Estimating Unobserved Mortality of *Chionoecetes* sp. Due to Encounters with Bottom Trawls

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Importance

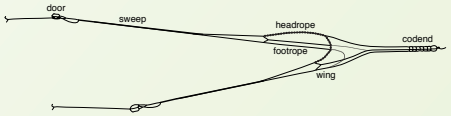
- Cooperative research with the groundfish fishing industry.
- Knowing the percentage of unobserved mortality is one more piece of the puzzle for managers to use to more accurately manage the crab and groundfish fisheries sustainably.

Objectives

- To estimate the percentage of unobserved mortality of *Chionoecetes bairdi* (Tanner crab) and *C. opilio* (snow crab) after encounters with bottom trawls.
- To determine if modifications to sweeps and footropes reduce unobserved mortality.

Methods

Fishing Gear

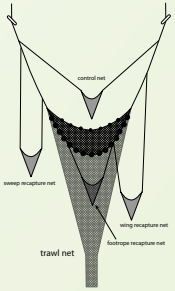


Schematic of a trawl net. Area swept by the parts of the gear: sweeps 90%, footrope 4%, wings on either side of footrope are each 3% for a total of 6%.

On-bottom sweep (right side of photo) vs. **off-bottom sweep** (left side of photo). The on-bottom sweep is the conventional gear currently used by most of the commercial flatfish fleet. The off-bottom sweep has 8" rubber bobbins every 45' to elevate the sweep 2-3" above the seafloor, allowing benthic invertebrates to pass underneath sweep. Off-bottom sweeps are currently under consideration by the North Pacific Fisheries Management Council as a gear regulation to protect habitat.

18" bobbin footrope, conventional gear currently used by flatfish fleet.

21" disk footrope, alternative footrope.



Catching Crabs After Trawl Contact

Bottom trawl with recapture nets. Recapture nets were used to catch the crab after they encountered the different parts of the trawl gear (i.e. sweep, footrope, wing, control and the modified sweep and footrope). The tows were 15-25 minutes in length and only one recapture net was fished at a time. Diagram to the left depicts where the recapture nets were attached to the main trawl net. The control net captured unaffected crabs to estimate mortality due to capture and handling. The footrope recapture net was fished directly behind the footrope, underneath the main net. The main net was fished with an open codend.

Reflex Assessment

Each crab was assessed for all six reflexes, given a **1** if the reflex was present and a **0** if the reflex was absent. Reflex impairment score is the sum of reflex impairments (one to six zeros) for each crab. A reflex impairment score of zero is a fully responsive crab. A reflex impairment score of six (with six zeros) is a dead crab. Sampled crabs with each reflex score were held in live holding tanks for at least five days to estimate probabilities of mortality.

Leg Flare
Holding crab by the carapace, do the legs flare straight out [1] or do the legs hang? [0]

Leg Retraction
Holding crab by the carapace, draw the first walking leg forward. Does it actively pull it back [1], or does it drop? [0]

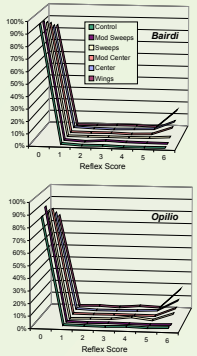
Chela Closure
Do the chela actively open and close [1] or can you stick your finger in the chela with no fear of being pinched? [0]

Eye Retraction
Do the eyes tuck up tight when poked with a probe [1] or can you manipulate the eye with the probe? [0]

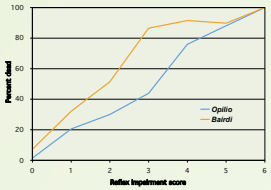
Mouth Closure
Do the external maxillipeds tuck up tight when poked with a probe [1] or do they stay open? [0]

Kick
Flip the crab over and use a probe to lift the abdominal flap. Do the legs kick up [1] or do the legs remain motionless? [0]

Results

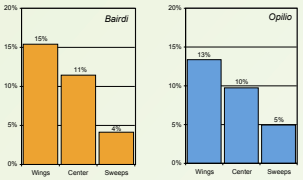


Percentage of crabs with each reflex score by gear component.



Reflex action mortality predictor (RAMP) curves for *C. bairdi* and *C. opilio.*

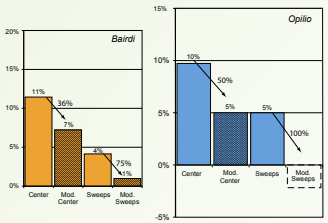
To estimate overall mortality rates the percentage of crab by each reflex score for each gear component was run through the RAMP analysis to establish the raw mortality estimates. The raw mortality estimates were then corrected for the handling mortality to reach the percent mortality by gear component for conventional and modified gears.



Percent mortality by gear component, corrected for handling mortality.

The overall mortality rates, *Bairdi* 4.9% and *Opilio* 5.7%, were computed by weighting component-specific rates by the area swept for each gear component (90% sweep, 6% wing, 4% center).

Reduction in percent mortality for modified footrope and sweep, corrected for handling motality. **36%** reduction for *Bairdi* with modified footrope. **75%** reduction for *Bairdi* with modified sweeps. **50%** reduction for *Opilio* with the modified footrope. Mortality was not significantly different from **zero** for *Opilio* with the modified sweep.



Conclusions

Mortality rates with conventional gear ranged from 4% –11%, but overall rates were 4.9% and 5.7% because most crabs encounter the least damaging gear component, the sweeps.

Simple gear modifications that increased seafloor clearance substantually reduced mortality rates.

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