Fisheries Information System

National Observer Program

FY 2023 Final Project Report

Project: The feasibility of protected species data collection from Hawaiis longline fisheries Electronic Monitoring (EM) video using AI automated detection and through assessments for post-interaction mortality.

Area of Interest: Electronic Monitoring Development and Implementation

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1. Report Title

The feasibility of protected species data collection from Hawaiis longline fisheries Electronic Monitoring (EM) video using AI automated detection and through assessments for post-interaction mortality.

2. Accomplishments and Contribution to NMFS mission

This project demonstrated the feasibility of using AI to detect cetacean interactions. About 7,425 annotations of cetaceans were added to the AI image library that were received from observer video from the Pacific Island Regional Office (PIRO) observer program. In addition, about 6,500 annotations of unidentified catch underwater were added from video of cetacean interactions to help detect cetaceans as they typically appear in limited footage above the water's surface. The cetacean and unidentified catch underwater annotations were used to train an AI algorithm to detect cetaceans. Some video footage from the PIRO observer program has been tested with the developed algorithm and demonstrates the model can successfully detect cetaceans. However, limited footage of cetacean interactions are available for testing from EM video footage in the Hawaii longline fisheries.

This project also demonstrated that electronic monitoring (EM) data can be used to assess mobula (manta and devil) ray interactions.

In addition, this project demonstrated what data is collectable with EM compared to the observer program by comparing all observer fields currently collected:
Stahl, J. P., Tucker, J. B., Rassel, L., and Hawn, L. A. 2024. Data Collectable Using Electronic Monitoring Systems Compared to At-Sea Observers in the Hawaii Longline Fisheries. https://doi.org/10.25923/eewf-gz02

3. Data Documentation

Raw, encrypted EM video data is stored on a NAS server in the PIFSC. AI models and imagery and annotation files for the AI library are stored in Google Cloud Platform or on the NAS server. EM video of protected species and mobula ray interactions are stored on the NAS server in PIFSC with review of protected species interactions summarized in a google doc.

4. Schedule Changes and Deliverables

As we progress with EM research and development, we are developing a better understanding of program needs and priorities. Through meetings with IT and developers in both PIFSC and PIRO we have a better understanding of how EM data may be most appropriately stored and integrated with observer data in the future. Development of EM and observer data integration was premature for this proposal time frame and will be instead further explored in a PIRO/PIFSC joint FIS funded Inflation Reduction Act (IRA) proposal.

Deliverables that were completed:
1) Four additional cetacean and seven sea turtle (including one leatherback sea turtle) interactions were reviewed and summarized from EM footage in the Hawaii longline fishery that were not included in the publication done in FY2022 (Stahl et al. 2023).
2) Twenty mobula ray interactions were reviewed and summarized from EM footage in the Hawaii longline fisheries.
3) A total of 7,425 annotations of cetaceans were added to the AI library from observer video data that we received from PIRO with about 6,500 additional annotations of unidentified catch underwater that were from imagery of cetaceans under the water's surface. In addition, 4,070 annotations of floats to prevent false positives and 3,500 shark annotations were added to the AI library.
4) A preliminary AI model was developed that can detect cetaceans in addition to fish on deck and sea turtles.
5) A data report was published on what data is collectable with EM compared to observer data: Stahl, J. P., Tucker, J. B., Rassel, L., and Hawn, L. A. 2024. Data Collectable Using Electronic Monitoring Systems Compared to At-Sea Observers in the Hawaii Longline Fisheries. https://doi.org/10.25923/eewf-gz02

Table: Completed Deliverable Summary

Activity Description	Planned Finish	Actual Finish
Perform research to evaluate if data can be collected to make determinations on the likelihood that protected species will survive a fishery interaction. Summarize findings in a NOAA Data Report and provide any recommendations for EM systems, fishing gear, fisher handling, and EM review to improve these determinations.	03/31/2024	05/01/2024
In FY2022 and FY2023, we will focus on adding annotations for data gaps to train an AI model for object detection of each of the different categories of catch encountered in the longline fisheries. We are aiming for a total of 10,000 annotations for each category with the following goals to add to our current library: 5,000 fish in the water, 10,000 unidentified catch in the water, 10,000 marine mammals, 10,000 sharks, and 10,000 pelagic stingrays (5,000 in water and 5,000 on deck).	03/31/2024	05/01/2024
Train and test AI models to automate detection of protected species interactions in the Hawaii longline fisheries.	03/31/2024	03/31/2024
The database engineer will build the EM tables that are conceptualized by the data-integration team that will be housed in the observer database.	03/31/2024	05/01/2024

5. Lessons Learned

Our AI model development research led us to the discovery that an AI model could be trained to detect cetaceans from not only footage of them breaking the water's surface but also by adding an object class of unknown catch underwater when these animals are completely submerged underwater. This can improve detection of cetacean interactions as these animals appear in limited footage where they break the water's surface. In addition, our AI model development indicated adding objects to our training that are commonly false positives could improve model results, so we annotated 4,070 floats for future model testing.

Review of mobula ray (including one manta ray) interactions revealed that we can use EM data to assess these interactions.

6. Cost Estimates Versus Actual Cost

$20,000 of funds that were original for a database engineer were reallocated to new CIMAR staff to work on AI annotations. We realized the time frame of this proposal was premature for a database engineer. EM and observer database integration will be assessed in the FIS IRA funded proposal and will be a joint effort of PIRO and PIFSC.

7. Transition Plan

We will continue to work towards EM implementation in PIR with the established ETSC, WPRFMC, and PIRO. EM research in the region will guide development of a timeline for implementation, how funds can be obtained and allocated, who (PIR staff, industry, and/or contractors) will be responsible for program operations (i.e. management, system maintenance, AI execution, video review, and data storage), and how to supplement the existing at-sea observer program. In addition, the following will act as guidance:
1) A Roadmap for the Potential Future Implementation of Electronic Monitoring in the Pacific Islands Region (NMFS. 2023a, https://www.fisheries.noaa.gov/resource/document/roadmap-potential-future-implementation-electronic-monitoring-pacific-islands)produced by Policy Analyst, Claire
Fitz-Gerald after her 3-month detail in PIR from October to December 2022.

2) A briefing document prepared by members of the Electronic Technologies Steering Committee and Pelagic Plan Team for the 196th Council Meeting on the potential goals and objectives for a pre-Implementation program on electronic monitoring in PIR.

3) Pacific Islands Region Electronic Technologies Implementation Plan (NOAA National Marine Fisheries Service 2021, https://media.fisheries.noaa.gov/2021-08/Pacific%20Islands%20ETIP_080621.pdf).

4) A NOAA technical memorandum (Carnes et al. 2019, https://doi.org/10.25923/82gg-jq77) that compares fish detection rates and other data collected between EM and at-sea observers.

5) A NOAA data report (Stahl and Carnes 2020, DR-20-012. https://doi.org/10.25923/n1gq-

m468.) that compares detection rates at different video review speeds and demonstrates the ability to detect protected species with EM.

6) A NOAA technical memorandum The role of electronic monitoring in assessing post-release mortality of protected species in pelagic longline fisheries (Stahl et al. 2023.

7) Data Collectable Using Electronic Monitoring Systems Compared to At-Sea Observers in the Hawaii Longline Fisheries (Stahl et al. 2024, https://doi.org/10.25923/eewf-gz02) compares the observer collected data fields by data form. This document will be a resource for the WPRFMC and the ETSC to guide them in structuring an EM program that can effectively supplement the at-sea observer program while still collecting data needed for management and stock assessment.

8. Discussion/Conclusions/Recommendations

EM past research and development in the Pacific Islands indicates that EM can detect both retained fish (Carnes et al. 2019) and protected species (Stahl and Carnes 2020) and can also assess the post release condition for sea turtles and cetaceans for most fishing interactions (Stahl et al. 2023). This project also showed that EM video footage can be used to collect data on mobula ray interactions. In addition, a published data report (Stahl et al. 2024) showed which observer fields currently collected can be obtained using EM footage or another source, which can better inform how EM can supplement the at-sea observer program.

Developed AI models indicate that not only fish on deck and sea turtles, but also cetaceans can be detected, which indicates AI models may be a reliable way to detect catch, including protected species from EM footage. This could reduce the time and costs of EM video review compared to a human reviewer alone as 90% of fishing gear has empty hooks. Reduced costs and review times may allow for easier adoption of EM implementation.

9. References

Carnes, M.J., J.P. Stahl, and K.A. Bigelow. 2019. Evaluation of Electronic Monitoring Pre-implementation in the Hawaii-based Longline Fisheries. NOAA Technical Memorandum. NMFS-PIFSC -90, 38 p. https://doi.org/10.25923/82gg-jq77

NMFS. 2023a. Roadmap for the Potential Future Implementation of Electronic Monitoring in the Pacific Islands Region. National Marine Fisheries Service, Pacific Islands Regional Office, Honolulu. p 16. https://www.fisheries.noaa.gov/resource/document/roadmap-potential-future-implementation-electronic-monitoring-pacific-islands

NOAA National Marine Fisheries Service. 2021. Pacific Islands Region Electronic Technologies Implementation Plan. August 2021, PIFSC, 1845 Wasp Blvd, Building 176, Honolulu, HI 96818.

https://media.fisheries.noaa.gov/2021-08/Pacific%20Islands%20ETIP_080621.pdf

Stahl J. and M. Carnes. 2020. Detection Accuracy in the Hawaii Longline Electronic Monitoring Program with Comparisons between Three Video Review Speeds. PIFSC Data Report DR-20-012. https://doi.org/10.25923/n1gq-m468.

Stahl, J. P., Tucker, J. B., Hawn, L. A., and Bradford, A. L. 2023. The role of electronic monitoring in assessing post-release mortality of protected species in pelagic longline fisheries. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-147. https://doi.org/10.25923/zxfv-5b50

Stahl, J. P., Tucker, J. B., Rassel, L., and Hawn, L. A. 2024. Data Collectable Using Electronic Monitoring Systems Compared to At-Sea Observers in the Hawaii Longline Fisheries. https://doi.org/10.25923/eewf-gz02

10. Did the project make a process less time-intensive or less expensive?

Y

11. Did the project contribute to improving the quality of collected data?

Y

12. Explanation

AI research indicates that an AI model can be developed to detect catch and protected species, which makes AI models a potential means to reducing costs and time of video review in the Hawaii longline fisheries compared to a human reviewer alone.

This project indicated that EM can be used to collect data on mobula ray interactions.

13. Did the project have its expected impact?

Y

14. Explanation

This project demonstrated that it is feasible to use AI models to detect catch, including protected species in the Hawaii longline fisheries. In addition, it showed that EM can collect data on mobula ray interactions. And finally our data report (Stahl et al. 2024) indicates what observer data fields are collectable with EM, which can help inform how EM can supplement the at-sea observer program in the Hawaii longline fisheries and help inform the regional fishery management organizations that are developing standards for EM data collection.