Roadmap for the FLC EM Pilot Project

Introduction

The pages below are intended to serve as a roadmap or common reference document as FLC, NMFS-AKRO, the Observer Program, and a selected EM provider work together to test the functionality of EM on FLC boats. Field-testing and evaluation is referred to as the "Pilot Project". The overall Pilot Project consists of several discrete milestones, each of which will focus on specific EM functionalities.

Overall Project Objective

The overall objective of the Pilot Project is to fully evaluate current EM technology for its potential in reducing sector dependence on human observer coverage. FLC envisions a future in which observer coverage on our vessels continues to be fulfilled by human observers on some trips, while for other trips EM is used. By fully exploring EM technology on our vessels, this project will help determine the ratio of human to EM coverage that best accomplishes monitoring and operational needs. The roadmap milestones are intended to identify what is necessary for a combination of EM and electronic logbook (eLogbook) reporting to provide fishery-dependent data that is, in combination with some human-observed trips, adequate for fulfilling management, compliance, and stock assessment needs. There is also potential for discovery of alternative human observer duties that, in combination with EM-based data collections on the same trip, would improve fishery-dependent data from FLC boats.

Project Structure

- **Installation of EM**
  Cameras, sensors, associated cables, modules, and data storage drives on selected FLC boats.
- **Data Collection Pilot**
  Conduct side-by-side monitoring on selected trips using both onboard observers and a freezer-longline-specific EM + eLogbook system. EM video review would be conducted blind to observer data.
- **Equivalency Analysis**
  Compare EM-derived estimates to observer data using bias, precision, detection probability, and variance metrics for retained catch, discards, and PSC.
- **Compliance and Enforcement Evaluation**
  Assess EM performance for detecting compliance-relevant events, including data reconciliation, audit triggers, and tamper detection. The suitability of live data transmission will be considered/tested for select compliance-related data types, e.g., flowscale tests, daily catch reporting.
- **Cost-Effectiveness Assessment**
  Compare lifecycle costs of observer coverage and EM in terms of cost per statistically valid data unit, without compromising data integrity.

The FLC Sector

Freezer longline catcher-processor vessels (i.e., HAL-CPs) target Pacific cod in the Bering Sea, Aleutian Islands, and the Gulf of Alaska and are subject to 100% onboard observer coverage by Lead Level 2 (LL2) observers. The 100% observer coverage requirement imposes significant costs to

FLC members - approximately $400/day while at sea. EM programs implemented in other U.S. fisheries (West Coast groundfish, Alaska trawl EM, IFQ halibut/sablefish) demonstrate that EM can reliably support catch accounting and compliance objectives when properly designed and validated.

FLC vessels and fishing operations share the following characteristics that make the sector well-suited for an evaluation of EM as a substitute for onboard observers.:

- Highly structured deck and processing layouts
- Integrated flow-scale systems
- Low discard rates relative to other gears
- Stable fishing behavior and a strong compliance history

Management Relevance
This evaluation directly supports:

- National Standard 2 (Best Scientific Information Available)
- National Standard 7 (Cost Minimization)
- Ongoing NMFS efforts to modernize monitoring programs while maintaining data quality and enforceability

Funding and Selection of EM System Provider: There is potential funding from NMFS HQ being routed through NMFS/AKRO to install EM hardware on 5-6 FLC boats.

Assuming funds do become available, NMFS/AKRO rather than FLC will solicit bids from AKRO-approved EM providers (Archipelago and Saltwater) for EM installation on FLC boats, and then subsequently select one of these companies to partner with FLC and NMFS for the Pilot Project.

Whether or not NMFS funding comes though, additional outside funding (NFWF, NPRB) will be explored to further support this pilot project.

Data storage and transfer: For FLC fishing trips taken during the pilot project and afterward, video/data from the EM system will be stored on hard drives. Upon return to port, and prior to video review, hard drive data will be uploaded to the cloud. As part of the pilot project, FLC and the EM provider will likely evaluate transfer and storage of some video from the vessel while at sea. This would most likely be to verify that EM systems are working correctly.

Note: The funding assistance for installation, if secured, will not cover costs to FLC for EM data storage and transfer. Having FLC pay for those services ensures FLC will "own" the EM data collected on its boats.

Timeline: A roughly 3 year timeline of the below events is indicated for each Phase of the Pilot Project. These are estimates of how long each Phase will take. The indicated times are meant to be *descriptive*, *not prescriptive*.

Phase 1 – EM System Setup – Fall 2026

Milestone #1 - Successful installation and operability of EM systems

Description: The EM system partner selected for the pilot project will install cameras (approx. 6 cameras per boat), sensors, associated cables, modules, and data storage drives on selected FLC boats.
Deliverables:

- Completed installation on ___ FLC boats

- For each vessel, provide a detailed description (written and diagrammatic) of:
    - Cameras
        - Number of cameras
        - Location, function of each
        - Adequacy of field of view
    - Sensors
        - Number, location, function
    - Data storage devices
        - Number, location
    - Other system components
        - Location, function
    - System operability

Milestone #2 - Ensuring EM is operable during fishing trips

Description: This milestone will likely continue throughout the Pilot Project, however, during the early stages the EM installer will review video from the first several fishing trips in order to identify any issues that arise with EM operability.

Deliverables: Reports to AKRO, Observer Program, FMAC on measures ensuring:

- Adequate video quality is maintained by limiting
    - effects of sea spray, fogging, etc
    - crew or objects blocking camera views
    - effects of variable lighting
- System operability
- Other: _____

Milestone #3 - Verifying use of EM for monitoring flow scale testing and operation

Description: Flow scales are required on FLC boats by regulation. A flow scale test is conducted daily when fishing. Under EM, flow scale tests will be done by vessel crew in the usual manner, but cameras will replace the human observer who typically verifies testing procedures and results. The number of cameras as well as their position and field of view needs to be determined during installation.

Test Procedure:

- Crew will use standard sandbags supplied by the scale manufacturer.
- The sandbags are first weighed on a platform scale at the observer station to obtain known the test weight.
- Crew will then run the sandbags over the flow scale for a total test weight of at least 400 kg.
- Flowscale readout must be within the maximum permissible error for flow scales (±3.0%)

Deliverables:

- Report to AKRO, Observer Program, FMAC on measures ensuring:
    - EM video adequately captures crew procedures for flowscale testing and flowscale operation during fishing.

Phase 2 – EM / eLogbook / Observer - 2027 - 2028

Fishing Effort

- After EM systems have been successfully installed on FLC vessels, side-by-side EM and observer data collection will occur on selected trips.
- Post-trip, EM video review will be conducted to generate observer reports.
    - Video reviewers will be blind to observer data.
    - Data from EM-based observer reports will be compared to observer reports.
        - This will include, to the extent possible, statistical equivalency analysis and measures of precision and accuracy.
- Additionally, methods will be developed for daily reporting by vessel captains .

Milestone #4 - Verifying suitability of EM for fishing gear/effort data collection

Description: Number of cameras, position, angle, field of view will need to be determined for each of the below measures of effort (See Chapter 7 in the Observer Manual). EM should be configured to obtain these measures while setting and retrieving.

- N_hooks per mag
- N_mags per set
- N_sets
- Hook spacing
- Other _____
- Other _____

Deliverables:

- Observer report on effort data collected by video review
- Report comparing video-based observer data to onboard observer report

Catch Composition

Chapter 8 of the Observer Manual identifies the types of catch data that onboard observers collect on longline vessels as well as sampling methods. Under a sampling regime, observers characterize a vessel's catch by quantifying the species caught within discrete segments of fishing operations which leaves much of fishing operations unobserved. EM video, on the other hand, is capable of providing a complete record of a vessel's catch on a given fishing trip making it a superior resource for characterizing the catch.

Milestone #5 - Verifying suitability of EM for catch data collection

Description: The major challenges with relying on EM video for catch characterization involves species ID and size measurement. Cameras will capture views of the line (inboard and outboard of the roller), sorting table, fishing deck, flowscale conveyor, bypass and readout. Video reviewers will be able to "sample" the catch at the same scale as onboard observers in order to generate observer reports of the below elements of catch composition.

*** Methods for the milestones below may involve several iterations, and will need to be developed collaboratively with the agency staff, selected EM provider, and EM video reviewers.*

Milestone 5a – Bycatch Species Identification

Objective

Develop and validate EM-based procedures that allow video reviewers to reliably identify non-target species encountered during fishing operations.

Proposed Methods and Procedures

1. Camera Configuration Optimization

- Configure cameras to provide:
  - Overhead sorting table view
  - Close-range species ID view
  - Rail/roller view for fish prior to discard
  - Conveyor/flow-scale view
- Test alternate focal lengths, lighting arrangements.
- Conduct species-ID field-of-view trials during fishing operations.

2. Species "Presentation Protocol"

Develop standardized crew handling procedures intended to improve video-based species identification:

- Crew briefly orient unidentified or difficult species toward camera.
- Fish placed momentarily in designated "ID zone" on sorting table.
- Minimum exposure duration established (e.g., 2–3 seconds).
- Use marked off reference area on sorting table to ensure consistent positioning.

3. Difficult Species Library

Develop a vessel-specific and fleetwide EM reference catalog containing:

- Video clips
- Still-frame screenshots
- Diagnostic characteristics
- Common misidentifications
- Seasonal or size-related appearance changes

Priority species may include:

- Rockfish spp.
- Skate spp.
- Other?

4. Blind Video Review Trials

- Video reviewers independently identify species without observer data access.
- Observer identifications treated as baseline comparison.
- Disagreement resolution conducted by senior taxonomic reviewer.

5. Species ID Confidence Scoring

Video reviewers may assign confidence categories:

- High confidence
- Moderate confidence
- Uncertain/unresolved

This allows:

- Quantification of uncertainty
- Estimation of detection probabilities
- Development of escalation protocols for uncertain observations

Deliverables:

- Report on video-based bycatch identifications methods

Milestone 5b – Species-Specific Tally, Weight, and Rail Discards

Objective

Validate EM methods for quantifying retained and discarded catch by species.

Proposed Methods and Procedures

1. Full Haul Video Annotation

Reviewers annotate:

- Species
- Retained/discard disposition
- Time stamp
- Conveyor passage
- Rail discard events

Annotation software should allow:

- Frame-by-frame review
- Event tagging
- Audit trail generation

2. Flow Scale Synchronization

Synchronize:

- EM timestamps
- Flow scale timestamps
- eLogbook entries

This allows retained catch weight to be reconstructed directly from:

- Species composition estimates
- Flow scale totals

3. Rail Discard Detection Procedures

Develop specific review protocols for:

- Fish dropping from hooks before reaching sorting table
- Intentional rail discards
- Fish bypassing sorting table

Methods may include:

- Outboard roller camera review
- Slow-motion playback
- Event-triggered review around hook retrieval

4. Discard Event Coding

Each discard event coded by:

- Species
- Estimated size category
- Condition
- Disposition location
- Confidence score

5. Census vs Sampling Comparison

Compare:

- Traditional observer subsampling methods
  vs
- Complete EM census approaches

- This is potentially one of the strongest scientific justifications for EM because EM may characterize total catch more comprehensively than observer sampling.

6. Weight Estimation Procedures

Evaluate several approaches:

- Proportional cod catch × total flow-scale weight
- Piece counts × average weights
- Length-weight conversions
- Compare each method to observer-derived estimates.

Deliverables:

- Report comparing video-based observer data to onboard observer report.
  - This will include, to the extent possible, measures of bias, precision, detection probability, and variance.
  - **Performance Metrics**
    - Species-specific weight agreement
    - Bias and precision
    - Discard detection probability
    - Retained/discard classification accuracy
    - Variance comparisons

Milestone 5c – Pacific Cod Biological Sampling

Objective

Develop hybrid EM and crew-assisted methods for collection of biological data traditionally obtained by onboard observers.

Proposed Methods and Procedures

1. Length Sampling Station

Create standardized sampling station including:

- Fixed measuring board
- Overhead camera
- Scale bar/reference markers
- Controlled lighting

Crew procedures:

- Randomly select cod at predefined intervals
- Place fish flat with mouth against stop
- Hold briefly for image capture

2. Electronic Length Extraction

Video reviewers measure fish lengths using:

- Calibrated image analysis software
- Fixed spatial reference points
- Automated or semi-automated image scaling

Validation:

- Compare EM-derived lengths to observer measurements.

3. Weight Sampling

Methods may include:

- Individual platform scale measurements
- Length-weight conversions
- Batch subsampling protocols

Cross-validation against:

- Observer data
- Flow-scale totals

4. Otolith Collection Protocol

Crew collect otoliths using:

- Pre-labeled barcode envelopes/vials
- Electronic sample log
- Video verification of sample collection

Chain-of-custody procedures:

- Sample ID linked to:
    - Trip
    - Haul
    - Fish length
    - Date/time

5. Sex and Maturity Determination

Develop standardized camera presentation methods for gonad visualization:

- Fish abdomens opened along prescribed cut line
- Gonads presented to camera
- Reviewer assigns:
    - Sex
    - Maturity stage
    - Confidence score

Initially focus on:

- Broad maturity categories
  rather than fine-scale histological staging.

6. Genetic Sampling Procedures

Develop tissue sampling protocols (done):

- Fin clips
- Dehydration on RiR cards
- Dry preservation

Video used to verify:

- Correct sampling procedures
- Label/sample matching
- Correct preservation methods

7. Sampling Design

Develop statistically valid sampling schedules:

- Randomized fish selection intervals
- Target sample sizes per haul/trip
- Stratification by area/season

Deliverables:

- Report comparing video-based observer data to onboard observer report.
    - This will include, to the extent possible, measures of bias, precision, detection probability, and variance.
    - **Performance Metrics**
        - Length measurement error
        - Sampling precision

- Otolith/sample recovery rates
- Agreement in sex/maturity assignment
- Sample labeling accuracy

Milestone 5d – Halibut PSC

Objective

Validate EM methods for detecting and quantifying halibut PSC and associated condition/viability metrics.

Proposed Methods and Procedures

1. Dedicated Halibut Camera Coverage

Configure cameras to capture:

- Hook retrieval
- Fish handling
- Release condition
- Discard pathway

Priority given to:

- Unobstructed lateral view
- Adequate lighting
- Minimal motion blur

2. Halibut Event Detection Protocol

Reviewers document:

- Every halibut encounter
- Hook location
- Hook removal technique
- Release timing

3. Viability Assessment Procedures

Develop EM-compatible viability scoring system adapted from observer protocols.
Potential observable indicators:

- Body movement
- Operculum movement
- Injury severity
- Bleeding
- Ability to self-right
- Controlled release behavior

Scoring categories:

- Excellent
- Poor
- Dead
- Uncertain

4. Weight Estimation

Evaluate:

- Length-based weight conversions
- Visual size binning
- Stereo-camera or laser-reference systems (if feasible)

Compare EM estimates to observer estimates.

5. Drop-Off Accounting
Develop procedures for documenting:

- Halibut drop-offs
- Escape events
- Partial visibility events

Methods may include:

- Roller camera review
- Hook-by-hook review
- Slow-motion replay

6. Handling Compliance Monitoring
Use EM to evaluate compliance with:

- Careful release requirements
- Dehooking procedures
- Release methods
- Handling duration

Deliverables:

- Report comparing video-based halibut PSC data to onboard observer report.
    - This will include, to the extent possible, measures of bias, precision, detection probability, and variance.
    - **Performance Metrics**
        - Halibut detection probability
        - PSC count agreement
        - Viability scoring agreement
        - Weight estimation bias
        - Drop-off detection rates

Protected Species

Number of cameras, position, angle, field of view will need to be determined to facilitate video reviewers can verify elogbook reports of seabird and marine mammal interactions. A set of outboard facing cameras will provide video that can be used to quantify sightings of seabirds, marine mammals throughout the trip and verify that seabird avoidance measures are correctly and consistently deployed while setting gear.

Milestone #6 – Verify suitability of EM for documenting seabird interactions

1. Dedicated Seabird Deterrence Camera
Configure camera(s) to capture:

- Correct and timely deployment of floats, streamers
- Sync with time stamps for gear setting

Ensure:

- Unobstructed view
- Adequate lighting

2. Seabird mortality event detection
Configure cameras to provide:

- Rail/roller view for hooked seabirds
- Close-range species ID view

Reviewers document:

- Every seabird hooking

Ensure:

- Test alternate focal lengths, lighting arrangements.
- Conduct species-ID field-of-view trials during fishing operations.

3. Species "Presentation Protocol"

Develop standardized crew handling procedures intended to improve video-based species identification:

- Crew hold, rotate bird in front of camera.
- Fish placed momentarily in designated "ID zone" on sorting table.

4. Species Reference Library for video reviewers

Develop an EM reference catalog containing:

- Video clips
- Still-frame screenshots
- Diagnostic characteristics
- Common misidentifications
- Seasonal or size-related appearance changes

Deliverables:

- Complete observer report on seabird interactions collected by video review
- Report comparing video-based observer data to onboard observer report.

Milestone #7 – Verify suitability of EM for documenting marine mammal sightings and interactions

1. Dedicated marine mammal sightings cameras

Configure outboard facing camera(s) to capture:

- Whales surfacing within ____ distance from vessel

Ensure:

- Unobstructed views
- Adequacy of lighting

2. Marine mammal interaction events

Configure cameras to record:

- Depredation of discards / drop-offs
- Incidental entanglements
- Close-range species ID
- Disposition

Reviewers document:

- Every marine mammal sighting

Ensure:

- Conduct species-ID field-of-view trials during fishing operations.

4. Species Reference Library for video reviewers

Develop an EM reference catalog containing:

- Video clips
- Still-frame screenshots
- Diagnostic characteristics
- Common misidentifications

Deliverables:

- Complete observer report on catch data collected by video review
- Report comparing video-based observer data to onboard observer report.

Phase 3 – EM / eLogbook - No Observer (EFP needed) – 2029

After data collection functionality and eLogbook daily reporting methods have been verified in Phase 2, select trips will occur without a human observer onboard which will require successful approval of an EFP.

Milestone #8 – Validating eLogbook Daily Reporting with EM

When vessels are active on these fishing trips, eLogbooks will provide data streams that are 1) normally provided by observers and 2) directly used for management and enforcement, including:

- Retained catch weight and species composition
- Discard occurrence and species composition
- Prohibited species catch (PSC) detection and accounting
- Fishing effort metrics (set/haul counts, timing, location)
- Compliance verification (area, season, gear configuration)

Deliverables:

- Complete observer report on catch data collected by video review
- Report comparing video-based observer data to eLogbook report.

One Page Pilot Project Summary

Phase 1 – EM System Setup (Fall 2026)

Milestone 1 – EM System Installation and Operability

The EM provider will install cameras, sensors, and data systems on selected vessels.

- Completed installation on ___ vessels
- Documentation of cameras, sensors, storage, and system performance

Milestone 2 – EM System Performance at Sea

Evaluate system performance during initial fishing trips.

- Adequate video quality
- Unobstructed camera views
- Reliable system performance

Milestone 3 – Flow Scale Monitoring

Evaluate EM capability to monitor flow scale testing.

- Verification of testing procedures
- Verification of flow scale operation
- Daily uploads?

Phase 2 – EM, eLogbook, and Observer (2027-28 Fishing Seasons)

Side-by-side EM and observer data collection will occur. EM-derived data will be compared to observer data.

Milestone 4 – Fishing Effort Data Collection

- Hooks per magazine
- Magazines per set
- Number of sets
- Hook spacing

Milestone 5 – Catch Data Collection

- Species identification
- Catch tally and weight
- Target species sampling
- Halibut PSC monitoring

Milestone 6 – Seabird Interactions

- Seabird avoidance measures
- Incidental catch

Milestone 7 – Marine Mammal Interactions

- Sightings
- Depredation
- Entanglements

Phase 3 – EM and eLogbook (No Observer; EFP Required) – 2029

Selected trips will occur without onboard observers under an Experimental Fishing Permit.

- Retained catch data
- Discard data
- PSC accounting
- Fishing effort metrics
- Compliance verification
- Cost-Effectiveness Assessment

	Milestone	Objective	Key Outputs
Phase 1	M1: Installation	Install EM systems	System configuration
	M2: Performance	Ensure operability	Performance reports
	M3: Flow Scale	Verify test, monitoring	Validation report
Phase 2	M4: Effort	Collect gear, effort data	Data report, comparison with obs-based
	M5: Catch	Characterize catch	Catch data report, comparison with obs-based
	M6: Seabirds	Monitor interactions	Interaction data
	M7: Marine Mammals	Monitor interactions	Interaction data
Phase 3	No Observer/EFP	EM validation of eLogbook reporting	Final equivalency report

[Insert vessel-specific camera layout schematic here]

Figure 1 – Example EM Camera Layout (Placeholder)
Note: Diagram should include camera positions covering the longline, sorting table, flow scale, discard chute, and deck operations.

[Insert flow scale monitoring diagram showing test procedure coverage]

Figure 2 – Flow Scale Monitoring Coverage (Placeholder)

[Insert data flow diagram: Vessel → Hard Drive → Cloud Storage → Video Review]

Figure 3 – EM Data Flow Architecture (Placeholder)
This figure should illustrate data handling from onboard collection through storage, transfer, and review.