EXECUTIVE SUMMARY

Practical Applications of Fishing and Handling Techniques in Estimating the Mortality of Discarded Trawl-Caught Halibut

by

Ellen K. Pikitch[1&2], Daniel L. Erickson[1], Christopher K. Mitchell[3], and John R. Wallace[1]

[1] University of Washington, Fisheries Research Institute, Box 357980, Seattle, WA 98195
[2] Osborn Laboratories of Marine Sciences, Boardwalk at West 8th St., Brooklyn, NY 11224
[3] Alaska Fisheries Development Foundation, 900 West Fifth Ave., Suite 212, Anchorage, AK 99501

I. Overview of Purpose and Methods. A field study was conducted aboard commercial groundfish vessels fishing off Kodiak, Alaska to describe and evaluate current practices and alternative methods for estimating the mortality of discarded trawl-caught Pacific halibut. Each of seven trawl vessels carried a NMFS observer and an AFDF project biologist. Observers were instructed to perform their duties as they normally would; data collected by observers included halibut catch (sometimes obtained via sub-sampling), and condition (excellent, poor, or dead). Project biologists counted and recorded the time each halibut was discarded, and collected information on fishing and fish handling practices employed during each tow. Data were collected during 28 trips conducted during February and March 1996.

Halibut bycatch mortality was estimated by several methods using various types of information collected by observers and/or project biologists. Key elements of the estimation procedures were: a) the IPHC model which relates halibut condition to halibut mortality; and b) the UW model which estimates mortality as a function of fishing and handling practices, and other aspects of fishing operations.

II. Results and Conclusions

A. Fishing and Handling Practices that Affect Halibut Condition and Survival. Previous field research documented that the post-capture survival of trawl-caught halibut returned to the sea-bed in cages decreased as deck exposure time, tow duration, air temperature, and the amount of sand or mud in the catch increased, and as fish size decreased (Pikitch et al. 1996). The UW model summarizes these results in the form of an equation predicting survival as a function of these factors. This section summarizes results obtained in the 1996 study focusing on the effects of various fishing and handling practices on halibut condition (as recorded by NMFS Observers) and halibut survival as measured by the IPHC model. A later section compares these results with those obtained using the UW model.

1. Deck exposure time. Deck exposure times observed in this study ranged

from less than one minute to over two hours. Halibut condition deteriorated as time on deck increased; about half of the halibut returned to the sea within 15 minutes were in excellent condition, whereas fewer than 10% of fish on deck up to one hour were in such condition. According to the IPHC model, survival of crew-handled halibut was predicted to be 46.8%. If crew had returned all halibut to the water within 15 minutes, survival estimated from the IPHC model would have increased to 61%.

2. Tow duration. Average tow duration varied widely among vessels, and ranged from a low of 1.4, to a high of 3.1 hours. Analysis of variance indicated that halibut condition significantly declined as tow duration increased.

3. Amount of sand in the catch. The condition of halibut was negatively impacted by the presence of large quantities of sand or mud in the catch. Survival of halibut caught in sandy or muddy tows predicted by the IPHC model (32%) was much lower than the overall predicted survival (46.8%).

B. Observer Sampling Procedures.

1. Whole-haul vs. sub-sampling. Overall, observers sub-sampled 91 and whole-haul sampled 63 tows to estimate the quantity of prohibited species. However, observers differed markedly in sampling intensity with some opting to whole-haul sample every tow, others sub-sampling every tow, and the remainder using both sampling techniques to varying degrees.

2. Frequency of condition assessments. The percentage of halibut examined for condition varied greatly among observers. One observer examined only 4% of the total halibut catch for condition (including tows for which halibut catches were small), whereas some observers sampled nearly every halibut caught.

3. Time distribution of condition assessments. We found large differences in deck exposure time for halibut assessed for condition by observers and halibut handled by the crew. On average, the crew discarded more than 35% of the halibut they ultimately handled within the first 15 minutes after catches were landed on deck, whereas observers recorded viability on less than 10% of their sample within that time.

4. Differences in condition assessments among observers. As each vessel carried only one observer, it was not possible to directly compare viability assessments among observers for the same fish. Thus, inferences about variation in condition assessments are based on indirect

measures. We found significant differences in viability distributions of halibut caught under similar conditions. While these results are not conclusive, they suggest that different observers may judge the viability of halibut differently.

C. Effects of Sampling Procedures on Bycatch Estimates

1. Estimated halibut numbers. For sub-sampled hauls there were more instances when bycatch was underestimated than overestimated. However, the tendency to overestimate halibut catch increased as halibut bycatch increased, so that overall, halibut catch was overestimated to a significant degree. The estimated catch of halibut in sub-sampled hauls exceeded the actual catch in these hauls by 44%.

2. Percent survival. Given the results described in II.A.1 and II.B.3 on halibut condition and its relationship to deck exposure time, the percent survival of bycaught halibut assessed by observers would be expected to differ from the actual survival of halibut handled by the crew. Applying the IPHC model to data from tows sampled by both NMFS observers and crew yielded survival estimates of 46% for halibut handled by crew members and 33% for halibut assessed for condition by observers.

3. Total bycatch mortality estimates. Sampling procedures used by observers in this study led to estimates of bycatch number and percent mortality that were biased high; hence total bycatch mortality was overestimated by observers (assuming the IPHC model is accurate).

D. Comparison of IPHC and UW Models

1. Qualitative comparisons of survival. Mean survival estimates obtained from the UW model increased as halibut condition assessments progressed from moribund to excellent, and as IPHC-estimated survival increased. In addition, the two estimators exhibited consistent trends between halibut survival and factors such as deck exposure time, towing duration and the presence or absence of large amounts of sand and/or mud in the tow. Thus, UW and IPHC estimators of halibut survival were qualitatively consistent.

2. Quantitative comparisons of survival. The relationship between IPHC- and UW-model estimates of survival was positive and curvilinear. The UW model typically provided higher survival estimates than the IPHC model when sample sizes were small, but estimates from the two models tended to converge as sample sizes increased. Overall mean halibut survival per tow estimated using the UW model was greater (58%) than that estimated for the IPHC model (43%), and this difference was

significant (paired t-test; n=109, P<0.01).

3. Further evaluation. This study was not designed to determine which of the two survival estimation models is more accurate or precise. Analyses of data from a joint IPHC-UW cruise in which both sea-bed cage methodologies and tagging were used should shed light on the causes of observed differences and the relative accuracy and precision of each of the estimation procedures. Some analyses are in progress, while others await recapture of sufficient numbers of halibut tagged during the joint cruise. A combination of the two approaches may provide better estimates than those obtained from the individual models.

4. Feasibility of data collection. Data required to utilize both IPHC- and UW-models were easily collected by the NMFS observer and AFDF project biologist present on each vessel during this study. Most of the data necessary to implement the UW model are already routinely collected by observers. Additional data needs are: the time the codend is landed on deck, air temperature, whether sand or mud is mixed with the catch, and the time that each halibut handled by the crew is discarded. Of these additional data requirements, only the last represents a significant departure from current practices. However, a single observer could not accurately record the time each halibut was discarded by the crew and simultaneously assess its condition. One observer could collect data needed to implement the UW model approach to survival estimation, but other duties now required of observers would likely be impacted. While IPHC estimates of survival are based on data collected by one observer we showed that resulting estimates are likely to be biased given current sampling procedures.

E. Conclusions. The major conclusions of this study are as follows:

1. The mortality of halibut caught in trawls can be reduced by modifying fishing and handling practices. Halibut condition and estimated survival were shown to improve as deck exposure time and tow duration were reduced and when sand or mud were absent from catches. These results were consistent for the two estimators (IPHC- and UW models) examined and with those from related studies. While not observed in data collected in this study, other work suggests that avoiding areas where small halibut congregate and fishing during seasons when air temperatures are relatively low will also result in reduced halibut mortality.

2. Current sampling practices employed by observers lead to overestimates of mortality when the IPHC-model is used. This is because sub-sampling catches yielded overestimates of halibut bycatch numbers and because halibut assessed for viability by NMFS observers remained on

deck longer than halibut handled by the crew. Correction of identified problems may require employing two observers per trip and/or changing sampling priorities of observers.

3. Data required to employ the UW-model are feasible to collect during commercial operations. Most of the data necessary to implement the UW model are already routinely collected by observers. The major additional data required is the time that each halibut handled by the crew is discarded. Viability assessments currently collected by observers are not needed for the UW model. We recognize that demands on observers are many, and it might still be necessary to have more than one observer aboard each vessel to fulfill all data needs.

4. Recording of the time each halibut is discarded by the crew would greatly improve survival estimates. Collection of this information would provide accurate estimates of the total number of halibut caught, and enable corrections of viability data to account for differences in the times halibut are handled by the crew and by observers. Therefore, unbiased estimates of survival using the IPHC model could be obtained. In addition, collection of this data would allow the UW model of survival estimation to be employed.

5. Estimates of halibut mortality provided by UW- and IPHC- models differed, with the former model producing higher survival estimates than the latter. It was beyond the scope of this study to determine which of these models is more accurate or precise. Further investigation is needed to address these questions as well as to examine the benefits of using a combined approach to mortality estimation.

Reference:

Pikitch, E.K., D. Erickson, G. Oddsson, J. Wallace and E. Babcock. 1996. Mortality of trawl-caught and discarded Pacific halibut (*Hippoglossus stenolepis*). ICES C.M. 1996/B:16.