Final Report
to NMFS
EFP 09-01

Halibut Bycatch Discard Survival Experiment for a Bering Sea, Non-pelagic Trawl Fishery

North Pacific Fisheries Foundation
January 2011

INTRODUCTION

The North Pacific Fisheries Foundation (NPFF) was approved under Exempted Fishing Permit (EFP) 09-01 to conduct an experiment to examine a proposed method of measuring the survival of Pacific halibut bycatch while participating in Bering Sea/Aleutian Islands (BSAI) non-pelagic trawl flatfish fisheries during 2009 and 2010. By regulation, trawl caught halibut must be immediately released with a minimum of injury after capture (50 CFR Parts 679.7 (a)(12) and 679.21 (b)(2)) and the EFP was granted to allow holding of halibut onboard ship for the experiment. This research project was developed in cooperation with the Fisheries Behavioral Ecology Program of the Alaska Fisheries Science Center, National Marine Fisheries Service (AFSC, NMFS) at Newport, OR, the International Pacific Halibut Commission (IPHC), and the Fisheries Monitoring & Analysis Division of the AFSC at Seattle, WA.

The F/T SEAFISHER, an Amendment 80 (A80) trawl vessel participating in cooperative quota and community development quota (CDQ) fisheries, served as the research platform during both years of the experiment. No additional halibut prohibited species quota (PSQ) was requested or used as part of this experiment. Halibut caught while conducting the experiment accrued against A80 cooperative PSQ in 2009 and CDQ PSQ in 2010.

Observers have collected halibut bycatch condition data since the late 1970s (Williams and Wilderbuer 1995) and since 2000 have used a dichotomous key, developed by the IPHC, to determine the condition of halibut bycatch (Williams 2008). The IPHC key uses a combination of external physical characteristics and reflex actions in up to nine categories (some various degrees of the same characteristic or reflex) to score halibut bycatch as excellent, poor, or dead. For trawl caught halibut bycatch, the mortality is estimated to be 20% for excellent, 55% for poor and 90% for dead condition fish (Clark et al. 1992). The reflex action mortality predictor (RAMP) method uses reflex actions (six in this study) to produce a numerical condition score with seven possible outcomes ranging from 0.0 – 1.0, where 1.0 represents a fully impaired fish with no reflex responses and 0.0 represents a fish with no reflex impairment (Davis 2007). At present, there are no RAMP derived mortality estimates for trawl caught halibut bycatch though laboratory studies have estimated a mortality curve (see Davis and Ottmar 2006).

Our experiment had three objectives:

1. Determine paired RAMP & IPHC viability assessment scores in individual halibut collected from hauls on board ship after capture by trawl during commercial fishing.

2. Calculate and calibrate a RAMP mortality curve for halibut.

3. Collect trawling, deck, and live tank environmental conditions data for determining fishing factors associated with halibut immediate, delayed, and total mortality.

MATERIALS & METHODS

The study was completed during commercial fishing trips in 2009 (August 8 – 14) and 2010 (April 4 – 11) aboard the F/T SEAFISHER, a 70 m stern trawler. The vessel is part of the Alaska Seafood Cooperative (formerly the Best Use Cooperative) and also harvests CDQ. In 2009, samples were collected while the vessel participated in A80 fisheries and targeted arrowtooth flounder in NMFS Areas 517, 518 and 519. In 2010, halibut were collected and held while the vessel targeted yellowfin sole CDQ in NMFS Areas 513 and 517 (Figure 1).

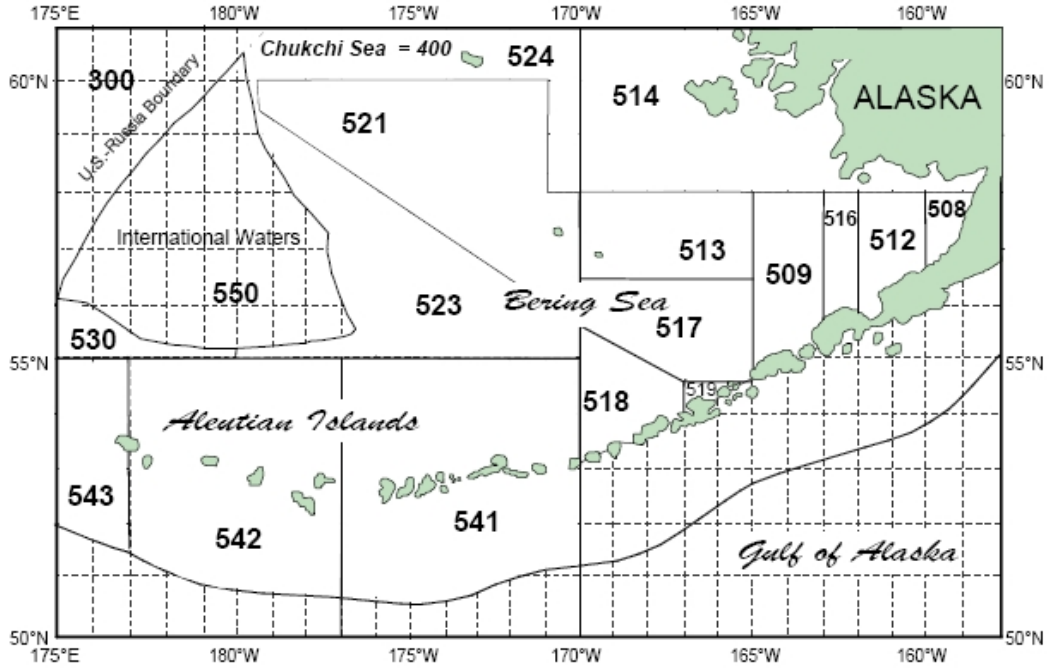


Figure 1. Bering Sea/Aleutian Islands NMFS regulatory areas.

A representative from the NPFF (Todd Loomis) and the IPHC (Katie Hallgren) served as the researchers and conducted all facilities set-up and data collection during both years of the experiment. They completed a RAMP training session at the NMFS Newport, OR facility with Dr. Michael Davis prior to completing field work. There were two fisheries observers assigned to the vessel in both years, but they did not actively participate in data collection outside of their normal duties. Prior to the first trip in 2009; researchers, observers, and several officers and crew participated in a pre-cruise discussion with NOAA Fisheries personnel to review the research plan, data sharing, and how the researchers and observers would interact. A similar meeting occurred in 2010 at the NOAA Fisheries' Observer Program field office in Dutch Harbor. The latter meeting did not include personnel from the vessel.

Halibut holding tanks consisted of six, 103 gallon Daco Magnum 1200 containers (ID 100 cm long x 68 cm wide x 57 cm high) installed in the processing factory (Figure 2). Each tank was fitted with a 1.5" water inlet and outflow and plumbed to the vessel's supply of seawater. Inlet volume was controlled by a water manifold with a ball valve for each tank and the outflow was fitted with a stand pipe to ensure the tanks were completely full when the standpipe was in the upright position. Each tank had a locking lid to minimize water motion and keep the tank environment darkened. Prior to halibut collection, tanks were cleaned, flushed with seawater,

and four, 13 oz cups of Unimin 4060 silica sand were evenly distributed on the bottom of the tanks. The sand provided a familiar substrate to halibut that helped settle them into the tank environment. In the absence of substrate, during laboratory testing, halibut continually rubbed against the bottom of the holding tanks causing abrasion wounds (Dr. Michael Davis, personal communication). Water flow was set at 3 – 5 gal/min and tanks were monitored twice per day using a bucket with gallon gradations to measure outflow at the stand pipe. The stand pipes were rotated approximately 45 degrees and the water level in each tank was permitted to equalize prior to flow measurement.

Figure 2. Halibut holding tanks and water supply manifold.

Halibut in the full range of conditions (i.e., unimpaired to fully impaired) were necessary to construct a curve expressing the relationship between reflex impairment and mortality in this study. Sampling attempted to obtain equal numbers of fish in the range of impairment states, as they became available from the sorting line or live tank. In 2009, halibut were collected primarily from the sorting line at a location after the observer sampling station; however, several halibut were collected directly from the live tank in an effort to find minimally impaired halibut. The permit conditions were modified for 2010 such that halibut collections were authorized to only take place from the sorting line after they passed by the observer's sampling station.

In both years of the study, the researchers worked together with one individual performing the assessment while the other recorded the data. The IPHC assessment was always completed first and was done according to the Key to Pacific Halibut Viability for Trawl Vessels (AFSC 2009, Appendix 1). Each halibut was scored as E – excellent, P – poor, or D – dead and raw scores for each category were recorded for each viability assessment (Appendix 3). The RAMP assessment

occurred second and six reflex actions were measured: unrestrained or open body flex, restrained body flex, mouth closure, opercula closure, gag, and vestibular ocular response (eye roll). RAMP reflexes noted during the IPHC assessment, but not during the RAMP assessment were recorded as absent because each assessment method was tested independently of the other. An additional RAMP reflex, mouth gaping/coughing, was noted, but not consistently recorded in 2009. It was consistently recorded in 2010.

A cushioned holding device and probe were used during RAMP assessments (Figure 3), but not for the IPHC assessments. The holding device was necessary for consistent halibut control while testing for reflexes and also for testing for restrained body flex. RAMP responses were scored as 1 for present and 0 for absent and final RAMP scores were calculated as:
RAMP = 1 – (∑ reflex scores/6). Thus, a RAMP score approaching one represented halibut with the most impairment, whereas a fish with little impairment would have a score approaching zero. Halibut were T-bar tagged in the pectoral fin, and held for three days or until they died. A maximum of six halibut were placed in each tank to minimize crowding and stress. At the end of the holding period individual halibut were netted from the tank, assessed once more using each method, the tag was removed, and the fish were released via the vessel's overboard conveyor.

Figure 3. RAMP test for opercula closure (note halibut in restraining device).

Holding tanks were monitored twice each day for halibut mortality, water temperature, flow, dissolved oxygen, and ammonia. Water temperature was measured using a digital thermometer in 2009 and an aquarium thermometer in 2010. Temperature was taken at the stand pipe outflow and water chemistry was measured using a HACH kit. Dissolved oxygen and ammonia were monitored only in tanks holding halibut. Additional information was collected from each trawl haul including: haul number, set and retrieval times, bin temperature, fishing depth and temperature, surface temperature, quantity of catch, and catch species composition. Catch and species composition data were obtained from the fisheries observers.

RESULTS

A total of 62 halibut were collected, assessed, and held on board ship under this EFP (Appendix 2). In 2009, 11 halibut were collected from two small hauls (2.4 mt and 3.8 mt) in NMFS Areas 517 and 519. Seven halibut were collected from the sorting line during the processing of the first haul and each was evaluated using both methods, tagged, and placed into holding tanks. Six halibut were placed in one tank and the seventh in a second holding tank (Figure 4).

Figure 4. A 64 cm halibut during the 3-day holding period.

In an attempt to find halibut in excellent (i.e., unimpaired) condition (see Table 1), three halibut were collected directly from the live tank immediately after haul 2 was emptied from the codend. Two of the three halibut collected fell within the desired length range (30 – 65 cm) and they were assessed, tagged and placed into a tank. The third halibut was too large (69 cm) and was given to the observer for sampling. Two additional halibut were collected from the sorting line during the processing of haul 2 and each was assessed, tagged, and placed into the second tank. For the remainder of the trip, which occurred in NMFS area 518 (August 9 – 12, 2009), the first 2 – 3 hours of sorting was monitored for halibut. While some halibut were noted in the catch, no halibut of a suitable length for holding were found during hauls 3 - 11.

Table 1. Halibut condition as expressed by IPHC and RAMP scores

Relative Condition	IPHC Score	RAMP Score
Unimpaired	Excellent	0.0
Moderately impaired	Poor	0.5
Fully impaired	Dead	1.0

During the morning water quality check at 0500 hrs on August 10, 2009 the first halibut mortality (Appendix 2, Tag #021706) was observed. The remaining five halibut were all alive, which was determined by observed swimming or operculum movement. During the evening

water quality check at 1900 hrs on August 10, 2009 a second halibut (tag 021703) was found dead. Each dead halibut was re-assessed (to make sure it was dead), tag removed, re-measured, and released overboard. No further halibut mortality was noted during the remainder of the 3-day holding periods in 2009 and water quality was acceptable throughout the trip (Table 2).

Table 2. 2009 and 2010 holding tank water quality test results.

	Temp. at depth (°F)	Tank temp. (°F)	Flow (gal/min)	O2 (mg/l)	NH3 (mg/l)
Low Reading (2009)	38.1	42.9	3.1	4	0.1
High Reading (2009)	39.4	46.5	5.0	6	0.2
Median (2009)	38.7	43.7	3.8	5.5	0.1
Average (2009)	**38.7**	**44.2**	**3.8**	**5.3**	**0.1**
Low reading (2010)	35.4	32	1.3	3	0.0
High reading (2010	38.8	38	10	11	0.0
Median (2010)	37.6	32	4	9.5	0
Average (2010)	**37.3**	**32.5**	**4.1**	**8.7**	**0.0**

At 2358 hrs on August 11, 2009 the 3-day holding period ended for tank 3. Beginning at 0013 hrs on August 12, 2009, each halibut was netted out of the holding tank and re-assessed prior to removing the tag and releasing the fish. At 0214 hrs on August 12, 2009 the 3-day holding period ended for tank 4 and beginning at 0223 hrs that day the halibut were netted, re-assessed, tag removed, and released. With one exception (halibut 021707), the same sampler that completed the initial IPHC or RAMP assessment completed the final assessment, but in all cases both researchers were present for all halibut assessments.

Initial IPHC viability assessments scored none of the halibut as excellent, 45% (5) as poor, and 55% (6) as dead while the final assessments yielded 55% (6) excellent, 27% (3) poor, and 18% (2) dead (Figures 5a and b). Using the initial IPHC halibut viability estimates and applying the IPHC mortality rates, predicted mortality in 2009 was 74% (8 of 11), but observed 3-day mortality was 18% of 2 of 11). While these results are interesting, the small sample size and 3-day holding period (compared to the IPHC long term tagging that was used to establish the mortality rates) prevents us from placing much emphasis on what was found in 2009 alone.

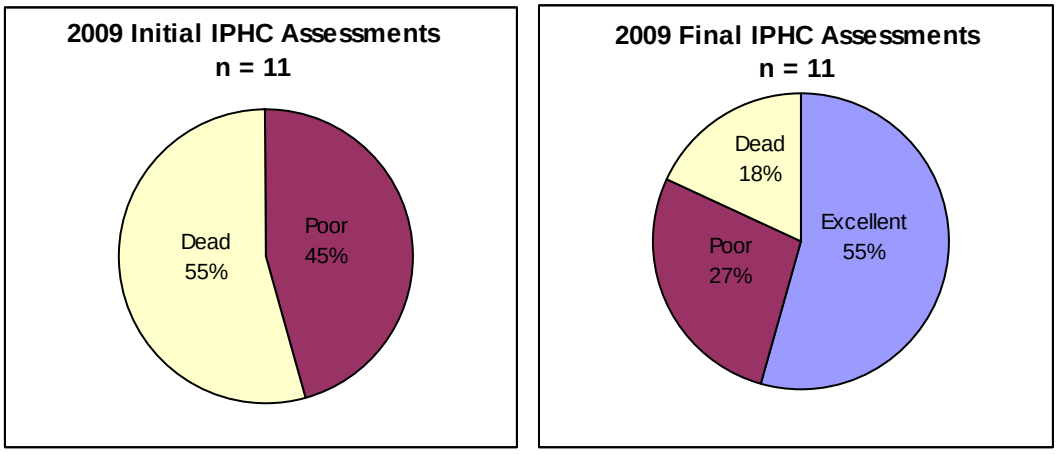


Figure 5a and b. Summary of 2009 IPHC halibut conditions before and after the 3-day holding period.

Of the 11 halibut held in 2009, many showed signs of recovery by the third day following the initial assessment. Of the six halibut initially assessed as dead, one actually died, two were in poor condition, and three were in excellent condition upon release (Figure 6). Of the five halibut initially assessed as poor condition, one actually died, one was in poor condition, and three were in excellent condition upon release.

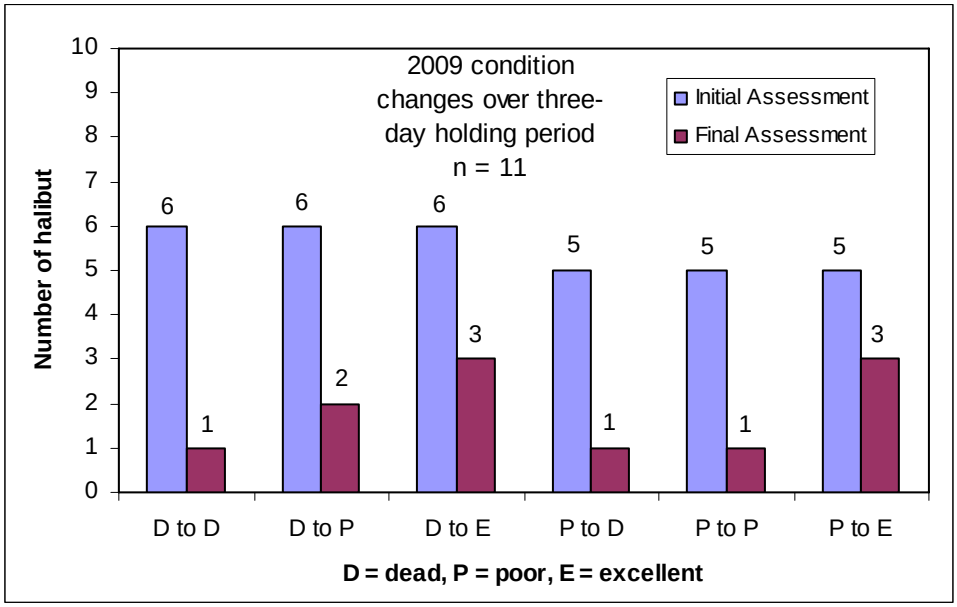
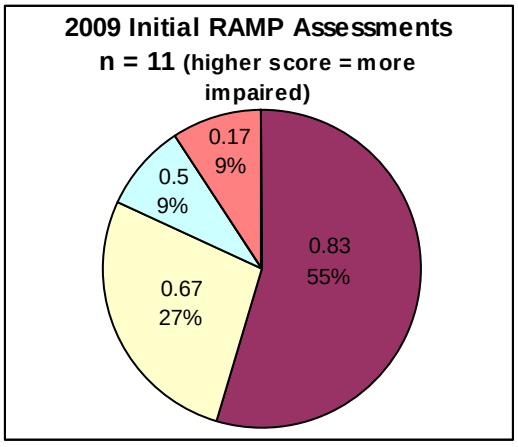
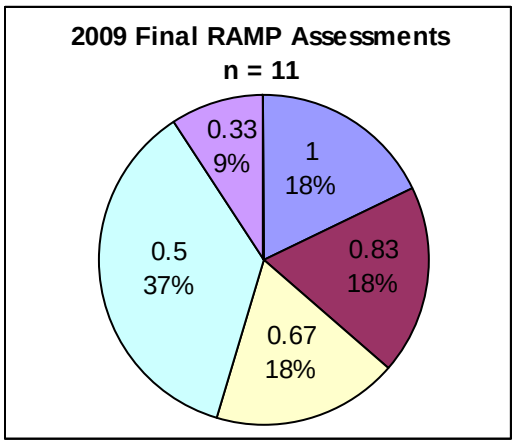


Figure 6. 2009 IPHC halibut condition changes from initial to final assessment.

For RAMP assessments in 2009, approximately 82% (9) of halibut scored as more than moderately impaired, 9% (1) as moderately impaired, and 9% (1) less than moderately impaired (Figures 7a and b, Table 3). At the end of the 3-day holding period 18% (2) halibut had died, 36% (4) scored as more than moderately impaired, 37% (4) were moderately impaired, and 9% (1) was less than moderately impaired. Note that the IPHC assessment was always done prior to the final RAMP assessment and in the small amount of time that elapsed reflexes some times disappeared. For example, some halibut were active with muscle tone during the IPHC





Figures 7a and b. Summary of 2009 halibut RAMP assessment scores from initial and final assessments.

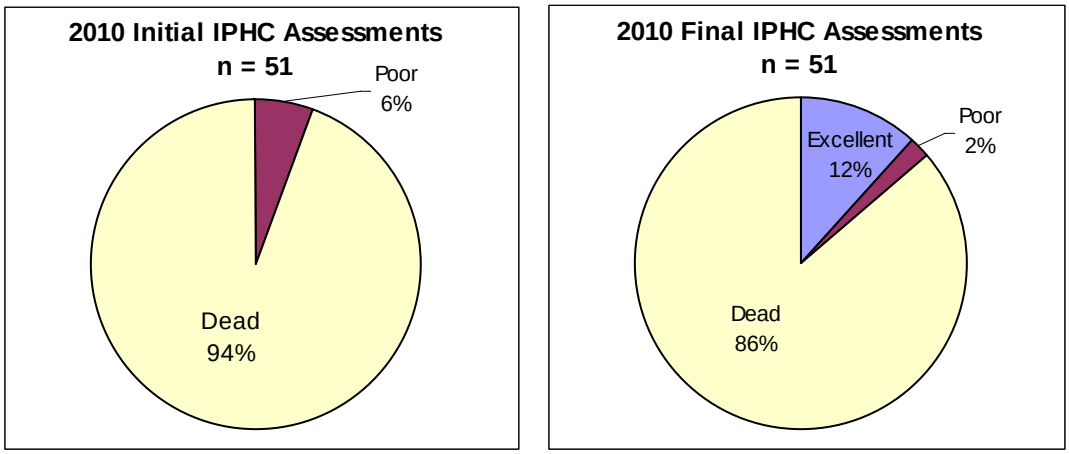
assessment, but did not have open or restrained body flex during the RAMP assessment. This pattern was noted for 4 of 11 halibut in 2009 indicating perhaps how quickly reflex actions are lost during handling. As noted in the methods section, a halibut had to show a particular reflex during the RAMP assessment in order for it to count.

A total of 51 halibut were collected, assessed, and held in the second year of the study (Appendix 2, Table 3). As mentioned previously, a change in permit conditions prevented halibut from being collected directly from the live tank in 2010. Halibut were collected in the natural order they exited the live tank and after they made their way past the observer sampling station. The change in permit conditions likely eliminated opportunities to find and hold poor and excellent condition.

Table 3. 2009 and 2010 RAMP initial and final assessment scores. Arrows illustrate change in condition.

	2009		2010	
RAMP Score	**Initial (# fish)**	**Final (# fish)**	**Initial (# fish)**	**Final (# fish)**
0.0 (unimpaired)	0	0	0	0
0.17	1	0	0	1
0.33	0	1	0	4
0.50	1	4	4	1
0.67	3	2	5	1
0.83	6	2	21	0
1.0 (fully impaired)	0	2	21	44

The vessel participated in the yellowfin sole fishery in a different NMFS Area in 2010 and halibut of the desired size range (e.g., 30 – 65 cm) were consistently available, although, the full range of halibut conditions was not. The experimental design required a number of samples from all halibut conditions (i.e., unimpaired to fully impaired), but we were not successful in finding any excellent or unimpaired halibut, only 3 of 51 were in poor condition, and the remaining 48 initially assessed as dead (Figure 8a). Predicted mortality (based on IPHC estimates) was 88% (45 of 51) and observed 3-day mortality was 86% (44 of 51, Figure 8 b) in 2010.



Figures 8a and b. Summary of 2010 IPHC halibut conditions before and after the 3-day holding period.

Environmental conditions were quite different in 2010 as the field season occurred in April vs. August the previous year (see Table 2). While the average temperature at fishing depth was relatively consistent (average difference 1.5°F) between years, the holding tank temperature was on average 11.7°F colder in 2010 when compared to 2009 and 4.8° F colder than temperature at depth. Air temperature was also considerably colder in the factory in 2010 when compared to 2009, where average live tank temperatures were 36.8° F and 54.7° F respectively.

Twenty-one halibut were collected from the first haul in 2010, but only three were initially assessed as poor (according to the IPHC protocol). The remaining 18 halibut were assessed as dead though 13 of those exhibited at least one RAMP reflex (Appendix 2). Over the remainder of the trip, an additional 30 halibut were collected, assessed, and held. All assessed as dead on the IPHC scale, but 14 of 30 exhibited at least one RAMP reflex and six of those had two or more RAMP reflexes.

There was more limited improvement in halibut condition from the initial to the final assessment in 2010 (Figure 9). Of the 48 halibut initially assessed as dead, 41 actually died, one was in poor condition, and six were in excellent condition upon release. Of the three halibut initially assessed as poor all died. These results are in stark contrast to what we found in 2009, but our limited sample size in 2009 prevents more rigorous comparison.

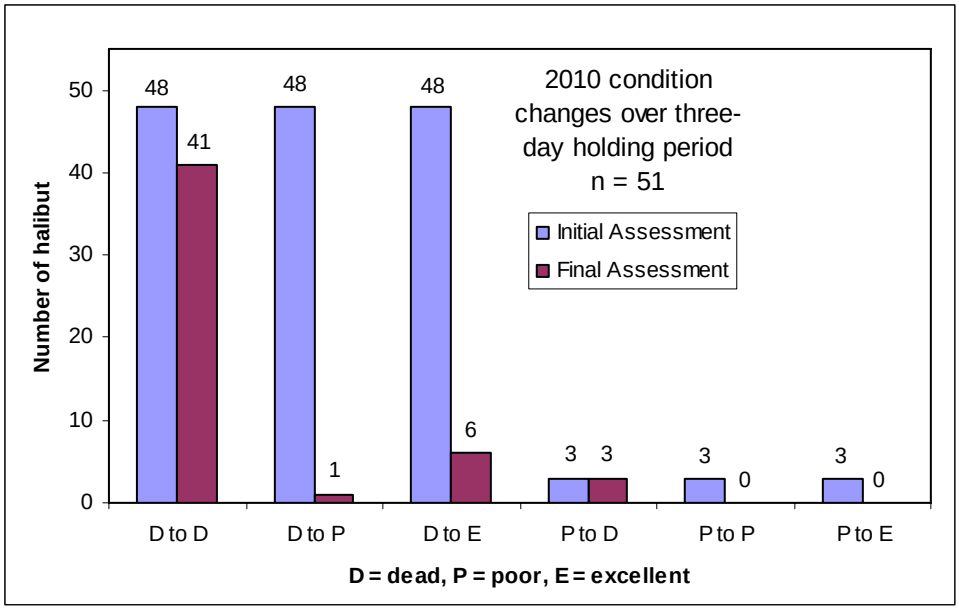
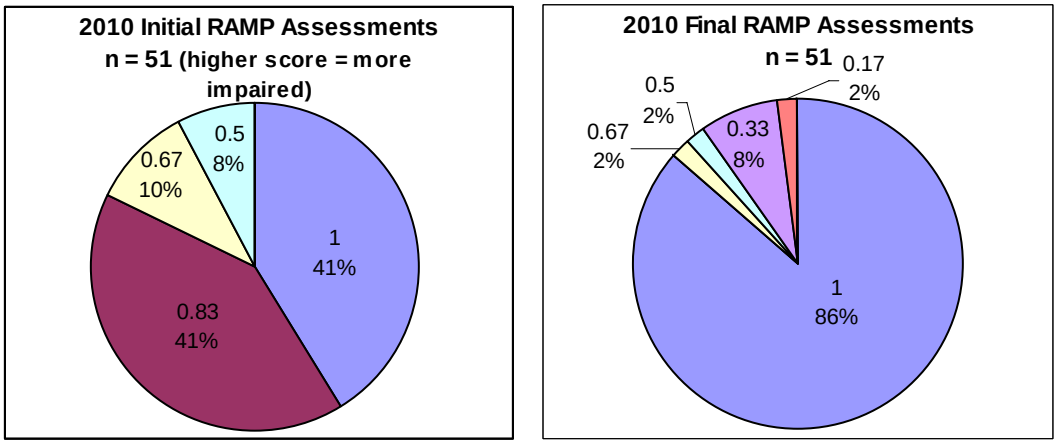


Figure 9. 2010 IPHC halibut condition changes from initial to final assessment.

For the RAMP method, approximately 92% (47) of halibut were initially assessed as more than moderately impaired and 8% (4) as moderately impaired. At the end of the 3-day holding period 86% (44) of halibut had died, 2% (1) was more than moderately impaired, 2% (1) was moderately impaired, and 10% (5) were less than moderately impaired (Figures 10 a and b). During both years of the experiment the IPHC assessment was always done prior to the RAMP assessment and in the small amount of time between the assessments we noted that certain reflexes would be present during the IPHC assessment and absent during the RAMP assessment (e.g., Appendix 3 tag numbers 021710 and 020953). For example, in four instances each year

halibut that were active with body tone during the IPHC assessment exhibited neither open nor restrained body flex moments later when we completed the RAMP assessment. We also noted six instances in 2010 when halibut closed their opercular during the IPHC assessment, but did not do so during the RAMP assessment.



Figures 10a and b. 2010 summary of halibut RAMP assessment scores from initial and final assessments.

DISCUSSION

Completing research during commercial fishing operations is always challenging. We anticipated a relatively short trip in 2009 and attempted to maximize the number of holding days available to us by having the vessel complete the first two hauls just outside Dutch Harbor. These hauls were done in an area not typically fished with trawl gear, but in one known to have bycatch of small halibut. Both hauls provided halibut of suitable size and condition for our experiment, but we did not find any halibut that fit into the 30 – 65 cm size range needed for the experiment during the remainder of the trip. While the location and fishery selected for our 2009 trip did not yield sufficient quantities or sizes of halibut, it did allow for the collection of useful information. We were able to demonstrate that it is possible to test for RAMP reflexes at sea and that holding live halibut in tanks at sea is feasible for halibut 30 – 65 cm. We also demonstrated that, when held in appropriate conditions, halibut can recover from capture stress during a three-day holding period onboard a vessel.

The weather was excellent for the duration of the 2009 trip and the ship was extremely stable throughout the sampling and halibut holding periods, which made for ideal halibut holding conditions. Water temperature in the holding tanks averaged 5.5° F warmer than temperature at fishing depth and this likely increased the halibut's level of activity as reflected in our reflex measurements. The conditions, coupled with the small tows sizes may account for the lower than expected halibut mortality in 2009.

Of the eleven halibut collected and held in 2009, nine were alive when they were released. Though the sample size is not sufficient for detailed analysis, it is noteworthy that short term survival was this high. Of the six halibut initially assessed as dead, only one actually died during the holding period. The remaining five were assessed as poor or excellent just prior to release. Similarly, of the five halibut initially assessed as poor, only one died during the holding period

and the remaining four were assessed as poor or excellent just prior to release. The observed halibut survival during our experiment was 56 percentage points higher than predicted, but we acknowledge that our three-day survival was perhaps expected to be higher than the long-term survival estimates obtained in the IPHC tagging studies where longer term mortality was taken into account. In addition, holding halibut in the tanks effectively allowed them to recover without the potential for predation as might occur if they had been immediately discarded.

While there was an overall improvement in the IPHC assessment scores following the holding periods in 2009, the trend was not as evident with RAMP scores (see Table 3). Compared to the initial assessments, post holding period RAMP scores improved for five halibut, were the same for two, and were worse for the remaining four (including the two that died). It is difficult to make a comparison between IPHC and RAMP scores of observed improvement after a three day holding period. This may be due to the finer ability for RAMP to discriminate changes and the possible bias of scoring RAMP after IPHC, where halibut reflexes appeared impaired after a period of handling active fish for testing.

Prior to the initial assessment, halibut experienced various stressors including capture, temperature and pressure changes, traveling over the conveyor belts, and handling. The cumulative effects of these stressors resulted in halibut that were somewhat catatonic, easy to handle, and allowed for fairly quick processing of individual fish. On the other hand, following the 3-day holding period, many halibut were vigorous and difficult to handle immediately after removal from the tank. Their level of activity degraded relatively quickly, but it took approximately twice as long (38 vs 20 seconds) for us to begin the IPHC assessment on post-holding period halibut. The need for this period of calming prior to the final assessment showed that fish recovered well during holding and became active, but as time passed their reflexes quickly degraded. We do not know if the calming period or IPHC assessment were stressful for halibut or if it simply caused fish to become less responsive as a normal reaction to handling, i.e., freezing motion in the presence of threat, as occurs in the presence of a predator. Future experiments may want to explore this more and perhaps avoid one of these biases by conducting the RAMP assessment first or conducting the assessments simultaneously.

With one exception, the tanks and facilities worked well during the 2009 cruise. The pump supplying our tank water failed on August 9, 2009, but the vessel's chief engineer realized it and was able to switch the water supply to another pump while making repairs. While this incident is worth noting, it does not appear that the pump failure impacted the halibut during the holding period as water flow was quickly restored and no changes in water quality were noted. One other issue researchers noted was the apparent difficulty determining the presence of the eye roll reflex in 2009. At the time it was attributed to either poor lighting or the size of the halibut (slightly larger than those we had been trained on in Newport).

Unfortunately a change in permit conditions for 2010 likely limited the amount of useful information that we were able to collect and this prevented us from doing a more thorough analysis of the RAMP method. A critical part of our data collection required that reflexes be measured on halibut from the full range of conditions (i.e., unimpaired to fully impaired). Permit restrictions kept us from collecting halibut directly from the live tank and basically eliminated our ability to find minimally impaired halibut. Our overall sample size was sufficient and was

excellent for the more than moderately impaired halibut, but without the full range of conditions we cannot satisfy all of our research objectives. Objectives we will not be able to realize include calculating and calibrating a RAMP mortality curve and determining which fishing conditions are associated with halibut mortality.

The weather was less than ideal during our 2010 field season. Cold air and surface temperatures coupled with rough seas for portions of the trip were in stark contrast to what we had experienced in 2009. The change to the yellowfin sole fishery, however, yielded sufficient numbers of the correct size halibut for holding on board ship. While holding tank temperature was warmer than temperature at depth in 2009, we had the opposite in 2010 with holding tank temperatures averaging just over 32° F, nearly 5° F colder than temperature at depth. Air temperatures were also cold and combined these differences likely stressed halibut considerably after capture.

Actual halibut mortality was 86% in 2010 and very closely mirrored the IPHC estimate of 88% according to the initial IPHC viability estimates. It is possible that the environmental and fishing conditions (more stressful) or the larger sample size in 2010 are responsible for the closing of this gap compared to 2009 when the actual mortality was only 18% as opposed to the predicted IPHC mortality of 74%.

While we experienced no pump failures in 2010, the extremely cold water temperatures presented some challenges controlling the flow to the tanks. On several occasions ice apparently built up in the manifold assembly and water flow would decrease below our desired range of 3 – 5 gal/min. After adjusting the flow at the next reading the flow would occasionally be in excess of our desired range because the ice had cleared. While worth noting, at no time did we observe halibut in the tanks having to swim against the current or a whirl pool effect developing in the tanks nor did we observe a water quality issue from a low flow condition. It does not appear that the issues maintaining consistent water flow impacted the halibut during the holding period.

In general, halibut were more lethargic in 2010, which is what you would expect at the depressed water temperatures. These temperature differences may have impacted the stress levels of the halibut and the scores that resulted from testing. For this reason, we chose not to combine 2009 and 2010 data and have reported it here separately. Future researchers may want to attempt to collect all their data at the same time of year or under similar environmental conditions if the data collection must be done over a period of time. Ideally, the desired sample size would be obtained during a summer cruise thereby minimizing the environmental effects that may inhibit obtaining samples of unimpaired or mildly impaired halibut.

It is important to highlight that the IPHC assessment was made first, followed by a separate RAMP assessment. This was done to maintain consistency throughout the study and so we could independently test fish using each method. In several fish, reflex actions were evident in the IPHC assessment and then became impaired in the subsequent RAMP assessment. This later impairment may have been associated with the sequential sampling of fish for IPHC and RAMP. For example, while completing the IPHC assessment several halibut displayed body flex or other signs of muscle tone, but when those same fish were assessed using the RAMP method the responses were not present (e.g., open body flex) and they were scored as absent. Further study

of the effects of prior handling on RAMP scores and the time course for reflex impairment after stress may help explain these results.

For RAMP reflexes, open body flex and opercular closure were the most common reflexes seen and the remaining four reflexes were noted less frequently throughout our study. It is possible that other reflexes (e.g., mouthing or coughing) should be added as it was noted in nearly 20% of halibut tested in 2010. The difficulty in determining eye roll that we encountered in 2009 was not as evident in 2010. Additional lighting may have rectified the issue or perhaps we were simply more comfortable determining its presence or absence as we tested more halibut.

Halibut are clearly able to recover from capture and handling stress over a three-day holding period at sea. Future researchers may want to assess the potential benefits of completing the RAMP portion of the assessment first or eliminating the IPHC assessment altogether. If the goal is to collect enough information to calculate and calibrate a RAMP curve, then eliminating the potential bias introduced by doing the IPHC method first may be warranted. It is also imperative that the permit conditions allow for the collection of halibut as early as possible, even if it means collecting them on deck or directly from the live tank. The methods and monitoring tools (e.g., observers and cameras) are available and have been tested for these purposes so restricting where halibut can be collected for research purposes makes little sense and clearly limited us during this project. An ideal platform for continued RAMP research would be a trawl survey vessel or chartered vessel where the haul size can be controlled and researchers will have the flexibility to collect the necessary conditions of halibut.

ACKNOWLEDGEMENTS

We'd like to thank the officers and crew of the F/T SEAFISHER for their assistance during both years of the experiment. Katie Hallgren served at sea during both years of this study and provided valuable comments on this report. Staff at the AFSC and IPHC helped make this work possible. Specifically, Dr. Michael Davis provided training, guidance, and comments throughout our study and Gregg Williams provided consultation and reviews of our work. We also thank the Aleutian Pribilof Island Community Development Association for allowing us to conduct the second year of the experiment while CDQ fishing.

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Appendix 1. IPHC key to Pacific halibut viability for trawl vessels (AFSC 2009).

Appendix P. Key to Pacific Halibut Viability for Trawl Vessels

Codes: Excellent = E, Poor = P, Dead = D, Unknown = U

1a. Fish is alive ..... Go to 2a
1b. Fish is dead when sorted from the catch ..... code **DEAD**
Fish is in rigor and lifeless, even if no apparent injuries. Gills appear washed out, i.e., dull red, pink, or white in color. Mouth may contain sediment.

2a. Body of fish appears uninjured, or has only minor injuries ..... Go to 3a
2b. Injuries to fish are significant and obvious ..... code **DEAD**
Body cavity is ripped open, exposing internal organs. Body tissue may be torn or ripped in a rough, ragged manner. Red hemorrhaging observed on 25% or more of the white side.

3a. Fish is able to close operculum when stimulated ..... Go to 4a
Operculum is closed strongly or weakly, but pressure is evident. Operculum may not stay closed for long, though pressure may last up to 5 seconds or longer.
3b. Fish cannot close operculum, even when stimulated ..... code **DEAD**

4a. Fish displays activity and has muscle tone ..... go to 5a
Fish displays a minimal amount of activity, especially when stimulated. May be able to clench jaw tightly.
4b. Fish exhibits no muscle tone ..... code **DEAD**

5a. Fish is not bleeding, or only slightly bleeding, if at all ..... go to 6a
5b. Blood is flowing freely and continuously in large quantity (profusely) ..... code **DEAD**
Bleeding is coming from a torn or severed gill arch, or a body injury.

6a. Body injuries are minimal, perhaps difficult to find ..... go to 7a
May consist of superficial nicks or cuts on body. Less than 10% of dorsal and anal fin area is frayed.
6b. Body injuries are readily apparent ..... code **POOR**
Skin is damaged with abrasions. Cuts and lacerations in body extend through the skin and just barely into the flesh (not deeply). Dorsal and anal fin area is frayed between 10-50% Fin edges may be bleeding. Roughly 10-25% of the white side of fish shows red hemorrhaging.

7a. Operculum pressure is strong and sustained ..... go to 8a
7b. Operculum pressure is weak and not sustained ..... code **POOR**

8a. Fish is strong and lively, displaying good muscle tone ..... go to 9a
Fish is flopping around the deck, hard to control. Jaw may be tightly clenched, difficult to open.
8b. Fish appears weak ..... code **POOR**
Movement is intermittent, perhaps occurring when provoked or stimulated. Body is limp.

9a. Fish is bleeding from gills ..... code **POOR**
Blood is flowing continuously, slow and steadily, but not profusely. Gills are deep to bright red in color.
9b. No bleeding observed ..... code **EXCELLENT**
Gills are deep red in color.

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Appendix 2. IPHC and RAMP summarized scores for halibut collected and held in 2009 and 2010.

			Score after initial collection		Score after 3-day holding	
Haul - Year	**Tag #**	**Length (cm)**	**IPHC score**	**RAMP score**	**IPHC score**	**RAMP score**
1 – 2009	021701	55	D	0.83	E	0.50
1 – 2009	021702	65	P	0.83	E	0.33
1 – 2009	***021703***	***64***	***P***	***0.83***	***D***	***1.00***
1 – 2009	021704	61	D	0.67	E	0.83
1 – 2009	021705	57	D	0.83	P	0.67
1 – 2009	***021706***	***59***	***D***	***0.83***	***D***	***1.00***
1 – 2009	021707	64	D	0.83	E	0.50
2 – 2009	021708*	63	P	0.5	E	0.50
2 – 2009	021709*	65	D	0.67	P	0.67
2 – 2009	021710	57	P	0.17	P	0.83
2 - 2009	021711	66	P	0.67	E	0.50
1 – 2010	***085651***	***45***	***D***	***0.83***	***D***	***1.00***
1 – 2010	***085652***	***40***	***D***	***0.83***	***D***	***1.00***
1 – 2010	***085653***	***42***	***D***	***0.67***	***D***	***1.00***
1 – 2010	085654	50	D	0.50	E	0.33
1 – 2010	***085655***	***58***	***D***	***1.00***	***D***	***1.00***
1 – 2010	085656	42	D	0.67	E	0.17
1 – 2010	***085657***	***35***	***D***	***0.83***	***D***	***1.00***
1 – 2010	***085658***	***44***	***P***	***0.83***	***D***	***1.00***
1 – 2010	***085659***	***47***	***D***	***0.83***	***D***	***1.00***
1 – 2010	***085660***	***43***	***P***	***0.83***	***D***	***1.00***
1 – 2010	***085661***	***46***	***D***	***0.83***	***D***	***1.00***
1 – 2010	085662	44	D	0.83	P	0.50
1 – 2010	***085663***	***49***	***P***	***0.83***	***D***	***1.00***
1 – 2010	***085664***	***43***	***D***	***0.83***	***D***	***1.00***
1 – 2010	***085665***	***61***	***D***	***1.00***	***D***	***1.00***
1 – 2010	***085666***	***39***	***D***	***0.83***	***D***	***1.00***
1 – 2010	***085667***	***65***	***D***	***0.83***	***D***	***1.00***
1 – 2010	***085668***	***41***	***D***	***0.83***	***D***	***1.00***
1 – 2010	085669	41	D	1.00	E	0.33
1 – 2010	***085670***	***60***	***D***	***1.00***	***D***	***1.00***
1 – 2010	***085671***	***52***	***D***	***1.00***	***D***	***1.00***
2 - 2010	***085672***	***56***	***D***	***1.00***	***D***	***1.00***
2 – 2010	***085673***	***64***	***D***	***1.00***	***D***	***1.00***
2 – 2010	***085674***	***41***	***D***	***1.00***	***D***	***1.00***
2 – 2010	***085675***	***37***	***D***	***1.00***	***D***	***1.00***
2 – 2010	***085676***	***52***	***D***	***1.00***	***D***	***1.00***
2 – 2010	***085077***	***54***	***D***	***1.00***	***D***	***1.00***
2 – 2010	***085078***	***42***	***D***	***1.00***	***D***	***1.00***
2 – 2010	***085079***	***52***	***D***	***1.00***	***D***	***1.00***
2 – 2010	***085080***	***44***	***D***	***1.00***	***D***	***1.00***
4 – 2010	***085081***	***51***	***D***	***1.00***	***D***	***1.00***
4 – 2010	***085082***	***45***	***D***	***0.83***	***D***	***1.00***
5 - 2010	***020974***	***51***	***D***	***0.67***	***D***	***1.00***
5 – 2010	***020973***	***50***	***D***	***0.50***	***D***	***1.00***
5 – 2010	020972	56	D	0.83	E	0.33
5 – 2010	***020971***	***44***	***D***	***0.50***	***D***	***1.00***
5 – 2010	***020970***	***50***	***D***	***0.83***	***D***	***1.00***
5 – 2010	***020968***	***60***	***D***	***0.83***	***D***	***1.00***
5 – 2010	***020967***	***52***	***D***	***0.67***	***D***	***1.00***
5 – 2010	***020966***	***53***	***D***	***1.00***	***D***	***1.00***
5 – 2010	***020965***	***58***	***D***	***0.83***	***D***	***1.00***

Appendix 2. Continued

			Score after initial collection		Score after three-day holding	
Haul-Year	**Tag #**	**Length (cm)**	**IPHC Score**	**RAMP Score**	**IPHC Score**	**RAMP Score**
6 – 2010	***020964***	***54***	***D***	***0.83***	***D***	***1.00***
8 – 2010	***020962***	***57***	***D***	***1.00***	***D***	***1.00***
8 – 2010	020961	48	D	0.67	E	0.33
8 – 2010	***020960***	***44***	***D***	***0.83***	***D***	***1.00***
8 – 2010	***020959***	***41***	***D***	***0.83***	***D***	***1.00***
8 – 2010	***020958***	***44***	***D***	***1.00***	***D***	***1.00***
8 – 2010	***020957***	***40***	***D***	***1.00***	***D***	***1.00***
8 – 2010	***020956***	***61***	***D***	***0.50***	***D***	***1.00***
8 – 2010	***020955***	***41***	***D***	***1.00***	***D***	***1.00***
11 – 2010	020953	38	D	1.00	E	0.67

* Collected directly from fish bin. ***Bold, italics indicate halibut that died during the holding period***

Appendix 3. Haul number, halibut tag number, IPHC and RAMP raw and summarized scores, halibut length, and sampler. '1' indicates a positive response and '0' a negative or non-response.

INITIAL or FINAL Assessment	HAUL	TAG NUMBER *	Alive (1a)**	Dead (1b)	Uninjured (2a)	Injured (2b)	Operc. Close (3a)	Operc. No close (3b)	Active (4a)	Not Active (4b)	No/min. bleeding (5a)	Bleeding (5b)	No injuries (6a)	Injuries (6b)	Strong Operc. (7a)	Weak Operc. (7b)	Strong /lively fish (8a)	Weak fish (8b)	Gills bleeding (9a)	Gills not bleeding (9b)	IPHC SCORE	Body flex open	Body flex restrained	Mouth Closure	Operc. Closure	Gag response	Eye roll	RAMP SCORE	LENGTH	IPHC sampler	RAMP sampler
I	278	021701	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	55	KH	TL
F	278	021701	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1	E	1	0	0	1	0	1	0.50	55	KH	TL
I	278	021702	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1			P	0	0	0	1	0	0	0.83	65	KH	TL
F	278	021702	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1	E	1	0	1	1	0	1	0.33	65	KH	TL
I	278	021703	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1			P	0	0	0	1	0	0	0.83	64	KH	TL
F	278	021703	0	1																	D	0	0	0	0	0	0	1.00	63	Dead	Dead
I	278	021704	1	0	1	0	1	0	0	1											D	1	0	0	1	0	0	0.67	61	KH	TL
F	278	021704	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1	E	0	0	0	1	0	0	0.83	61	KH	TL
I	278	021705	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	57	KH	TL
F	278	021705	1	0	1	0	1	0	1	0	1	0	1	0	0	1					P	1	0	0	1	0	0	0.67	57	KH	TL
I	278	021706	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	59	KH	TL
F	278	021706	0	1																	D	0	0	0	0	0	0	1.00	58	Dead	Dead
I	278	021707	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	64	KH	TL
F	278	021707	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1	E	1	0	0	1	0	1	0.50	64	TL	KH
I	279	021708	1	0	1	0	1	0	1	0	1	0	1	0	0	1					P	1	0	0	1	0	1	0.50	63	TL	KH
F	279	021708	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1	E	1	1	0	1	0	0	0.50	62	TL	KH
I	279	021709	1	0	1	0	1	0	0	1											D	0	1	0	1	0	0	0.67	65	TL	KH
F	279	021709	1	0	1	0	1	0	1	0	1	0	1	0	0	1					P	1	0	0	1	0	0	0.67	64	TL	KH
I	279	021710	1	0	1	0	1	0	1	0	1	0	1	0	0	1					P	1	1	1	1	0	1	0.17	57	TL	KH
F	279	021710	1	0	1	0	1	0	1	0	1	0	1	0	0	1					P	0	0	0	1	0	0	0.83	57	TL	KH
I	279	021711	1	0	1	0	1	0	1	0	1	0	1	0	0	1					P	0	0	0	1	0	1	0.67	66	TL	KH
F	279	021711	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1	E	1	0	0	1	0	1	0.50	66	TL	KH
I	66	085651	0	1																	D	0	0	0	1	0	0	0.83	45	KH	TL
F	66	085651	0	1																	D	0	0	0	0	0	0	1.00	45	Dead	Dead
I	66	085652	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	40	KH	TL
F	66	085652	0	1																	D	0	0	0	0	0	0	1.00	38	Dead	Dead
I	66	085653	1	0	1	0	1	0	0	1											D	0	0	0	1	1	0	0.67	42	KH	TL
F	66	085653	0	1																	D	0	0	0	0	0	0	1.00	-	Dead	Dead
I	66	085654	1	0	1	0	1	0	0	1											D	1	1	0	1	0	0	0.50	50	KH	TL
F	66	085654	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1	E	1	1	1	1	0	0	0.33	48	KH	TL
I	66	085655	1	0	1	0	1	0	0	1											D	0	0	0	0	0	0	1.00	58	KH	TL
F	66	085655	0	1																	D	0	0	0	0	0	0	1.00	58	Dead	Dead
I	66	085656	1	0	1	0	1	0	0	1											D	0	0	0	1	1	0	0.67	42	KH	TL
F	66	085656	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1	E	1	1	1	1	1	0	0.17	40	KH	TL
I	66	085657	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	35	KH	TL
F	66	085657	0	1																	D	0	0	0	0	0	0	1.00	34	Dead	Dead
I	66	085658	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1			P	0	0	0	1	0	0	0.83	44	KH	TL
F	66	085658	0	1																	D	0	0	0	0	0	0	1.00	44	Dead	Dead
I	66	085659	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	47	KH	TL
F	66	085659	0	1																	D	0	0	0	0	0	0	1.00	-	Dead	Dead
I	66	085660	1	0	1	0	1	0	1	0	1	0	1	0	0	1					P	0	0	0	1	0	0	0.83	43	KH	TL
F	66	085660	0	1																	D	0	0	0	0	0	0	1.00	42	Dead	Dead
I	66	085661	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	46	KH	TL
F	66	085661	0	1																	D	0	0	0	0	0	0	1.00	45	Dead	Dead
I	66	085662	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	44	KH	TL
F	66	*085662*	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1			P	1	1	0	1	0	0	0.50	43	KH	TL
I	66	085663	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	8			P	0	0	0	1	0	0	0.83	49	KH	TL
F	66	085663	0	1																	D	0	0	0	0	0	0	1.00	48	Dead	Dead
I	66	085664	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	43	KH	TL
F	66	085664	0	1																	D	0	0	0	0	0	0	1.00	44	Dead	Dead
I	66	085665	1	0	1	0	1	0	0	1											D	0	0	0	0	0	0	1.00	61	KH	TL
F	66	085665	0	1																	D	0	0	0	0	0	0	1.00	61	Dead	Dead
I	66	085666	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	39	KH	TL
F	66	085666	0	1																	D	0	0	0	0	0	0	1.00	39	Dead	Dead
I	66	*085667*	1	0	1	0	1	0	0	1											D	0	1	0	0	0	0	0.83	65	KH	TL
F	66	085667	0	1																	D	0	0	0	0	0	0	1.00	64	Dead	Dead
I	66	085668	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	41	KH	TL
F	66	085668	0	1																	D	0	0	0	0	0	0	1.00	41	Dead	Dead
I	66	085669	1	0	1	0	1	0	0	1											D	0	0	0	0	0	0	1.00	41	KH	TL
F	66	085669	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1	E	1	1	1	1	0	0	0.33	40	KH	TL
I	66	085670	0	1																	D	0	0	0	0	0	0	1.00	60	KH	TL
F	66	085670	0	1																	D	0	0	0	0	0	0	1.00	60	Dead	Dead
I	66	085671	0	1																	D	0	0	0	0	0	0	1.00	52	KH	TL
F	66	085671	0	1																	D	0	0	0	0	0	0	1.00	51	Dead	Dead
I	67	085672	0	1																	D	0	0	0	0	0	0	1.00	56	KH	TL
F	67	085672	0	1																	D	0	0	0	0	0	0	1.00	55	Dead	Dead
I	67	085673	0	1																	D	0	0	0	0	0	0	1.00	64	KH	TL
F	67	085673	0	1																	D	0	0	0	0	0	0	1.00	65	Dead	Dead
I	67	085674	1	0	1	0	0	1													D	0	0	0	0	0	0	1.00	41	KH	TL
F	67	085674	0	1																	D	0	0	0	0	0	0	1.00	41	Dead	Dead
I	67	085675	0	1																	D	0	0	0	0	0	0	1.00	37	KH	TL
F	67	085675	0	1																	D	0	0	0	0	0	0	1.00	37	Dead	Dead
I	67	085676	0	1																	D	0	0	0	0	0	0	1.00	52	KH	TL
F	67	085076	0	1																	D	0	0	0	0	0	0	1.00	52	Dead	Dead
I	67	085077	0	1																	D	0	0	0	0	0	0	1.00	54	KH	TL
F	67	085077	0	1																	D	0	0	0	0	0	0	1.00	54	Dead	Dead
I	67	085078	1	0	1	0	0	1													D	0	0	0	0	0	0	1.00	42	KH	TL
F	67	085078	0	1																	D	0	0	0	0	0	0	1.00	41	Dead	Dead

INITIAL or FINAL Assessment	HAUL	TAG NUMBER	Alive (1a)	Dead (1b)	Uninjured (2a)	Injured (2b)	Operc. Close (3a)	Operc. No close (3b)	Active (4a)	Not Active (4b)	No/min. bleeding (5a)	Bleeding (5b)	No injuries (6a)	Injuries (6b)	Strong Operc. (7a)	Weak Operc. (7b)	Strong /lively fish (8a)	Weak fish (8b)	Gills bleeding (9a)	Gills not bleeding (9b)	IPHC SCORE	Body flex open	Body flex restrained	Mouth Closure	Operc. Closure	Gag response	Eye roll	RAMP SCORE	LENGTH	IPHC sampler	RAMP sampler
I	67	085079	0	1																	D	0	0	0	0	0	0	1.00	52	KH	TL
F	67	085079	0	1																	D	0	0	0	0	0	0	1.00	53	Dead	Dead
I	67	085080	0	1																	D	0	0	0	0	0	0	1.00	44	KH	TL
F	67	085080	0	1																	D	0	0	0	0	0	0	1.00	44	Dead	Dead
I	69	085081	1	0	1	0	0	1													D	0	0	0	0	0	0	1.00	51	TL	KH
F	69	085081	0	1																	D	0	0	0	0	0	0	1.00	51	Dead	Dead
I	69	085082	1	0	1	0	1	0	0	1											D	0	0	0	0	1	0	0.83	45	TL	KH
F	69	085082	0	1																	D	0	0	0	0	0	0	1.00	44	Dead	Dead
I	70	020974	1	0	1	0	1	0	0	1											D	0	0	1	1	0	0	0.67	51	TL	KH
F	70	020974	0	1																	D	0	0	0	0	0	0	1.00	51	Dead	Dead
I	70	020973	1	0	1	0	1	0	0	1											D	0	0	1	1	1	0	0.50	50	TL	KH
F	70	020973	0	1																	D	0	0	0	0	0	0	1.00	49	Dead	Dead
I	70	020972	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	56	TL	KH
F	70	020972	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1	E	1	1	1	1	0	0	0.33	56	TL	KH
I	70	020971	1	0	1	0	1	0	0	1											D	0	0	1	1	0	1	0.50	44	TL	KH
F	70	020971	0	1																	D	0	0	0	0	0	0	1.00	43	Dead	Dead
I	70	*020970*	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	50	TL	KH
F	70	020970	0	1																	D	0	0	0	0	0	0	1.00	50	Dead	Dead
I	70	020968	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	60	TL	KH
F	70	020968	0	1																	D	0	0	0	0	0	0	1.00	60	Dead	Dead
I	70	020967	1	0	1	0	1	0	0	1											D	0	0	0	1	1	0	0.67	52	TL	KH
F	70	020967	0	1																	D	0	0	0	0	0	0	1.00	51	Dead	Dead
I	70	*020966*	1	0	1	0	1	0	0	1											D	0	0	0	0	0	0	1.00	53	TL	KH
F	70	020966	0	1																	D	0	0	0	0	0	0	1.00	53	Dead	Dead
I	70	020965	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	58	TL	KH
F	70	020965	0	1																	D	0	0	0	0	0	0	1.00	57	Dead	Dead
I	71	020964	1	0	1	0	0	1													D	1	0	0	0	0	0	0.83	54	TL	KH
F	71	020964	0	1																	D	0	0	0	0	0	0	1.00	54	Dead	Dead
I	73	020962	0	1																	D	0	0	0	0	0	0	1.00	57	TL	KH
F	73	020962	0	1																	D	0	0	0	0	0	0	1.00	57	Dead	Dead
I	73	020961	1	0	1	0	1	0	0	1											D	1	0	0	1	0	0	0.67	48	TL	KH
F	73	*020961*	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1	E	1	0	1	1	0	1	0.33	48	TL	KH
I	73	020960	1	0	1	0	0	1													D	0	0	0	1	0	0	0.83	44	TL	KH
F	73	020960	0	1																	D	0	0	0	0	0	0	1.00	44	Dead	Dead
I	73	*020959*	1	0	1	0	1	0	0	1											D	0	0	0	1	0	0	0.83	41	TL	KH
F	73	020959	0	1																	D	0	0	0	0	0	0	1.00	41	Dead	Dead
I	73	020958	1	0	1	0	0	1													D	0	0	0	0	0	0	1.00	44	TL	KH
F	73	020958	0	1																	D	0	0	0	0	0	0	1.00	44	Dead	Dead
I	73	020957	1	0	1	0	0	1													D	0	0	0	0	0	0	1.00	40	TL	KH
F	73	020957	0	1																	D	0	0	0	0	0	0	1.00	40	Dead	Dead
I	73	*020956*	1	0	1	0	1	0	0	1											D	1	0	0	1	1	0	0.50	61	TL	KH
F	73	020956	0	1																	D	0	0	0	0	0	0	1.00	61	Dead	Dead
I	73	020955	1	0	1	0	1	0	0	1											D	0	0	0	0	0	0	1.00	41	TL	KH
F	73	020955	0	1																	D	0	0	0	0	0	0	1.00	40	Dead	Dead
I	76	*020953*	1	0	1	0	1	0	0	1											D	0	0	0	0	0	0	1.00	38	KH	TL
F	76	*020953*	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	0	1	E	0	0	0	1	0	1	0.67	38	TL	KH

* Italics indicate halibut was 'mouthing' or 'coughing' during RAMP assessment

** Numbering (e.g., 1a) corresponds to IPHC key categories in Appendix 1.