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Scoping a California State Fishery Bycatch Monitoring Program

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Executive Summary

Monitoring and accurately quantifying fishery bycatch are essential components of modern fishery management, especially for fisheries with unselective gear types and/or high ecological risk. This initial scoping document explores the potential development of a state-managed California fishery bycatch monitoring program using a combination of human observers and electronic monitoring (EM). The immediate purpose of this document is to provide a resource to the California Department of Fish and Wildlife (CDFW) and California Fish and Game Commission (Commission) outlining key background information required to build a successful observer program for the California set gillnet fishery as an initial pilot program that could then be expanded to other state fisheries as needed. This report does not detail the internal staffing and infrastructure costs of building a new program within CDFW – as these costs are highly variable – and acknowledges a critical aspect of implementing such a program is dedicated, long-term funding.

Section I summarizes the elements of an observer program, including an overview of existing federal observer programs. These elements include qualifications for observers, observer contracts, the funding and costs of existing observer programs, methods to ensure random sampling of fishing trips under partial observer coverage, and safety and data collection protocols.

Sections II and III summarize federal Alaska observer programs, the West Coast Groundfish Observer Program, and the West Coast Region Observer Program and how they are structured and funded.

Section IV explores case studies of state-developed observer programs, including the California state set gillnet observer program of the 1980s, the Massachusetts state sampling program, and the North Carolina state observer program.

Section V discusses EM and examines the extent to which EM can complement or substitute human observers. This section of the report provides information on 1) how EM works, 2) leading EM systems, 3) current EM usage nationally, 4) the advantages and disadvantages of EM, 5) electronic logbooks in fisheries, and 6) a discussion of costs of systems, installation, video review, and program management. This section also discusses how EM could be implemented in California fisheries in combination with human observers.

Section VI presents recommendations for reinstating federal observer coverage in the immediate term and developing a new state-managed observer program through a pilot project for the California set gillnet fishery. It also provides specific recommendations for improving observer data collection protocols for set gillnets.

Introduction – The Need for a California State Fishery Observer Program

The Need for Data on Fisheries Bycatch in California

Under California law, "Bycatch" means fish or other marine life that are caught in a fishery, that are either not the target of the fishery or not retained. "Bycatch" includes discards of target species as well as retained non-target species.[1] Primary conservation concerns with bycatch include discarded animals that do not survive and retained catch of species not managed in Fishery Management Plans (FMPs) or without current stock assessments. These types of bycatch present significant risks to sustainable fisheries because they can contribute to overfishing and population declines.[2] California's marine ecosystems are a center for biodiversity and many marine species are regularly targeted in fishing.

A key data gap in many state-managed fisheries, including those in California, is the species composition and quantity of the catch, including retained and discarded species. California fishery managers are currently reviewing bycatch in California halibut gillnet and bottom trawl fisheries. Some observer data is available for the California set gillnet fishery (Table 1); however, data gaps remain – specifically, limited sporadic coverage and a lack of comparable total effort data. A key management need is to improve bycatch estimates through regular, standardized collection of data on catch and discards, and fishing effort.

Year	Annual Percent Observer Coverage
2007	17%
2008	0%
2009	0%
2010	12.5%
2011	8%
2012	Unknown
2013	Unknown
2014	0%
2015	0%
2016	0%
2017	Unknown
2018	0%
2019	0%
2020	0%
2021	0%
2022	0%

Table 1. NMFS California set gillnet observer coverage levels from 2007 to 2022.[3] The observer program ceased observing the fishery in 2017. In years 2012, 2013, and 2017, percent coverage is unknown because the total number of fishing sets during those years is unknown.

[1] California Fish and Game Code Section 90.5. Available: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=178840
[2] NMFS. 2011. U.S. National Bycatch Report (W. A. Karp, L. L. Desfosse, S. G. Brooke, Editors). U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-117E, 508 p. https://spo.nmfs.noaa.gov/sites/default/files/tm117E.pdf
[3] NMFS. 2022. California Set Gillnet Observer Program Observed Catch Summary, January 1, 2007, through December 31, 2017. Available: https://media.fisheries.noaa.gov/2022-01/setnet-catch-summaries-2007-2010-2013-2017.pdf

Under the California Marine Life Management Act (MLMA), state FMPs must include information on amount and type of bycatch, analysis of bycatch and its legality, and the effect of the bycatch on other fisheries and the ecosystem. If the California Fish and Game Commission deems bycatch unacceptable under the MLMA standards, they must seek solutions to minimize the bycatch. This process is guided by a bycatch inquiry detailed in the MLMA Master Plan for Fisheries.[4]

Currently, there is no state program to collect bycatch information for state fisheries, and the state must rely upon landings data, logbooks, and federal observer data to assess bycatch impacts. Landings data provides information on the species that are retained, but does not provide information on catch that is discarded at sea. The state also relies upon logbook reporting requirements and resulting data, which requires fishermen to log all fishing activity under a given permit. All fisheries, state and federally managed, are required to report protected species interactions to the National Marine Fisheries Service (NMFS), which provides some information on protected species bycatch. However, such self-reporting may not be accurate especially if there are incentives to misreport or underreport. An Oceana analysis of self-reporting data obtained via the Freedom of Information Act found that approximately 94% of marine mammal interactions in the California set gillnet fishery are not self-reported, despite this reporting being required by law.[5]

Fishery Observers and Electronic Video Monitoring

Observers, or trained biological technicians that work aboard fishing vessels to quantify total catch, estimate bycatch, and monitor fishery interactions with marine mammals and other protected species, are currently the best method for tracking bycatch.[6,7,8] NMFS deploys observers on fishing fleets to monitor federally managed species under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the Marine Mammal Protection Act (MMPA), and/or the Endangered Species Act (ESA).

At its discretion, the federal government may deploy observers for state-managed fisheries that interact with federally managed fish or protected species. However, outside of these critical species, federal observer programs do not have authority over many state fisheries, and observing a specific state fishery may not be a federal priority. From 2007-2022, NMFS observed 6 years of fishing in the California set gillnet fishery, with a coverage level less than

[4] See CDFW. Master Plan for Fisheries. Chapter 6. Available at: https://wildlife.ca.gov/Conservation/Marine/MLMA/Master-Plan/Ecosystem-based-Objectives
[5] Oceana. 2023. Underreporting of Marine Mammal Bycatch in the California Set Gillnet Fishery. Available: https://usa.oceana.org/wp-content/uploads/sites/4/2023/10/Oceana_CA-set-gillnet-self-reporting-analysis.pdf
[6] Karp, W.A., McElderry, H. and Nolan, C.P., 1999. Catch monitoring by fisheries observers in the United States and Canada. https://www.fao.org/3/x3900e/x3900e13.htm
[7] Davies, S.L., Reynolds, J.E. (eds.), 2002. Guidelines for developing an at-sea fishery observer programme. FAO Fisheries Technical Paper, No. 414. FAO, Rome 116p. https://www.fao.org/3/y4390e/y4390e.pdf
[8] Perez Roda, M.A., Gilman, E., Huntington, T., Kennelly, S.J., Suuronen, P., Chaloupka, M., Medley, P., 2019. A Third Assessment of Global Marine Fisheries Discards. FAO Fisheries and Aquaculture Technical Paper. No. 633. FAO, Rome 79 pp.
https://www.researchgate.net/publication/330400691_A_third_assessment_of_global_marine_fisheries_discards

20% in those years (Table 1). This means 10 of those years were left unobserved, despite the NMFS 2011 National Bycatch Report recommendation for this fishery "…to increase observer coverage to at least 20% to better document bycatch of key species with low abundance."[9] An increase in coverage would require a substantial increase in program funding to implement. NMFS has not observed the fishery since 2017 and California has no control over the level of federal observer coverage in this fishery.

Curtis and Carretta (2020) found that high levels of observer coverage (as high as 100%) are needed to detect bycatch of rare or infrequently caught species,[10] so observer programs should consider what the appropriate coverage is needed based on management needs. Quantifying total amounts of bycatch with precision requires both observer data and total fishing effort. A key data gap in the California set gillnet fishery is the inability to estimate total bycatch, as the federal observer program measures fishing effort differently than the state of California. The state has been tracking the number of times a permitted vessel lands fish, also called the number of trips. The observer program has recorded catch data per "set", or every time a net is deployed and retrieved. Incomparable units of fishing effort between the observer program and total fleetwide effort prevent fishery managers from quantifying the scope of bycatch and total catch, making it difficult to assess potential impacts to fish stocks and bycatch species.

To address these issues, an effective solution would be to set up a California state-run fishery observer program. Rather than relying on the federal government to provide observers, California would create a program that ensures an effective amount of observer coverage and data collection that meets the management needs. Implementing a state-run observer program is a complex and costly undertaking and requires coordinated effort among federal and state fishery managers. The California halibut set gillnet fishery has been prioritized as the first state fishery to be run through the updated management process outlined in the MLMA Master Plan for state fisheries.[11] Considering the bycatch monitoring needs of the California set gillnet fishery and the moderate fleet size, this fishery is ideal for a pilot state-run observer program.

This report discusses several existing federal observer programs, as well as case studies on state-run observer programs and examines the potential of EM in fisheries management.

[9] NMFS. 2011. U.S. National Bycatch Report [W. A. Karp, L. L. Desfosse, S. G. Brooke, Editors]. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-117E, 508 p. https://repository.library.noaa.gov/view/noaa/31335
[10] Curtis, K Alexandra, and James Carretta. 2020. Assessing Observer Coverage Needed to Document and Estimate Rare Event Bycatch. Fisheries Research (May 1, 2020): 105493. https://doi.org/10.1016/j.fishres.2020.105493
[11] "Prioritizing Management Efforts: Chapter 2 of the Marine Life Management Act." MLMA Master Plan. Available: https://mlmamasterplan.com/2-prioritizing-management-efforts/. Accessed 23 June 2023.

Section I. Elements and Considerations for Observer Programs

There are many different observer programs that can be implemented for fishery observation; the type of program is dependent on which questions the observer program is trying to answer. When setting up a fishery-specific observer program it is important to consider how human observation can provide the data needed to ensure bycatch is tracked and accounted for as much as possible. This section explores critical aspects of existing federal observer programs to inform a potential state-run pilot observer program.

Images courtesy of NOAA Fisheries. Fishery observers on vessels recording fish length.

Observer Qualifications

Any observer program must develop qualification requirements and training for its observers. Across federal observer programs, there are generally two levels of observers. The first level of observers are at-sea monitors, who require less training and no Bachelor of Science. These observers generally record their observations of total observed catch counts on the vessel. The second level of observers are biological technicians who collect samples and measurements of species along with additional data. These fishery observers are required to have a Bachelor of Science, specialized training, and knowledge of species identification. Biological technician observers tend to cost more, as they require higher education and extensive training; and because they collect more data.

Contracting Observers

Federal observer programs contract observers through third-party organizations. NMFS uses many different third-party contractors to provide observers throughout the United States. In the Atlantic, the Gulf of Mexico, the Caribbean, and the Southeast United States, NMFS uses A.I.S., Inc. to provide observers. In the Northeast, NMFS utilizes A.I.S., Inc., East West Technical Services LLC, and Fathom Resources LLC to provide observers to eight different fisheries. In the Pacific Islands, NMFS uses FLOAT partners to provide observers to the fisheries, and in the North Pacific, NMFS utilizes A.I.S., Inc., Alaskan Observers, Inc., Saltwater, Inc., and TechSea International, Inc. to provide observers to the region. On the West Coast, NMFS uses Alaskan Observers, Inc., Frank Orth & Associates, Saltwater, Inc., and TechSea International, Inc. to

provide observers.[12] The NMFS West Coast Regional Observer Program, which has observed the California set gillnet fishery in the past, contracts observers through Frank Orth & Associates.

Assigning Observers to Ensure Random Coverage

Unless 100% of fishing effort is observed, random sampling of effort in a fishery is critical to obtain accurate representative estimations of total bycatch. Under this randomized sampling system, fishermen must be prepared for an observer to be on their vessel during any given fishing trip. If observers are a part of a direct contract, congressionally mandated system, fishermen are required to give 48-hour notice of their fishing trips. All reported fishing trips are then placed in a pool and are randomly selected for observer coverage. This ensures the most fair and equal randomized selection system. However, if an observer program is not a regulatory requirement, fisherman approval is needed before putting observers on a vessel, which may affect the randomness of the observer sample.

Some vessels may be deemed unobservable due to the size of the vessel, weather conditions, or the safety of the observer. To ensure random, unbiased, sampling in this situation, there either needs to be an elimination of the unobservable exemption (i.e., prohibit fishing without an observer) or require equivalent data collection through EM on vessels that cannot host an observer.

Data Collection Protocols

A key element of managing an observer program is training observers to use consistent data collection protocols. Data collection by observers depends both on the management needs of the fishery as well as the fishing technique. There are different methods for observing and counting bycatch for different gear types, such as trawl fisheries or gillnet fisheries. Some observer programs count bycatch and catch via the weight of the catch, rather than individual species. For example, the observed catch and bycatch in the West Coast Groundfish trawl fishery is recorded by weight to enable management of weight-based individual fishing quotas by species. Conversely, the California set gillnet fishery is observed based on counts of individuals because the primary purpose is to estimate how many individual marine mammals are taken.

Counting catch via different units creates challenges in comparing across fisheries or making extrapolations if fish are counted in different units than are recorded during landing. For the California set gillnet fishery, where landed catch is reported via weight, recording observed catch and bycatch in a method that is easily transcribed to weight would allow for comparison and extrapolation based on total landing weight. One way to accomplish this is to record the length of each individual fish, or a subsample of each species, which can be converted to estimated weight using known length-weight ratios. Standardizing bycatch reporting enables comparison across fisheries and improved accuracy of total bycatch estimates.

[12] NMFS. 2021. Observer Providers. Available: www.fisheries.noaa.gov/national/fisheries-observers/observer-providers. Accessed June, 2023.

Observer Coverage

One hundred percent observer coverage requires an observer on every single fishing trip. This method removes the operational complexities of ensuring random sampling and eliminates uncertainties in estimating total bycatch from partial sampling, but it is more expensive. The closer to 100% observer coverage of the fleet the higher the chance rare event or infrequently caught species are detected.[13] This method is also employed to enforce strict limits on protected species interactions such as sea turtle interactions in the Hawaii shallow-set longline fishery, or individual vessel quotas on fish species such as the West Coast trawl fishery.

Partial observer coverage (i.e., less than 100%) is less expensive than full coverage but increases uncertainty in total bycatch estimates, and requires additional methods to ensure representative sampling. Higher coverage rates offer more accurate depictions of bycatch in the region by increasing awareness of rare species catch, providing better knowledge of total catch, and allowing more opportunity for biological sampling.[13]

The Funding and Costs of a Human Observer Program

Current federal observer programs are either funded by congressionally mandated funds via direct contract with the observers, or by the industry, when an industry pays for observer coverage of a certain number of trips. Most observer programs fall under the direct contract category, with the exception of several industry-funded programs in Alaska. Congressional funds also pay for all observer training. The cost of maintaining observer programs changes depending on the size of the fleet that needs monitoring, the distance of the fishery from the coast, the percentage of the fleet covered by observers, and the time observers need to be on the vessel.

Observation costs can be dependent on fishing vessel and gear type as well, which impacts cost estimates. Estimating costs is challenging, as there are fixed costs upon initially establishing the program, and variable costs depending on the level of observer coverage. Fixed costs include the training of observers, management of the program and its data, regulatory costs, insurance for observer maritime safety, and payment of the observer contractor. Variable costs depend on the number of observers, the number of observed trips, observer transportation, housing, and wages.

In direct contract programs, the programs ask for a certain number of sea days covered. The hiring company of third-party observers determines how many observers to hire to ensure there is enough availability. In a year where the California set gillnet fishery was observed in the West Coast Region Observer program, fiscal year 2013, the WCROP received the majority of its observer program funds ($899,357) through the National Observer Program (NOP) budget line.[14] These funds cover all annual costs of running the program. The program observed a total of 391 sea days in 2013 using 5 observers for the California large-mesh drift gillnet, the California set gillnet, and the California deep-set pelagic longline fisheries. In 2013 the program observed 169

[13] Curtis, K Alexandra, and James Carretta. 2020. Assessing Observer Coverage Needed to Document and Estimate Rare Event Bycatch. Fisheries Research (May 1, 2020): 105493. https://doi.org/10.1016/j.fishres.2020.105493
[14] NMFS. 2017. National Observer Program FY 2013 Annual Report. NOAA Tech. Memo. NMFS F/SPO-178, 34 p. https://media.fisheries.noaa.gov/dam-migration/fy2013_nop_annual_report.pdf

sets in the California set gillnet fishery, however it is unknown what annual percent coverage this provided (Table 1). For context, NMFS estimates fleetwide effort in the California set gillnet fishery has ranged from 1,387 to 2,123 sets from 2007 – 2011.[15]

Lack of direct data on past program costs specifically for the California gillnet fleet make estimating observer costs difficult. Comparing potentially similar programs may provide a general estimate of annual program costs. For example, an annual estimate of at-sea monitoring for a single gillnet vessel in the New England Groundfish fishery is ~ $28,500 per year.[16] This estimate comes from a projected costs estimates report for the Groundfish fishery, and is based on an example gillnet vessel of 40ft, that fished 50 days/trips (3 sets/trip), assuming each trip was18-24 hours. The estimate includes all program management, data processing, overhead and observer costs accrued annually for an established 100% coverage program. Annual costs of an observer program are based on a number of assumptions that may not necessarily reflect the fishing and observer needs of the California gillnet fleet, but do provide an idea of what a 100% coverage observer program may cost annually.

Challenges

There are challenges to consider in designing and managing an observer program. Observers require additional space on a vessel that may not be available on certain vessels. Additionally, harassment on fishing vessels in the form of physical, emotional, and sexual abuse has occurred. Fishermen may feel threatened having an observer document their catch. Therefore, NMFS has ensured specific training for observers to mitigate harassment and put a protocol in place to report incidents. In addition to training, NMFS provides a debriefing session and in-season advising for observers placed on fishing vessels. Observers are encouraged to report inappropriate behavior and are provided training to identify inappropriate behavior.[17]

In partially observed fisheries, the "observer effect" is a well-documented phenomenon, where fishermen behave and fish differently with observers onboard.[18] This effect can impact the

[15] NMFS. California Set Gillnet Observer Program Observed Catch Summary, January 1, 2007, through December 31, 2017. https://media.fisheries.noaa.gov/2022-01/setnet-catch-summaries-2007-2010-2013-2017.pdf
[16] CapLog Group LLC. 2019. Projected Cost of Providing Electronic Monitoring to 100 Vessels in New England's Groundfish Fishery. Commissioned by the Nature Conservancy. Available: https://em4.fish/wp-content/uploads/2019/04/TNC-EM-Cost-Assessment-Report-Submission-to-NEFMC-4_10_19.clean_.pdf
[17] NMFS. "Keeping Fishery Observers Safe from Harassment." *NOAA*, 11 Dec. 2019, www.fisheries.noaa.gov/feature-story/keeping-fishery-observers-safe-harassment.
[18] Faunce, C. and Barbeaux, S. "Deployment and Observer Effects as Evidenced from Alaskan Groundfish Landing Reports." [Poster] Seattle, WA. (2008). Available at: https://access.afsc.noaa.gov/pubs/posters/pdfs/pFaunce02_deployment-observer.pdf

precision and accuracy of fishery-level inferences drawn from observer data, though this is rarely addressed when extrapolating up to total catch and discard estimates.[19,20,21]

Another challenge that must be considered when creating a partial coverage observer program is the difficulty of setting up a program for random sampling. Random sampling is difficult to achieve on both operational and conceptual levels because observer data must be random on multiple levels. For example, there must be a random sample of the vessels, a random sample of the fishing effort (in number of trips or number of sets), as well as a random sample of the catch and bycatch being recorded.[22] One issue for random sampling design is that some vessels may be deemed unobservable due to the size of the vessel, weather conditions, or safety of the observer.

Partial coverage observer programs rely upon fishermen to notify the observer program in advance when they are going fishing. Unless there is careful monitoring of fishing activities and accountability for failing to provide notification, fishermen may be able to avoid being observed. Even if fishermen do call to give notice of their upcoming fishing trip, there are questions of whether an observer is available, if there is enough funding for the ideal number of at-sea days covered, and the complexities of getting observers to a certain location.

Section II. Overview of US and Alaska Federal Observer Programs

There are many observer programs already in place all over the country, most managed by NMFS under the authority of the MSA or the MMPA.[23] Table 2 provides an overview of existing federal observer programs in Alaska and West Coast, the number of observers, and the percent coverage for a given fleet.

[19] Benoît, Hugues & Allard, Jacques. (2009). Can the data from at-sea observer surveys be used to make general inferences about catch composition and discards? Canadian Journal of Fisheries and Aquatic Sciences. 66. 2025-2039. 10.1139/F09-116. https://cdnsciencepub.com/doi/10.1139/F09-116

[20] Mucientes, Gonzalo, Marisa Vedor, David W. Sims, and Nuno Queiroz. (2022) "Unreported Discards of Internationally Protected Pelagic Sharks in a Global Fishing Hotspot Are Potentially Large." Biological Conservation 269: 109534. https://doi.org/10.1016/j.biocon.2022.109534

[21] Walsh, W. A., Kleiber, P., and McCracken, M. (2002). Comparison of logbook reports of incidental blue shark catch rates by Hawaii-based longline vessels to fishery observer data by application of a generalized additive model. Fish. Res. 58, 79 –94. doi: 10.1016/S0165-7836(01)00361-7. http://www.soest.hawaii.edu/pfrp/reprints/walsh_logbook_blue_shark.pdf

[22] Cahalan, Jennifer & Faunce, Craig. 2020. Development and implementation of a fully randomized sampling design for a fishery monitoring program. Fishery Bulletin. NOAA. 118. 87-99. 10.7755/FB.118.1.8. https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/fish-bull/cahalan_0.pdf

[23] Benaka, L. (editor). 2023. National Observer Program FY 2021 Annual Report. NOAA Tech. Memo. NMFS-F/SPO-241, 32 p. https://spo.nmfs.noaa.gov/tm.htm.

Location	Authority to Place Observers	Fisheries Observed	Number of Vessels	Funding Sources	Target Coverage	Actual Coverage	Number of Observers
Alaska	MSA	Bering Sea & Aleutian Islands (BSAI) Groundfish Trawl BSAI and Gulf of Alaska Catcher Processors Longline Pacific Cod GOA Groundfish Program and Catcher Processors	1,418	North Pacific Marine Resource Observers National Observer Program Reducing Bycatch Congressional Funding Industry Funding	100%	100%	378
Alaska	MSA	BSAI and GOA Groundfish, Trawl, Longline, and Pot Fisheries US Pacific Halibut Fishery	1,418	North Pacific Marine Resource Observers National Observer Program Reducing Bycatch Congressional and Industry Funding	Pot: 15 - 18% Hook/ Line: 15-18% Trawl: 16 - 21%	Pot: 16.5 – 20.5% Hook/Line: 12.4 – 17.4% Trawl: 19.9 – 28.2%	378
TOTAL ALASKA REGION OBSERVER PROGRAM FUNDING (CONGRESSIONAL): $8,951,381 TOTAL ALASKA REGION INDUSTRY EXPENDITURES: $16,029,415 TOTAL ALASKA REGION OBSERVER PROGRAM FUNDING (ALL SOURCES): $ 24,980,796							
West Coast	MSA MMPA	California Large Mesh Drift Gillnet Fishery	7	National Observer Program	20%	22.8%	9
West Coast	MSA MMPA	Deep Set Buoy Gear Exempted Fishing Permit (EFP)	30	National Observer Program	10 – 30%	24.7%	9
West Coast	MMPA	California Deep-Set Pelagic Longline	3	National Observer Program Industry Funded	20%	26.7%	9
West Coast	MSA	**West Coast Trawl Catch Share** **Catch Share Using Electronic Monitoring**	140	National Catch Share Program West Coast Observers Industry Funding National Observer Program Cost Recovery National Catch Share Program	100%	100%	95 47
West Coast	MSA	**West Coast Groundfish Non-Catch Share Fisheries**	LE Long-line 190; trap 33 OA Permits: ~1,000	National Observer Program West Coast Observers Reducing Bycatch	10%	LE: 34% OA: 2-18%	56
TOTAL WEST COAST REGION OBSERVER PROGRAM FUNDING (CONGRESSIONAL): $8,931,781 ($1,219,173 of which funds the West Coast Region Observer Program – DGN, DSBG, Pelagic Longline) TOTAL WEST COAST REGION INDUSTRY EXPENDITURES: $2,918,664 TOTAL WEST COAST REGION OBSERVER PROGRAM FUNDING (ALL SOURCES): $11,850,445							

Table 2: NOAA federal observer programs in Alaska and West Coast, according to the NMFS National Observer Program Annual Report 2021. Table provides location in the United States, the authority through which the observers are placed on vessels, fisheries observed, the number of vessels in the fishing fleet, the source of funding, target coverage, actual coverage, number of observers in the program, and observer program funding. Bolded programs are described in Federal Case Studies.[24]

[24] Benaka, L. (editor). 2023. National Observer Program FY 2021 Annual Report. NOAA Tech. Memo. NMFS-F/SPO-241, 32 p. https://spo.nmfs.noaa.gov/tm.htm

Section III. Federal West Coast Observer Programs

There are two main federal observer programs on the U.S. West Coast: The West Coast Groundfish Observer Program and The West Coast Region Observer Program.

West Coast Groundfish Observer Program

The West Coast Groundfish Observer Program is overseen by NMFS' Northwest Fisheries Science Center, and places observers on both Catch Share Groundfish fisheries and Non-Catch Share Groundfish fisheries. [25] The goal of this program is the collection of coast-wide, year-round catch and discard amounts by species for groundfish fisheries along the West Coast to manage individual quotas for federally managed trawl groundfish fisheries. The program also tracks and estimates protected species bycatch, including threatened and endangered fish, seabirds and marine mammals. NMFS works with third-party private companies to train and provide at-sea observers to quantify the discard rate and ensure it does not result in excessive overfishing of groundfish species. The program measures catch via weight. This program currently observes a number of West Coast fishing sectors, including the West Coast Groundfish Trawl Catch Share, the Limited Entry Bottom Trawl, the West Coast Fixed Gear, the West Coast Pink Shrimp Trawl, the California Halibut Trawl, and the West Coast Nearshore Groundfish fisheries.[26] Occasionally, the West Coast Groundfish Observer Program observes state-managed fisheries and fisheries operating under an exempted fishing permit.

Observers in this program work on vessels fishing with a variety of gear types, including longline, pot, and shrimp trawls. During their time at sea, which can last up to three weeks, observers gather fishing effort and location information, sample species composition, and collect biological data from both target and non-target species. This program is all-encompassing: it trains observers, devises sampling plans, manages observer resources, notifies vessels when they are required to have observers onboard, outfits observers with safety and sampling gear, stores and manages collected data, and debriefs observers. This program is essentially divided into two components: catch share and non-catch share.

The Catch Share Program requires 100% observer coverage while the vessel is active in the catch share fishery. Full coverage is needed to enforce individual vessel catch limits. The Non-Catch Share Groundfish Observer Program uses partial observer coverage, and NMFS has developed a vessel selection process to ensure random sampling coverage. The Non-Catch Share Program is paid for via federal funds, whereas the Catch Share Program is paid in part by industry in addition to congressional funds.

[25] NMFS. 2023. West Coast Groundfish Observer Program. https://www.fisheries.noaa.gov/west-coast/fisheries-observers/west-coast-groundfish-trawl-catch-share-observer-program
[26] Benaka, L. (editor). 2023. National Observer Program FY 2021 Annual Report. NOAA Tech. Memo. NMFS-F/SPO-241, 32 p. https://spo.nmfs.noaa.gov/tm.htm

West Coast Region Observer Program

The West Coast Region Observer Program (WCROP) is managed by NMFS, and places trained fishery observers aboard fishing vessels primarily to monitor the incidental catch of marine mammals, sea turtles, and seabirds.[27] In addition to protected species, observers also collect data on target and non-target fish species and selected biological specimens. The program is run by NMFS West Coast Regional Office in Long Beach, California, and monitors California fisheries, including the California large-mesh drift gillnet fishery, California deep-set buoy gear, and the California deep-set pelagic long-line fishery. In 2021, the WCROP received $1,219,173 in funding to monitor these 3 fisheries, which covered all annual costs of running the program.[26] This funding employed 9 WCROP observers, which covered a total of 456 at-sea days (approximately 25% of fishing effort) observing the 3 California fisheries in 2021 (Table 2). The program once also monitored the California set gillnet fishery and began placing observers on vessels in the 1990's but ceased in 2017.

When in place, the goal of the California set gillnet observer program was to monitor and estimate marine mammal take by the number of individual animals under the MMPA. Because the California set gillnet fishery is managed by the state, NMFS authority to observe the fishery is based on the take of federally protected marine mammals under the MMPA. While observers were on vessels, they collected data on all species in addition to protected species. This fishery is a limited entry fishery primarily conducted in federal waters (3 to 200 nautical miles from shore) in southern California that targets a multi-species assemblage including California halibut, white seabass, California barracuda, and yellowtail. Between 2007 and 2017, 6 years were observed.[28] The observer program is not currently active in the California set gillnet fishery. There are currently 35 active set gillnet vessels from Santa Barbara to San Diego, and 90 existing permits. Observers of the California set gillnet fishery were contracted exclusively through Frank Orth & Associates.[29] The observer program requests a certain number of at-sea days annually for all its observer fisheries, and Frank Orth hires the appropriate number of observers. On average, the company hires 7 to 10 observers in a season.

Section IV. State-Managed Observer Programs

While there are many federal observer programs run by NMFS, there are very few state-managed observer programs. The most comprehensive and long-lasting state program is in North Carolina. Massachusetts also has a small-scale sampling program. Rather than relying on observers provided by NMFS, states provide and contract the observers; however, in some state programs funding is partially provided by the federal government.

Historic State Observer Program in the California Set Gillnet Fishery

[27] NMFS. 2023. West Coast Region Observer Program. Available : https://www.fisheries.noaa.gov/west-coast/fisheries-observers/west-coast-region-observer-program. Accessed June 2023.
[28] NMFS. California Set Gillnet Observer Program Observed Catch Summary, January 1, 2007, through December 31, 2017. Available: https://media.fisheries.noaa.gov/2022-01/setnet-catch-summaries-2007-2010-2013-2017.pdf
[29] NMFS. 2023. West Coast Region Observer Program. Available : https://www.fisheries.noaa.gov/west-coast/fisheries-observers/west-coast-region-observer-program. Accessed June 2023.

The historic state observer program for the California set gillnet fishery ran from 1987 to 1990 before NMFS began monitoring the fishery from 1990 onward. It was created by the California Department of Fish and Wildlife (CDFW), then called the California Department of Fish and Game, and was a voluntary program. The program's goal was to assess retained and discarded catch, as well as data on discarded bird and marine mammal species such as the common murre, harbor porpoise, and southern sea otter.[30] The funding for this program came from CDFW and private sources.

Observers were not always placed on the same vessel as the fishermen; instead, they often followed and counted catch aboard a separate vessel. This program had approximately 5% coverage during the 3 years of operation.[30]

North Carolina State Observer Program

The North Carolina State Observer Program first began in 2009 when NMFS informed North Carolina that its estuarine gillnet fisheries would be subject to federal closures under the ESA unless the state found a solution to address unauthorized takes and discards of endangered sea turtles. [31] The request from NMFS expanded to Atlantic sturgeon in January 2012.

In response to these requests, the North Carolina Division of Marine Fisheries (DMF) applied for and obtained two Incidental Take Permits for sea turtles and Atlantic sturgeon in its fisheries using anchored gillnets in estuarine waters. The reason the state applied for these permits was to ensure they could continue to allow fishing in these estuarine gillnet fisheries while minimizing bycatch of sea turtles and sturgeon. The Incidental Take Permits require these fisheries to have observers from the DMF. The minimum amount of observer coverage under this permit is 7% of large mesh fishery and 1% of small mesh fishery, and observers must collect data from every moment they are onboard to stay in compliance with the federal Incidental Take Permit that the state requested from the federal government.[32]

The DMF works with an observer contractor that provides observers for the North Carolina State Observer Program. All observers are trained in protected species interactions, fishing effort, gear characteristics, and fish populations. Because observers cannot be on all fishing trips, the DMF uses a federally approved statistical system to observe a portion of trips and provide an extrapolated estimate on takes. Observers are therefore put on trips with fishermen randomly selected from the permit pool.

[30] CDFG. 1986. Progress Report: California Gill and Trammel Net Investigations (Northern Area). Prepared by P.W. Wild. (pers. comms. Burr Heneman)
[31] North Carolina Division of Marine Fisheries. 2023. North Carolina Observer Program. Available: https://www.deq.nc.gov/about/divisions/marine-fisheries/science-and-statistics/observer-program#ProgramDetails-4364
[32] Register, Rhett. 2015. The Power of Observation. North Carolina Sea Grant, Coastwatch. Available: https://ncseagrant.ncsu.edu/coastwatch/previous-issues/2015-2/autumn-2015/the-power-of-observation/

The North Carolina State Observer Program was appropriated $1.1 million in 2013 for the fiscal year of 2013-14 to maintain the observer program.[32] In addition, the DMF approved a 25% increase in commercial fishing license fees starting in the fiscal year of 2014 to 2015 to fund the program in the future. After seeking further public input for additional funding for the program, the North Carolina Fisheries Association suggested that the North Carolina Marine Fisheries Commission establish a Commercial Fishing Resource Fund, which receives revenues from a 100% increase in fees for six of the different commercial fishing licenses. This fishery has over 2,600 participants, so such an approach may not work for smaller fisheries like California set gillnet fishery with fewer than 40 active participants. The fee money contributed to the fund to pay for observer coverage to fulfill the state's Incidental Take Permit. The North Carolina Incidental Take Permit program is scheduled for renewal in late 2023.

In addition to the observer program, self-reporting by fishermen is required. Fishermen have guidelines to follow for each protected species caught. For example, regulations are in place for both sea turtle bycatch prevention and protocol for commercial or recreational fishermen when a sea turtle is caught. Recreational and commercial fishermen are required to self-report unobserved interactions with sea turtles and Atlantic sturgeon to the DMF. While this data is likely incomplete, it helps the DMF biologists improve their understanding of impacts to protected species so they can work with fishermen to avoid hotspot areas. However, self-reporting is widely understood to be biased and vastly under-represents bycatch. Self-reports should therefore not be used in management or for estimating bycatch.

Massachusetts State Sampling Program

The smaller scale Massachusetts State Observer Program also has a program entitled Fisheries Dependent Investigations (FDI), which works with fishermen to collect data to inform stock assessments and fishery policy to avoid excess bycatch in the fishery.[33] The agency also completes sampling requests submitted by biologists and collaborators and conducts long-term monitoring research projects. Yearly funding is provided by the National Fish and Wildlife Foundation and the Nature Conservancy.

FDI conducts fisheries sampling on docks and commercial vessels. The agency employs a sampling methodology consistent with the NMFS Northeast Fisheries Observer Program. FDI priorities include sampling for the agency's Lobster Investigations Project and experimental fisheries. These data support commercial trawl, gillnet, longline, and dredge fisheries management.

In addition to sampling on the water, the FDI samples fish markets to inform stock assessments. Observers sample commercial catches that include species such as striped bass, dogfish, squid, black sea bass, menhaden, and tautog. One of their largest portside sampling programs is the Atlantic herring portside sampling and bycatch avoidance program, which was started in 2008 by the Massachusetts Department of Marine Fisheries (DMF). The goal of the program is to reduce

[33] Massachusetts Division of Marine Fisheries. Fisheries Dependent Investigations. Available*:* www.mass.gov/service-details/fisheries-dependent-investigations. Accessed June 2023.

river herring and American shad bycatch by 50%. Rather than placing biologists on the vessels as observers, the program has biologists sample landings when vessels offload their catch. The DMF samples an average of 133 trips and 17,000 metric tons of landings each year.[34] Coverage rates for Atlantic herring typically exceed 75%. Observers also record fish length and collect biological samples portside. If bycatch is found in a landing, they report the fishing location as a hotspot and encourage fishermen to avoid fishing those areas.

Although the Massachusetts sampling program is state-run, they coordinate their protocols and sampling priorities with NMFS Northeast Fisheries Observer Program.

Section V. Electronic Monitoring of Bycatch

Electronic Monitoring Background

Electronic monitoring, or EM, is a broad category of systems used to monitor fisheries. There are different EM systems, such as video monitoring, logbooks, count catch data, vessel monitoring systems to track vessel locations, electronic logbooks allowing fishermen to digitally enter data, and electronic fish tickets to replace paper tickets when fish are sold. The choice of systems depends on the management needs. Important factors to determine which EM system to use include the location of the fishing trip, gear-type, the duration of the fishing trip, and the amount of bycatch.

Video EM is a tool used to collect fishing data including the number of fish that are caught, fishing effort, and bycatch. Cameras are generally placed on vessels pointed at the deck and can watch fishing activity up to 24-hours a day. Some systems may monitor fishing 24-hours a day but are only triggered to record when gear-hauling hydraulics activate. This saves space on EM-related hard drives. EM companies work with the fishing vessels to place cameras to ensure the fishermen are comfortable with the camera angle, the necessary data that are collected, and blind spots are being prevented as much as possible. These systems may one day have the potential of replacing or complementing a human observer, however, a human is still required to review the footage as artificial intelligence recognition technologies are not fully developed.[35]

[34] Massachusetts Division of Marine Fisheries. Herring Portside Sampling and Bycatch Avoidance. Available: www.mass.gov/service-details/herring-portside-sampling-and-bycatch-avoidance. Accessed June 2023.
[35] D.C. Bartholomew et al. 2018. Remote Electronic Monitoring as a Potential Alternative to On-Board Observers in Small-Scale Fisheries. Biological Conservation 219 (2018): 43 p. http://www.sciencedirect.com/science/article/pii/S0006320717307899.

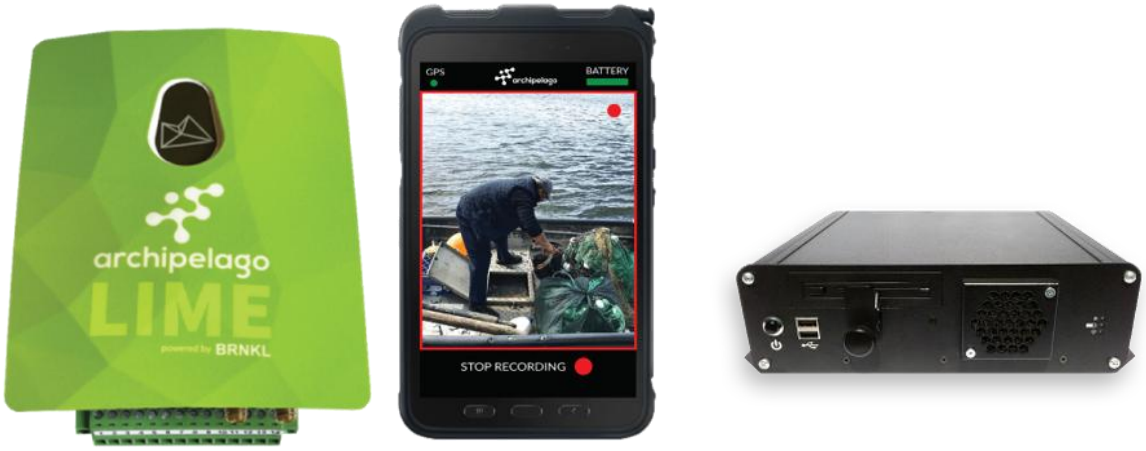
Images courtesy of NOAA Fisheries. Electronic monitoring systems installed on fishing vessels.

Leading Electronic Monitoring Systems

EM is an expensive technology for what is currently a small collection of clients. The technology is competitive because there is no standardized method for EM, and EM companies compete for a small number of fishermen or observer programs to choose their systems over another system.

Existing EM providers include Archipelago Marine Research Ltd., Saltwater, Inc., TeamFish, Transparensea, New England Marine Monitoring, and Integrated Monitoring. The programs tend to remain within their region of origin, and all have different business models.

Some of the service providers offer hardware and software but not video review, while some offer all three. Archipelago Marine Research Ltd. is one of the leading systems in EM in California. They provide comprehensive data collection platforms, high-quality video cameras and gear sensors, full design and management of EM systems, log systems, comprehensive training, and EM options for small inshore fishing to large pelagic vessels.



Images courtesy of Archipelago Marine Research Ltd. Different EM observation systems including (from left to right) a vessel tracking system, a system using video to track discarded vs. retained catch, and a system that records data from cameras for commercial fishing vessels.

Federal Encouragement for Electronic Monitoring Utilization

NMFS and the National Fish and Wildlife Foundation (NFWF) have programs in development to help encourage fishermen to participate in EM programs. NMFS's program, the Fisheries Information System Program, is a state-regional-federal partnership that offers an annual, competitive funding proposal process that helps improve EM monitoring.[36] Additionally, the NFWF has a fund entitled the Fisheries Innovation Fund, which offers financial incentive for fishermen to put EM systems onto their vessels.[37] One potential project could be to install EM video systems and observers at the same time then investigate the efficacy of these video systems for set gillnets.

Current Electronic Monitoring Usage

In the United States there are several EM programs that have been fully implemented, including the Alaska small-boat fixed gear program, the Atlantic pelagic longline fishery, and the Northeast groundfish fishery.[38] Each EM program is designed to meet the different management needs of the fisheries. The Alaska EM program is used to monitor and collect data on all catch, while the Atlantic longline fishery EM program monitors incidental catch of bluefin tuna.[39] The Northeast groundfish fishery employs two EM programs – a logbook audit model on smaller vessels and on larger vessels a system that monitors compliance with maximized retention.[40]

There are also many EM projects and programs in development in the United States.[39] On the West Coast, EM in the groundfish fishery is anticipated to be fully implemented in 2025. In Alaska, full implementation of EM in the midwater trawl pollock fishery is scheduled for 2024. EM projects are also underway in the Pacific Islands pelagic longline fishery, in addition to several pilot EM projects in Alaska and the Gulf of Mexico. EM for bycatch monitoring has not yet been explored for California set gillnets.

Advantages and Disadvantages

One major disadvantage with EM systems is that so far there has been no coordinated effort to standardize the hardware and software of EM technology. Even if the technology can be standardized and artificial intelligence incorporated, it will likely augment rather than replace human observers. While EM has proven to be an effective tool to meet fisheries monitoring

[36] NMFS. 2023. Fisheries Information System Program. Available: www.fisheries.noaa.gov/national/commercial-fishing/fisheries-information-system-program. Accessed June 2023.
[37] National Fish and Wildlife Foundation. 2023. Fisheries Innovation Fund. Available: www.nfwf.org/programs/fisheries-innovation-fund?activeTab=tab-3. Accessed June 2023.
[38] NMFS. 2020. National Electronic Monitoring Workshop Report 2019/2021. https://s3.amazonaws.com/media.fisheries.noaa.gov/2020-09/2020-EM-National-Workshop-Report-FINAL-4-webready.pdf?ci7Mq1XPdpkHw2yzVtxGTtWXXObKWlPr
[39] NMFS. 2020. National Electronic Monitoring Workshop Report 2019/2021. 46 p. https://s3.amazonaws.com/media.fisheries.noaa.gov/2020-09/2020-EM-National-Workshop-Report-FINAL-4-webready.pdf?ci7Mq1XPdpkHw2yzVtxGTtWXXObKWlPr
[40] NMFS. 2022. Electronic Monitoring for Sectors [Fact Sheet]. Greater Atlantic Regional Office, 2 p. https://media.fisheries.noaa.gov/2022-05/EM-spring2022-508nefsc.pdf

objectives, data collected require manual review and analysis to extract meaningful catch accounting information. This can be an expensive and time-consuming effort. Developing an accurate machine learning or algorithm-based model for marine species recognition requires a large and diverse dataset of labeled and verified images. Collecting such data can be challenging, especially for rare or lesser-known species. However, efforts are underway to advance these systems and develop durable models. The EM Innovation (EMI) project is one that aims to address these issues by researching and piloting cost-effective and durable machine learning and computer vision (CV) advancements for EM camera system deployments, with the goal of providing near real time, automated, catch accounting and reporting. [41]

Another complexity with video EM is confidentiality. Fishermen have raised concerns with cameras running 24 hours a day on their vessels and have expressed concern about how the footage will be used or shared. To address this concern, NMFS has created a confidentiality policy entitled Policy on Electronic Technologies and Fishery-Dependent Data Collection that details how they apply information law to the data they are collecting. [42]

Another challenge posed by EM is blind spots and system maintenance. There are certain fishery operations that are more prone to data gaps or data tampering, and all captains and crews with EM systems must maintain these systems, including cleaning the camera lens so that clear images can be captured. In most cases, a trial is needed to figure out where cameras should be placed to evaluate the appropriate operations of the vessel, and every EM program to date in the U.S. has completed trials to work out the best placement for cameras on a vessel. Even with the presence of cameras, it is important to review the video footage to understand vessel crew behavior and catch handing operations, such as recognizing if a bycatch event occurred outside the view of the cameras (e.g., in the water next to the vessel). A longline fishery operating at night may be difficult to monitor solely through a camera lens, even with floodlights, so human observation may be necessary in these situations. Since EM for set gillnets has not yet been explored on the West Coast, systems will require testing to determine how to make EM viable for this gear type.

Despite these disadvantages, in the long-term, EM has potential to be more efficient than humans on certain tasks, such as counting catch. Therefore, any new efforts to use EM to quantify bycatch should use both human observers and EM video on the same trip, so that the data collected by each method can be compared.

[41] Lee Son, G. S. et al. 2023. Development of electronic monitoring (EM) computer vision systems and machine learning algorithms for automated catch accounting in Alaska Fisheries. AFSC Processed Rep. 2023-01, 113 p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115. https://repository.library.noaa.gov/view/noaa/49143

[42] Alger, Brett. 2019. Policy on Electronic Technologies and Fishery-Dependent Data Collection. Office of Science and Technology, 5 p. https://media.fisheries.noaa.gov/dam-migration/04-115.pdf

Electronic Logbooks

Logbooks rely on fishermen self-reporting catch and other information about their fishing trips. Historically, fishermen filled out paper logbooks and submitted them to fishery managers. Electronic logbooks offer the potential for submitting this information digitally through a tablet with internet connection or cellular service. However, in the context of bycatch data collection, the use of electronic logbooks may mimic existing under-reporting and biased data problems with self-reporting, especially if there is an incentive not to report bycatch. For fisheries with high rates of bycatch, electronic logbooks may not be practical for obtaining catch and bycatch composition. That said, they may be useful for collecting other data from fishermen, such as the type of nets used, the start and end points of fishing activities, and bycatch hotspots. Electronic logbooks could also be a means to report data collected by oceanographic and environmental sensors on fishing vessels or gear.

How Electronic Monitoring Could Be Implemented

If EM was to be implemented as part of a California State Observer Program, it should initially be considered as a complement to human observers, rather than a replacement. Once EM has been demonstrated to have comparable accuracy to human observers, a data optimization system could inform a percentage of observation covered entirely by humans and portion covered entirely by EM. However, it is imperative that observer programs treat human observers and EM systems as two completely different observation methods. Humans can collect data in a detailed and accurate manner, whereas a camera can offer efficient data collection without the same accuracy. There are costs and benefits to each method; therefore, observers and cameras cannot be expected to collect the same data. Comparing data collected by observers and EM on the same fishing trips would be informative in future applications of EM.

Other types of EM than video monitoring could be used to complement observers. EM systems with vessel tracking and net sensors can track when and where nets are in the water, while human observers could collect fine scale data such as species identification, catch composition, and biological samples. In this example, EM and human observers complement one another.

EM is still in its early stages, and fully developing the technology to meet the needs of the fishery managers may take longer than originally anticipated. Communication with the industry and programs already using EM is invaluable to ensure EM continues to develop optimally and previous mistakes are not repeated.

The Costs of Electronic Monitoring

EM has the potential to collect certain data efficiently and reduce costs. A 2018 study conducted in Peru estimated that an EM system would cost half of the cost of human observers.[43] Additionally, for cod vessels in Alaska, EM costs were estimated at 27 to 41% less than the costs of observers.[44]

However, in many fisheries EM costs remain high and the technology has not yet reached the point of replacing human observers. Existing EM companies compete for a tiny marketplace with a small number of customers; therefore, the companies are not making a lot of money to further develop their hardware and software. Even though it may be relatively inexpensive to build a simple program that counts catch in a gillnet, it may not be feasible to expect automatic species identification, so it will likely be necessary to include human review of the video footage.

Cost estimations for EM are complex due to the variability of situations and the many different types of EM. EM costs are dependent on the number of vessels participating in the EM program, the number of systems that need to be purchased and/or replaced on an annual or recurrent basis, deployment rates, field support services, video review, and other factors. Vessel length can be used as a general proxy for the cost of purchasing and installing EM. A 2017 report projecting cost estimates for EM in the New England Groundfish Fishery concluded: 1) the video monitoring systems cost approximately $8,000 to purchase and install per vessel; 2) the average costs (based on the gear type) for 100% video review ranged from $270 to $335 per day; and 3) the average annual cost per vessel for equipment, purchase, installation, program management, and review of 100% of video collected was estimated at $15,000.[45] Once established, the highest annual cost is accrued from EM submission, review and reporting. For gillnet vessels in this fishery, 100% EM video review is estimated to cost $284 per fishing day (4 sets/day, at $71/set). In this projected EM costs report, a cost breakdown is presented of a sample gillnet vessel based on the scenario of 100% EM coverage and 50% video review (Figure 1).

[43] D.C. Bartholomew et al. 2018. Remote Electronic Monitoring as a Potential Alternative to On-Board Observers in Small-Scale Fisheries, Biological Conservation 219: 43 p., http://www.sciencedirect.com/science/article/pii/S0006320717307899.
[44] S. Buckelew et al. 2015. Electronic Video Monitoring for Small Vessels in the Pacific Cod Fishery, Gulf of Alaska. North Pacific Fisheries Association and Saltwater Inc., 2015, 19 p. https://www.npfmc.org/wp-content/PDFdocuments/conservation_issues/Observer/EM/Pcod%20Tech%20report_FINAL.pdf
[45] CapLog Group LLC. 2019. Projected Cost of Providing Electronic Monitoring to 100 Vessels in New England's Groundfish Fishery. Commissioned by the Nature Conservancy. Available: https://em4.fish/wp-content/uploads/2019/04/TNC-EM-Cost-Assessment-Report-Submission-to-NEFMC-4_10_19.clean_.pdf

Sample Vessel Two:
Gear: Gillnet
Length: 40 feet
Trips per Year: 50 trips
Trip Length: 18-24 hours
Sets per Trip: 3 sets per trip
EM Catch Handling Efficiency: Average
Vessel EM Service Requirements: Average

Estimated Annual (Year 3) Cost for User-Specified Vessel	
Policy, Regulatory and Program Dev Costs	**$ -**
Program Planning and Development	$ -
On-Vessel Costs	**$ 1,620**
EM Equipment and Software	$ -
Repair and Support of EM Systems	$ 1,620
Program Admin and Operations Costs	**$ 9,527**
Program Management	$ 2,520
Management Software and Systems	$ 300
EM Submission, Review and Reporting	$ 6,000
EM Video / Data Storage	$ 707
Total for EM Program	**$ 11,147**

100% ASM Coverage v 100% EM Coverage	
# of Fishing Days	50 days
Sample FY2018 ASM Rate for full day (18-24 hr)	$ 570
Vessel Cost for 100% ASM Coverage	**$ 28,500**
Vessel Cost for 100% EM Coverage	**$ 11,147**

Figure 1. Example estimation of annual EM cost of a gillnet vessel in the New England Groundfish fishery, based upon 100% EM coverage and 50% video review. EM estimates are compared to at-sea monitoring (ASM) estimates for the same vessel.[45]

The costs presented in the 2017 report represent those of an experimental program that tested new processes and technologies. As any EM program evolves from experimental to an established stage, it is reasonable to expect cost per vessel to decrease.

Section VI. Recommendations for a California Observer and Bycatch Monitoring Program

Objectives for the State Observer Program

Within the California set gillnet fishery, the main needs of an observer program are to collect accurate catch and bycatch compositions both by weight and number of individuals, of species such as fishes, invertebrates, marine mammals, sea turtles and seabirds, and other rare species. If coverage is less than 100%, accurate and consistent information on fishing effort is essential to ensure that expanded estimates of total catch and bycatch are achievable. Bycatch data collected by the observer program would be most useful when collected in the same unit as landed catch data, which is currently recorded by weight. Total effort of the fleet can be tracked in several ways, however, and the observer program should track number of sets, sets per trip, the length of the net panels, and soak duration to quantify accurate total effort of the fleet.

Currently, NMFS combines data from all California set gillnets as a single fishery. However, there are two distinct mesh sizes (6.5 inches and 8.5 inches) which are intended to target different species assemblages. We recommend future observer coverage clearly identify the mesh

size used in each set to enable analysis of the bycatch and catch data by mesh size in addition to in aggregate.

Specific to the California set gillnet fishery, NMFS has previously recommended a minimum of 20% observer coverage year-round.[46] Higher coverage levels up to 100% may be necessary to detect rare species interactions and/or enforce potential hard caps on bycatch.

Authority and Funding

When setting up a state-run observer program, the state must establish regulations to require vessels to carry observers upon request, along with notification requirements. NMFS currently requires the California set gillnet fishery to carry observers upon request under the authority of the MMPA.

Since California does not currently have a state-run observer program, new funding will be needed. One option would be to establish a new budget allocation to CDFW to establish and run an observer program. Another option would be to seek funding from the California Ocean Protection Council to develop a pilot observer program. There may be federal funding opportunities through the NMFS Bycatch Reduction and Engineering Program, and Saltonstall-Kennedy grant programs. Additionally, non-state funding from non-governmental or philanthropic organizations (such as the National Fish and Wildlife Fund) could be used to fund the program through a public-private partnership.

The fishing industry could be required to pay at least partially for the costs of observers either directly or through increased landings fees, like the funding model described above in the North Carolina State Observer Program. As another example, the North Pacific Groundfish and Halibut Fishery Observer Program is funded based on the amount of target organisms landed by vessels in the partial coverage category. The vessels are given a 1.65% fee multiplied by the price of landed catch weight.[47] This fee percentage is set in regulation and reviewed periodically by the North Pacific Fishery Management Council. Additionally, this fee is split between the buyer of the fish and the vessel owner or operator. This program also started funding certain EM fleets in 2019. However, it is important to note that the California set gillnet fleet is significantly smaller with a fraction of the participants compared to the fleets in the examples above.

Recommendations for Observing the California Set Gillnet Fishery

We recommend a 3-phase approach where initially the state would work with NMFS to reinstate the federal observer coverage while the state concurrently develops its own pilot state observer program that would inform a long-term program and expand to other state managed fisheries. The benefit of this approach is that observer coverage of the gillnet fleet could resume near-term.

[46] NMFS. 2011. U.S. National Bycatch Report [W. A. Karp, L. L. Desfosse, S. G. Brooke, Editors]. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-117E, 508 p. https://spo.nmfs.noaa.gov/sites/default/files/tm117E.pdf
[47] NMFS. 2022. Observer Fee Collection and Payment - North Pacific Groundfish and Halibut Fisheries Observer Program. Available : www.fisheries.noaa.gov/alaska/commercial-fishing/observer-fee-collection-and-payment-north-pacific-groundfish-and-halibut. Accessed June 2023.

However, the eventual implementation of a state-run program would be a long-term solution for state fishery monitoring and management needs. For any of these potential observer programs, data collected at sea must be consistent and comparable with landings and total effort data.

i. Reinstating Observer Coverage by the National Marine Fisheries Service

In the immediate term, reinstating the currently dormant federal observer coverage could ensure timely data for the California set gillnet fishery. The state of California would need to work with NMFS to allocate funds for additional, regular observer coverage, and possibly an increase in the number of observers, under the existing West Coast Region Observer Program.

Under this approach, it is important to consider whether NMFS can amend its current data collection protocols to meet the state's management needs, such as adding new requirements for observers to take length or weight measurements of observed marine species. Additionally, it is important to ensure there are enough observers in the region to provide coverage to an additional fishery. In its review of available bycatch data in the set gillnet fishery, CDFW raised concerns that "the Federal Observer Program only documented a sub-sample of the fleet, and observation assignments were not randomly sampled across the various fishing ports or active permittees".[48] To address this issue and to ensure that observer data are accurate and usable in the future, additional funds may be needed to hire the appropriate number of observers and ensure random assignment.

To avoid past data discrepancies between the observer program and the state's records, the state would need to refine logbook reporting requirements to align its estimates of total fishing effort with the way NMFS tracks effort. If the NMFS observer program continues to record catch per set, the state should consider also tracking total effort by number of sets, to allow for accurate extrapolation of the observer data.

ii. A Pilot California State-Managed Observer Program

We recommend the best long-term approach for California to obtain accurate bycatch data for its data-limited fisheries is to implement a California state-run observer program. This state-managed observer program could begin as a three-year pilot program for the California set gillnet fishery, for which a discrete funding package would fund with the goal of informing long-term costs. This could be considered a one-time funding allocation over a limited duration, which would likely be a higher initial cost as the program is being developed.

Under this approach, the state would have the ability to determine observer coverage needs, the selection process for vessels, and what data the observers are collecting. The state would also need to develop its own training protocols and requirements to ensure all observers are properly trained, as well as provide the necessary equipment. Previous state observer programs have largely used existing federal training and data collection methods to ensure data is comparable

[48] CDFW. 2023. Evaluating Bycatch in the California Halibut Set Gill Net Fishery. Available: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=213567&inline.

and the agencies remain collaborative. One suggestion would be for the state to partner with public state universities to train observers.

Notably, the state would not be starting from scratch. The state could draw upon the training and data collection protocols from existing federal programs and could consider contracting observers from the same observer providers that already have experience observing the California set gillnet fishery and other fisheries, which in this case is the contractor Frank Orth and Associates.

The challenges with creating a state program are first and foremost the costs. Building a new program will require time, training, negotiation, funding, and the creation of new roles in CDFW. These roles would include contract management with the observer provider, training manager and overseer, debriefing observers, communication with the captain of the vessels, data management and data queries, and coordination with other programs around the country.
As discussed above, we recommend including an EM program alongside the development of a human observer program to better evaluate and develop EM as an efficient long-term solution. In addition to catch accounting, vessel tracking and net sensors would enable fishery managers to validate soak times, net length, and fishing locations. The next step would be to create trials for video cameras while observers are also on vessels to compare data and assess the accuracy and limitations of EM. California can look to other fisheries using more advanced EM systems, such as Alaska, to evaluate those tools and compare the costs of observers to the installation of EM systems and the of hiring technicians to review video footage.

iii. Long-term Permanent California Fisheries Observer Program

Under this approach, funding for the initial development of the pilot project to get the program up and running would then be followed by ongoing funding to continue the program into the long term. Upon completion of the pilot state observer program, funding, infrastructure, workload, staff capacity, equipment and technology needs could be assessed to inform long-term budget and funding pathways for regular observer coverage. This program, once established, could be expanded to other state-managed fisheries.

VII. Conclusion

Accurate and consistent catch and bycatch data are critical to sustainably manage the target species and ensure the overall health of the ocean ecosystem. This report compiles several examples of federal observer programs across the country, and it must be noted that all NMFS observer programs receive millions of dollars in appropriations. This highlights the need for dedicated, long-term funding, which is the greatest barrier to implementing and continuing an observer program for state-managed species. While there are many factors to consider in addition to funding, California can draw on experience from the federal government, other states, and its own historic program to develop a fishery observer program for state-managed fisheries such as the California set gillnet fishery. In this report, we have outlined a potential pathway for the state to implement more regular and extensive monitoring of its fisheries, utilizing human observers

and new EM technologies. Ultimately, an investment in increased observer coverage will benefit fishing communities, sustainable fisheries populations, and marine ecosystems.

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