UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

November 7, 2011

Eric Olson, Chairman
North Pacific Fishery Management Council
605 West 4th Avenue, Suite 306
Anchorage, Alaska 99501

Re: Review of an Exempted Fishing Permit application to study various fishing and handling methods for reducing halibut mortality in the non-pelagic trawl fishery.

Dear Chairman Olson:

On October 10, 2011, NMFS received an application from Mr. John Gauvin on behalf of the Alaska Seafood Cooperative (AKSC) for an exempted fishing permit (EFP). We are providing the application to the U.S. Coast Guard, International Pacific Halibut Commission (IPHC), State of Alaska, and the North Pacific Fishery Management Council (Council), as required by 50 CFR 600.745(b)(3)(i) and 50 CFR 679.6(c)(2). This EFP would allow operators of non-pelagic trawl vessels to assess the operational feasibility of reducing halibut mortality in fisheries for flatfish by removing and releasing halibut from a codend on deck of a catcher/processor. Issuance of EFPs is authorized by the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area and its implementing regulations at 50 CFR 679.6, Exempted Fisheries.

The applicant developed the EFP in cooperation with NMFS staff. On October 27, 2011, the Alaska Fisheries Science Center found the EFP application constitutes a valid fishing experiment appropriate for further consideration. The study conducted under this EFP would begin in early April 2012, and continue until the end of September 2012, when a sufficient number of halibut had been sampled and assessed for condition and likelihood of survival. The EFP would allow seven AKSC non-pelagic trawl vessels to sort halibut removed from a codend on the deck of the vessel, and release those fish back to the water after sampling halibut for length and condition using IPHC halibut mortality assessment methods. The EFP is intended to provide operators of non-pelagic trawl vessels with new information for reducing halibut mortality in trawl fisheries by evaluating various fishing and handling practices.

This proposed action would exempt catcher/processor vessels *Constellation, Cape Horn, Vaerdal, U.S. Intrepid, Seafisher, Arica,* and *Ocean Peace* from the prohibition to bias the sampling procedure employed by an observer through sorting of catch before sampling, at

§ 679.7(g)(2); the requirements to weigh all catch by an Amendment 80 vessel on a NMFS-approved scale at § 679.27(j)(5)(ii) and § 679.28(b); the requirement for all catch to be made available for sampling at § 679.93(c)(1); and the requirement for halibut to not be allowed on deck without an observer present at § 679.93(c)(5). These exemptions would apply to halibut only, and for the period of time required to complete the experiment in 2012 in areas open to directed fishing for flatfish.

The EFP applicant seeks exemptions to regulations that NMFS currently requires for monitoring and enforcement of the Amendment 80 sector to ensure proper accounting for allocated quota species. NMFS believes that allowing observers access to unsorted catch, and ensuring that all catch is weighed prior to sorting are essential for ensuring accurate reporting by members of Amendment 80 cooperatives. The analysis justifying these requirements are documented in the Environmental Assessment/Regulatory Impact Review/Final Regulatory Flexibility Analysis for Amendment 80 (see: http://www.alaskafisheries.noaa.gov/sustainablefisheries/amds/80/earirfrfa0907.pdf). Approval of this EFP would not constitute NMFS endorsement of large scale revisions to these longstanding monitoring and enforcement safeguards in this fishery.

The research conducted in this EFP is an extension of the EFP conducted by the Amendment 80 sector in 2009 (see EFP 09-02). In 2009, the three Amendment 80 sector vessels authorized to participate in this experiment were allowed to apply estimated halibut savings of 17 mt to additional catch of groundfish. For the 2012 EFP, the applicant proposes to stay within the halibut prohibited species catch apportioned to the AKSC by reducing its 2012 halibut allocation by 75 metric tons (mt), resulting in no additional halibut mortality under this EFP and the Amendment 80 fishery. If issued, the permit associated with this EFP application would authorize 75 mt of halibut to be caught by the permitted vessels engaged in experimental fishing.

After reviewing the proposed EFP in relation to NOAA Administrative Order (NAO) 216-6, including the criteria used to determine significance, NMFS has determined that the proposed EFP research would not have a significant effect on the human environment. Specifically, the proposed action qualifies for a Categorical Exclusion under section 6.03c.3(a) because it is a research program of limited size and magnitude with no effect on the environment and for which any cumulative effects are negligible.

We are initiating consultation with the Council by forwarding the application, as required by 50 CFR 679.6(c)(2). We understand that you have scheduled Council review of the proposed project at the Council's December 2011 meeting. Please notify Mr. John Gauvin of John Gauvin Associates., of your receipt of the application and invite him to appear before the Council during the December meeting in support of the application. We will publish a notice of receipt of the application in the *Federal Register* with a brief description of the proposal. Enclosed are copies of the application, the Alaska Fisheries Science Center's memorandum of approval of the experimental design, and the Categorical Exclusion supporting this proposal.

Sincerely,

James W. Balsiger, Ph.D.
Administrator, Alaska Region

Enclosures (3)

G:\FMGROUP\EFP\halibut 2011 presort (quick release) EFP\FR Notice EFP Application Halibut quick release\2012 halibut handling EFP Council (10-26-11).ltr.docx

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Jhartman: 08/09/11, 10/26/11, 10/2/11, 11/3/11
Gaberle:
Mbrown: 10/18/11, 10/26/11/11/1/11
Gmerrill:

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

November 7, 2011

MEMORANDUM FOR: The Record

FROM: James W. Balsiger, Ph.D.
Administrator, Alaska Region

SUBJECT: Categorical Exclusion for an Exempted Fishing Permit # 2012-1 to reduce mortality of halibut on non-pelagic trawl catcher/processors (RIN 0648-XA642)

NMFS has received an application for an exempted fishing permit (EFP) from the Alaska Seafood Cooperative (AKSC). The EFP would allow seven vessels in AKSC to sort halibut removed from a codend on the deck of each vessel, and release those fish back to the water after sampling halibut for length and accounting for the halibut condition using standard International Pacific Halibut Commission viability methods for predicting mortality of individual fish. The seven catcher/processor vessels are the *Constellation, Cape Horn, Vaerdal, U.S. Intrepid, Seafisher, Arica* and *Ocean Peace*. The EFP will allow these vessels to alter the amount of time that halibut are in a codend, on deck and the amount of handling they receive prior to release.

This proposed action would exempt these designated factory trawler vessels from:

1. the prohibition to bias the sampling procedure employed by an observer through sorting of catch before sampling, at § 679.7(g)(2);
2. the requirements to weigh all catch by an Amendment 80 vessel on a NMFS-approved scale at § 679.27(j)(5)(ii) and § 679.28(b);
3. the requirement for all catch to be made available for sampling at § 679.93(c)(1); and
4. the requirement for halibut to not be allowed on deck without an observer present at § 679.93(c)(5).

The EFP would apply from approximately April 1, 2012, through September 30, 2012, to designated vessels in the Amendment 80 fishery.

Halibut in this experiment would be removed from the codend on deck, systematically sampled, or enumerated with a scale, and returned to the sea, during directed groundfish fisheries in which each of these vessels is authorized to fish. Experimental fishing is not anticipated to alter fishing parameters such as tow length, tow speed, amount of groundfish retrieved in a codend, and locations fished compared with operations typically used by these vessels. This EFP would be of limited scope and duration and would not be expected to appreciably alter trawling by the non-AFA trawl catcher/processing sector, duration of the groundfish fishery, gear, or the total amount or species of fish caught.

This EFP would apply during 2012 and would be concurrent with the time and areas that the BSAI is open to directed fishing for flatfish to vessels in the AKSC Amendment 80 cooperative. The activities under this EFP would be conducted within the 2012 harvest specifications of groundfish and halibut prohibited species catch. Though exempted fishing from this proposal would be conducted during the open commercial fisheries for the Amendment 80 sector, catch accounting for halibut PSC, and monitoring for experimental activities with halibut will be conducted independently of the commercial fishery. As a condition of issuing the proposed EFP, the AKSC would be required to remain within their 2012 Halibut PSC limits and all groundfish apportioned to the cooperative for 2012.

Groundfish harvested and the incidental catch of halibut during groundfish fishing under this EFP is within the scope analyzed in the Environmental Impact Statement, January 2007, (Alaska Groundfish Harvest Specifications). Based on the EIS, NMFS found no significant impacts on the human environment from this action.

After reviewing the proposed action in relation to NOAA Administrative Order (NAO) 216-6, including the criteria used to determine significance, we have determined that the proposed action, if implemented, would not individually or cumulatively have a significant effect on the human environment. Specifically, this proposed action is categorically excluded under section 5.05b of NAO 216-6 from both further environmental review and the requirement to prepare an environmental review document because it is within the scope of previous analyses that "for the "same [*sic*] action demonstrated that the action will not have significant impacts on the quality of the human environment." This action does not trigger any of the exceptions to a Categorical Exclusion listed under section 5.05c of NAO 216-6 because it does not involve a geographic area with unique characteristics, is not the subject of public controversy based on potential environmental consequences, does not have uncertain environmental impacts or unique or unknown risks, does not establish a precedent or decision in principle about future proposals, will not result in cumulatively significant impacts, and will not have any adverse effects upon endangered or threatened species or their habitats.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Fisheries Monitoring and Analysis Division
Alaska Fisheries Science Center
7600 Sand Point Way N.E., Building 4
Seattle, WA 98115-6349

MEMORANDUM FOR: James W. Balsiger
Administrator, Alaska Region

OCT 27 2011

FROM: Douglas P. DeMaster William Karp
Science and Research Director, Alaska Region

SUBJECT: Halibut Mortality EFP Draft Application Review

AFSC staff reviewed the scientific aspects of the October 10th revised application for an exempted fishing permit (EFP) to continue research on ways to reduce halibut bycatch mortality rates on Amendment 80 vessels through modifications to fishing practices and catch handling procedures. We reviewed an earlier application and provided you comments on September 2, 2011. The revised draft application addresses the substantive comments we had on their earlier submission. We met with the applicant on September 14th to assist in clarifying our earlier comments and to help them with approaches that would improve the application. We have some remaining technical clarifications regarding methods to handle below-deck halibut, but we could address them directly through the permit language that your staff would develop if you approve the EFP. After reviewing the scientific aspects of the application, we conclude that the application constitutes a valid fishing experiment appropriate for further consideration. We also recommend some conditions to include in the EFP, if issued, and note the EFP proposes to shift some key agency responsibilities that we would like to highlight for your consideration.

<u>Conditions to consider if an EFP Permit is issued</u>

The proposed EFP shifts the responsibility for sampling and estimation of halibut bycatch and bycatch mortality from NMFS, using established NMFS and IPHC methodologies, to the Alaska Seafood Cooperative using their own methods without NMFS oversight. To illustrate, the current process in the commercial fisheries directs NMFS certified observers to follow a NMFS established sampling protocol in the factory which provides an independent source of halibut catch rates. NMFS uses these rates to estimate halibut bycatch weight. NMFS then applies IPHC established halibut discard mortality rates to this bycatch weight to estimate the halibut mortality for deduction from established bycatch mortality caps. The IPHC rates are estimated periodically, every three years, from finalized viability (injury and condition) information collected by NMFS certified observers. Those rates are then applied to the estimated halibut bycatch weight in subsequent fisheries to estimate mortality. The NMFS certified observers are provided NMFS training, oversight during deployment, and their data are extensively reviewed in a debriefing with NMFS staff before being finalized.

In contrast, this EFP will shift the sampling responsibility to technicians (sea samplers) hired by the Cooperative, following their own protocols. Their protocols establish a new sampling design which is conducted on deck and uses mean viability rates from the *in situ* samples applied in-season to the halibut caught under the EFP. In short, the experimental data will be used to monitor the halibut catch and mortality during the experiment, and monitoring of halibut during the EFP will be by industry and not by NMFS. NMFS is not providing oversight, training, or quality control debriefing to the cooperatives technicians.

Under this EFP, the AFSC will be unable to provide you independent information on halibut catch or mortality because the halibut data will not be independently collected by observers and reported to AFSC. Observers will still be on board the boats participating in this EFP, but they will be engaged in catch sampling for the non-halibut species used to manage the fishery quotas and those data will be available through AFSC. We will need to modify observer work somewhat to comport with the EFP protocols so we ask that any EFP permit issued to the applicant, specify that Principle Investigator be required to inform AFSC of each boats' EFP activities prior to their start so we can appropriately instruct observers. Specifically, this information will assist AFSC in identifying missed halibut that are weighed on the flow scale that we will need to subtract from the scale weight for NMFS internal estimation of non-halibut species catch.

Long Term Implementation Issues

We previously noted this study is assessing a methodology that we think would be difficult to implement in the commercial fishery. Based on the previous study (EFP 09-02), the proposed approach to halibut catch sorting would minimally require significant increases in observer labor (by the applicant's accounts a doubling of current labor), potential design changes in fish handling by the vessels, reprogramming of data collection and estimation applications, and excellent cooperation from vessel personnel for whom there is an economic incentive to under-report halibut mortality. The revised EFP notes that the applicant will suggest steps that would need to be addressed before implementation of the experimental methodology into the commercial fisheries, and states that it will coordinate with the AFSC Observer Program and NMFS Regional Office in development of analyses or conclusions pertaining to monitoring and catch accounting in the final report. We suggest that the monitoring and catch accounting issues are internal concerns, outside of the purview of the EFP applicant, which we should discuss after receipt of the final report rather than as part of the development of that report. That will also help to clarify that this is an industry sponsored and conducted study without NMFS direct involvement. Thus, we recommend that any EFP permit issued for this activity clarify that the scope of the subsequent EFP report not include an assessment of the implications of the results of this EFP to NMFS catch accounting or monitoring.

From a mission perspective, the FMA division of the AFSC has been charged with the responsibility for providing independent estimates of catch and bycatch in the groundfish fisheries. Therefore, while the revised draft application contains the information to address the substantive scientific aspects that were of concern in their earlier application and describes a valid fishing experiment, we cannot recommend implementation of this method of halibut sampling and estimation. The halibut sampling and estimation would be removed from the Center's immediate responsibility and control, preventing the Center from meeting its catch estimation responsibilities for groundfish fisheries management.

cc:
G. Merrill
M. Loefflad
B. Karp

Application for an exempted fishing permit (EFP) to continue research on ways to reduce halibut bycatch mortality rates on Amendment 80 vessels through modifications to fishing practices and catch handling procedures

Date of Application: October 10, 2011

Requested permit dates:

April 1 through September 30, 2012

Applicant Information:

Alaska Seafood Cooperative**,** 4241 21st Avenue W., Suite 302, Seattle, WA 98199
Telephone: 206 462 7682, Fax: 206 462 7691
Principle Investigator: John R. Gauvin, Fisheries Science Projects Director, Alaska Seafood Cooperative
Telephone: 206 660-0359, 206 213-5270
Email: gauvin@seanet.com

EFP vessel information:

F/T Constellation
O'Hara Corporation
120 Tillson Avenue
Rockland, ME 04841
Contact: Paul McFarland
Phone: 207-594-4444
Fax: 207-594-0407
Coast Guard#: 640364
NMFS FFP#: 4092.
LOA: 150 ft
Homeport: Rockland, Maine

F/T Cape Horn
Cape Horn Fisheries Inc.
4257 24th Ave. W.
Seattle 98199-1214
Contact: Dave Wilson
Phone: 206-286-1661
Fax: 206-286-1793
Coast Guard#: 653806
FFP#: 2110
LOA: 165 feet

F/T Vaerdal
United States Seafoods, LLC
6901 West Marginal Way SW
Seattle WA 98106
Contact: Dave Wood
PH: 206-763-3133
Fax: 206-763-0635
USCG #: 611225
NMFS FFP#: 2123
LOA: 124 ft
Homeport: Seattle WA

F/T U.S. Intrepid
Owner: U.S. Fishing, LLC
Operator: Fishermen's Finest, Inc.,
1532 NW 56th St, Seattle, WA 98107
Phone: 206-283-1137
Fax: 206-281-8681
Contact: Susan Robinson
USCG #: 604439
FFP # 2800
LOA: 185 ft
Homeport: Seattle, WA

F/T Ocean Peace
4201 21st Avenue West
Seattle, WA 98199
Phone: 206 282-6100
Fax: 206 282-6103
Contact: Mark Gleason
Vessel Home port: Dutch Harbor
USCG #: 677399
NMFS FFP: 2134
LOA: 219 ft

F/T Seafisher
Cascade Fishing, Inc.
3600 15th Ave., W. #201
Seattle, WA 98119
Contact: Todd Loomis
PH: 206-282-3277
FAX: 206-282-6738
USCG#: 575587
NMFS FFP#: 3835

LOA: 230’
Homeport: Seattle, WA

F/T ARICA
Arica Vessel LLC.-c/o Iquique U.S. LLC
4257 24th Ave W-Seattle WA. 98026
Contact: Dave Wilson
ph:206-286-1661 ext:206, fax: 206-286-1793
USCG# 550139, NMFS FFP# 3694
LOA:185’
Homeport: Seattle, WA. U.S.A

Introduction:

The Alaska Seafood Cooperative (AKSC) operates under Amendment 80 to the Bering Sea and Aleutian Islands (BSAI) Fishery Management Plan (FMP). Amendment 80 allocates target species allowances and prohibited species caps (PSC) to cooperatives. PSC management regulations and particularly the halibut prohibited species caps have traditionally constrained yields in flatfish fisheries and other non-pollock Bering Sea trawl fisheries. The potential for halibut bycatch to limit the Amendment 80 sector increased to some extent with the program's implementation because the halibut PSC available to the sector was reduced by 50 mt per year over a four-year period. One goal of the AKSC is to minimize prohibited species bycatch through research collaborations on gear modification and bycatch reduction programs so that available yields of target fish can be maximized.

To reduce halibut bycatch rates, cooperative members have been utilizing two approaches for many years. First, all member vessels participate in the Co-op's bycatch avoidance program. Sea State, Inc is retained to assist sharing bycatch data among member vessels. These data are compiled into charts and used to identify areas with relatively high prohibited species bycatch rates (PSC hotspots). With this information, the Co-op's fishermen can better shift operations to areas with relatively low PSC bycatch rates to help ensure they stay under their PSC caps.

Through EFPs and other research, AKSC members have also developed gear modifications to flatfish nets called halibut "excluders" to reduce halibut bycatch. Halibut excluders use sorting grates installed in the trawl intermediate to allow halibut to escape while retaining a high fraction of the target flatfish. Excluders restrict halibut passage into the codend through both sorting grate size selectivity and changes in water flow designed to encourage halibut to swim up and out of the net. Halibut excluders appear to perform better when halibut are considerably larger than the target species because this improves the selectivity of the sorting grate. In some fisheries, halibut excluders are less effective because the average halibut size is not substantially greater than that of the target catch.

Although significant progress has been made to control halibut bycatch with excluders, further reduction in halibut bycatch or halibut mortality is desirable if it can be shown to be feasible. For this reason, Amendment 80 fishermen would like to develop additional ways to reduce halibut mortality. Many fishermen feel that a productive area for reducing halibut bycatch would be to develop ways to reduce halibut bycatch mortality. This comports with National Standard 9 to minimize, to the extent practicable, bycatch or bycatch mortality. As will be explained, reducing halibut mortality would require changes to both fishing practices and current observer sampling methods.

Intuitively, decreasing towing duration and reducing catch size might increase the viability of halibut taken as bycatch. However, the degree to which viability would differ from published mortality rates needs to be understood more precisely to evaluate the tradeoffs between reducing halibut mortality rates and the anticpated increase in costs and workloads needed to achieve these mortality reductions within specific fisheries. Smaller catch amounts would increase the number of tows and work for deck crew and on board fishery observers (more haulbacks, tows to sample, and data to enter). Wear on fishing gear and equipment, trip length, and fuel consumption could be significantly increased.

These and other practicality considerations underscore the need to have a better understanding of the tradeoffs between changes in fishing practices that might affect halibut mortality rates and fishing efficiencies. Such information would help the industry and managers strike a proper balance of practicality and benefits from reducing halibut mortality through adjustments to fishing practices.

Under current Amendment 80 catch handling regulations, changes to fishing practices alone would not result in improvements to halibut viability. Regulations in place for Amendment 80 fisheries prohibit sorting and releasing/discarding catch from the deck. Prohibited species catch can only be returned to the water after being dumped into a stern tank, and after it passes over the flow scale in the processing area. While these procedures are currently needed to ensure that all catch is available for observer sampling, the downside is that some halibut remain out of the water and in the holding tanks for up to several hours. This undoubtedly increases mortality rates because, according to Amendment 80 fishermen, some fish appear to be in relatively good shape when they come on board. Viability gains from reducing haul sizes and tow times would therefore be lost by the time observers sample viabilities at the discard chute. Therefore, changes in fishing practices (assuming they are feasible) <u>and</u> regulatory catch handling changes would be necessary to make meaningful, cost-effective improvements in halibut bycatch survival.

In May 2009 (EFP 09-02), the AKSC conducted a pilot study in consultation with the National Marine Fisheries Service's Fishery Monitoring and Analysis (FMA) division (part of the Alaska Fisheries Science Center) and the International Pacific Halibut Commission (IPHC). The main study objective was to evaluate ways to reduce halibut mortality rates on Amendment 80 catcher processors. Styled loosely on the "careful release" methods for longline vessels and other pilot study efforts on trawl vessels, the objective of the 2009 EFP was to evaluate a set of alternative fishing practices in combination with changes in trawl catcher processor catch handing. The research was also intended to help the industry learn about both the operational feasibility of these modifications and their effectiveness for minimizing halibut bycatch mortality.

As a starting point, the 2009 EFP was focused on a discrete set of summer fisheries considered to have the highest chances of success due to favorable weather conditions, ability to work with relatively small catch amounts per haul, and other operational factors. Additionally, the 2009 EFP data collection protocols dictated viability and length data collection for <u>each and every</u> halibut, hence a complete census of halibut viability and length data for each individual fish brought on board the vessel. While this avoided the need to develop a sampling strategy, it unfortunately created backlogs of halibut sorted from the catch on deck. With halibut awaiting length and viability assessments on many tows, viability was likely reduced. To understand this effect on the 2009 results, it is worth noting that the average time required to complete sorting, measurement, and halibut viability sampling on deck in 2009 was 26 minutes while on many tows the sorting itself actually took only 10 minutes on many tows.

In the end, the 2009 pilot study did show that halibut mortality rates could be reduced to almost half of the average rates in Amendment 80 fisheries. An average of 45% mortality was achieved for halibut sorted on deck compared to the published mortality rates of approximately 75-80% in the fisheries that were the subject of the 2009 study. However, in order to better understand the full potential for increasing halibut survival using these methods, the 2009 study concluded that additional research would be needed and the study design would need to be revised to understand whether additional halibut mortality reductions were possible. One specific recommendation from the 2009 research was to implement a sampling protocol to speed halibut catch accounting and viability assessment. The limited scope of the 2009 study also meant that the feasibility of alternative catch handling procedures was not evaluated across the full range of Amendment 80 flatfish fisheries and vessel sizes in the sector. Therefore, the 2009 EFP also recommended that fieldwork should explore a greater range of target fisheries, seasonal weather conditions, and vessel sizes to obtain a more realistic assessment of the feasibility of the alternative fishing practices and procedures for sorting/accounting for halibut on deck. Further background information is provided in the summary of the final 2009 EFP report included as Appendix 1 to the EFP application.

AKSC fishermen believe that Amendment 80 increases the incentive to adjust fishing practices and return halibut to sea faster than is currently possible and that these actions would reduce halibut mortality rates. By reducing halibut mortality, fishermen assume that halibut mortality savings they achieve are available to them in some manner and that lower mortality rates would reduce the possibility that their fishing will be constrained by halibut bycatch mortality. From this perspective, the relevant question is:

What would the mortality rates be under those modified fishing practices and would it be feasible to adopt them into some or all of the regular Amendment 80 fisheries?

Objectives for this EFP to further evaluate ways to reduce halibut mortality rates on Amendment 80 vessels while maintaining accurate accounting of halibut

Through this EFP application, the AKSC is seeking an exempted fishing permit for research that builds on the 2009 EFP. Results of this new EFP are expected to inform industry and managers of the tradeoffs between practicality and potential benefits from lower halibut mortality in Amendment 80 fisheries. The specific objectives of this new EFP are as follows:

EFP Objectives

1. Evaluate the degree to which changes in fishing and catch handling procedures (combined) are effective in reducing halibut mortality rates on Amendment 80 vessels.
2. Evaluate if changes in fishing and catch handling procedures associated with sorting, assessing, and accounting for halibut on deck are feasible. This includes testing the procedures in a range of Amendment 80 fisheries with varying amounts of halibut bycatch, in various weather conditions associated with different times of the year, and on Amendment 80 vessels of different sizes.

3. Use the sampling design developed for this EFP application to estimate halibut catch and viability on a per-tow and per-vessel basis. Evaluate the sampling methods to see how well they estimate the weight of halibut sorted on deck per tow and per vessel for each EFP vessel. Collect time stamp information with the halibut viability assessments to allow for evaluation of effects of time out of water on halibut viability. This will allow the effects of time on viability "within-tow" to be evaluated directly.
4. Evaluate the effectiveness of sorting halibut from catch on deck (percent sorted on deck by number and weight) and compare this to the results of the 2009 EFP. Sorting halibut on deck was for the most part highly effective in 2009 but the range of fisheries and time of year etc. for that EFP was selected based on the expectation of ease and effectiveness of sorting and this EFP involves a wider range of target fisheries, seasonal conditions, and vessel sizes.
5. Provide information that would be useful for the future evaluation of staffing, workload, and other requirements necessary to consistently conduct deck sorting and halibut catch and viability sampling under commercial fishing conditions.
6. Inform future changes in vessel design or technological innovations to enable catch handling procedures to reduce halibut mortality.
7. Generate information and insights into how the new deck sorting and halibut catch and viability sampling procedures could be incorporated into the observer and catch accounting systems.

How the EFP objectives will be accomplished

EFP testing will occur during Amendment 80 fisheries between April 1 and September 30, 2012. Testing will include a range of target fisheries and vessel sizes designed to inform the sector regarding feasibility of the alternative catch handling procedures to reduce halibut mortality. While engaged in the EFP, participating vessels will conduct fishing and handle catches on deck in a manner designed to help minimize stress on halibut bycatch. Haul size and towing duration will be decreased relative to normal times/amounts in the same target fisheries. On-deck catch handling procedures will minimize mortality by rapidly sorting halibut from the catch, and moving them via a chute to the sea sampler for sampling. This is expected to allow the halibut to be returned to the sea soon after it is sorted from the catch on deck, thus reducing halibut mortality.

How this EFP would expand on conclusions from the 2009 EFP

While the 2009 EFP showed that crews could sort a large fraction of halibut on deck in certain fisheries, this new EFP focuses on a wider range of target fisheries. Thus halibut deck sorting will be evaluated under a wider set of target fisheries, and with different average halibut size, weather conditions, and vessel sizes.

AKSC vessels of different size classes (from the above list) will participate in the EFP at different times throughout the EFP's duration. The EFP will assess how different vessel characteristics (including deck space and vessel configurations) affect the ability to sort and account for halibut catches and viability.

The EFP will evaluate the feasibility of changing fishing practices to minimize stress on halibut. EFP vessels will make one or two trips each during their EFP participation, with a goal of approximately 10 vessel trips overall. An EFP testing plan that considers vessel scheduling and fishing plan constraints will be developed prior to start of the fieldwork. In this way, the EFP holder will develop a testing plan that attempts to balance vessel availability while informing the Amendment 80 industry's assessment of the feasibility of changes to fishing and catch handling procedures.

Finally, halibut viability improvements were constrained by the census approach adopted under the 2009 EFP. This EFP will explore how a sampling methodology can reduce time out of water to decrease halibut mortality.

Halibut handling and sampling methodology

Halibut length and viability data will be collected on approximately 80% of each vessel's tows before being returning them to the sea, and will be referred to as "standard" EFP tows. For "non-standard" tows, all halibut will be collected post sampling to evaluate the precision of sampling methods. On the non-standard tows, only length data from each sampled halibut will be collected. The purpose for and differences in standard and non-standard procedures is explained below.

Vessel crew will be responsible for sorting halibut from the catch as it is spilled out of the codend in the trawl alley. Sea samplers will monitor crew sorting activities. The EFP will employ the rigorous catch handling procedures detailed below to rapidly sort halibut, sample them for viability and length, and return them to the water. The EFP catch handling protocol will only allow for halibut deck sorting. All other catch must be handled and accounted for according to the current Amendment 80 catch handling regulations.

The crew will move sorted halibut from the trawl alley to the sea sampler's work station on deck via a chute attached to the deck. Sea samplers will conduct sampling on or directly adjacent to the halibut chute, depending on deck space and which is more workable.

The sea sampler will count all deck-sorted halibut using a thumb counter as they pass by on the chute. Halibut counts will be used for estimating total weight of deck-sorted halibut as well as for determining which halibut will be sampled under the sampling schedule. Halibut lengths will be determined by sliding the fish onto an anchored length strip, and recording the fish's length with a wax pencil mark. Standard IPHC viability assessment methods for trawl vessels will be used to assess halibut viability. Sampled halibut will be returned to the halibut chute and moved overboard in the same manner as un-sampled halibut.

Sample size for both standard and non-standard tows will be approximately one-fifth of the halibut sorted on deck. Halibut will be randomly selected such that one out of every five will be sampled as they pass across the halibut chute. To prevent bias, the sea sampler's sampling schedule will be different for each tow. The sampling schedule for each tow will be generated via a computer program that randomly selects which fish will be sampled in each sequence of five (e.g. fish 3, 9, 11,18….). Only the sea sampler will have access to this sampling schedule. In this manner, the crew should have no way of knowing which halibut of every five will be sampled. The sea samplers will record the time every time they select a halibut for data collections.

The estimated weight of halibut sorted on deck will be calculated by multiplying the number of halibut sorted on deck (the count) by the average weight of sampled halibut (using the length to weight conversion provided to the EFP applicant by the IPHC).

The sample plan and size were developed through a statistical analysis designed to ensure reasonable accuracy for estimating catch and viability. The statistical methods and major findings of that analysis are summarized in the methods/experimental design section below, and the full statistical analysis is included as Appendix 2 to this application.

By sampling, data collections are expected to be considerably faster than in the 2009 EFP. The sampling plan is intended to provide a sufficiently large sample for estimating the amount of halibut sorted on deck and its viability with reasonable precisions while keeping pace, to the greatest extent possible, with the crew's sorting operations. If this is realized, a deck-sorted halibut should pass down the chute and be available for sampling within minutes of its sorting. Halibut sorted on deck should also be back in the water within a few minutes of being sorted on deck (for standard EFP tows).

To evaluate the effectiveness of sorting halibut on deck, halibut missed during deck sorting operations will be collected in the processing area under the supervision of sea samplers. Sea samplers will count and measure all halibut missed during deck sorting. The lengths of halibut recovered in the factory area will be converted to weight using the same conversion function described above. The sum of these weights will be used to account for halibut recovered in the processing area (missed during sorting operation son deck).

Evaluating precision of sampling methods

As mentioned above, 20% of the EFP tows per EFP vessel will be handled differently on deck to evaluate sampling precision for estimating weight of halibut sorted on deck. For these non-standard tows, sea samplers will only collect length data from halibut selected for sampling. Additionally, rather than moving sampled halibut directly overboard, all halibut in non-standard tows (those selected for sampling and those not selected) will be collected in totes after sampling. After all the non-standard tow halibut have been sorted, the sea sampler will do a second count and record the length of each halibut in the tote. At the direction of the sea sampler, crew will provide assistance in moving the halibut out of the totes during this process. Once all halibut in the totes are enumerated and measured, they will be placed overboard.

To evaluate halibut sampling estimation precision, the lengths for each halibut in the tote will be converted to a weight (using the length to weight conversion provided to the EFP by the IPHC). The sum of these weights will serve as the "census", and compared to the same tow's weight estimate of halibut sorted on deck via sampling. This will allow us to evaluate the magnitude of differences between estimated and actual weights, degree of variability in those differences, and whether there is any selectivity bias from the sampling methods.

Non-standard tows will be selected by using a "one out of five" card draw. The drawing will occur during haul-back so fishing cannot be manipulated, and crew cannot make catch composition more favorable or easier for the non-standard procedures. Based on the statistical analysis done in support of the EFP sampling plan (Appendix 2), selecting 20% of each vessel's tows is expected to be a sufficient to evaluate the sampling precision for estimating halibut catch in each haul.

While it would also be desirable to evaluate sampling accuracy under this EFP, such an undertaking is beyond the scope of this project. Halibut collected in totes after sampling probably no longer accurately reflect their viability at the time they were sampled. The time needed to sample and measure all the halibut stored in totes would likely affect viability. While sampling is not expected to take very long, based on the 2009 EFP we know that measuring and assessing viability for all fish would likely mean that the viability assessments for the fish at the bottom of the tote (or last tote) would not reflect their viability at the time of sampling.

In our view, a different type of experiment would be needed for evaluating the precision of viability sampling, which probably require perhaps 4-6 sea samplers per vessel. Additionally, this type of experiment would likely slow the flow of fish into the factory and overall production to the degree that commercial feasibility would be sacrificed. Therefore, this type of study is not likely to accomplish the feasibility evaluation objectives that are an important component of this work.

Post-project evaluations

To help inform whether changes to fishing and monitoring protocols are feasible, the EFP PI and field project manager will conduct post-project surveys and interviews. EFP captains, key vessel personnel, sea samplers, and a representative of the observer provider company providing the sea samplers will be asked to provide information useful to our feasibility assessment and ideas for improvements in catch handling/sampling. Interview methodology is described in the methods sections below.

Vessel captains will log tow times and corresponding individual haul catch amounts obtained from the flow scale. Sea samplers will record the time between net haulback and completion of individual halibut viability assessments in addition to the times each halibut was selected for sampling and final completion of sampling activities. Together, these data will be useful for evaluating how haul duration, catch amount per haul, and time out of water per halibut (time between haulback and completion of individual viability assessment) may affect halibut viability. This will improve upon the 2009 research where collecting time stamp information was impossible as it would have further delayed halibut viability assessments. Formal covariate evaluation, such as how time out of water affects halibut viability, will not be possible for these data. However, some insights and inferences for further research into determinants of halibut viability may arise from these data.

Draft and final reports will describe activities during the EFP, changes in halibut mortality rates, halibut mortality savings, assessment of sampling accuracy, and overall feasibility of the modified catch handling procedures for the Amendment 80 sector. The final report will also recommend changes to the procedures described above should the fieldwork find that some aspects of the modified catch handling procedures are not feasible or recommend ways that halibut viability could be reduced further.

The EFP will also suggest steps that would need to be addressed before implementation into the regular fisheries (e.g. monitoring and changes to the catch accounting system). The report authors will coordinate with the Observer Program (FMA) and NMFS Regional Office staff in development of any analysis or conclusions pertaining to monitoring and catch accounting as part of our draft final report.

EFP vessel selection, target fisheries, timing, and project area:

The EFP testing plan will require close coordination with AKSC vessel owners and operators as they develop their 2012 fishing plans. Accordingly, we will be unable to determine the number of participants, trips, or fisheries until December 2011/January of 2012 when we will have more information about the 2012 fisheries. For this reason, our EFP application contains a more extensive list of vessels than the 2009 EFP application, and not all vessels may participate in the EFP. Having the flexibility to select vessels that work best given scheduling considerations is expected to facilitate the ability to meet the EFP objectives. Once the EFP testing plan is developed, the EFP PI will provide the projected timeline for vessel participation to NMFS Alaska Region and Alaska Fishery Science Center EFP contacts. Prior to the start of a vessel's actual EFP participation, the EFP holder will provide adequate notice to NMFS (check in and out) throughout the 2012 EFP testing.

All EFP fishing will occur in areas open to non-pelagic trawling in the Bering Sea as well as sub-area 541 of the Aleutian Islands where arrowtooth/Kamchatka flounder would be the likely target. Flatfish fisheries will be the EFP focus, although some target fishing for cod will likely occur during the EFP. Catch compositions and amounts are expected to be similar to non-EFP fisheries conducted during these times and in these areas. EFP fishing is expected to be concentrated mostly east and northeast of the Pribilof Islands, and in the "Horseshoe" (northeast of Dutch Harbor), although locations within the Bering Sea must be left flexible so that vessels are able to operate where fishing conditions dictate within areas open to Amendment 80 fishing activities. No access is sought to areas closed to non-pelagic trawl fishing. Non-pelagic trawls with required modified sweeps will be used to conduct EFP fishing. Depending on halibut bycatch rates, EFP vessels may use halibut excluders to help control halibut bycatch rates. Use of halibut excluders is typical of Amendment 80 catcher processors in these fisheries, and consistent with the objectives of the EFP in terms of evaluating deck sorting under representative conditions.

Non-halibut species use and catch accounting:

AKSC receives annual target species allocations, including yellowfin sole, rock sole, and flathead sole. Additionally, AKSC vessels regularly engage in other non-allocated BSAI flatfish fisheries, such as arrowtooth and Kamchatka flounders.

Within AKSC, allocated quotas are distributed to vessels or companies. Individual captains and company representatives use a combination of data sources to ensure fishing amounts do not exceed quotas. Additionally, AKSC managers monitor catch amounts for all cooperative vessels, and NMFS monitors aggregate cooperative quota catch to ensure quotas are not exceeded. Non-allocated target species are managed by NMFS. In-season managers determine when non-allocated total allowable catch (TAC) amounts are reached and close fisheries accordingly.

Observer data collected on Amendment 80 vessels are electronically transmitted to FMA, and then transmitted to NMFS' Alaska Region in Juneau, AK. The catch accounting system (CAS) expands observer data, stores these data, assigns fishery targets, and performs other critical in-season management tasks. These data are used by NMFS and AKSC to manage both allocated and non-allocated target fisheries.

For this EFP, both allocated and non-allocated target and prohibited species (all catch except halibut) will be managed, tracked, and stored in the CAS according to non-EFP fishing protocols. NMFS will debit allocated aggregate non-halibut catch from AKSC allocations. ***No additional non-halibut quota is requested as part of this EFP application, and all groundfish catch will accrue against Amendment 80 target species and non-allocated catch allowances.*** However, because halibut bycatch will be treated differently than during non-EFP fishing, all catch harvested under the EFP will be flagged "research" so that analysts and managers may use these data appropriately.

As noted elsewhere in this application, target fisheries selected for this project are prosecuted as part of normal Amendment 80 operations. These fisheries will be selected to meet EFP objectives, and to supplement our understanding of the feasibility of fishing practice changes and on-deck halibut sorting during normal fishing operations. Because catch amounts will accrue against Amendment 80 allocations, catch composition of fishing is not expected to change under the EFP. Therefore, the overall amount and composition of groundfish taken during the course of this EFP is expected to be commensurate with normal fishing operations in the target fisheries and time frame selected for the EFP.

Halibut quota, use, and catch accounting:

The 2009 EFP included a mechanism for crediting halibut mortality savings to EFP participants. Halibut mortality savings were calculated as the difference between published halibut mortality rates and mortality rates achieved in the EFP. Because halibut mortality rates differ among Amendment 80 target fisheries, comparing EFP mortality rates to published rates was done on a target fishery-specific basis. These calculations are complex, and required extensive NMFS review of individual halibut catch and viability records, the permit holder's target-specific halibut catch, and resulting mortality savings.

Coincidentally, 2009 EFP participant's halibut bycatch rates were relatively low in the second half of 2009 compared to the first half. For this reason, EFP participants did not utilize their 2009 halibut mortality savings from the first half of the year. However, during May and June of 2009, participants could not have known whether halibut bycatch would decrease later in the year, thereby maintaining incentives to reduce halibut mortality under the operational constraints. AKSC believes these incentives are an important study design component, and help inform NMFS, the North Pacific Fishery Management Council, the IPHC, and industry of possible halibut mortality reductions in a real-world production application. This EFP application also includes similar incentives for reducing halibut mortality by allowing vessels to utilize halibut mortality savings.

Under this EFP, sea sampler and observer data will be reported from vessels on a daily basis according to the sample design protocol. AKSC will hire a third party familiar with NMFS in-season management protocols to track halibut catch amounts, assign a fishery target, calculate what mortality would have been based on NMFS published mortality rates (Table 9 to the annual harvest specifications), and calculate actual halibut mortality based on the sampled halibut and calculations described in this EFP application. This third party has not been selected yet, but would possess the skills/experience needed with the Amendment 80 catch accounting system (CAS) and would be approved by NMFS prior to permit issuance.

Mortality will be calculated based on actual sampled and observed mortality applied to EFP halibut catches, and debited against halibut EFP limits. Methods for calculating EFP halibut catches and applying halibut mortality rates from EFP fishing are described below. The third party and AKSC staff will provide real-time cumulative halibut mortality to vessels, so that captains can cease EFP operations prior to reaching the halibut limit set for them within the EFP fishing plan, which will be set aside by AKSC prior to the EFP commencing.

Because halibut mortality and viabilities will be sampled according to the methods described below, halibut catch estimates and viabilities will not be entered into the CAS. The CAS is programmed to accept data according to current observer sampling protocols. To accept halibut data collected under this EFP's sampling protocols, significant reprogramming would need to occur. Reprogramming the CAS is outside the scope of this EFP.

Additionally, this EFP's sampling design, catch accounting procedures, and monitoring are outside the scope of normal Amendment 80 operations. Therefore, non-allocated halibut quota will be required to conduct this EFP. ***To conduct this EFP, 75 mt of additional halibut mortality is requested for EFP activities scheduled to occur in 2012.*** The 75 mt is needed to support fishing for the above listed vessels during the expected EFP fieldwork period from April through September 2012. ***To avoid increasing the amount of halibut bycatch mortality used by the AKSC in 2012, AKSC will reduce the amount of halibut PSC mortality available to the AKSC in 2012 by 75 mt.***

EFP halibut mortality needs were arrived at in the following manner. The 2009 EFP expected to conduct approximately 10 individual vessel trips, with a goal of one or two trips per vessel. One or two trips per EFP vessel in an Amendment 80 target fishery of interest is considered by the EFP applicant to be necessary for a thorough feasibility assessment of the alternative catch handling procedures.

For this EFP, we have evaluated the amount of test fishing and related halibut bycatch needed to accomplish the EFP objectives, as explained below, and used this to estimate the need for 75 metric tons of halibut mortality. Total halibut bycatch in the 2009 EFP was approximately 67 mt. Totalhalibut mortality for the 2009 EFP was approximately 50 mt taking into account the approximately 17 mt of halibut savings. Average mortality rates for halibut sorted on deck were approximately 45% in 2009.

For this EFP, the testing plan has been expanded somewhat over what occurred in 2009 to encompass a wider timeframe and a larger set of Amendment 80 vessel sizes and fisheries. An objective of the 2009 EFP was to include Amendment 80 vessels of all sizes, but scheduling conflicts prevented participation by a vessel in the smaller size category of the Amendment 80 fleet (108 to 124 feet). Additionally the vessel that represented larger Amendment 80 vessels was unable to complete a full trip due to unplanned halibut constraints. To account for the desired participation by vessels of different sizes and scope of fisheries in the EFP objectives, we have increased the expected EFP halibut mortality while assuming that mortality deck sorted rates will be reduced to the level seen in 2009 (to approximately 45%).

To determine halibut mortality needed for this EFP, we considered several factors:

1. The 2009 EFP halibut mortality rate (45%);
2. Additional vessel and fishing time needed to accomplish this EFP's goals and objectives;
3. Whether we expect halibut mortality to decrease under this EFP's revised catch handling procedures; and
4. Halibut sorted on deck for census tows (non-standard tows) will be assigned the published halibut mortality rates (see below).

Given the variability inherent in annual and seasonal fishing operations, the unknowns associated with the mortality rates that will be achieved in standard tows, and the use of published rates for non-standard EFP tows where all halibut will be collected for verification of sampling precision, the amount of halibut needed to conduct this EFP has been estimated conservatively so as to ensure that there is a sufficient allowance to accomplish all the objectives of the EFP. While some EFP objectives (such as calculating halibut mortality rates by sampling) would, standing alone, probably require less than 75 mt of halibut mortality, the feasibility assessment and sorting efficiency evaluation objectives require testing on vessels of different sizes and testing under different seasonal conditions. Therefore, we believe that 75 mt of halibut mortality will be needed to accomplish all the objectives of the EFP. The applicants understand that if EFP fishing results in less than 75 mt of halibut mortality, AKSC will essentially forfeit the difference between its reduced 2012 Amendment 80 halibut allocation and the EFP halibut mortality usage amount.

Each participating vessel will agree not to use a specific amount of Amendment 80 annual allocated halibut PSC. This amount will be equal to the EFP halibut amount assigned to the vessel. For example, if the research design and EFP fishing plan dictates that "Vessel A" is assigned 20 mt of EFP halibut mortality, "Vessel A's" AKSC halibut PSC allocation will be reduced by 20 mt. Aggregate EFP halibut use for all participating vessels will be equal to, or slightly less than, AKSC's Amendment 80 halibut PSC allocation reduction. ***This construct will not increase overall BSAI halibut mortality allowances available to the AKSC.*** AKSC will draft an internal contract dictating the terms of halibut use under the EFP, once vessel participants and fishing plans for 2012 are developed.

Halibut catch estimations and mortality rate calculations for the EFP

For the analytical purposes of the EFP, halibut catch data and mortality will be collected and recorded on a tow-by-tow basis. This is necessary to meet the EFP's scientific and catch accounting objectives and allow information to be aggregated to more generalized levels, such as halibut catch per trip for each EFP vessel, and overall halibut catch and mortality usage. Data collection at the individual tow level will facilitate comparing fishing and catch handling factors to halibut viability within each tow. For example, we will want to compare catch amount per tow to halibut viability in the tow to see how tow size affects halibut viability. Similarly, we will want to evaluate how catch amounts affect sorting effectiveness (the percentage sorted on deck compared to total amount of halibut in the haul by number and weight).

Because the EFP will use methods for estimating halibut catch and mortality that are different from those used in the regular Amendment 80 fishery, it is important that our methods for calculating catch and mortality for the EFP be understood from the outset. These methods are described below, first for standard halibut catch handling procedures, then for tows where halibut will be collected to evaluate sampling precision etc. (non-standard tows)

For standard EFP tows (approx. 80% of tows), halibut catch will be calculated in the following manner:

1) Estimated weight of halibut sorted on deck. This will be calculated by converting the length of each sampled halibut to a weight using the standard conversion and then dividing the sum of the weights by the number of halibut sampled. This average weight of halibut in a tow will then be multiplied by the number of halibut in the tow, which is determined by the sea sampler's tally.
2) Estimated mortality of halibut sorted on deck. The estimated weight of halibut sorted on deck (1 above) will be multiplied by the average mortality rate for sampled halibut. For example, if there are five sampled halibut in a tow and three are assigned a rating of excellent, one is assigned a rating of "poor", and one is assigned a rating of "dead", then the average mortality rate will be: (0.2 + 0.2 + 0.2 + 0.55 + 0.9)/ 5 = 0.41 The estimated weight of deck-sorted halibut within the tow (#1 above) would then be multiplied by 0.41, resulting in the estimated mortality of deck-sorted halibut for that tow.
3) Weight of halibut collected in the processing area (missed during deck sorting). Each halibut collected in the factory will be measured and assigned a weight using the IPHC length/weight table.
4) Mortality of halibut collected in the factory. Sea samplers will conduct viability assessments on all halibut collected in the factory. The mortality rate of each fish will be multiplied by its weight. Total mortality of halibut collected in the factory will be the sum of the mortality (weight times mortality rate) of each halibut.
5) Total mortality of halibut in EFP tow: This is the sum of #2 and #4 above.

For non-standard EFP tows where all halibut are collected for evaluating the precision of sampling procedures (approx 20% of EFP tows per vessel), halibut catch and mortality per tow will be calculated in the following manner:

1) <u>Weight of halibut sorted on deck:</u> All halibut in the totes are measured and lengths are converted to weights using the same conversion. Sum of all weights is total weight of halibut sorted on deck
2) <u>Mortality of halibut sorted on deck:</u> Weight of halibut in #1 above is multiplied by the published mortality rate for the fishery target assigned to the tow (see explanation below).
3) Mortality of halibut collected in the factory (same procedure as for standard EFP tows (#4) above
4) <u>Total mortality of halibut in the EFP tow</u>: This is the sum of #2 and #3 directly above.

Evaluating sampling precision and bias for estimating amount of halibut sorted on deck is an important element of the EFP. Likewise it would have been instructive to evaluate precision of sampling for estimating viability of halibut. But after considering how long halibut would be held in the totes it became clear that doing viabilities of all the halibut would not be very representative of their viability at the time of sampling. The only reason to conduct viability assessments on these halibut would be to account for the total EFP halibut mortality but that would also be very time consuming. For this reason, it was decided that applying the published halibut mortality rate for the target fishery on a tow-by-tow basis would be a reasonable way to account for the halibut mortality of the halibut collected in totes on the non-standard tows.

In using the published mortality rates by assigning the published rate based on the specific target fishery for that tow, it is important to note that NMFS' CAS does not assign halibut mortality rates to a specific tow. Rather, the CAS calculates halibut bycatch mortality on a weekly basis for the predominant target fishery within a given federal management area. But our EFP requires that we assign mortality to specific tows. So to see how much of an effect it had to apply the published rates to tows in a target fishery versus the way NMFS applies them we examined potential differences between these two halibut mortality calculation methodologies. To look at this we asked Sea State Inc to examine the potential difference between the two calculation methodologies. Sea Sate Inc is a well-known data management company,\ and provides services to most sectors fishing off Alaska. Sea State Inc also contracts with AKSC for database and in-season management services.

As it turns out, using tow specific targets for assigning halibut mortality rates appears to have little effect on halibut mortality estimation. Sea State examined how much mortality would have been assigned to the AKSC member vessels in different target fisheries in 2011 using the two methods. For AKSC's main target fisheries (yellowfin, rocksole, Arrowtooth flounder, and flathead sole), the differences were all in the range of between -0.7% (flathead) and 1.5% (rocksole). For this reason, using tow-specific target assignments for attributing mortality rates appears to be a reasonable way to proceed in the non-standard tows of the EFP. The major advantage with this methodology is that it will allow the EFP to track mortality usage more precisely, and avoid having to resolve small halibut mortality discrepancies between the two methodologies. Additionally, assigning tow-specific halibut mortalities allows AKSC to manage total halibut catch in real-time and on specific vessels.

EFP monitoring and project management: Each vessel will carry two (2) sea samplers while engaged in EFP fishing. EFP vessels will also continue to meet normal observer coverage requirements (2 observers) at all times. Sea samplers will only work on the EFP halibut sampling/accounting duties, and the vessel's regular observers will complete their normal duties save for any sampling/accounting of halibut catch in the factory. Sea samplerswill be required to meet all NMFS NorthPacific Groundfish Observer Program requirements, but will not be under contract as current observers. Sea samplers will work 12-hour shifts so that halibut data are collected on all hauls. Because sea samplers may work independently, AKSC will consult with FMA to ensure high quality sea samplers are deployed. AKSC will cover all additional costs for sea samplers during the EFP.

Additionally, AKSC will deploy an experienced field project manager during the EFP whenever EFP work is occurring under the EFP. The field project manager will be responsible for managing fieldwork, and communicating with the principle investigator as outlined below. To ensure all field personnel are sufficiently informed on all EFP duties and protocols, AKSC will conduct a briefing prior to deployment.

Exemptions to the Amendment 80 and other regulations needed for this EFP:

To accomplish the study objectives, specific regulatory exemptions from current Amendment 80 catch handling procedures will be needed:

1. Catch handing regulations currently prohibit catch sorting or removal on deck, prior to observer sampling (50 CFR 679.93(c)(1)). Additionally, these regulations require all catch to be weighed on a NMFS-approved scale. During the EFP, catch estimates and viability assessments of halibut will occur principally on deck (and in the processing area for any halibut missed on deck) according to the methodology described below. These activities would normally occur at the observer work station below deck.
2. Second, regulations at 50 CFR 679.93(c)(5) prohibit catch from remaining on deck without an observer present. Because halibut will be handled on deck, exemption from this regulation is necessary.
3. Regulations at 50 CFR 679.7(g)(2) prohibit sorting catch prior to observer sampling. Because sampling will occur on deck, a regulatory exemption will be needed.
4. Regulations at 50 CFR 679.27(j)(5)(ii) and 679.28(b) describe catch weighing requirements. Because halibut weights will be determined by measurements and the IPHC length-weight table, an exemption from these regulations is needed.

Provisions for public release of data and information from EFP and provisions for interim and final reports from EFP:

Upon completion of the fieldwork described above, the EFP applicant (principal investigator) will analyze the EFP data and draft a report summarizing findings. The draft report will be a concise description of EFP objectives and methods, and the qualitative and quantitative findings. This draft report and the raw data used in the analysis will be made available for review by FMA, NMFS, Alaska Region, and IPHC.

Once the principal investigator receives and incorporates draft report comments, a second draft will be compiled and shared with the above agencies. After comments on the second draft are incorporated into the report, the principal investigator will notify the North Pacific Fishery Management Council that the report is ready for presentation, and make it available to Council staff. Finally, the principal investigator will present findings to the Council and its advisory bodies at their convenience.

Sampling Methods and Sample Size:

The decision to use sampling rather than collecting data from every halibut has already been discussed in the context of objectives of adequately accounting for the amount of halibut sorted on deck and effects of time on the viability assessments of halibut. But sampling carries with it a set of additional work to develop methods for unbiased sampling as well as the need for an analysis of sample size to ensure reasonable precision of estimates. Prior to adopting the sampling approach for this EFP, we considered ways to collect data from all the halibut sorted on deck without the problems experienced in 2009. This included consideration of using additional sea samplers per shift or mechanical means to expedite data collections. Mechanical approaches considered involved using a modified version of the current technology for flow scales to weigh all halibut individually on deck instead of measuring each fish as was done in 2009.

In reviewing potential modifications to the 2009 EFP procedures we consulted with the field project manager who supervised the 2009 EFP and the sea samplers who worked on that project for whom we had current contact information. We also consulted with several companies that provide conveyor belts and scales for industrial applications in the fishing industry. The discussions with scale and conveyor belt providers attempted to get information about the state of technology for mechanical devices to rapidly weigh or measure halibut individually on deck. In both cases, these conversations led back to a few common themes, the most pressing was the space limitations on the decks of Amendment 80 vessels if data from every halibut is to be collected. Additionally, we learned that the technology to weigh fish or use “imaging” to measure them exists on paper but has never been used on fully live fish (it has been used on bled fish). At the same time it is potentially very expensive to adapt those technologies to an on-deck setting and on-deck applications with full exposure to the typical weather conditions in Alaska have never been attempted.

In reviewing the problems encountered in 2009, one idea was that we hold the halibut in a tank on deck with running sea water. This could reduce the effects of holding time so that it would have less effect on viability. In fact a shallow pen was used in the 2009 EFP to hold halibut when the number of halibut outstripped the capacity of the sea sampler on duty to collect data.

But the pens used in 2009 would not hold water effectively given the ambient movement of the vessel. A deeper tank or trough might hold water but would require lifting the halibut to get them into the tank. Also, getting them out of the tank might be a challenge by itself. Overall, the practicality of using water tanks on deck with circulating sea water pumped into them was considered to be marginal at best.

Another alternative approach was to continue to use a census approach for halibut but have two or more sea samplers working on deck per 12 hour work shift on each EFP vessel. In reality, this was considered in the design of the 2009 EFP but it was ruled out because Amendment 80 vessels have significant limitations in terms of room available between the trawl alley and the off board scuppers where halibut length and viability data needs to be collected. The pictures below taken prior to the 2009 EFP illustrate the limited work area for sea samplers during the 2009 fieldwork. The sea samplers in 2009 worked at the farthest end of each of the halibut chutes where halibut length data was collected by marking a length data strip with a pencil. Under the direction of the sea samplers, halibut were slid to the sea sampler by a crewmember when the sea sampler indicated he was ready for the next fish. None of the 2009 EFP vessels had sufficient room for another sea sampler in the location where halibut data were collected. Further, the 2009 EFP did not include an Amendment 80 vessel under 124 feet in length where space limitations would be expected to be even greater.

These photos are illustrative of the limited space available on flatfish catcher processors for collecting the EFP data.

Given the problems discussed above, the approach adopted for this EFP was to employ sampling to estimate halibut catches and halibut viability. The objective was to look at the 2009 data and come up with a sampling plan that afforded reasonable precision, minimized bias, and would also minimize slowdowns in data collections and handling time for catches on deck.

Sample size for estimating halibut viability and catch per haul

To evaluate sample size tradeoffs for balancing precision objectives with practicality of sample size, data from the 2009 EFP were used to develop a an analysis of precision and bias tradeoffs with sampling. That analysis is summarized below and available in its entirety as Appendix 2 to this EFP application.

In considering the data used for the analysis, it is important to recognize that the 2009 halibut viability data likely reflect some additional mortality from the delays that occurred in collecting length and viability data on each halibut. Ideally, a different data set without the effects of the delay in getting halibut viability assessed would be available. Given that observer data from the regular fishery likely reflect holding time before viability assessments take place to an even greater extent than data from the 2009 EFP, observer data were clearly not suitable for this analysis.

One way of looking at the 2009 data is that they likely include more variability in viability rankings (a greater proportion of fish classified as poor and dead) than would have occurred without the slowdowns. From this perspective, the 2009 data can be viewed as being "conservative" in terms of its use for evaluating sample size because if the slowdowns had not occurred, a higher proportion of halibut would likely have been in excellent condition. Sample size, therefore, could have been considerably smaller because there would be less variability in the data. As a way of taking this into account in the development of a sampling plan, some of the statistical analyses in Appendix 2 evaluate the degree to which sample size could have been smaller if the data had not included higher variability as a result of holding time before viability assessment.

Summary of the statistical analysis:

In 2010, the Alaska Seafood Cooperative hired Ruth Joy, a Ph. D candidate in experimental statistics at Simon Fraser University, to develop the analysis included in Appendix 2 to this application. The objective of the analysis was to evaluate tradeoffs with sample size for estimating halibut catch and viability in the context of the data collected in the 2009 EFP.

For the analysis, the Alaska Seafood Cooperative provided Ms. Ruth all the electronic data files from the 2009 EFP. The data comprised all 281 hauls made by the three EFP vessels in May and June of 2009. The total weight of groundfish catch covered by the EFP data was 3,592 metric tons, approximately 93% of which was flatfish of the different target species pursued by EFP vessels during May and June of 2009. Pacific cod was the next largest component of the catch. Total halibut catch in the 2009 EFP was approximately 67 metric tons, of which 93% by weight was sorted on deck. The data include individual length and viability assessments for 16,986 individual halibut and associated fishing and catch handling information on a tow specific basis.

Specific findings of the sampling analysis: Prior to developing the analysis, the statistician undertook some summary analyses (pages 1-13 of Appendix 2) to learn more about the halibut data in the context of the 2009 EFP. The main findings from the data summaries were that:

- Larger halibut had higher viability rankings.
- The three EFP vessels had approximately the same proportion of halibut in the three viability rankings (excellent, poor, dead).
- The number of halibut per haul was positively correlated with the proportion of halibut in the "dead" and "poor" categories and negatively correlated with the proportion in the "excellent" category. This may be due to delay in the time needed to take length measurements and assess viability of each halibut and/or related to other factors such as quantity of catch per haul, towing time, etc.

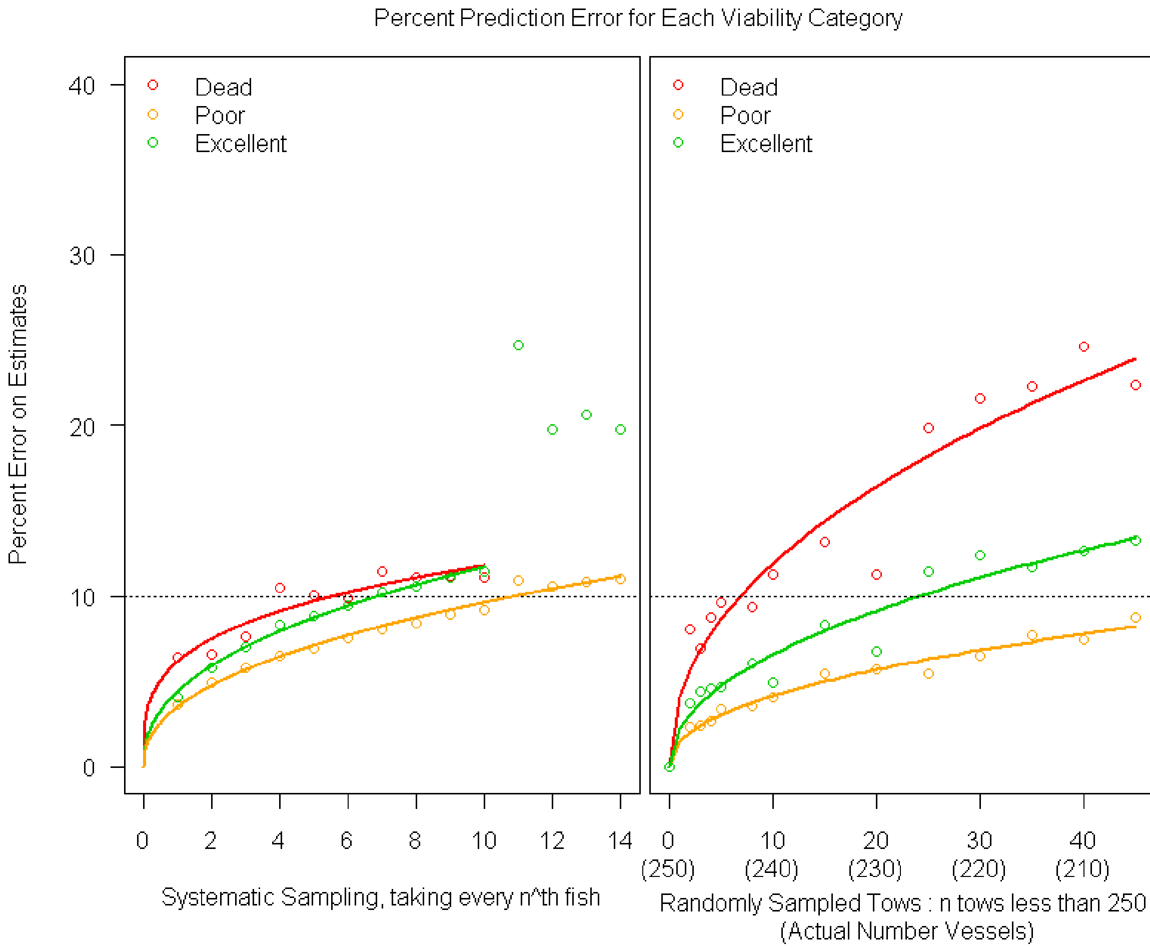
- The time needed to complete sorting, measuring, and assessing halibut viability per haul (referred to as "processing time" in the analysis) is positively correlated with the proportion of halibut falling into the "dead" and "poor" categories and negatively correlated with the proportion in the "excellent" category.
- Duration of tows was positively correlated with the proportion in the "dead" category.
- Amount of groundfish per haul was positively correlated with the proportion of halibut in the "dead" category up to hauls with approximately 30 mt. When haul size exceeded 30 mt, this relationship is no longer seen but very few individual tows caught more than 30 mt.

Sample size tradeoffs associated with the objective of sampling fish from each EFP tow (pages 14-20 of Appendix 2)

- If we sampled every 4th fish, we would have 39 tows with only 1 halibut sampled, and 213 with >1 halibut sampled.
- If we sampled every 5th fish, we would have 43 hauls with only 1 halibut sampled, and 208 with >1 halibut sampled.
- If we sampled every 6th fish, we would have 45 hauls with only 1 halibut sampled, and 206 with >1 halibut sampled.
- Overall: Dropping sample size too low would result in some hauls with no halibut sampled. Hauls with no halibut sampled reduces sampling precision greatly (see below). For the 2009 data, 18% of the hauls had six or fewer halibut in them.

Randomizing sampling: The analysis looked at three different randomization methods for sampling. Percent error was minimized when systematic sampling started with the first fish (page 16 of Appendix 2 left side) where the analysis shows we could subsample every 5th fish. But sampling the first fish on all tows maximizes possible bias. This is seen in the graph in Appendix 2 on page 17 (left side) showing what the maximum possible bias could be. Based on this, it makes sense to randomize sampling within the sampling intervals (e.g. randomly selecting one out of every five fish) or to randomize the starting point for sampling to reduce potential for bias. The method ultimately selected for sampling in the EFP randomizes the fish collected within each set of five. This is expected to be a very effective way of avoiding potential for intentional bias.

Sample size tradeoffs for estimating halibut viability: The findings of the analysis of sample size for estimating halibut viability suggest that to maintain percent error under 10%, every tow should be sampled and sample size needs to at least be as large as one-tenth of the halibut (expressed as one of every ten, see figure below which is the percent prediction error figure on page 16 of Appendix 2). At the same time, the results show that the most certain approach would be to sample every 2nd fish. From a practical perspective, however, sampling every other fish would be unlikely to avoid the back-ups in collecting data such as the ones that occurred with the work done by sea samplers in 2009. Sample sizes in the range between one in two and one in ten halibut were considered based on this general result. One-fifth of the halibut was ultimately selected for sample size because it was in the middle of the range and it seems practical in terms of getting as large a sample as possible without creating the slowdowns that occurred in 2009.



Additionally, it is useful to think about the 2009 data in the context of how the data collection methods likely affected the data. One way to think about the problem with the 2009 EFP is that the methods used in the collection of the length and viability data likely increased the proportion of halibut in the "poor" and "dead" categories. This was due to the delay in getting all the halibut processed for length and viability. To take this into consideration, the analysis looked at ways to evaluate the 2009 data. One way done in Appendix 2 was to order the data by viability ranking within each haul such that the fish in the "excellent" category were ordered first, then fish in the "poor" condition ordered second, (see page 19 of Appendix 2, left side) etc. This is logical because one can imagine that the fish sorted first would generally have better viability and would score better in the viability assessment simply because they were not held out of water very long before the assessment for viability.

When the data for each tow were ordered as described above and a simulation was run where sub-sampling started with the first fish per tow, the results suggest that sample size in the range of every 4th, 5th, or 6th fish would clearly be adequate. This was based on the assumption that ordering the halibut in each haul for the 2009 data is a reasonable way of "compensating" for the higher variability in the viability rankings due to delays in processing halibut for length and viability.

The sample size analysis also examined alternative ways to directly account for the higher occurrence of fish that fell into the "dead" category due to the delays in processing fish. One way was to simply exclude the halibut falling into the "dead" category from the data for purposes of some of the simulations done for the analysis. This showed that if we based the sample size on just the halibut with "poor" and "excellent" scores only, we can sample every 5th fish with adequate precision using either the method of starting with the first fish or a random start (also page 19, left panel). Seen this way, it may be sufficient to have lower certainty for the "dead" category while maintaining higher certainty for sampling halibut in the "excellent" and "poor" categories.

Sampling to estimate amount of halibut sorted on deck: Appendix 2 also looks at how sampling affects our estimation of the weight of halibut sorted on deck for each haul and by vessel over the course of the EFP (pages 21-31 of Appendix 2). This analysis showed that for two of the three EFP boats in the 2009 dataset, sampling rates of every 4th, 5th, or 6th fish had no major loss of precision on the estimate of the amount of halibut sorted on deck. This means that as long as we get a reasonable number of hauls over the fishing period for EFP testing (similar to the number done in 2009), sub-sampling rates such as every 4, 5, or 6th fish will result in incremental errors that should cancel each other.

These results for the precision of sampling for estimating amount of halibut sorted on deck per tow or per vessel should be considered in the context of the current methods for estimating halibut catches on Amendment 80 vessels. Currently, catch composition and halibut as a component of catch per haul is determined by extrapolating the fraction that halibut comprises of an observer sample (typically 300 kg sample size). Haul size in the regular fishery is typically between 20 and 40 metric tons. In light of this, a sample of halibut catch based on every 4^{th}, 5^{th}, or 6^{th} fish is likely to be more precise in estimating an EFP vessel's catch of halibut over the period in which it participates in the EFP than estimation of halibut catches per tow or per vessel in the regular fishery using standard observer sampling protocols.

To examine the expected precision of taking one-fifth of the halibut to estimate catch per haul, it is instructive to compare expected precision to the level of precision from the current observer sampling methods. Page 26 of the sampling analysis in Appendix 2 evaluates sampling precision relative to methods used by observers in the regular Amendment 80 fisheries. The simulation shows the relative precision of taking three, 100 kg samples to estimate halibut catch per haul and overall halibut catch per vessel in the 2009 study data compared to estimating halibut catch per vessel by sampling one-fifth of the halibut according to the stratified random sampling procedures described above. In that simulation, sampling one-fifth of the halibut is shown to be roughly six times more precise than taking three 100 Kg samples. This finding is seen through the relative width of the 95% confidence intervals in Figure on page 27 and discussion on page 26 of Appendix 2.

In summary, the statistical work shows that sampling every 4th, 5th, or 6^{th} fish is reasonable based on interpreting the 2009 data to have higher variability than it otherwise would have due to delays in assessing viability of halibut. Given the practicality considerations needed in the EFP to avoid the slowdowns in processing fish for length and viability, we selected one-fifth of the halibut as reasonable strategy for sub-sampling as long as fish are selected randomly from within those intervals as they move across the halibut chute.

Evaluating the precision of sampling procedures for estimating amount of halibut sorted on deck:

An important EFP objective is to measure the relative precision of the sampling methods for estimating the amount of halibut sorted on deck per tow. Although the sampling analysis provides some confidence that the sample size selected is adequate, measurement of actual precision and bias will help to ground truth sampling methods.

To measure precision and bias, all halibut (sampled and non-sampled) will be temporarily collected for length sampling on a subset of EFP tows on each vessel as described above. The question of on what proportion of tows should all the halibut be collected and measured is critical to both the evaluation of precision and evaluation of potential for bias. In consideration of what proportion, it is also important to take the broader objectives of the EFP to evaluate the feasibility of the alternative fishing and catch handling procedures into account. For example, if all halibut are collected on a large fraction of the tows, the EFP's objectives to evaluate the feasibility of the alternative fishing and catch handling procedures will be negatively affected.

To come up with a reasonable number of tows where verification of precision/bias is undertaken, Appendix 2 examines how the precision of our estimation error of halibut catch (weight of halibut sorted on deck) increases as the number of times all halibut are collected for comparison of sample to census amount. To do this, simulations were run by calculating the estimates of halibut weight using both the every fifth halibut sub-sample procedure and the census of halibut catch per haul done for all hauls in the 2009 EFP dataset. For each run of the simulation, a fixed number of hauls were selected and estimates from sampling and census amounts of halibut catch weight were compared.

The simulation randomly selected hauls for each EFP vessel from 2009, with the same number of hauls selected for each vessel. In this manner the catch of halibut per vessel was first estimated with just three hauls – one haul for each vessel. This was then increased to six hauls, which is two hauls for each vessel, nine hauls – three per vessel, etc. This was done out to one-third of 250 hauls in the dataset or 63 hauls (21 per vessel). This was repeated 1000 times, and the relative error and the coefficients of variation were calculated for each increase in number of hauls.

The figures on page 29 of Appendix 2 show that the coefficient of variation for halibut catch by each vessel generally decreases as the number of hauls with sampling/census comparisons increases from just one per vessel to 10 per vessel. Beyond 10 per hauls per vessel, the difference (decrease) in the coefficient of variation becomes relatively small. This finding was used to support the approach that there is little additional gain in reduced uncertainty with more census verification work after 10 hauls per vessel. From the figure on page 29 of Appendix 2, one can see that the additional reduction in uncertainty from comparing census to sampling on 60 tows (20 per EFP vessel) compared to 10 per vessel is small.

For the overall 2009 data, there were 251 hauls so if a census/sample verification process were done on 30 hauls, approximately 12 percent of the hauls would be subjected to the census verification. The number of hauls in the 2009 EFP per vessel was in fact unevenly distributed (46, 82, 153 for *Ocean Peace*, *Cape Horn*, and *Constellation* respectively). So instead of using the approach used in the simulation in Appendix 2 directly based on a fixed number of tows per vessel, we opted to use a percentage of tows per EFP vessel. This was done because in review comments from the AFSC, the suggestion was made that a random selection of tows for evaluation of sampling precision was preferred. Those review comments also suggested that a reasonably fraction of hauls per EFP vessel was 20%.

EFP tows will be randomly selected for sampling/census data collections using the random draw approach described above. It is important that the random selection of tows occurs at a point in time when the catch composition cannot be changed (during net haulback). This approach will help avoid bias in case fishermen can somehow modify fishing to affect the number of halibut in the haul (for instance to minimize the work of collecting them and the time needed for the sea samplers to measure each one). Further, we have considered the 20% of tows proportion of all EFP tows and this appears to be a workable percentage that will not inordinately slow down the fishing or data collection too much during the EFP. The proportion of tows also affects the usage of halibut mortality in the EFP because sampling to census evaluations will increase halibut mortality usage in the EFP. This is because the halibut will stay out of water longer on the non-standard tows; the reason the published mortality rates will be used in lieu of the using mortality actual rates as will be done in standard tows.

A percentage approach was preferred because it avoided “oversampling” on EFP vessels that might only participate in the EFP for one trip (approximately 30 tows) which could affect our assessment of practicality/feasibility. At the same time, if an EFP participant remains in the EFP for up to three trips, the number of census tows would better reflect the vessel’s participation in the fieldwork than if a fixed number of tows (e.g. 10 tows) were used.

Approaches used for conducting interviews/surveys to assess the feasibility of the modified fishing and catch handling procedures:

The results from the 2009 EFP were encouraging from the perspective of the effectiveness of sorting halibut on deck and overall feasibility of the alternative fishing and catch handling procedures for most of the target fisheries during the EFP. An important finding in 2009, however, was that feasibility of the fishing and catch handling procedures was considerably lower for the yellowfin sole target relative to other EFP targets. The EFP final report provides considerable discussion of that outcome for yellowfin sole and the major factor appears to be that relatively small hauls are not economically feasible for a relatively low-value flatfish species such as yellowfin sole.

Understanding how workable the alternative fishing and catch handling procedures are for the Amendment 80 fleet is very important for the industry’s understanding of costs and benefits. For this reason, an important additional objective of the new EFP is to expand upon and ground truth the findings of the 2009 fieldwork in terms of feasibility for boats in the size classes that participated in 2009, and extend the testing to vessel sizes that were not represented or underrepresented in 2009. Likewise, the plan for this new EFP is to extend the testing to some target fisheries that were not part of the 2009 EFP but are important to the sector. Any future consideration of the alternative fishing and catch handling procedures for adoption into the regular fisheries will need to have the benefit of information about how the procedures will work in different fisheries and on different vessel sizes. This information is needed by the industry in its consideration of where to go in terms of potential extensions of the program for regular fisheries or future research needs.

As in 2009, our assessment of feasibility will include looking at the performance data in terms of the time needed to sort halibut, account for amounts sorted on deck and viability and comparing performance on different sized vessels during the EFP and different target fisheries. Variables such as target fishery, amount of catch per tow, weather, and other factors that likely explain performance and feasibility will be tracked during the EFP in the manner they were tracked in the 2009 fieldwork. To really get at feasibility, a great deal of production information regarding how many cases of fish per day are produced, quality considerations for that product, and changes in fishing and processing costs will ultimately be important determinants of feasibility. This EFP will not delve directly into that type of analysis and will not attempt to collect that kind of specific data directly. In lieu of that, our feasibility assessment will be ultimately based on the opinions expressed by key personnel on EFP vessels such as the vessel captain, factory manager, and vessel owner/manager. That information will be obtained through interviews conducted (for captain and key crew) directly following the EFP fieldwork on that vessel.

Interviews will be used to solicit the captain's perspective on how well the changes in fishing and fish handling were incorporated into the vessel production process. For the interviews in 2009, captains and factory managers were asked very general questions about how they were able to accommodate the changes in fishing practices, changes in crew shifts and labor assignments with deck sorting and this format will be used for this EFP as well. The questions will also enquire into general information about the effects on fish processing rates per day and whether the different labor shifts associated with smaller catches per haul were needed. We also asked captains and crew to give us their overall assessment of the feasibility of the different fishing and catch handling practices in the context of how the benefits of the halibut mortality savings which might help ensure they can catch all of their target fish allocations. As occurred last time, notes from the interviews will be used to summarize the findings on feasibility.

In considering how to approach the interviews of captains and crew for informing our analysis of feasibility, the tradeoffs between using formalized interview questions and methods versus informal discussions with EFP participants were considered. While formalized interviews are clearly more likely to collect information systematically from the different EFP participants, from our experience captains and crew will be less forthcoming if they sense they are being asked to provide specific, often proprietary information as opposed to having a follow up conversations about how things went in the EFP and general observations about feasibility.

Post EFP feedback from sea samplers will be obtained using a written questionnaire as occurred in 2009. The survey questions will ask the sea samplers to indicate how well they felt the catch sorting, accounting, and viability procedures of the EFP were carried out and whether each party (e.g. deck crew, factory crew, vessel captain, factory manager, field project manager) did what they were supposed to do according to the briefing materials provided to the sea samplers at the pre-EFP briefing. Questions about the amount of time/work it took to account for halibut catch and do viability assessments and how weather conditions might affect this kind of work at other times of the year. Additionally, sea samplers will also be asked to comment on how the procedures for catch handling, sorting, and sampling could be improved for any future fieldwork or possible trials in the regular fisheries. Finally sea samplers will be asked to comment on any challenges they see for implementation of the alternative catch handling procedures into the regular Amendment 80 fisheries.

In addition to getting input on the feasibility aspects of the fishing and catch handling procedures of the EFP from captains, key crew members, and sea samplers, we will ask for input from the observer provider companies who provided the sea samplers for the EFP. The intent here is that they will be getting feedback from sea samplers following the EFP and it will be important to ground truth the feedback we receive from sea samplers with the representatives of the observer provider companies who hear from the sea samplers following the EFP. Also, observer provider companies could someday be responsible for providing qualified personnel for any extensions of changes in halibut handling procedures in the future so their input on the prospects of finding the personnel for these kinds of duties will be sought. Informal discussions with the representatives of observer provider companies will be used for this purpose.

One final source of feedback will be from the companies that own/manage the vessels that participate in the EFP. They will be talking to their captains and key crew during and following the EFP and that input will be critical to the EFP's overall assessments of feasibility. Vessel owners and managers will therefore be asked about day to day feasibility considerations and how they see the tradeoffs between increased costs from modifications to fishing and catch handling (plus added expected costs for monitoring etc) and expected benefits from reduced halibut mortality rates.

All the information collected from this new EFP will help inform the final report of the EFP as to the likely success of any future efforts to apply the modified fishing and catch handling procedures in the sector's regular fisheries. Part of that is simply having better information on the range of fisheries where such changes are workable. The quantitative information such as the percent of halibut sorted on deck, time needed to complete sorting, estimated mortality rates will also inform the report's assessment of the expected benefits and costs. The input from captains/vessel owners/ factory managers will help form the EFP's assessments of feasibility in terms of effects on fish production rates per day tradeoffs associated with the alternative fishing and catch handling procedures. Unknown in the overall consideration of changes in costs to compare to benefits is the additional monitoring costs that would be expected to come with any adoption of changes in catch handling to reduce halibut mortality. While this EFP will not generate information on that directly, as we learn more about the procedures for catch handling through the EFP, this will help the industry and mangers to better understand how monitoring would be done to be effective. Finally, as we learn more about ways to handle catches to reduce halibut mortality, vessel owners can begin to develop ideas for how to make those more efficient as they consider modifications to their vessels or vessel replacement.

Another important consideration in the future would be how changes in catch handling to reduce halibut mortality might be made to work within NMFS' in-season data collection system and monitoring/enforcement objectives. While steps to evaluate this directly are not explicitly part of this EFP, knowing more about the specifics of catch handling procedures in different fisheries will help us understand what range of fisheries are workable, what specifically will be involved, and what types of monitoring would be appropriate. All this has a bearing on whether the costs to industry, in-season catch accounting, and monitoring/enforcement are worth the halibut savings. Additionally, it is hoped that the NMFS Regional Office, FMA, or the IPHC will be able to send out someone with experience in field research from their programs on some of the EFP trips. To this end, the AKSC will do everything in its power to adjust vessel schedules and arrange for special pick ups or drop offs of these personnel if this increases the chance of getting them out on EFP boats during the field work. Firsthand experience observing the procedures of the EFP is expected to provide insights to agency personnel on how to develop monitoring as well as modify or simplify steps in order to make the procedures more workable for agency adoption.

For this new EFP application as well as the one in 2009, considerable attention has been given to the question of how much EFP fishing is needed to derive meaningful estimates of the halibut mortality rates as well as feasibility of the new fishing and catch handling procedures. For the 2009 EFP, it was assumed that it was important for the EFP vessel to make up to three trips using the EFP procedures to allow them to fully assess the feasibility of those changes in fishing and catch handling. This would have amounted to 9 or 10 separate trips during the 2009 EFP. Unfortunately, a vessel representing the smaller range of flatfish catcher processors was not available in the 2009 EFP and the vessel in the large category was only able to make one trip.

For this new EFP application, we have expanded the list of vessels that would be authorized and therefore may participate in the EFP to include several in each vessel length category. This was done both to cover all the relevant vessel size classes and because the expanded list will allow the AKSC to accommodate vessel schedules in 2012 more flexibly and therefore to select vessels for different time/fishery slots as fishing plans take shape in the latter part of this fall. At the same time, we have reduced the expectation in terms of the number of trips to one or two trips per vessel. This is because in the 2009 project, it was felt that while it was not optimal, a single trip was sufficient for assessment of the feasibility.

As in 2009, this new EFP requests that the permit allow a sufficient amount of EFP testing to create a reliable baseline for the degree to which the modified fishing and catch handling procedures are workable for deck crew and for the production aspects of the processing plant as well. The specific objective here is to have at least one vessel in each vessel length category make one or two trips in relevant target fisheries with a focus on fisheries where no testing to date has occurred. We believe that applying this approach will result in approximately 10 separate vessel trips during the EFP.

Catch handling and catch accounting/halibut viability assessment procedures for the follow up EFP

The procedures described below follow those of the 2009 EFP fairly closely except where changes to catch handling and catch accounting duties are needed based on the changes in methods as explained above.

Procedures for new EFP:

The catch handling and accounting procedures for the 2012 EFP are as follows:

1. The EFP holder is responsible for notifying NMFS prior to the start of any EFP fishing by the vessels listed above. Notice must be made at least 7 days before the start of any EFP fishing activities. Once EFP fishing activities commence, all hauls by an EFP vessel must follow the catch handling and accounting procedures of the EFP until the vessel's EFP activities are concluded. The EFP holder will notify NMFS at the conclusion of EFP activities of all vessels that participated in the EFP.
2. Prior to haulback, sea samplers will record the EFP haul identification number on data collection sheets used for the EFP.
3. The codend will be brought on deck and pulled forward of the live tank hatch to create adequate room for sorting halibut as the codend is being dumped into the tank.
4. The codend zipper will be removed in a manner that achieves a reasonable rate of flow of catch out of the codend to allow halibut to be sorted out of the catch by the deck crew and slid from the trawl alley to the specialized halibut chute on each EFP vessel
5. Only halibut can be removed from catch on deck. The one exception to the "only halibut can be sorted on deck" rule is for marine mammals, large sharks or debris etc. as per standard procedures for regular Amendment 80 fishing.
6. Halibut will be handled in a manner so as to minimize injury/mortality and should not be lifted by the tail or gills. Crew members will place halibut sorted from the catch on deck onto the chute or conveyor belt leading to where the sea sampler on duty is working. Crew members will work with the sea sampler to adjust the pace at which halibut are moved, to provide the sea sampler with adequate time to collect and record length and viability data on halibut selected for sampling.
7. Sea samplers will be provided a work table adjacent to the conveyor belt or chute that allows them adequate space to do length and viability data collections on halibut selected for sampling. The table provided will allow for halibut data collections without having to lift the halibut to get them on and off.
8. Sea samplers will count all halibut per haul using a thumb counter and record this data as part of their overall halibut data collections.
9. Prior to each haul, sea samplers will use a random sampling interval program developed in consultation with FMA to randomly select halibut for sampling from within each set of five moving across the chute/conveyor. Sea samplers will ensure that the crew do not have access to the sampling schedule generated for each tow.
10. Sea samplers will select halibut for length and viability data collection via a random sampling schedule for each tow described above.

11. Sea samplers will record the start time (time that codend is brought on deck), end time (when last halibut from a tow is returned back to the water) and time at assessment of each halibut. Time when sorting activities are concluded will also be recorded. Every halibut selected for sampling will have a data record with the EFP haul number and we will be able to evaluate elapsed time, length, and viability ranking.
12. A sea sampler must be present on deck whenever halibut sorting and halibut length and viability data collections are occurring. The sea sampler on duty must be on deck for the entire time whenever halibut are being handled on deck for each tow during the EFP.
13. To ensure full accounting of any halibut that were missed during deck sorting, all portals to the conveyor belt from the stern (live) tank(s) will remain closed until sorting and halibut data collection activities are completed on deck. Portals to the live tank can be opened once the sea sampler on duty is present in the processing area and has indicated to the crew that catch sorting operations for fish in the stern tank may commence.
14. Following the conclusion of halibut sorting and length/viability data collections for a given tow and once the sea sampler on duty is in the factory area, factory crew can begin running the belt to the flow scale and sorting the fish from that tow.
15. For any halibut missed during the sorting on deck, factory crew will remove those halibut from the sorting belt after the flow scale under the direction of the sea sampler. Halibut missed from deck sorting operations will be placed in a tote or other designated bin as indicated by the sea sampler working in the processing area.
16. The sea sampler will collect length and viability data for all the halibut missed during sorting operations on deck.
17. In case any halibut slips by the crew members sorters on sorting belt in processing area, factory crew working "downstream" will be responsible for bringing those halibut back to the sorting area so that they are placed it the tote designated for halibut missed during deck sorting.
18. When working in the processing area, sea samplers will communicate with the vessel's regular observers to minimize disruptions to the catch sampling duties of the regular observers. The sea samplers will make arrangements to use the workspace in the factory in a manner that does not disrupt the activities of the observers.
19. Arrangements will be made between the sea sampler working in factory and the regular observers to put any halibut that happens to come up in observer's sample in the tote designated for halibut collected in the factory.
20. Sea samplers will provide total halibut catch weight per tow (calculated in the manner described above) to the regular observers for each tow during the EFP.
21. Halibut catch per day broken out by weight of halibut sorted on deck and weight of halibut recovered in the processing area will be reported by the sea samplers to the field project manager on a daily basis. Average halibut mortality rates per tow will also be reported to the field project manager. This information will help the PI, field project manager, and EFP participants to monitor halibut usage during the EFP so that EFP participants can gauge their performance in the EFP.
22. Sea samplers will immediately report any problems and departures to the above EFP procedures to the EFP field project manager. The EFP field project manager will assess the nature of the problem. If the field project manager feels that what has occurred is a major issue, then he or she will immediately report this to the EFP principle investigator.

The principle investigator will, in consultation with NMFS personnel assigned to this project, make a determination as to whether the vessel's participation or the entire EFP must be suspended or terminated. NMFS or the EFP principal investigator may terminate EFP fishing on any of the vessels under this permit at any time.

23. If the problem/departure reported to the field project manager can be addressed through improvements in communication and training of the vessel crew and sea samplers, then the EFP field project manager will take steps to remedy the situation in that manner. However, if these steps do not remedy the problem/departure in a reasonable timeframe, then the EFP field project manager will report this to the EFP principal investigator and a determination will be made in consultation with NMFS regarding the vessel's participation or the EFP or the termination of the EFP overall. NMFS or the EFP Principal Investigator may terminate a vessel's participation in this EFP at any time.

Appendix 1

Summary of EFP 09-02

Under a May, 2009 exempted fishing permit (EFP 09-02), the principle investigator, in consultation with NMFS, FMA, and IPHC staff, conducted a pilot evaluation of ways to reduce halibut bycatch mortality rates on Amendment 80 catcher processor vessels. Styled loosely on the “careful release” methods for longline vessels and similar efforts on trawl vessels, the 2009 EFP objective was to evaluate a set of alternative fishing practices and changes trawl catcher processor catch handing procedures. The research informed the feasibility of catch handling modifications, and their effectiveness for minimizing halibut bycatch mortality. The discussion below summarizes the findings of EFP 09-02: what was learned about the feasibility of alternative fishing and catch handling procedures, where additional questions remain regarding feasibility, and where the research findings were not adequate for determining the extent to which halibut mortality rates can be reduced.

Changes in fishing practices for the 2009 EFP involved limiting tow duration to approximately two hours. This was done to help ensure halibut would be less fatigued from swimming in the trawl, as well as reducing catch amounts per haul so halibut would be exposed to less stress from the weight of target catch as the net was retrieved. Catching approximately half as much per tow and towing less than two hours was expected to reduce halibut mortality. Under these constraints, captains felt that halibut would be in relatively good condition when the net is first retrieved and this is important because even if they are returned to the sea faster with the alternative catch handling practices of the EFP, they need to be in relatively good condition from the outset in order to reduce mortality rates. The basis for the opinion of captains that the alternative practices would work came from their experiences. Captains often watch as hauls are dumped into the vessel’s stern tanks to get a preview so they can know if they are catching what they trying to catch before the net is set again. While not scientific information, captains have observed that halibut seem lively as they are being dumped into the stern tank when tows are relatively short and catch amounts are similarly small.

With smaller catch amounts per tow and shorter tow times, changes in crew shifts on deck were needed to set and haul the gear more frequently. Changes in shifts for processing workers were also needed to preserve labor efficiencies with the different rate of flow of catch through the processing facilities of EFP vessels. The objective was to restructure labor on the vessels to see if loss of efficiency could be minimized under the different rates for catching fish and hence different factory production flow.

Catch handling procedures during the 2009 EFP involved bringing the net on board in a manner that provided sufficient space to allow crew members to carefully sort halibut out from the target flatfish species on deck as the contents of the net were slowly spilled into the vessel’s live tank below deck. The 2009 EFP protocol required that only halibut could be sorted out of the catch and every halibut had to follow the same pathway for moving it from the deck to the side of the vessel via the halibut conveyer/chute installed on each EFP vessel.

Prior to the start date for the 2009 EFP, deck crew and key factory personnel were briefed on the objectives of the EFP and instructed on ways to handle halibut carefully so as to minimize mortality. Following these methods for handling halibut, halibut were moved from the trawl alley by the crew by sliding them through a portal cut through the trawl alley. This slot cut through the trawl alley wall avoided the need to lift the fish over the trawl alley wall since halibut can be injured if lifted incorrectly. Once outside the trawl alley, halibut were then slid to the off board side of the vessel via a chute designed for that purpose. Prior to being put overboard, each halibut was measured and assessed for viability by sea samplers working on each EFP vessel. Sea samplers used the viability assessment criteria from the regular fishery to assess viabilities.

The overall intent of the alternative fishing and catch handling protocol of the 2009 EFP was to reduce mortality rates while still allowing for accurate accounting of halibut catches and assessment of mortality rates. It is worth noting that these objectives conflict to some extent because minimizing time out of water is critical to halibut survival. Time needed for accurately accounting for halibut catches and viability rates on each fish increases time out of water. This issue will be discussed below in the context of the need to do additional research as a follow up to the 2009 EFP.

The baseline for reduction in halibut mortality rates for the 2009 EFP was the mortality rates that would have been assigned to the halibut caught by the EFP vessels if they had been in the normal Amendment 80 target fisheries. Halibut bycatch limits for those normal Amendment 80 fisheries are in terms of extrapolated weight of halibut catches (extrapolations from species composition sampling) applied to target fishery-specific halibut mortality rates. Rolling averages of halibut bycatch mortality based on observer viability assessments over the course of three years on all vessels in the fishery are used in the regular fishery for this purpose. Average rates across all trawl vessels in the Bering Sea over time are used instead of vessel-specific rates from specific hauls because workload for in-season management would otherwise be greatly increased. Currently, halibut mortality rates in most Amendment 80 target fisheries are approximately 80%.

One reason that mortality rates are relatively high fleet-wide is that under current Amendment 80 regulations, halibut cannot be removed from the catch on deck.[1] Halibut catches are accounted for by species composition sampling by observers as the fish from each haul are moved out of the below-deck holding tank and into the catch sorting area. Observer sampling occurs below deck in the regular fisheries to help ensure that all of the catch is accessible to observer sampling. A downside is that current fish handling requirements in combination with other Amendment 80 regulations such as sampling every haul and no mixing of catches from different hauls effectively mean that halibut are sometimes held out of the water for more time than is optimal for their survival. For instance, in the extreme it can take up to several hours for halibut to be returned to the sea.

[1] To ensure that observer sampling has access to all components of the catch, no part of the catch can be removed from the catch on deck. In practice, catch of very large fish or materials (e.g. sharks or debris) are occasionally sorted and discarded on deck with permission of the observer when dumping such items into the vessels catch holding bins would present problems for conveying them overboard from the processing area.

For the most part, EFP 09-02 was a partial success in terms of conducting a pilot assessment of the feasibility of alternative fishing and catch handling procedures used in the EFP for the fisheries and vessel size categories that were the subject of the EFP. Probably most notable in terms of successes was that crew members on each of the three EFP vessels were able to sort halibut from the target fish relatively quickly and with high effectiveness (overall 93% of halibut by weight were removed on deck). Additionally, each EFP vessel was able to accommodate the shorter tow times and reduced catch per haul. Average groundfish catch per haul in the EFP was approximately 13 metric tons. This is approximately one-half of normal haul size of most of the target fisheries that were the primary focus on the 2009 EFP.

In the processing areas of the EFP vessels, the smaller catch amounts coming into the live tank more frequently were successfully accommodated by changes to labor shifts. While no explicit analysis of changes in processing efficiencies was done as part of EFP 09-02, the final report states that EFP participants did attempt to minimize loss of efficiency by reducing the number of processors working at a time and changing labor shifts around that new schedule. On one EFP vessel, the factory reported concentrating on higher-valued product forms to adjust the factory labor flow based on smaller amounts of catch occurring more frequently.

Regarding the 2009 EFP's overall assessment of feasibility, the EFP application states that one objective was to examine how the modified fishing and catch handling procedures worked on all the different size classes in the Amendment 80 sector. According to the EFP final report, this objective was not met because a vessel in the smallest size class was not available to participate in the EFP. Likewise, the largest size sector vessel class was underrepresented in the test fishing because the vessel in that class (185 feet and greater) was only available to make one trip during the EFP for reasons explained before. Finally, the vessel in the mid-size category made less than two trips due to a later than expected start and a prior commitment to use the vessel in a NMFS research charter. So from the perspective of accomplishing the amount of feasibility testing and coverage of all sector vessel classes that were part of the objectives of the 2009 EFP, the experiment clearly fell somewhat short but the final report does relate that the principle investigator felt that the data collected were still valid for inferences about the feasibility of the alternative procedures.

To some extent, EFP 09-02 also demonstrated that halibut mortality rates could be reduced. Overall, halibut mortality rates were approximately one-half of the mortality rates applied to halibut PSC in the Amendment 80 sector target fisheries that were the subject of the 2009 EFP. Specifically, an average halibut mortality rate of 45% was obtained overall in the EFP for halibut sorted on deck.

As was reported in the EFP holder's final project report, the lower halibut mortality result was certainly suggestive of potential for savings from changes in fishing and halibut handling procedures in the Amendment 80 target fisheries (e.g. flathead sole, arrowtooth flounder) that were the subject of the EFP research. But as was clear from the final EFP report, the 2009 research was not able to fully explore the potential for reduction in halibut mortality rates. This occurred in part because under the EFP procedures, sea samplers were required to measure and do viability assessments of each halibut sorted on deck during the EFP. While generating a large data set for the analysis was the intent in the design of the fieldwork, the downside to sampling every fish was that the time needed for the sea samplers to perform their duties typically exceeded the time needed for vessel crew members to conduct halibut sorting operations. This was particularly true for hauls with medium to high numbers of halibut.

According to sea samplers working on the project and EFP captains, the mismatch between crew sorting time and the halibut accounting and assessment work required of sea samplers at times resulted in a back-up of halibut. The back-up occurred at the start of the chute to transport the halibut from the trawl alley to the side of each EFP vessel. This meant that crew members had to hold halibut back until the sea sampler on duty could catch up with the backlog. The backlog was sufficiently large on some hauls that sea samplers were not able to catch up until well after all the catch had been sorted and all the halibut had been moved to the start of the halibut chute.

The degree to which this problem might affect the success of the EFP was not anticipated in the design of the fieldwork. Consequently, the EFP's data collection mechanisms for gauging the flow of halibut from the trawl alley to the off board release point were not designed to evaluate the effects of this bottleneck directly. While it is not an ideal measure of degree to which the delay affected the results, the final EFP report concluded that that the crew's halibut sorting operations took as little as ten minutes on many tows. In comparison, the time between the net coming on board and the last halibut in a tow being measured and assessed for viability was on average approximately 26 minutes. While many factors can affect viability of halibut and halibut are known to be a relatively resilient fish, 20 minutes out of water is often noted as the point where halibut condition slips from excellent to poor, and thus reduced survival occurs (personal communication from Gregg Williams, IPHC).

The delay in getting halibut accounted for and placed overboard likely meant that the 2009 EFP results do not necessarily estimate the "envelope of the possible" in terms of reduction in mortality rates on Amendment 80 vessels using the alternative catch handling and fishing procedures used for the EFP. One could simply assume that additional reduction in mortality rates would have been obtainable with faster processing times for collecting length and viability data. But making this assumption is problematic because from the perspective of the Amendment 80 sector, the potential benefits from reducing halibut mortality need to be carefully understood and compared to the additional labor and other costs of reducing halibut mortality. Through this comparison, the degree to which the program would be worthwhile if it were implemented in the regular fishery can be given proper consideration by Amendment 80 vessels.

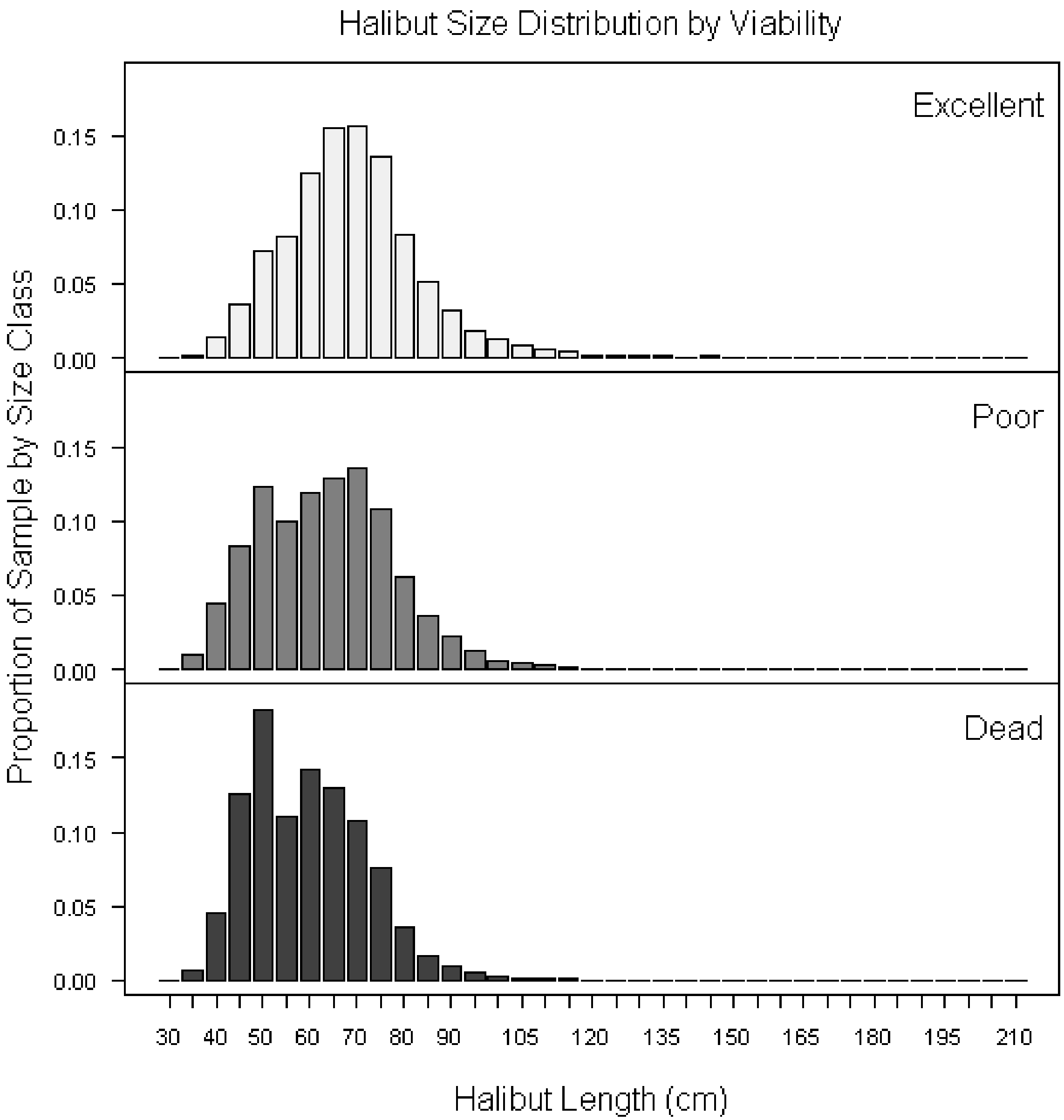
One area where additional costs of the program would be felt if it were implemented into the regular fishery is for monitoring to ensure boats are following the required deck sorting protocols. To get an initial assessment of the utility of electronic monitoring (EM) for that purpose, the 2009 EFP included the installation and use of a camera system developed by Archipelago Marine Resources Inc. of Victoria, BC for electronic monitoring applications on fishing vessels. The purpose of the installation was to monitor the entire deck areaas well as closer monitoring with additional cameras of the area where halibut sorting and accounting were taking place. The camera system was installed on one of the EFP vessels during the vessels EFP operations in May-June of 2009 and the system operated throughout that vessel's participation in the EFP. The cost of this deployment including the review of the video data was approximately $35,000 for25 days of at-sea data collection.

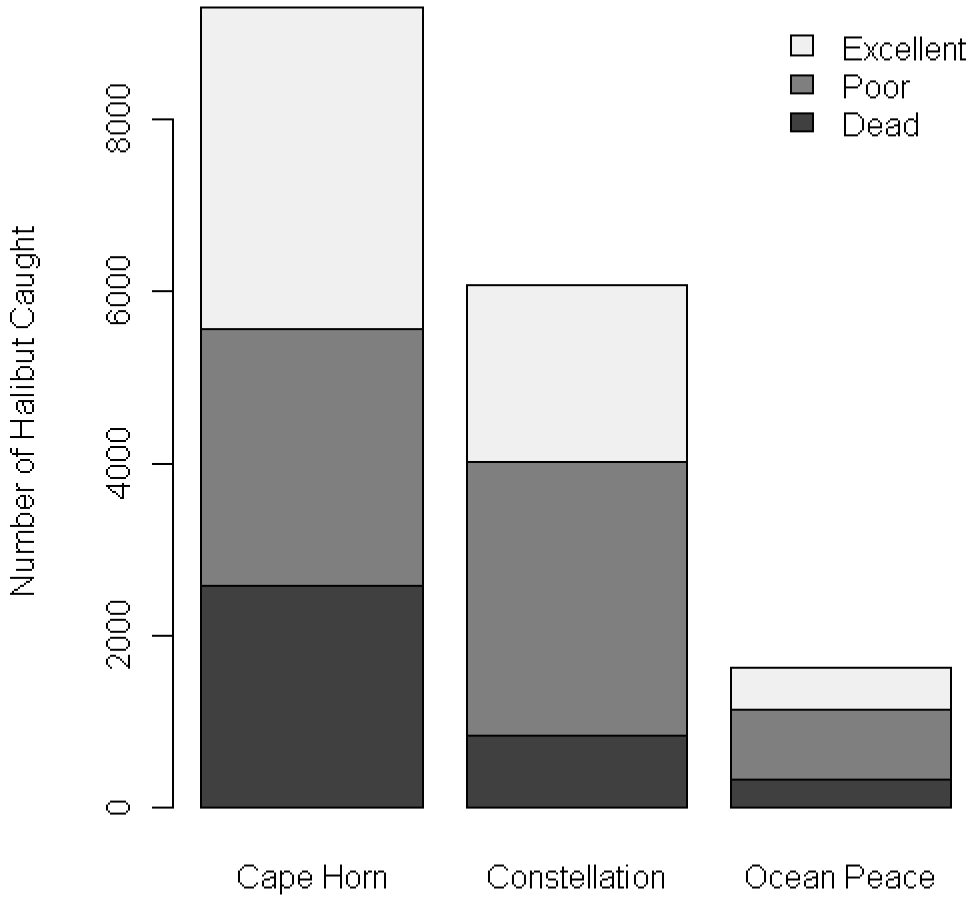
As part of their contract, Archipelago Inc. produced a report summarizing the effectiveness of the video monitoring system for the intended purposes of detailed monitoring of sorting operations for halibut and monitoring of the deck area overall to ensure that discards followed the EFP procedures (that report is an appendix to the 2009 EFP final report, Appendix One here). Archipelago's report concluded that electronic monitoring could be an effective way to ensure that vessels sorted halibut on deck according to the protocol used in the 2009 EFP but that additional cameras in the system would facilitate and improve monitoring. But EM costs applied to the regular fishery would not be trivial considering there are 20 active Amendment 80 vessels and assuming 100 to 150 fishing days in flatfish targets per vessel per year. Of additional concern is that there is currently no EM service provider based in Alaska so costs would be expected to be high until such service was regularly available and had sufficient volume to create economies of scale.

Given the potential for significant costs not just for monitoring but for increases in vessel labor and potentially slower production, it is important that the full potential for bycatch mortality reduction be known reasonably well from the outset. This will allow the Amendment 80 sector and fishery managers to evaluate benefits in terms of ability to conduct fisheries with lower halibut mortality and costs in a constructive manner. While halibut mortality rates were lower based on the 2009 EFP data, the Amendment 80 sector believes that even greater reductions can be achieved if slowdowns in measuring and assessing halibut viability can be avoided and the time needed to collect the necessary data more closely approximates crew sorting time. To look at the full potential, it will be necessary to redo the fieldwork with different halibut catch accounting and viability assessment procedures from those used in EFP 09-02.

Appendix 2 (included as separate attachment to EFP application)

APPENDIX 2

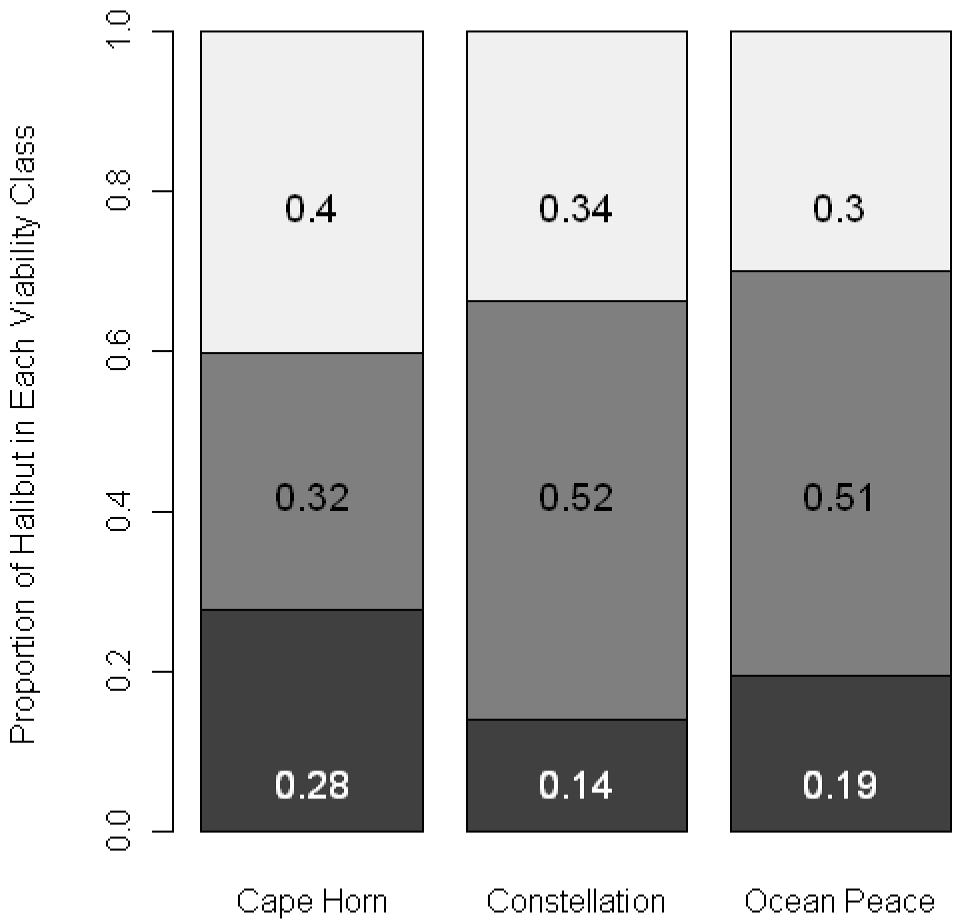

Halibut Size Distribution by Viability
Excellent
Poor
Dead
Proportion of Sample by Size Class
0.00
0.05
0.10
0.15
30
40
50
60
70
80
90
105
120
135
150
165
180
195
210
Halibut Length (cm)



There were:
82 Hauls for Cape Horn,
138 Hauls for Constellation, and
32 Hauls for Ocean Peace.

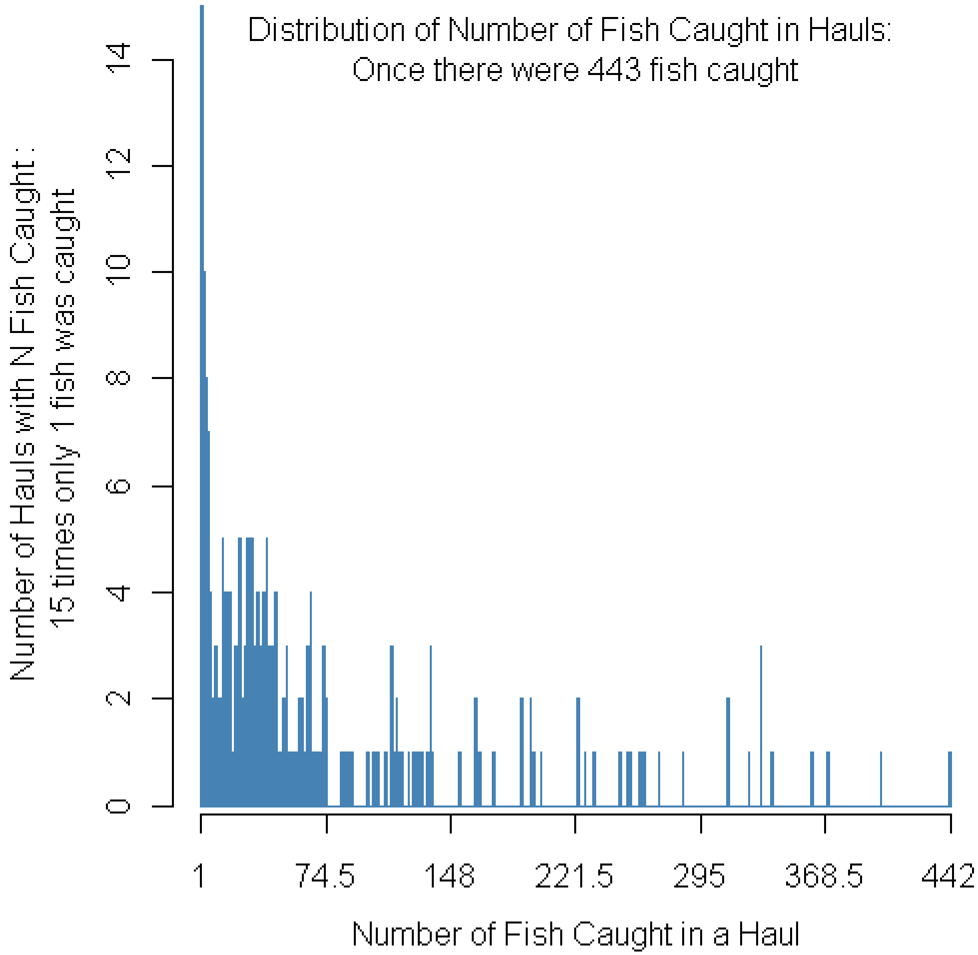
Count by Viability Class and by Vessel:

Viability	Cape Horn	Constellation	Ocean Peace
Excellent	3742	2045	486
Poor	2975	3178	823
Dead	2584	836	314



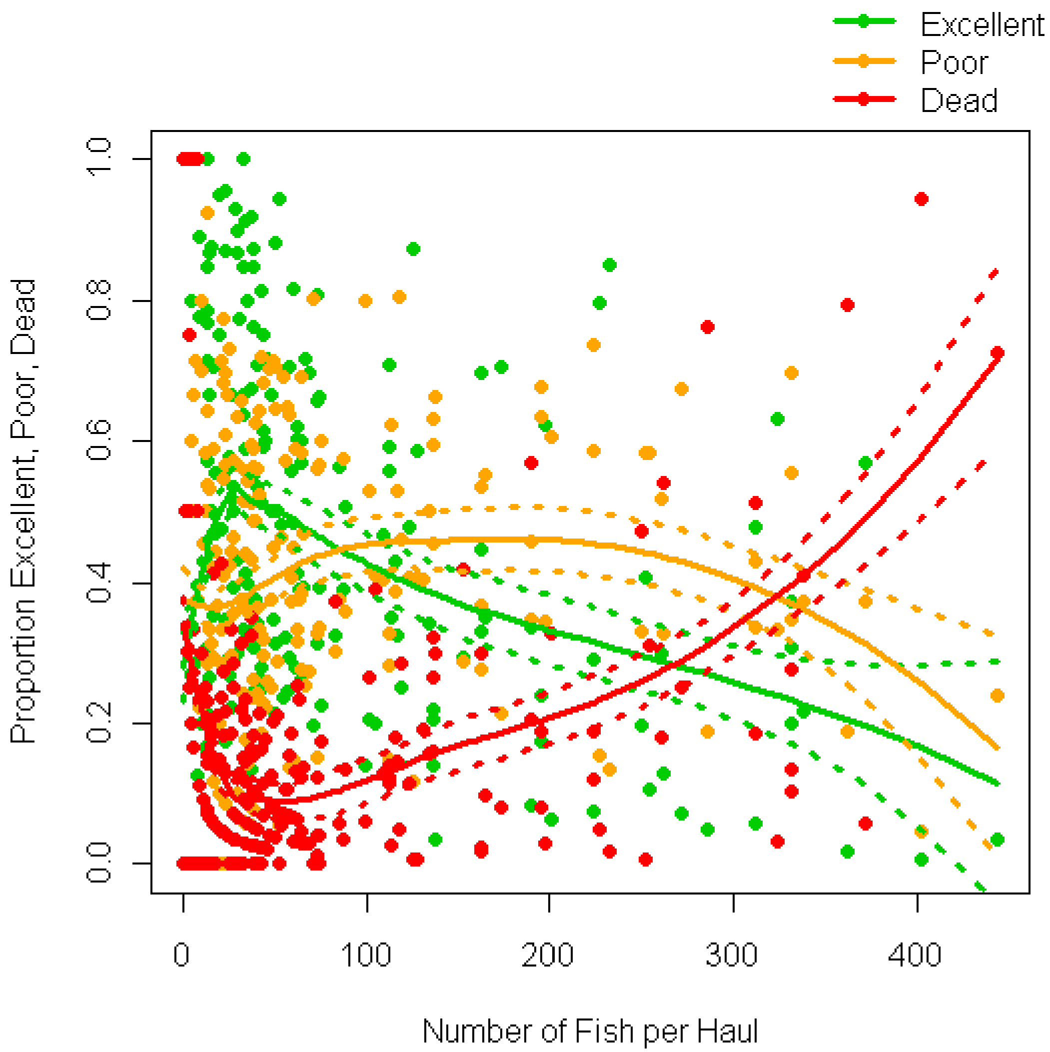
Median Lengths (cm) by Ship and by Viability Class

	Excellent	Poor	Dead
Cape Horn	68	61.0	55
Constellation	67	62.5	62
Ocean Peace	**71**	**71.0**	**66**

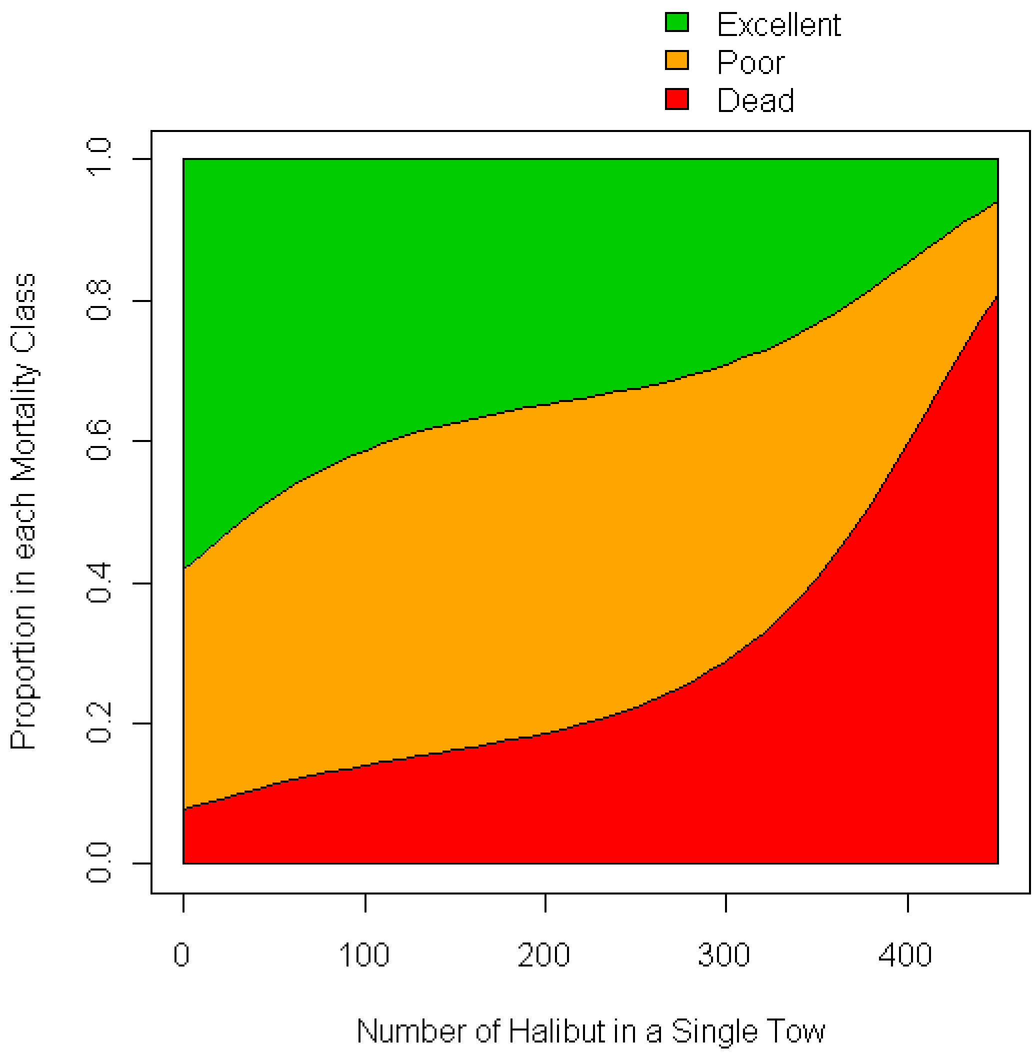


77% of hauls had 75 fish or less.

	number	count	cumul.sum	prop.sum
1	(0,25]	94	94	0.37
2	(25,50]	65	159	0.63
3	**(50,75]**	**34**	**193**	**0.77**
4	(75,100]	5	198	0.79
5	(100,125]	12	210	0.83
6	(125,150]	8	218	0.87
7	(150,175]	6	224	0.89
8	(175,200]	5	229	0.91
9	(200,225]	3	232	0.92
10	(225,250]	3	235	0.93
11	(250,275]	5	240	0.95
12	(275,300]	1	241	0.96
13	(300,325]	3	244	0.97
14	(325,350]	4	248	0.98
15	(350,375]	2	250	0.99
16	(375,400]	0	250	0.99
17	(400,425]	1	251	1
18	(425,450]	1	252	1



Local Polynomial Regression Fit (Loess):
A quick-and-dirty localised fitting procedure which shows the more halibut in the haul, the higher the proportion with viability rating "**Dead**", and the less with rating "**Excellent**".



Multinomial Logit Model using spline-smoothed regression coefficients: Modeled result is the same as previous page: The more halibut in the haul, the higher the proportion with viability rating "**Dead**", and the less with rating "**Excellent**".

Notes on Methods :

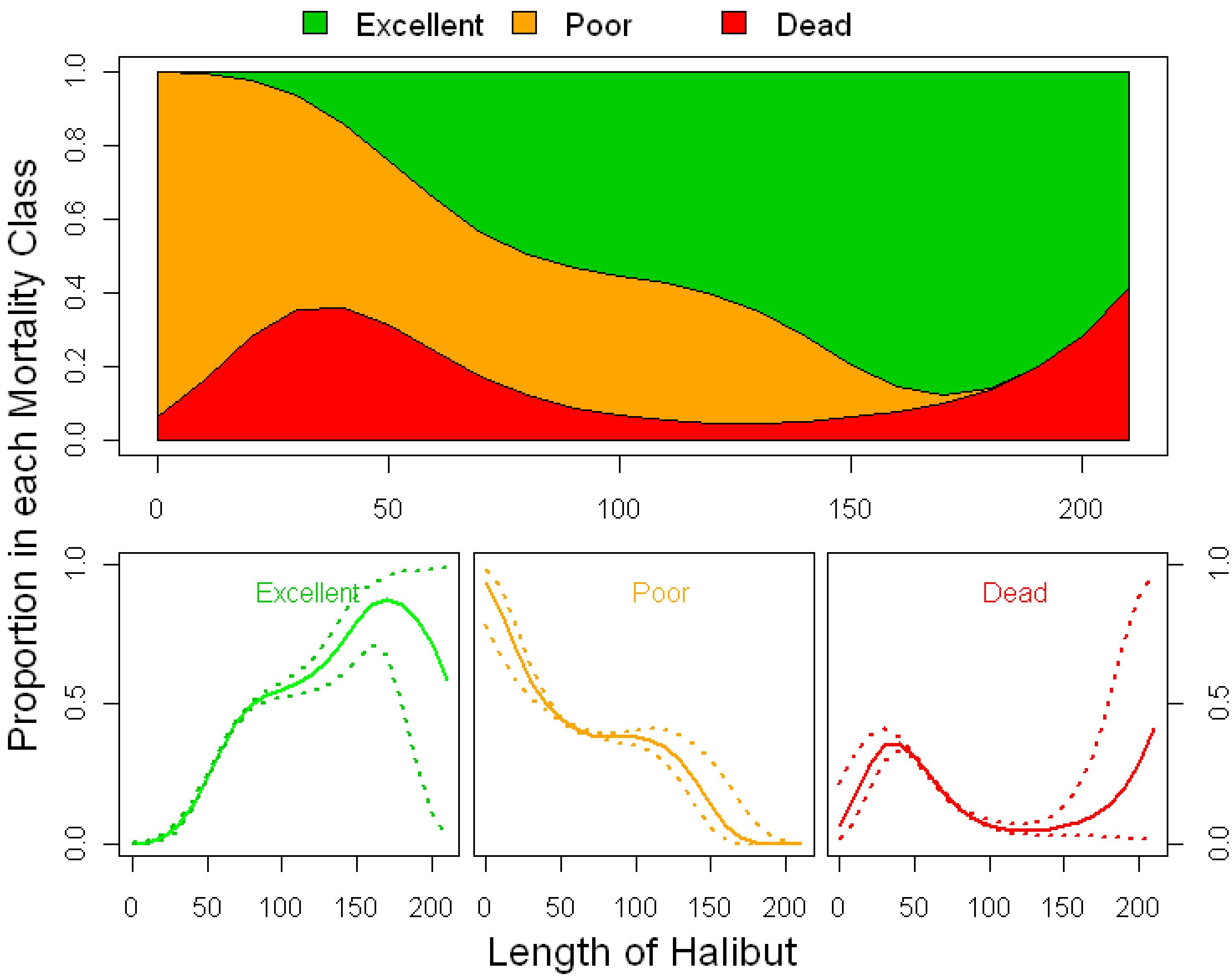
I did not include the tows that were not processed on deck immediately. There were 5 tows that were not included because of this, three that were already excluded from the Excel Deck_Hbt worksheets, and 2 additional ones that I selected out (Constellation Haul 71, Ocean Peace Haul 33).

I analysed the halibut mortality class data as multinomial logit models, which are regression models that generalize the more familiar logistic regression by allowing more than two discrete outcomes (for us this allows for outcomes “Excellent”,”Poor”,”Dead”). This modeling approach is appropriate as it uses the logit transform to transform probabilities, such that the sum of the probabilities of the three mortality classes sums to 1, the confidence intervals are restrained between 0 and 1, and their variances follow a known functional form.

I wanted to allow the fitted regressions to be more flexible than assuming a linear relationship between the independent and dependent variables. I therefore used a regression spline (with 3 degrees of freedom) to model the relationships on the following graphs. This makes it impossible to interpret the coefficients directly, but shows well the relationships between the variables. This helps me think about how to structure the Power Analysis simulation, and I have provided simple interpretations of results are beside the figures in textboxes.

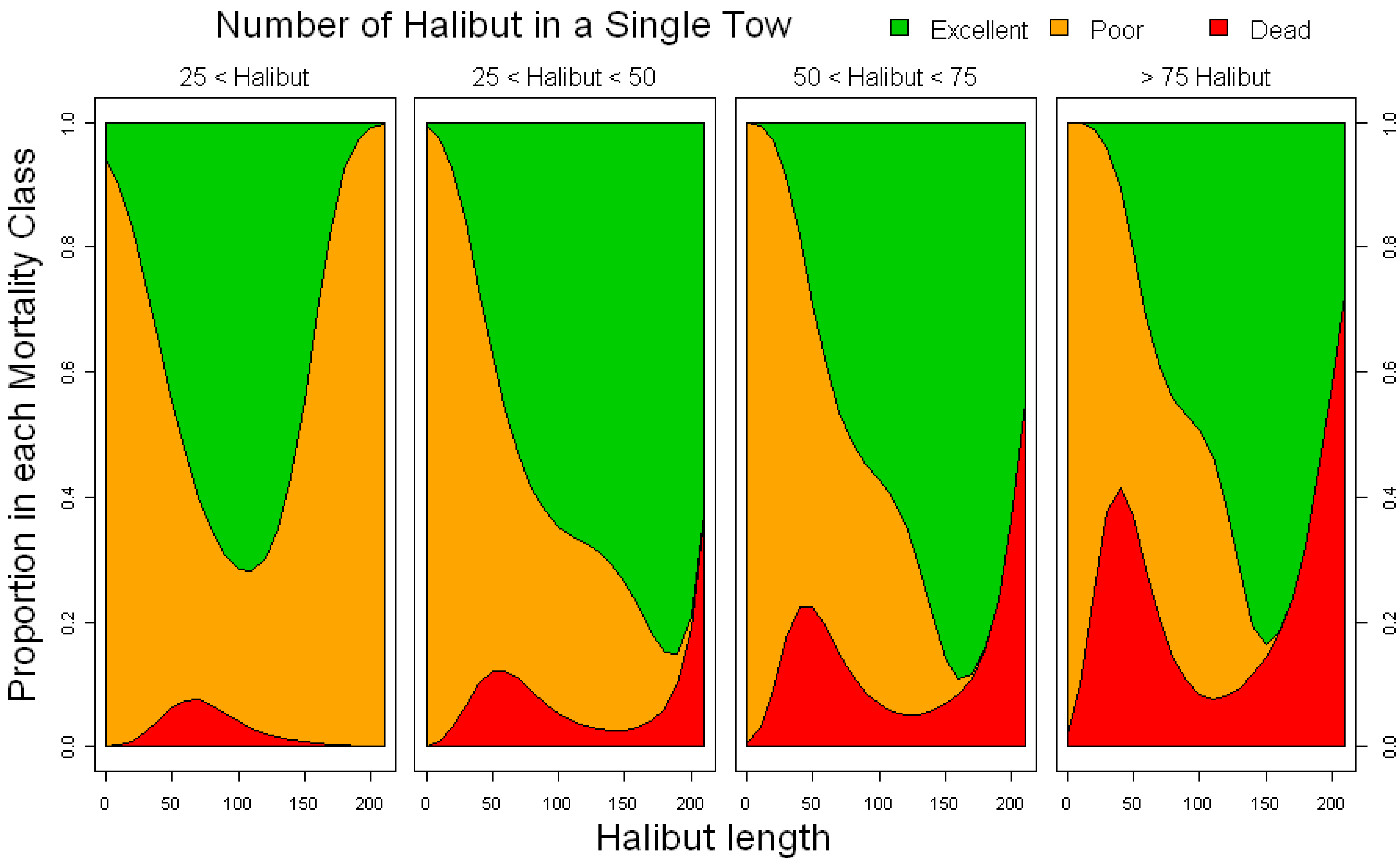
With respect to the power analysis, I am currently thinking there are 2 levels to this problem:

Level 1:
The number of halibut caught in each tow is important in resulting viability of halibut in the tow. So we need to make sure that we have enough tows sampled to capture this variability. As we discussed, this would be achieved through a simple randomized sampling design.
Level 2:
The subsample within a tow is to characterize the probability of the mortality classifications within a certain level of precision. For this we can use the multinomial distribution for the 3 mortality classes : Dead, Poor, Excellent. As we discussed, for this part of the sampling protocol, I think we will want to use a systematic sampling approach, because it will not be known how many halibut are in the net until the contents are processed. Therefore it makes sense to take every one, then every second one, etc. through a simulation, and then i can just quantify the loss of precision by lowering the sampling intensity by one each time. This limits our theoretical ability to get an estimate of error (technically, the sample has to be random to permit estimating errors), but we'll get the empirical estimate of the sampling error through the simulation. I think that will still be good as long as the conditions seen in this years data, repeat themselves next year.

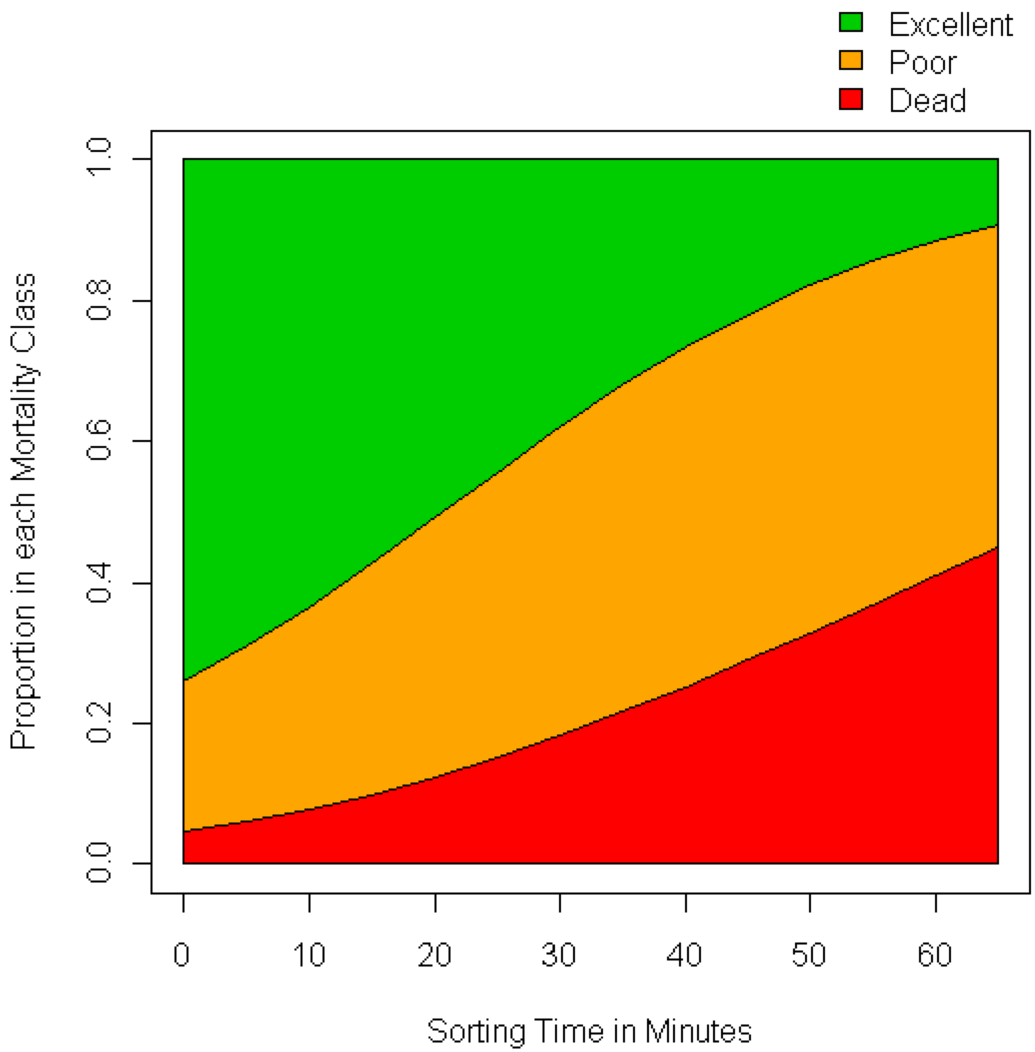


Multinomial Logit Model using spline-smoothed regression coefficients: Modeled result shows the longer the halibut, the higher the probability of having viability rating "**Excellent**", and the less with rating "**Dead**". Large confidence intervals at large halibut sizes, make it unreliable to interpret.

The lower 3 panels show the confidence intervals around the probabilities. Note that the top panel is a cumulative probability plot, whereas these show the probability for each category separately.



Multinomial Logit Model using spline-smoothed regression coefficients: Result shows the greater the number of halibut in the tow, the higher the probability of having viability rating "**Dead**" (the more red there is on the plot). Plot also shows the previous result of higher proportion of "**Excellent**" ratings with larger halibut.



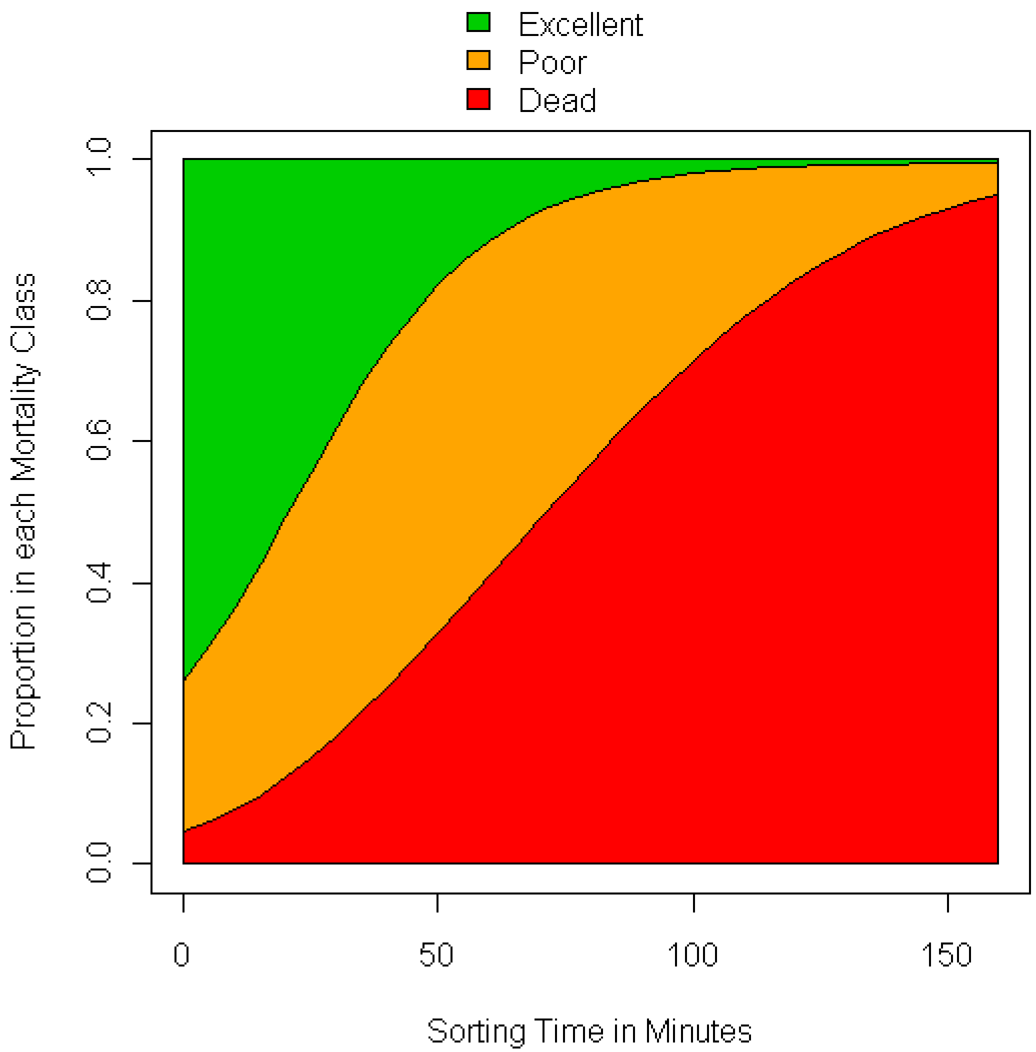
Multinomial Logit Model using spline-smoothed regression coefficients: Modeled result shows the longer the sorting time, the higher the probability of having viability rating "**Poor**" or "**Dead**", and the less with rating "**Excellent**".

SORTING TIME (this page) AND NUMBER OF HALIBUT (pages 5,6) CAUGHT IS SIGNIFICANTLY CORRELATED, and thus are describing the similar phenomenon – if you process quickly, halibut have a better chance of being "Excellent".

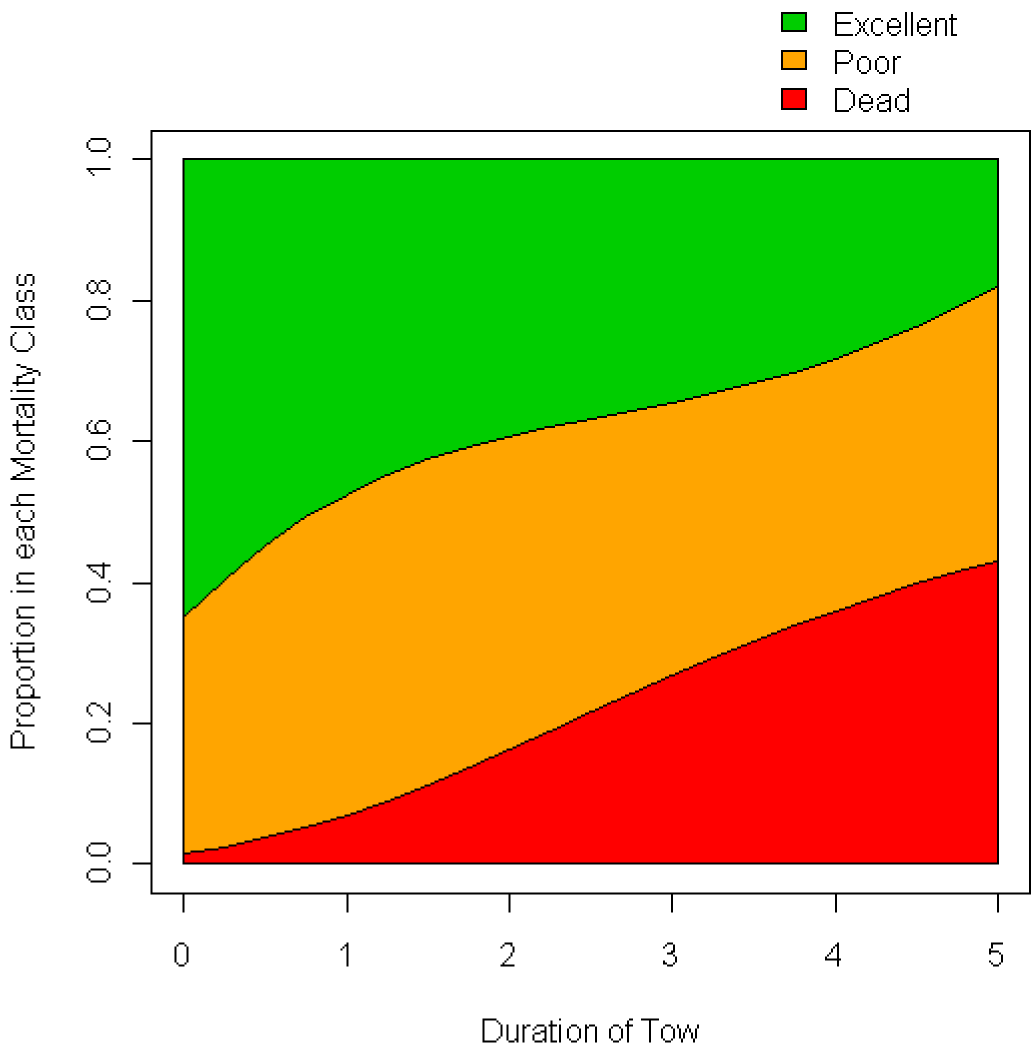
Pearson's product-moment correlation
cor
0.5619777
t = 10.6994,
df = 248,
p-value < 2.2e-16

95 percent confidence interval:
0.4707314 0.6413294
sample estimates:

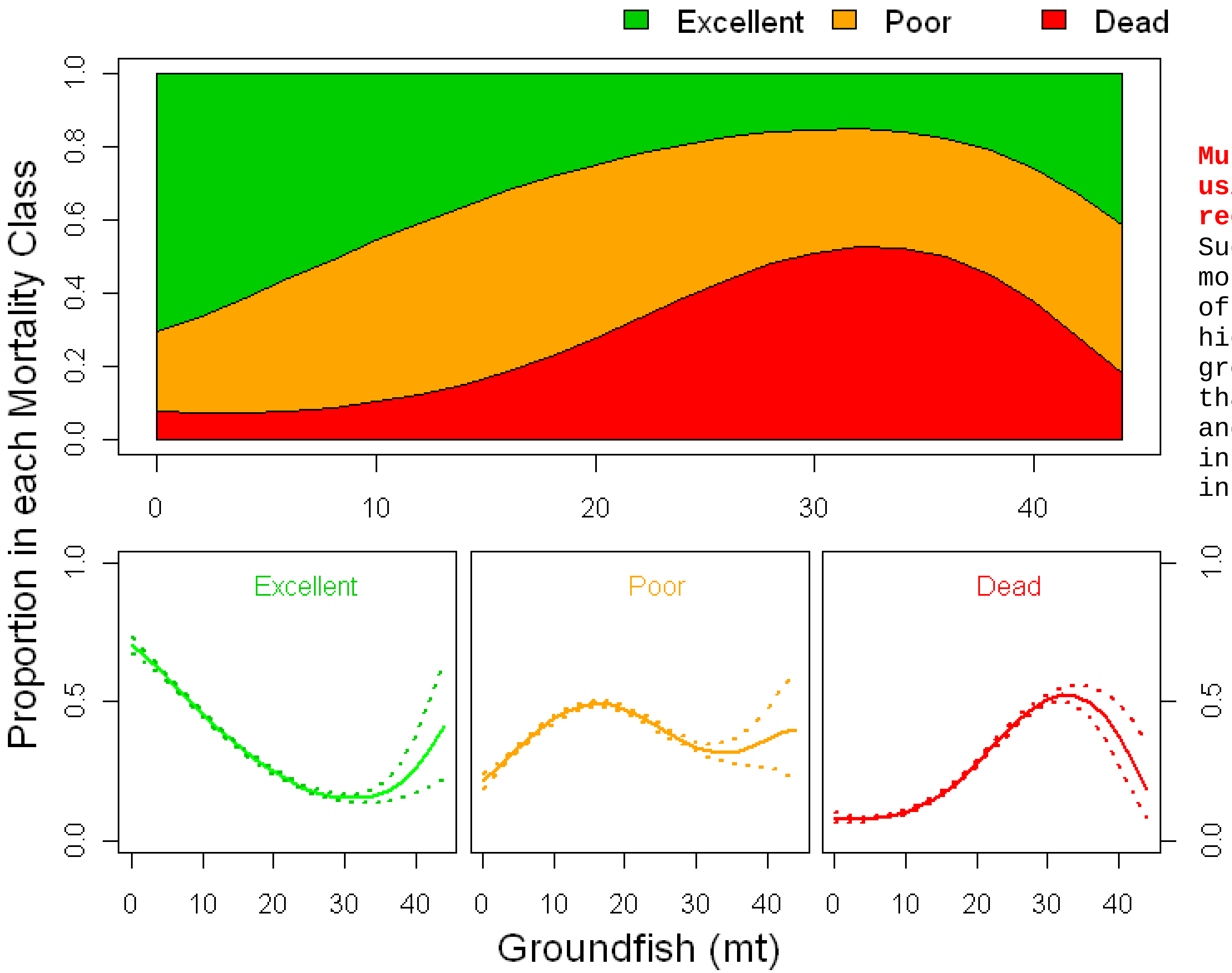
(cor=0.5275942, p < 2.2e-16 if I don't include the 157 minute sorting time)



Same as previous plot,
this one just includes the
outlier of 157 minutes of
sorting time. (All sorting
times except 1 took 65
minutes or less)



Multinomial Logit Model using spline-smoothed regression coefficients: Modeled result shows the longer the duration of the tow, the higher the probability of having viability rating “**Poor**” or “**Dead**”, and the less with rating “**Excellent**”.



Multinomial Logit Model using spline-smoothed regression coefficients: Suggests an increase in mortality up to a plateau of 35 mt. Lots of error at high biomass of groundfish, so not sure that the region between 35 and 40mt can be interpreted as a decline in "**Dead**" frequencies. .

Methods for My Investigations into Predictive Error and Bias.

I ran two different power analyses, which were organized around what we talked about – I wanted to highlight how you might have sampled the halibut caught last year differently. The two figures on the following pages, show what the tradeoffs are between the 2 different approaches to minimizing effort.

The first power analysis (and the left hand panel of both plots) looks at the error and bias i.e. if you sampled every single tow, but sampled the halibut at a **systematic** and predetermined frequency. **The second power analysis (and the right hand panel of both plots)** looks at the error and bias if you sampled every single halibut, but **randomly** sampled a subset of the tows.

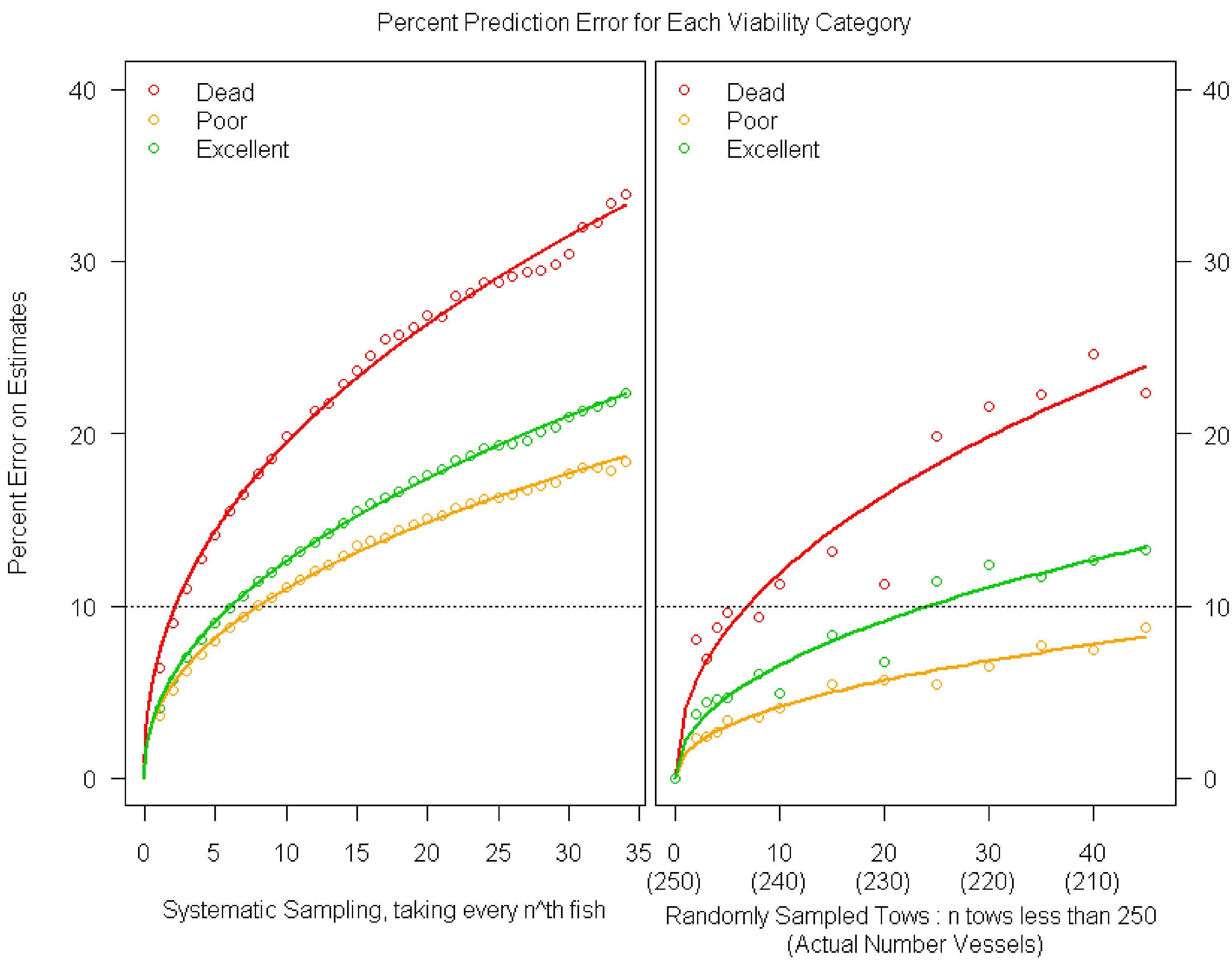
Percent error on estimates (page 15,16) is defined here as :
the width of the subsample's 95% confidence interval/prediction probabilities from the full data set. In the first power analysis the modeled confidence interval was used, in the second incident a randomization routine was used, and the 95% confidence intervals were derived by taking the 2.5th, and 97.5th ordered predictions. The interpretation of both methods to obtain estimates of the percent error are the same. This interpretation is that if we took 100 samples from the same distribution as ours, 95 of those predictions would fall within this limit. The denominator is to give it a relative error scale with respect to the "true" (full sample) prediction probabilities.

All panels show the 10% error or precision (page 15) and bias (page 16) cutoffs as mentioned in one of our first discussions. These 10% cutoff lines show where the relative error/bias is either > or < 10% of the "true" prediction probability.

Prediction Bias (page 17) is defined as the difference between the subsampled estimate of proportion, and the "true" (full sample) prediction probabilities. Again, bias was scaled to a relative measure by selecting the denominator to be the prediction probabilities from the full data set. This was not rerun as the bias would automatically increase if we took the first halibut rather than systematically sampled ones as the desired benefit of decreasing processing time is to keep more halibut "**excellent**".

A quick note on the "true" precisions against which bias is measured is that it is assumed to be "correct". This means then that the sampling protocol in place last year would have given a bias-free estimate of the proportions in each Viability Category. By the preliminary analyses (pages 8-13), and by the figure on page 16, we know that bigger hauls have higher mortality rates, so there are underlying problems with estimating overall halibut Viability without considering the effect of haul size on these overall estimates of viability.

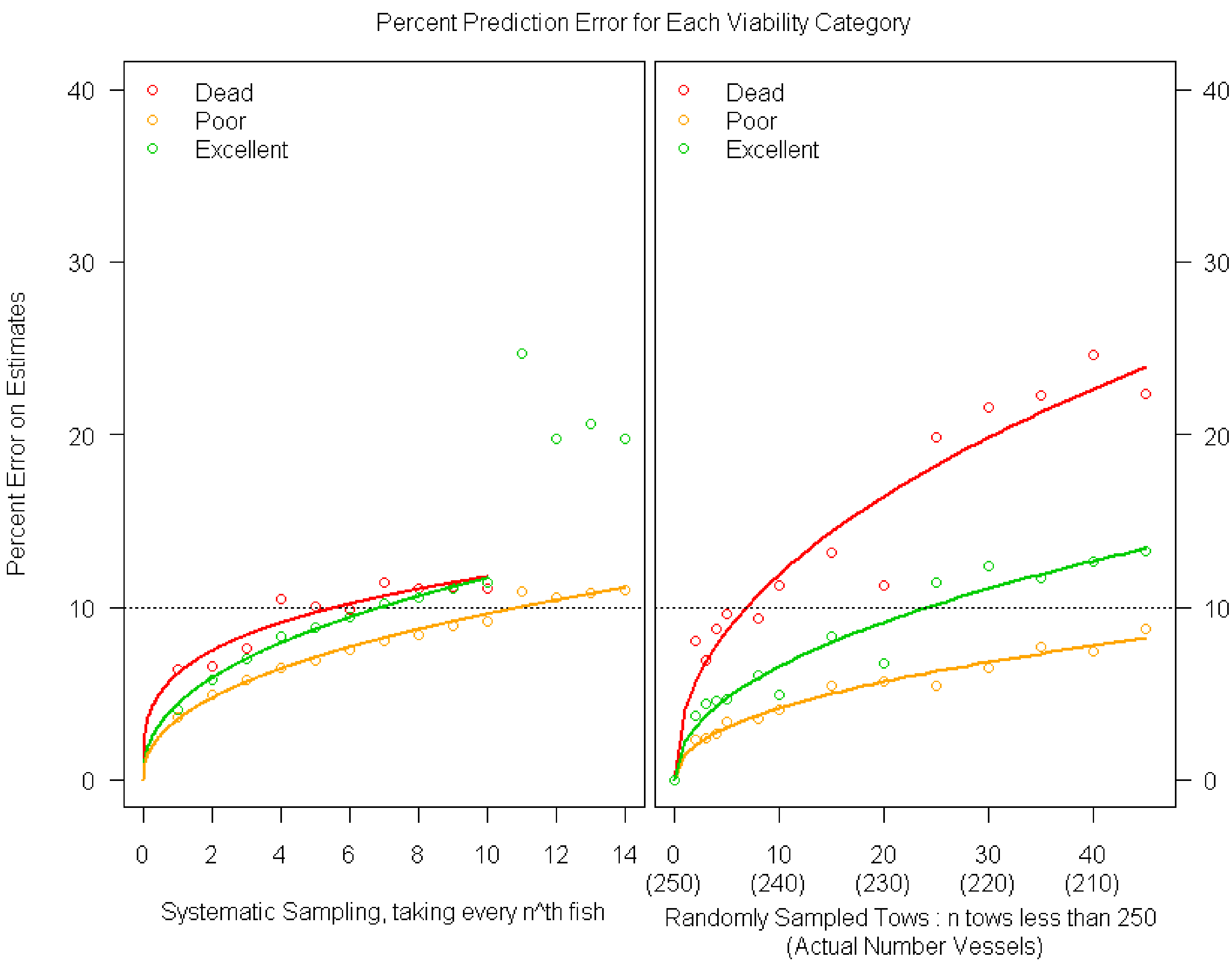
I have provided simple interpretations of results beside the figures on the next 2 pages.



Prediction Errors

To be within 10% error rate of systematically subsetting within a haul (left panel), but sampling all hauls, you can drop the frequency to every 2nd halibut. If the benchmark halibut Viability category was "Excellent", you could safely subsample every 6th halibut.

In the random sampling protocol (right panel), you need to sample all except 7 hauls to be within the 10% error rate of the most error prone Viability category ("Dead"). If you were happy to be within 10% error for a benchmark Viability of "Excellent", you could not sample on 20 of the tows.

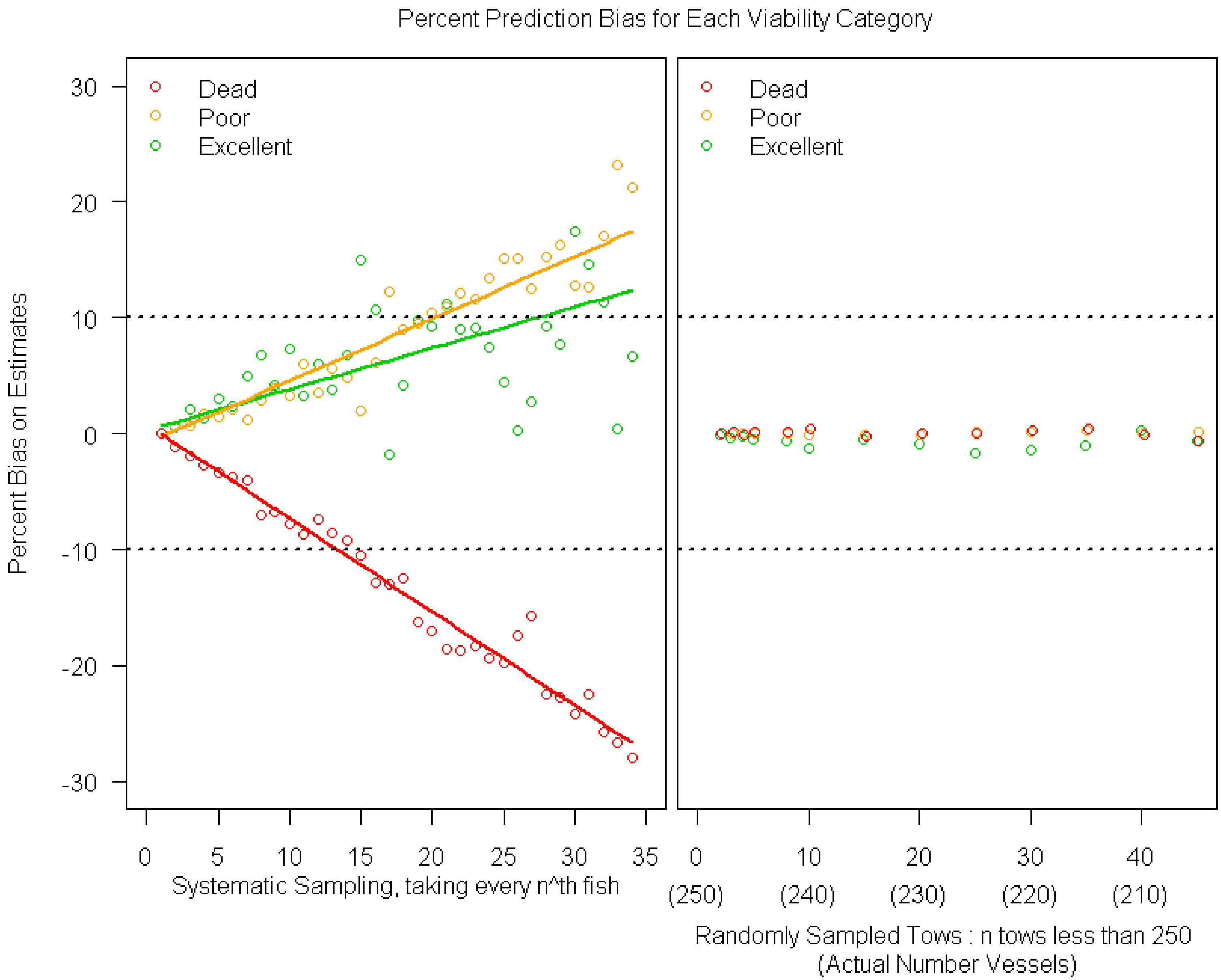


Redoing Power Analysis to Evaluate the Prediction Errors

Redoing the selection of halibut from all hauls, but selected the number of fish as before using the systematic sampling protocol, but took the first fish's viability score, rather than the one associated with the n^{th} halibut. This stabilized the error associated with Viability Category (compare left panels of this page with previous page (pg 15)).

To be within 10% error, you can drop the frequency to every 5^{th} halibut. If you drop below every 10^{th} halibut, the error rate jumps to untolerable levels (see green dots at n>10 for "Excellent", dots are off the upper scale for Category "Dead").

The random sampling protocol (right panel), is the same as previous page, except I reran the simulation.



Subsamping Bias

Systematic Sampling (left panel) has considerable bias associated with it, Random Sampling (right panel) does not. The reason for this is that as you take less and less fish, you are mostly taking only 1 halibut (the first halibut) per tow.

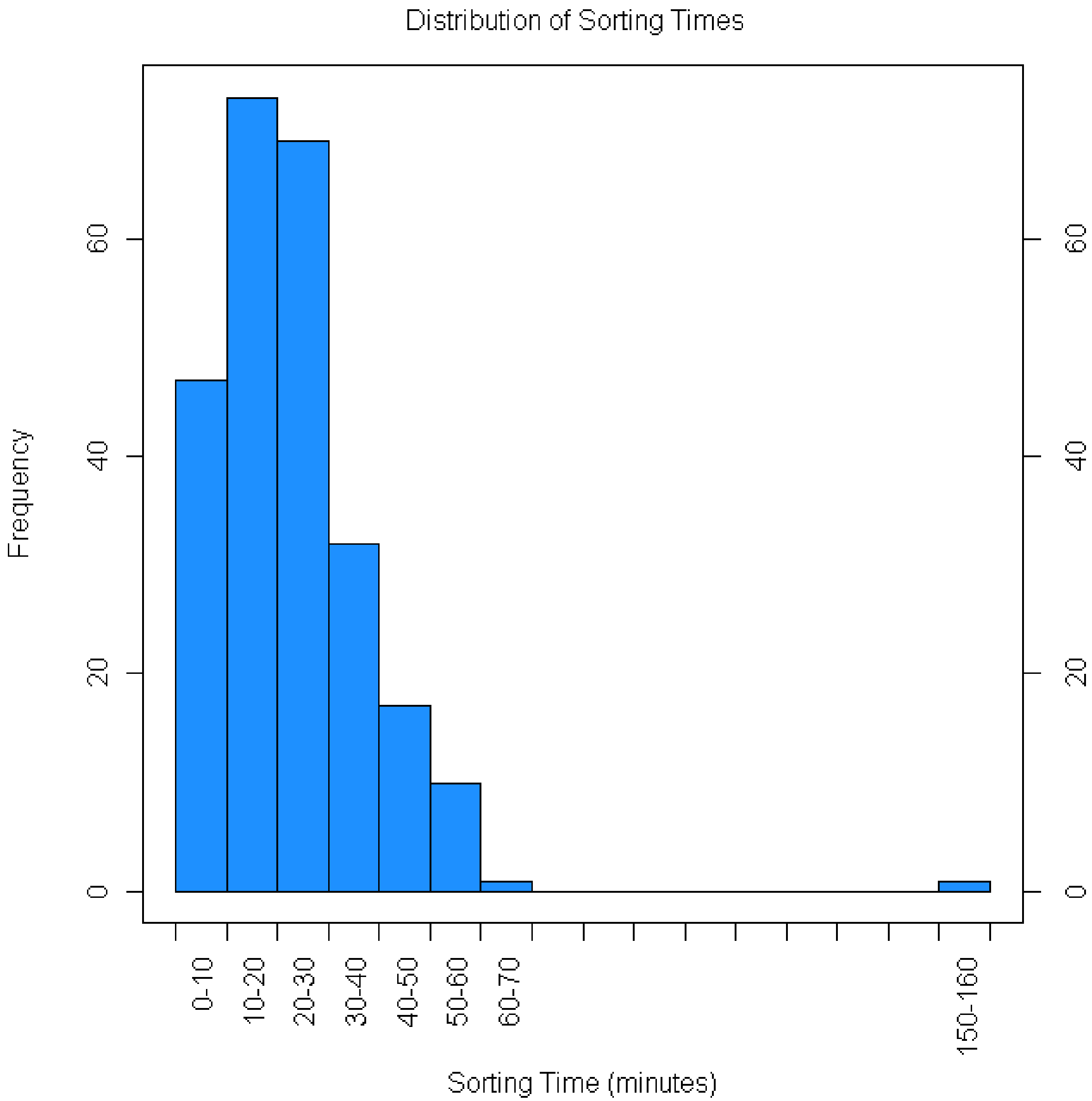
e.g. see page 4 graph

Number halibut Per Haul	Number Vessels
1	15
2	10
3	8
4	7
5	4

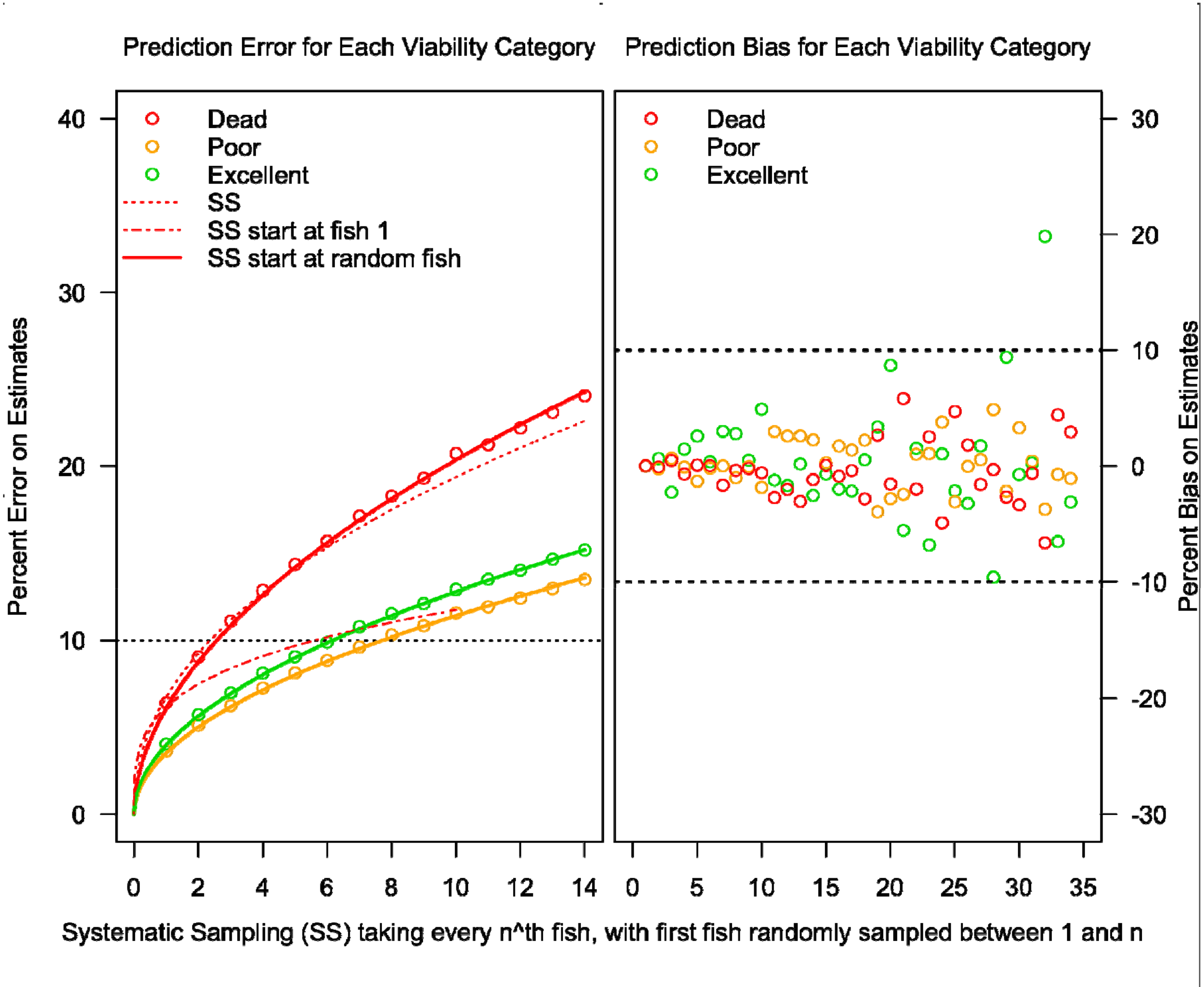
Therefore by the time the systematic sampling protocol gets to every $n=5^{th}$ halibut, there are 39/250 hauls that are only selecting the first halibut. (By 13 halibut, 62 tows are only picking the first halibut)

To keep prediction bias < 10%, you must sample at least every 13^{th}.

Below is a figure, and table that show the Number (Count) of Tows that were sorted in each of 10 minute increments, e.g. there were 47 tows processed in 10 minutes or less. (Each bar in the histogram is a row in the table.)

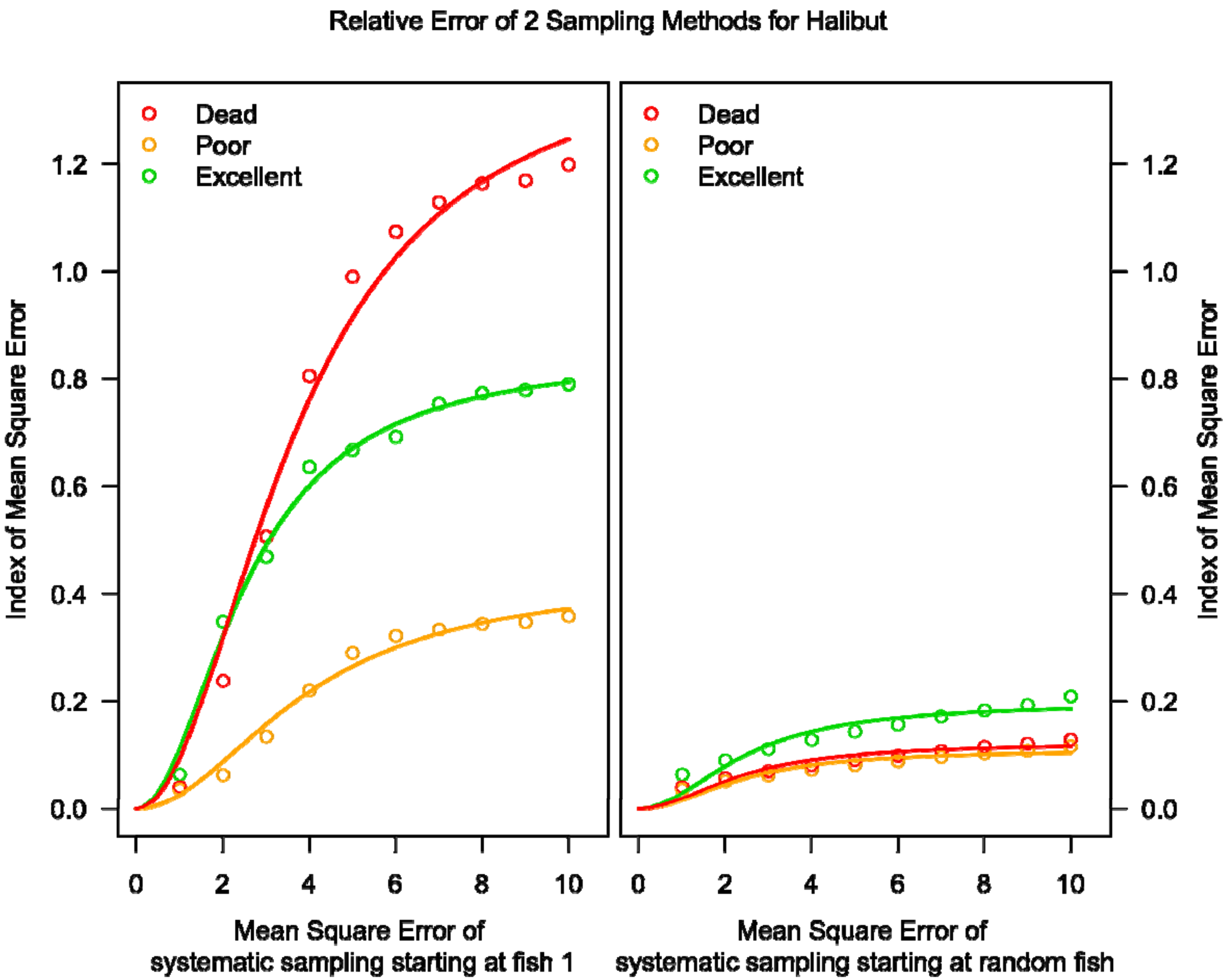



```
> haul.time
   Sorting.Time.Window Count.of.Tows
1               (0,10]            47
2              (10,20]            73
3              (20,30]            69
4              (30,40]            32
5              (40,50]            17
6              (50,60]            10
7              (60,70]             1
8              (70,80]             0
9              (80,90]             0
10            (90,100]             0
11           (100,110]             0
12           (110,120]             0
13           (120,130]             0
14           (130,140]             0
15           (140,150]             0
16           (150,160]             1
```



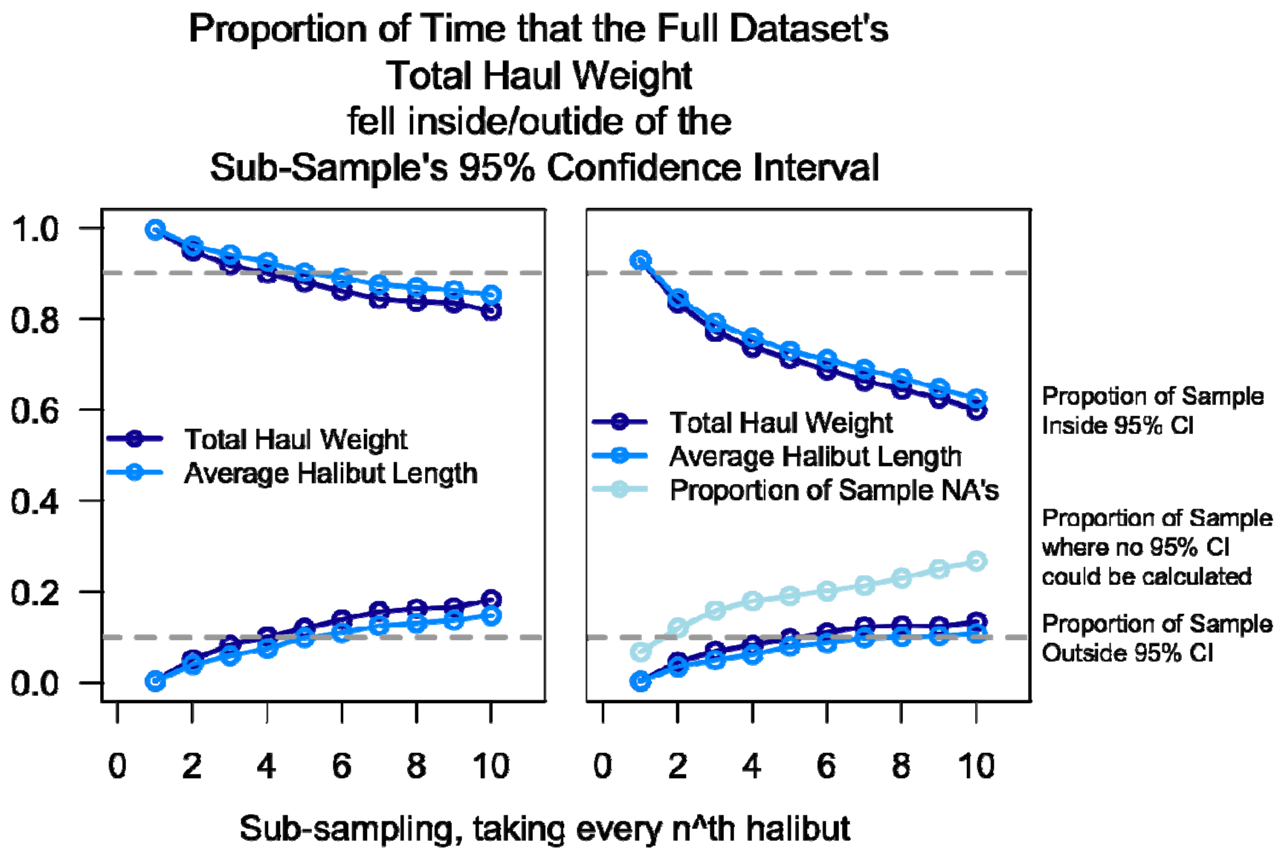
The left panel shows the percent error in the prediction, the right panel shows percent bias. I have overlaid in the left panel the error associated with the worst category ("Dead") for the two methods already evaluated. This percentage of Ray's method is similar in magnitude to the SS method (left panel, page 16), and higher than the error associated with SS starting with the first fish (left panel, page 17).

This modified design suffers from loss of sample size, similar to the loss in the SS method. The gain in this method is seen in the right panel where there is no systematic pattern to the bias, besides a moderate increase with a decrease in sampling intensity.



I used an index of Mean Square Error (MSE) to compare between 2 of the sampling methods for halibut. MSE is usually the variance + bias^2 of the estimator. I used this formula but used the percent prediction error (left panels, pg 16, 19), and percent prediction bias (left panel, page 16; right panel, pg 19), to give a relative measure of MSE for these 2 methods. This figure suggests that the gain in precision using the SS start at fish 1, is swamped by the magnitude of the bias associated with always selecting the first fish in the series.

It would seem that the systematically sampling that starts with a random fish, has lower overall error.



The left and right panels in the figure above show almost the same thing, the difference is in the denominator used to calculate the proportion Inside and Outside of the 95% CI. On the left, I exclude the NA's from the denominator, on the right, I took the total number of hauls (252) as the denominator, and includes as a significant the counts of NA's in which no estimate of variance was possible (and therefore no CI's either). 10% error is shown as the dashed lines at 0.1, and 0.9 on both graphs.

Of those samples that we can calculate a CI for, it is possible to sample every 4th fish and get no more than 10% of hauls misspecifying the total haul weight (See next page for exact results). Length of halibut has one less source of error associated with the sampling, and every 5th fish will give equivalent confidence.

Brief Methods: I calculated the mean, standard error and confidence intervals for the estimated "total haul weight" of halibut for each of the 252 hauls. This was done as discussed by calculating the mean halibut weight, and then multiplying by the number of halibut in the haul. I set up the simulation to count the number of times the total haul weight of the full dataset fell within the 95% confidence interval of mean haul weight of the subsampled-at-every-nth fish haul sample. This was redone 100 times for each of the 1 through 10 subsampling intensities to ensure the results we obtained were representative of the expected values for these quantities.

```
> temp[,c(1:3)]
```

	Tot.Wt.Out	Tot.Wt.In	Tot.Wt.NA
1	1.00	234.00	17.00
2	11.51	210.15	30.34
3	17.59	194.45	39.96
4	20.85	185.83	45.32
5	24.45	179.48	48.07
6	27.94	173.12	50.94
7	31.06	167.17	53.77
8	31.59	162.45	57.96
9	31.30	157.77	62.93
10	33.76	150.97	67.27

The same protocol was followed for the "average halibut length" analysis.

```
> temp[,c(4:6)]
```

	Leng.Out	Leng.In	Leng.NA
1	1.00	234.00	17.00
2	8.83	212.83	30.34
3	12.65	199.39	39.96
4	15.62	191.06	45.32
5	20.16	183.77	48.07
6	22.11	178.95	50.94
7	24.86	173.37	53.77
8	25.46	168.58	57.96
9	25.98	163.09	62.93
10	27.33	157.40	67.27

For a vertical slice through 6 on the x-axis of left panel of figure on page 21:

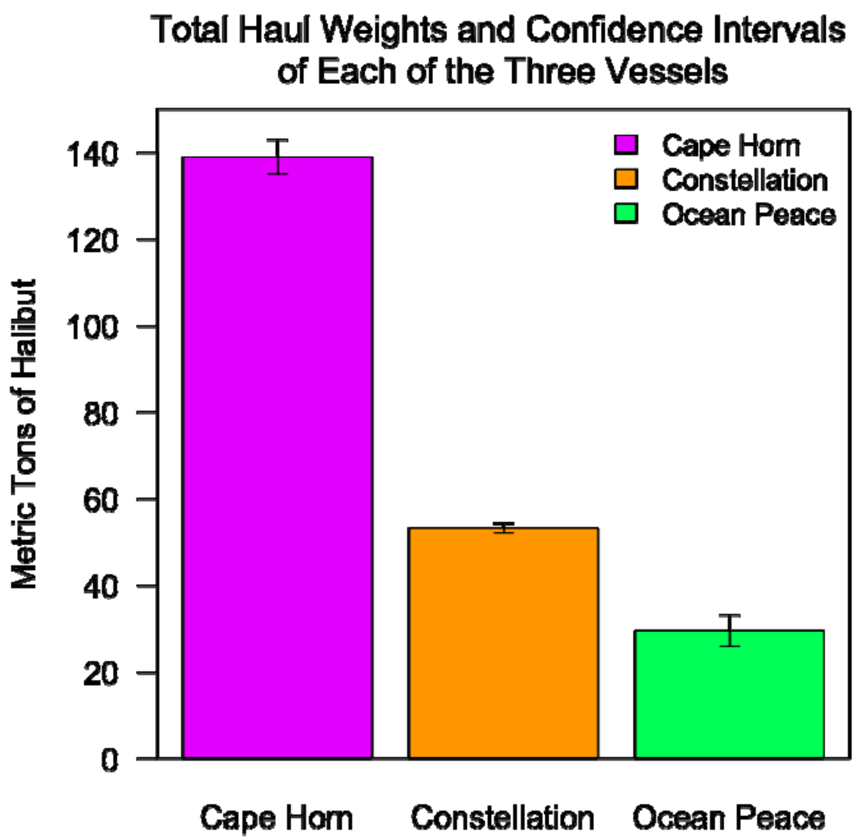
20.85/206.68 = 10.0% ; 20.85/252 = 8.3%

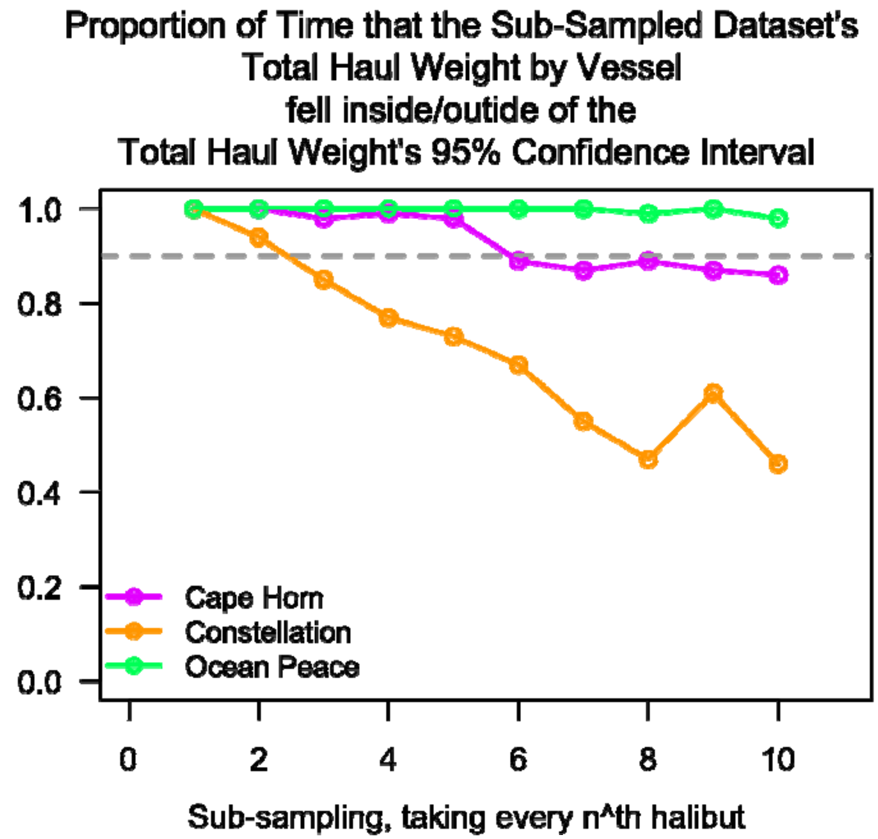
185.83/206.68 = 90.0% ; 185.83/252 = 73.7%

45.32/252 = 18.0%

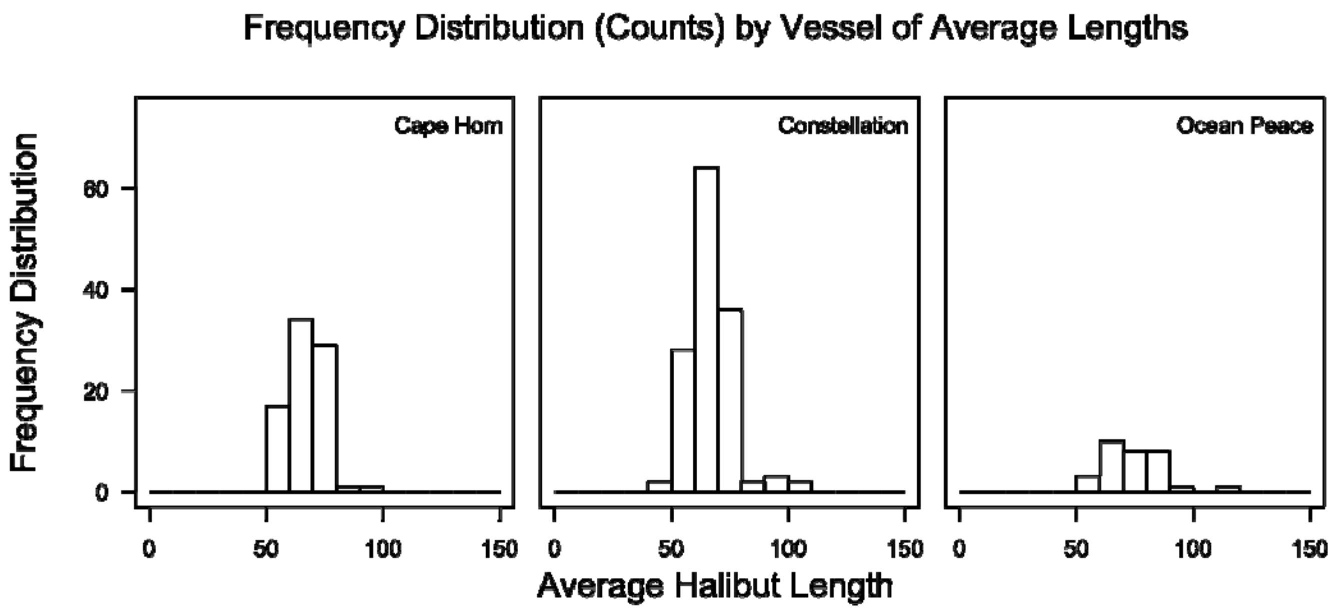
If we were to subsample every **4**th halibut, only 10% of all valid trials, would not include the mean of the full dataset from which we've subsampled.

As we subsample and lower and lower frequencies, we get more samples from which no CI can be derived. By sampling every **6**th fish, we have over **20%** of hauls that have 0 or 1 fish length measured.

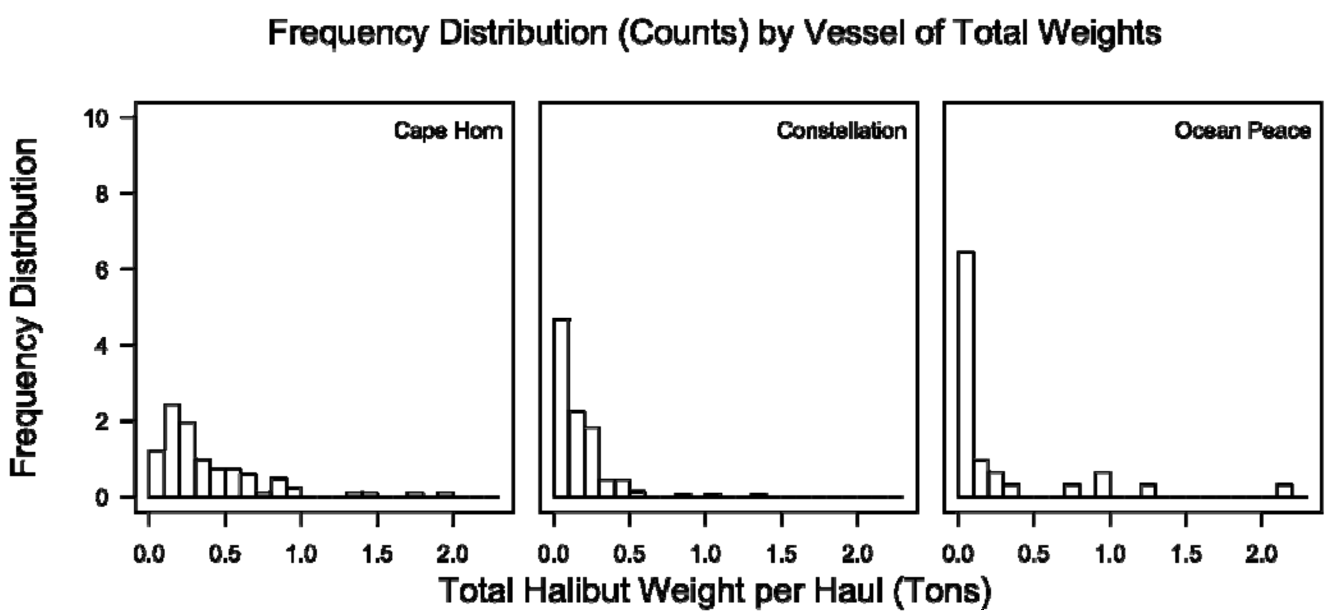




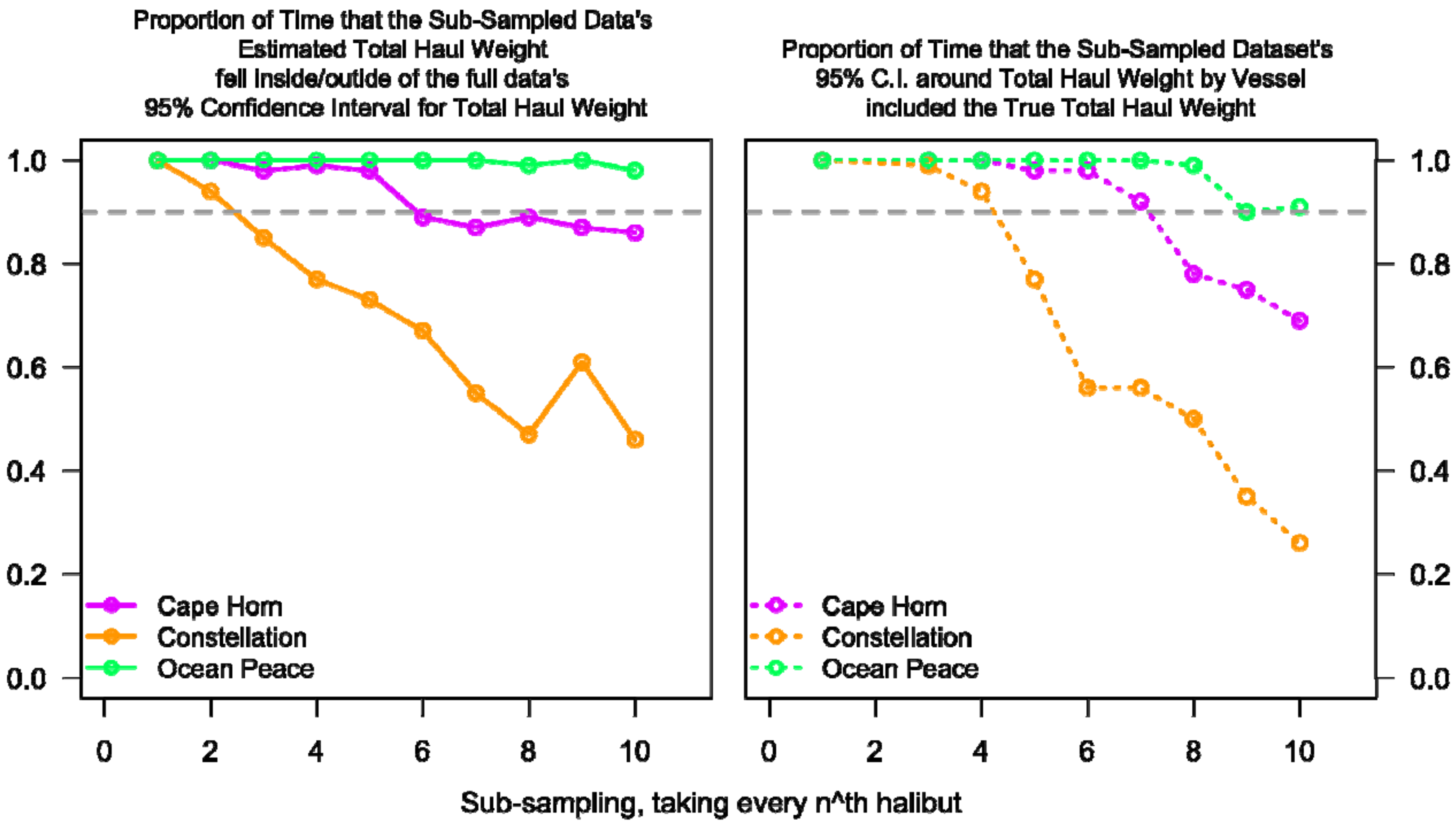
Brief Methods: To determine what the effect of subsampling the hauls would be on the accuracy of the estimate of total haul weight by vessel, I ran a simulation in which I counted the proportion of subsampled total haul size estimates, that were inside the confidence interval of the full dataset. The results are shown in the righthand figure above.



Frequency Distribution (Counts) by Vessel of Average Lengths
Cape Horn
Constellation
Ocean Peace
Frequency Distribution
0
20
40
60
0
50
100
150
Average Halibut Length



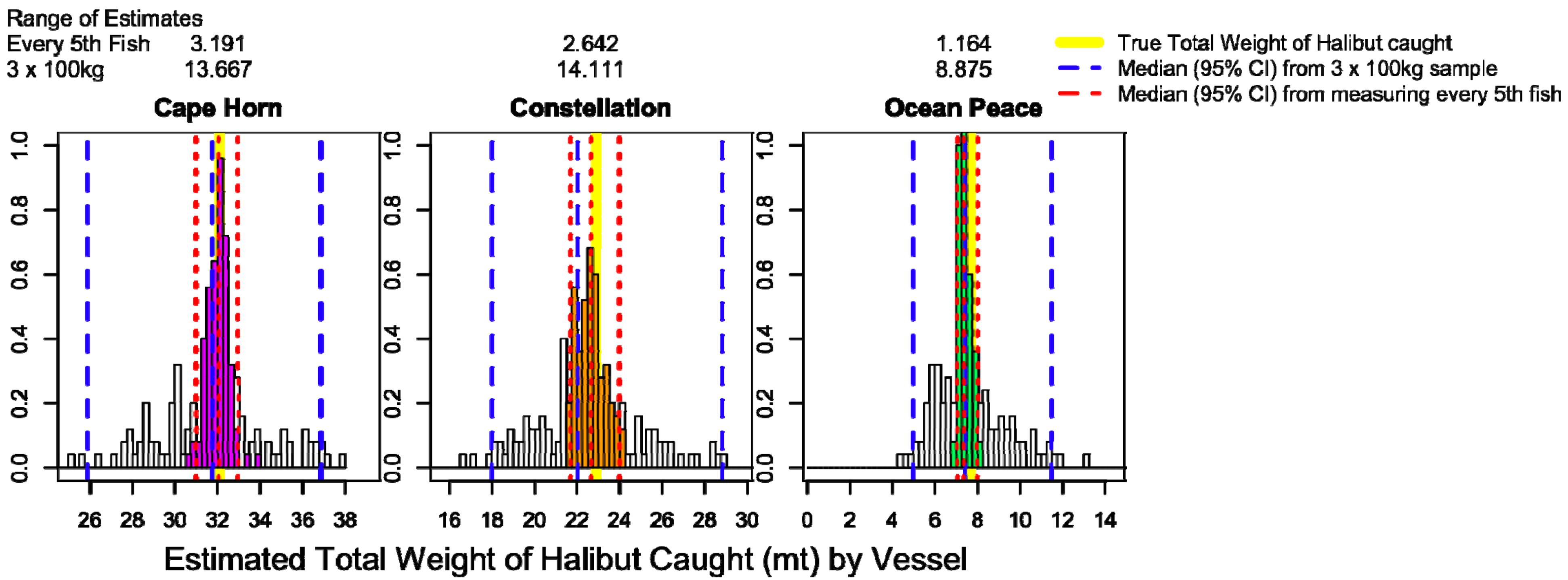
Frequency Distribution (Counts) by Vessel of Total Weights
Cape Horn
Constellation
Ocean Peace
Frequency Distribution
0
2
4
6
8
10
0.0
0.5
1.0
1.5
2.0
Total Halibut Weight per Haul (Tons)



Left Panel the same as Page 23 (="Plan A") where we looked at the proportion of time that the sub-sampled estimated total haul weight fell outside of the full data's 95% C.I. for total haul weight. If you sample every single halibut (i.e. all ~17000), you have a very good estimate of the total catch of halibut in the study for each vessel, so the confidence intervals will be small no matter what you do. If I look at the halibut that the Constellation caught -- the three biggest halibut of all were caught by this vessel, including the 2.08 metre (136kg) monster-halibut. Constellation had, by luck, high within-vessel variance (and low between vessel variance as we talked about before), and sub-sampling in this vessel gives higher uncertainty in estimating the total haul weight from the subsample, than for the other vessels. The Right Panel (="Plan B"), calculates 95% C.I. on the subsampled data, and shows the proportion of time that these intervals include the true total halibut catch weight by

vessel. Similar issues affect the uncertainly for Constellation, as were observed with previous method.
Another approach was to calculate the proportion of time that the "true" (full dataset's) haul weight fell within the sub-sample's confidence intervals. In other words, as we subsample every 2nd,3rd,4th,5th,... halibut, the variance (and CI's) on the total haul estimate will get wider and wider, but we hope will still include the "true" total haul weight. If it doesn't then the subsampling is not estimating total haul weight well. The difference in this approach from plan A is that plan A sets a CI on the entire dataset that are thin, and it's hard to hit that place on the dart board if you have high within-vessel variability. The latter approach calculates CI on subsampled data where these wider CI are moving around the dart board and if the sampling is good, including the bullseye ("truth").

This figure below compares the amount of uncertainty associated with subsampling to every 5^{th} fish, and the uncertainty of estimating total haul weight from this (green lines), compared to the more “usual” method of collecting three 100kg samples (white histogram, blue lines). Both method’s estimates of total haul weights appear to be unbiased (median’s more or less overlap the yellow “truth”), but we have a much more precise measure by taking every 5^{th} halibut than by the other method (green CI are much narrower than the blue ones, width of the range of estimates shown above each plot). Range of X axis represents the “truth” +/- 7mt, Y axis is between 0,1 for comparison.


Range of Estimates
Every 5th Fish 3.191 2.642 1.164
3 x 100kg 13.667 14.111 8.875
True Total Weight of Halibut caught
Median (95% CI) from 3 x 100kg sample
Median (95% CI) from measuring every 5th fish
Cape Horn
Constellation
Ocean Peace
0.0 0.2 0.4 0.6 0.8 1.0
26 28 30 32 34 36 38
16 18 20 22 24 26 28 30
0 2 4 6 8 10 12 14
Estimated Total Weight of Halibut Caught (mt) by Vessel

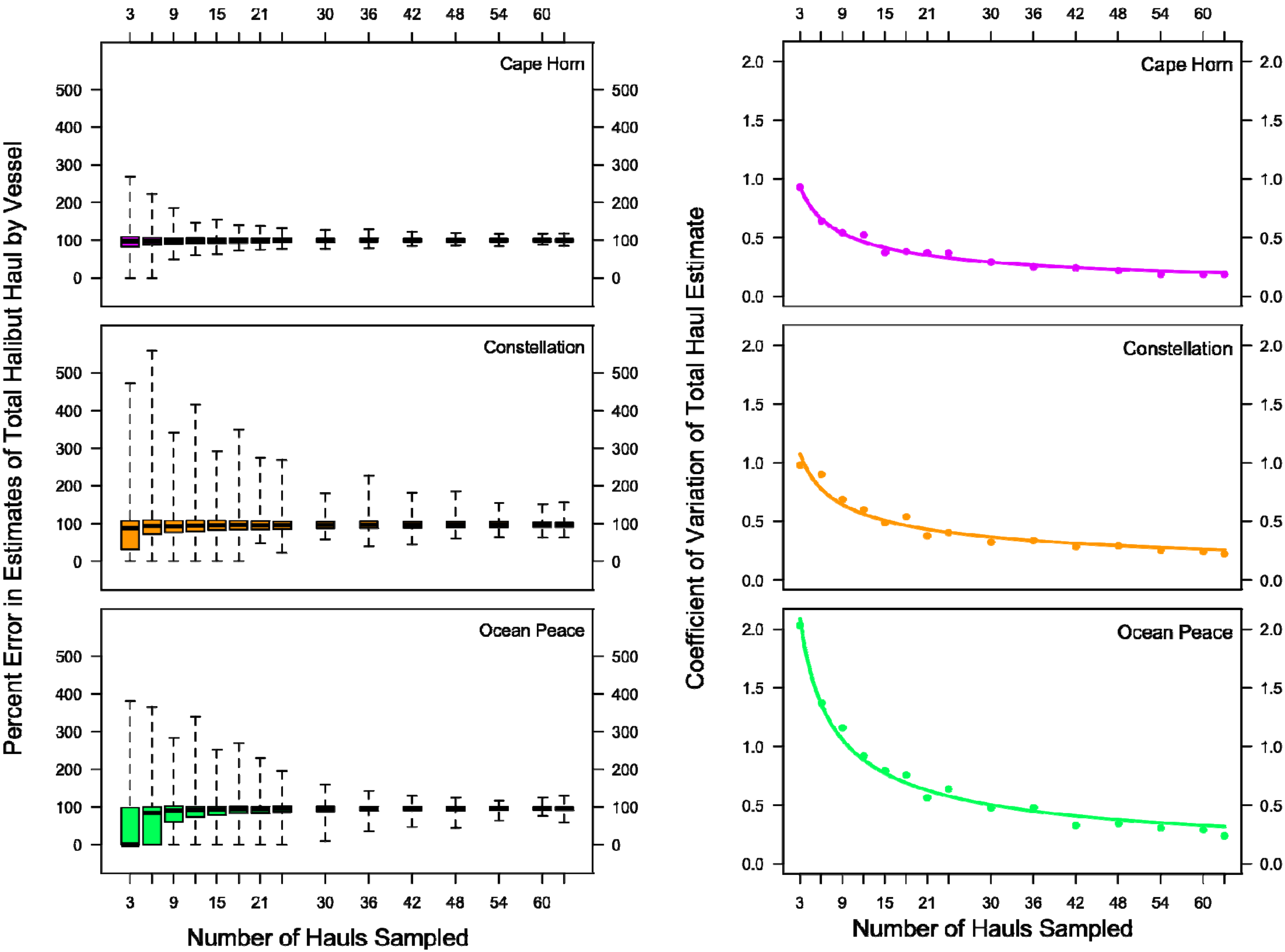
Empirical Confidence Intervals based on a Siimulation of Size of 100. For both methods I took the 2.5 and 97.5th limits of our 100 simulated estimates. This is the same as ordering the 100 estimates, and interpolating where the 2.5th and 97.5th value would lie.

[1] "Cape Horn Widths of C.I."
[1] "Every 5th Halibut Estimate"
1.962
[1] "3 x 100kg Estimate"
10.959
[1] "Constellation Widths of C.I."
[1] "Every 5th Halibut Estimate"
2.305
[1] "3 x 100kg Estimate"
10.841
[1] "Ocean Peace Widths of C.I."
[1] "Every 5th Halibut Estimate"
0.933
[1] "3 x 100kg Estimate"
6.493

The Next Page contains two plots of how the error decreases with the number of hauls. In this simulation, I randomly selected hauls by vessel, with the same number of hauls for each vessel. In other words, I started estimating total catch of halibut per haul with just 3 hauls – one for each vessel, then I increased to 6 hauls – 2 for each vessel, 9 hauls – 3 per vessel, etc. out to 1/3 of 250 hauls or 63 hauls – 21 per vessel; this is reflected in the X axis which goes up by 3's. (X axis = 3,6,9 means 1,2,3 hauls per vessel).

I repeated this 100 times, and plotted the boxplots of the relative errors by vessel (left plot). I also looked at how the coefficient of variation decreased with increased sample size (i.e. square root of the variance of the 100 estimates divided by the total haul size by vessel (or "Truth").

These two plots show that the variability starts to attenuate at +/- 30 hauls. The boxplot interpretation is the whiskers mark the range of estimates, the colored "box" (rectangles) mark where 75% of the estimates are, and the black line in the middle is the median estimate. So one important result seen in the left plot is that Ocean Peace underestimates amount of halibut catch per haul until at least 7 hauls from this vessel are sampled.


Cape Horn
Constellation
Ocean Peace
Percent Error in Estimates of Total Halibut Haul by Vessel
Coefficient of Variation of Total Haul Estimate
Number of Hauls Sampled
Number of Hauls Sampled
3 9 15 21 30 36 42 48 54 60
0 100 200 300 400 500
0.0 0.5 1.0 1.5 2.0

Overall Methods:

A simulation study was designed to assess the variability associated with the 2 different sub-sample based estimates of total weight of halibut caught. Each vessel was kept separate in the simulation, as there was significant between vessel variability both in the number of hauls, and the numbers of halibut in those hauls. The number of hauls, and the characteristics of those hauls (number and weights of halibut) were faithful to the original dataset; thus the random procedure was applied at the individual halibut level via the halibut that were selected for the subsample. In this way, the simulated catch captures the observed within and between haul variability, from which the two subsampling-based estimates of the total weight of halibut caught were calculated. The assumption behind this approach assumes that the original data of 250 hauls (Cape Horn=82, Constellation=137, Ocean Peace=31) captures the full variability in hauls for this area, and that if similar conditions were to be observed, this dataset is a good representative of any future year of fishing under similar conditions.

Every 5th fish (sample based) estimate:

Methods:

In this simulation study we systematically subsampled every 5th halibut, and used the characteristics of the subsample along with the known number of halibut per haul to estimate total weight of halibut.

The simulation proceeded by assuming there was no pattern or bias in halibut size associated with the order in which they come out of the net for processing. The simulation begins by generating a random start number between 1 and 5, and then selecting that and every 5th fish thereafter. When all halibut caught in that haul have their processing order randomized, then measuring every 5th halibut amounts to the same as measuring 20% of the halibut caught, as long as there were at least 5 halibut in the haul. If the random start number was greater than the number of fish in the haul, then no halibut were selected for processing for that haul.

For small hauls of halibut, the error enters the estimate in two ways. If no halibut were selected for weighing, then the haul estimate would equal zero. For example, in the original dataset there were 15 hauls containing only 1 halibut, and the probability of selecting 1 as the random start number for subsampling is 20%. In other words there is an 80% chance that no halibut were sampled, and the haul size estimate would be zero. If 80% of these 15 haul estimates were not subsampled, then 12 out of these 15 vessels would be biased (under) estimates of 0.0 kg halibut. The second source of error for small hauls is the usual estimate error of using a subsample of halibut to represent the whole sample. A small subsample size of halibut on which the estimate is based, is more prone to the vagaries of chance large or small individuals, than a large subsample would be. Larger hauls had larger numbers of halibut to average to dampen the effect of any single outlier.

3 x 100 kg (sample based) estimate:
Methods:
For this simulation study, we selected 100 kg of fish three times from each haul and averaged the proportional weight of halibut in those three samples, to infer total halibut weight in each haul. Because halibut are a large fish and contributed a relatively small weight to the total groundfish catch, a single sample of 100 kg would on average not hold many halibut, and in many cases not hold any. We investigate the error of this subsampling method in the following simulation study.

Fish were randomly assigned to a sample until the cumulative weight of fish was at least 100kg, thus the number of fish in each 100kg sample varied. In addition, since only whole fish were included in the sample, the total weight of the simulated sample varied. Therefore, the 100kg sample would be larger than 100kg by the amount of weight that last fish contributed past 100kg. Each individual in the 100kg sample was either a halibut or not, and thus whether or not a fish is a halibut can be thought of as a Bernoulli trial where the probability of the fish is halibut is equal to the known relative proportion of halibut in the entire haul (total weight halibut/total haul weight (OTC)). Sample weights of halibut were divided by the total sample weight to obtain proportion estimates for each of the three 100 kg samples per haul, and used to calculate the weight of halibut as the proportion of weight in the entire haul. For example, if there was an average of 10 kg of halibut in the three 100kg samples, then the estimate of halibut for the haul would be 10% of the total haul weight.

Census-based estimate:
In each of the simulations described above, a census-based estimate in which the weight of all halibut in each haul was simultaneously calculated. In this way, the simulation mimicks the job of the on-board observers measuring every halibut, and for each run of the simulation, the “true” haul weight of halibut is available for comparing relative error.

Number of Hauls to conduct census and sample based estimatation

Methods:

This simulation study was designed to examine how the estimation error of halibut weight decreased as the number of subsampled hauls increased. The simulations were run as before by calculating the estimates of halibut weight from both the every-5th-halibut subsample and the fully censused haul. For one run of the simulation, we selected a fixed number of hauls and calculated both subsample and census estimates of halibut catch weight. The simulation randomly selected hauls by vessel, with the same number of hauls selected for each vessel. In other words, we started estimating total haul with just 3 hauls – one for each vessel, then we increased to 6 hauls, which is 2 hauls for each vessel, 9 hauls – 3 per vessel, etc. out to 1/3 of 250 hauls or 63 hauls (21 per vessel). This was repeated 1000 times, and the relative error and the coefficients of variation were calculated for each increase in number of hauls.