Final report for EFP 15-02

Background on deck sorting:

Halibut is a prohibited species (PSC) for groundfish fisheries and annual halibut bycatch limits (called PSC caps) have constrained Bering Sea flatfish yields to varying degrees over the last 30 years. As a prohibited species, regulations require that halibut be returned to the water as soon as possible and with minimal injury while allowing for the necessary handling for monitoring, management and accounting purposes.

In light of the constraint halibut bycatch caps pose on groundfish fisheries and in recognition that many halibut appear to be viable when first brought up in flatfish trawls, changes in regulations to allow halibut to be returned to the sea from the deck (deck sorting) have long been a high priority for the Alaska Seafood Cooperative and others in the Bering Sea non-pollock catcher processor (CP) trawl fleet. In the mid-1990s, cooperative research on the Pacific Glacier attempted to use “grid sorting” to return halibut to the water while viable. In 1999, Groundfish Forum started working on its “halibut mortality avoidance program” proposal (HMAP) to allow deck sorting on its flatfish catcher processor vessels. Unfortunately, neither proposed program was implemented because the needed monitoring and accountability measures were unavailable at the time.

The concept of deck sorting is simple, yet the management and regulation of it is complex. The catch handling procedures for Bering Sea CP trawlers currently require all catch to be put into the vessel’s stern tank to allow for complete accounting of weight and catch composition at the observer sampling station below deck.

Regulatory changes would be needed to allow the crew to bring the net forward of the hatch to the stern tank so they can sort out the halibut and put them back in the water from the deck after completion of the necessary accounting. Absent changes in regulations, deck sorting can only be done under exempted fishing permits. To explore the feasibility of modifications to catch handling procedures to sort and account for halibut on deck, the Alaska Seafood Cooperative (AKSC) has conducted three exempted fishing permit projects, the latest being EFP 15-02 which is the subject of this report.

One challenge with deck sorting has been how to get sufficient information from halibut (number, weight, and viability) without hamstringing vessel operations and delaying return of viable fish to the water. The monitoring program must also achieve accurate accounting of halibut and ensure that no other species are removed on deck. At the same time, the tasks associated with data collection must allow observer resources to complete their other duties. Integrating data on halibut removals into observer sampling methods also poses nuanced challenges, as halibut sorted on deck and halibut that reach the observer sampling station will have different viability rates.

Another important consideration is the varied uses of observer data serving diverse fishery management objectives and programs. These include general fishery management (such as achieving optimum yield), bycatch management objectives, and operational objectives of the Amendment 80 cooperatives. The complexity of integrating deck sorting into the diverse set of

Bering Sea groundfish management programs is a primary factor in delaying implementing something as seemingly simple as deck sorting. The cooperative efforts of industry and the agency should be recognized as important context to the information presented in this final report for EFP 2015-02.

Previous research

Prior to 2015, AKSC conducted two exempted fishing permits to evaluate different aspects of deck sorting. The first (EFP 09-01 in 2009) was essentially a pilot study to evaluate the concept of sorting halibut on deck and basic approaches under the Amendment 80 catch handling rules to collecting necessary data from halibut. Two sea samplers were added to the two regular fishery observers on each vessel to collect halibut data. Given the uncertain benefits from deck sorting and the associated complexities and costs of the catch handling protocols, most of the 2009 EFP operations occurred in the relatively low-volume target fisheries (e.g. flathead sole) and at times of the year with relatively good weather. Participants expected that lower haul sizes would be more workable for rapid and effective sorting of halibut from the catch. Also, fisheries with a relatively large difference in halibut size relative to target fish were selected to facilitate sorting and avoid slowdowns.

The 2009 permit required length and viability to be collected for each halibut sorted on deck. While useful as a starting point for designing future sampling methods in the future, we learned that this upwardly biased mortality rates. While crews in 2009 were generally able to sort out approximately 95% of the halibut in as little as ten minutes, measurement and viability assessment for each fish took considerably longer. During a 2012 EFP, we learned that the fraction of fish in excellent condition becomes somewhat marginal after 20-25 minutes. Unfortunately, the 2009 study did not include collection of time out of water data for each halibut to avoid further delaying return of halibut to the water.

The main objectives of the 2012 EFP were to further evaluate the feasibility of deck sorting in a wider set of fisheries and times of the year, and to test methods for stratified random sampling based on 20% of the halibut sorted on deck. Another important aspect of including a sampling approach was to collect the necessary data while avoiding slowdowns and “pile ups” of fish awaiting measurement/viability assessment by subsampling a portion of halibut removed from the catch. In both of these areas, the 2012 EFP was successful. The 20% sample size allowed samplers to keep up with crew sorting activities in several target fisheries and the comparison of sampling to census analysis demonstrated that the 20% sample size accurately accounted for the amount of halibut sorted on deck. Finally, sampling also allowed for successful collection of time out of water and viability data.

An interesting aspect of the 2012 project was that participants in 2012 attempted to sort virtually all of the halibut on deck. Crews might have adopted a “biggest bang for the buck” approach of sorting as much fish as possible in the first 25 minutes when the greatest marginal reduction in mortality might be expected, had the 2009 project collected time out of water data. The 2012 EFP analysis demonstrated that a high fraction of the fish sorted in less than 20-25 minutes were judged to be in “excellent” condition and are assigned a 20 % mortality rate. Mortality drops substantially under the two lower IPHC standard viability ratings, with fish judged to be “poor” assigned 55% mortality, and fish adjudged “dead” assigned 90% mortality.

The final report for the 2012 EFP includes a wealth of detailed information about deck sorting methods and procedures that were replicated in 2015 for the most part. It also provides considerably more detail on aspects of feasibility of deck sorting from post-EFP informal interviews of participants. That report is available online at:
https://alaskafisheries.noaa.gov/sites/default/files/efp12-01halibut_a80.pdf

Objectives for the 2015 deck sorting EFP (15-02)

The principle objective of 2015 EFP was to look at the possible scale of mortality savings if deck sorting were expanded to a wider set of vessels, Amendment 80 fisheries, and times of the year. This was intended to help managers, the industry, and the public assess the feasibility and benefits of eventual implementation of deck sorting into the regular fisheries. The decision to take a second look at feasibility in the 2015 EFP was based on the outcome of the 2012 EFP where deck sorting had not achieved good results for higher volume fisheries such as yellowfin sole. Yellowfin sole is one of the most important flatfish target fisheries and the inability to make deck sorting work well in the yellowfin sole target in the 2012 EFP was problematic because a program that does not work in one of the most important Amendment 80 fishing targets is potentially of limited value. In this regard, a specific aspect of the 2015 EFP was to revisit deck sorting in yellowfin sole to see if reductions in mortality and improvements in feasibility could be achieved, if crews focused on sorting as much halibut as they could in the first 20-25 minutes instead of sorting every fish (2012).

Another element of the 2015 EFP design was inclusion of a means for vessels to “toggle” out of the EFP for some tows when weather conditions or other factors impeded deck sorting efforts. This addressed a fundamental problem with the 2012 EFP, where vessels that stopped deck sorting due to inclement weather or any other reason had to drop out of the EFP. To allow vessels to toggle in and out of the 2015 EFP, a protocol was created for providing observer/sea sampler notice of whether or not a tow would be deck sorted. The effectiveness of that protocol is discussed below.

Finally, the 2015 EFP was intended to begin the process of defining management and monitoring measures that would allow deck sorting as an optional catch handling procedure in the sector’s regular fisheries outside of an EFP. This included definition of a workable set of catch handling and sampling procedures based on earlier EFPs, intending those procedures to serve as an early strawman to start the regulatory process to implement deck sorting. As part of looking at eventual implementation, the Alaska Region of NMFS added a requirement into the 2015 EFP for cameras on deck to begin evaluating monitoring of deck sorting. Given that this requirement was added towards the end of the permit drafting process, the agency allowed vessels to phase-in cameras, requiring approval of the field of view on one date and full functionality of the camera on a later date.

Context on incentives to reduce halibut mortality rates

As has been the case for all the previous EFPs on deck sorting, the participants in the EFP were incentivized to undertake all the extra effort and added operational costs associated with deck sorting. The incentive was that they would have access to the halibut mortality savings their vessel achieved in the EFP and therefore in theory be able to harvest more of their directed fishing allowances. AKSC member companies have annual allowances of halibut mortality and assign these to the vessels they own/manage. If through deck sorting under the EFP a vessel achieved a decrease in halibut mortality relative to fishing outside the EFP, then that vessel/company theoretically would have more fishing opportunity.

In any season, the variability of halibut bycatch rates both across years and within a year mean that halibut savings incentives arise whether or not the halibut limit is binding at the end of the year. In the 2015 in particular, that incentive was greater than usual because AKSC in January 2015 set a target for halibut mortality usage for the year substantially below its limit. This was done to help the IPHC set the directed fishing limit for the halibut fishery higher than would otherwise been advisable.

Facing this situation, AKSC members could use any and all of the available tools to reduce halibut bycatch such as small test tows and communications on the grounds, using halibut excluders, and participating in the EFP. AKSC advised participants to focus on getting as much halibut sorted during the first 20-25 minutes to maximize mortality savings. Outside of that, participants used their own judgment to determine tow time, catch per haul, and other fishing variables and practices that could affect the viability of halibut under the EFP.

Finally, in terms of context on incentives in 2015, AKSC members were aware that the North Pacific Fishery Management Council was likely to move forward on a fast-track reduction of the Bering Sea halibut allowances available to the non-pollock trawl sector. For this, the Amendment 80 sector was likely to be the primary target. In this regard, work to develop or improve of tools like deck sorting or excluders was a high priority because reductions would probably make halibut bycatch even more constraining starting in 2016.

For those who used the EFP as part of their overall efforts, the permit prescribed deck handling and halibut catch and mortality accounting methods. Under the methodology, the mortality of a vessel’s deck sorted halibut was entirely dependent on the catch and viability of the vessel’s halibut bycatch. As a result, each vessel participating in the EFP had a strong incentive to utilize fishing and deck sorting practices that achieved meaningful decreases in halibut mortality rates relative to the default rates in the fishery.

<u>Methods for deck sorting/data collection for EFP 15-02</u>

The methods used by crew to sort halibut from the catch on deck and in the factory (for fish missed on deck) were almost identical to those used in the 2012 EFP. The net was pulled forward of the hatch to allow room for sorting and crew sort the halibut as the net is dumped into the tank. A single chute was then used to move the fish to where the sea sampler on duty collected length, viability, and time data for sampled fish. The change in strategy to concentrate on getting the most fish in 20-25 minutes was the one notable change in the actual sorting method relative to 2012. However, vessels made significant changes in the work stations so that sea samplers were able to do their sampling with lower physical demands and without prolonged kneeling. This was done by creating ramps up to working tables as part of the chutes used to move halibut to the samplers.

Sea samplers once again had to be certified fishery observers for the North Pacific who were hired through observer providers to collect halibut data on EFP trips. There were two sea samplers on vessels in addition to the vessel's regular two observers. To ensure a sea sampler was available whenever vessels sorted halibut on deck, sea samplers worked on opposing 12 hour shifts. Sea samplers were responsible for collecting data from halibut only and the vessel's regular observers collected all the other standard management data on EFP tows.

To ensure that all of the halibut missed during deck sorting were accounted for in the factory ("factory halibut"), sea samplers oversaw the crew's collection of all halibut that entered the stern tank as they came into the processing area on conveyor belts. To ensure complete monitoring, the catch could not be run out of a stern tank during deck sorting and the door leading from the tank to the factory had to be closed. After deck sorting was completed, the sea sampler on duty would go down to the factory and the crew could then open the door to the stern tank to begin running fish out of the tank. For any non-EFP tows (when a vessel had toggled out), observers collected halibut data through the standard protocol and sea samplers were off duty and not involved in data collection.

To count and sample deck sorted halibut, sea samplers used a set of deck sheets each with one of five separate stratified random sampling designs. Each row contained boxes with some randomly bolded to identify which fish should be sampled. Under the design, approximately one of five fish (20%) of the fish sorted on deck was sampled.

Standard viability assessment methods as described in the Observer Manual were used by sea samplers to assign a viability ranking to each sampled deck halibut.

Crew were responsible for collecting any halibut missed during sorting on deck in the factory and placed them into a tote designated for this purpose. Sea samplers measured all the factory halibut during the time they oversaw the crew's collection of "factory halibut" and after as necessary.

Both deck and factory halibut data were entered into a spreadsheet that extrapolated the deck halibut size and viability information from the sampled fish to the overall number sorted on deck. For factory halibut, the total weight and number of halibut was simply summed once the spreadsheet converted lengths to weights. A default mortality rate of 90% was assigned to all factory halibut, based on the results of the 2012 and 2009 EFPs where viability of factory halibut handled in the same manner were assessed.

For additional details on EFP fish handling and sampling procedures as occurred in 2012 and again in 2015 please see the final report from the 2012 EFP (https://alaskafisheries.noaa.gov/sites/default/files/efp12-01halibut_a80.pdf).

The EFP included an allowance for a vessel to deck sort with a single sea sampler on a limited basis, not to exceed 12 hours per day. AKSC requested this to be included in the permit to facilitate EFP participation of smaller vessels. The single vessel that used this allowance did so for only a short time before concluding that conducting EFP operations for a limited portion of a day was unworkable.

Finally, for vessels to make use of the ability to “toggle out” of deck sorting, a one-hour notice requirement was required prior to bringing an EFP tow on board. The 2015 EFP also included a seven-day advance notice for participation in the EFP and a 72-hour notice to NMFS to allow scheduling of a pre-cruise briefing for observers on EFP trips.

Field project management

Given the complexity of deck sorting procedures including the notice needed to toggle in and out of the EFP for specific tows and use of spreadsheets by sea samplers to transfer data from the deck sheets, AKSC recognized the need to have field project managers in Dutch Harbor and on boats, as needed. The field project managers were deployed for the entire first EFP trip for each participating vessel. Project managers were also available to ensure captains, crews, and samplers understood the catch handling and data collection duties of the EFP.

AKSC hired two field project managers, Cory Lescher and Collin Winkowski. Both had senior status as fishery observers when they retired from working in that area. Collin was recommended by staff at the IPHC and had worked for several seasons as a sea sampler on IPHC annual surveys. She also worked as a lab technician for IPHC prior to and after the EFP. After deciding to stop observing in the west coast observer program, Cory Lescher served as an observer coordinator to Alaskan Observers. Following that he worked as a field project manager on numerous projects to collect specimens for NMFS and on the salmon excluder EFP for the North Pacific Fisheries Research Foundation.

In addition to going out on initial trips to help sea samplers and crew understand the catch handing and notification requirements of the deck sorting EFP, field project managers attended shoreside pre-cruise briefings and error checked EFP data throughout the fieldwork. They also were a primary resource whenever questions and unforeseen circumstances arose during the EFP, via email when shoreside, on other vessels, at pre- and post-EFP briefings.

Finally, AKSC monitored vessel data on a daily basis and remained in close communication with field project managers, sea samplers, and EFP captains throughout the EFP. AKSC communicated with sea samplers on a daily basis to ensure that any concerns, questions, or other issues were addressed. This oversight was somewhat redundant (intentionally) because the field project managers were also communicating with samplers via email and at pre-cruise briefings and vessel visits.

Results

AKSC received its exempted fishing permit in April of 2015. After the time needed to arrange for sea samplers and gear up for EFP activities, EFP fishing commenced in early May. Participation continued at varying levels until the final EFP tow on November 17, 2015. Late October to mid-November is the normal time for most Bering Sea flatfish boats to finish their fishing activities and start shipyard work.

Participation

Nine of the 14 active AKSC vessels participated in the 2015 EFP. A core of four of AKSC's dedicated Bering Sea flatfish boats participated for most of their fishing from May through October/November. For some vessels trying deck sorting for the first time, participation was limited to no more than a few trips. For one of these vessels, the deck configuration and stern tank capacity proved largely unworkable from the outset and the vessel was checked into the EFP for only one trip (discussed below). Others were mid-level participants who engaged in the EFP over one or two months. Some of these mid-level participants were vessels that target Atka mackerel in the Aleutian Islands or participate in Gulf of Alaska or CDQ fisheries that are not included in the EFP.

To accommodate the EFP, observer provider companies geared up with extra personnel and did a remarkable job finding the two qualified sea samplers needed for EFP participation whenever vessels stayed within their original schedule. Observer providers were at times even able to find sea samplers on very short notice to accommodate changes in vessel scheduling. Despite this, some interested vessels that modified their schedules were unable to come up with a sufficiently concrete revamped plan that allowed the providers to work with them. The vicissitudes of fishing are challenging and some vessels that did not participate or participated minimally appeared to struggle with the complexity of planning for Bering Sea flatfish trips while meeting the seven days and 72 hour notice requirements.

Groundfish catches, numbers of trips, and halibut mortality savings in comparison to the 2012 EFP

The 2015 EFP expanded substantially on the 2012 EFP with groundfish catches in 2015 totaling 38,000 metric tons compared to under 2,000 MT in 2012. Likewise, the total number of EFP tows in 2015 was 1,940 compared to 98 in 2012.

Another metric for the scale of the 2015 EFP is the number of halibut sorted on deck compared to 2015. This is an indicator of actual magnitude of the effort to reduce halibut mortality because every fish sorted on deck is an effort/opportunity to reduce halibut mortality relative what would occur if that fish had been put in a tank and likely not returned to the water for several hours. In this regard, the 2015 EFP was once again remarkably larger with 83,429 halibut sorted on deck in comparison to 16,646 deck sorted fish in 2012. Of these 83,429 halibut sorted on deck, sea samplers collected length and viability data from 16,331 individual fish (20% of the fish sorted on deck).

The most prominent result for 2015 is that very substantial halibut mortality savings were achieved. The reduction in halibut mortality was an integral part of AKSC's pledged target amount of mortality savings for 2015 in order to supplement the amount available to the directed halibut fishery in the Bering Sea.

All but one of the nine vessels in the EFP achieved mortality rates in the range of 41-52%. For reference, the standard mortality rates in the Bering Sea flatfish fisheries average approximately 80%.

Table 1 below illustrates EFP performance by vessel through the last EFP tow on November 17, 2015. Halibut catch in the EFP totaled 481.7 MT. In the absence of the EFP sorting, 385 MT of mortality would have resulted based on 80% mortality as an average rate for operations without deck sorting. Instead, mortality under the EFP was reduced to approximately 49% resulting in 152 MT of mortality savings.

The overall catch of halibut in the EFP was 481.7 MT with the total weight of halibut collected in the factory of 74 MT. This means that overall crews were able to sort out 85% of the overall catch of halibut in the EFP. This was somewhat lower than previous EFPs where sorting on deck removed over 90% of the halibut by weight. In this regard, it appears that the strategy to sort out as many fish as possible in 20-25 minutes worked because sorting was still reasonably comprehensive, yet the mortality rates for halibut were substantially lower than in 2012. The decision to focus on 20-25 minutes was also successful in avoiding slowdowns for vessel efficiency as will be discussed below.

Table 1

Vessel	EFP Groundfish MT	Halibut catch MT	EFP mortality MT	EFP mortality rate	IPHC mortality MT*	Net Savings MT	Dates in EFP
Constellation	9,818	117.0	58.5	50%	93.6	35.1	May 24-July 4; July 17-Oct 24
Legacy	794	21.6	9.0	41%	17.3	8.3	May 16 -June 4
Arica	11,130	140.4	68.2	49%	112.3	44.1	June 9- Nov 17
Cape Horn	5,589	74.2	34.4	46%	59.4	25.0	June 3- July 26; Sept 14-Nov 6
Rebecca Irene	944	15.0	6.5	43%	12.0	5.5	July 20-Sept 2
Defender	5,153	65.4	34.2	52%	52.3	18.1	June 22-Oct 16
Unimak	3,656	21.3	10.7	50%	17.0	6.4	Aug 29-Oct 11
Ocean Peace	1,318	26.6	12.2	46%	21.3	9.0	Aug 12-Sept 2
Enterprise	159	0.2	0.1	70%	0.2	0.0	Sept 17-Sept 19
Totals	**38,561**	**481.7**	**233.8**	**49%**	**385.4**	**151.6**	

* Using 80% as a weighted average across target fisheries

The relative size of halibut sorted on deck compared to those recovered in the factory is of interest to understanding how participants used deck sorting to reduce mortality rates. Specifically, an expectation coming into the 2015 EFP was that crews would focus on larger halibut because they are easier to find and sort out, particularly for hauls with larger groundfish amounts. Larger halibut may be more viable as well and this is analyzed using the 2015 data below. For this reason, we expected to see a large differential size between deck and factory halibut. In reality, however, the difference in size was relatively small. Table 2 below reports average and median size of deck and factory fish by vessel. Overall, the differences range from 23% to 43% based on a comparison between median values per vessel.

Table2

	Avg wt (kg) of a deck sorted halibut	Median wt (kg) of a deck sorted halibut	Avg wt (kg) of a factory halibut	Median wt (kg) of a factory halibut	% difference based on median values
Constellation	4.8	4.2	3.5	3.0	29%
Legacy	3.3	2.9	2.2	1.9	34%
Arica	5.0	4.7	3.2	2.9	38%
Cape Horn	5.3	4.9	3.1	2.8	43%
Rebecca Irene	4.5	4.0	3.0	2.7	33%
Defender	5.2	4.4	3.4	3.0	32%
Unimak	4.2	4.0	3.3	3.1	23%
Ocean Peace	5.0	4.6	3.5	3.3	28%
Enterprise	5.2	4.8	3.8	3.5	27%

<u>Feasibility in the context of the 2015 catch handling and sampling procedures</u>

The EFP included a wide range of vessel sizes and months and nearly all participants in 2015 were able to make the deck sorting procedures work in flatfish fisheries. Most impressive was the fact that participants were able to conduct a large amount of EFP activity in the yellowfin sole fishery on both small and large vessels. Yellowfin is the most significant flatfish fishery in terms of annual catch, vessel participation, and annual revenues. Yet due to the high catch volume per haul needed to make the fishery economical, deck sorting has not worked in this fishery prior to 2015. This time, however, the strategy to sort as many halibut as possible within 20-25 minutes and other changes to the EFP protocols, such as the allowance to temporarily opt out of deck sorting when necessary, allowed vessels to achieve significant halibut savings in yellowfin target fishery relative to the standard mortality rate (83%).

EFP catch handling procedures still presented some challenges. Participants pointed out that the inability to run fish out of the stern tanks during deck sorting presented challenges for some vessels. Interestingly, vessel size was not necessarily the determinant of which boats were affected by this the most. The most critical factor was the capacity of bins on the vessel to store fish after sorting and observer sampling. Vessels with large capacity bins could keep fish flowing into the processing machines and the factory operating even when the flow of fish from the stern tank was suspended to allow for deck sorting. Hence, the prohibition on running fish out of the stern tanks during deck sorting appears to be more restrictive to boats with minimal bin capacity.

Additionally, boats that have significant bin capacity and two large stern tanks appear to be in the best position to avoid production slowdowns while deck sorting. Not only can these vessels better accommodate delays from not being able to run fish out of the stern tank during deck sorting, but also can make a second tow even if the first stern tank is full, minimizing temporary interruptions in the flow of fish throughout the system. This ideal arrangement helps supply a consistent flow of fish under deck sorting and avoids slowdowns to a great extent.

As is evident from the general results (Table 1) above, one EFP participant had somewhat higher halibut mortality rates. This vessel experienced practical problems with the modified catch handling procedures. In spite of this, the vessel was still able to reduce mortality rates relative to the standard rates in the fisheries they selected for deck sorting. The amount of EFP fishing they did, however, is rather insignificant relative to other participants. Challenges for that vessel stemmed from the size of their stern tank, factory capacity, and deck layout. The vessel could only sort halibut from a relatively small fraction of each haul. Accordingly, the vessel only made seven EFP tows in 2015, and modifications would probably be needed to achieve success similar to the other EFP vessels.

An important goal for the 2015 EFP was to evaluate how well the deck sorting and catch accounting protocols were understood and adhered to on a daily basis. Overall, the 2015 protocols worked well. For the vast majority of EFP tows, catch handling procedures and protocols were followed carefully and precisely. Given the complexity of EFP procedures, we feel that the industry's commitment to make deck sorting work was demonstrated through their careful adherence to the rules and procedures. Training of sea samplers and crew by our field project managers prior to and during deployments was also critical for this encouraging outcome.

The EFP included several notification requirements that added to this complex scheduling challenge. These included giving notice to NMFS seven days prior to an initial EFP trip, and scheduling and conducting pre-cruise briefings 72 hours before initial EFP trips and whenever new sea samplers, observers, and key crew came on board. In instances where unforeseen challenges arose with meeting the pre-EFP notice deadlines, the NMFS Fishery Monitoring and Analysis (FMA) division provided helpful flexibility.

The EFP rules specified that sea samplers were not allowed to use FMA-issued survival suits, personal locator beacons (PLB), and other equipment. Therefore, all these had to be provided by the EFP vessel or AKSC. PLBs also require registration with SARSAT NOAA in the name of the individual carrying it. This task required additional coordination so that the units were registered during sea sampler deployments and removed from registration when deployments were completed. All of the above created complex logistics related to the use of sea samplers in the EFP.

One aspect of the 2015 EFP rules that allowed participants to make better use of the EFP was the allowance to "toggle" between EFP and non-EFP tows when weather did not allow for safe deck sorting operations, or operational constraints prevented efficient deck sorting. This flexibility was not available in past EFPs, and vessels had to drop out of the EFP to avoid the costs of shutting down fishing operations when weather conditions were not safe for deck sorting but still suitable for fishing without deck sorting. The ability to switch in and out of EFP mode helped participants minimize disruptions and downtime, but increased the complexity involved with making sure sea samplers, observers, and crew were aware of the appropriate sampling and reporting requirements.

Some 2015 EFP participants used this flexibility to switch frequently between EFP, Amendment 80, and CDQ tows, allowing vessels to maximize factory throughput. Vessels also utilized this option when they encountered weather conditions where deck sorting was potentially unsafe or when fishing conditions were encountered with little or no halibut. In the latter case, captains determined that the halibut mortality savings through deck sorting would be more than offset by the additional mortality arising from delays caused by the additional time needed to deck sort halibut. Sea samplers were “off duty” at these times, but were of course paid the same daily compensation even if they were not working on some or all of the hauls on some days.

Some EFP participants also made arrangements with the observer providers to keep sea samplers engaged even when they did not intend to do deck sorting for parts of their trips (e.g. target fisheries outside of flatfish). This was done because they planned to do deck sorting on the next trip and retaining the samplers avoided the possibility that they would not be available because the observer provider needed them for another deployment.

EFP communication procedures for notifying sea samplers and observers which tows would be EFP tows generally worked well, but some challenges occurred. In a few instances, proper and timely notice was given that the next haul would be an EFP tow, but equipment needed for the tow to be sorted on deck (e.g. winches, cranes, working halibut chutes) malfunctioned and the tow could not be deck sorted. When this occurred, the proper procedure was for the crew to inform the sea sampler that the codend would be dumped into the stern tank without deck sorting and the EFP procedures for halibut accounting in the factory by crew and the sea sampler should have been done. On a few occasions this did not occur in the proper manner. The lack of clarity in some of these cases created confusion over whether the tow was to be handled as an EFP or Amendment 80 tow (non-EFP tow).

In a very few cases, some deck sorting had already occurred when the piece of equipment malfunctioned and the crew incorrectly decided to treat the remainder of the tow under Amendment 80 rules and reporting. This was not correct because some halibut from the tow had already been removed on deck. In these few cases and after consultation with the project managers and AKSC, participating vessels were instructed to report the occurrence to NMFS just as they would in any situation where a vessel noted the lack of conformance to a specific regulation. When questions arose, field project managers and AKSC staff worked with the vessel to get things back on track and NMFS assisted in this effort in cases where their assistance was sought.

Metrics to evaluate the performance of sampling methods for halibut sorted on deck

Overall, the sampling procedures to select halibut for measurement, viability, and time out of water accounting on deck functioned well. The sample size and much of the details of these procedures mirrored the 2012 EFP and thus the 2015 results reaffirm the preliminary findings of the 2012 EFP that the sample size and methods for collecting data from deck sorted halibut fish are sound.

Additionally, sea samplers were able to collect data from deck-sorted halibut at the pace of crew’s sorting operations. This avoided creating a backlog of fish awaiting measurement and viability assessment which would have contributed to fish being held out of water and increasing mortality.

The degree to which the stratified random sampling design used for the EFP resulted in no halibut sampled on tows with fewer than five halibut sorted out of the catch on deck is of particular interest. In conversations, AFSC's FMA Division (Observer Program) expressed an interest in examining the potential for deck sampling to encounter no halibut at all. To evaluate this, Table 3 below reports several metrics for tows with fewer than five deck sorted halibut on a vessel-specific basis. We also include information below about the overall number of halibut sorted on deck on tows where no fish were sampled.

The process of selecting fish for data collection worked as follows. The 8.5 by 11inch waterproof deck sheets were used to collect a variety of data. The number of halibut sorted on deck was recorded by checking a box for each halibut sorted on deck. Highlighted boxes on each sheet also served to indicate which fish were to be selected for sampling (length, viability, time out of water). An Excel program was used to randomly highlight 20 percent of the boxes on each sheet. Five different versions of the sheets randomly mixed into reams of waterproof deck sheets were issued to sea samplers.

To reduce the chances that no fish would be selected if only five or fewer halibut were sorted on deck, all five of the versions of the sheets used included at least one highlighted box in the first 5 boxes. Periodically during the EFP, sea samplers filled their clipboards with sheets from the reams in a manner that meant that the different versions of the sheets were once again mixed.

During deck sorting, samplers were instructed to keep the clipboards away from crew who were sorting and sliding fish across the chute to the sea sampler. This would prevent crew from knowing in advance which fish would be selected.

The back of each deck sheet also had spaces to record lengths for halibut collected in the factory. Sea samplers supervised the crew's collection of halibut in the factory and measured each factory fish. Room to record vessel name, haul number, start and end time (when the net came on board to the time the last halibut was sampled) was also incorporated into the deck sheets.

Based on the use of this approach in 2012, our expectation was that there would be very few tows with low numbers of halibut and therefore few cases where the sampling on deck did not get any halibut. This expectation was, however, based on previous EFPs where only a small number of tows were in the yellowfin sole target. Yellowfin sole generally has lower halibut bycatch rates and, based on the limited experience with collecting all halibut from tows in the 2012 EFP, bycatch rates for halibut can be zero or just a few fish per tow. Recognizing the potential for more EFP fishing in yellowfin sole in 2015, only deck sheets with sampling of at least one of the first five fish were used to avoid the potential for no sampled fish in a tow.

Table 3 below shows the number of tows with fewer than five halibut sorted on deck and the number of tows where no halibut were sampled.

Table 3

Vessel	# of EFP tows	Avg # of deck sorted hal/tow	Greater # of halibut per tow	# of tows with <=5 halibut sorted on deck	Percentage of total EFP tows with <=5 halibut sorted on deck (tows with >0 halibut)	# tows with halibut sorted on deck but none in sample	Percent of EFP tows with halibut sorted on deck but none sampled
Constellation	508	41	570	33	6.5%	12	2.4%
Legacy	62	86	494	1	1.6%	1	1.6%
Arica	504	46	223	24	4.8%	5	1.0%
Cape Horn	310	40	508	42	13.5%	16	5.2%
Rebecca Irene	56	50	320	1	1.8%	0	0.0%
Defender	281	35	305	24	8.5%	8	2.8%
Unimak	152	26	209	30	19.7%	12	7.9%
Ocean Peace	61	80	331	0	0	0	0.0%
Enterprise	6	n/a	n/a	n/a	n/a	n/a	n/a

Of note is that for the average number of halibut deck sorted per tow, the sampling fraction of 20% draws information from a meaningful number of halibut. Tows with five or fewer halibut, however, occurred on every vessel and at a much higher rate than was the case in 2012 (in 2012 this almost never occurred). The number of tows with fewer than five halibut does not include instances where there were no halibut in the haul (on deck and in the factory) or tows where deck sorting was not done at all.

To understand why there are "EFP tows" with no deck sorting some background information is needed. Specifically, under the EFP rules a haul had be declared to be an EFP haul or a non-EFP haul prior to commencing deck sorting to ensure that the proper personnel were in place for catch accounting and the correct methods were used. So if a vessel expected to deck sort a tow but equipment became inoperable (e.g. the gilson winch or deck crane failed) or if the weather came up and it was unsafe, it had to be handled as an EFP tow if catch accounting was started in that mode. In some cases where equipment problems arose, no deck sorting had been done at that point so all of the halibut were collected and measured by sea samplers in the factory. When this occurred, the default 90% mortality rate was assigned to the tow. This is a higher rate than normally occurs in Amendment 80 fisheries with no deck sorting creating a penalty of sorts for not sorting on deck or sorting only a small fraction of the halibut in EFP tows.

Examining Table 3 one can see that the number of tows with five halibut or fewer sorted on deck varied across vessels. This makes sense because participants engaged in different target fisheries and inherent differences in bycatch rates exist between fisheries. This likely explains the range from 1.6% to 19.7%.

We further examined the number of tows where halibut were sorted on deck but none were sampled. For three of the EFP vessels, this occurred 12 or more times over the course of the EFP. To understand this in the context of EFP participation, the table also reports the number of EFP tows by the vessel. Hauls with no halibut sampled amount to 5-8% of EFP tows for two vessels while being a much lower percentage for others. Not surprisingly, both of these vessels engaged to a large degree in the yellowfin sole target for the EFP and in fact the vessel with the 8% of EFP tows with no halibut in the sample engaged uniquely in yellowfin fishing for the EFP.

To put this issue into context, we next looked at the overall number of halibut sorted on deck for tows where no halibut were sampled (once again excluding EFP tows with no deck sorting and tows with no halibut catch). The 52 tows with no halibut sampled under the randomized 20% sampling methodology is actually a small percentage of the 1,940 EFP tows (<3%). In terms of the number of halibut, only a total of 109 halibut were sorted on deck in the tows with no halibut in the sample. To put this into context, the EFP sampled a total of 16,331 halibut from a total of over 80,000 halibut sorted. The fraction of halibut in tows that "fell through the cracks" for our sampling methods was therefore just 0.07% of the overall number of halibut sampled in the EFP.

From our experience with deck sorting to date, each EFP has encountered tradeoffs with sampling approaches. Alternative sampling designs could be used in the EFP to reduce or eliminate the chance that the sampling would not encounter any halibut if the tow had five or fewer halibut. One would be to increase the sampling fraction above 20%, such as one out of four or one out of three. Experience in previous EFPs tells us that under increased sample sizes, sea samplers are very likely to fall behind the pace of deck sorting on most tows. This lag will delay returning halibut to the water and increase mortality rates.

One has only to look at the average and highest number of halibut (Table 3) above) to see how a larger sampling fraction could start to reduce halibut viability considerably. Specifically, the tows with extremely high number of halibut had between 300 and 500 halibut. The time needed to sample these tows extended the time out of water beyond 25 minutes but in most cases not by much. To help frame this, consider that a haul with 300 halibut sorted out on deck meant that approximately 60 fish were sampled. To complete sampling in thirty minutes, sea samplers would need to sample two fish per minute. This was a challenge but doable for an experienced sampler.

Requiring the first fish to be sorted on deck to be sampled could be considered as an alternative sampling strategy. This rule would eliminate the problem of tows where no halibut sere sampled. The downside of this approach, however, would be that the crew would know that the first fish would be sampled, hence crews could have an incentive to select a small fish that appears to have higher viability.

To provide additional context to the concern that tows with five or fewer fish sorted on deck do not always have sampled halibut from deck sorting (hence no halibut mortality is attributed from deck sorting based on our methods for that haul), one can consider the regular Amendment 80 sampling protocol. Based on AKSC member vessel data, observer sampling methods in regular Amendment 80 fishing typically have a sample size of between 250 and 400 kg. Tow size in flatfish fisheries typically fall into a range of 20 to 30 MT. This amounts to a typical sample size in the range of 0.08% to 2% of the overall weight of the tow. Captains report that it is not uncommon for sampling to fail to encounter halibut for hauls where halibut is part of the catch.

On the flip side, at times several halibut or one or more large ones are collected in an observer sample even when the tow seems not to have many halibut. When halibut comprise a large fraction of the weight of a sample, this extrapolates to a large amount of halibut catch in the tow. When halibut is a small fraction of the catch, sampling variance on a tow by tow basis with regular observer sampling methods is likely considerably higher than for the 20% sample for deck sorted fish in our EFP. Any sampling protocol will result in cases of unsampled species.

Other aspects of the 2015 EFP catch accounting procedures

At the outset of EFP activities in May, video supplied by one of the EFP vessels to AKSC indicated that sea samplers on the vessel were not always taking adequate time to do all the steps involved with viability assessments on fish. Careful adherence to the halibut viability key in the NMFS Observer Manual is critical to EFP results. To help improve viability sampling, AKSC instructed its field project managers to step up their efforts to remind the sea samplers at briefings that the full set of steps for viability sampling needed to be followed exactly, even for fish that are actively moving and clearly appeared to be viable.

At times, field project managers also instructed crew on proper halibut handling on deck. This occurred most on vessels that had not previously participated in a deck sorting EFP. Whenever sea samplers reported improper handling methods, the project manager or AKSC discussed the issue with the vessel's captain. In all cases, follow-ups with sea samplers indicated that the problems were resolved.

The EFP included a requirement for vessels to have deck cameras to monitor sorting operations. This requirement involved sending camera images for approval by Alaska Region personnel before June 29, 2015 and full operation of the systems by July 15th. Participating vessels were able to meet these deadlines and from AKSC's perspective the approval process went smoothly with only a few instances in which vessels had to modify initial camera installations. During the EFP, participants were also required to confirm on a daily basis that the monitoring cameras were operational. Through this process, several vessels identified system interruptions and failures and had to curtail EFP operations until their video monitoring systems were returned to operation. In these cases, vessels reverted to Amendment 80 accounting rules until their systems were fixed.

Video review and validation to confirm that procedures were followed on deck has not been done yet. Once that is completed, the utility of the monitoring system can be assessed and any changes to the systems or the requirements can be made. The monitoring cameras were designed to supplement the monitoring by sea samplers and observers on each vessel, and to document conformance with EFP procedures. AKSC and its project managers have received no indication from sea samplers or observers that crew members failed to comply with all EFP procedures.

Collection of halibut in the factory

Halibut accounting in the factory went well in the 2015 EFP and crew members followed the procedures to place all halibut recovered in the factory into the tote or bin designated for that purpose. Sea samplers were then responsible for measuring each fish to fully account for halibut that were not sorted on deck. This proved to be a relatively easy task given the generally low number of fish that made their way into the factory after deck sorting.

To provide perspective on the amount of halibut typically collected in the factory in the 2015 EFP, Table 4 below reports the average factory halibut weight and number of factory halibut in a tow, the highest weight of factory halibut in a tow, and overall weight of halibut collected in the factory for each EFP participant.

Table 4

Vessel	# EFP Hauls	Total Factory Halibut (MT)	Avg # Factory halibut /Tow	Avg Wt of factory halibut/Tow kg	Greatest Wt of factory halibut /Tow kg
Cape Horn	310	7.8	8	25	194
Rebecca	56	2.3	14	40.4	325
Arica	504	21.7	13	43	835
Unimak	152	5.7	11	37.5	277
Constellation	508	17.3	10	34	361
Defender	281	13.3	14	47.3	551
Ocean Peace	61	1.9	9	31.6	259
Enterprise	6	0.13	4	17.9	46
Legacy	62	3.8	27	55	413

On average, 12 halibut per tow were collected in the factory with one vessel averaging more than twice that number (27). The average weight of halibut collected in the factory per tow was 37 kg. The relatively low average number and average weight of halibut collected in the factory includes situations where only a portion of the net was able to be sorted on deck and tows where no sorting on deck was done but halibut were accounted for in the factory under EFP procedures. The tow with the greatest weight of halibut recovered in the factory provides some perspective on the halibut in EFP tows with minimal or no deck sorting. The most halibut to reach the factory in a tow was 835 kg, which occurred when the crane on deck was damaged preventing any sorting of the tow. A crane is needed to varying degrees on different boats to allow the crew to slowly spill the contents of the net onto the deck to allow for sorting.

AKSC and the observer provider companies received significant feedback from sea samplers on the issue of long hours overseeing the crew's collection of halibut in the factory. The requirement to oversee the crew's collection of halibut missed during deck sorting often created long hours for sea samplers in the factory, particularly on vessels that have minimal fish bin capacity downstream of the flow scale. For the 2015 EFP this meant that some sea samplers were frequently in the factory or on deck for most of their 12-hour shift. Because fish could not be run over the scale unless the sea sampler was present in the factory overseeing crew sorting activities, vessels had to shut down the conveyor belts coming out of the stern tanks periodically to allow sea samplers to take biological breaks, eat meals, etc.

In some cases, EFP vessels were still running fish out of the tank when the sea sampler's 12-hour shift was completed. This meant that the sea sampler would be requested to extend his/her shift over the 12-hour limit. This was only supposed to occur on rare occasions according to the rules of the EFP. When brought to the attention of AKSC, AKSC and its field project managers notified the captain that he was not following the EFP procedures. Whenever this occurred, we received feedback from sea samplers that the situation had been remedied. AKSC's written training materials for sea samplers and in-person training by project managers stressed the need to inform AKSC if shifts exceeded 12 hours. Nonetheless, we recognize that sea samplers may not have brought this issue up with the vessel personnel, project managers, or reported it to AKSC.

In July and August of 2015, observer providers notified AKSC that they were having some difficulties finding interested sea samplers for the EFP. This was in part due to the pollock "B" season and other fisheries being in full operation. It was also to some extent apparently due to the perception of long hours and tedium associated with overseeing factory collection of halibut.

Additional factors affecting deck sorting success and benefits

An increased presence of killer whales alongside the vessels was noticed for EFP arrowtooth trips relative to other EFPs. These occurred in May and early June on some of the EFP boats fishing on the shelf break areas off Akutan, and also on the shelf adjacent to Pervenets canyon. Earlier deck sorting EFPs in 2009 and 2012 had encountered a few orca whales at times but only intermittently and the whales left whenever a longline vessel started fishing in the area. In this EFP, some vessels fishing arrowtooth had a continuous presence of killer whales over several days. Where this occurred, whales were at times observed to be near the chute used to return halibut to the water. To attempt to thwart the whales from consuming halibut, participating vessels tried deck sorting while moving the vessel at the speed normally used for transiting between fishing areas (approximately 8-10 knots). This appeared to successfully prevent predation because the whales generally opted not to follow the vessel. The effects of returning halibut to the water in this manner are not known.

One EFP captain who experienced the whale situation expressed interest in trying to devise a holding tank to temporarily contain the halibut while providing a flow of sea water. This would avoid the need to return the halibut to the water immediately and the captain felt he could steam away at normal towing speed and the whales might not follow. Delaying the return of the halibut to the sea thus might allow it to occur with lower probability of predation. This was not attempted in 2015 because construction of the holding pen required some engineering, and after consulting with NMFS, it was decided that the regulations require that halibut and other PSC be returned to the sea as fast as possible. In this case, that part of the PSC regulation may at times be in conflict with the mandate to minimize mortality to PSC.

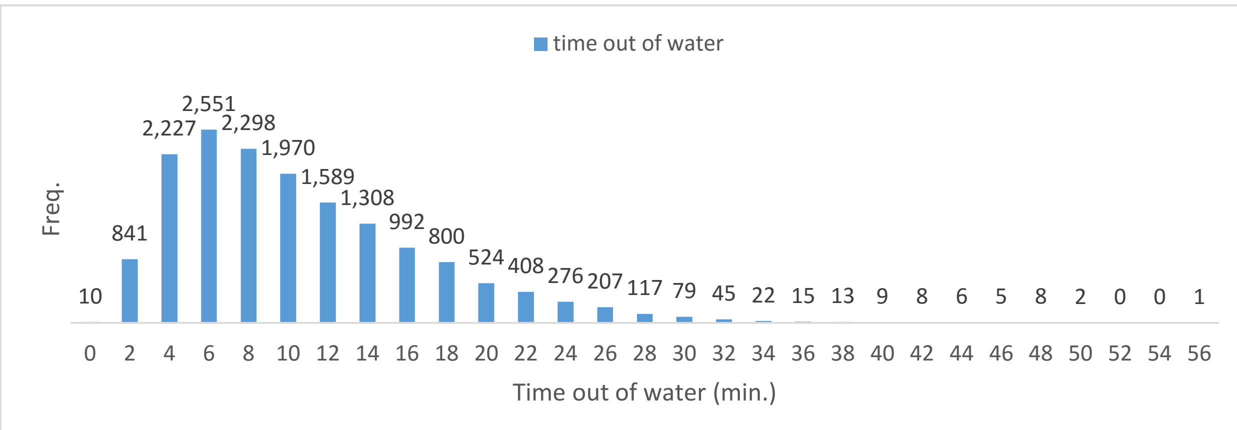
Analysis of fishing and catch handling/accounting factors affecting halibut viability

Data were collected in the EFP to inform how time out of water affects halibut viability. Additionally, some limited data are available to look at other factors that could explain halibut viability as well. The analyses below are therefore intended to explore inn a limited sense possible factors affecting halibut viability but it is important to keep in mind that the main objectives of the EFP were to evaluate the scale of actual morality savings not to collect data to model how fishing and catch handling factors affect viability separately or in combination.

With that as context, time out of water data and other possible factors that might explain the halibut viability differences are discussed below with an eye to comparisons to the 2012 results and as a (cursory) exploration of whether expected relationships are demonstrable.

Figure 1 below shows the total number of halibut sorted on deck in the EFP grouped by minutes out of the water. This illustrates that the EFP accomplished its objective to get halibut back in the water in less than 25 minutes and in fact the vast majority of the halibut were out of water for less than 20 minutes. This can be compared to 2012 where the average time out to complete sorting and sampling was 28 minutes and mortality rates for halibut were considerably higher than what was seen in the 2015 EFP.

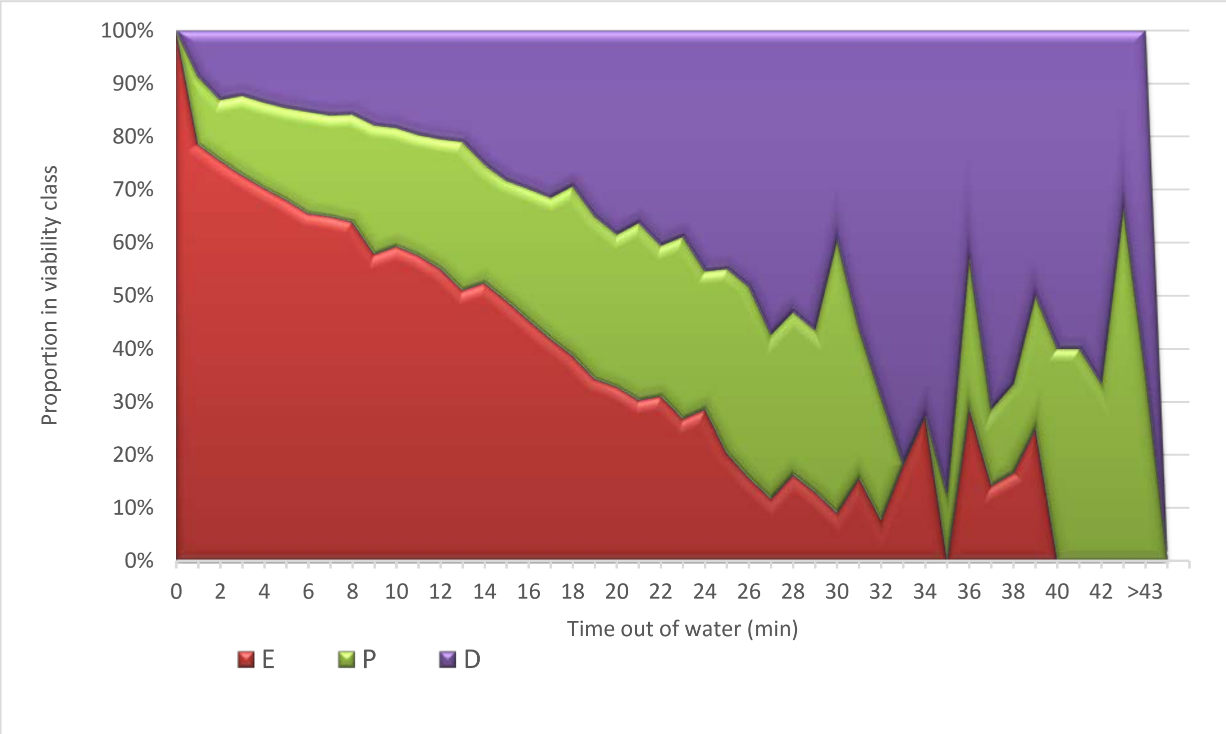
Figure 1



The proportion of halibut falling into the three viability categories (excellent =20% mortality; poor =55% mortality, dead = 90% mortality) is seen in the Figure 2. As we expect from the mortality savings results in the EFP overall, a rather high proportion of the halibut returned to the water within the first 15 minutes were assessed as excellent. At 25 minutes, about 25% of halibut are in the excellent category but the combination of excellent and poor still adds up to considerable savings relative to the standard mortality rates without deck sorting (which averages 80% mortality). It is also evident that some of the fish sorted in the first 10 or so minutes were still assessed as poor or dead as well. This shows that time out of water explains viability to a large degree but other factors are also likely to be important to viability.

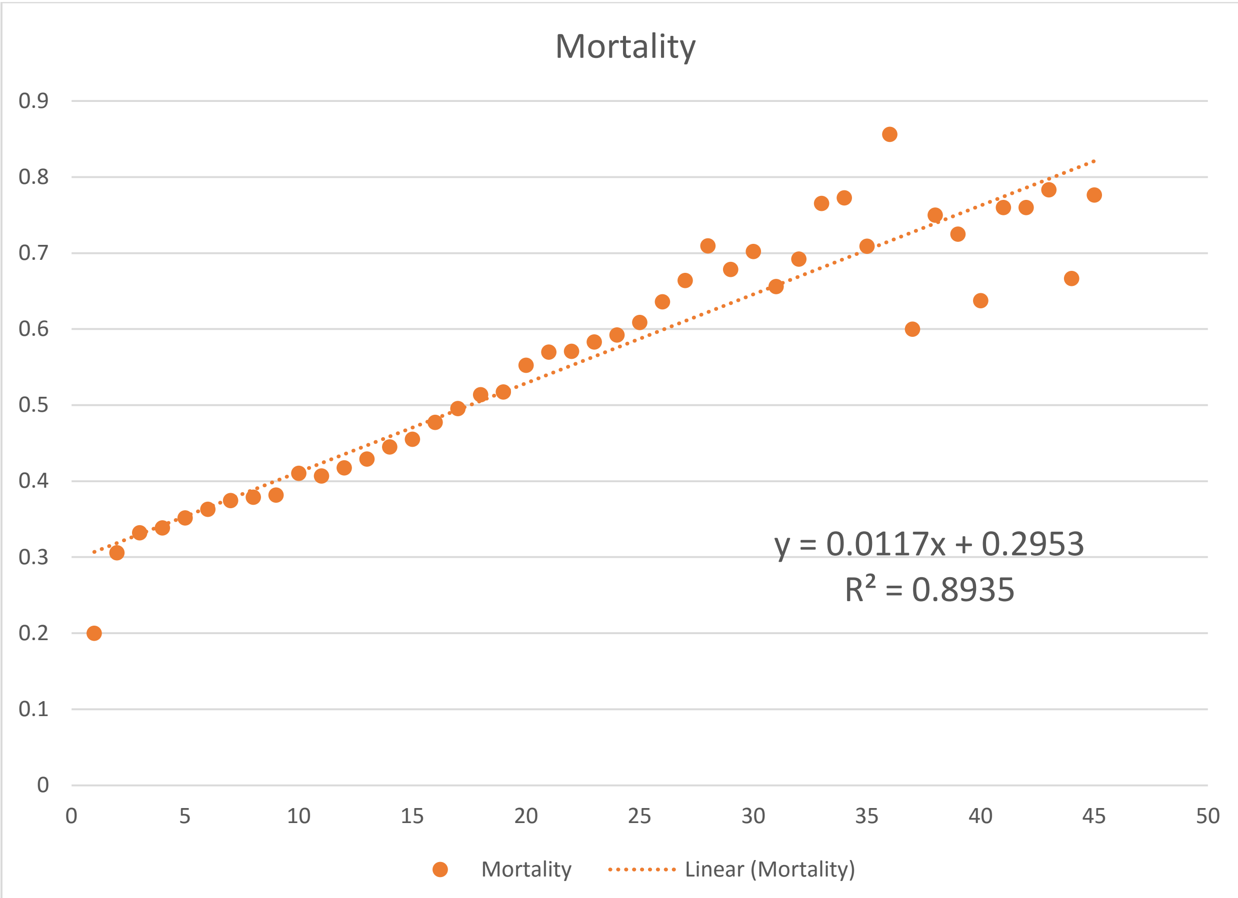
Of particular interest here is the difference in the proportion of fish in each viability category in 2015 in comparison to 2012 (Figure 3 in the 2012 report). One important difference is that time out of water on average was generally much greater in 2012 than in 2015. Another is that the proportion of fish in excellent condition was much greater in 2015. This suggests that focusing on returning fish to the water in the first 20 minutes in 2015 was effective in achieving better mortality rates in 2015.

Figure 2



Grouping halibut into time out of water intervals can also be illustrated as a "functional relationship" between time and mortality rate. This can be done by averaging the rates of mortality seen as proportions above within the three viability ratings for each per-minute time out of water grouping. This is shown in Figure 3 below. This averaging of the mortality ratings produces a relationship between time out of water and mortality and this could be used to predict mortality based on time out of water or the predicted increase in mortality resulting from each minute it takes to get a halibut back in the water.

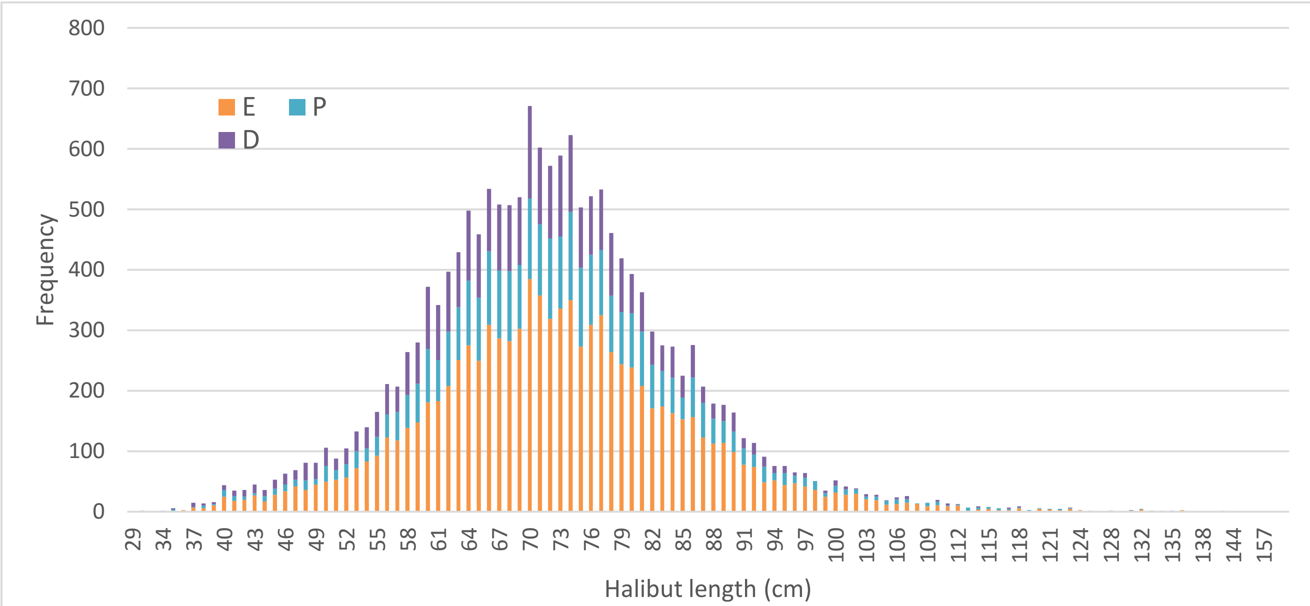
Figure 3



In evaluating the strength of the relationship seen in the Figure 3, however, recall that Figure 2 indicates that proportions of fish falling into the different viability categories showed non-negligible proportions of dead and poor rated fish within the first 10 minutes. One has to keep this variability in mind when thinking about averaging of mortality into a single average mortality rate as seen in the nearly linear relationship between time out of water and mortality rate above. This averaging of rates done for the mortality slope figure has a very high R square "goodness of fit" statistic. This is not the same when one attempts to predict the viability rating of all the individual fish in the dataset by their time out of water alone (not shown here).

Halibut size may also be a factor that explains viability, with larger fish expected to have better viability and vice versa. Expecting this to be potentially quite noisy in terms of fit, we plotted the viability ratings by fish length in the Figure 4 below.

Figure 4



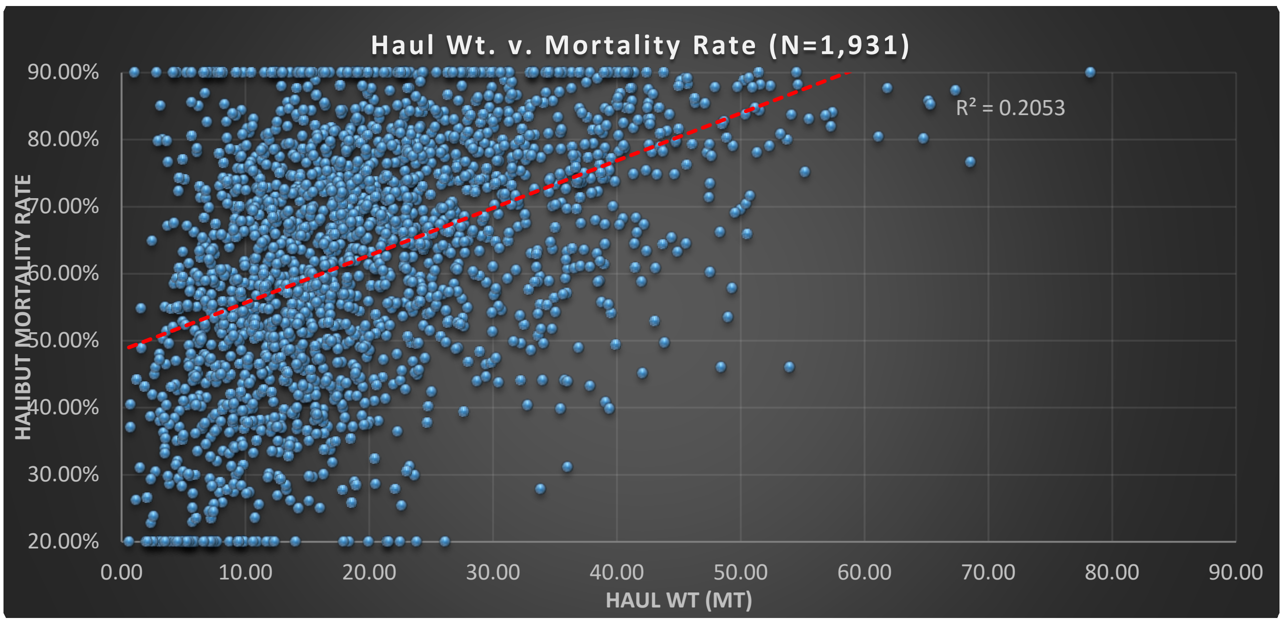
If fish size were an important factor for predicting viability then we might expect to see the frequency of poor and dead fish distributed more towards the smaller fish and the frequency of large fish dominating the right-hand tail of the distribution above. In reality we see some relatively small fish ranked as "excellent" and a few very big fish were rated as poor or dead. In the middle there is quite a consistent distribution between the viability categories. On balance, however, Figure 4 does show that large halibut have a higher chance of being in excellent condition than poor or dead. The time it takes to sort large fish being sorted from the deck may affect these results. Some big fish may have come out of the net last so time out of water might have affected the results in a manner that masked the ability to see an expected relationship of larger fish being able to survive being caught in a trawl better than small ones. Likewise, the crew's ability to sort out big fish faster and the strategy to sort in a manner that gets the biggest reduction in mortality in 20-25 minutes may affect our ability to see a relationship between size and viability.

Finally, the effects on fishing variables on viability are of interest. We initially looked at these factors in 2012 but were unable to uncover any strong relationships that made intuitive sense. One concern is that most fishing variables (such as the amount of catch in the haul and tow duration) are not independent explanatory variables. These interactions present potential for multicollinearity problems with multivariate regressions and hence more complex (and unfamiliar to the PI for this EFP) modeling methods would be needed.

For the 2015 EFP, we did not log towing times, speeds, and other variables of interest for attempting to examine the relationship between fishing variables and halibut viability. One piece of information that we did collect in 2015 was the overall weight of catch per haul from the vessel's flow scale (referred to as "OTC") per haul. Total catch might be a factor in explaining viability to some extent because it is probably related to towing time which many captains feel can affect viability as fish tire with extended towing times. Likewise, the amount of catch in the net when the net is brought up the stern ramp may affect the amount of pressure on halibut in the net.

To look at this, OTC (catch weight per haul) was plotted against viability in Figure 5 below. Overall, there does not seem to be a strong relationship between tow size and viability. If anything, it does appear that the very large hauls do have higher mortality rates but the relationship overall is week and especially noisy for the lower catch per haul end of the spectrum. Also, the "R" squared statistic for the regression is low, which is typical for analyses of applied data in "real world" experiments.

Figure 5



Conclusions:

The main objective of EFP 15-02 was to evaluate the potential scale of mortality savings for a set of catch handling practices collectively referred to as deck sorting. In that regard, the combination of procedures worked to create more than 150 MT of mortality savings and demonstrated that deck sorting has large potential for generating savings in halibut mortality. Additionally, all but one of the nine EFP vessels achieved mortality rates in the range of 41-52%, and deck sorting was generally feasible for participants in a wide variety of flatfish target fisheries including yellowfin sole. These are very encouraging results.

The evaluation of factors affecting viability of halibut above suggested that the most critical determinant of halibut viability is time out of water. The data from this EFP and the one in 2012 suggested that viability declines substantially if the fish is not returned to the water within 20-25 minutes of when the net is brought on board. EFP data collection procedures were specifically designed to allow data to be collected without increasing time out of water appreciably. A sampling structure that allows data collection to keep pace with the crews' ability to sort and return halibut to the water is needed to ensure that deck sorting achieves its potential mortality savings. The sampling protocol also proved to obtain accurate data concerning halibut bycatch quantities and mortality. A balance needs to be struck between collecting accurate and complete data and slowing return of halibut to the water. The EFP protocol obtained a reasonable balance. If sampling and catch accounting methods used by sea samplers or observers (in the future) result in fish staying out of water longer, viability savings will be squandered due to overemphasis on catch accounting precision.

Although time out of water is a primary determinant of viability, several other factors (including fishing practices) may affect viability. These factors likely are likely responsible for the variability in that complicates predicting viability based solely on time out of water. For example, some fish out of water for less than 20 minutes do not achieve "excellent" viability and conversely, a higher than expected number of fish out of water in excess of 30 minutes were in excellent condition. It is likely that fishing practices are responsible for some of this variability. The effects of fishing practices is most evident when one considers examples in the extreme, such as extremely long tow times or large haul sizes. Viability of halibut from these practices may be poor regardless of whether the fish are returned to the water quickly. The design of the accounting under EFP specifically addressed these uncertainties by using data from each haul to determine the halibut mortality from that haul.

This use of vessel and haul specific accounting was also important to establishing incentives for halibut mortality savings under the EFP. This EFP project was not designed or intended to identify which fishing and catch handling variables are most important to halibut viability. Nor was it designed to look at how incremental changes in one of more of these factors would change viability outcomes the most. But the analyses of factors affecting halibut viability serves to illustrate that one factor alone cannot ensure the achievement of a reduction in mortality rates. As a result, incentives need to be present to help ensure mortality savings are achieved. By accounting for halibut at the tow level, each vessel was incentivized to attempt to achieve actual mortality savings on each tow, notwithstanding the unpredictability of that savings. The presence of incentives was evident in variability of mortality across vessels in the EFP and the responses to those different rates. Specifically, by accounting for mortality at the vessel level, vessels that were not achieving reductions in mortality made adjustments in fishing and handling practices to make improvements and those unable to achieve reasonable gains from deck sorting elected to drop out of the EFP, instead relying on other tools to achieve mortality reductions. Had the EFP halibut accounting protocols not recognized this difference (instead applying a uniform mortality rate to all vessels), it is likely that vessels unable to achieve substantial improvements in mortality rates under the EFP would have continued to fish under the EFP to receive the benefit of the lower mortality rate under the EFP. By allowing the viability tests on a vessel to determine the mortality of halibut sorted on that vessel, the EFP both incentivized halibut savings and provided substantially more accurate accounting of halibut mortality of vessels fishing under the EFP. Preserving this incentive is important given the uncertainty of fishing practices effects on halibut mortality and the range of mortality rates found on the different vessels in the EFP.

The insights gained in the post EFP informal interviews in 2012 and again this year reinforce the conclusion that we need to preserve the direct and vessel-specific incentive structure used in the EFPs to date. In this regard, it needs to be recognized that fishing practices that reduce halibut mortality and halibut sorting by crews are essentially added fishing and catch handling costs affecting profits for vessel operators. If incentivized through halibut mortality savings to the operator of the vessel a, then operators will be very likely to take the necessary steps to ensure those savings are achieved. Ensuring that savings are available to the fishermen willing to incur the costs and efforts to make them is really the only workable approach. Regulating fish handing, towing times, haul size, and other factors is simply not feasible, would have unknown impacts on mortality, and would not be good fishery management practice.

The success of the EFP in achieving its goal of halibut mortality reduction arose in large part from its design. Crediting each vessel with its own mortality savings ensured that vessel operators took the steps needed to achieve actual savings. Structuring data collections from halibut to keep pace with sorting ensured halibut would be returned to the water as quickly as possible, helping to prevent an outcome where time taken to do halibut data collections reduced halibut viability. These features will be important to maintain in future deck sorting initiatives.