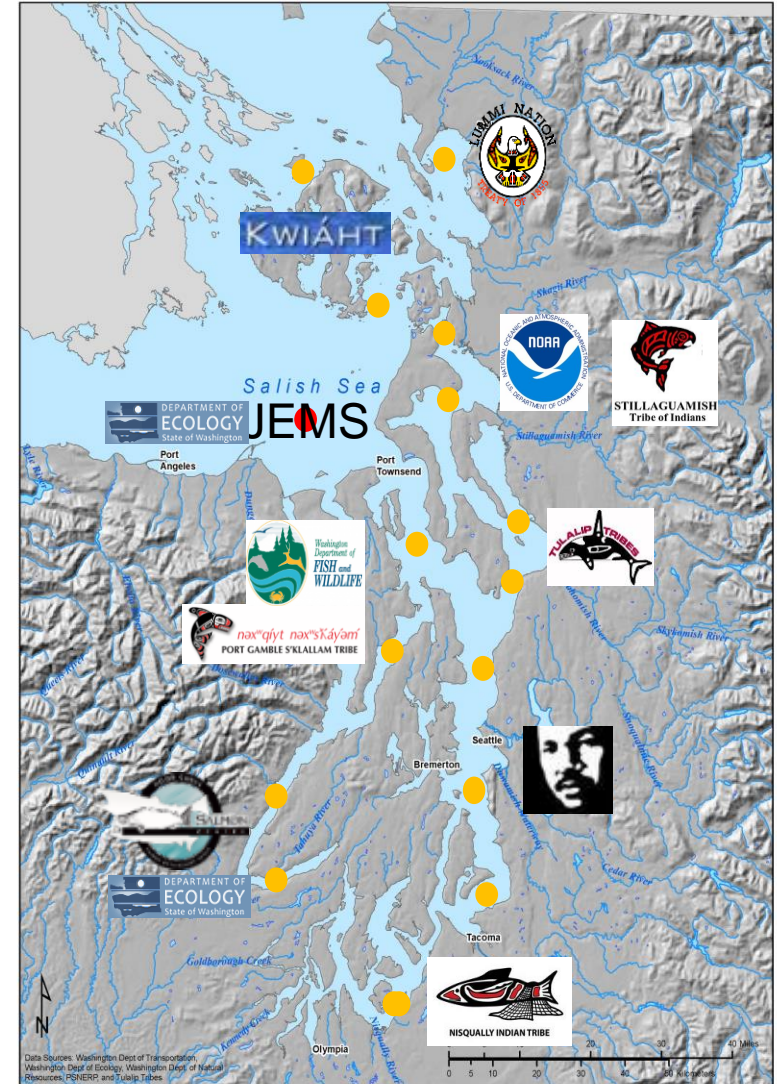
Initiated in 2014 to address hypotheses of bottom-up controls on salmon survival.

Provides data on:

- 1) Response of zooplankton community to environmental change.
- 2) Patterns in prey availability for salmon and other fish and seabirds.

Fills long-standing data gap for fishery and ecosystem modelers and managers

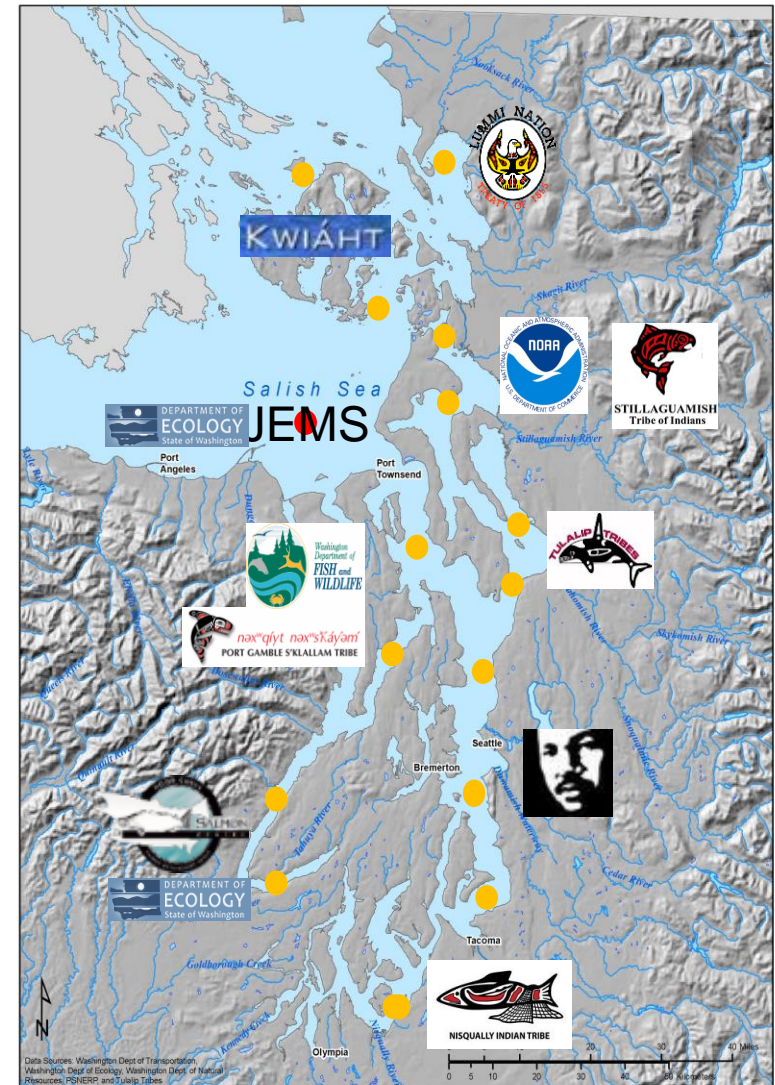
- *Diet Studies*
- *Climate Impacts*
- *Ecosystem Health Indicator*



Puget Sound sampling:

At most locations,
Bi-weekly sampling March-Oct
King County year-round

- **Oblique bongo net tows**
Upper 30 m
60-cm dia., 335- μ m mesh
- **Vertical net tows**
Full water column tows
in ~ 100 m depth
60-cm dia., 200- μ m mesh

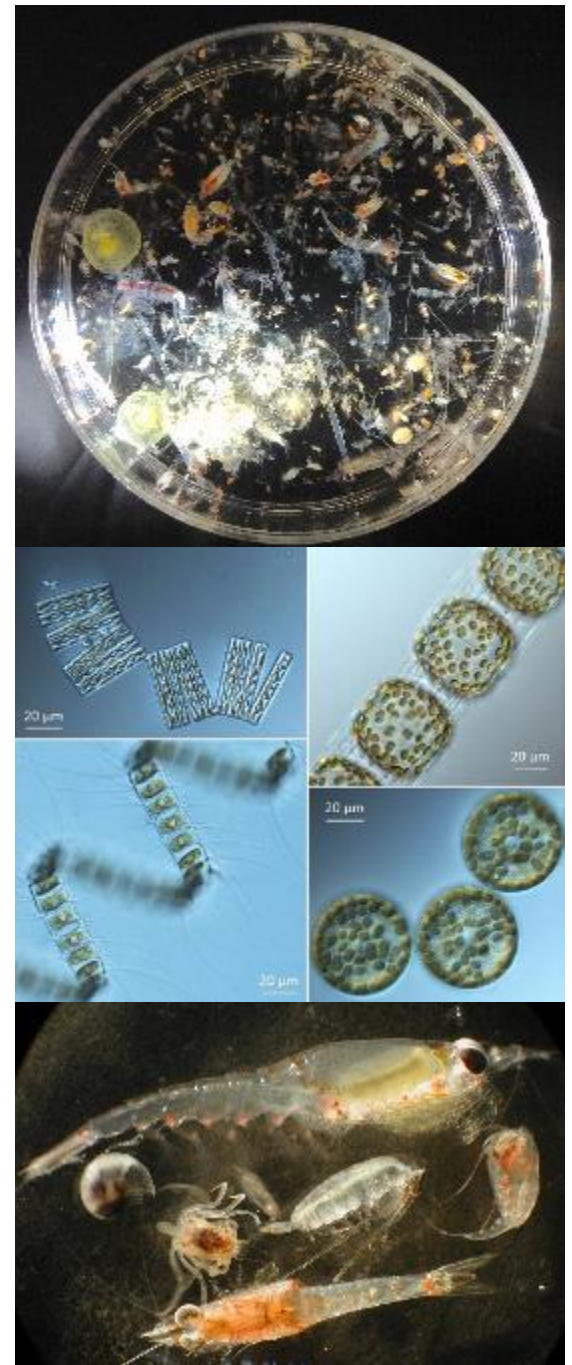


Puget Sound sampling:

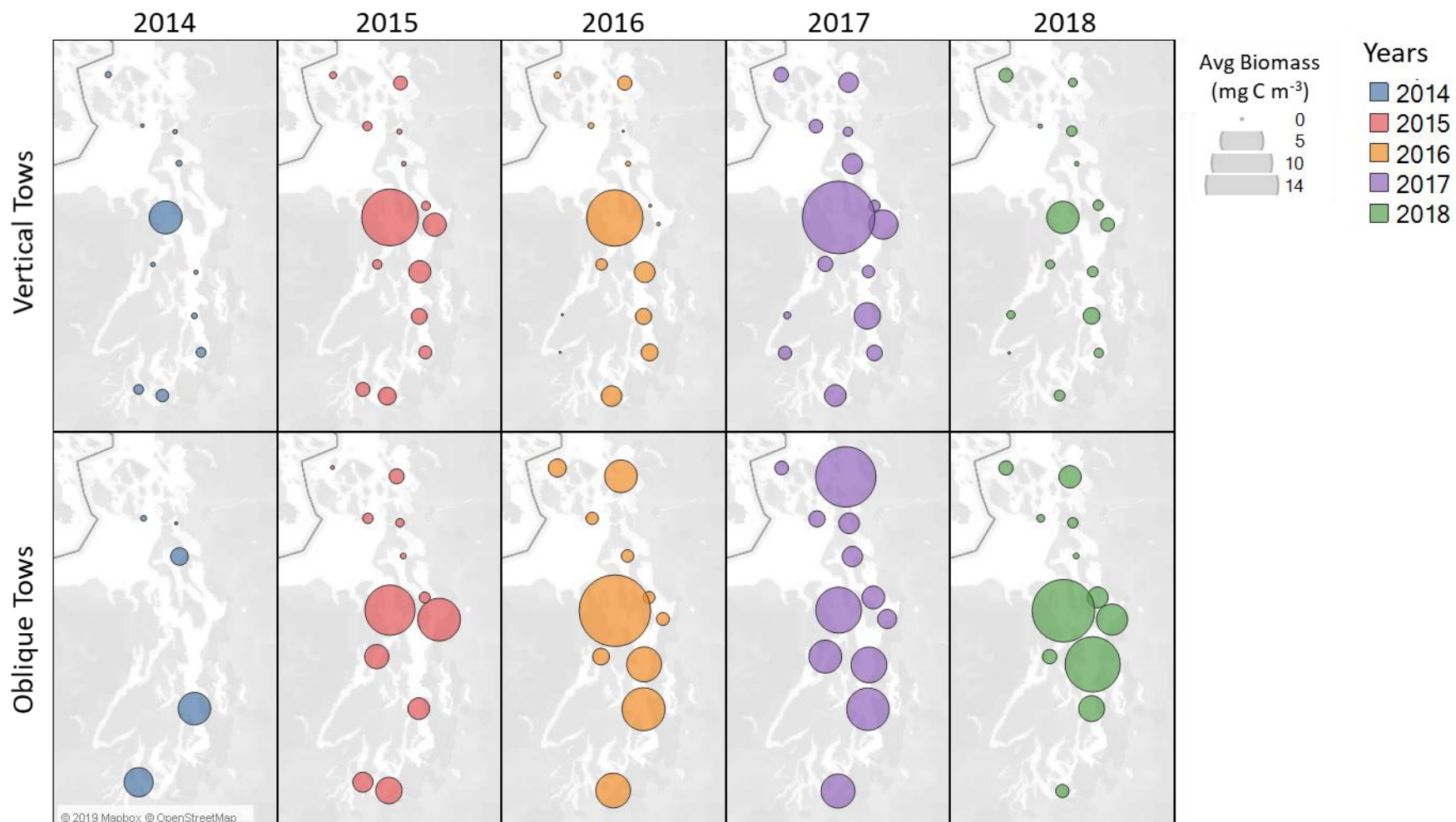
Data Collected Include:

- **Zooplankton** diversity, abundance and biomass
- **Phytoplankton** diversity and biomass
- **Water quality** parameters
 - *Salinity*
 - *nutrients*
 - *Chlorophyll*
 - *DO*

**Current uses geared towards
Puget Sound Salmon recovery**



May-Aug Avg Cancridae Biomass



Enter the fishery in 2019

On the Horizon

- Crab Aging
- Pre-recruit surveys
- Local movement studies
- Correlate environmental data to fishery landings and test fishing abundance data
- Assessing impact of all that crab bait on the ecosystem



THANKS FOR LISTENING!



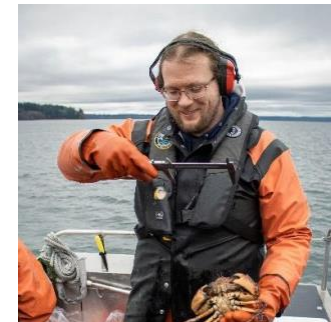
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If you have questions in the future, please feel free to contact any of us.