

Fisheries Information System

National Observer Program

FY 2022 Final Project Report

Project: Advancements in Pacific Islands Region Electronic Monitoring (EM): Assessing protected species interactions with improvements in data and image collections while developing the regulatory framework for EM implementation.

Area of Interest: Electronic Monitoring Development and Implementation

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Advancements in Pacific Islands Region Electronic Monitoring (EM): Assessing protected species interactions with improvements in data and image collections while developing the regulatory framework for EM implementation.

1. Is it Influential Scientific Information?

Ν

2. Has it had sufficient Peer Review?

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Ν

4. Does the publication contain new data, new interpretations or other information that has not had peer review or has not been previously published?

Y

5. Report Title

Advancements in Pacific Islands Region Electronic Monitoring (EM): Assessing protected species interactions and development of a roadmap for future EM implementation

6. Accomplishments and Contribution to NMFS mission

This project demonstrates that electronic monitoring (EM) data can be used to assess the likelihood of mortality of protected species that interact with the Hawaii longline fisheries, and as such can be an alternative to observer data for collecting critical protected species information. Protected species data is required to estimate annual rates of human caused mortality and the maximum number of animals that can be removed from stocks in U.S. waters. Protected species data are also crucial in the PIR longline fisheries as interactions can result in management actions, such as fishery or area closures.

This work also allowed further advancement of the AI image library that is used to develop AI models to detect catch events from EM footage. A succesful AI model that detects catch could reduce the cost and time of EM video review, as about 90% of hooks have no catch. With a reduction of cost for video review it is more likely that EM will be implemented in the future.

In addition, a roadmap was developed for future EM implementation by bringing in a policy anayst on a 3-month detail. This person also helped facilitate communication between NOAA's Pacific Islands Fishery Science Center (PIFSC) and Pacific Islands Regional Office (PIRO) which initiated work towards determining how EM can meet regulatory requirements and what regulations need to be developed to implement EM in the Hawaii longline fisheries.

7. Data Documentation

Raw, encrypted EM video data is stored on a NAS server in the PIFSC.

Imagery and annotation files for the AI library are stored in Google Cloud Platform.

A NOAA technical memorandum was published that summarizes the EM video review and analysis that demonstrates EM can be used to collect data to assess the likelilhood of post-release mortality of protected species: 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

EM video of protected species interactions are stored on the NAS server in PIFSC.

A NOAA paper was developed from the 3-month detail: 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. <u>https://www.fisheries.noaa.gov/resource/document/roadmap-potential-future-implementation-electronic-monitoring-pacific-islands</u>

8. Schedule Changes and Deliverables

As we progress with EM research and development, we are developing a better understanding of program needs and priorties. 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 Reducation Act (IRA) proposal. In addition, we decided to postpone working on length estimation for sea turtles and fish as currently other priorities need to be addressed and staff time is limited.

Deliverables that were completed:

1) A NOAA technical memorandum summarizing the EM video review and analysis that demonstrates EM can be used to collect data to assess the likelilhood of post-release mortality of protected species: 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

2) A NOAA paper developed from the 3-month detail: 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

3) Increasing our AI image library by 20% for a total of 208,309 annotations by June 1, 2023. In addition, the AI library was cleaned up following best practices and 154,216 annotations were removed that were from publicly available data from The Nature Conservancy as there was some issues with the dataset and misalignments and we wanted to have our annotations from the Hawaii longline fisheries unless imagery is insufficient for training such as in the case of protected species.

Table: Completed Deliverable Summary

Activity Description	Planned	Actual
	Finish	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. This would include a summary of our investigations of different camera views.	05/01/2023	09/15/2023
A Policy Analyst will perform a detail in PIR and work with the ETSC, along with other staff and partners to develop a regulatory roadmap and a timeline for EM implementation.	05/01/2023	04/15/2023
A data integration team will produce a draft document with a conceptual model for a database build of the EM data that includes the tables, fields and relationships to current data. In addition, this document will summarize options for EM video storage, data input, and reporting.	04/01/2023	07/01/2023
We will increase our AI image annotation library by 20% by the end of the funding cycle, adding to the current >250,000 annotations.	04/01/2023	06/01/2023
Add length attributes for sea turtle annotations (when available) and for one hundred bigeye tuna annotations for an initial investigation with Kitware staff to research methods of applying AI to estimate lengths from these data.	04/01/2023	04/01/2024

9. Lessons Learned

During this project we collaborated with protected species staff to understand how injury determinations are made for cetaceans and how post-release mortality estimates are assigned for sea turtles. This knowledge helped us to determine what data to examine and document in EM video to assess protected species interactions (e.g., hook location). This understanding will allow EM staff to better assess additonal protected species interactions in the future. Recommendations and lessons learned are summarized in the NOAA technical memorandum here: 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

Discussions with IT from PIRO and PIFSC helped us better understand how EM data may be most appropriately stored and integrated with observer data in the future. As such, we postponed the objective of EM and observer data integration to future investigations when appropriate resources (staff, time, and funding) are available.

Through work with a contractor Deloitte we learned about AI best practices and were able to clean up our image library and add additional annotations that provide a more balanced data set for AI training.

Through a policy analyst 3-month detail we learned what steps should be taken in the region to move EM toward implementation in the future with recommendations outlined in the publication: 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. <u>https://www.fisheries.noaa.gov/resource/document/roadmap-potential-future-</u>

implementation-electronic-monitoring-pacific-islands

10. Cost Estimates Versus Actual Cost

No changes between cost estimates and actual costs.

11. 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, <u>https://www.fisheries.noaa.gov/resource/document/roadmap-potential-future-implementation-electronic-monitoring-pacific-islands</u>)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, <u>https://media.fisheries.noaa.gov/2021-</u>08/Pacific%20Islands%20ETIP_080621.pdf).

4) A NOAA technical memorandum (Carnes et al. 2019, <u>https://doi.org/10.25923/82gg-jq77</u>) 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-

<u>m468</u>.) 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 postrelease mortality of protected species in pelagic longline fisheries (Stahl et al. 2023, <u>https://doi.org/10.25923/zxfv-5b50</u>) that summarizes research findings on what data EM can and cannot collect for protected species interactions.

12. Discussion/Conclusions/Recommendations

EM 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).

Al models developed in FY23 using annotations developed in FY22 indicate that initial Al models are successful at detecting fish and sea turtles and have the potential for reducing costs and time for video review.

This project indicated the need for PIRO and PIFSC to work together in the future towards EM implementation. This includes developing infrastructure for EM data storage for an operational program and developing necessary regulations.

13. References

A Roadmap for the Potential Future Implementation of Electronic Monitoring in the Pacific Islands Region (NMFS. 2023a, <u>https://www.fisheries.noaa.gov/resource/document/roadmap-potential-future-</u> <u>implementation-electronic-monitoring-pacific-islands</u>)produced by Policy Analyst, Claire Fitz-Gerald after her 3-month detail in PIR from October to December 2022.

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A NOAA technical memorandum The role of electronic monitoring in assessing postrelease mortality of protected species in pelagic longline fisheries (Stahl et al. 2023, <u>https://doi.org/10.25923/zxfv-5b50</u>) that summarizes research findings on what data EM can and cannot collect for protected species interactions.

14. Did you investigate whether there were opportunities to build upon past/ongoing efforts?

Y

15. Explanation

We received previous FIS funding in FY2019-FY2021 and have received future funding for FY2024 as well as FIS IRA funding with a joint proposal with PIRO and PIFSC.

16. Did you seek collaboration and/or engagement outside of your organization, e.g., state partners, FINs, fisheries, other regions, NGOs, vendors, etc.?

Y

17. Explanation

In FY2022 we were able to further our AI modeling and improve our AI image library through a contract (funded through headquarters) with Deloitte. This partnership also allowed us to set up infrastructure in Google Cloud to run models using virtual computers and to store our annotation imagery and files in google cloud.

18. Can the project's outcomes be directly applied across regions, partners, or fisheries?

Y

19. Explanation

The lessons learned on assessing protected species interactions with EM can be applied across pelagic longline fisheries worldwide and other regions. This information is especially important as the WCPFC and IAATC discuss EM implementation. The AI models developed from annotations created in FY2022 could

potentially be used by other longline fisheries to detect fish on deck and sea turtles on deck or in the water.

20. Explanation

Moving annotations and image library into google cloud for AI training and inferencing allows for AI model development by reducing training time from 1 month or more to about 2 weeks.

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

Y

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

Y

23. Explanation

This project improved the quality of data collection by determining what data are needed to be examined in EM video footage to assess protected species interactions.

24. Did the project have its expected impact?

Y

25. Explanation

This project was able to advance EM in the Pacific Islands by determining that EM data could be used to assess protected species interactions for cetacean injury determinations and sea turtle post-release mortality. This will help inform how EM can best supplement the at-sea observer program. In addition, this project helped develop a roadmap towards EM implementation with recommendations on next steps. And finally this project further advanced AI model development, which could provide a reduction in cost and time of EM video review in the future.