APPENDIX B

PRELIMINARY RESULTS OF BERING SEA CRAB ASSESSMENTS CONDUCTED DURING JUNE 2005 BY THE BERING SEA FISHERIES RESEARCH FOUNDATION -- A PILOT STUDY

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INTRODUCTION

In cooperation with the NMFS Alaska Fisheries Science Center (NMFS/AFSC) and Alaska Department of Fish and Game (ADFG), the Bering Sea Fisheries Research Foundation (BSFRF) organized and completed its first season of field research during June 2005. As presented during the Crab Plan Team meetings of September 6-9, 2005, this pilot study focused on the testing of specialized trawl gear and crab survey methods in the Bering Sea that have been utilized for several years to assess *opilio* Tanner crab in the Gulf of St. Laurence, Canada.

This document provides a brief narrative and 15 exhibits summarizing the objectives, methods and preliminary results of the pilot study's cooperative research. Area swept crab abundance estimates generated from this survey and from the standard NMFS trawl survey within the same 4,000 square nautical mile study area are presented and compared. Final results and detailed description of methods and the survey design will be completed in the near future.

RESEARCH OBJECTIVES

BSFRF research objectives for the 2005 survey work were:

1. To determine the feasibility of conducting a survey using a gear/equipment package presently designed and used in Eastern Canada, to survey Bristol Bay red king crab, *bairdi* Tanner crab and *opilio* snow crab in a selected area of the SE Bering Sea,

2. To estimate mean and variance of the abundances of juvenile and mature male and female Bristol Bay red king crab, Tanner crab and snow crab in the study area,

3. To compare estimates of crab density by species/size/sex categories from the pilot survey with estimates from NMFS standard survey in the same areas of high density, and

4. To evaluate the scientific utility, feasibility and cost of the alternative survey design for long term application.

SURVEY GEAR AND METHODS

The BSFRF chartered the 120 foot stern ramp trawler *F/V American Eagle* and her crew of four for the survey work. The scientific party of five was lead by chief scientist Dr. Gerard Conan who is working under contract for the BSFRF. Dr. Conan has been a key person in the design and conduct of the Gulf of St. Lawrence *opilio* snow crab research program for several years. The remainder of the scientific party consisted of Jean-Gilles Chiasson, a skipper/gear expert from Canada, Scott Goodman, a biologist with Natural Resources Consultants, Rachel Alinsunurin, a biologist with ADF&G and Casey Campbell, a technician hired by BSFRF for the survey work.

The gear package was leased by the BSFRF from a Canadian firm and it matched the gear package recently used by Dr. Conan in the Gulf of St. Lawrence *opilio* survey. The package consisted of otter trawls and trawl doors (three identical sets in case of gear damage/loss) specially designed and rigged for "heavy on bottom tending characteristics," NETMIND™ acoustical sensors for trawl spread and performance measurements and associated instrumentation and software for performance monitoring and data recording. The research trawls measured 20 meters on the head rope by 27 meters on the footrope. The trawls were equipped with a "tickler chain array" designed to "dig out" crab in the substrate for subsequent capture (Exhibits 1-4).

Operations were conducted during a 20-day period in June of 2005 and timed to match the standard NMFS survey of Bristol Bay red king crab in the southeastern Bering Sea. The pilot survey for red king crab was conducted in 10 NMFS standard survey blocks that in the two prior years had represented a core area of higher density legal sized male red king crab (Exhibit 5). Within this 4,000 square mile

area, 129 tow sites were randomly chosen from a predetermined sampling grid (Exhibit 6). Tow durations were set at 5-7 minutes and gear performance was monitored and recorded during each tow for area swept (spread and distance towed with full bottom contact). In the Bristol Bay red king crab survey, all captured crab were sorted, sexed and measured without subsampling. All haul, catch and biological data were entered into an electronic database with backup onboard the *F/V American Eagle*. All data was subsequently error checked and edited.

The Bristol Bay red king crab survey as planned was completed five days ahead of schedule which provided for some limited work on the *opilio* grounds. For that work, three standard NMFS survey blocks north of St. Paul Island (Exhibit 5) were chosen for a mini survey which consisted of 26 pre selected tow sites (Exhibit 7). The selection of three blocks for the *opilio* mini survey was also based on likely high density areas according to NMFS data from the previous two years.

Analysis of BSFRF survey data from the 10 blocks surveyed in the Bristol Bay red king crab district was completed using the standard NMFS area swept methodology of generating crab densities in numbers of animals per square nautical mile and expanding these numbers to crab abundance estimates for the area in the 10 blocks (about 4,000 square nautical miles). Analysis of red king crab abundance was summarized by the NMFS five standard size/sex categories; large males (≥135 mm), medium males (110-134 mm), small males (<110 mm), small females (<90 mm) and large females (≥90 mm). For the same 10 blocks, we also received from NMFS their 2005 survey haul and crab catch data. We analyzed this data following the same area swept procedures to generate a comparison with the crab abundance determined from the BSFRF survey.

RESULTS, BRISTOL BAY RED KING CRAB

The Canadian gear package performed extremely well on the Bering Sea red king crab grounds. Equipped with a variable pitch propeller, the *F/V American Eagle* was able to tow the small trawl at desired slow speeds of 1.8-2.2 knots. The NETMIND™ acoustical sensors also performed well and indicated good trawl contact with the seabed as did physical indicators of the trawl. For the short tow durations, the trawl did not "over load" with bottom debris and the coarse sand/gravel substrate filtered out of the trawl effectively.

The *F/V American Eagle* and crew were able to complete 9-15 tows per day with an average of 11 tows completed per day during this survey. NMFS tows in the Bristol Bay red king crab district, which consists of 136 survey blocks, caught red king crab in only 61 blocks during 2004 and in 65 blocks during their 2005 survey (Exhibits 8-9). Given a focus on survey blocks in the red king crab district with crab catches and avoidance of blocks without red king crab catches, a BSFRF style of survey could be conducted in about two months of vessel time at the 2005 sampling density of about 13 tows per 400 square miles. Optimal sampling densities are being further investigated and will be updated.

Exhibit 10 provides densities and abundance estimates of red king crab from the 10 survey blocks as a result of the BSFRF survey and as a result of the standard NMFS survey of the same 10 blocks. The BSFRF survey produced substantially higher densities of all sizes of both male and female red king crab than did the standard NMFS survey (Exhibit 11). If one assumes that the catchability coefficient of the BSFRF trawl gear was 1.0, the NMFS trawl catchability coefficient equaled 0.60 for large male red king crab, 0.38 for medium males, 0.34 for small males, 0.48 for large females and 0.49 for small females (Exhibit 12). It should be noted that BSFRF survey area swept per tow used for preliminary results is based on conservative estimates of tow duration, tow speed and trawl spread of 7 minutes, 2.2 knots and 8 meters, respectively. Final analysis may prove different actual tow specifications yielding a smaller area swept which would increase BSFRF abundance estimates further.

RESULTS, *OPILIO* TANNER CRAB

On the much softer and more muddy substrate of the *opilio* grounds, the Canadian gear package performed well but tended to "mud up" from 5-7 minute tow durations. On haul-back, codends on the *opilio* grounds contained substantial mud but most could be cleared from the trawl by prop wash if the codend was towed near the stern of the vessel for several minutes before being hauled up the stern ramp (Exhibit 13). Gear performance is still being reviewed but preliminary indications are that tow durations much longer than 5-7 minutes with this trawl would likely compromise gear configuration and operational performance. Whole haul catch sampling proved impossible due to the high catch volumes of *opilio* (Exhibit 14), and as a result for this limited survey, only total *opilio* catch weights were obtained. The crew was not prepared to subsample *opilio* catches by collecting random subsamples of *opilio* for sexing and measurements. *Opilio* catches from the 26 tows completed in the three blocks surveyed were typically 5-7 baskets of crab per 5-7 minute tow but peaked at 19 baskets weighing 303 kilograms.

Opilio densities determined from the BSFRF 26 tow mini survey of the three blocks representing about 1,200 square nautical miles translated to a biomass of total *opilio* (all sizes, male and female) of approximately 183 million pounds. The biomass estimate from the NMFS survey of the same 3 survey blocks was approximately 27 million pounds (Exhibit 15).

CONCLUSIONS AND CONTINUING WORK

The Canadian otter gear package performed very well on the seabed in the Bristol Bay red king crab district. Survey effort and collection of biological data from whole haul sampling proved feasible and progressed at an average rate of 11 tows per day. Using this gear package and survey methodology, future surveys of Bristol Bay red king crab over grounds where red king crab has occurred in recent years would likely require about two months of vessel time. Area swept by the NMFS

trawl survey in a 30 minute tow was about 11 times the area swept by the Canadian trawl in a 5-7 minute tow. For the 10 blocks surveyed by both gear types involving 129 BSFRF tows and 10 NMFS tows, the resulting crab densities and abundance estimates differed substantially for nearly equal areas of the seabed swept by a trawl. We conclude that the NMFS trawl is sampling about 60% of the legal sized red king crab and much less of smaller sized king crab. The limited *opilio* work completed during the BSFRF 2005 survey was a bonus. While the gear performance was reasonably good at 5-7 minute tows, gear "mud-up" may be a problem on some *opilio* grounds. *Opilio* catch rates were high in the limited area sampled and it was not possible to sex and measure all crab in catches without subsampling—a task which needs to be further investigated for future *opilio* work. Results of the limited BSFRF *opilio* survey and comparisons with the NMFS standard trawl survey over a 1,200 square nautical mile area indicate that the NMFS trawl survey grossly underestimates *opilio* abundance.

During the next two months, Dr. Conan will analyze the results of the BSFRF survey of Bristol Bay red king crab using his analytical tools and complete variance and biomass estimates for a more detailed comparison to the NMFS trawl survey in the 10 blocks surveyed during 2005. Similar work will also be completed with the limited *opilio* survey data. We will also determine an optimal sampling density based on the BSFRF methods that can be deployed in the future to maximize survey coverage per unit of survey cost with minimal loss of precision of crab abundance estimates.

The BSFRF is pleased to present preliminary results of their work during 2005 to the North Pacific Fishery Management Council's Crab Plan Team and we look forward to continuation of this research in the future. We thank the Alaska Fisheries Science Center and Alaska Department of Fish and Game for their assistance in this cooperative research.

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