

# Monitoring Alternatives for the Alaskan Fixed Gear Fleet

*Discussion Draft*

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**Prepared for:** North Pacific Fishery  
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Working Group

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## Introduction

At the October Council meeting, the Council requested that NMFS *provide a strategic planning document for electronic monitoring (EM) that identifies the Council's EM management objective of collecting at-sea discard estimates from the 40' – 57.5' IFQ fleet, and the timeline and vision for how the EM pilot project in 2013 and future years' projects will serve to meet this objective, including funding* (October 2012 Council Motion). This led to creation of the North Pacific EM Workgroup.

At the August 13, 2014 EM Workgroup conference call, the cooperative research program was discussed in light of the upcoming SSC review. Comments were made that Track 1 needed to have clearer research objectives, analytical methods, and deliverables, in order to be ready for SSC review, as well as a budget and responsible party for each component. It was also pointed out that the research tracks needed to integrate with each other better, and they need to address the Council's problem statement for EM: *The Council recommends use of a catch estimation approach to develop EM for the halibut and sablefish fisheries* (June 2013 Council recommendation).

## Purpose

The purpose of the EM Cooperative Research Program (CRP) is to test the use of EM to be used in conjunction with the existing observer program to produce an integrated monitoring program that provides high quality fishery data. The purpose of this document is to provide a framework to assist the CRP planning discussions at the upcoming November 19-20 EM Workgroup meeting as well as serve as an outline for a final document. The document begins with a brief background section on the fishery to provide scope. It includes:

- Suggested operational definitions;
- Background on the operation and scale of the fishery as it relates to catch monitoring design (with appendices);
- Main monitoring goals and objectives; and
- Specific information and data requirements.

The second section outlines five general monitoring strategies or alternatives. Alternative 1 is a baseline Observer-based strategy while Alternatives 2-5 are EM-based and represent increasing complexity and reliance on fisher involvement.

One of the objectives of the document is to provide context to highlight major and minor decision points that emerge during discussion and writing that will require resolution as well as outline research tasks.

## Goals and Objectives

### Management Goals

- To enable monitoring on vessels that are difficult to monitor with observers.
- To develop cost effective monitoring for the fleet.
- Develop an integrated monitoring package (observers and EM) to produce higher quality information for the groundfish fixed gear fisheries.

### Operational Goals

The intent is to develop a cost effective EM program that easily integrates with the existing observer program. It will also have (or continue to have) these characteristics:

- Compatible with vessel operations;
- Scalable to required number of ports;
- Flexible to address changes as the information needs evolve;
- Comprehensive with respect to species, vessels, and gears;
- Timely to meet management, operational, and scientific goals
- Aligned with other existing data activities (data collection, enforcement)
- Understandable/transparent; and
- Catch estimates accurate enough to meet science, management and enforcement needs.

### Operational Objectives

- Total cost should be less than a target budget (e.g. X% of landed revenue)?
- Total cost should be X% less than the cost of the current \$1.2 million for the current “40 – 57 ft observer program?”
- The new program will allow same access to multiple area fishing and current ports;
- New data and data system must be aligned with observer data, fish tickets and regulations, and enforcement needs.

### Data and Information Objectives

#### Catch related data:

- Provide accurate total catch by weight of all species with a primary focus on “managed” species on a timely basis.
- Landings provided at trip level from fish tickets;
- Confirmation of retention (no discarding) of Demersal Shelf Rockfish;

- Confirmation of adherence to trip limits by vessel for non-target species (Maximum Retainable Amounts, MRA is a percentage of another fishery's TAC);
- Total estimates of discarded ecosystem component species (e.g. grenadier) estimated and monitored at the fleet level (not trip– track, but no ACL);
- Total estimates of Protected Species Catch (PSC) provided at fleet level
  - Halibut, salmon, crab, and herring.
- Auxiliary data on discarded halibut concerning
  - Confirmation on size restrictions – 32 inches FL (at sea), or 24 inches head removed (landings);
  - Halibut release methods;
  - Injury data on discarded halibut.

**Effort related data:**

- Data captured at event level but estimated for the fleet from sampled trips;
- Time/date (start/end);
- Location;
- Total number of events;
- Total hook count by event;
- Total number of skates per event;
- Port of landing captured at trip level (for landings) landings to vessel, discards at fleet level.

## Operational Definitions

### “Catch” related definitions and related issues

It is important to clarify the word choice for the various routes or dispositions that a captured specimen can take. Figure 1 provides a structured view of the catch handling/disposition and related semantics. The work group may wish to decide on different word choices.

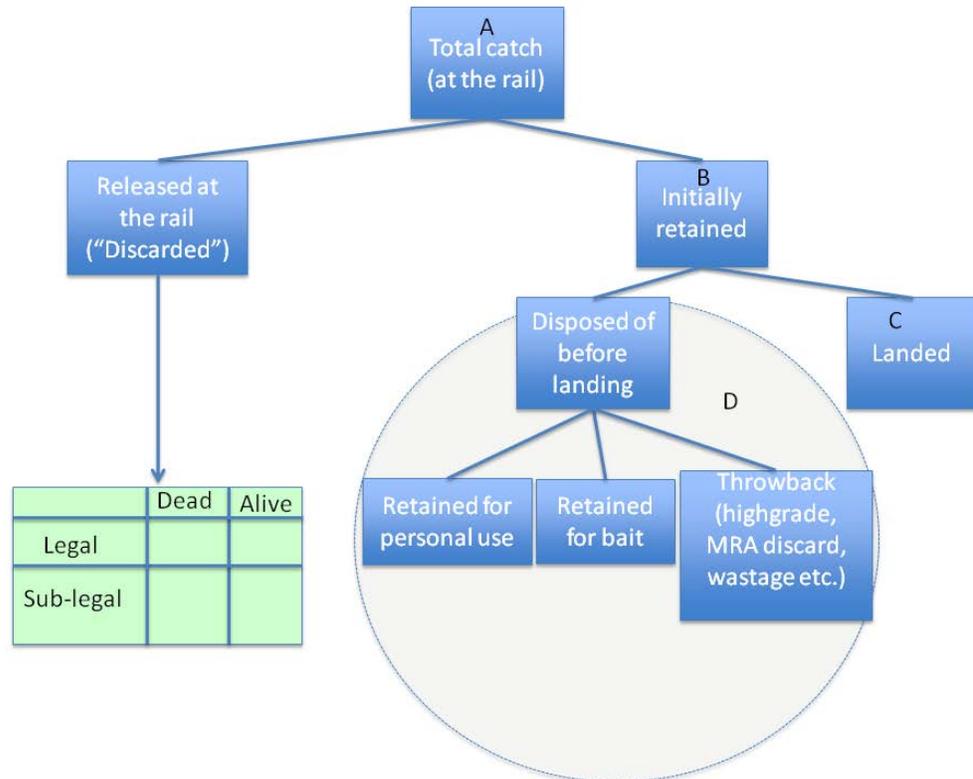


Figure 1. Diagram of all possible uses of catch from a typical longline retrieval event (haul).

### Post retention discarding (PRD)

In some fisheries, specimens that are initially retained (in view of the camera in Alternatives 2-5) may then be subsequently discarded (or eaten) prior to unloading and being tracked in landings data. There are various reasons for post-retention discarding (PRD) as illustrated in Figure 1. The important point for monitoring is that estimating this overall quantity (“D” in Figure 1) in EM programs can be problematic since EM at-sea counts of retained specimens cannot easily be compared with weights from landings. If PRD is a concern, EM-based monitoring programs may require additional monitoring elements such as fishing logbooks or piece counts at unloading, as in BC.

In describing Alternative 1-5 below, we have not addressed PRD but emphasize that it is important for the work group to decide on whether it is a problem.

**Decision Point:** Does the monitoring have to provide estimates of PRD?

### Primary vs. Secondary species

The NOAA memorandum on “Draft Catch reporting standards in the GOA hook-and-line fishery” (Hollowed and Rigby 2014) notes that an EM system “should be designed to accurately account for the catch of target species as well as incidental catch of non-target and ecosystem species. However, the definition of what is an “adequate” degree of accuracy may vary among species. Also, in designing sampling strategies, it is nearly impossible to achieve “adequate” accuracy for species, which are rarely encountered without incurring

unacceptable costs. Furthermore, considering all possible species at all times early in the design stages will tend to overwhelm the design process.

Without being dismissive of lower profile species, it will be important to identify a key or “primary” group of species to focus on during design. This group would include all or most managed species, and perhaps a small number of other species, chosen to represent specific monitoring challenges.

**Decision Point:** Need to distinguish between policy goals and reasonable strategic objectives for species identification.

**Decision Point:** Need to distinguish between primary and secondary species categories.

## Fishery Background

### Landings by Port

2013 fixed gear landings were summarized by port and vessel size category, showing the number and percentage of total landings (Appendix, Exhibit 1). Since the 40' to 57' size group is the priority for EM, the landing ports have been placed in diminishing order using this category. The green shaded percentage cells represent the ports that collectively account for 50% of the total landings within the size category. Yellow, represents the next 25% such that the two colors account for 75% of the total landings.

#### **Observations:**

- Collectively the fleet makes over 10,000 landings at about 50 ports.
- Among the 40-57' group, landings occur at 33 ports with 50% from four ports, 75% from eight ports and 90% from 14 ports.
- The top five ports for 40-57' group are Kodiak, Sitka, Seward, Homer and Juneau (60% of landings).
- The top five ports for <40' group are St. Paul, Kodiak, Homer, Sitka and Yakutat (52% of landings)
- The top five ports for >58' group are Kodiak, Sitka, Seward, Homer and Dutch Harbor (54% of landings).

### Landings by Target Species

2013 fixed gear groundfish landings were summarized by month and trip target species and by vessel size category (Appendix, Exhibit 2a/b). These data are presented in tabular form and as bar charts. These summaries are prepared to show how landings are distributed by vessel size and target species. Landing patterns do not directly translate to fishing effort which is presumably how monitoring effort would be distributed.

### Observations:

- Halibut target trips represent 46% of total landings, followed by cod (34%) and sablefish (20%).
- About 70% of the cod landings occur in the first quarter of the year and landings occur in all months. The majority (60%) of cod fishing is by the >58' fleet, followed by 40-57' sector (26%).
- Half the halibut trips are by <40' sector, followed by 40-57' (30%) and >58' (20%).
- Conversely, about half (47%) the sablefish trips are by >58' sector, followed by 40-57' (43%) and <40' (10%).
- Landing patterns in the <40' halibut fleet are distinctly seasonal, most active June to August, while the other fleet groups are distributed more evenly between the months of April to October.
- Sablefish landing patterns are similar to the > 40' vessel halibut landing patterns.

## Landings by Month and Region

2013 fixed gear groundfish landings were summarized by month and geographic region (Appendix, Exhibit 3a/b). These data are presented in tabular form and as bar charts. Landing ports within each region are shown in Exhibit 3c. These summaries provide a regional perspective of landings.

### Observations:

- The greatest activity (all landings) is the Southcentral (42%), followed by Southeast (26%), Aleutian (23%) and Western region (9%).
- Among the 40-57' fleet, the greatest activity is the Southcentral (45%), followed by Southeast (32%), Aleutian (22%) and Western region (1%).
- Aleutian region is distinctly summer, mostly (95%) by the <40' vessel group.
- Southeast landings are mostly March to November period, while Southcentral and Aleutian have landings year round. The early season landings in the latter regions are due to the cod fishery.

## Estimated Effort for 2015

This summary (from North Pacific Council, Oct 6.14, 2014, C1 – Faunce – 2015 Draft ADP), provides an estimate of 2015 days, trips and observer trips for groundfish size and gear stratum. The size strata are: Full (100%) for vessels >125', T (24%) for >58 to 125'; t (12%) for 40-57', and Zero (0%) for <40'. Gear strata are hook and line (H&L), Pot and Trawl.

**Observations:**

- Among the total estimated days, H&L represents 54%, followed by trawl (36%) and pot (8%). Results are similar for days.
- Among the total estimated 40-57' group, H&L represents 95% of trips, followed by pot (5%). Results are similar for days.
- Among the total estimated H&L days, > 125' represents 22%, followed by 58-125' (29%), 40-57' (29%) and 40' (20%).
- Among the total estimated H&L trips, > 125' represents 15%, followed by 58-125' (21%), 40-57' (29%) and 40' (35%).
- Among the total estimated Pot days, > 125' represents 8%, followed by 58-125' (82%), 40-57' (10%) and 40' (0.5%). Results are similar for trips.

**Catch Data for H&L Target Trips**

Exhibit 5a through 5e provide catch data for H&L target trips for cod, sablefish, halibut (2c), halibut (3a) and halibut (3b), respectively. The former two are from 2013 observer data while the latter are from 2013 IPHC survey data. Observer data are direct observations from monitored commercial trips. IPHC survey data show species composition from the top 1/3 (by halibut WPUE) survey stations as recorded by the onboard observer. All five tables are structured similarly, ordering catch by fish and other, then by declining abundance in pieces. The following describes additional columns in each table:

- ID Level – Catch items are recorded either to species or group level.
- Percent Occurrence – Percent occurrence of each catch item as a proportion of the total catch pieces recorded. The green shaded cells represent catch items greater than 0.1% occurrence.
- Usual Disposition – Catch items are classified as either kept, conditionally retained (>10% retained) and discarded (<10% retained). These classifications are based on retained information from observer data and estimations from the IPHC survey data.
- EM ID Ability – Each catch item is classified according to the expected ability of a reviewer to identify the catch to a given level (either species or group). At the species level, classifications are either yes, no or '?' (to be determined), based on species distinctiveness and past experience. At the group level, classifications are either yes or '?', the latter representing cases where the item may be too small for detection.
- Management Status – Catch items are identified if they the following management status: PSC, protected species, ACL, annual catch limits, and IFQ, for species under individual fisher quotas. Cells shades in blue represent those species identified in the Hallowed and Rigby memo as target stocks.

The purpose of these tables is to characterize catch patterns within each sector of the fixed gear fishery to provide a 'fishery snap shot' that shows catch items (species or groups) that occur in each segment along with relative abundance, a pre-assessment of ID ability, and some indicators of management importance.

### Observations:

- All the tables show a very rapid attenuation with a handful of common species and a long list of uncommon species.
- Species composition varies by sector.
- The stated goal of 'complete catch accounting for all managed species' implies that species identifications for all catch items is necessary. There are many instances where catch item identifications are to the group level.
- The 'a priori' assessment of EM identifications points out a lot of positive identifications for common (>0.1%) species, however there are a large number of catch items which are unknown at this time.
- Further work is needed on these tables.

## Current Data Elements

- Observer program (see Alternative 1);
- Landed weight at the level of individual species for each trip are obtained from fish tickets;
- IPHC logbooks – only for Halibut trips;
- NMFS logbooks;
- Port sampling programs.

## Current Information

- Individual vessel landed catch available from fish tickets;
- Total landings are obtained from summing the fish tickets from individual trips;
- Estimates of total discards (released at the rail) by species are provided by expanding observer data. Therefore discard estimates are only available at rolled up fleet level not at the trip level (except for the observed trip);
- Discard estimates are partitioned into legal or sublegal total estimates;
- Some viability observations are collected, which are used to adjust mortality rate of the discards of some species (is this true?).
- Total catch is assumed to be equal to the sum of total landings and the estimates of total discards (at the rail);

- No attempt is made to estimate PRD.

## Monitoring Alternatives

The monitoring alternatives are presented as a continuum of increasing complexity and reliance on fisher involvement. Alternative 1 represents current at-sea monitoring program using observers while Alternatives 2 to 5 represent various methods using EM. Alternatives 2 to 4 build in complexity and the differences from the preceding alternative are highlighted with underscoring. The data collected varies among the alternatives and uses different tactics to assimilate as fisheries information. The alternatives vary in the tools and methods, but ultimately deliver the same information, albeit with different levels of precision and resolution (e.g. species vs. species group).

The deployment method is not specified within the alternatives. For Alternative 1 (status quo), we assume there is no change to the way observers are assigned to vessels. For Alternatives 2-5, we expect the method for assigning vessels to host EM systems to differ from Alternative 1.

Independent landings monitoring ('dockside monitoring') is an option that could be applied to all Alternatives but with differing utility. None of the options are dependent upon dockside monitoring. Later in this document we discuss the potential benefits of dockside monitoring for the various alternatives.

## Alternative 1: Observer Program (Status Quo)

### Operational Overview

- This alternative represents the existing status quo deployment of at-sea observers.
- All vessels are trip selected (i.e., observer deployed for a specified fishing trip).
- Observers generally monitor all fishing events for a trip.
- On a given monitored fishing event the observer divides their time between rail view census of catch hook by hook, and deck level sampling to obtain species identifications and weights. These elements are combined to provide catch accounting by species, disposition and weight.
- Vessels are instructed to carry out their fishing trip as per normal commercial operations, except for hosting the observer and modifying catch handling practices to enable observer access to retained and discarded catch.
- Observer data are submitted after the trip.

### Data elements

#### Observer data

- Gear setting date, time, and location.

- Gear hauling date, time, and location.
- Seabird interactions during setting
- Total effort (hooks, skates, hauls)
- Catch in weight by species and disposition
- Length samples for selected species
- Biological samples and age structures for selected species

### EM data

- This alternative does not use EM technology

### Skipper data (Fishing Logs)

- This alternative does rely on skipper data (no change from existing system)

### Landings data (Fish tickets)

- Vessel details
- Landing date and time
- Total effort
- Landed weight by species (includes DSR - rockfish)
- Halibut length (above sublegal limit)

## Key information tactics

### Primary sampling unit

- The sampling unit is a fishing event (retrieval operation).

### Discard estimates

- The basic sampling unit is a fishing event (retrieval operation).
- Fishery level species discards are estimated by expansion of the samples to fleet grouping, area and fishery.
- Expansions are based on effort (#s of hooks set).
- Samples from >58ft fleet are applied to <40ft fleet since no observer sampling occurs on this vessel group.

### Trip level catch estimates (managed species)

- Landings data provide the trip (vessel) and fleet level total landed catch.
- IFQ and ACL data are summed from landings.

## Alternative 2: EM Program (Stand-alone)

### Operational Overview

- This option considers the use of EM technology in a fashion that involves a minimal level of involvement by vessel and crew.

- A standard EM system is installed on the vessel for the monitoring period. The system consists of CCTV cameras (rail and deck views), GPS, gear sensors and a control center.
- EM system is powered on for the entire fishing trip, recording sensor information continuously and CCTV imagery during gear setting, hauling and catch stowage operations (i.e., recording continues for a specified period after retrieval is completed to ensure all catch has either been retained or discarded).
- Vessel is responsible to ensure the EM system is powered and operating (running self test) and providing periodic minor maintenance (i.e., cleaning cameras, checking wires and secure mounting of components).
- All catch must be handled at control point (in direct camera view) where stowage and discard operations can be discerned. All catch not discarded within camera view is assumed to be retained.
- Except as specified above, vessels are instructed to carry out their fishing trip as per normal commercial operations.
- EM data (hard drives) are collected on a periodic basis (to be specified) for analysis.

**Decision Point:** What is the required frequency of data collection?

## Data elements

### Observer data

- This alternative does not require the use of onboard observers for hosting EM. Observer data may be used for purposes such as determination of average piece weights.

### EM data

- Meta analyses to ensure data set is complete (no hidden bias to the data set) and quality of sensor and image data is acceptable.
- Gear setting date, time, and location
- Gear hauling date, time, and location
- Seabird interactions during setting
- Visual assessment of effort (hooks, skates, hauls)
- Visual census of catch in pieces by species (or species groups) and disposition

### Skipper data (Fishing Logs)

- This alternative does rely on skipper data (no change from existing system)

### Landings data (Fish tickets)

- Vessel details
- Landing date and time

- Total effort
- Landed weight by species (includes DSR - rockfish)
- Halibut length (above sublegal limit)

### Key information tactics

#### Primary sampling unit

- The sampling unit can either be a fishing event (retrieval operation) or the full trip, depending on information and sampling design.

#### Discard estimates

- Species discards for a fishing event are estimated by applying the total number of pieces by an average piece weight.
- Fishery level species discards are estimated by expansion of the samples to fleet grouping, area and fishery.
- Expansions are based on effort (#'s of hooks set).
- Samples from 40 to 57ft (target EM group) are applied to <40ft fleet since this group is currently exempt from monitoring.

#### Trip level catch estimates (managed species)

- Landings data provide the trip (vessel) and fleet level total landed catch.
- IFQ and ACL data are summed from landings.

## Alternative 3: EM Program (Enhanced)

### Operational Overview

- This option considers the use of EM technology in a fashion that involves a moderate level of involvement by vessel and crew.
- A standard EM system is installed on the vessel for the monitoring period. The system consists of CCTV cameras (rail and deck views), GPS, gear sensors and a control center.
- EM system is powered on for the entire fishing trip, recording sensor information continuously and CCTV imagery during gear setting, hauling and catch stowage operations.
- Vessel is responsible to ensure EM system is powered and operating (running self test) and providing periodic minor maintenance (i.e., cleaning cameras, checking wires and secure mounting of components).
- All catch must be handled at control point (in direct camera view) where stowage and discard operations can be discerned. All catch not discarded within camera view is assumed to be retained.
- Special handling requirements for certain species to ensure full accounting. For example, there may be a requirement for extended presentation of certain species to the camera or full retention for other

species (rockfish) for accounting upon landing. Length graduated boards may also be used to distinguish legal and sublegal size categories.

- Vessel masters are required to maintain a record of fishing effort (sets, skates and hooks).
- Except as specified above, vessels are instructed to carry out their fishing trip as per normal commercial operations.
- Hard drives are collected on a periodic basis (to be specified) for analysis.

## Data elements

### Observer data

- This alternative does not require the use of onboard observers for hosting EM. Observer data may be used for purposes such as determination of average piece weights.

### EM data

- Meta analyses to ensure data set is complete (no hidden bias to the data set) and quality of sensor and image data is acceptable.
- Gear setting date, time, and location
- Gear hauling date, time, and location
- Seabird interactions during setting
- Periodic assessment of effort (hooks, skates, hauls).
- Visual census of catch in pieces by species (or species groups) and disposition.

### Skipper data (Fishing Logs)

- Total effort (hooks, skates, hauls) recorded in a logbook, corroborated by EM data.

### Landings data (Fish tickets)

- Vessel details
- Landing date and time
- Total effort
- Landed weight by species (includes DSR - rockfish)
- Halibut length (above sublegal limit)

## Key information tactics

### Primary sampling unit

- The sampling unit can either be a fishing event (retrieval operation) or the full trip, depending on information.

### Discard estimates

- Species discards for a fishing event are estimated by applying the total number of pieces by an average piece weight.

- Fishery level species discards are estimated by expansion of the samples to fleet grouping, area and fishery.
- Expansions are based on effort (#'s of hooks set).
- Samples from 40 to 57ft fleet (target EM group) are applied to <40ft fleet since this group is currently exempt from monitoring.

### **Trip level catch estimates (managed species)**

- Landings data provide the trip (vessel) and fleet level total landed catch.
- IFQ and ACL data are summed from landings.

## **Alternative 4: EM Program (Discard Measurement)**

### **Operational Overview**

- This option considers the use of EM technology in a fashion that involves a higher level of involvement by vessel and crew.
- A standard EM system is installed on the vessel for the monitoring period. The system consists of CCTV cameras (rail and deck views), GPS, gear sensors and a control center.
- EM system is powered on for the entire fishing trip, recording sensor information continuously and CCTV imagery during gear setting, hauling and catch stowage operations.
- Vessel is responsible to ensure EM system is powered and operating (running self test) and providing periodic minor maintenance (i.e., cleaning cameras, checking wires and secure mounting of components).
- All catch must be handled at control point (in direct camera view) where stowage and discard operations can be discerned. All catch not discarded within camera view is assumed to be retained.
- Special handling requirements for certain species to ensure full accounting. For example, there may be a requirement for extended presentation of certain species to the camera or full retention for other species (rockfish) for accounting upon landing. Length graduated boards may also be used to distinguish legal and sublegal size categories.
- All discarded species must pass across a graduated chute to enable length measurement.
- Vessel masters are required to maintain a record of fishing effort (sets, skates and hooks).
- Except as specified above, vessels are instructed to carry out their fishing trip as per normal commercial operations.
- Hard drives are collected on a periodic basis (to be specified) for analysis.

## Data elements

### Observer data

- This alternative does not require the use of observers for hosting the EM system.

### EM data

- Meta analyses to ensure data set is complete (no hidden bias to the data set) and quality of sensor and image data is acceptable.
- Gear setting date, time, and location
- Gear hauling date, time, and location
- Seabird interactions during setting
- Periodic assessment of effort (hooks, skates, hauls).
- Visual census of catch in pieces by species (or species groups), length and disposition

### Skipper data (Fishing Logs)

- Total effort (hooks, skates, hauls) recorded in a logbook, corroborated by EM data.

**Research question:** What audit level is necessary to verify accuracy of self reported effort information?

### Landings data (Fish tickets)

- Vessel details
- Landing date and time
- Total effort
- Landed weight by species (includes DSR - rockfish)
- Halibut length (above sublegal limit)

## Key information tactics

### Primary sampling unit

- The sampling unit can either be a fishing event (retrieval operation) or the full trip, depending on information.

### Discard estimates

- The weight of individual catch items is determined by converting length to weight.
- Species discards for a fishing event are estimated by summing the weights of the total number of pieces.
- Fishery level species discards are estimated by expansion of the samples to fleet grouping, area and fishery.
- Expansions are based on effort (#s of hooks set).
- Samples from 40 - 57ft fleet (target EM group) are applied to <40ft fleet since this group is currently exempt from monitoring.

### Trip level catch estimates (managed species)

- Landings data provide the trip (vessel) and fleet level total landed catch.
- IFQ and ACL data are summed from landings.

## Alternative 5: EM Program (Logbook with EM audit)

### Operational Overview

- This option considers the use of EM technology in a fashion that involves the highest level of involvement by vessel and crew.
- A standard EM system is installed on the vessel for the monitoring period. The system consists of CCTV cameras (rail and deck views), GPS, gear sensors and a control center.
- EM system is powered on for the entire fishing trip, recording sensor information continuously and CCTV imagery during gear setting, hauling and catch stowage operations.
- Vessel is responsible to ensure EM system is powered and operating (running self test) and providing periodic minor maintenance (i.e., cleaning cameras, checking wires and secure mounting of components).
- All catch must be handled at control point (in direct camera view) where stowage and discard operations can be discerned. All catch not discarded within camera view is assumed to be retained.
- Special handling requirements for certain species to ensure full accounting. For example, there may be a requirement for extended presentation of certain species to the camera or full retention for other species (rockfish) for accounting upon landing. Length graduated boards may also be used to distinguish legal and sublegal size categories.
- Vessel masters are required to maintain a complete record of fishing operations, including effort (sets, skates and hooks) and catch (retained and discarded species by pieces and weight).
- Except as specified above, vessels are instructed to carry out their fishing trip as per normal commercial operations.
- Hard drives are collected on a periodic basis (to be specified) for analysis.

**Decision Point:** should vessel logbooks include all species or just regulated species?

### Data elements

#### Observer data

- This alternative does not require the use of onboard observers for hosting EM. Observer data may be used for purposes such as determination of average piece weights.

### EM data

- Meta analyses to ensure data set is complete (no hidden bias to the data set) and quality of sensor and image data is acceptable.
- Gear setting date, time, and location
- Gear hauling date, time, and location
- Seabird interactions during setting
- Periodic assessment of effort (hooks, skates, hauls).
- Periodic assessment of catch in pieces by species (or species groups) and disposition

### Skipper data (Fishing Logs)

- Total catch and effort (hooks, skates, hauls) recorded in a logbook, corroborated by EM data.

**Research question:** What audit level provides enough data to catch and discourage misreporting?

**Research question:** How does a set audit rate compare to the sampling rate in terms of overall effort required? (Audit may not necessarily be the cheapest option).

### Landings data (Fish tickets)

- Vessel details
- Landing date and time
- Total effort
- Landed weight by species (includes DSR - rockfish)
- Halibut length (above sublegal limit)

## Key information tactics

### Primary sampling unit

- The sampling unit can either be a fishing event (retrieval operation) or the full trip, depending on information.

### Discard estimates

- Species discards for a fishing event are determined from the skipper fishing logbook by using estimated weights recorded.
- EM data are used to corroborate skipper logbooks, providing a trip by trip assessment of data quality.
- Fishery level species discards are estimated by expansion of the samples to fleet grouping, area and fishery.
- Expansions are based on effort (#s of hooks set).
- Samples from 40 – 57ft fleet (target EM group) are applied to <40ft fleet since this group is currently exempt from monitoring.

**Trip level catch estimates (managed species)**

- Landings data provide the trip (vessel) and fleet level total landed catch.
- IFQ and ACL data are summed from landings.