NOAA FISHERIES

Pacific Islands Fisheries Science Center

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EM in the Hawaii-based longline fishery

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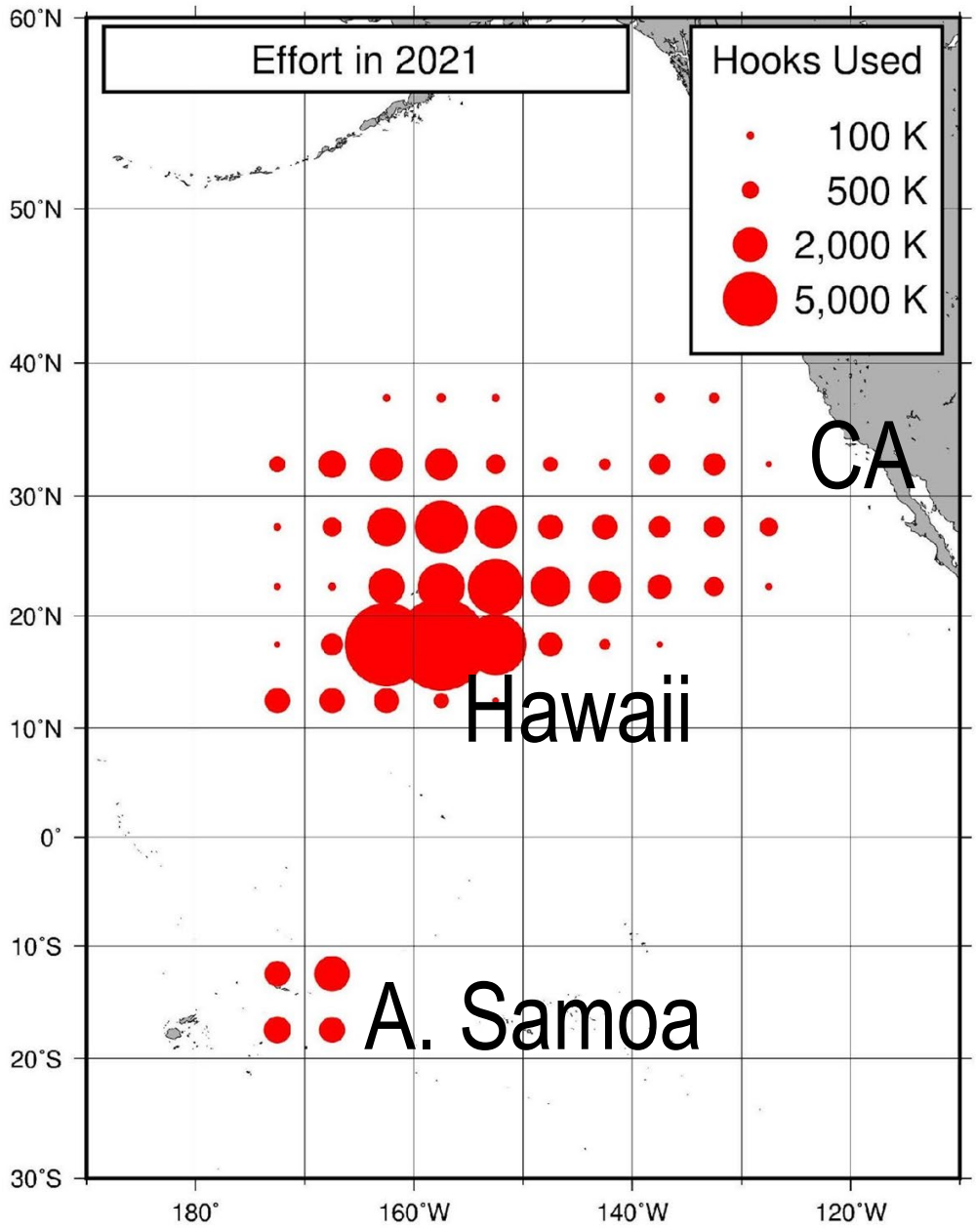
Outline

- US longline fisheries in the Pacific Ocean.
- EM program goals.
- EM systems and video review.
- Confidentiality and data retention policy.
- EM research studies.
- Artificial Intelligence for catch detection.
- Regulatory framework for EM implementation.

USA longline fisheries in the Pacific Ocean



US longline fisheries in the Pacific Ocean

Longline fishery (2021)	Vessels	Target species	Effort (million hooks)	Observer coverage (%)	Ex-vessel value ($million)
Hawaii deep-set	146 stable	Bigeye tuna	62.7	20	131
Hawaii shallow-set	11 increasing	Swordfish	0.8	100	5
A. Samoa deep-set	11 stable	South Pacific albacore	4.2	5	4

EM program goals

- To detect catch events, including retained and bycatch with emphasis on protected species.
- To identify catch by species.
- To collect information on post-release condition of protected species.
- EM is not for regulation compliance.

EM systems

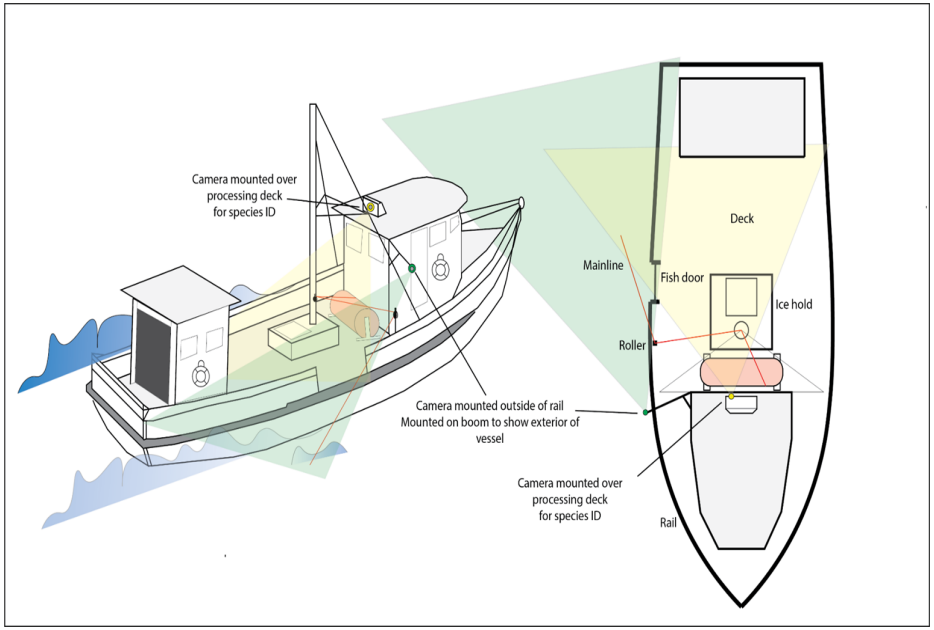
- NOAA temporary funds (Fisheries Information Systems).
- 20 volunteer vessels.
- Agreements with NOAA Fisheries and permit holders.
- Video records only during fishing hauls.
- 0.5 TB data per trip with two, 4 megapixel cameras.
- Cooperative Institute staff maintains systems, retrieves and uploads data.

EM systems

Systems - 20 vessels

Cameras -

- Deck – Retained species
- Rail – Discarded catch/protected species. View from fish door to stern, exterior of boat.



Sensors -

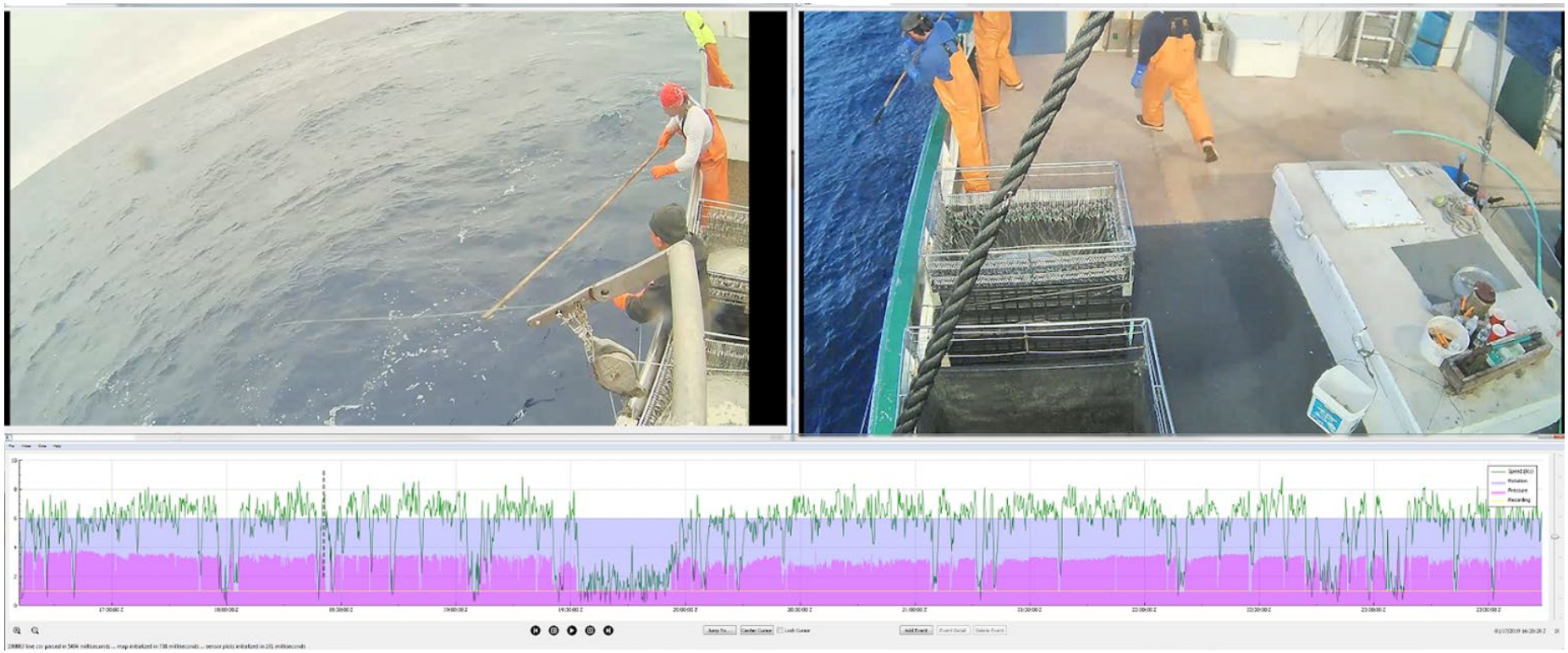
- GPS – Vessel speed and location
- Reel rotation & hydraulic pressure – Trigger cameras during hauling.

Computer -

- Runs software & connects sensors and cameras with power-over-ethernet cable.

EM video review

- Video reviewed simultaneously with a Timeline.
- Timeline displays sensor data and annotated catch.



Confidentiality and data retention policy

- Raw EM data treated similar to observer data and distribution is limited under Magnuson-Stevens Act.

- EM data retention - published policy directive
  - 5 years if collected by US government.
  - 1 year if collected by 3rd party provider.

Evaluation of Electronic Monitoring Pre-implementation in the Hawai‘i-based Longline Fisheries

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Pre-implementation study

Objectives

- To determine EM detection accuracy compared to at-sea observers.

Methods

- Detections of retained and bycatch species were compared for EM and observer data for 238 hauls.

Pre-implementation study

Results

- 98% of retained species detected from EM data.
- Bycatch accuracy better for observer data.

Deep-set longline fishery (193 hauls)	Observer	EM	% difference
Kept (retained) catch	6,647	6,666	0.4
Bycatch (discarded) catch	8,464	6,735	-20.4
Sharks (discarded)	1,657	696	-50.8
Sea Turtles	2	2	0.0
Marine Mammals	1	1	0.0
Seabirds	11	10	-9.1

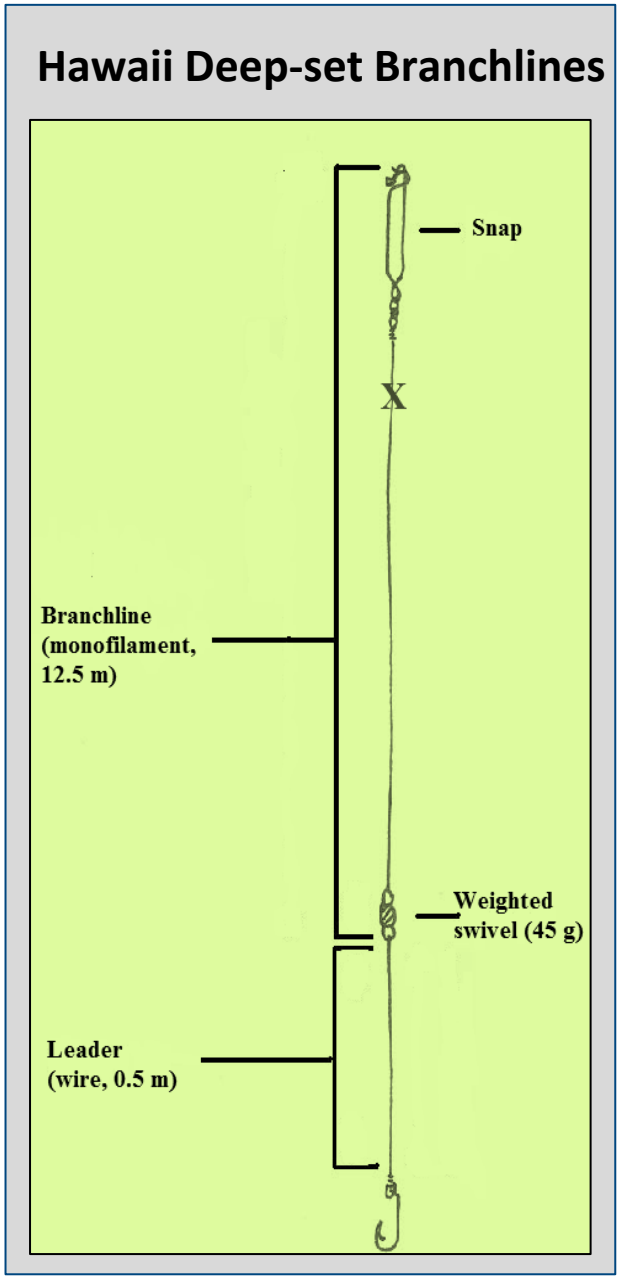
Pre-implementation study

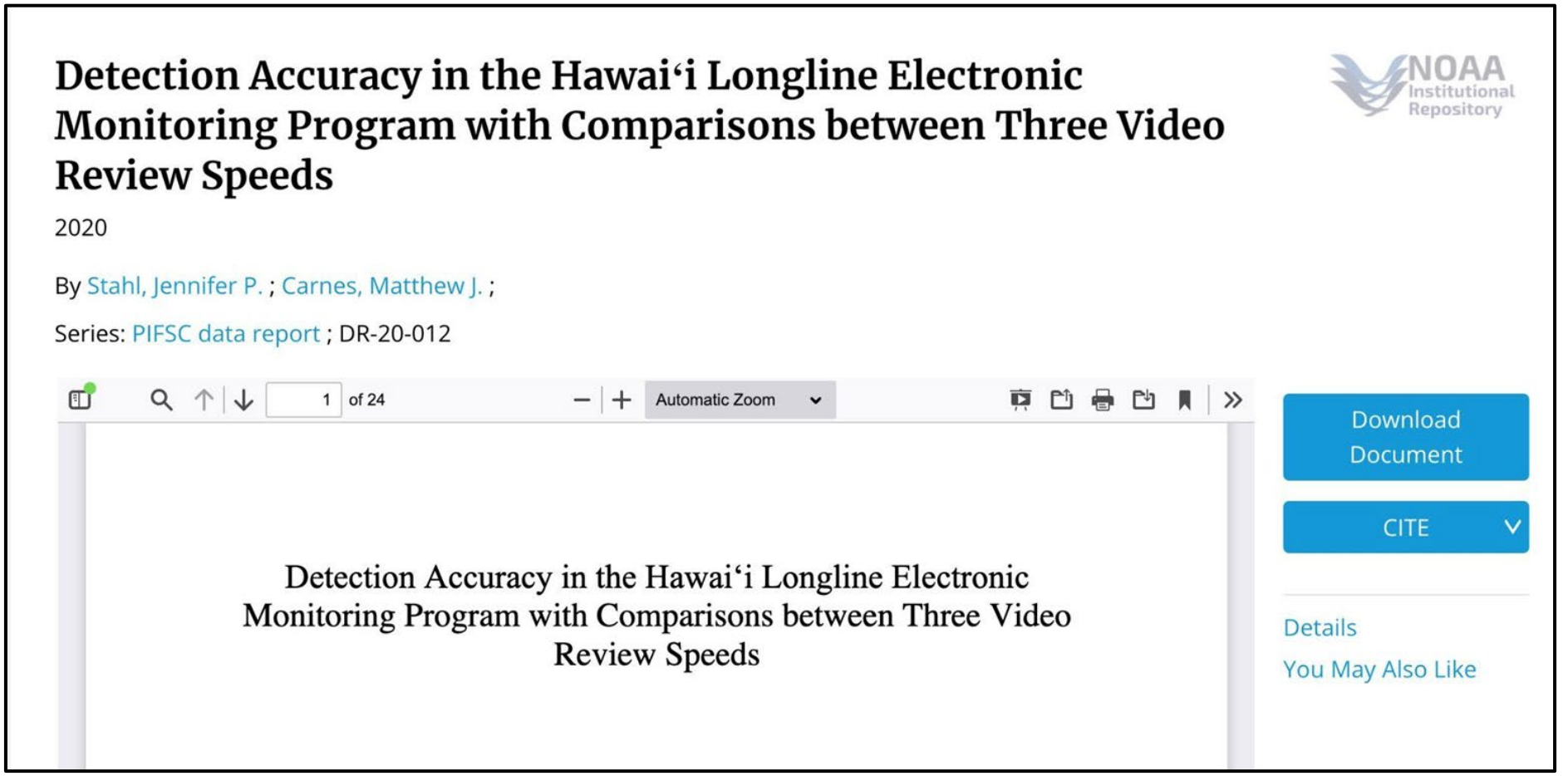
Conclusions

- EM has potential to supplement at-sea observer data.
  - Good detection accuracy for retained catch.
  - Protected species were detected but need bigger sample size.
  - Need to improve accuracy of bycatch detections, especially for sharks.

Future catch handling study

- Sharks often not in view of camera - branchlines (with wire leaders) cut close to snap as soon as fishers verify shark.
- Sharks may be in camera view with fleet changes to mono leaders - some fishers may bring sharks in to retrieve weights.
- Catch handling study needed - determine minimum distance to bring sharks to vessel for camera view.





https://repository.library.noaa.gov/view/noaa/27083

Video speed study

Objectives

- Determine detection accuracy at various video speeds with emphasis on protected species.

Methods

- Reviewer detections compared at video speeds of 4x, 8x, & 16x real-time.
- Fishing trips with protected species selected *a priori*.

Video speed study

Results

- 4x - 1 sea turtle and 1 marine mammal missed.
  - Video skipped - misinterpreted as gear issues and speed likely too slow for reviewer attention.
- 8x - no protected species missed.
- 16x - seabirds missed.

Species/Groups	Observer	EM	Detection %
Sea turtles	32	31	96.9
Marine mammals	7	6	86.7
Seabirds	9	4	44.4

Video speed study

Conclusions

- 8x best for attention and detection accuracy, 3 hours of video review per longline retrieval.
- Reviewers need protocols to review ALL footage.
- Hard to maintain attention for hours of review.
- More future research to explore catch detection using Artificial Intelligence to remove human factor.

Artificial intelligence (AI) research

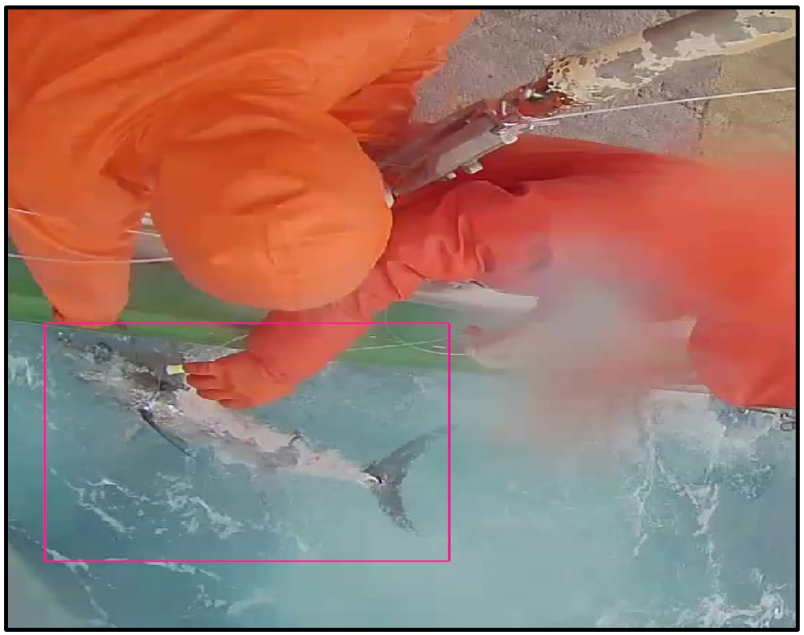
Objectives

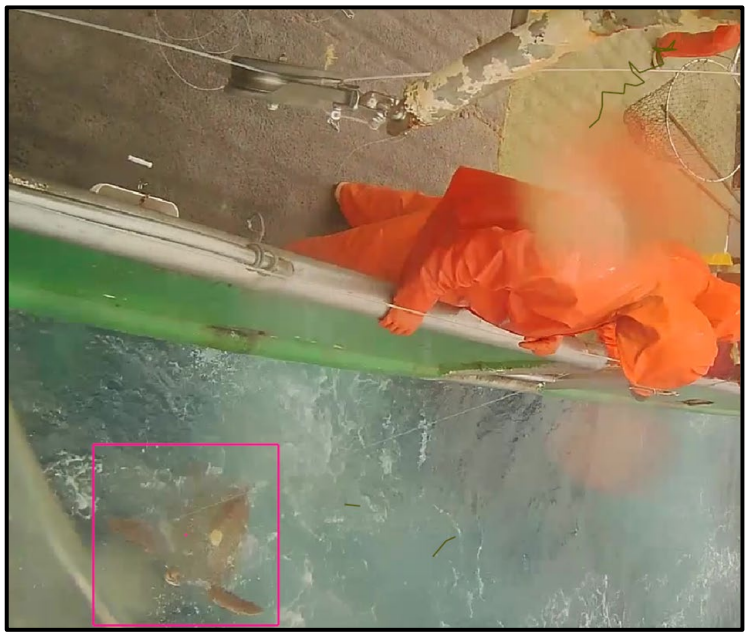
- To reduce video needed for human review - majority of fishing haul has no catch (90% of hooks).
- Improve detection accuracy - humans would not be needed to focus for long hours looking for catch events.

Artificial intelligence research

Methods

- Build library of annotated images of retained and bycatch.
- Train AI models with image library to detect catch events.
- Test models by running raw video footage through model.





Artificial intelligence research

Results so far…

- Annotations - 116,900 annotated images, including >69,000 fish and >10,000 sea turtles.
- Training - successfully built a model to detect fish on deck.

Future

- Annotations - build library with >10,000 images for each object type, including catch in water.
- Training - build model to detect catch events in water.
- Improve accuracy of detection for fish on deck.

Regulatory framework for EM implementation

- Established Electronic Technologies Steering committee (stakeholders from Pacific Islands Regional Office, PIFSC, Western Pacific Fishery Management Council and Industry, primarily the Hawaii Longline Association).
- Need a regulatory framework to determine where, when and how EM will supplement observer coverage.
- Need to establish who pays for EM systems/review.
  - US government funded program or user pays.
  - US government conducts review or 3rd party review.

Questions?

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Release of confidential information

NOAA has some fairly strict requirements for maintaining the confidentiality of information submitted by operators under the MSA, including vessel logbooks. MSA 402(b)(1)(H), allows disclosure of confidential information submitted to NOAA "in support of homeland and national security activities, including the Coast Guard's homeland security missions as defined in section 888(a)(2) of the Homeland Security Act of 2002 (6 U.S.C. 468(a)(2))." Under section 468(a)(2), living marine resources (fisheries law enforcement) and marine environmental protection are "non-homeland security missions." Homeland security missions include post, waterways and coastal security, drug and migrant interdiction, defensive readiness, and "other law enforcement."

1) Background from IATTC

Confidentiality: How policies and rules relating to confidentiality of the imagery information and EM data generated from it has been discussed and followed in your EMS program.

Compliance: In case compliance is reviewed in your EMS program, it would be important to mention the types of compliance it is reviewed, for example: compliance related only to EM standards, compliance related to management resolutions in your fishery issued in programs other than EMS, etc.

If incentives for compliant behavior are established in your EMS program, it would be very valuable if those are mentioned. For example, incentives for compliant behavior directly related to lower data review rates (e.g., to reduce EM costs).

EM equipment: It would be interesting to know, 1. If the EM equipment installed on the vessels are required to meet standards for detecting, reporting, and recording malfunctions and tampering on any of the EM equipment components. 2. If your program reviews rules and procedures for handling cases of EM equipment malfunctions and tampering that may take place at sea or while in port, and also how are these actions carried out or sanctioned.

EM coverage and EM data review rate: It would be interesting talk about what percentage of vessels fishing in your EMS program are mandated to have the EM equipment installed, and what percentage of EM data collected on those are required for review. In addition, it would be also important to mention if this coverage and review rate were fixed from the start of the EMS program, or it was increased programmatically based on scientific studies, or adjusted due to compliant behavior (in case of EM data review rate). Finally, it would be important to mention if a vessel with the EM equipment installed is required to record all the fishing activities conducted for that vessel during the entire trip, regardless if the EM data review rate is not 100%.