

1. PROJECT INFORMATION

NPRB Project Number:	711
Title:	Quantification of unobserved injury and mortality of Bering Sea crabs due to encounters with trawls on the seafloor
Subaward period	June 1 2007 – March 30, 2010
Amount of funding	\$ 221,848
Report period	July 1 to December 31, 2009
Report submission date	January 15, 2009
Lead Author of Report*	Craig S. Rose

Principal Investigator(s), Co-Principal Investigators and Recipient Organization(s):

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2. PROJECT OVERVIEW

a. Briefly (4-5 sentences) describe both the research purpose and the underlying need for this research.

The potential for unobserved mortality of crabs encountering bottom trawls, but not brought aboard the fishing vessel, has long influenced the management of Bering Sea groundfish fisheries. Our research addressed the lack of data on the mortality rates of such crabs for two principal commercial crab species of the Bering Sea, Tanner crab and snow crab. We applied and improved existing methods for collecting crabs immediately after trawl encounters. Assessments of reflex impairment were used to more efficiently estimate delayed mortality rates with reduced requirements for long-term holding (Davis 2006). This proposal leverages pilot funding from the NMFS cooperative research program. Pilot fieldwork in early Summer 2007 established recapture net designs and handling, as well as procedures for holding crabs onboard. Reflex and reflex impairment observations of captive animals at the Kodiak NMFS laboratory provided information needed for field assessments of crab condition. The principal fieldwork in Summer 2008 combined these developments to assess the mortality probabilities of snow and tanner crabs that have passed the sweeps, wings and central footrope of a commercial groundfish trawl as well as control animals collected identically without trawl encounters. Mortality estimates were derived by combining condition assessments based on reflex impairments with the delayed mortality rates of retained animals. Additional work in 2009 provided mortality estimates for red king crab.

b. State your hypotheses.

- 1) The loss of reflex behaviors after stress or injury can predict the probability of subsequent mortalities for Bering Sea crab species
- 2) That some crabs encountering bottom trawls die due to that interaction. (We use hypothesis 1 to estimate the rate at which such mortalities occur).

c. List the objective(s) of the research project, exactly as described in your approved Statement of Work.

- Objective A: Evaluate reflex behaviors in Alaska crabs that hold potential as predictors of stress
- Objective B: Assess the sensitivity of behavioral indices to stress
- Objective C: Evaluate relationships between behavioral indices (vs physical injury) and mortality
- Objective D: Develop methods for capturing crabs affected by trawls and appropriate control animals and making them available for evaluation and holding aboard the study vessel
- Objective E: Estimate mortality rates for Alaska crabs encountering different components of bottom trawls
- Objective F: Communicate Results and Follow-up

d. Provide a table showing the timeline and milestones for the entire project.

<u>DATE</u>	<u>Milestone</u>	
June 1, 2007	NPRB funding notification	complete
June - August 2007	Pilot fieldwork (supported by matching funding)	complete
January 2008	Presentation at Marine Science Symposium 2008	complete
April 2008	Charter of vessel for principal fieldwork	complete
May 2008	Lab tests complete	complete
May - August 2008	Principal fieldwork	complete
December 2008	Mortality assessments and analysis complete	complete
January 2009	Presentation at Marine Science Symposium 2009	complete
May 2009	Submission of results for peer-reviewed publication	partial
August 2009	Follow-up fieldwork on red king crab RAMP	complete
October-December 2009	Fishing industry and management outreach	complete
March 2010	Final report	

3. PROGRESS SUMMARY

a. Describe report period progress.

- Objective A: Evaluate reflex behaviors in Alaska crabs that hold potential as predictors of stress
 - Objective B: Assess the sensitivity of behavioral indices to stress
 - Objective C: Evaluate relationships between behavioral indices (vs physical injury) and mortality
 - Objective D: Develop methods for capturing crabs affected by trawls and appropriate control animals and making them available for evaluation and holding aboard the study vessel
- Objectives A to D were completed in 2007 and have been published.*

- Objective E: Estimate mortality rates for Alaska crabs encountering different components of bottom trawls
- Objective E was completed in 2008 for snow and tanner crabs and during this period for red king crab.*

Objective F: Communicate Results and Follow-up

Much of our work in this period has been directed at communicating the results from the 2009 field work, specifically the estimates of mortality for red king crab (*Paralithodes camtschaticus*) following trawl encounters. These have included presentations to scientific, management and industry meetings and initial work on manuscripts.

b. Describe preliminary results.

Our fieldwork during August 2009 provided data from which we estimated unobserved mortality rates for red king crab, *Paralithodes camtschaticus*, following contact with each major component of a bottom trawl (Figure 1).

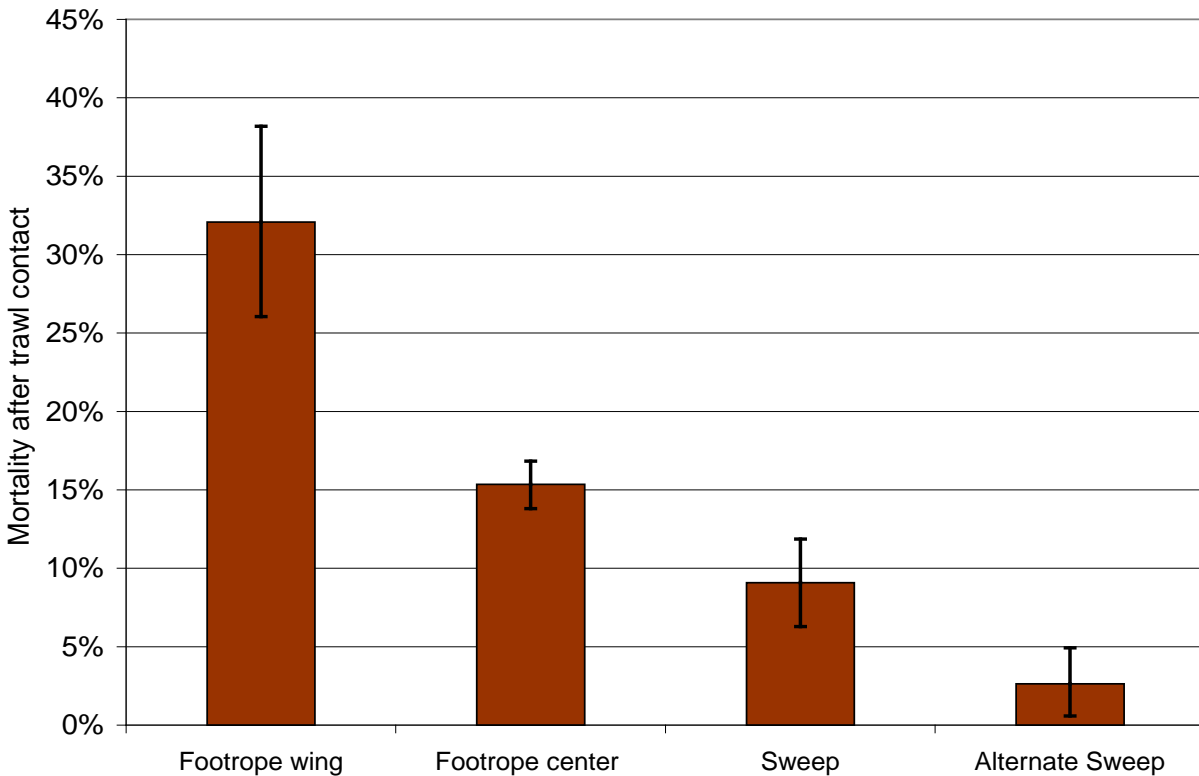


Figure 1 – Mortality rate estimates for red king crab, *Paralithodes camtschaticus*, following contact with major components of a bottom trawl and sweeps modified to raise them above the seafloor.

These rates showed the same pattern as those for snow and Tanner crabs, with highest mortality caused by the footrope wings and lowest by the sweeps. Each of these rates was substantially higher than the corresponding rates for snow and Tanner crabs, a result congruent with the much larger size of the red king crabs.

Raising sweeps 2-3 inches above the seafloor reduced red king crab mortality by 71%, from 9.1% to 2.6%. As this is the part of bottom trawls that covers the most seafloor area, this result was important to the NPFMC’s consideration of requiring these modifications for bottom trawlers targeting flatfish in the Bering Sea.

c. Describe any concerns you may have about your project’s progress.

Due to our completion of work on *Paralithodes camtschaticus*, we have decided to combine these results with the manuscript of our results with *C. opilio* and *bairdi*. This overall manuscript is in development and expected to be ready for AFSC review by March 2010. While this misses our planned May 2009 milestone for the initial paper, it will provide a more comprehensive documentation of our estimation of crab mortalities.

d. Poster and oral presentations at scientific conferences or seminars

The preliminary results of this project were presented at a workshop on modifying fishing gear to reduce bycatch and ecosystem impacts at the 2009 PICES conference in Jeju, Korea.

3. Education and outreach

Fisheries managers were very supportive of extending this project to estimate mortality rates for red king crab and had requested timely updates as those results became available. As the NPFMC was making their final decision on requiring modifications to bottom trawl sweeps for Bering Sea flatfish trawlers in October 2009, they wanted assurance that the results showing reduced mortalities for snow and Tanner crabs also extended to red king crab. We presented our results, which were indeed positive for red king crab, to the Council's Crab Plan Team in Seattle on September 15, 2009 and to their Scientific and Statistical Committee in Anchorage on October 1, 2009. Finally, a poster depicting project results was displayed during the NPFMC's December meeting in Anchorage.

The fishing industry itself has been very supportive of this project and has been the primary focus of our outreach. During this reporting period, we identified several gatherings where we could present project results. The first of these was a gear development workshop, held at the flume tank at Memorial University, St. Johns, Newfoundland (October 14-16, 2009). Fleet interest in implementing the sweep modifications increased following their adoption by the Council. We convened two separate workshops, for the Pollock Conservation Cooperative and for Bering Sea and Gulf of Alaska bottom trawlers, where we presented project results during discussions of the rationale and implementation of the sweep modifications. Finally, as we have throughout this project, we presented and discussed project plans and results at the annual meeting of skippers of the Groundfish Forum and the Best Use Cooperative.

4. PROGRESS STATUS

This project remains on schedule and we anticipate meeting the remaining milestones. We are very pleased that we will be able to achieve all project goals and expect to complete all NPRB requirements by the end date of March 31, 2010.