Project Title: Effects of environmental conditions on halibut bycatch rates in the Gulf of Alaska, Bering Sea, and Aleutian Islands groundfish fisheries $78.7K

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Overview: The goal of this project is to investigate whether local environmental conditions influence rates of halibut bycatch in groundfish trawl and longline fisheries in the Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands (BSAI). It is currently unknown whether bycatch rates of halibut in groundfish fisheries are driven by fishing behavior, environmental conditions, or other factors. This work would be focused on detecting environmental conditions which influence halibut bycatch rates and identifying possible halibut hotspots to help groundfish fleets lower halibut bycatch rates.

In the past 10 years, at least one groundfish fishery annually has been closed due to reaching seasonal halibut bycatch catch limits prior to achieving catch limits for targeted species. The GOA deep- and shallow-water species complexes are impacted most often, while impacts on yellowfin sole are greatest among Bering Sea species. Halibut bycatch mortality in GOA and BSAI trawl and longline groundfish fisheries was estimated at 5,109 t (14,712 t was caught) in round weight in 2013. For comparison, the combined directed 2013 IFQ and CDQ halibut quota for the GOA and BSAI was 13,910 t in round weight.

Identifying methods for avoiding halibut bycatch in GOA and BSAI groundfish trawl and longline fisheries would allow greater catches of groundfish while lowering usage of halibut prohibited species catch (PSC) limits. In addition, advancing research and development of new fishing techniques designed to lessen environmental impacts of federally managed fisheries is a key research priority for the Alaska Fisheries Science Center.

The proposed project would deploy mini-data loggers on groundfish trawl and longline fishing vessels to measure temperature and conductivity at depth at the time of fishing. This information would then be linked to observer, VMS, logbook, and landings data to explore whether local environmental conditions influence halibut catch rates.

Research description:

Small-sized data loggers will be purchased and used to measure temperature and salinity at depth on longline and trawl groundfish fishing vessels operating in the GOA and BSAI. The data loggers will be deployed on BSAI groundfish trawl vessels with headropes and BSAI longline vessels. Industry partners will assist in identifying a subset of vessels that can provide maximum spatial and seasonal coverage of the BSAI and an analysis of observer data will be conducted to confirm that selected vessels are likely to cover a broad range of areas and dates. Deployment of data loggers on GOA trawl and longline vessels will be coordinated with assistance from industry partners to maximize the overlap of data collection by data loggers and observers.

Volunteer fishers will be identified during fleet meetings held in Seattle, Washington in 2015. AFSC scientists will travel to Kodiak and Dutch Harbor, Alaska to coordinate a reliable system for distribution of data loggers among vessels, and collection and shipping of data loggers. Fishers selected for this project will be provided with the data loggers and instructions on how to deploy the data loggers in December 2015. The data loggers will be deployed on the headrope or on the third-wire headrope sounder of trawls within protective housing to minimize the probability of loss or damage to data loggers. On longline vessels, two data loggers will be deployed on each set, one on each end of a single longline string. Many longline sets are made across slopes and, given the length of a single string (10 to 40 km), potentially across environmental fronts. Deploying data loggers on both ends of a string will provide information on variability within sets. Data loggers will be set to collect data only when the logger reaches a depth of 10 meters or greater. The loggers will collect a data point every one minute while submerged when used on trawls and every 10 minutes while submerged when used on longline sets.

Data loggers will be mailed to AFSC scientists for analysis every two months throughout the fishing season and when they are finished fishing for the year or by 31 December 2016. The data will be downloaded by AFSC scientists to a temporally referenced ORACLE database at the AFSC designed for this project. After data are downloaded, loggers will be cleared and mailed back to each vessel for further data collection to reduce the overall number of data loggers needed for the project. The downloaded environmental data will be linked through time and date to the observer, VMS, logbook, and landings databases. Exact haul location, species composition, length, and total weight of halibut and other groundfish catch in each haul will be available.

A mixed-effects modeling approach (Minami et al. 2006; Zuur et al. 2009) will be used to investigate linkages between temperature, salinity, and halibut and targeted groundfish catch with the aim of identifying environmental covariates that consistently predict halibut encounter rates, as well as halibut catch rates in commercial fishing operations. Analyses will be completed by September 2017 by the project's principal investigators. All results will be presented to the fishing industry at the Seattle Pacific Marine Expo in November 2017.

Several data loggers, polyurethane and stainless steel protective housing, and the experimental design will be tested by volunteer fishers in the summer of 2015 to identify and fix any potential problems with equipment and deployment methods. Two types of mini data-loggers exist and both will be evaluated during the testing phase of the study. Data loggers that record temperature and conductivity are preferred for the project, but require further testing on GOA and BSAI trawls and longline vessels to ensure that they will withstand conditions when attached to fishing gear. A second type of mini data-logger does not measure conductivity, but these data loggers have been used extensively in previous studies and would gather temperature data at depth reliably if data loggers that record temperature and conductivity are not sufficiently robust.

Performance Indicators:

1) Completion of public meetings in Kodiak and Dutch Harbor, Alaska by September 2015 describing the project and seeking volunteers.
2) Identification of trawl and longline vessels willing to deploy data loggers in the GOA and BSAI groundfish fisheries.
3) Deployment of data loggers onto fourteen commercial fishing vessels by January 1, 2016.
4) Return of at least 10 of the data loggers to AFSC researchers by January 10, 2017.
5) Development of a database on the AFSC ORACLE server for the environmental data from the returned data loggers.
6) Final report on the project completed in the form of a NOAA technical memo by September 2017.

Deliverables:

1) Oracle dataset of depth, temperature and conductivity at depth, and time of fishing from the returned data loggers, linked to number and weight of halibut catches and targeted groundfish stocks from observer, VMS, logbook, and landings data.
2) Completion of a NOAA technical memo entitled "Impacts of temperature, salinity and depth on Pacific halibut (*Hippoglossus stenolepis*) bycatch in the North Pacific groundfish fisheries." by September, 2017.
3) Presentation of results at a special session of the Seattle Pacific Marine Expo in November 2017.

Mini-CTD technical specifications for project:

Sensors:	Conductivity, temperature, pressure
Size:	Less than 50mm in length
Housing:	Ruggedized casing to withstand commercial fishing applications
Memory capacity:	At least 84,000 measurements
Memory management:	Customizable memory management
Temperature resolution:	At least 0.05°C
Temperature accuracy:	At least +/-0.1°C
Temperature range:	-1°C to +30°C
Standard depth ranges:	10 m to 2000 m
Depth resolution:	At least 0.1 m
Depth accuracy:	At least 2 m
Conductivity ranges:	At least 3 to 30 mS/cm
Conductivity resolution:	At least 0.01 mS/cm
Conductivity accuracy:	At least +/-1.5 mS/cm

Clock:	Real time clock with an accuracy of at least +/-1 min per month
Sampling interval:	Adjustable sampling interval of between 0.5 and 20 minutes.
Number of different sampling intervals:	At least 4
Communications:	USB communications
Battery life:	At least 3 years

Budget:

Item	**Cost per item**	**Number**	**Total**
1) Personnel	**$ -**		**$ -**
2) Fringe Benefits	$ -		$ -
3) Travel			
Travel to Dutch Harbor and Kodiak (2 scientists)			
Flight	$ 1,600	2	$ 3,200
Per diem and hotel	$ 292	6	$ 1,752
4) Equipment	$ -		$ -
5) Supplies			
Miniature data logger	$ 1,056	60	$ 63,360
Protective housing for data loggers	$ 80	40	$ 3,200
Data logger reading software	$ 271	1	$ 271
Data logger reading hardware	$ 399	1	$ 399
6) Contractual	$ 2,500	2	$ 5,000
7) Other			
Supplies and Equipment Shipping	$ 1,500	1	$ 1,500
8) Total Direct Charges			$ 78,682
9) Indirect Charges	$ -		$ -
10) Totals			**$ 78,682**
11) Leveraged Sources of Funding	$ -		$ -

Budget justification:

The majority of the budget ($67,230) is for the purchase of miniature data loggers which record temperature and conductivity at depth, protective housing for data loggers, and hardware and software to read the data from the data loggers. It is expected that 50 data loggers will be deployed at any one time. An additional 10 loggers are needed as backup equipment, as some equipment failure is expected given the harsh conditions these sensors will endure when attached to fishing gear.

Travel funds ($4,952) are sought for a researcher to travel to both Dutch Harbor and Kodiak in the summer of 2015 to coordinate a system for deployment, collection, and shipping of data loggers. It is expected that each trip will take three days.

Contractual funds ($5,000) are sought to compensate one individual in each location (Kodiak and Dutch Harbor) to distribute, collect, and ship data loggers to AFSC scientists according to plans that will be developed and finalized by researchers and industry partners during travel to Kodiak and Dutch Harbor in summer of 2015.

Office supplies such as envelopes, packaging, and shipping of loggers and accessories back and forth to industry partners will cost approximately $1,500.

References:

Minami, M., C.E. Lennert-Cody, W. Gao, and M. Roman-Verdesoto. 2006. Modeling shark bycatch: The zero-inflated negative binomial regression model with smoothing. Fisheries Research 84:210-221

Zuur, A., E. N. Leno, N. Walker, A.A. Saveliev, and G. M. Smith. 2009. Mixed effects models and extensions in ecology with R. Springer, New York