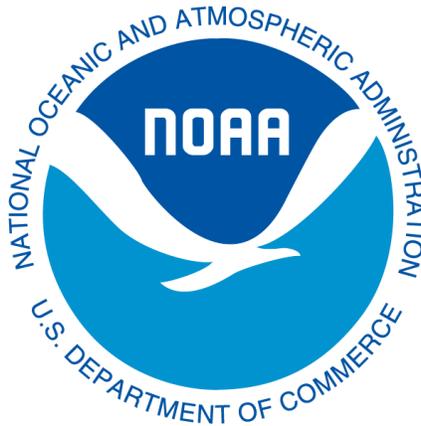# -DRAFT-

COST ANALYSES FOR THE 2016 DEPLOYMENT OF EM
INTO THE PRE-IMPLEMENTATION SMALL VESSEL (<57 AND <40)
FIXED GEAR VOLUNTEER FLEET

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Background

In 2016, operational testing of electronic monitoring (EM) on fixed gear vessels will proceed according to the EM pre-implementation plan developed by the EM workgroup (EMWG) and final decision rests with the Council at it's October,2015 meeting. At the July, 2015 EMWG meeting, cost information and fleet statistics were used to forecast EM deployment costs to cover EM equipment (cameras, wiring, hard drives, etc), field support for deployment and retrieval of the camera systems was presented to evaluate costs relative to available funds. The EMWG recommended that the current PSMFC contracted EM service provider Archipelago Marine Research (AMR) bring forward anticipated costs for deploying EM consistent with the pre-implementation plan for 2016, which was reviewed at the September EMWG meeting.

At the July, 2016 meeting the EMWG recommended a random vessel selection rate of 0.30 for deploying electronic monitoring (EM) systems to a fleet of up to 60 volunteer vessels. The current volunteer fleet consists of 56 vessels and it remains uncertain if an additional 4 vessels will become part of the 2016 pre-implementation fleet. The EMWG also recommended 4 separate time intervals for deploying and removing EM systems that includes January-February, March-June, July-October and November-December. Vessels are selected with replacement therefore a vessel could be selected across multiple periods.

The primary purpose of this analyses is to forecast total costs for the EM deployment (2016 EM Pre-Implementation Plan) and characterize the uncertainty in cost estimates among two approaches projecting costs incurred during 2015 and on cost estimates provided by the EM service provider for 2016 EM deployment. This analyses is intended to promote discussion about balancing risk of exceeding budget, and a range potential costs associated with fleet size and deployment rate. It also serves to supports future EM implementation by promoting discussion for developing an economic analyses in a future NEPA document for the 2018 EM implementation in the North Pacific.

Materials and Methods

A simulation analyses was conducted to forecast median cost and range of potential costs (25th and 75th quantiles) in cost estimates based on random deployment of EM systems into a 60 vessel fleet with a selection rate of 0.30. There are a number of data sources used to inform the simulation model that include; 1) current list of the 56 vessels currently in the 2016 EM pool and their associated 2014 landings information, 2) 2015 EM volunteer fleet statistics (Humaidhi et al., 2015) 3), video review rate information (Humaidhi et al., 2014 and 2015), 4) cost information derived from the contractual service contract and expenditures in 2015 and 5) total cost information provided by AMR on anticipated EM deployment costs into the 2016 volunteer pool of randomly selected vessels (AMR Memorandum, 2015).

The simulation model incorporated the four separate time intervals for EM system deployment and removal from the vessel. The model took 500 random draws of all vessels within each time interval using a 0.30 selection rate. The analyses explicitly incorporated the seasonal fishing pattern of vessels on the current EM volunteer list based on 2014 landing information and vessel specific dates of the first and last fishing trip. In order to properly track the number of EM systems required (for cost analyses), it was assumed that an EM system from a vessel that completed fishing (in a time-interval) would be available for re-installation 7 days

after the landing. Further, vessels selected in an earlier time period and the re-selected in a later time period were tracked and assumed to retain the previously installed sensor package to adjust EM system deployment costs downward accordingly since a sensor package would already be installed from a previous time period.

This analyses estimated three discretionary costs that included; 1) installing sensors and wiring on all vessels to accommodate easy exchange of EM systems and validate self-reported data on effort, 2) video review assuming that 100% of the video would be examined for species count and composition, 3) video review that includes hook-count to accommodate within and between haul expansion if video data are missing or are of poor quality. To evaluate the costs of installing sensors and wiring for all vessels within the fleet, costs for each draw and time period was tracked and accounted for to ensure an accurate estimate. The estimated costs for installation included purchase of sensors and wiring to support an EM system and installing a stand-alone sensor package on vessels that were not selected, but fished in a given time period. Data gathered using a stand-alone sensor package could be used to validate the total number of hauls for vessels not selected to carry an EM system. Currently, self-reported data in logbooks are used to determine effort. The cost for post-processing video from an average fishing day was derived using hourly salary and benefits for video review personnel and the 2015 EM volunteer video review statistics and assumes that 100% of video is reviewed. The costs for processing video that included hook counts was derived in the same manner, but based on 2014 EM volunteer video review statistics (Table 1).

The analyses examined three approaches to simulate the 2016 deployment cost distribution: 1) "Fully Loaded Daily Cost" based on 2015 cost information, 2) "Fully Loaded Vessel Cost" based on 2015 cost information 3) "Fully Loaded Daily Cost" based on AMR anticipated costs for deploying into the 2016 EM selection pool.

Fully Loaded Daily Cost

The daily vessel deployment cost was estimated by dividing total deployment costs, paid to the EM provider in 2015, by the total number of fishing days observed in the 2015 EM pool of vessels (Table 2). The "Fully Loaded Daily Cost" was the sum of the deployment cost and the video review cost on a per-fishing day basis. The estimated cost from a single random draw is based on the observed trips and associated number of days fished by the group of selected vessels for that draw and time period.

The same method was used in a second approach but total deployment costs were based on the EM service provider (AMR) anticipated costs for deploying EM into the 2016 EM pool "AMR Fully Loaded Daily Cost". These costs represent the presumed budgeted and range of potential costs for EM deployment in 2016.

Fully Loaded Vessel Cost

The third approach "Fully Loaded Vessel Cost" divided costs into four cost categories that included; 1) monthly lease cost for each EM system, 2) EM system install with sensor package costs, 3) project management that includes, system maintenance, service support, travel, data recovery costs and 4) video review costs (same as above). Since contractual cost and expenditure information is used to separate out each cost category these costs are confidential and not provided (Table 3). The assumption is that dividing out the costs based on each of these cost categories, instead of rolling up into a fully loaded daily rate, would better simulate the actual cost structure for deploying EM systems in 2016.

A range of costs presented for each of the approaches represents an equal division of the frequency distribution of costs derived from the simulation containing the same fraction 25% above the median and 25% below the median of the total population.

Results

Comparison of the magnitude of discretionary costs for video review indicate costs without hook counts are approximately half of total costs when including hook count with median values of $65,000 and $156,465 respectively. The median value for installation and purchase costs for sensors and wiring on vessels that were not selected to carry an EM system was $143,897 (Table 4 and Figure 1).

Comparison of the two cost categories incorporated to estimate the "Fully Loaded Daily" approach indicates that costs for video review is a relatively minor component (Figure 2). A comparison of the four cost categories used to estimate a "Fully-loaded Vessel Rate" indicate that management, camera and vessel installation costs are roughly equal and video review was the lowest cost (Figure 3). Both approaches to forecasting costs in 2016 are very similar in overall costs (Figure 4). Large differences in costs in each of the time intervals is not unexpected and are due to the seasonal nature of the fishery. Trips taken in the March to June time period generally target halibut and Pacific cod in the fall time period (July-October). The range of costs among each of the cost estimation approaches is largely drive by the uncertainty in the number of vessels randomly selected, EM systems required (Figures 5 and 6) and their associated fishing days and trips (Figure 6). The estimated number of EM systems required is significantly lower since the model accounts for the number of EM system re-deployed unto another vessel within a time period.

The median estimated annual cost using the "AMR Fully Loaded Daily" approach was considerably higher than either the "Fully Loaded Daily" or the "Fully Loaded Vessel" approach (Figure 7). The median cost estimate using the "Fully Loaded Daily" approach was $515K and the lower and higher quantiles were $447K and 721k, respectively. The median cost estimate using the "AMR Fully Loaded Daily" approach was $760k and the lower and higher quantiles were $660k and 1,06mil, respectively (Table 5). Including costs for video review that includes hook count, sensor, or both increase estimated median costs approximately 11%, 14%, 21% respectively (Table 6 and Figure 8).

Discussion

There are important differences in the cost information used in simulation approaches that should be considered when comparing projected overall program costs. The fully loaded daily and the fully loaded vessel approaches simply re-project 2015 costs to estimate total program costs in 2016. In 2015, EM was deployed on all vessels in a small volunteer fleet (12) in a limited number of ports (3). In 2016, EM will be deployed among a 60 vessel fleet at a 30% selection rate and must account for potential deployments in remote ports outside primary service ports and extended over a full calendar year. The cost estimate provided by AMR incorporated these program changes into their overall cost estimate and therefore is the best representation of potential costs in a fully implemented EM program at this time. The uncertainty in the program costs in this analyses are based on the random selection of vessels and number of fishing days associated with those vessels. Because of the changed deployment strategy in 2016 and requisite changes to

cost structure the range in total costs presented here may not well represent the true underlying uncertainty for costs in 2016.

Although costs for EM deployment are now covered by federal Grants, once implemented EM deployment will be funded by fees derived from the landing tax. There will be a future need to balance risks and costs between two data collection programs to estimate catch (observer and EM) while balancing the trade-offs in the information content, data quality from each program and its ability to support management, collect biological data to inform stock assessment, marine mammal and bird interactions within the fishery. Further, because each of these programs are competing not only for resources, but also a single pool of vessels, a balance may have to be found to ensure that data gaps in either program does not diminish the quality of catch estimates.

Tables

Table 1. Summary of fleet and video review statistics (Humaidhi et al., 2015[1]) and estimated average review cost for reviewing video from a single day of fishing. 1/ http://www.npfmc.org/wp-content/PDFdocuments/conservation_issues/Observer/EM/PSMFC_EMProgram_Alaska_FinalReport_2015-07-24_Final.pdf

Based on PSMFC EMWG 2014 and 2015 Reports

	2014		2015
Review Minutes	With Hooks	No Hooks	No Hooks
Haul Count	65	31	114
Average Review Hrs/Haul per hau	3.37	1.48	1.4
Review Hrs/Sea Day (2 hauls)	6.73	2.97	2.8
Cost/Review Hour	50	50	50
Review Cost/Fishing Day	336.5	148.5	140

Table 2. Summary of cost per vessel, trip and day was derived by dividing total 2015 deployment budget by fleet statistics using information derived from 2015 (Humaidhi et al., 2015).

Fully loaded daily rate for deployment

Budget for 2015 deployment	$	250,000
Number of participating vessels		12
Number of fishing days		259
Number of fishing trips		59
Deployment Costs per Vessel	$	20,833
Deployment Costs per trip	$	4,237
Deployment Costs per day[1]	$	981

/1 includes overhead rate on contract

Table 3. Cost category description for simulation data inputs for the "Fully Loaded Vessel Rate" approach. Values are not listed due to the confidential contractual information.

Break down of deployment costs

Based on 2015
Stand alone sensor package (purchse and installation)
Cost for EM lease per vessel month
EM system install and sensor package per vessel
Project management, service support, travel, data recovery per trip

Table 4. Comparison of median and range of costs (25th and 75th quantile) for discretionary costs that include 100% video review, sensor installation on all vessels and video review that includes hook count.

Discrecionary Costs	Video only	Sensor only	Video+Hook
Low (1st Quartile on Total Etimated Costs)	$54,455	$133,619	$131,081
Median	$65,000	$143,897	$156,465
High (3rd Quartile on Total Estimated Costs)	$74,780	$154,176	$180,005

Table 5. Comparison of estimated 2016 EM deployment costs based on two approaches (Fully Loaded Daily Rate and AMR Fully Loaded Daily Rate) to actual EM deployment costs incurred during 2015 deployment.

Costs for Selected Vessels Only	Information Derived From		
	Budget[1/]	Daily Rate[2/]	AMR[/3]
Year	2015	2016	2016
Budget or estimated costs	$250,000	$515,074	$722,973
Number of participating vessels	12	60	60
Selection Rate	1	0.3	0.3
Sum of selected vessels across all time periods	12	18	18
Number of fishing days	259	410	410
Number of fishing trips	59	94	94
Deployment costs per vessel	$20,833	$28,615	$40,165
Deployment costs per trip	$4,237	$5,480	$7,691
Video review costs per fishing day with hook count	$337	$337	$337
Video review costs per fishing day	$140	$140	$140
Daily deployment cost per fishing day	$981	$1,256	$1,763
Fully Loaded Daily Rate[\5]	**$1,121**	**$1,396**	**$1,903**
Total Costs			
Low (1st Quartile on Total Etimated Costs)[\4]		**$447,144**	**$660,303**
Median		**$515,074**	**$759,642**
High (3rd Quartile on Total Estimated Costs)		**$721,499**	**$1,069,341**

1/ Actual costs incurred during the 2015 deployment

2/ Simulation using the 2015 fully loaded daily rate + video review cost

3/ Simulation based on AMR 2016 fully loaded daily rate + video review cost

4/ The low and high range values represent a range of costs that are 25% above the median and 25% below the median based on simulation.

5/ Fully Loaded Daily cost (daily deployment + video review cost without hook count)

Table 6. Comparison of estimated 2016 EM deployment costs based on the AMR Fully Loaded Daily Rate with video review with or without hook count and with full sensor coverage for the entire fleet (whether selected or not).

AMR Daily Rate Approach	Total costs include video review and		
	Hook Count	Sensor	Hook + Sensor
Fully loaded Daily Rate	$2,062.38	$2,139.21	$2,349.00
Low (1st Quartile on Total Etimated Costs) [4]	$735,000	$780,069	$854,545
Median	$845,576	$877,076	$963,092
High (3rd Quartile on Total Estimated Costs)	$1,190,310	$1,174,266	$1,295,235

Figures
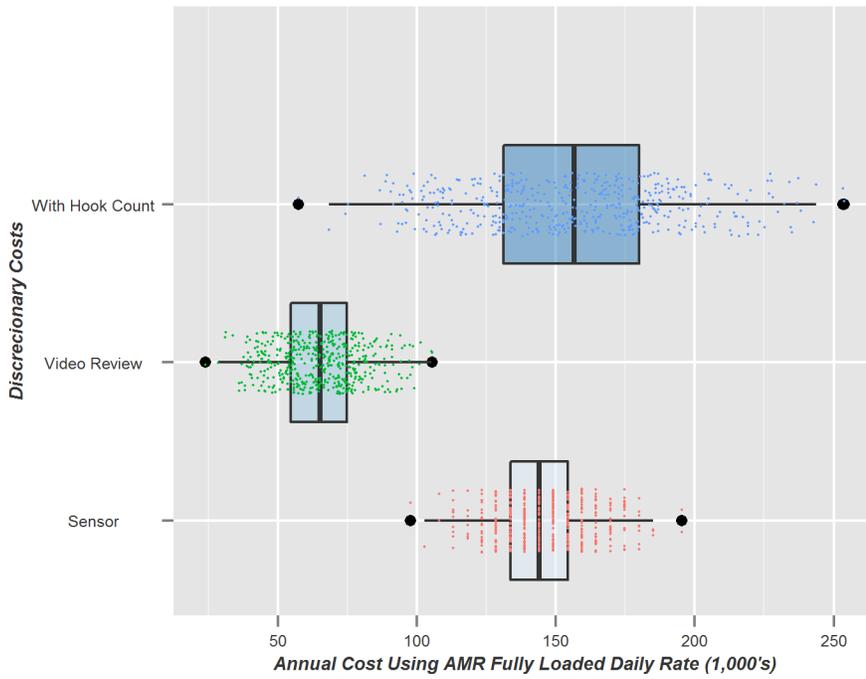
Figure 1. Box Plot of costs for installing sensors and wiring on all non-EM selected vessels, video review and video review that includes hook count. Boxes represent the lower and upper quantile of costs and dots represent extreme values.
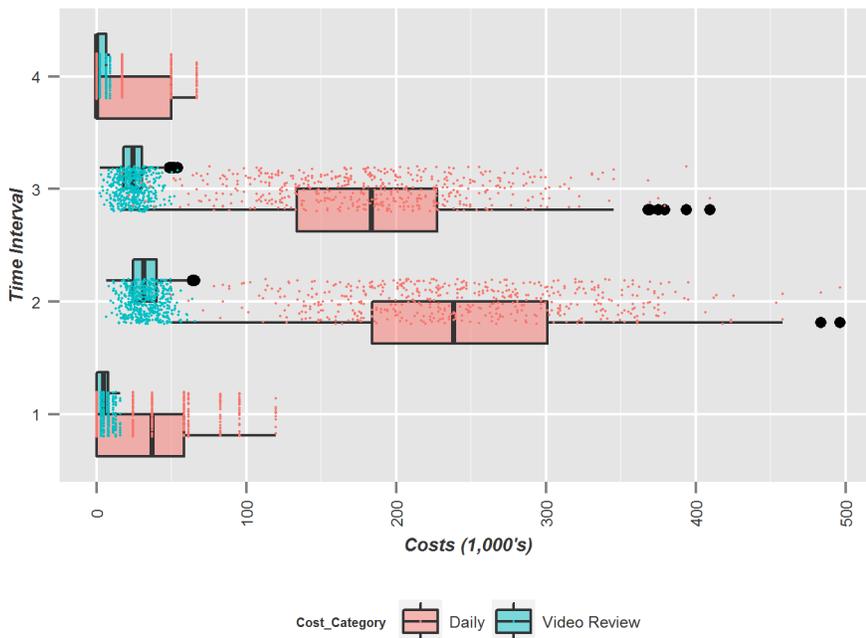
Figure 2. Box Plot to compare the magnitude of costs between daily deployment and daily video review used to estimate a "Fully Loaded Daily Rate". The costs are shown for each of the proposed EM deployment time interval. Boxes represent the lower and upper quantile of costs and dots represent extreme values`1
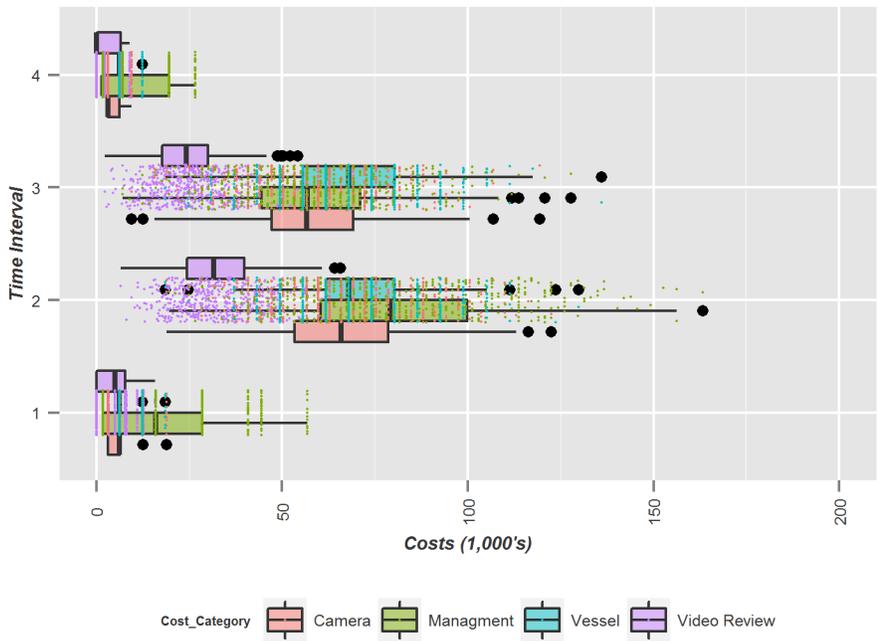
Figure 3. Box Plot to compare cost in each of the proposed EM deployment time periods for each of the 4 cost categories that were used to estimate a "Fully-loaded Vessel Rate". Boxes represent the lower and upper quantile of costs and dots represent extreme values.
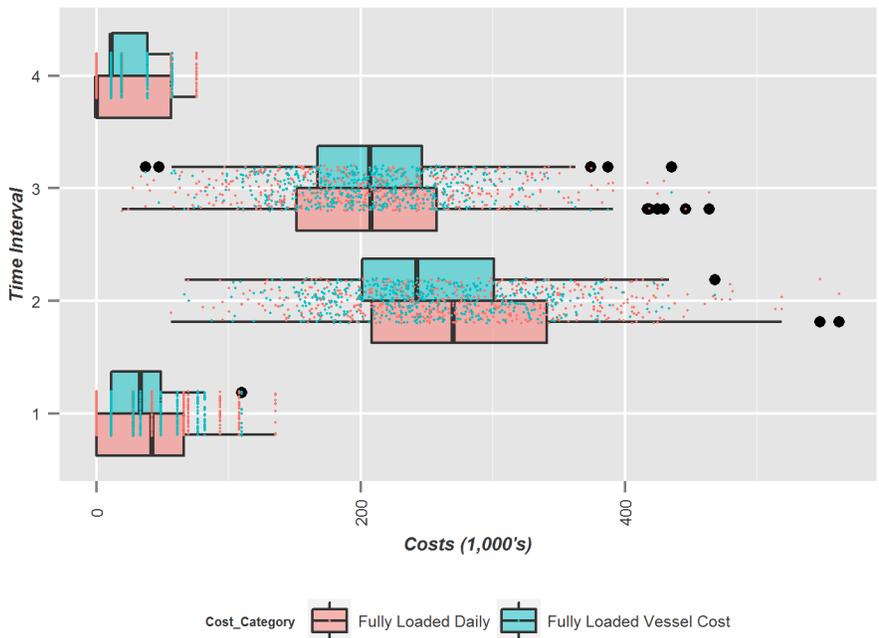

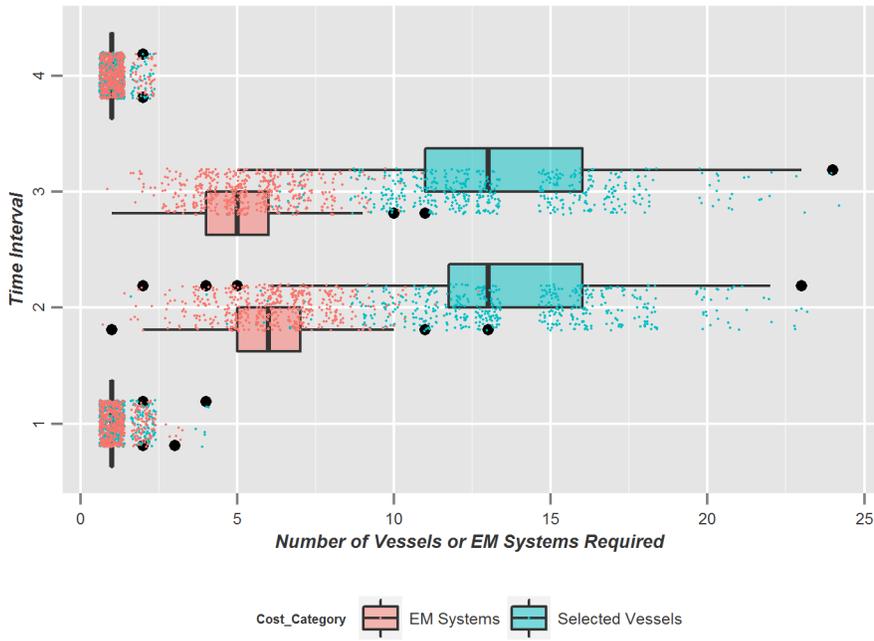Figure 4. Box Plot to compare costs estimated between the "Fully Loaded Daily" and "Fully Loaded Vessel" approaches by time interval. Boxes represent the lower and upper quantile of costs and dots represent extreme values.

Figure 5. Comparison on the estimated number EM systems required and the number of selected vessels in each time interval. Boxes represent the lower and upper quantile of costs and dots represent extreme values.
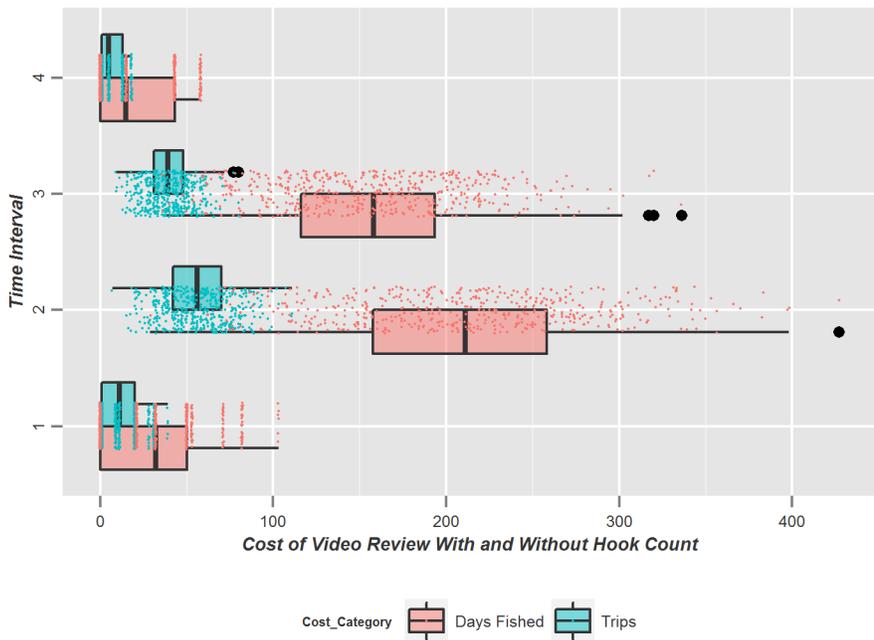

Figure 6. Comparison on the estimated number days fished and the number trips for selected vessels in each time interval. Boxes represent the lower and upper quantile of costs and dots represent extreme values.
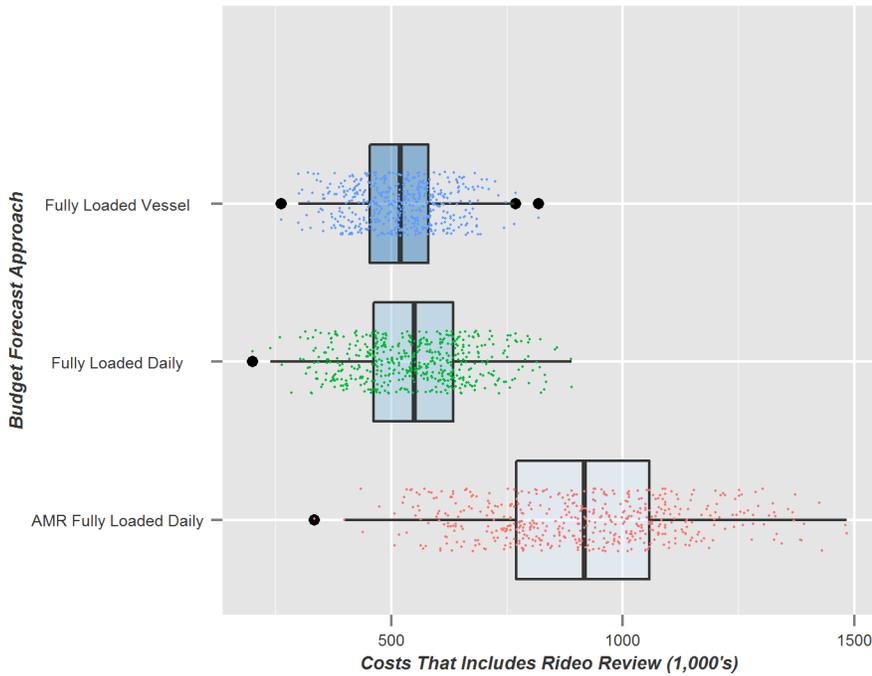
Figure 7. Box Plot to compare annual estimated costs using three different approaches to estimating costs including; "Fully Loaded Daily", "Fully Loaded Vessel" and "AMR Fully Loaded Daily" using cost information provided by Archipelago Marine Research. Cost distributions are shown with and without costs for installing sensor packages on the vessels that were not selected to carry EM systems. Boxes represent the lower and upper quantile of costs and dots represent extreme values.
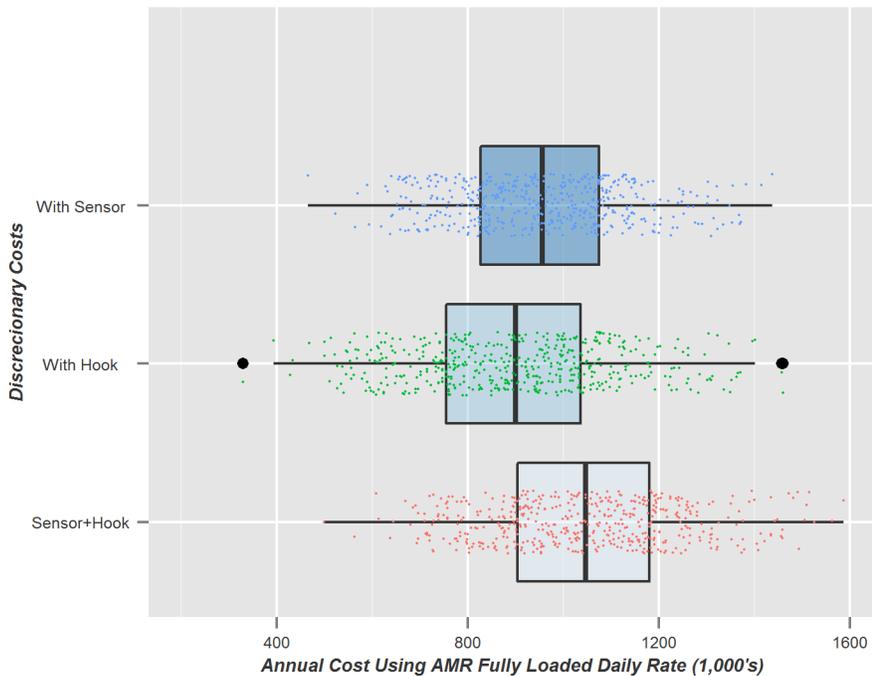

Figure 8. Box Plot to compare annual estimated costs using the "AMR Fully Loaded Daily" that includes discretionary costs for hook count, deploying sensors on all vessels in EM pool and costs of both.