Project #: 711

Title: Quantification of unobserved injury and mortality of Bering Sea crabs due to encounters with trawls on the seafloor

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Subaward Period and Amount of Funding: June 1 2007 – June 30, 2009, $ 221,848

Report Period: July 1 to December 31, 2008

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Lead Author of Report: Craig S. Rose.

PROJECT OVERVIEW

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 (Rose 1999). 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 will combined these developments to assess the mortality probabilities of 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 will be derived by combining condition assessments based on reflex impairments with the delayed mortality rates of retained animals.

DATE	Milestone	
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
May 2008	Lab tests complete	complete
April 2008	Charter of vessel for principal fieldwork	complete
May - August 2008	Principal fieldwork	complete
December 2008	Mortality assessments and analysis complete	complete
January 2009	Presentation at Marine Science Symposium 2009	
May 2009	Submission of results for peer-reviewed publication	

PROGRESS SUMMARY
Report Period Progress:

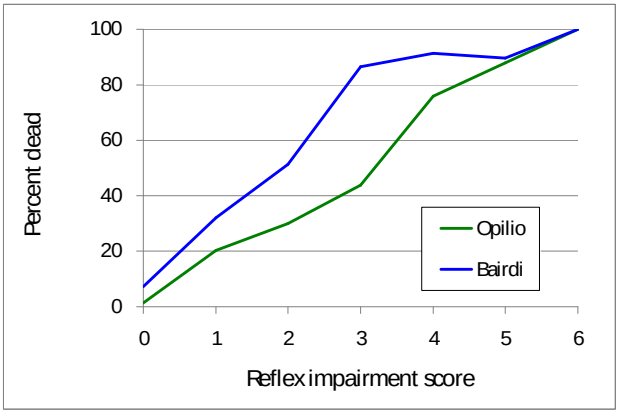
Two major milestones were completed during this reporting period, the principal fieldwork and the analyses to generate mortality estimates. Operations were conducted aboard the F/V Pacific Explorer in the Bering Sea from July 30 – August 15. Crabs were collected in auxiliary nets after encountering the central footrope, wings and sweeps of a commercial bottom trawl. Two sizes of sweeps (18" and 21") were used in the central footrope to contrast the mortality rates across gear alternatives. Because the North Pacific Fisheries Management Council is considering requiring modified sweeps to reduce habitat effects, both conventional and modified sweeps were tested. A site, approximately 50 nm east of the Pribilof Islands was selected because it provided catches of both *C. bairdi* and *C. opilio* with sufficient numbers and full size ranges. One hundred and twenty one tows were completed, providing approximately 20 tows for each gear condition (including a control). Tows were kept short (8 – 25 minutes) with the goal of taking 50 crabs of each species while minimizing damage in the recapture nets.

Crabs were carefully brought aboard and assessed using a six part reflex test. A subsample of those crabs was held for 5 – 12 days to establish the relation between reflex state and delayed mortalities. The proportions of crabs in different reflex states and the reflex-mortality relationship were used to estimate raw mortality rates for crabs encountering each part of the trawl. Results for crabs captured with a control net, fished in front of the trawl to serve as a scientific control for the effects of the recapture net itself, were used to assess and adjust for mortalities due to capture and handling.

Analyses of the resulting data generated mortality estimates for both species for each gear components (see Preliminary Results).

Preliminary Results:

1) Holding additional crabs (912 opilio and 604 bairdi) during the 2008 work confirmed and improved on the relationship between reflex scores and mortality probabilities based on the 2007 pilot study (Figure 1).
2) Reflex assessments on 7030 opilio and 6830 bairdi crabs allowed mortality probabilities to be estimated for those affected by each gear type as well as handling in the control net. Adjusting for handling (control) yielded estimates for footrope and wing mortalities of 10 – 15% and sweep mortalities of about 5%. (Figure 2).



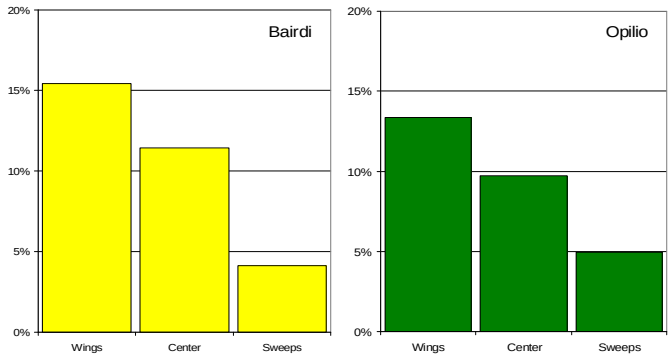


Figure 1 – Reflex Assessment Mortality Predictor (RAMP) Figure 2 – Crab mortality estimates.

3) The alternative footrope (21" disks vs. 19 inch bobbins) reduced crab mortality by 40 – 50%, while the sweep modifications reduced mortality to nearly zero.

4). For the typical Bering Sea flatfish trawler (swept area 90% sweeps, 6% wings, 4% center footrope), these rates calculate to an overall average of approximately 6% mortality of crabs in the whole trawl path with conventional gear and 1.5% for modified gear.

Project Progress Concerns:
While the 2008 field work was completed on time, a delay in the paper processing that added NPRB funds to the vessel contract (part of a multi-year contract with that vessel) resulted in AFSC funds being applied to that invoice. Attempts to correct this internally without losing the AFSC funds were not successful, so we have contacted NPRB about project adjustments to correct this problem.

While we were able to make mortality estimates as proposed for two Bering Sea crabs (*C. opilio* and C. *bairdi*), adding estimates for red king crab (RKC) was not feasible. Suitable sites for RKC were too far away and tank holding capacity and available time were insufficient to make useful estimates for all 3 species. Some preliminary work on a red king crab RAMP was accomplished and our methods can be applied to that species during future work.

Education and Outreach:
The first presentation of these results was made to the InterGovernmental Crab Meeting on December 18, 2008. This presentation provided our results to many of the scientists studying the biology and management of the crab stocks of Alaska, a very significant user group for our results.

Photos were taken during the fieldwork and will be forwarded to NPRB.

PROJECT STATUS

This project remains on schedule and we anticipate meeting the remaining milestones. Additional presentations are planned at a meeting of Bering Sea bottom trawl skippers (1/9), the AMSS (1/21) and a poster at the Lowell Wakefield symposium (March). Our May milestone for primary manuscript preparation is reasonable, though submission to a Journal may be affected by the AFSC review process.