Operational Deployment of Electronic Monitoring in Alaskan Fixed Gear Fleets:

Track 1 Cooperative Research Project

Draft Research Plan

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

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1 Research Direction

1.1 Long-term Goal

This long-term goal of this cooperative research project is to gather information that can help stakeholders understand the key decision points related to the strategic deployment of EM. This is intended to help program participants meet catch accounting objectives (i.e., estimating species composition and weight of retained and discarded catch) in fixed gear fisheries. This will incorporate the use of other data sources to compliment the data collected using EM.

1.2 Project Goal

The project goal is to assess the efficacy of EM (in combination with other methods) for catch accounting of retained and discarded catch, and to define the operational program specifications required for deployment of an EM program. This goal will be achieved through field trials of EM systems on vessels in the ports of Sitka and Homer, Alaska (with possible expansion), as well as desktop studies where appropriate.

1.3 Objectives and Measureable Outcomes

1.3.1 Catch Accounting Objectives

Catch accounting objectives focus on the use of EM to characterize the retained and discarded catch by quantity (pieces or weight) and species for the following components:

1. Species identification:
    a. Assessment of the species identification ability for Alaska fixed gear groundfish target and bycatch species, with emphasis on discarded catch.
    b. With species for which ID is not likely to be achieved, provide a methodology for species groupings that balances reliability and resolution for data sets with a defined level of quality.
2. Examine different catch accounting methods for discarded halibut pieces that incorporate size, release method and condition.
3. Examine different indirect approaches for weight determination of discarded catch.

1.3.2 Operational Program Objectives

Operational program objectives focus on the issues of building scale in an operational EM program:

1. Develop feasible monitoring approaches for integrating EM into an overall monitoring package and identify key decision points; these may rely on different uses of EM (catch estimation, logbook verification, compliance verification) in combination with other data sources.
2. Develop program design that defines the required operational or support components of the proposed program.

1.4 Current Knowledge

1.4.1 Fishery Background

There are several unique elements of the Alaska fixed gear fishery that justify this study:

- There is little monitoring history with fixed gear fisheries (see reports outlined below).
- The fleet is sparsely distributed and some active ports are very isolated (e.g., Sitka and Homer).
- To date, no detailed analysis has been conducted of operational EM program requirements for the Alaskan fixed gear fleet.

1.4.2 EM Background

Related Studies

A variety of studies have demonstrated that EM can be used to monitor different types of fisheries across a wide geographic area, and in some cases, monitoring can be more effectively carried out using EM. The list of studies below is particularly relevant to the Alaska fixed gear fishery.

Conceptual Studies:

- *Lowman et al. (2013)* –Fishery Monitoring Roadmap, outlining a planning process for designing or fishery monitoring programs using EM.
- *NMFS (2013)* – Strategic Plan for EM/ER in the North Pacific – Integrating Monitoring Technology into the North Pacific Fisheries Dependent Data Collection Program.
- *NOAA (2013)* – Discussion Draft Electronic Monitoring and Electronic Reporting: Guidance & Best Practices for Federally - Managed Fisheries. For managers and stakeholders to consider how EM/ER tools can help contribute to more cost-effective and sustainable collection of fishery dependent data.
- *Zollett et al. (2011)* – Guiding principles for development of fishery monitoring program, developed as an outcome of two workshops conducted in 2010. The principles provide guidance for fishery managers

and stakeholders in developing, planning and implementing fishery monitoring programs.

Applied Studies:

- *Pacific States Marine Fisheries Commission* (*ongoing*) – PSMFC currently has EM systems deployed on catch share fishing vessels fishing bottom trawl, fixed, and mid-water trawl gears off the coast of California, Oregon and Washington.
- *Pria et al. (2014)* – EM study in the New England groundfish fishery and the use of EM for retention compliance monitoring and outlines the monitoring options for scaling to an operational program. The project considers a number of EM program design elements and program cost estimation considerations.
- *McElderry (2014)* – This report provides a summary of a seven year program where EM was deployed in the US shore based whiting fishery. The report addresses several practical program planning and design issues of an operational EM program.
- *Archipelago Marine Research (2013)* – This reports summarizes the results of a NFWF funded project with the Alaska Longline Fishermen's Association, with a limited scale pilot study example using EM on fixed gear vessels in Southeast Alaska.
- *Pria et al. (2012)* – Part of a larger project with the New England groundfish fishery where the accuracy of EM was examined for estimating catch weight and species identification, based on comparisons with observer data.
- *Stanley et al. (2011)* – This study provides an assessment of the effectiveness of EM for monitoring in the BC hook-and-line operational program. The Alaska fixed gear fishery is very similar to the BC hook-and-line fishery.
- *Bryan et al. (2010)* – This report summarizes a pilot study on the use of EM in groundfish fixed gear vessels in Morro Bay California.
- *Cahalan et al. (2010)* – Catch Sampling and Estimation in the Federal Groundfish Fisheries off Alaska.
- *Stanley et al. (2009)* – This study is based on the BC groundfish hook and line EM program and compares catch estimates for Yelloweye rockfish derived from audited self reported (logbooks) and expansions from the random 10% sample used for the audit.
- *Pria Ramos et al. (2008)* – This report summarises the results from a pilot study contracted by NMFS to demonstrate feasibility of using EM to estimate catch on groundfish fixed gear vessels in California.

- *Ames et al. (2007)* – This summarizes IPHC research conducted in 2002 and 2004 comparing catch composition from EM data and at-sea observer data from the Alaska longline fishery.
- *MRAG (2004)* – This report is a review of existing technologies (including electronic monitoring) and how they can be incorporated to augment existing at-sea observer programs with emphasis on applicability to the Gulf of Alaska and Bering Sea/Aleutian Island fisheries.
- *McElderry* (2003) – This report was an feasibility assessment of EM, forming the basis for the design of the British Columbia fixed gear EM program.

Lessons Learned

Based on the studies above, and experience in other fisheries and gear types, several lessons have been learned and documented related to the deployment of EM at an operational level within a fishery:

- EM systems cannot be a "plug-and-play" alternative to human observers.
- The utility of EM for collecting fisheries data relies on a careful design process that integrates the EM technology, the vessel specifications, and specific on board catch handling and EM system duty of care requirements.
- EM programs require a structured approach, and operational elements including program governance, program management, field technicians, data technicians, training programs, and QA/QC processes.
- Successful use of EM often depends upon integration with other data collection methods.
- Programs require local infrastructure to support ongoing operations, and it is possible to train and develop local infrastructure that can be scaled to an operational program.
- To be effectively deployed, EM programs should be developed in a scaled way moving from a small to full capacity operation in a controlled and organized way.
- EM technology is improving and systems now offer greater reliability and higher quality and quantity of data than in the past. These improvements include:
    - Digital, high frame rate capable cameras with better imagery and data outputs;
    - Increased flexibility of camera deployment because recording settings can be set for each camera individually, and

- Reduced reliance on skipper interaction with the system because of engine sleep sensors (i.e., will not need to switch the system on/off when leaving port).

1.5 Data Sources

The data collection for the project involves several complementary data sources that provide a complete understanding of the catch on a given fishing trip and for fishing events within a trip.

Existing Data Sources

- Fishing logbooks
  - IPHC logbooks – set/haul start and end location, catch detail by event (net landed pounds of halibut, pounds of sablefish sold).
  - Alaska logbooks – set/haul start and end location, catch detail by event (target species pounds).
- Offload data
  - Trip landings record (dealer data).

New Data Sources (included as part of this study)

- EM data outputs are:
  - Raw sensor data recorded in 10-second intervals throughout the trip and includes time, location, engine activity, hydraulic pressure and drum activity;
  - Image data for each fishing event consisting of time stamped imagery that is associated with the sensor data. Digital IP cameras recording at up to 30 frames per second depending on the camera view. Image data is stored as digital MP4 files that are compatible with Windows Media Player©, and
  - EM metadata for the trip consists of details of technical information from the system including event types (e.g. shut down, start up), time gaps, video gaps, and function test results.
- Other data sources will provide comparable and complementary catch and effort data for the trip and fishing event. These include:
  - Fishing logbooks
    - Voluntary effort log for participating vessels – date and time of fishing events,
  - Offload data

- Offload data collected for retained rockfish (total pieces by species per trip, total landed weight by species per trip).

- Supporting information will be gathered to further to assess the operational elements of the program. These data sources include:
  - Captain questionnaires on the efficacy and reliability of the EM systems;
  - Program operational data such as the time required for EM system installation, dockside monitoring, EM data retrievals, EM data review;
  - Demographic data on fleet segments by fishery, seasonal effort distribution, catch histories, and landing patterns;
  - Existing published literature such as length-weight relationships, and
  - Canadian operational program data including piece count and weight conversions.

1.6 Logistical and Budget Constraints

There are logistical constraints that must be considered:

- The fleet is large and sparsely distributed, therefore it will be challenging to ensure coverage of the entire fleet given that there are limited funds for monitoring;
- Vessel participation is voluntary and is unlikely to be a representative sample of the fleet vessels, and
- This study is limited in scope, and it is important to note that longer timelines and fisher experience with EM will lead to improved data quality over time.

2 Proposed Study

2.1 Program Overview

The proposed study is a collaborative research program with shared responsibilities among the Alaska Longline Fishermen's Association (ALFA), National Marine Fisheries Service (NMFS), the Alaska Fisheries Science Center (AFSC), Pacific States Marine Fisheries Commission (PSMFC), Archipelago Marine Research Ltd. (Archipelago), and Saltwater Inc. (Saltwater),. Electronic monitoring (EM) systems provided by both Archipelago and Saltwater will be installed on five vessels in Homer and five vessels in Sitka, with possible expansion to include Petersburg, Kodiak, and Seward.

The study will be conducted over the next several years with joint duties being shared between:

- ALFA – coordination of stakeholder outreach and input;
- NMFS/AFSC – coordinate government interface with field work and study planning; review and provide input on data analysis;
- PSMFC – data review and analysis, reporting;
- Archipelago – lead role in study design and planning. EM systems deployment and data collection, data review for quality and analysis, reporting;
- Saltwater –EM system deployment, data collection, and data review for quality, provide input on data analysis.

This project is expected to take place during 2014 and 2015. The scope of the field effort in terms of numbers of vessels and ports will be based on the program budget considerations. The sample size (number of vessels, trips, fishing events) and level of analysis will be based on early results and the budget, building on the principle that the research project is building scale in a fashion that would lead to an operational program.

2.2 EM Operations

2.2.1 Equipment Provision

Data collection will initially take place on five vessels based in Sitka, and five vessels based in Homer with possible expansion to Petersburg, Kodiak, and Seward. Each participating vessel will carry one of two EM systems.

- Archipelago: two or three digital cameras, GPS, winch and hydraulic sensors, engine sensor, user interface, and control center.
- Saltwater: (TBC)

2.2.2 Field Services

Port Infrastructure

- Ports are isolated from other towns and this will require logistical planning between local infrastructure and participating parties (ALFA, PSMFC, NFMS/AFSC, Archipelago, and Saltwater).

Installation/Servicing/Repair

- EM technical support including data retrievals, camera adjustments, and trouble shooting. Archipelago and Saltwater will provide field services for the equipment that they provide, either directly, or through subcontractors.
- Scheduling of EM mobilization and demobilization at the start and end of the season.
- Working with data services to support Vessel Monitoring Plans (VMPs) and provide feedback to fishers.

Data Retrievals & Captain Survey

- Data retrievals will be conducted by field services at a defined frequency (e.g. every trip, every two trips, etc).
- Captains will be asked to complete a questionnaire after every trip to evaluate their experience with the EM system.

Dockside Monitoring

- Archipelago and Saltwater will provide dockside monitoring services (DSM) for the vessels carrying their equipment, either directly, or through subcontractors (e.g., Sitka Sound Science Center on behalf of Archipelago).
- DSM will be carried out opportunistically on participating vessels that complete fishing trips with no rockfish discards.
- DSM will occur in Homer, Sitka, and other ports as opportunity allows.

2.2.3 EM Data Analysis

PSMFC will complete EM data analysis to document fishing effort, and catch accounting.

Primary Data Processing (EM review)

- Sensor and image data review by event:
    - Characterize the data success (e.g., imagery quality, expected quantity, types of data gaps, data inventory, and duty of care);

- Identify fishing effort within a trip (e.g., trip start and end, set/haul start and end), and
- Document catch data from imagery review by event (catch species, disposition of halibut, release method and condition).

Secondary Data Processing

- Comparison of EM data to complimentary data sources (fishing logbooks, and dockside monitoring data).
- Creating an in-season and post-season report.
- Comparison of data review methodologies and cost factors.

Data Quality Control

- EM service providers will review EM data regularly to ensure that the data meet the defined objectives.
- Feedback will ensure that necessary improvements to the data collection and onboard catch handling procedures are made, and that the required data are collected.

2.2.4 Program Coordination

Feedback

- Feedback to fishers and conversations with fishers will occur as required (as frequently as every trip) to ensure continuous refinement of the data quality.

Program Operational Data

- Program operational data will be collected and can be used in the development of alternative monitoring approaches and to estimate costs. This includes EM system installation time, service intervals, time required for data retrievals, offload monitoring, data and review.
- Includes time required for dockside monitoring, EM data retrievals, system servicing, EM data review.

Scheduling/Planning

- Mobilization and demobilization of EM equipment.
- EM servicing and data retrievals.
- Post-trip captain questionnaires.
- Turnaround time for in-season data analysis and reporting, which involves establishing specific goals for data turnaround times (i.e., from trip complete to report complete).

- Based on data turnaround goals, identify staff resource needs for data retrievals, data analysis and data reporting.

2.3 Data Analysis

2.3.1 Catch Accounting Objectives

1. Species identification:
    a. Provide an assessment of species identification ability for Alaska fixed gear groundfish target and bycatch species, with emphasis on discarded catch:
        - Identify important target and bycatch species such as halibut, and rockfish, ESA species, and MMPA protected species. Priority species will be based on a list generated during the February EM workshop (Appendix A). All catch (retained and discarded) will be identified to the lowest taxonomic level.
            - Evaluate the catch history of the fishery, and the occurrence pattern for these priority species (i.e., how frequently are they caught, landed and discarded?).
            - Generate an *a priori* "difficult to ID" species list based on knowledge of ability to identify frequently encountered catch.
        - Assessment of species ID based on project data:
            - EM vs. dockside data comparisons of rockfish piece counts by species will corroborate EM rockfish ID by species and group.
            - Compare actual imagery of fish species with the *a priori* assessment.
        - Evaluate risk associated with misidentification based on:
            - EM reviewer identification to groups (or species assemblages/complexes) compared to dockside data;
            - Reviewer feedback on identifiability to specific groups or species that are indistinguishable, and
            - The expected frequency of occurrence of multiple "difficult to ID" species in the same location.

b. With species for which ID is not likely to be achieved, provide a methodology for species groupings that balances reliability and resolution for data sets with a defined level of quality.

- Propose feasible solution to identify fish species to the highest taxa possible, without compromising accuracy. This involve the development of species codes for closely related or species that look alike, or modifying the catch handling protocols to improve identification.

2. In the case of released halibut, examine different catch accounting approaches that incorporate size, release method and condition for released halibut.

- Evaluate risk associated with the identification of halibut condition:
  - Document what data can be obtained from EM given the existing catch handling procedures;
  - Identify critical data that cannot obtained using EM along with the current catch handling procedures, and
  - Evaluate alternatives to collect missing critical data through changes to catch handling and EM data collection methods.
- Propose feasible solution to collect critical halibut condition data for discarded halibut based on the results of the field trials. This may involve a combination of monitoring methods, modification to retention practices, catch handling protocols, or development of condition codes for EM.

3. Examine different indirect approaches for weight determination of discarded catch.

- Evaluate risk associated with error in discarded catch weight estimates:
  - Conduct a desktop study to determine accuracy and precision of length-weight conversions using EM, and identify the most accurate and precise results that length to weight data can provide, and
  - Assess the cost and benefit from measuring all discarded catch. What is the value added and does it out-weigh the cost of increased review time to measure all catch?
- Describe a feasible solution to convert piece counts to weight based on the results of the field trials. This may involve a

combination of monitoring methods, modification to retention practices, or catch handling protocols.

2.3.2 Operational Program Objectives

1. Develop feasible monitoring approaches for integrating EM into an overall monitoring package and identify key decision points; these may rely on different uses of EM (catch estimation, logbook verification, compliance verification) in combination with other data sources.
    - This objective builds on the results of the above catch accounting objectives and uses these to inform the selection of a monitoring approach.
    - Model alternate approaches for generating fisheries data using EM, dockside monitoring and fishing logbook as sources recognizing that each approach has different onboard methods (catch handling, installation) and review methods.
    - Identify the key fishery characteristics that will affect the selection and design of an appropriate monitoring approach.
    - Develop decision tree or list of key decisions that help guide the selection of monitoring approach. These will relate to the project results as discussed above:
        - halibut condition;
        - rockfish ID capability and groupings, and
        - discarded catch weight.
2. Develop program design that defines the required operational or support components of the proposed program:
    - Provide recommendations on the level of port-based field service support required to accommodate an EM-equipped fleet including dockside monitoring as needed:
        - Examine landings data to determine fleet activity by port and month to assess the predictability of landings patterns (and need to respond to vessel landing);
        - Define target vessel QA/QC visits, data retrieval frequencies, and time required for data retrievals, dockside, and review, and
        - Identify efficient methods for transferring of raw data from port to location of data analysis.
    - Define the required onboard methodology for optimal data capture and quality:

- EM system attributes, and
- Operator responsibilities including catch handling and EM system duty of care.

- Define data analysis and integration methodology:
  - Define a methodology for integration of EM data with other information sources to achieve catch accounting goals, and consider how other monitoring tools could contribute to an integrated monitoring approach;
  - Specify processing and reporting standards for EM data analysis that incorporates both fishery data needs and program operational needs.
  - Define the required performance standards
    - Trip start/end time and location;
    - Set and haul start/end time and location;
    - Time gaps and risk categorization, and
    - Image quality.
- Develop a costing framework to assist with assessment of an operational EM deployment based on data from this project and previous studies that includes consideration of:
  - Fishery characteristics;
  - EM system hardware and installation costs;
  - Deployment strategies across the fleet;
  - Effort required for specific activities (offload monitoring, data retrieval, processing time), and
  - Processing time - review and reporting.

3 References

Ames, R.T., Leaman, B.M., Ames, K.L. 2007. Evaluation of Video Technology for Monitoring of Multispecies Longline Catches. North American Journal of Fisheries Management. 27: 955-964.

Archipelago Marine Research 2013. EM Pilot Study for Alaskan Halibut and Sablefish Vessels. Unpublished report prepared for Alaska Longline Fishermen's Association by Archipelago Marine Research Ltd., Victoria British Columbia, Canada. 31 p.

Bryan, J., Pria Ramos, M.J., McElderry, H. 2010. Use o fan Electronic monitoring system of estimate catch on groundfish fixed gear vessels in Morro Bay California – phase II. Unpublished report prepared for The Nature Conservancy by Archipelago Marine Research Ltd., 59p.

Cahalan, J., Mondragon, J., Gasper, J. 2010. Catch sampling and estimation in the Federal groundfish fisheries off Alaska. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-205, 42 p.

Lowman, DM, R Fisher, MC Holliday, SA McTee, and S Stebbins. 2013. *Fishery Monitoring Roadmap.*

McElderry, H., Beck, M., Schrader, J. 2014. The 2004 to 2010 US shore-based whiting EM program: what did we learn? Archipelago Marine Research Ltd., Victoria British Columbia, Canada.

McElderry, H., J. Schrader; and J. Illingworth. 2003b. The Efficacy of Video-Based Monitoring for the Halibut Fishery. Fisheries and Oceans Canada, Research Document 2003/042. 79 p. Available at: http://www.dfo-po.gc.ca/CSAS/Csas/English/Research_Years/2003/2003_042_E.htm

MRAG. 2004. Fisheries Monitoring Technologies. A Project Report Submitted to the North Pacific Management Council by MRAG Americas, Inc. Tampa, Florida. In: Appendix I to the EA/RIR/IRFA for BSAI Amendment 86/GOA Amendment 76: Extension or Modification of the Program for Observer Procurement and Deployment in the North Pacific, public review draft, May 12, 2006. The entire EA/RIR/IRFA is provided at: http://www.fakr.noaa.gov/npfmc/current_issues/observer/OPO606.pdf.

NMFS 2013. Strategic Plan for EM/ER in the North Pacific – Integrating Monitoring Technology into the North Pacific Fisheries Dependent Data Collection Program. Agenda B-3. June 2013. Prepared by NMFS Alaska Fisheries Science Center and NMFS Alaska Regional Office. 51 p.

NOAA 2013. Discussion Draft Electronic Monitoring and Electronic Reporting: Guidance & Best Practices for Federally - Managed Fisheries. Prepared by NOAA and NMFS. 79 p.

Pria, M.J., McElderry, H., Stanley, R.D., Batty, A. 2014. New England Electronic Monitoring Project Phase III. Unpublished report prepared for the US Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service and Northeast Fisheries Science Center by Archipelago Marine Research Ltd., Victoria British Columbia, Canada. 93 p.

Pria, M.J., McElderry, H., Fedoruk, A., McVeigh, R. 2012. Estimating weight and identifying species through electronic monitoring (EM): a preliminary comparison of electronic and observer-based reporting. Archipelago Marine Research Ltd report prepared for Northeast Fisheries Science Center, Fisheries Sampling Branch of the National Oceanic and Atmospheric Administration.

Pria Ramos, M.J., McElderry, H., Oh, S., Siddal, A., Wehrell, R. 2008. Use of video electronic monitoring system to estimate catch on groundfish fixed gear vessels in California: a pilot study. Unpublished report prepared for the National Marine Fisheries Service by Archipelago Marine Research Ltd., Victoria British Columbia, Canada. 46 p.

Stanley, R.D., Olsen, N., Fedoruk, A., 2009. Independent validation of the accuracy of Yelloweye Rockfish catch estimates from the Canadian groundfish integration pilot project. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 1:354–362, 2009.

Stanley, R. D., McElderry, H., Mawani, T., and Koolman, J. 2011. The advantages of an audit over a census approach to the review of video imagery in fishery monitoring. ICES Journal of Marine Science, doi:10.1093/icesjms/fsr058.

Zollett, E., Trumble, R., Swasey, J., Stebbins, S., Bonzon, K., Annuand, C., Arnason, R., Belay, B., Gilroy, H., Henninger, H., Jones, M., Leaman, B. 2011. Guiding principles for development of effective monitoring programs. Report prepared for Environmental Defense Fund. MRAG Americas, Essex, MA. 59 p.