

GROUND FISH ELECTRONIC MONITORING POLICY ADVISORY COMMITTEE REPORT November 2013

Report to the Council

At the September 2013 meeting, the Council provided guidance to the Groundfish Electronic Monitoring (GEM) Policy Advisory Committee (GEMPAC) and the Groundfish Electronic Monitoring Technical Advisory Committee (GEMTAC) for the October GEM Committees' meeting:

1. discuss, a "phased-in approach" for implementation of electronic monitoring (EM), starting with midwater trawl and fixed gear fisheries, then a separate phase for bottom trawl fisheries
2. discuss the use of data logger systems as a component of the EM program,
3. discuss alternatives for an EM program that includes species that may be discarded under maximum retention fisheries, and
4. explore ways to minimize discards made for safety reasons.

On October 15-16, 2013, the GEMPAC and GEMTAC met in Seattle, Washington to consider the Council's requests and develop draft alternatives for an EM program. National Marine Fisheries Service staff was not able to attend the meeting because of a shutdown of government operations. This report provides the GEMPAC's recommendations for the Council, responses to the Council's September requests, and the Committee's revisions to the draft alternatives.

Summary of Recommendations and Responses

Response to Council Direction

1. _____ The GEMPAC considered the "phased-in" approach as suggested by the Council. This alternative is included under Section 1.5 "Implementation". In addition to phasing in by fishery, the GEMPAC also recommends an alternative that would phase in implementation through retention rules whereby those fisheries that are willing to fish under a maximized retention regulatory system would be allowed to use EM in lieu of an observer. As methodologies and technological advances for speciation are developed, other retention rules could be implemented to allow discards of specific species or species groups.

Section 1.5 includes an alternative which would phase in EM through the use of Exempted Fishing Permits (EFPs). While a long-term policy is being developed by the Council, as an immediate step, the GEMPAC recommends that the Council initiate an out-of-cycle process whereby EFPs would be used to allow some vessels to commence

- using EM in the near-term. For example, any vessel that is willing to fish under maximum retention rules might be allowed to use EM in lieu of observer coverage.
2. The GEMPAC discussed the use of data loggers as a tool to document the position of a fishing vessel while using EM. The GEMPAC believes this is a useful tool, and if used, should be integrated into the EM hardware system. Data loggers are covered in Section 2.2 of the attached alternatives document.
 3. The GEMPAC discussed alternatives for an EM program that includes species that may be discarded under maximum retention fisheries. Council staff developed Table 3 (Section 1.3) to compare four alternatives with different levels of discard by catcher vessels. It also includes the species groups that may be discarded under each of the alternatives (Tables 4, 5 and 6). The GEMPAC made minor changes to Table 4 to clarify certain discard options and exceptions. The committees also discussed that Alternative 1, “Full Retention”, may not be practical or achievable for all fisheries since statutory management measures such as the Endangered Species Act (ESA) or the Marine Mammal Protection Act (MMPA) may prevent vessel operators from fully retaining those species, and that discards for safety reasons are necessary in most fisheries.
 4. Lastly, the GEMPAC discussed ways to minimize discards made for safety reasons.

One approach suggested by the Council was to consider limiting tow times. Vessels typically use net sensors to monitor catch in the cod end and tow times vary based on densities of fish. Occasionally sensors may fail, resulting in too much fish at haulback and the need for releasing fish for safety reasons. However, most fishermen can monitor their catch and begin haulback when the cod end is nearly full or at a level of catch needed to fill the vessel. Tow times that catches the same amount of fish can vary greatly based on fish density and may range from 15 minutes to 6 hours, so limiting tow times is not a feasible option to prevent overfilling nets and reducing instances of non-selective discards for safety reasons.

The GEMPAC discussed the general issue of whether measures might be needed to reduce the occurrence of non-selective discards. Under the whiting electronic monitoring program and maximized retention regulations in place prior to the trawl rationalization program, instances of non-selective discards justified based on safety concerns were considered problematic. There are important differences between pre-trawl rationalization and trawl rationalization conditions such that non-selective discard problems would be expected to be substantially diminished in the rationalized trawl fishery. Specifically, prior to trawl rationalization, the fishery was managed as a derby; the primary incentive for vessels was to maximize revenue and catch history by maximizing the poundage in their deliveries; and discarding did not diminish vessel gross revenue. Attempts to maximize revenues resulted in overfilling nets and topping of holds (for vessels delivering shoreside).

Under the trawl rationalization program, the incentive is to maximize the value for a given amount of quota that a vessel has available to it. Non-selective discards are estimated by observers and deducted from quota accounts, making such discards costly for a vessel. Such estimates and deductions would continue under an EM program. Additionally, while under derby management, any diminishment of product quality from

overfilling a net might be offset by increased volume. Under the trawl rationalization program there is no opportunity for such offsets and any diminished product quality diminishes the value a vessel derives from its available quota. Inversely, improved product quality through shorter or smaller tows may increase total revenue from a given amount of quota.

Finally, operational costs associated with non-selective discards provide another disincentive for such discards. Net bleeding and handling of excess fish takes time and effort, adding to operational costs and reducing net revenue. Thus, under trawl rationalization, making larger tows does not increase a vessels revenue and the incentive may be for shorter or smaller tows in order to reduce lost revenue opportunity from discards, increase product quality, and limit operational costs associated with the handling of excess fish.

Recommendations for Modifying the Alternatives

The GEMPAC reviewed the alternatives provided to the Council in Agenda Item H.8.a, Attachment 1(November 2013). It recommends a number of revisions to these alternatives, as identified by the underline and strikeout in the version of the alternatives attached in this report. The full list of recommendations is in Section 3. A few of the more significant recommendations are provided here.

Remove from further consideration alternatives which would require mandatory use of EM. The GEMPAC believes that participation in an EM program should be voluntary; therefore, they recommend removing Alternative 1, “EM is Mandatory” (Section 1.1) from further consideration in any future detailed environmental analysis. To be consistent with this recommendation, the GEMPAC also recommends removing Alternative 3, “Use only an EM program” (Section “Overarching Policy Decision”). At this time, both alternatives remain in the document for consideration by the Council.

Leave most of the details in Section 2 for development during implementation. The GEMPAC recommends that performance standards for regulations be developed during implementation by the National Marine Fisheries Service (NMFS), working in consultation with the Pacific States Marine Fisheries Commission (PSMFC), the states, and contractors for some items identified in Section 2, “Data Capture and Processing,” including video hardware, onboard operations, and transfer of data (video, electronic logbooks, data logger information). The Council would review the draft regulations during the deeming process.

GEMPAC Recommended Revisions to Agenda Item H.8.a, Attachment 1.

Prior to the meeting, Council staff provided a draft set of alternatives to the committees and the Council (November 2013, Agenda Item H.8.a, Draft Alternatives for GEMPAC). These alternatives were revised at the October GEM meeting and are included in this report. Changes to the original version under Agenda Item H.8 are noted throughout Sections 1 and 2 of this report. Underlined text is new text; strikethrough text indicates the text was revised or removed by the GEMPAC.

There appears to be three major decisions needed for all elements of an EM program.

1. Is the element of the program one that should be decided by the Council or can it be left to NMFS to determine implementation?
2. If warranting a Council policy decision, should the element be specified in a prescriptive manner or as a performance standard with some criteria to measure if the standard has been met? For example, only certain species may be allowed to be discarded, therefore those species would be prescribed in regulations. An EM hardware and software system that captures the necessary images and data to document discard events may be implemented through a performance standard to provide opportunities for innovation and improvement.
3. If a performance approach is decided, should the Council specify the performance criteria and if so, what should those criteria be? See Appendix A for an example.

Section 1 covers major policy decision topics:

1. EM Participation and eligibility
2. Discard monitoring method
3. Species that may be discarded
4. Individual Vessel Monitoring Plans
5. Implementation of an EM program

Section 2 covers more detailed provisions for an EM program. The section titled “Data Capture and Processing” includes options for an EM system (i.e., hardware, data sources, formats) and how the fishery data would be processed (i.e., data transfer, validation, analysis).

Compliance and enforcement considerations will be discussed throughout development of alternatives. After draft alternatives are developed and a reasonable range of alternatives are selected by the Council, a detailed analysis of impacts will be drafted for further Council consideration.

Over Arching Policy Decision

Under the National Environmental Policy Act, a reasonable range of alternatives must be identified for a federal action, and includes the “no-action” alternative or status quo. Prior to moving forward with an EM program, the Council must decide the level of EM use and compare it to the status quo of 100 percent observer coverage. Three alternatives have been identified to provide 100% coverage of the fleets for compliance monitoring in the trawl rationalization fishery:

Alternative 1: No Action – 100 percent ~~industry funded~~ human observer coverage, no EM program.

Alternative 2: Use ~~industry funded~~ human observers and or an EM program.

Alternative 3: Use only an EM program. (GEMPAC does not support Alternative 3 for mandatory use of EM and suggest removal of this alternative; see Recommendation 1 in Section 3)

After this decision is made, all other major policy decisions can be made to develop an EM program.

1. Major Policy Decisions

1.1 EM Participation and Eligibility

Many constituents believe that EM should be an option and not mandatory, and that participants should need to meet certain criteria to be eligible to use EM in lieu of carrying an industry funded observer. Participation in an EM program could either be mandatory or voluntary.

Alternative 1: EM is mandatory (GEMPAC does not support Alternative 1 for mandatory use of EM and suggest removal of this alternative; see Recommendation 1, Section 3)

Alternative 2: EM is voluntary

1) Participants must be eligible

a) Eligibility: ~~criteria~~

i) Initial eligibility: Must have an approved individual vessel monitoring plan (IVMP) to participate, no IFQ deficits, all permits have been acquired, (TO BE SPECIFIED).

ii) Continued eligibility: Must be in compliance ~~“good standing”~~ with IVMP, demonstrate proper documentation of the discards, etc.

(1) Example: Vessels not in compliance ~~good standing would~~ may be required to carry an observer. The requirement to be in ~~good standing~~ compliance would provide administrative incentive for compliance. Others ideas: Allow continued use of EM; however, data must be provided on a trip by trip basis or review of video must be increased above current levels.

(2) Criteria for ~~good standing~~ compliance: TO BE SPECIFIED. Need to develop continued eligibility criteria

Discussion:

If the program is mandatory, the program may lack industry “buy-in”. However, a mandatory program would provide a consistent source of discard data. If participation is voluntary or a privilege, the program would provide operational flexibility that allows participants to choose between a human observer or EM. If it’s a privilege to participate, then the need to maintain the privilege may provide incentives for compliance. However, it’s possible that industry funded observer monitoring costs may increase if there is less demand for observers, particularly in smaller ports. Eligibility criteria would need to be developed along with a standard for compliance for operators/owners for continued participation under a voluntary program.

1.2 Monitoring for Discards

A discard monitoring method that would adequately account for discard in each fishery is necessary. One method may not work for all so each fishery will need to be examined. However, the decision will need to incorporate options for which species or species groups may be discarded in a fishery; see section 1.3 Discard Alternatives. For each of these alternatives, where an observer is used for monitoring, the observer would follow the status quo for monitoring procedures.

Alternative 1: Self-reporting and Audit Approach

EM system is used to validate the vessel's account for discards. Harvester reports the catch in a logbook and the EM system is used to verify the logbook information through random sample (X%) of video review for verification. Electronic logbook data will likely be the sole source for discards. (Initial minimum sampling rate to be specified.)

Alternative 2: Video Census Approach

Only EM system is used to account for discards. All video is reviewed for discard events and weight estimates are applied to get total discard accounting.

Alternative 3: Video Sampling for Expansion Approach

EM system is used to account for discards. Estimate discards by the random sample viewing of some percentage (e.g., X%) of all fishing events across all trips or within a trip and expanding weight estimate for total discard for all trips or by trip. (Initial minimum sampling rate to be specified.)

Sub Alternative for Alternatives 1 through 3: Spatial Management Alternative

This option could be applied to any of the above approaches. Under this option, fishing activity in areas that are likely to have lower bycatch could be monitored with EM rather than using observers. Vessels would declare their fishing area prior to departure and be required to follow the appropriate fishing protocols for that area.

- i. Sub Alternative - if you chose to fish in a high bycatch area, a higher level of EM review may be required

Discussion:

The choice of a discard monitoring method impacts costs, data and vessel turnaround times (the time required to incorporate discard data into the quota tracking system), and certainty about account status, accuracy of estimates, and degree of compliance incentives.

Major cost factors include the need for an electronic logbook system, time reviewing video, fishery policy and enforcement costs, and effects on observer costs (Table 1).

Table 1. Relative costs among EM alternatives for discard monitoring. Note: This is not a comparison between costs for observers and EM; this is not a complete listing of all costs.

	Cost Categories		
	Logbook	Video Review	Fishery Policy, Enforcement, & Observers
Alternative 1 (self report/audit)	Cost of E-logbook system	Cost of sampling (less than alt 2 but more than alt 3)	Possible higher per day costs for observers than current costs per day for observers status quo .
Alternative 2 (census)	No impact	Cost of census (most expensive)	Possible higher per day costs for observers than current costs per day for observers status quo .
Alternative 3 (sampling w/ expansion)	No impact	Cost of sampling (least expensive)	Possible higher per day costs for observers than current costs per day for observers status quo .
Sub-Alternative (subareas)	Minor impact if paper logbooks are revised/created	Less overall reliance on EM which may result in higher average costs. <u>If higher level of review is needed for sub alternative cost may increase.</u>	More regulatory complexity, higher enforcement costs, and more reliance on observers at <u>higher per day costs for observers than current costs per day for observers</u> than status quo .

Only Alternative 1 requires an electronic logbook system while Alternatives 2 and 3 rely solely on video review for the estimation of discards. Alternatives 1 and 3 both rely on sampling video and so may entail comparable video review costs which are less than the costs of full census, Alternative 2. The main impact on enforcement costs would be the subalternative which would allow the use of videos in place of observers only when vessels are fishing in certain areas. Such a provision would require the establishment of a set of management lines which may be modified over time, increasing the costs of developing fishery policy and the complexity of the regulations that fishermen would have to understand. The additional regulatory complexity would likely add to enforcement costs as well. Finally, the subalternative would likely entail greater continued reliance on observers if areas to fish with EM are limited in scope and vessels choose to fish with an observer outside those areas. This would result in lesser reliance on video review compared to alternative 1. Under all alternatives here, a reduction in total demand for observers could result in higher per observer day costs than under status quo and lesser video review could result in higher average video review costs relative to other EM alternatives.

Data turnaround and vessel turn-around times will vary by alternative and depend on other aspects of policy. Longer lags to process the data may lessen certainty in a vessel's account balance prior to departure on the next trip.

Table 2. Impacts to data processing and vessel turnaround time under each discard monitoring method (alternatives 1 through 3).

	Discard Data Turnaround	Vessel Turnaround	Account Balance Certainty
Alternative 1 (validation)	Shortest - Immediate	Immediate ^{a/}	Greatest
Alternative 2 (census)	Longest - Time required for complete census of video	Immediate ^{a/}	In Between
Alternative 3 (sampling)	In Between - Time required for review of sample of video	Immediate ^{a/}	Least (incentive to mitigate by retaining all fish)

a/ Immediate, assuming continuation of current policy under which vessels are allowed to fish until data shows up in the system showing that they are in deficit.

Data turnaround times could be the fastest with Alternative 1 under which the primary source of data would be electronic logbooks. Discard data from logbooks could be transmitted immediately upon the end of a trip. Video would be reviewed later to spot check the logbook reports, validating their accuracy. Current policy allows a vessel to keep fishing until information is recorded that indicates it has incurred a deficit. Since discard information comes from observer reports, such information may come in weeks after the completion of a trip. A continuation of this policy would allow vessels to leave on its next trip with greater certainty about its account status than under status quo, assuming that it is reasonable to expect that accurate logs would be validated by video review with no changes. There has been some discussion that under a video system a vessel might not be able to leave port until after the video is reviewed but at this point that has not been recommended for consideration by the committee or the Council.

Using a video census approach (Alternative 2), and assuming a comparable video review capacity, there would be the greatest time lag between completion of a trip and resolution of the vessel account balances.¹ Vessels could maintain their own estimates of discards but there would likely be some differences with the estimates made through cameras, contributing to uncertainty about account balances until video review is completed.

Using a video sampling approach (Alternative 3) there would likely be a lesser time lag in getting discard data into the system than under Alternative 2 but greater than under Alternative 1. As with the other alternatives, the vessel could leave on its next trip immediately but there would be greater uncertainty regarding its account balance. Because vessels would not likely know which events would be expanded as a result of random sampling, this alternative would entail the greatest uncertainty regarding the vessels eventual account balances. Vessel might attempt to mitigate this uncertainty by keeping fish they might otherwise discard (e.g. a damaged overfished species or fish for which species identification on camera might be less certain).

Alternative 3 would be the least accurate among the alternatives and could adversely impact the remainder of the fleet. If the video sample picked up some less frequent incidental catch species

¹ Note: There would have to be some higher level of video review capacity than under Alternatives 1 or 3, otherwise video review would constantly fall behind by longer and longer amounts.

and expanded that result out to the entire trip or across trips, more quota for a species in low supply might be required to cover the trip, resulting in less availability of quota pounds of that species for the remainder of the fleet. The relative accuracy of Alternatives 1 and 2 would depend on the degree of compliance incentive for accurately filling out the e-logbooks. Assuming good-faith compliance, Alternative 1 would provide two estimates as compared to the single estimate provided by the census approach. Inevitably there would likely be some discrepancy between the two and rules would be needed on which estimate to use. Example rules include: the higher of the two, the camera estimate, or the logbook estimate unless the camera estimate was higher by some threshold amount.

The third approach might create an incentive for underreporting. Also required would be a rule for the amount of deviation between camera reports and logbook reports that would have to be observed for a vessel to be considered out of compliance and not in good standing for purposes of being classified as an eligible participant in the EM system (see Section 1.0). However, overall the first approach would provide an ongoing assessment of the performance of the video review for upward bias. If over time the cameras consistently over estimated relative to the logbooks, it is likely that such overestimation would stimulate complaints and a response to improve accuracy. If there were consistent underestimation, this might also be detected by video reviewers comparing video estimates to logbooks. For Alternative 2, there would be no separate data stream available to indicate possible biases. On the other hand, Alternative 2 would provide an independent census of the entire trip and not rely on expansions. If video review results in unbiased estimates, the results might be more accurate than Alternative 1 but less information would be available to validate the video estimates (compared to Alternative 1).

Under all alternatives there may be some incentive to frustrate the video monitoring system by discarding off camera or otherwise interfering with camera performance. On the other hand, the chances of payoff from discarding off camera would be lower because the review is sampling rather than census. Under Alternative 1 there would also be an opportunity to under-report some discard events in hopes that they would not be sampled. Under Alternative 3 on the one hand there might be the greatest incentive to do so, in that, if an event is sampled and some reporting of discard is avoided then the payoff would be greater (the reduced discards reported for the expanded estimates) than would be the case for the video census.

Useful information to gather to inform the analysis:

What are the sampling rates of other systems (or is census used)?

Are there any systems that ~~don't also~~ have logbooks and are they e-logbooks?

Cost estimates for video census vs. sample (will be driven by sampling rates).

1.3 Discard Alternatives

The Council will need to decide which species will be allowed for discard with an understanding that those approved for discard are accurately accounted for or verified through video review under the appropriate discard monitoring method. Currently, under the trawl rationalization program each fishery may discard, or is required to discard, certain species. Under an EM program, discard events will be documented with video; however, it may be difficult to identify some species or differentiate between species. There are four alternatives identified that allow for discard (Table 3); they range from full retention (no discard allowed) to discard at will (discard any species). Table 3 shows the species groups that may potentially be discarded under each

alternative. The discard species are grouped by catch share groundfish species, non-catch share groundfish species, non-groundfish species, prohibited species (halibut, salmon and Dungeness crab), and ESA/MMPA protected species (turtles, marine mammals, seabirds, etc.).

The alternatives reference discards of catch share and non-catch share species. These species lists are different for the IFQ and mothership co-op fisheries. Tables 4 and 5 identify which species are considered catch share and non-catch share species for each of these fisheries. Table 6 contains ESA-listed species that may be found in the area of operation for groundfish fisheries.

Discard events are categorized as selective (intentional discard of certain species) and non-selective (generally, discard that ~~was~~ is not intentional). Under each alternative, selective discard options may be chosen for different gear groups; therefore, *options* to selectively discard certain species or species groups, and *requirements* to selectively discard certain species are noted in the table.

The GEMPAC discussed whether measures might be needed to reduce the occurrence of non-selective discards for safety. Under the whiting electronic monitoring program and maximized retention regulations in place prior to the trawl rationalization program, instances of non-selective discards justified by safety concerns were considered problematic. There are important differences between pre-trawl rationalization and trawl rationalization conditions such that non-selective discard problems would be expected to be substantially diminished in the rationalized trawl fishery. Specifically, prior to trawl rationalization the fishery was managed as a derby; the primary incentive for vessels was to maximize revenue and catch history by maximizing the poundage in their deliveries; and discarding did not diminish vessel gross revenue. Attempts to maximize revenues resulted in overfilling nets and topping of holds (for vessels delivering shoreside). Under the trawl rationalization program, the incentive is to maximize the value for a given amount of quota that a vessel has available to it. Non-selective discards are estimated by observers and deducted from quota accounts, making such discards costly for a vessel. Such estimates and deductions would continue under an EM program. Additionally, while under derby management any diminishment of product quality from overfilling a net might be offset by increased volume, under the trawl rationalization program there is no opportunity for such offsets and any diminished product quality diminishes the value a vessel derives from its available quota. Inversely, improved product quality through shorter or smaller tows may increase total revenue from a given amount of quota. Finally, operational costs associated with non-selective discards provide another disincentive for such discards. Net bleeding and handling of excess fish takes time and effort, adding to operational costs and reducing net revenue. Thus, under trawl rationalization, making larger tows does not increase a vessels revenue and the incentive may be for shorter smaller tows in order to reduce lost revenue opportunity from discards, increase product quality, and limit operational costs associated with the handling excess fish.

Vessels typically use net sensors to monitor catch in the coded and tow times vary based on densities of fish. Occasionally sensors may fail, resulting in too much fish at haulback and the need for releasing fish for safety reasons. However, most fishermen can monitor their catch and begin haulback when the coded is nearly full or at a level of catch needed to fill the vessel. Tow times that catches the same amount of fish can vary greatly based on fish density and may range from 15 minutes to 6 hours so limiting tow times is not a feasible option to prevent overfilling nets and reducing instances of non-selective discards for safety reasons.

The following is a description of possible alternatives however some statutory management measures such as the Endangered Species Act (ESA) or the Marine Mammal Protection Act (MMPA) may restrict the consideration of some discard scenarios. For example, under a full retention fishery whereby all catch is retained, the retention of species listed under the ESA or MMPA would prevent vessel operators from retaining those species unless exceptions were made. Such exceptions have been made for the catcher vessels in the at-sea whiting mid-water trawl fishery that do not sort at sea and deliver their catch to at-sea and shoreside processors.

Alternative 1: Full retention

1. No selective discard. Retain all catch share species and non-catch share groundfish species for the IFQ and co-op fisheries (see Table 4 and 5, respectively); non-groundfish species; prohibited species; ESA species (Table 6); and MMPA species.
2. No non-selective discard.

Alternative 2: Maximize Retention

1. No selective discard for catch share species, non-catch share groundfish species
2. No selective discard for non-groundfish species (~~excluding prohibited or protected species~~ Non-FMP and not prohibited species).
3. Allow selective discard of trash, mud coral, etc.
4. Require selective discards of prohibited species; see exceptions for mothership and shoreside catcher vessels below and in Table 3. except when mid-water trawl IFQ vessels sort at sea MS processors must discard prohibited species.
5. Require selective discards of ESA and MMPA species (protected species).
6. Exceptions:
 - Allow non-selective discards for safety, "bleeding net", zipper accidentally opened, or fish came off hook. Non-Selective discards will be debited from IFQ vessel accounts and co-op allocations where appropriate (fish gilled in the net are not currently counted in observer estimates).
 - Mother ship (MS) catcher vessels (CV) may discard from the CV minor amounts of catch that were not in the net and not delivered to MS. All discards must be enumerated and reported.
 - Shoreside (SS) mid-water trawl IFQ trip must retain halibut, salmon, and crab unless sorting at sea.
 - There may be exceptions to retain marine mammals, seabirds, and turtles for necropsy.

Alternative 3: Retention of Catch Share Species with Options.

1. No selective discard for catch share species. It's possible to add fishery specific options that allow selective discard of some catch share species; options here are not mutually exclusive; however, there must be adequate camera species identification and weight estimates for discard of catch share species.

Options: Proposed selective discard options for groundfish by all catcher vessels except those midwater trawl vessels delivering to motherships (sub-options are noted):

- a) For catch share species
 - Option a – Allow discard of flatfish
 - Option b – Allow discard of lingcod and sablefish

- Option c – Allow discard of all non-rockfish groundfish (full retention of rockfish only)
- Option d – Allow discard if species that are verifiable with EM
- b) For non-catch share groundfish species
- Option c – Allow discard of all non-rockfish groundfish (full retention of rockfish only)
- Option d – Allow discard if species that are verifiable with EM
2. No selective discard for non-groundfish (~~excluding prohibited or protected species~~ Non-FMP and not prohibited species)
 - Option d – Allow discard if species that are verifiable with EM
 - Option e – Allow discard of all non-groundfish species
 2. Allow selective discards of trash, mud, coral, etc.
 3. Require selective discards of prohibited species; see exceptions for mothership and shoreside catcher vessels below and in Table 3. ~~except when mid-water trawl IFQ vessels do not sort at sea. MS processors must discard prohibited species.~~
 4. Require selective discards of ESA and MMPA species.
 5. Exceptions:
 - Allow non-selective discards for safety, "bleeding net", zipper accidentally opened, or fish came off hook. Non-Selective discards will be debited from IFQ vessel accounts and co-op allocations where appropriate (fish gilled in the net are not currently counted in observer estimates).
 - Mother ship (MS) catcher vessels (CV) may discard from the CV vessel minor amounts of catch that were not in the net and not delivered to MS. All discards must be enumerated and reported.
 - Shoreside (SS) mid-water trawl IFQ trip must discard halibut, salmon, and crab if sorting at sea.
 - There may be exceptions to retain marine mammals, seabirds, and turtles for necropsy.

Alternative 4: Discard At Will (Status Quo)

1. May discard catch share species, non-catch share species (e.g., at-sea whiting set-asides)
2. May discard non-groundfish (~~excluding prohibited or protected species~~ Non-FMP and not prohibited species).
3. Allow selective discard of trash, mud coral, etc.
4. Require selective discards of prohibited species; see exceptions for mothership and shoreside catcher vessels below and in Table 3.
5. Require discards of ESA and MMPA species (protected species).
6. Exceptions:
 - Allow non-selective for safety, "bleeding net", zipper accidentally opened, or fish came off hook or gilled in net. Non-Selective discards will be debited from IFQ vessel accounts and co-op allocations where appropriate (fish gilled in the net are not currently counted in observer estimates).
 - Allow discard of unmarketable species (e.g., small size, damage, sand fleas)
 - Mother ship (MS) catcher vessels (CV) may discard from the CV vessel minor amounts of catch that were not in the net and not delivered to MS. All discards must be enumerated and reported.

- Shoreside (SS) mid-water trawl IFQ trip must retain halibut, salmon, and crab unless sorting at sea.
- There may be exceptions to retain marine mammals, seabirds, and turtles for necropsy.

Table 3. Selective species discard alternatives for catcher vessels only. Key - White: No Discard/must retain species; Gray: May Discard; Black: Discard Required; Crosshatch: No discard with exceptions or options.

Species Discarded	Alt 1. Full Retention					Alt 2. Maximize Retention					Alt 3. Retention of Catch Share Species with suboptions					Alt 4. Discard at will				
	MS CVs MWT CO-OP	IFQ Program Fisheries				MS CVs MWT CO-OP	IFQ Program Fisheries				MS CVs MWT CO-OP	IFQ Program Fisheries				MS CVs MWT CO-OP	IFQ Program Fisheries			
SS MWT (whiting and Non-whiting) ^{a/}		BTW	Fixed Gear (LL)	Fixed Gear (POT)	SS MWT (whiting and Non-whiting) ^{a/}		BTW	Fixed Gear (LL)	Fixed Gear (POT)	SS MWT (whiting and Non-whiting) ^{a/}		BTW	Fixed Gear (LL)	Fixed Gear (POT)	SS MWT (whiting and Non-whiting) ^{a/}		BTW	Fixed Gear (LL)	Fixed Gear (POT)	
Catch share species										3 See Option e	See Option a, b, c, d	See Option a, b, c, d	See Option a, b, c, d	See Option a, b, c, d						
Non-catch share species										3 Option a, b, c, e	Option c, d	Option c, d	Option c, d	Option c, d						
Non-FMP/Not Prohibited										3 Option e	Option c, e	Option d, e	Option c, e	Option d, e						
Other (trash, mud, coral)																				
Prohibited: Halibut						3					3				3					
Prohibited: Salmon, Dungeness crab OR/WA						3					3				3					
ESA/MMPA																				
Exceptions						1, 5	1,5	1, 5	1,5	1,5	1,5	1,5,6	1,5,6	1,5,6	1,5,6	1,2,5	1,2,5	1,2,5	1,2,5	1,2,5

a/ No regulatory distinction between non-whiting and whiting MWT trips. For example chaffing gear regulations in the MWT fishery apply to both types of activity.

Exceptions:

1. Non-selective discard for safety, "bleeding net", zipper accidentally opened, fish came off hook, gilled in net
2. Unmarketable (e.g., small size, damage, sand fleas)
3. MS CVs must enumerate all catch ~~discard halibut, salmon, and crab~~ on the vessel and not in the net that are not delivered to MS and are discarded by CV.
4. SS mid-water trawl IFQ trip must retain halibut, salmon, and crab unless sorting at sea.
5. ~~SS IFQ may discard minor amounts of catch~~
5. 6. There may be exceptions to retain marine mammals, seabirds, and turtles for necropsy.

Options: (not mutually exclusive)

- a. Allow discard of flatfish
- b. Allow discard of lingcod and sablefish
- c. Allow discard of all non-rockfish groundfish
- d. Allow discard if species are verifiable with EM
- e. Allow discard of all nongroundfish species

Table 4. IFQ program and Non-IFQ groundfish species groups that are noted in Table 3 as potential discards. Source regulations are noted in each list.

<p>Catch share species (IFQ program groundfish species, From: 660.140(c)(1))</p>	<p>Non-catch share species (Non-IFQ Groundfish Species From: Table 1 and 2 to Part 660, Subpart D -- Limited Entry Trawl Rockfish Conservation Areas and Landing Allowances for non-IFQ Species and Pacific Whiting North and South of 40°10' N. Lat.)</p>
<p>ROUNDFISH Lingcod N. of 40°10' N. lat. Lingcod S. of 40°10' N. lat. Pacific cod Pacific whiting</p> <p>Sablefish N. of 36° N. lat. Sablefish S. of 36° N. lat.</p> <p>FLATFISH Arrowtooth flounder Dover sole English sole Other flatfish stock complex Petrale sole Starry flounder Pacific halibut (IBQ) N. of 40°10' N. lat.</p> <p>ROCKFISH Bocaccio S. of 40°10' N. lat. Canary rockfish Chilipepper S. of 40°10' N. lat. Cowcod S. of 40°10' N. lat. Darkblotched rockfish Longspine thornyhead N. of 34°27' N. lat. Minor shelf rockfish complex N. of 40°10' N. lat. Minor shelf rockfish complex S. of 40°10' N. lat. Minor slope rockfish complex N. of 40°10' N. lat. Minor slope rockfish complex S. of 40°10' N. lat. Pacific ocean perch N. of 40°10' N. lat. Shortspine thornyhead N. of 34°27' N. lat. Shortspine thornyhead S. of 34°27' N. lat. Splitnose rockfish S. of 40°10' N. lat. Widow rockfish Yelloweye rockfish Yellowtail rockfish N. of 40°10' N. lat.</p>	<p>Minor nearshore rockfish & Black rockfish Cabezon Shortbelly Spiny dogfish Longnose skate Other Fish (sharks (except spiny dogfish), skates (except longnose skate), ratfish, morids, grenadiers, and kelp greenling). Longspine thornyhead South of 34°27' N. lat. Minor nearshore rockfish & Black rockfish California scorpionfish</p>

Table 5. Co-op program groundfish species lists noted in Table 3 as potential discards. Source regulations are noted in each list.

Catch share species (Co-op groundfish species formally allocated, From: MS Co-op program species, 660.150(c)(1)(i))	
Pacific whiting Canary rockfish Darkblotched rockfish	Pacific Ocean perch Widow rockfish
Non-catch share species (At-Sea Whiting Fishery Annual Set-Asides, 2013, From Table 1d. To Part 660, Subpart C)	
Arrowtooth Flounder BOCACCIO, S. of 40°10 N. lat. Chilipepper, S. of 40°10 N. lat. COWCOD, S. of 40°10 N. lat. Dover Sole, Coastwide English Sole, Coastwide Lingcod, N. of 40°10 N. lat. 15 Lingcod, S. of 40°10 N. lat. Longnose Skate, Coastwide Longspine Thornyhead, N. of 34°27 N. lat. Longspine Thornyhead, S. of 34°27 N. lat. Minor Nearshore Rockfish, N. of 40°10 N. lat. Minor Nearshore Rockfish, S. of 40°10 N. lat. Minor Shelf Rockfish, N. of 40°10 N. lat. Minor Shelf Rockfish, S. of 40°10 N. lat.	Minor Slope Rockfish, N. of 40°10 N. lat. Minor Slope Rockfish, S. of 40°10 N. lat. Other Fish, Coastwide Other Flatfish, Coastwide Pacific Cod, Coastwide Pacific Halibut, Coastwide Petrale Sole, Coastwide Sablefish, N. of 36° N. lat. Sablefish, S. of 36° N. lat. Shortspine Thornyhead, N. of 34°27 N. lat. Shortspine Thornyhead, S. of 34°27 N. lat. Starry Flounder, Coastwide YELLOWEYE, Coastwide Yellowtail, N. of 40°10 N. lat.

Table 6. ESA-listed species that may be found in the area of operation for groundfish fisheries.

ESA Species	
Green sturgeon (<i>Acipenser medirostris</i>)	Southern Resident killer whales (<i>Orcinus orca</i>)
Eulachon (<i>Thaleichthys pacificus</i>)	Guadalupe fur seals (<i>Arctocephalus townsendi</i>)
Humpback whales (<i>Megaptera novaeangliae</i>)	Green sea turtles (<i>Chelonia mydas</i>)
Steller sea lions (<i>Eumetopias jubatus</i>)	Olive ridley sea turtles (<i>Lepidochelys olivacea</i>)
Leatherback sea turtles (<i>Dermochelys coriacea</i>)	Loggerhead sea turtles (<i>Carretta carretta</i>)
Sei whales (<i>Balaenoptera borealis</i>)	Short-tailed albatross (<i>Phoebastria albatnfs</i>)
North Pacific Right whales (<i>Eubalaenajaponica</i>)	Marbled murrelet (<i>Brachyramphus marmoratus</i>)
Blue whales (<i>Balaenoptera musculus</i>)	Southern sea otter (<i>Enhydra lutris nereis</i>)
Fin whales (<i>Balaenoptera physalus</i>)	California least tern (<i>Sterna antil/arum browni</i>)
Sperm whales (<i>Physter macrocephalus</i>)	

Discussion:

Key aspects of the decision for which species or species group discards will be allowed include the camera's ability to capture required information, impacts on video review costs, and impacts on the collection of biological information.

With respect to camera ability, for non-IFQ species discards the key is the ability to differentiate the non-IFQ species discards from IFQ species in order to ensure that IFQ species are properly accounted for. For non-IFQ species, further speciation (beyond ensuring that the discard is a non-IFQ species), weights, or other measures would not be required. For IFQ species, the camera system would need to identify the exact species and also generate a video image with enough quality to estimate weight using a video reviewer or through length weight relationships (but other technologies may develop over time).

The more species are discarded, the more events will likely require more careful video review, possibly increasing costs. The degree of cost increase will depend on the review method chosen, the frequency of occurrence for certain species, and the technologies that develop over time to automate the video review and species identification/measurement process.

With full retention, an opportunity is generated for the shoreside collection of biological information which is currently collected by at-sea observers. As the scope of allowed discards increases, the opportunity for shoreside collection of biological data decreases. Such reductions might be inversely related to the amount of biological observer coverage required under the program. Evaluation of this potential impact will require input from the West Coast Groundfish Observer Program.

1.4 Individual Vessel Monitoring Plans (IVMP)

A major policy question is whether to have IVMPs as part of the EM program and, if so, the duration of effectiveness of such plans. It's likely that these plans will be required to facilitate an effective program and serve as a clear plan for discard documentation, installation and maintenance an EM system, protocols for data storage and transfer, among other things. Each vessel operator/owner would be responsible for developing an IVMP for the vessel and acquiring the needed approval. It's likely that NMFS would approve the plan and determine when and how long it would be effective. Vessel specific fish handling protocols may need to be developed to provide clear visuals of species discarded. A general list of the categories to be included in the IVMP is provided here but specifics for these elements and the criteria to be met for approval would be specified in Section 2, Data Capture and Processing.

- 1) Approval of plans: (NMFS to decide how this is done)
 - a) Approved by NMFS based on criteria specified in regulation

- 2) Duration of Effectiveness:
 - a) ~~Monthly~~ No Expiration unless modifications are made
 - i) Plan modification provisions: (NMFS to decide how this is done)
 - (1) EM Provider and vessel operator provisions – changes that do not need re-approval (MODIFICATION DESCRIPTION NEEDED)
 - (2) NMFS provisions - changes that trigger the need for re-approval (e.g. operator will use a different vessel)
 - b) Annual or if modifications are made quarterly plan, etc
 - i) Plan modification provisions: (NMFS to decide how this is done)
 - (1) EM Provider and vessel operator provisions – changes that do not need re-approval (MODIFICATION DESCRIPTION NEEDED)

(2) NMFS provisions - changes that trigger the need for re-approval (e.g. operator will use a different vessel)

~~e) Specified by NMFS or IVMP is set between fisher and provider~~

3) Potential categories of information in an IVMP (specifics identified in Section 2):

- a) Type of system
- b) Hardware
- c) Software
- d) Emergency protocols
- e) Back-up equipment use protocols
- f) Catch handling protocols
- g) Layout of vessel
- h) Screen shots of all camera views
- i) Number of cameras needed with placement specifications
- j) Care and maintenance of the EM system
- k) Types of sensors and data for sensors to capture
- l) Download/maintenance schedule
- m) Logbook format (electronic or paper)

4) Declaration of EM use:

- a) No Declaration to appropriate agencies and contractors
- b) Declaration to NMFS appropriate agencies and contractors for use of EM (i.e., vessel will opt to use EM for a specified period of time within fishing year)
 - i) Option 1 - For the coming year, participants must indicate in which months, if any, it will use EM and in which months, if any, it will use an observer. (e.g. quarterly)
 - ii) Option 2 - Trip by trip basis (to provide the option for the vessel and the observer provider to work out when observers may be available on a per trip basis).
 - (1) IVMP lays out the responsibility for vessel operator to notify NMFS, EM provider, and Observer program when EM will be used and when observer will be used.
 - iii) Option 3 - Emergency situation – camera broke so need an observer tomorrow, vice versa
 - (1) IVMP lays out the responsibility for vessel operator to notify NMFS, EM provider, and Observer program when EM will be used and when observer will be used.

1.5 Implementation

Implementation of an EM program could be done for all fisheries at one time through regulation (Alternative 1). However, there may be other options. Implementation of an EM program could be done through a pilot program using an Exempted Fishing Permit (ESP.) (Alternative 2). For example, an EM program may be developed for a fishery, and then implemented on a temporary basis through an ESP. to identify issues and improve the program before it is implemented full scale for a particular fishery or all fisheries. It could also be done through a “phased-in” approach. For example, if development of an EM monitoring program (i.e., regulations, camera system, EM providers, review process, accounting protocols, enforcement, etc.) is ready for use in the mid-water trawl fishery then NMFS could implement the program by regulation before other EM programs are fully developed for use in other fisheries such as the bottom trawl (Alternative 3). Another approach would be to implement an EM program based on retention rules (Alternative 4),

starting with any gear types that are willing to fish under a maximized retention type fishery (See Alternative 2 in Section 1.3 for a description of a maximize retention fishery). For example, bottom trawl and non-whiting mid-water trawl vessels that are willing to retain and land all fish (excluding prohibited species and ESA/MMPA species) would be allowed to use EM. Then, as EM capabilities improve to provide verifiable species identification (for example distinguishing aurora rockfish from rough eye rockfish), the EM program could be expanded to include other discard options (See Alternative 3 in Section 1.3). A list of species that are shown to be verifiable with EM would need to be developed over time.

Phasing in Implementation could be organized in a number of ways.

Alternative 1: Implement EM program for all fisheries at one time

Alternative 2: Phase in with a pilot program with EFPs

Alternative 3: Phase in by sector/gear (MWT whiting may be ready first)

Alternative 4: Implement by retention rules; start with maximize retention fisheries and move to other retention rules as reliable technologies for speciation are developed.

2. Data Capture and Processing

The success of an EM program relies on the ability to capture the data and process it in a timely manner. There are multiple ways to set up a system and many details are absent here; however, some general topics are listed here to begin development of a system.

2.1 Vessel Hardware, and Data Maintenance, and Onboard Procedures

1) Data formats:

~~Alternative 1: Create a standardized format that can be used by multiple users. (NEED TO BE SPECIFIED BY OTHER TECH ADVISORS during implementation of what format would be best to use) Specific format(s)?~~

~~Alternative 2: Open source format to utilize the video images using a range of commercially available viewers, without having to purchase licenses from vendors who collected the data. NMFS policy encourages the use of open source code or standards that facilitate data integration and offer long term cost savings rather than becoming dependent on proprietary software.~~

5) Video Hardware: (performance standards to be developed during implementation between NMFS, PSMFC, states, and contractors; similar to British Columbia fisheries, See appendix A) Image quality must be sufficient to allow clear identification of species or species categories being discarded.

~~Alternative 1: Analog~~

~~Alternative 2: Digital~~

~~Alternative 3: Both Alternatives 1 or 2 can be used~~

~~Alternative 4: Other?~~

6) Logbook Data Source: It is assumed that electronic logbooks would be required processed by NMFS for quota pound accounting. Without such logs, the time required for video review

~~would expand and likely make the program cost prohibitive. The fields and data format would be specified by NMFS.~~

Allow either paper or electronic logbooks; however, electronic logbooks should be encouraged to increase efficiencies in the EM analysis.

- 7) On Vessel Data Storage: (video hardware, sensor data, vessel location data, logbook data) integrated and in a secure format
 - ~~Alternative 1: Only harddrives~~
 - ~~Alternative 2: Hard drives in combination with cloud storage.~~
- 8) Onboard operations (performance standards to be developed during implementation between NMFS, PSMFC, states, and contractors) Topic examples:
 - a) Self check system to ensure proper functioning of EM system (“functionality test” within the EM system with a record that the test was performed)
 - b) EM system is powered on during entire trip, however cameras could be triggered to turn on at first hydraulic event and remain on for the duration of the trip.
 - c) Back-up equipment use protocols if EM unit or portions of it fail

2.2 Data Transfer Processes

Protocols would need to be established for data transfer. Since the data could potentially be used in enforcement actions, data transfer protocols would have to address chain of custody issues.

Data protocols may vary by sector. For example, mothership catcher vessels may seldom return to port. This may not only affect the volume of data that they would have to store but also the data transfer protocols used. If the data transfer processes are to be included in the Council recommended policy then both generic provision (provisions applying to all vessels or all vessels of a certain class) and individual vessel performance criteria should be specified. Protocols may also vary based on the type of data being transferred (video, electronic log, or data logger).

- 1) Video transfer, Electronic logbook, Data loggers (performance standards developed during implementation between NMFS, PSMFC, states, and contractors)
 - a) Secure transfer – chain of custody requirements
 - b) Possibly allow captain and crew to transfer data to EM provider
 - ~~e) Timing of transfers~~
 - ~~d) Channel for data transfer (possibilities include)~~
 - ~~i) Hard drive removal/replacement~~
 - ~~ii) Transmission via internet shoreside~~
 - ~~iii) Physical transfer of hardware to reviewers~~
 - ~~iv) Other?~~
 - ~~e) Other necessary provisions?~~
- 2) Electronic logbook
 - ~~a) Timing of transfers~~
 - ~~b) Channel for data transfer (possibilities include)~~
 - ~~i) Hard drive removal/replacement~~
 - ~~(1) Transmission via internet shoreside~~
 - ~~(2) Physical transfer of hardware to reviewers~~
 - ~~ii) Wifi or cellular transmittals~~

- ~~iii) Thumbdrive submission~~
- ~~iv) Through VMS~~
- ~~e) Other necessary provisions?~~

~~3) Data loggers~~

- ~~a) Timing of transfers~~
- ~~b) Channel for data transfer (possibilities include)~~
 - ~~i) Hard drive removal/replacement~~
 - ~~(1) Transmission via internet shoreside~~
 - ~~(2) Physical transfer of hardware to reviewers~~
 - ~~ii) Wifi or cellular transmittals~~
 - ~~iii) Thumbdrive submission~~
 - ~~iv) Through VMS~~
- ~~e) Other necessary provisions?~~

2.3 Data Processing, Validation, and Analysis

EM data processing would likely involve analysis of EM sensor, video data, and electronic logs. The following is an outline of some of the considerations to be taken up under this topic.

Allow state and federal enforcement access to data

- 1) Video review and log comparison
 - a) Potential reviewers for discard events (not mutually exclusive)
 - i) Alternative 1: Sustainable Fisheries Division NMFS
 - ii) Alternative 2: Pacific States Marine Fisheries Commission
 - iii) Alternative 3: Independent contractor
 - b) Review process:
 - i) Percent reviewed (depends on method chosen to monitor discards in section 1.2)
 - ~~(1) Alt 1: X% of all trips are reviewed, (percentage of review may increase if compliance issue)~~
 - ~~(2) Alt 2: Census of all trips~~
 - ~~(3) Alt 3: Radom selection of discard~~
 - ii) Match video segments with logbook discard events; may need to define audit units that match fishing logs units (i.e., fishing events). For some fisheries fishing events are not clearly defined to facilitate an audit. (developed during implementation between NMFS, PSMFC, and contractors)
 - ~~(a) Include sensor data in video to verify time and location of fishing events~~
 - ~~(b) Use GPS data in logs~~
 - ~~(c) Use data logger~~
 - iii) Validation: (developed during implementation between NMFS, PSMFC and contractors)
 - ~~(1) Use observer data from an EM trip to validate data collected (video and/or logbook) —on trips for which the biological observers overlap with EM.~~
 - ~~(2) Species identification capabilities~~
 - ~~(3) Weight estimation capabilities~~
 - ~~(4) Protocols for additional video review~~

- ~~(5)~~
- ~~(6) when non-compliance issues arise;~~
 - ~~(a) Create incentives to comply (management incentives vs. enforcement action)~~
 - ~~(a) Look at ways the Alaska co ops model might be used to implement the program, e.g., self imposed sanctions within a group or fleet~~
- e) ~~Logbooks~~
 - i) ~~Requirements~~
 - ~~(1) Require only electronic logs?~~
 - ~~(2) Option to use either one?~~
 - ii) ~~Electronic~~
 - ~~(1) Format~~
 - ~~(2) Minimum data fields needed (standardize)~~
 - ~~(3) Submission requirements~~
 - iii) ~~Paper~~
 - ~~(1) Minimum data fields needed (standardize)~~
 - ~~(2) Submission protocol~~
 - ~~(3) Develop method to enter data and match with video~~

3. GEMPAC Recommendations

Recommendation 1: The GEMPAC does not support Alternative 1 that would make EM mandatory and suggest removal of this alternative listed under Section 1.1 “EM Participation and Eligibility. To be consistent with this recommendation, the GEMPAC also recommends removal of Alternative 3, “Use only an EM program,” and that both alternatives should not be analyzed in detail in any future environmental analysis.

Recommendation 2: Provide option for an out-of-cycle ESP. for Council consideration. Example, allow any vessel any gear that wants to fish under a maximized retention type fishery program to be exempt from observer coverage while using EM.

Recommendation 3: The GEMPAC considered the “phase-in” approach as suggested by the Council. In lieu of phasing in by fishery, the GEMPAC recommends an alternative that would phase in implementation through retention rules; start with maximize retention alternative and move to other retention rules as methodologies for speciation are developed.

Recommendation 4: GMEPAC recommends that performance standards for regulations be developed during implementation between NMFS, PSMFC, the states, and contractors for some items identified in Section 2, “Data Capture and Processing,” including video hardware, onboard operations, and transfer of data (video, electronic logbooks, data logger information).

Appendix A

Department of Fisheries and Oceans – Canada PACIFIC REGION INTEGRATED FISHERIES MANAGEMENT PLAN GROUNDFISH, EFFECTIVE FEBRUARY 21, 2013 (April 11, 2013 – Version 1.1)

Appendix 2: Groundfish Hook and Line/Trap Monitoring Requirements (At-Sea and Dockside), Mortality Rates, and Size Limits

3.2. Systems Requirements

Any electronic monitoring system must be approved by the Department and must include the following minimum specifications and component requirements:

- a) a video and sensor data-logging engine (control box), equipped with monitor and keyboard to verify correct power supply and EM system software and hardware performance, equipped with an external control to allow the user to manually insert time stamped event markers into the sensor record;
- b) operating software to record imagery during fishing events;
- c) peripheral sensor devices suitable for fishing-deck work environment, including GPS, an electronic hydraulic pressure transducer, and a winch rotation sensor;
- d) a minimum of two closed circuit television cameras, suitable for fishing-deck work environment, configured with an adjustable focal length lens to provide a clear view of the catch retrieval process and the measurement of released fish.
- e) have the sensor box connected to a monitor and keyboard to allow the user to view recorded EM imagery and conduct system checks to test system functionality.