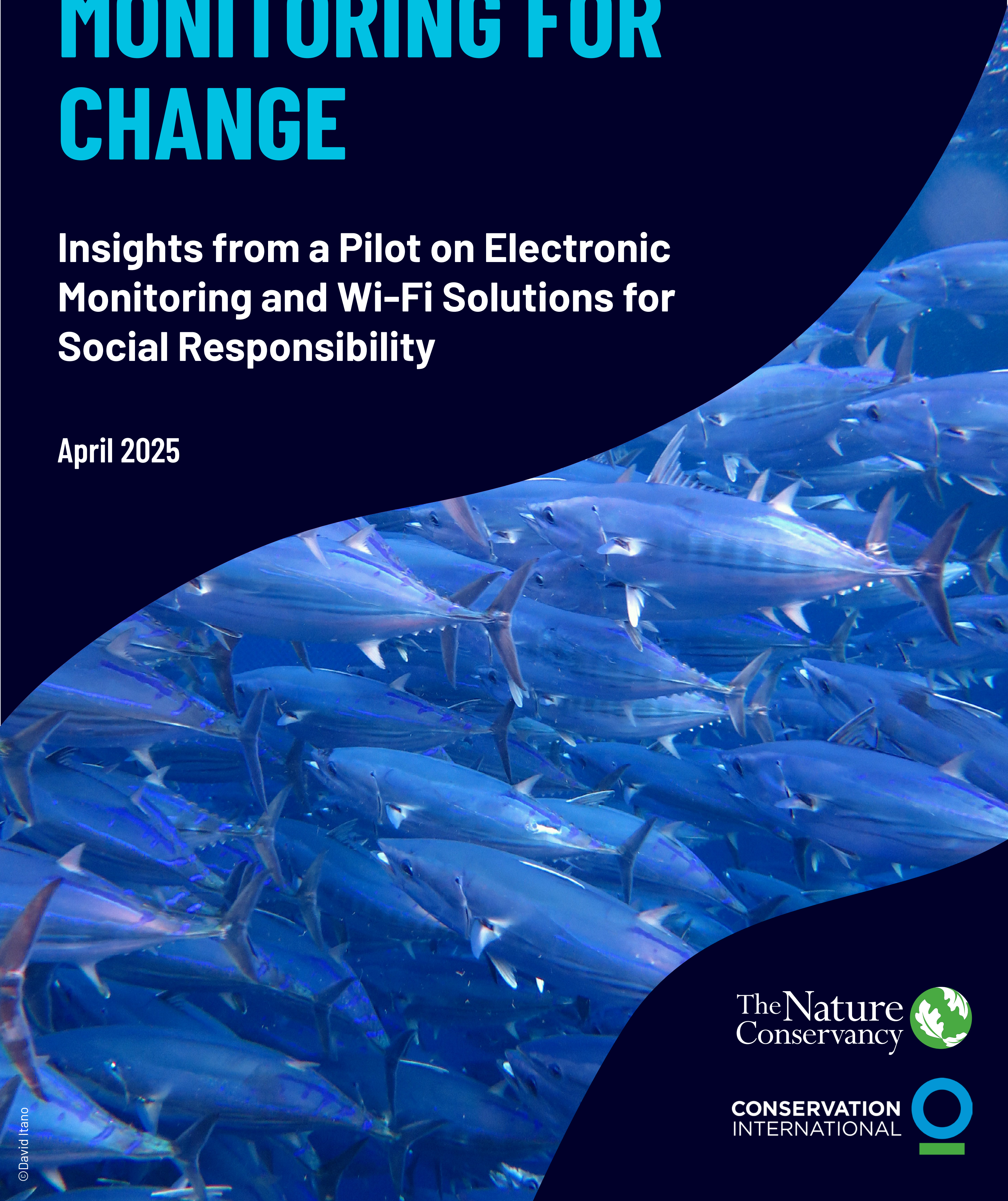
MONITORING FOR CHANGE

Insights from a Pilot on Electronic Monitoring and Wi-Fi Solutions for Social Responsibility

April 2025



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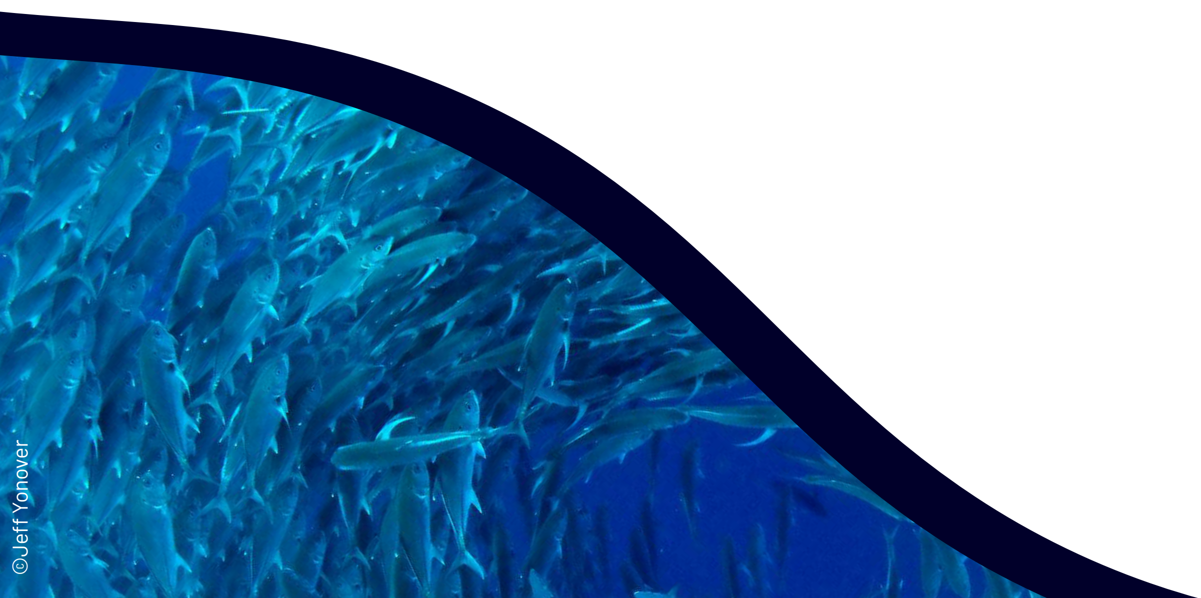
Acronyms

		ILO	International Labor Organization
AI	Artificial intelligence	**IOTC**	Indian Ocean Tuna Commission
CAP	Corrective Action Plans	**ITF**	International Transport Workers' Federation
CCTV	Closed-circuit Television	**IUU**	Illegal, Unreported, and Unregulated
CI	Conservation International	**MCS**	Monitoring, Control, and Surveillance
CSO	Civil Society Organization	**MSC**	Marine Stewardship Council
DOS	Digital Observer Services	**NGO**	Non-Governmental organization
EM	Electronic Monitoring	**O2**	Ocean Outcomes
EPO	Eastern Pacific Ocean	**OSH**	Operational Safety and Health
ETP	Endangered, Threatened and Protected	**PCT**	Presbyterian Church of Taiwan
EU	European Union	**PPE**	Personal Protective Equipment
FIP	Fishery Improvement Project	**RMFO**	Regional Fisheries Management Organization
GDPR	General Data Protection Regulation	**SRA**	Social Responsibility Assessment Tool for the Seafood Sector
GPS	Global Positioning System	**TNC**	The Nature Conservancy
HRSR	Human Rights and Social Responsibility	**UPS**	Uninterruptible power supply
HRC	Humanity Research Consultancy	**VMS**	Vessel Monitoring System
IATTC	Inter-American Tropical Tuna Commission	**WCPFC**	Western and Central Pacific Fisheries Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas	**WCPO**	Western and Central Pacific Ocean



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Definitions

Electronic Monitoring (EM): EM refers to the use of technology, such as cameras, sensors, and GPS, to remotely monitor on-the-water fishing activities. These systems collect video footage and data to improve transparency, ensure compliance with regulations, and monitor environmental and social practices. EM systems are particularly valuable in remote or high-seas fisheries where on-site observation is challenging.

Closed-Circuit Television (CCTV): In the context of Taiwan's distant-water fishing fleet, CCTV refers to the mandatory shipboard monitoring systems that must be installed on all Taiwanese large-scale fishing vessels. The CCTV comprises of a main unit, cameras, an Uninterruptible Power Supply (UPS), and display screens. According to Taiwan's regulations, fishing vessel operators are required to install these systems by mid 2025. The CCTV must store recorded footage for a minimum of three years. However, the data verification and video review mechanism are not established. Vessel captains are responsible for maintaining the functionality of these systems during voyages.

Connectivity: Connectivity in the context of this project refers to the capability of vessels and crews to maintain communication and data exchange while at sea. This typically involves satellite-based internet (Wi-Fi) or communication systems, enabling crew members to access information, stay in contact with onshore support, and report grievances. Reliable connectivity is also crucial for remote troubleshooting of onboard technology and for the timely transmission of EM data.

Large-Scale Fishing: Large-scale fishing (also referred to as industrial fishing) is typically used to classify fishing operations that take place on high-capacity vessels that are equipped with on-board facilities for storing and processing catch. The defining criteria for industrial vessels can change by jurisdiction but industrial vessels are generally classified as vessels over 20-24M in length. These vessels tend to remain at sea for several months at a time before returning to port.

Social Responsibility: Social responsibility involves individuals and companies balancing profit-making activities with activities that benefit society. In the seafood industry, social responsibility is focused on ensuring seafood is produced or sourced in a way that respects human rights, the welfare of workers and benefits communities involved in supply chains, including fair labor practices, safe working conditions, and preventing issues of forced labor.

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1. Executive Summary

Large-scale fishing covers over half of the world's oceans, providing vital protein to over three billion people and contributing billions of dollars to the global economy (Akbari et al., 2023). Illegal, unreported, and unregulated (IUU) fishing activities threaten livelihoods, food security, marine biodiversity, and human welfare. Illegality in the fishing industry also encompasses a wide range of human rights violations; workers at sea are vulnerable to forced labor, human trafficking, debt bondage and sexual and labor exploitation, and this issue is both globally prevalent and highly complex.

A key issue is a lack of independent monitoring on legally licensed large-scale fishing vessels. Without verifiable on-the-water monitoring, illegal activities can go unnoticed and unpunished (Paolo et al., 2024). This undermines the effectiveness of conservation and management measures, weakens governance frameworks, and introduces environmental and human rights risks into global supply chains.

To combat these issues, many entities have turned to the use of electronic monitoring (EM) which involves the use of onboard video cameras, gear sensors, and GPS to monitor, verify, and transmit data about fishing activity. EM has been demonstrated to improve transparency, enforcement, and data quality for better fisheries management. However, few studies and pilot projects have explored using electronic monitoring to identify labor indicators as a tool for social responsibility.

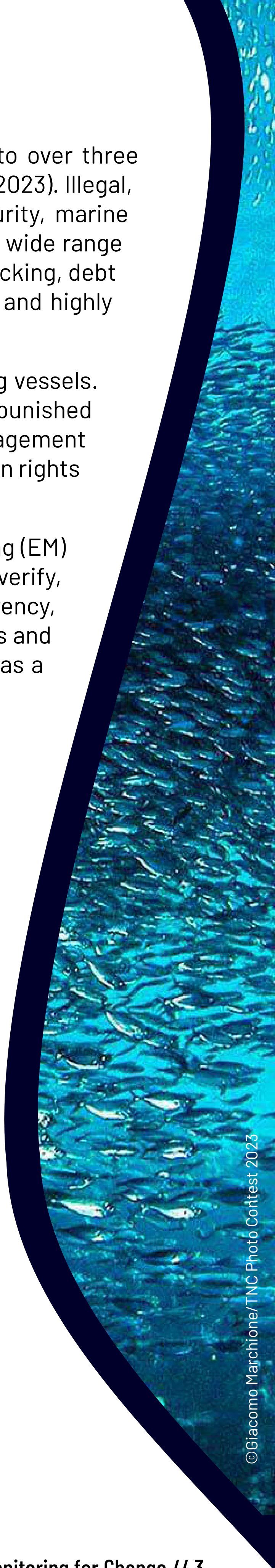
Project Aim

Pilot EM and Wi-Fi technologies on tuna longline vessels to combat both illegal fishing practices and human rights abuses, and research how EM might integrate into a wider systems approach to improve crew welfare.

Methodology

In a novel, exploratory pilot project, we evaluated how EM can be used to monitor labor indicators (i.e., human rights violations, safety, and working conditions) and track progress towards social responsibility. The project was conducted between November 2022 and January 2025, involving:

- Desk-based research on ethical considerations of surveillance, privacy, and consent.
- Identification and mapping of labor indicators.
- Stakeholder interviews.
- Installation and testing of EM and Wi-Fi systems on three Taiwanese-flagged tuna longliners.
- EM video review and data analysis.



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The project team trialed both EM and Wi-Fi systems on three Taiwanese-flagged tuna longline vessels and used a typical EM program design for monitoring environmental-focused fishing operations to assess if status quo EM program set-up could be used for monitoring labor indicators, or if entirely new EM system layouts would be needed. To help inform our approach, we mapped out labor indicators that could be successfully captured through EM video review. The pilot project lasted six months (March 2024 – August 2024) and we reviewed 20% of all fishing operations plus randomly selected 24-hour assessments of worker activities. To gain valuable insights from vessel owners, captains, crew, and other industry stakeholders, we performed over 50 pre and post trip interviews.

Key Findings

EM can feasibly capture on-the-water labor indicators, including accidents, injuries, presence of personal protective equipment (PPE), work/rest hours and trip length.

However, several critical indicators such as sanitary conditions, verbal abuse, access to food and water, medical supplies and child labor, were not visible due to camera placement, privacy accommodation, and the lack of audio recording. Importantly, certain labor violations, such as forced labor, require additional verification mechanisms beyond video review via worker interviews and grievance mechanisms.

Wi-Fi is a critical intervention for crew welfare.

Wi-Fi access is one of the most impactful interventions for improving crew well-being, enabling real-time communication with family, grievance reporting, and financial management. On average, monthly crew and captain data usage combined was 283GB and average monthly crew use alone was 98GB equating to an average of 7.5GB of data per crew member per month. Crew members reported feeling safer and more connected to the outside world when they had access to Wi-Fi, reducing isolation, and expressed a preference for working on vessels with Wi-Fi. However, inconsistent connectivity, slow data speeds, signal strength and access restrictions created uncertainties and/or frustration among captains and crew members. Some captains and vessel owners expressed interest for clear policies on Wi-Fi management due to lack of awareness and standardized procedures.

EM review rates and costs may pose challenges for wider uptake and scaling of this technology.

Standard EM environmental monitoring programs typically review only 20% of fishing operations, meaning that some labor-related incidents may be missed. More frequent reviews (e.g., 35% or more) would improve monitoring accuracy but may significantly increase costs for vessel owners. Adding labor indicator review accounted for approximately 24% of the total review time, indicating that higher costs will be associated with EM programs reviewing data for both environmental and labor indicators. The manual review process is time-consuming—automated AI-based monitoring could improve efficiency but requires further development and validation.

EM footage is seen as valuable evidence to help settle disputes.

Both captains and crew viewed EM footage as a valuable tool for resolving disputes, providing verifiable evidence in cases of accidents, safety violations, or conflicts. Some captains saw EM as "insurance" to protect themselves from false accusations, while crew saw it as protection against mistreatment. However, sharing and using EM data as evidence to address grievances still needs to be tested and proven.

EM for social responsibility requires careful consideration and ethical implementation to minimize potential harms of surveillance.

Policies should be in place to ensure video data is used ethically and not used to unfairly target or discriminate against crew members. The impact on personal privacy is a key consideration, and typical solutions to reduce privacy impacts for environmental monitoring will need to be adjusted to monitor labor indicators. Data protection measures must be in place to safeguard personal information, and there should be accountability mechanisms to prevent misuse of surveillance data. Transparency on the use of surveillance technologies and obtaining informed consent from those being monitored is crucial.

Scalability requires stronger policies and industry commitments for improved labor conditions.

Without regulatory enforcement or buyer demand, vessel owners have little incentive to invest in EM and Wi-Fi. Integrating EM into labor standards, certification programs, and trade policies could drive wider adoption. Government and industry collaboration is necessary to establish standardized protocols for labor monitoring, Wi-Fi provision, and grievance reporting.

Conclusions

This pilot project demonstrates the potential of EM and Wi-Fi technologies to improve social responsibility in the fishing industry, highlighting the need for comprehensive social responsibility systems, ethical considerations, and further research to scale these solutions effectively.

While EM has been proven to be an effective fisheries management tool, Wi-Fi access emerged as a crucial factor in improving crew welfare, safety, and communication, and is a fundamental component of an effective EM for labor monitoring system. As such, Wi-Fi access for crews should be a priority for industry stakeholders, regulators, and technology providers. Despite challenges and concerns of applying EM solutions to labor indicators—including the cost of EM implementation, accessibility, privacy concerns, and enforcement gaps—this study underscores that by pairing EM with Wi-Fi, fisheries can improve oversight, empower workers, and create safer, more transparent working conditions. Moving forward, more research is needed to collect evidence on the impact of EM and Wi-Fi on crew welfare, and if shown to be positively impactful, labor indicators should be integrated into EM programs, alongside the use of Wi-Fi for crew.

Key Recommendations

Bundle EM with Wi-Fi:	Pair EM with Wi-Fi to enhance crew communication, enable real-time reporting of labor violations and timely EM video review. **Buyers and retailers should provide financial incentives for vessel owners to adopt EM and Wi-Fi systems, to reduce harmful downward price pressures.**
Develop Comprehensive Social Responsibility Approaches:	Integrate EM footage with formal grievance reporting systems to allow workers who report mistreatment to have accompanying video evidence, and integration into broader human rights due diligence programs. Third-party labor review groups should be involved to access and review EM data relevant to reported cases of misconduct, to assist with case resolution and remediation.
Ensure Ethical Use of Surveillance Technologies:	Implement best practices for ethical data use, including privacy protection, data protection and informed consent. The application of surveillance technologies warrants careful consideration, as the datafication of labor issues carries risks which may further harm vulnerable and marginalized communities.
Strengthen Policies & Agreements:	Develop enforceable agreements between vessel operators, industry stakeholders, and governments to ensure compliance with social responsibility standards. Use pilot projects and studies like this to advocate for policy changes that require EM for both fisheries management and labor monitoring, as well as Wi-Fi access to crew members. Establish clear policies on Wi-Fi access to balance worker needs with operational concerns, and EM data sharing agreements for grievance resolution.
Enhance Cost Efficiencies:	Define appropriate review rates; explore automation and AI-assisted video review to reduce review costs, and optimize the transmission of EM records over Wi-Fi to lower data and storage costs.
Conduct Further Research & Pilots:	Moving forward, it will be important to trial these tools across different vessel types, fleets, and geographies to refine best practices, study the global impact of EM adoption on crew wellbeing and retention, and evaluate long-term cost-benefit scenarios for integrating EM with broader social responsibility initiatives. **Evidence substantiating the positive impact of EM on crew welfare will be crucial in proving this as a suitable tool for social responsibility.**

2. Introduction

Illegal, unreported, and unregulated (IUU) fishing poses a significant threat to the social and environmental sustainability of global fisheries (Selig et al., 2022, Widjaja et al., 2023). This pervasive issue undermines sustainable fisheries management, leading to overfishing, habitat destruction, and loss of biodiversity, and the ability of communities to access nutritional and economic benefits (Sumaila et al., 2020, Stefanus and Vervaele, 2021). To combat these challenges, electronic monitoring (EM) has emerged as a promising solution.

Electronic monitoring involves the use of on-board cameras, sensors, and vessel tracking systems (VMS or GPS) to collect accurate and timely data on fishing activities. These tools enable monitoring of catch volumes, bycatch, and fishing locations, ensuring compliance with regulations and enhancing transparency in the fishing industry. More recently, satellite communications have enabled the live transfer of video data to the cloud for timelier video review. EM systems can aid in reducing the risk of non-compliance with regulatory requirements to reduce IUU fishing and increase compliance and data generation for fleets with low observer coverage, such as longline vessels. By providing a reliable and cost-effective means of surveillance, EM helps to deter illegal activities, improve stock assessments, and support sustainable fishing practices.

Illegality in the large-scale fishing sector also encompasses a wide range of human rights violations. Fishers at sea are vulnerable to human rights abuses, and this issue is both globally prevalent and highly complex in its root causes. Human rights abuses in large-scale fisheries include forced labor, human trafficking, debt bondage and physical abuse (Tickler et al., 2018). Violations and labor exploitation on vessels is often unaddressed due to lack of oversight and visibility on vessels, despite being widely acknowledged by regulatory authorities, multilateral institutions, the private sector, and non-governmental (NGO) actors (International Labour Office et al., 2013).

Though EM has proven to be a critical innovation for adding visibility into the first mile of the fisheries supply chain to reduce IUU fishing, the application of EM in human rights has yet to be developed, tested, explicitly applied or evaluated in this context. With recent Regional Fisheries Management Organizations (RFMO) adopting EM standards, and markets and sustainability certifications requiring more on-the-water monitoring through EM or human observers to access international markets, EM uptake may increase amongst tuna fishing vessels over the coming years. If EM proves helpful in identifying and monitoring labor indicators, this technology could present an opportunity to monitor both environmental and labor conditions on vessels which historically have had low levels of monitoring.

Given that large-scale fishing vessels often operate in remote environments for long periods at sea, crew members face significant labor risks, including isolation, limited access to emergency services, and harsh working conditions. To mitigate some of these risks, the implementation of satellite Wi-Fi on fishing vessels has emerged as a transformative solution which has become cheaper and more available within the last few years (International Labor Rights Forum, 2025). While there are regulations that require communication equipment to be available onboard fishing vessels for medical assistance (ILO C188), there are very few policies that detail the requirements and terms for crew access. As such, crews rarely have access to Wi-Fi at sea despite the many benefits to crew welfare and reduced labor risks (Siggs et al., 2024).

This project presents the first independent research to explore and test the potential applications of EM to capture labor indicators, in addition to the typical environmental indicators. This research paired EM with Wi-Fi access for crews, to understand whether these systems can enhance monitoring of labor conditions on vessels, track onboard activities, and improve both detection, reporting, and remedy of abuses.

Project Aim

Pilot EM and Wi-Fi technologies on tuna longline vessels to combat both illegal fishing practices and human rights abuses, and research how EM might integrate into a wider systems approach to improve crew welfare.

Key Research Questions

- Can EM be used to track and verify labor indicators on-the-water? If so, what are the labor indicators that can be captured in EM data?
- What review process is needed to capture labor indicators?
- What are the risks of applying EM systems to monitor labor?
- Can EM data contribute to other social responsibility initiatives?
- How can EM integrate with Wi-Fi solutions to better protect fishers?
- How might EM systems be scaled via market and regulatory adoption?

Importantly, applying EM to new applications, such as labor indicators, may come with additional risks. The *way* technologies are applied and implemented to support human rights can be the difference between solutions that are helpful and harmful. As such, this research also reviewed ethical considerations of applying surveillance technologies to social and labor elements, and presents the opportunities, limitations and risks.

This research piloted EM and Wi-Fi onboard three Taiwanese-flagged tuna longliners. Large-scale industrial longline vessels were prioritized for the pilot given documented labor risks, and characteristics such as remote fishing locations and lack of transparency and accountability mechanisms, and extended time at sea. Taiwan was prioritized as a flag State for the pilot as it is one of the world's top distant water fishing fleets, with over 22,000 migrant crews (Chiu, 2022).

3. Methodology

Between November 2022 and January 2025, we explored the application of EM to monitor labor indicators, and Wi-Fi to enable timely EM review and crew connectivity access at sea. This research included design (November 2022 – February 2024), pilot (February 2024 – August 2024), and analysis (August 2024 – January 2025) phases.

The exploratory activities completed include:

- Desk-based research on the ethical considerations of surveillance, privacy, and consent
- Designing and mapping labor indicators for monitoring in EM data
- Stakeholder interviews
- A pilot of EM and Wi-Fi systems onboard 3 Taiwanese tuna longliners
- EM video review and data analyses

The pilot involved installing and testing EM systems and Wi-Fi on three Taiwanese-flagged tuna longliners operating in the high seas in the Pacific Ocean to catch mainly albacore, as well as bigeye, yellowfin, and skipjack. The selection process incorporated a multifaceted assessment of vessel availability, including scheduled landing dates, crew composition, voyage details, anticipated return-to-port schedules, and the operators' familiarity with electronic monitoring systems. The vessels port in Pago Pago, American Samoa and Kaohsiung, Taiwan. Characteristic of the longline industry, migrant workers make up the workforce. All crew on the pilot vessels (approximately 12 to 15 per vessel) were Indonesian, while the captains and engineers were Taiwanese. Since April 2020, these pilot vessels have been a part of fishery improvement project (FIP) making progress on both environmental and social improvements.

3.1. Desk-based research

To design the project and pilot, including identifying potential labor indicators, we conducted desk-based research between November 2022 and December 2023 on the ethics of surveillance, privacy, and consent. The team reviewed over 50 academic papers, project reports, news articles, regulations and standards including the ILO Work in Fishing Convention, 2007 (C188). The project team partnered with OceanMind, Arizona State University and HRC during this research phase.

3.2. Labor indicator identification & mapping

Based on the desk-based research, we selected labor indicators potentially identifiable in EM data from ILO C188 articles (Annex 3). All indicators were clustered thematically into 6 groups (Table 1). These indicators were also mapped to the indicators of the Social Responsibility Assessment (SRA) Tool, a voluntary risk-assessment tool for conducting human rights due diligence in seafood supply chains.

Grouping	Labor indicators
Trip- level data	Total number of crew for safe minimum manning
	Trip length
Accident / violence	Incidence of accident and/or injury
	Incidence of violence and/or harassment
Transshipment / crew transfers	Incidence of crew transfers
Vessel observations	Accommodation and sanitary conditions
	Access to water
	Access to food
	Adequate medical supplies
	OSH drills training
	Presence of PPE
Crew work hours	Rest hours
Documentation / identification	Crew list
	Crew identity verification
	Fisher access to work agreement
	Medical certificate
	Child labor

Table 1. List of potential labor indicators to flag during electronic monitoring review. Each indicator was categorized thematically.

Each indicator was researched to test the feasibility of monitoring in EM data, and assigned a low, medium or high feasibility score based on whether they could be observed in video data. For the medium and high feasibility indicators, a review process was developed for how to monitor and record these indicators, alongside the typical environmental indicators. If an indicator was identified in the review process, it was recorded as an individual event, with identifiers such as timestamp and location of event, description and severity rating (if needed) (Annex 3).

3.2.1. Consent to participate

During installation, all workers were informed of the pilot and provided time for questions and discussion. A half day training session was conducted to inform workers of the scope and aims of the project, EM and Wi-Fi system (including maintenance and troubleshooting) placement of the cameras, private areas, EM review process and labor indicators to be monitored, worker rights and access to grievance mechanisms. Consent was obtained via signatures from all workers on each vessel.

3.3. Interviews with key stakeholders

Three sets of interviews were conducted to understand crew, captain, and vessel owner perspectives about the use of EM, CCTV, and Wi-Fi systems. In total, 50 interviews with relevant stakeholders were completed. The results of these interviews are detailed in section 4.2.

Interview Set #1 (January 2024 – February 2024):

HRC interviewed 15 Indonesian crew onboard Taiwanese-flagged longline vessels. The purpose of these interviews was to understand crews' knowledge of human rights and grievance mechanisms, and the use of CCTV onboard, their preference in having CCTV in operation at their workplace, the positioning of CCTV facilities, and the use of CCTV for surveillance to inform the design of the project (e.g., camera placement and labor indicators). Additionally, HRC conducted interviews with seven representatives from the fishing industry including vessel owners, representatives of fishery associations in Taiwan, and academics to understand the landscape related to EM utilization and social compliance.

Interview Set #2 (February 2024):

Ocean Outcomes and Conservation International interviewed captains and five to eight Indonesian crew onboard three pilot vessels during the installation of Wi-Fi and EM systems. The purpose of pre-departure interviews was to understand perceptions related to the capture of labor conditions, privacy considerations, EM and Wi-Fi onboard, and grievance reporting and EM video review prior to real-life experiences with EM and Wi-Fi onboard.

Interview Set #3 (August 2024):

At the end of the fishing trip, Ocean Outcomes and Conservation International interviewed captains and five to eight Indonesian crew on each of the pilot vessels, as well as a vessel owner. The purpose of post-trip interviews was to understand how views have changed over time and use around EM and Wi-Fi, as well as any challenges and benefits related to EM and Wi-Fi onboard, and if there were any incidents (e.g., violations, accidents, injuries, etc.) that occurred during the fishing trip and whether these were reported. In total, interviews with 28 individuals (crews, captains, vessel owners) were conducted across the pilot interviews (interviews 2 & 3).

Alongside this project, **Ocean Outcomes conducted a social risk assessment using the SRA, which included worker and management interviews, vessel inspections and observations, and document review.** The assessment provided a baseline understanding of risks to workers, as well as progress to address previously identified risks on the pilot vessels. This provided a unique opportunity to explore how EM footage can be an important source of data to support the verification of findings and triangulation of data to further monitor risks and progress of improvements and support grievance resolution.

3.4. EM & Wi-Fi pilot setup

In February 2024, EM and Wi-Fi systems were installed on the three longline vessels in Pago Pago, American Samoa. The installation of the EM and Wi-Fi systems was executed over a two-week period, with each vessel requiring approximately three to five days for installation to be fully completed.

3.4.1. Camera placement

Satlink, our selected EM service provider, installed the three vessels with SeaTube: an all-inclusive EM system made up of:

- five cameras to record activity at sea
- a 4G connectivity unit to support onboard Wi-Fi
- sensors to track time
- GPS location
- VMS/satellite connectivity

We utilized a typical EM program design for monitoring environmental-focused fishing activities on-the-water to assess if status quo EM program set-ups could be used for monitoring labor indicators, or if entirely new EM system layouts would be needed to effectively monitor human activity. As a result, all five cameras placed on each of the three vessels was set up for standard environmental review of fishing activities and no additional cameras were added to areas of the vessel where certain labor indicators could have occurred (i.e., crew quarters, restrooms, engine room, etc.) (Figure 1).

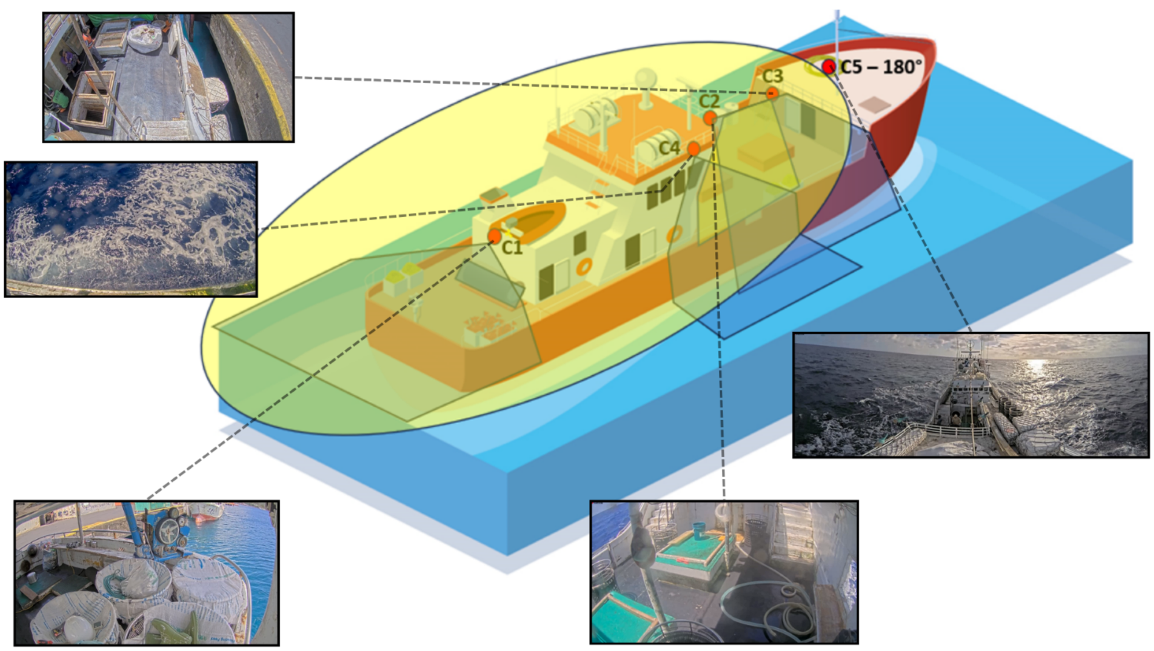


Figure 1: Camera configuration onboard all three vessels. A standard environmental EM set-up was used to discern if current EM set-ups could be used to track labor indicators as well or if new set-ups would be needed.

Each camera was uniquely positioned to oversee specific activities (Annex 1). Camera C1 was used to monitor longline setting and related crew activity. Cameras C2 and C3 were used to monitor longline hauling, catch identification, and related crew activity. Camera C4 was used to monitor catch before it was hauled into review catch data for species of interest—no human activity could be tracked from this angle except for target catch and bycatch handling practices. Camera C5 provided panoramic views of the vessel's surroundings and allowed for broad, but less refined, monitoring of crew activity.

3.4.2. Wi-Fi

Starlink maritime data packages were included in the EM system to provide Wi-Fi onboard all three vessels, for both crew and captain access, and for EM data transmission. The Wi-Fi router was installed along with the EM hardware in the bridge of the vessel. Passwords were distributed to all crew and captains and posted on the vessel before trip departure. All vessels had a one terabyte data package per month.

For Vessel 1, a single Wi-Fi network was set up for access by both the crew and captain and for transferring EM video footage to the cloud (EM data transmission). Due to technological difficulties, we were unable to separate out the networks between captain and crew use, and EM data transmission.

On the other two vessels (Vessel 2 and Vessel 3), two Wi-Fi networks were set up, one for the captains/crew and the other for EM data transmission. Each vessel was given one terabyte (TB) of data to use per month which was then split evenly - 500 gigabytes (GB) for captain/crew communications, and 500GB (EM data transmission). For Vessel 2, we established 2 separate networks; one for all crew, and one for the captain, so that we could report on data usage by the crews and the captain separately. For Vessel 3, the network was shared, so the data usage is combined crew and captain.

There were no restrictions on usage times for any of the three vessels, allowing both captains and crew to send messages and conduct voice calls anytime outside of work hours. However, certain applications—such as video entertainment apps—were restricted, and video calling for the crew was limited to prevent excessive data consumption.

Data usage by captains and crew, and EM data transmission was recorded on a monthly basis for the duration of the 6-month fishing trip, to determine how much data out of the total 1TB was used each month. Due to technical difficulties, it was only possible to begin recording data usage in April, so the numbers reported in the Results section only depict five months' worth of data usage.

3.5. EM review & work hours analysis

3.5.1. EM review & analysis

To analyze the EM videos, EM analysts from Digital Observer Services (DOS), a subsidiary company to Satlink, conducted two types of video reviews: (1) Every month, DOS randomly selected and reviewed 20% of all fishing operations and (2) Once at the end of the study, DOS randomly selected 12 days and reviewed the 24-hour footage. A 20% review rate was selected as this is seen as current best practice for industrial longline tuna vessels (Murua et al., 2025). Over the course of the 6-month fishing trip, a total of 52 fishing operations were reviewed across all three vessels. Notably, EM data was uploaded while the vessel was still at sea, which is a novel innovation enabled by new satellite technology, where previously vessels would not be able to share EM data until the vessel arrived at port and shipped the hard drive to a data review center.

During the monthly review, while the analysts used all cameras (i.e., C1-5), the analysis was mainly done using the C1- C3 cameras that showed fishing operations (i.e., setting and hauling) as most of the crew members are congregated in specific deck areas when working on fishing operations. Between March 2024 – August 2024, the analysts produced a trip report at the end of each month for each vessel (n=six monthly trip reports per vessel).

Within the guidelines of the analysis, the EM analysts reported any labor related events or incidents of interest using the reporting template (Annex 5). They included a description of the event and if any medical attention was required. A score of one (low severity) to five (high severity) was assigned to relevant incidents (accidents / violence, and if injuries occurred).

3.5.2. EM-driven work hour analysis

Additionally, two approaches to estimate work hours were used:

1. **Average fishing work hours calculation**

   The equation shown below was used to quickly estimate the number of average work hours during a fishing operation. The number of crew working during both setting and hauling was recorded and multiplied by the number of hours spent on those two fishing activities, divided by the total possible fishing work hours to give the average work hours for an individual. For example, a typical set may take 5 hours and involve 5 crew = 25 (setting) hours. A typical haul may take 10 hours and involve 10 crew = 100 (hauling) hours. Total fishing (set + haul) work hours = 125. The total fishing work hours (125) was then divided by the total number of crew (n=10) multiplied by 24 hours (240), to give the average work hours (125 / [10*24] = 0.52 * 24 hours = 12.5 fishing work hours).

$$\left[\frac{(setting\ manning * setting\ hours) + (hauling\ manning * hauling\ hours)}{total\ manning * 24\ hours}\right] * 24\ hours$$
$$= average\ fishing\ work\ hours$$

2. **24-hour work hour analysis**

   EM data was reviewed for a complete 24-hour period to identify what additional activities the crew engage in beyond the average fishing work hours described above.

Driving further work hour insights: a case study with Global Fishing Watch (GFW)

Fisheries managers often use vessel location-based technologies such as AIS and VMS to support MCS efforts by understanding where vessels are moving, when they're fishing, and when they are interacting with other vessels. Researchers have used vessel position data to estimate social indicators, including fishing hours, but these efforts have historically not been proven using on-the-water data from the vessels. EM data provided through this project provided a unique opportunity to explore the relationship between coarse global models predicting fishing operations with vessel-level EM data depicting verified activities. That said, to what extent can patterns in AIS data serve as an initial filter, highlighting vessels whose operational patterns suggest the need for further scrutiny?

To explore this question, we collaborated with Global Fishing Watch (GFW) to compare set and haul durations predicted using AIS data to those measured from the EM data. GFW developed a model that predicts drifting longline activity on AIS and VMS data. The output data for each vessel includes a start and end time for each fishing operation, and whether the model predicts the activity as setting, hauling, or not fishing – this output serves as a proxy for "active fishing operation". The EM dataset for the three selected vessels included the start and end times of each recorded set and haul event, from March 2024 to August 2024.

See Page 20 for more information.

4. Results

This first of its kind project, focused on advancing EM and Wi-Fi solutions for social responsibility, contained several key results that should be further investigated in future EM projects. We've broken down the result into the following two subsections: 1) EM and Wi-Fi pilot results, and 2) Interview findings.

4.1. EM and Wi-Fi pilot results

4.1.1. Labor indicators identifiable in EM data

Feasibility of reviewing labor indicators varied greatly across categories, with some requiring minimal additional review as part of the process of setting and hauling events, while other categories proved to not be feasible for monitoring (Table 2).

Table 2. KEY	
Indicator cannot be determined using EM data	(grey)
Indicator cannot be determined using EM data during a certain vessel activity	(dashed X)
Indicator can be reviewed using EM data during a certain vessel activity	✓

Table 2: List of labor indicators showing the feasibility of identification (low, medium and high), review process for identification and description of process.

Group	Indicator	Feasibility using environmental-EM set up	Potential additions to improve feasibility	Vessel activities for EM review				Assumptions and Caveats
				Fishing trip start and stop	Setting and hauling events		Other events	
Trip Level Data	Minimum manning	High		✓	✓	X	X	Minimum manning information is based on the assumption that hauling events require almost all crew. This indicator can also be reviewed once during the trip during a fishing operation.
	Trip length	High		✓	X	X	X	If combined with the number of fishing operations, the trip length can give a simple indicator on fishing frequency and work.
Accident / Violence	Accident and Injury	High	AI-assisted video review	X	✓	X	X	Violence and harassment may take place outside of fishing operations or in areas where cameras do not capture. A standardized severity rating is an important component to record details of the incident and could be used to determine which indicators are escalated for further review with a labor review group.
	Violence and Harassment	High	AI-assisted video review	X	✓	X	X	
Transhipment / Crew Transfer	Crew transfers	High		X	X	✓	X	Many EM review processes include reviewing transhipment events so this indicator could be incorporated into typical EM review. However, most cameras need to be reviewed.

Group	Indicator	Feasibility using environmental-EM set up	Potential additions to improve feasibility	Vessel activities for EM review				Assumptions and Caveats
				Fishing trip start and stop	Setting and hauling events	Transhipment events	Other events	
Vessel Observations	Sanitary conditions	Low						Crew typically do not drink or eat on deck. Sanitary conditions, access to water and food may be possible to review if cameras were placed below deck, such as in the galley, however this should not be at the expense of privacy
	Access to water	Low						
	Access to food	Low						
	Adequate medical supplies	Low						Cannot identify medical supplies, but can identify if medical care was provided during accidents / injuries.
	OSH Drills training	Medium	Further research on vessel operations characteristics				✓	Operational Safety and Health (OSH) drills, such as fire drills and man overboard drills, are not possible to identify during typical EM review as these occur outside of fishing operations. Whilst theoretically it is possible for EM data to capture drills, there would need to be a method to identify when these drills took place, to narrow down the review window to observe this.
	Presence of PPE	High	A method for discerning between personal choice and the availability of PPE.		✓			While monitoring the presence of personal protective equipment (PPE) is possible to view in EM data, we cannot discern the cause of a lack of PPE (personal choice not to use it versus the unavailability of PPE (e.g., not enough life jackets per crew)).
Crew Work Hours	Work / Rest hours	High	AI-assisted video review	✓	✓	✓	✓	EM analysts need to review 24-hour video footage to quantify the duration of all activities and calculate average rest hours
Documentation / Identification	Crew identity	Low	Incorporation of digital ledger technology accessible by review teams					Documentation and/ or identification in the fishing sector is largely analogue, making access to paper documentation and comparisons with video data extremely challenging.
	Crew list	Low						
	Fishers Work Agreement	Low						
	Medical Certificate	Low						
	Child labor	Low						We cannot determine age from video data.

Several labor indicators can be recorded during fishing operations. Trip level data such as minimum manning is easily observed during hauling events which include all crew and is recorded once per trip. In addition, trip length is also easily recorded during review, and if combined with the number of fishing operations, can give a simple indicator of fishing frequency and work. For example, a fishing trip of 30 days with 25 fishing operations, may indicate longer work hours and less rest (fishing operations occur every 1.2 days) than the same trip duration with only 15 fishing operations (fishing operations occur every 2 days).

Certain accident and violence indicators can be identified during review of fishing operations, such as falls or injuries. A standardized severity rating is an important component to record details of the incident and could be used to determine which indicators are escalated for further review with a labor review group (e.g., minor falls may not be escalated versus more severe injuries). Which indicators are shared for further review and investigation should be determined by third-party experts, as described in Annex 4.

Several indicators were not possible to review, in entirety, in EM data. For example, physical violence may take place outside of fishing operations or in areas where cameras do not capture, and verbal abuse would not be captured as there is no audio recording. Recording many vessel observation indicators such as sanitary conditions, access to food and water is not possible due to limited camera views and placement on deck only. Access to water and determining child labor would require additional data and are not verifiable through EM data alone.

Operational Safety and Health (OSH) drills, such as fire drills and man overboard drills, are not possible to identify during typical EM review as these occur outside of fishing operations. As such, OSH drills were not observed in the pilot review or the 24-hour review. Given drills take place infrequently, it is unlikely random sampling to review data outside of fishing operations would identify these indicators. Whilst theoretically it is possible for EM data to capture drills, there would need to be a method to identify when these drills took place, to narrow down the review window to observe this. Similarly, monitoring the presence of PPE is possible in EM data. However, a method for recording this information and discerning between the availability of PPE and the personal choice not to use it versus the unavailability of PPE (i.e. not enough life jackets per crew) would need to be developed. Monitoring access to boots and gloves is easier, as crew typically wear these.

All indicators in the grouping 'Documentation' were not identifiable in EM data. This is because the fishing sector is largely analogue, making access to paper documentation and comparisons with video data extremely challenging. In the future, if documents were digitized and accessible by review teams, it might be possible to verify these documents through video data, though other digital tools may be more advantageous.

Finally, although transshipment events did not take place during the pilot, the camera placement appears feasible to monitor this indicator. Many EM review processes include reviewing transshipment events, as well as fishing operations, so this indicator could be incorporated into typical EM review.

4.1.2. Crew work hour findings

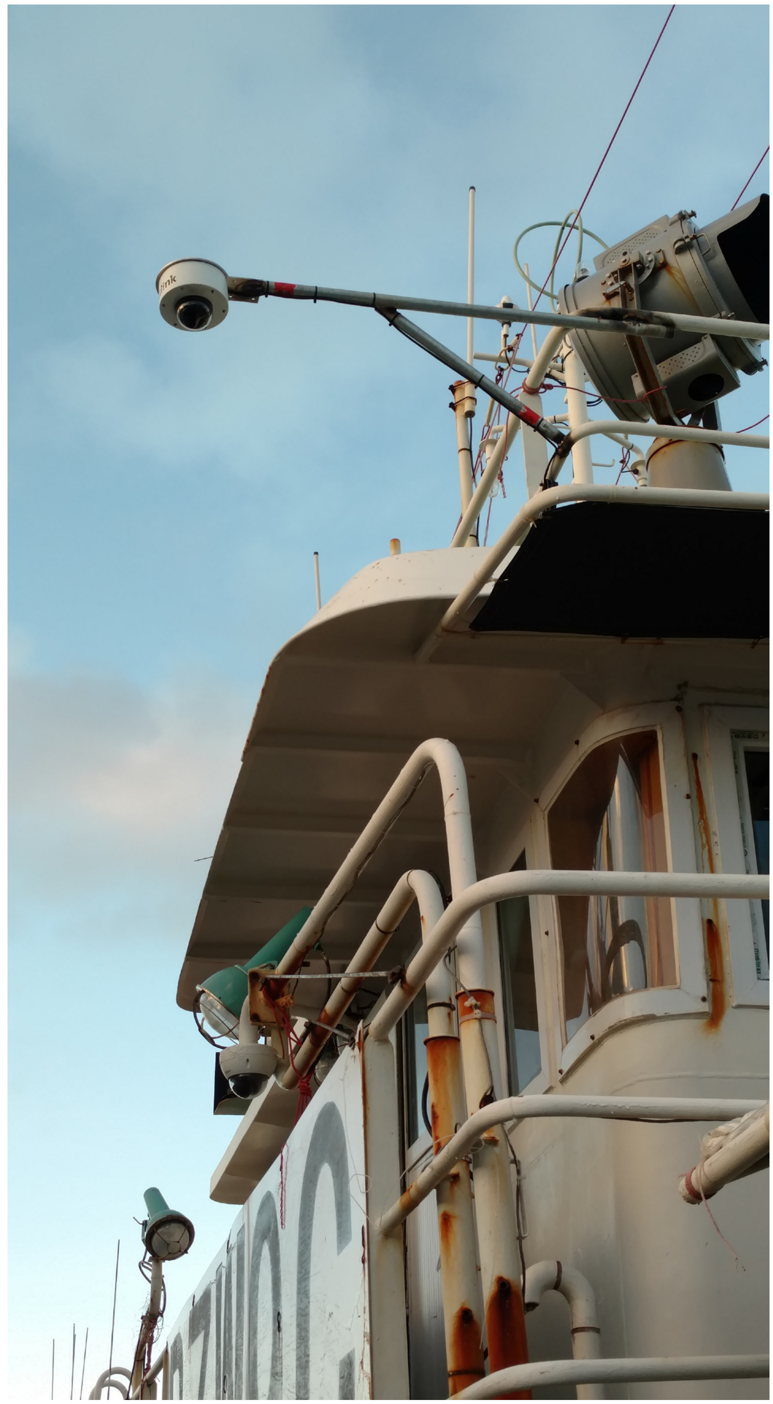
Calculating worker hours proved to be quite difficult for several reasons. First, given the camera placement on deck, there was no way to identify if work continued inside more private vessel quarters. Second, tracking individual workers was difficult and manually intensive, as they moved between camera views. Additionally, as cameras fogged up or collected water droplets, it was challenging to identify individuals. Finally, vessels that operate using split shifts make calculating which crews had worked and which had rested on a given day very challenging with current methods. Therefore, individual work hours could not be calculated under the scope of this project and therefore work hour estimates are not reported due to potential inaccuracies.

Below we critique the methodology and report on recommendations for advancing this work in the future:

1. **Average fishing work hours.** This method required minimal extra review, making it a cost-effective way to estimate work hours across the entire crew. As a result, it was possible to estimate fishing work hours for all analyzed fishing operations. However, as this method only estimates work hours during fishing operations, it does not include other work activities that occur outside of fishing operations (i.e., equipment maintenance, fishing preparation, etc.), therefore it may underestimate total work hours. In future work, it would be interesting to explore correlations between the number of hooks and working hours, as more hooks may correspond to longer fishing operations.

2. **24-hour work hour review.** This method reviewed all work activities in a given 24-hour period. This method was more labor intensive and required a separate review process that took approximately 4.5 hours of additional review time per 24-hour period reviewed. EM reviewers were able to pull out high-level activities performed by the crew across 24-hour periods on both fishing and non-fishing days (Annex 3). However, this method still proved challenging as many crew performed different activities simultaneously, making it challenging to calculate the individual and average times spent on each. This review highlighted that additional time was spent on fishing preparation activities, post catch activities and vessel maintenance, outside of fishing operations. This suggests that calculating work hours only during fishing operations (method 1) underestimates work hours.

24-hour work hour analysis comprised over half of the labor data review time (Annex 2), indicating that this may not be a cost-effective method for calculating work hours. In contrast, average fishing work hour calculations was easy to implement, but is less inaccurate and will likely underreport work hours due to work activities that take place outside of fishing operations. More research is needed to develop an effective and trusted methodology to calculate work hours.



Results from a case study with Global Fishing Watch (GFW)

After cleaning the EM dataset, 624 events were available for comparison with model predictions, 312 setting, and 312 hauling events. The predicted events for the same time range were 342 setting and 345 hauling. By matching the predicted activity to the recorded activity, the difference in durations and start and end times of setting and hauling events was computed. The time in between setting and hauling events was also compared and used as a proxy for resting time. There is no definitive way to determine whether the crew are genuinely resting during these periods or performing other duties.

The EM data analysis described in this report lists a diverse set of crew activities associated with life on a longline vessel beyond the routine setting and hauling of the hooked lines. It showed that remotely sensed positional data such as AIS cannot capture the majority of these activities, and therefore offers only a limited view of fishing operations. We found that modeled set and haul durations corresponded quite well to those identified via EM with minimal differences in the mean set durations and a mean difference of roughly an hour for haul durations (Table 3). This suggests that while further refinements may be possible, AIS data and the current GFW model can provide reasonable estimates of the duration of fishing operations, however these may not translate to work hours as not all crew participate in fishing operations, therefore it may be impossible to predict accurate work hours per individual using this method.

	EM data				Model predictions			
	Mean	Standard	Median	Sample size	Mean	Standard	Median	Sample Size
Setting	6.23	0.03	6.27	312	6.09	0.08	6.04	342
Hauling	11.28	0.08	11.25	312	10.39	0.13	10.8	345

Table 3. Duration (hours) of setting and hauling events.

While the model appears reasonably good at detecting fishing operations, it is expected that using remotely sensed data to determine when crew members have the opportunity to rest will be especially challenging. For example, on a longline vessel, the time when the hooked line is in the water "soaking" may represent a chance for the crew to rest, eat, or socialize or might simply be a time when the crew are engaging in alternate work such as cleaning, gear repair, or bait prep. The same could be said for the time between the last haul and the next set. While recognizing these limitations, it is still possible, by assuming all time not spent setting or hauling is spent resting to calculate a maximum rest duration. As previously highlighted, this will be inaccurate, but any vessel falling short on estimated rest time, even under this exceedingly rosy assumption, is one that certainly deserves further consideration and additional review.

4.1.3. EM system analysis and review

Regarding camera placement, we found that the standard environmental-focused EM camera placement was adequate for tracking most on-deck activities – including several labor related activities. Cameras 1-3 were essential for monitoring human activities. Camera 4 was not needed to monitor human activities, but was crucial for monitoring catch, bycatch and handling practices. Camera 5 would be helpful in reviewing man-over-board incidents and provides the reviewer with a helpful overview of the deck and walkways. An entirely new EM set-up and program are not essential for tracking human-related activities.

The EM review sampling size (i.e., 20% of all fishing operations) successfully captured many labor indicators. The additional 24-hour footage review allowed the team to glean key insights on day-to-day crew activities (Annex 2). On average, it took the EM analysts five hours to review one 24-hour period with a focus on labor indicators. However, through interviews, we identified that this sampling procedure did miss additional minor accidents (e.g., crew slipping). Current sampling procedures were also not adequate to monitor compliance with 7-day rest hour requirements. While EM systems could theoretically *capture* severe labor indicators (e.g., man overboard or violence), conducting 100% review of all footage is not possible with human reviewers due to significant cost, therefore these indicators may not be *identified* during review.

4.1.4. EM review times & Wi-Fi costs

Another crucial finding in this project relates to EM review times and Wi-Fi costs. It is important to note that all reported costs are generalized estimates based on this unique project. Project costs are subject to change based on several diverse factors, including:

- Vessel type (i.e., length, weight)
- Fishing type (i.e., longline, purse seine, etc.)
- Duration at sea
- Sets per trip
- Location of vessel installation and return port(s)

Below is a breakdown of the projected time associated with EM data review based on several different scenarios using this project as a case study. This breakdown assumes that vessels are fishing over a period of one month during which time up to 20 setting settings and hauling may occur. These breakdowns are generalized based on this specific project and are not reflective of all EM trial projects.

Review Plan	Total Time (Hours) Spent on Review per Month	Fishing Data (hours)	Labor Data (hours)	Reporting (hours)
Scenario 1: 20% data review (including one 24-hour review)	20% of sets = ~4 sets reviewed/month	31	8	4.5
	One 24-hour review/month	N/A	4	0.50
	Total: 48 hours/month	**31**	**12**	**5**
		~66%	**~24%**	**~10%**
Scenario 2: 50% data review (including two 24-hour review)	50% of sets = ~10 sets reviewed/month	78	19.50	11
	Two 24-hour reviews/month	N/A	9.00	1.00
	Total: 118 hours/month	**78**	**28.50**	**12**
		~66%	**~24%**	**~10%**
Scenario 3: 100% data review (including four 24-hour review)	100% of sets = ~20 sets reviewed/month	156	39	22
	Four 24h review period/month	N/A	18	2.00
	Total: 237 hours/month	**156**	**57**	**24**
		~66%	**~24%**	**~10%**

Table 3: This table represents three different EM review scenarios and the predicted time by which it takes to review the different environmental and labor indicators as well as report on the data on a monthly basis. These estimates based on the unique circumstances driven by this project experience and should not be considered comprehensive and/or representative of all other unique scenarios. Data review rates are for review of fishing operations.

Table 3 indicates that **including review for labor indicators in EM review can account for roughly 24% of the total review time** and therefore associated review costs.

It's important to note that this applies specifically to this project. EM review costs vary greatly depending on the review rate, and what data is extracted from review. Costs of review per longline tuna set can typically range from $200-$500 (Rogers et al., 2023, National Oceanic and Atmospheric Administration, 2023). Therefore, adding in a review of labor indicators could add approximately $48 - $120 to review costs per longline set. Additionally, in many instances, an economy of scale can influence the associated costs as the volume of review increases. For this reason, one could expect the costs of both Scenarios 2 and 3 to remain higher than Scenario 1, but likely to come in at lower values in a real-world scenario.

As mentioned previously, there are several factors that influence the cost of an EM program outside of the selected review rate. EM costs typically fall into the following categories, each having its own associated cost:

- EM data review and analysis (including reporting costs, EM hardware costs (i.e., cameras, wiring, installation materials, Wi-Fi units, etc.)
- EM hardware shipping costs (dependent on proximity of EM service provider to installation port)
- Associated installation fees (i.e., travel costs for EM installers)
- Associated project management costs which depend on what kind of services the EM service provider is responsible for. This may include activities like developing the installation plan and preparation and team management to coordinate on project deliverables.
- Wi-Fi subscription services and data storage plans. Estimated Starlink costs associated with this project are reported below. This project used the Starlink data plan 2 (1TB/month/vessel) shown in Table 4.
- EM system maintenance

Associated subscription services & data plan options	
Service Plans	Unit Price (USD) per vessel
Starlink data plan 1 (50GB)	$250/month
Starlink data plan 2 (1TB)	$1,000/month
Starlink data plan 3 (5TB)	$5,000/month

Table 4: This table represents the current Starlink packages and price for maritime use.

4.1.5. Wi-Fi usage

On average, the 3 pilot vessels used only half of the total 1TB data allowance per month. EM data transmission was equal to or less than crew and captain data usage per month, and averaged at 250GB per month. This suggests that a 500GB data package per month may be adequate for both crew and captain Wi-Fi use, and EM data transmission. Starlink has reported that it will be coming out with a 500GB option soon which might be a more feasible and financial responsible option given that no vessel exceed the 1TB package in any given month.

The average monthly crew and captain data usage combined was 283GB (for Vessel 2 and 3), and ranged from 170GB – 390GB per month. This suggests that a 300GB data package may be adequate for crew and captain use alone.

The average monthly crew use alone was 98GB (for Vessel 2), and ranged from 50GB – 190GB. Given there were 13 crew members onboard Vessel 2, this equates to an average of 7.5GB of data per crew member per month.

A breakdown of the average monthly data consumption by vessel can be seen in Table 5 below. All graphs showing detailed Wi-Fi usage per vessel can be found in Annex 1.

Average Monthly Data Use Per Vessel				
Vessel ID	Crew Use	Captain Use	EM Data Transmission Use	Total Avg. Use
Vessel #1	N/A	N/A	N/A	347 GB
Vessel #2	98 GB	159 GB	271 GB	528 GB
Vessel #3	310 GB		229 GB	540 GB

Table 5: Table represents the average Starlink data consumption per month for the three vessels along with the breakdown between use by captains and crew, and use for EM data transmission.

Feedback from crew and captain interviews (described below) provides some additional insights on Wi-Fi usage, including:

- **Speed:** Quality of Wi-Fi service and data speeds were poor on all three vessels. This may have contributed to lower data usage as slow upload and download speeds prevented users from consuming large amounts of data quickly, indirectly reducing their overall data consumption.
- **Outages:** There were frequent reported outages across all three vessels, sometimes for days at a time, which reduced data usage.
- **Signal strength:** Placement of the router in the bridge, and poor signal strength meant that crew needed to stand close to the router to connect to Wi-Fi. On occasions the signal was not strong enough to reach the crew cabins, which may have impacted crew usage.
- **Approved applications:** Video calling was not permitted, and certain entertainment applications were blocked to minimize data-intensive use.

Given these limitations, and that separate crew data usage was only reported for one vessel (Vessel 2), it is recommended that further research is conducted to better understand crew data usage needs.

4.2. Interview findings

Workers' experiences and perspectives played a fundamental role in the design of the project, and in the development of key learnings. Findings from interviews with crew, captains, and vessel owners provided valuable insights on diverse topics which have been compiled into several key themes – capture of labor conditions, preferences to work on vessels with EM and Wi-Fi, the use of EM footage as evidence, and access and management of Wi-Fi.

4.2.1. Capture of labor conditions

During preliminary research, Indonesian crew onboard Taiwanese-flagged vessels were asked what labor conditions (or indicators) could be observed onboard. Crew stated that cameras would be able to capture different elements of labor including accidents, being engulfed by waves, man overboard, fighting, and work and rest hours. To capture working conditions, cameras should be placed on the decks in the front and back of the vessel where the most activity occurs consistent with typical EM camera placement.

At pre-departure, captains and crew that were participating in the pilot were asked the same question of whether EM would be able to capture working conditions, and if so, what specifically. Crew on pilot vessels similarly stated that EM would capture accidents, injuries, and working hours. While EM was described to "give certain protection" it wouldn't capture all issues due to the lack of audio/video incidents such as verbal abuse or requests related to food or water.

Captains expressed that cameras would observe injuries, crew fighting, and fishing practices like bycatch. Captains confirmed that "cameras should be in similar spots they are typically installed, without being put in the bathrooms or sleeping quarters." However, cameras would not capture everything in all public spaces on a vessel. Additionally, working hours would be difficult to capture according to captains, and they expressed concerns about inaccurate calculations of rest hours or working hours being different than requirements/standards. Captains and crew both considered the engine room to be a location of important work but could not be captured with typical camera placement.

Key Learnings

4.2.2. Preferences related to working on vessels with monitoring

All crew shared that the cameras on vessels increased their safety overall and provided security and protection. While majority of crew were not concerned with cameras impacting their privacy, two fishers expressed some discomfort with the ideas of someone watching them during rest hours. However, at the post-trip interviews, all crew interviewed reported to feel less concerned and shared ways they adapted to the placement of camera including better coverings for privacy when showering.

> **When asked about their preference to work on a vessel with EM, *all* crew interviewed stated that they would prefer to work on a vessel with cameras.**

4.2.3. Footage as evidence during disputes

Captains and crews shared similar perspectives on the use of EM footage as valuable data that could be used as evidence in case of a dispute. One captain stated that "EM feels like insurance and if there is an issue with crew when fishing, there is evidence to support them." Another captain stated that EM could provide "solid evidence for captains, for example if crew tripped and fell overboard it would provide evidence to protect the captain." Another captain described how EM could support improved practices. Sharing an example of crew being injured without wearing protective equipment like boots or gloves, he believed footage would support the captain. Similarly, crew also considered footage to be critical evidence in the case of an accident or violation. Several crew members expressed that the footage would help prevent deception during disputes if vessel owners or captains were to lie about incidents onboard. Images or recording could support verbal or written reports submitted by crew.

4.2.4. Wi-Fi access and management

Crew

Overall, crew expressed preference to work on a vessel with Wi-Fi due to increased security and the ability to communicate with family and if necessary, authorities. Several crew members stated they would return to their current vessel due to a "good captain and Wi-Fi access", with two crew members already making formal requests to return with their recruitment agency. One crew described Wi-Fi to provide "emotional support to communicate with family and friends." Another crew member shared his experience using Wi-Fi to support his family during a medical emergency. He used Wi-Fi to communicate with his agent in Indonesia to send money to his family instead of waiting several months.

The only negative crew responses were related to the quality of service throughout their trip. On the vessel with the most consistent, quality service, crew reported several days with no signal. Even with consistent service crew reported that quality was "slow and sometimes it takes time for messages to come through because the signal is poor." Additionally, it was shared that connectivity was not consistent across the entire space of the vessel. Signal was strongest closest to the router in the bridge. Crew reported that they would stand on the narrow walkways along the sides on the bridge or on the upper deck on the vessel above the bridge in order to access Wi-Fi. This presents safety concerns related to standing in hazardous areas and experiencing dehydration due to sun exposure in unshaded areas. Crew suggested that the router be more intentionally placed, or potentially having two routers in both the captains and crew quarters.

On one vessel, crew believed that the captain had unplugged the Wi-Fi on several occasions because they would lose signal. However, there was no evidence of an outage resulting from unplugged or shut down systems. This created tensions and mistrust between captains and crews. Crews shared that they would prefer to have a single network so the captain would be less inclined to do so, or crew would have their own router and/or network to avoid this dynamic. In terms of scheduling access (e.g., specific hours) crew expressed resistance or concern with a set schedule stating that "everyone's schedule is different so some of us would be shut off with a fixed time…sometimes crew are working and other crew are resting."

Captains

The three captains had varying perspectives and experiences related to crew's access to Wi-Fi. On the first vessel, the captain was very hands off and expressed a trust for crew to work and rest when necessary. He stated that crew should follow the rules and not use their phones during work hours. He preferred to have a separate network from crew. On the second vessel, the captain shared that Wi-Fi is positive for all groups. For crew, it is convenient for them to communicate with friends and family. Most crew use Wi-Fi during rest hours, and it doesn't change the way they fish. For himself, he could more easily reach out to engineers and onshore support. On the third vessel, the captain was concerned with the amount of rest crew were getting with the introduction of Wi-Fi onboard. He reported that "not resting was a problem with one or two crew members," sharing that they would get very limited rest (approximately one to three hours of sleep) with access to Wi-Fi. However, he noted that "most crew use Wi-Fi quickly after work and it doesn't change how they rest or fish."

Vessel owners

During interviews with vessel owners, their main concern was crew Wi-Fi access. The concern on a possible strike was shared, as this is a story they heard being shared among captains and vessel owners in Taiwan. One vessel owner was particularly interested in having Wi-Fi onboard but shared worries about potential negative perceptions by their peers to be advocating or campaigning for crew Wi-Fi. The same vessel owner believed that the Wi-Fi onboard would introduce family issues and unmanageable emotional stress. They added that crew should have more resources including training or support from a religious organization to comfort them during times of distress. Lastly, vessel owners were interested in additional guidance and resources on how to manage Wi-Fi on vessels to reduce concerns and/or challenges.

5. Critical Elements For Effective Implementation

Technologies, in isolation, will have very limited impact, if not paired and embedded within a wider system of transparency and accountability to address the conditions which cause human rights violations. This is especially true when dealing with labor issues in the seafood sector. Whilst there are many enabling conditions and systems that need to be considered and adapted to address complex and often systemic issues, such as fair recruitment practices or direct employment to prevent debt bondage, these are considered out of scope of this research which has focused on the immediate systems that must be in place to enable EM to be applied for social responsibility. The key elements needed include (International Labor Rights Forum, 2025):

- Connectivity at sea (Wi-Fi)
- Integration with trust ed third-party labor group(s) and grievance mechanisms and remediation services
- Enforceable agreements

Recognizing the limitations of this research, with further research and longer pilots, there may be more key elements for successful implementation in the future.

5.1. Connectivity at sea (Wi-Fi)

Connectivity for crews at sea is a critical unlock for many components of applying electronic monitoring solutions for labor elements, as well as improving working conditions onboard vessels.

Isolation is a prominent issue in the large-scale fishing sector, due to long times spent at sea. Connectivity at sea can begin to address this, improving the well-being of workers, and supporting workers to access their rights. Being connected can enable crew and captains to contact friends and family, improve mental health, and seek support via port services or faith-based groups. Connectivity allows workers to access their rights including freedom of association and to access grievance mechanisms and follow up on the status of labor disputes and complaints they have submitted. It also provides workers with access to information, such as status of wage payments, access to translation services or educational materials, and/or policy updates relevant to their work and migration status.

Connectivity for crews is a key enabler to access grievance mechanisms during fishing trips. While a variety of grievance mechanisms are available including national hotlines or channels established by faith-based or worker organizations like the Presbyterian Church of Taiwan (PCT) or Stella Maris, accessibility is mainly limited to when crews are in port. By allowing crew to be connected at sea, they can contact these services and report issues as they occur.

It's critically important that EM systems are paired with Wi-Fi if these systems are to be applied to on-the-water tracking and verification for social responsibility. The current mechanism for reviewing EM environmental data in most traditional EM systems is to retrieve hard disks with stored video data from the vessel when it enters port (though newer EM system designs increasingly enable data offload via satcomm technology). The hard disks are then shipped to a review center for analysis. The collection and shipping of hard disks can take several weeks to complete. Once the review center receives the hard disks, they analyze data from the entire trip, which can take another several weeks. The entire process from the end of the fishing trip to receiving results from the EM footage can range from one to three months. Given the sensitivity of labor data, coupling Wi-Fi with EM so that EM data review and analysis can occur on a rolling basis is the recommended approach for review of labor indicators.

5.2. Integration with trusted labor groups and grievance mechanisms

EM environmental data is rarely shared at the vessel level, and there typically are no data sharing agreements in place to enable this. It is essential that if EM data is applied for social responsibility, that EM video data is accessible and actionable, and is part of the process in identifying and resolving labor issues. Otherwise, this technology will simply be a data collection tool and will fail at making improvements. The involvement of trusted, third-party labor groups is essential to ensure that EM systems and their associated technologies, such as Wi-Fi, are used effectively and ethically in addressing labor issues in the fishing industry. These groups act as intermediaries between workers, employers, and monitoring bodies, providing workers with confidence that their rights are respected and that any grievances will be addressed fairly.

5.2.1. Trusted labor group(s)

A method to ensure EM data is actionable, is by sharing relevant video data, that warrants further review and investigation, with labor experts that are trusted by crew. These experts should have knowledge of labor and fisheries, and the ability to review data and support remediation. They must handle sensitive labor and human rights issues as third-party entities, ensuring workers' needs are prioritized and the remediation process is fair and effective. These experts are referred to as "trusted labor groups" in this report, and they should be existing groups or individuals already trusted by the crew, and vessel owners who will have to agree to share EM data with these groups (see Agreements section below).

Trusted labor groups should include a range of existing organizations like unions, worker representatives, NGOs, faith-based organizations, and government bodies already involved in worker welfare and rights advocacy in the fisheries sector. These organizations have the experience to represent workers effectively and build trust in the system.

Trusted labor groups ensure workers have a voice in the monitoring process, and by involving these groups at every stage—from monitoring to addressing grievances—ensures workers are supported and violations are addressed promptly and safely. Workers should be involved in designing and delivering this system, focusing on their safety, data handling, and effective case resolution.

5.2.2. Integration with grievance mechanisms and remediation services

For EM to be effectively used to protect crews, a clear grievance process which includes EM data and relevant data sharing protocols should be in place, adhere to national and regional regulations and involving all relevant actors.

Effective responses to labor issues at sea depend on 1) who mandates EM and the grievance system, 2) who owns the data, and 3) who processes the data and grievances. Key steps include identifying a labor issue, raising a case, engaging the worker, obtaining and reviewing EM footage, and resolving the case with the worker and relevant actors (Figure 2). Captains and crew should have a solid understanding of EM and the data review process, and that data can support disputes or reported issues.

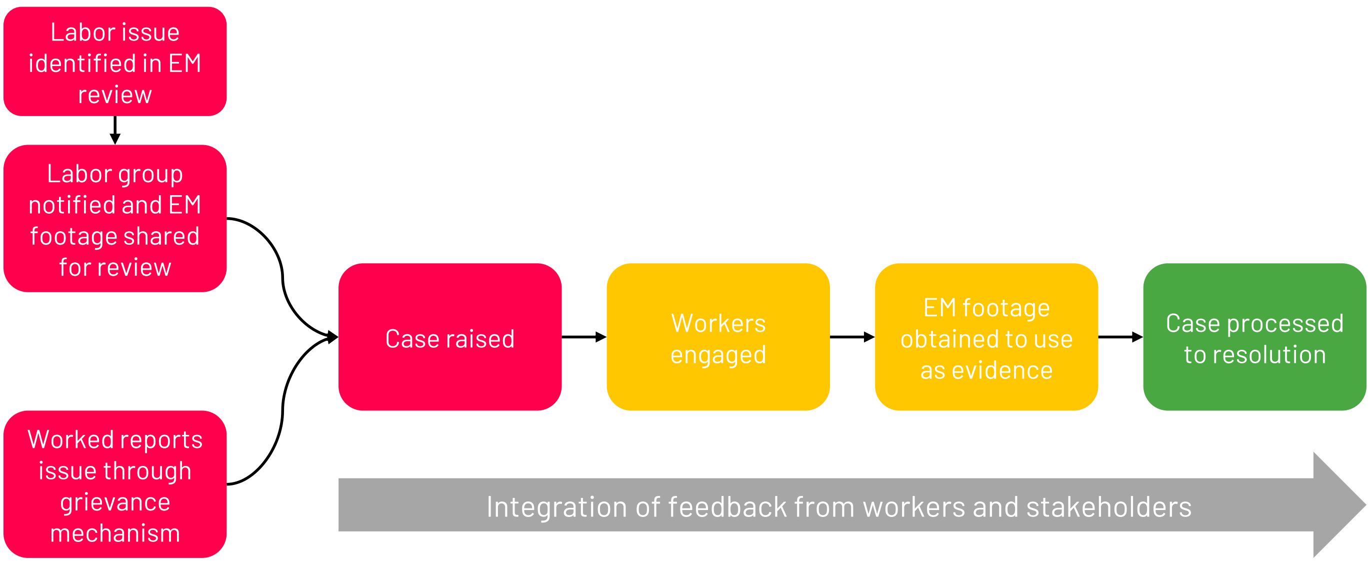


Figure 2: Diagram illustrating how EM data can be integrated with grievance mechanisms and remediation services.

There are two main pathways for integrating EM data with grievance mechanisms:

1. **EM-led identification:** Labor issues are identified during EM video review, and a trusted labor group is notified, and relevant video clips shared.
2. **Worker-led identification:** Workers report issues through existing grievance mechanisms, and the grievance receiver requests relevant EM video data to support the case.

Once a labor issue is raised, a standardized remediation process is initiated, using EM data as key evidence. Protocols for further investigation and monitoring should be developed with stakeholders, workers, and experts. Procedures for unreported issues observed in EM data should be carefully planned to respect crew members' experiences.

The trusted labor group then facilitates or supports issue resolution by engaging the worker, employer, and relevant authorities, possibly involving mediation, corrective actions, or legal proceedings, as appropriate. A legal framework should support the use of EM in grievance cases, ensuring workers feel safe using recordings as evidence and are aware of their rights, while maintaining data confidentiality.

5.3. Enforceable agreements

Effective enforcement is fundamental to the success of any social responsibility intervention. Workers need terms and protections embedded in their contracts to hold employers and others in the supply chain accountable (International Labor Rights Forum, 2025). These legal agreements should clearly articulate the rights and responsibilities of each party and dispute resolution procedure, as well as provisions that guarantee an effective grievance mechanism, and zero tolerance for reprisals. The contractual obligations of employers and supply chain partners must be accompanied by established consequences for those that violate commitments.

In many sectors, unions play an important role in the protection of workers. In the seafood industry, representation through unions is not always feasible or is legally limited in certain contexts. In countries where rights to collective bargaining exist in the law, seafood workers can be excluded from or unable to participate. In these cases, it's even more imperative that companies establish policies to meaningfully engage workers, and they have an effective enforcement mechanism through contractual obligation.

In the case of EM and Wi-Fi technologies, terms and use conditions should be integrated into enforceable agreements, such as worker contracts. The agreement will need to cover specific, agreed upon labor and human rights issues, access and use of EM & Wi-Fi technologies, and include a grievance mechanism covering those agreed upon rights. In particular, there must be clear data sharing protocols to enable the sharing of EM data with trusted labor groups to support remediation. To scale across different fleets and geographies, scenarios will also need to be tested for data sharing between flag, coastal, port and crew States. All parties including current and future participating suppliers and brands/retailers in the supply chain must be willing to commit to and comply with the terms and conditions.

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6. Key Surveillance Considerations

EM technologies may offer an effective way to capture and identify labor issues, in an environment that is typically data poor, and where evidence of issues is rarely captured digitally. It may also help hold malicious actors accountable by capturing video data of perpetrators. However, these technologies when applied to social elements, may also introduce new issues regarding privacy and autonomy. The way the technology is applied can have a huge impact on whether the solution is helpful or harmful. While this report researches the potential ways these technologies can be helpful, it is equally important to highlight the potential harms of this technology, and important surveillance considerations around privacy, data protection and consent.

The application of surveillance technologies, such as cameras in EM data, warrants careful consideration, as the datafication of labor issues carries risks which may further harm vulnerable and marginalized communities, such as migrant crew members. These surveillance risks include:

- **Privacy Invasion**: Continuous surveillance may lead to feelings of being constantly watched, which may cause stress and discomfort among crew members.
- **Misuse of Data**: There is a risk that surveillance data could be misused, either intentionally or unintentionally, leading to unfair treatment or discrimination.
- **Misinterpretation, Bias and False Accusations**: Digital data allows for remote review and investigations to take place, which can perpetuate biases and lead to misinterpretation (Milivojevic et al., 2020).
- **Psychological Impact**: The presence of cameras can create a high-pressure environment, potentially affecting the mental health and well-being of the crew.
- **Technical Failures**: Malfunctions or technical issues with the cameras could lead to incomplete or misleading data, which can lead to incorrect assessments being made about crew behavior.
- **Marginalization of situated and contextual knowledge:** reviewers may become detached from local knowledge and local needs, which may enable coercive interventions, and perpetuate global power imbalances.

It is important that video data is used ethically, and not used to unfairly target or discriminate against crew members. Surveillance must also adhere to international and local laws, including compliance with regulations on data retention and the use of surveillance footage. As such, best practices should be followed to set parameters around data capture, usage and review, including:

- **Justification for Surveillance:** Surveillance must be necessary, justified and proportionate. This means that implementing EM for social responsibility in a new context (i.e., fleet, country, region) may need a full impact assessment which addresses reasons for monitoring, why the objectives cannot be achieved without monitoring, and expected impacts.
- **Clear Policies and Guidelines**: Transparent policies that outline the purpose, scope, and use of surveillance data should be established. These policies should be communicated to all crew members to ensure they understand the purpose of surveillance and how the data will be used.

- **Non-Discriminatory Practices**: Surveillance data should be used to monitor clearly defined labor indicators rather than targeting specific individuals or groups, and the same standards and procedures should be applied uniformly across all crew members.
- **Third-Party Review**: Include an independent third-party organization to review and analyze surveillance data, and help to maintain objectivity and prevent any potential biases in the interpretation of the data.
- **Regular Audits**: Conduct regular audits of the surveillance system and data usage to ensure compliance with established policies and to identify any instances of misuse or discrimination.
- **Training and Awareness**: Provide training to all personnel involved in handling and analyzing surveillance data. This training should emphasize the importance of ethical data use and the consequences of discriminatory practices.
- **Feedback Mechanisms**: Implement feedback mechanisms that allow crew members to report concerns or grievances related to surveillance practices. This ensures that any issues can be addressed promptly and fairly.

6.1. Privacy

One of the most significant challenges regarding the use of EM is the impact on personal privacy of those being observed and recorded. Two solutions are available to reduce privacy impacts:

1. **Minimize personal data collection:** When setting up EM systems for monitoring fishing operations, cameras should remain focused on fishing gear and catch areas and should exclude as much identifying imagery of people as possible. This solution to minimize personal data collection works for environmental monitoring. However, when monitoring labor indicators, it is desirable for EM cameras to be positioned with the intention of also capturing human activity and interactions without infringing on the rights of workers. As such, a balance needs to be struck between capturing labor indicators and minimizing personal data collection such as through private spaces and camera placement. As discussed, to protect crew privacy, cameras should not be installed in private spaces, such as cabins, galleys and the head (bathroom). There should also be designated private spaces on the deck, such as where crew members shower (which is common on longline vessels) that are clearly marked, even though this may limit or reduce the ability to capture certain labor indicators. Where possible, EM systems should be designed to minimize the amount of personal data collected, whilst still meeting the monitoring objectives of the EM program.
2. **Anonymization:** Anonymization provides a potential solution to meet personal data protection, and software solutions exist to anonymize individuals through pixelation (EU Fisheries Control Coalition, n.d). However, this presents a challenge to identify individuals, perpetrators and victims if labor indicators are identified. Rather than permanent anonymization, for individuals involved in more severe labor violations that warrant further investigation, there should be a process of identification to support investigations. Therefore, where possible, data should be anonymized to protect individual identities, but readily available should the need for further investigations arise.

6.2. Data protection

The EU General Data Protection Regulation (GDPR) has significant impact on monitoring practices, and while this regulation applies to vessels flagged to countries within the European Economic Area, their principles should be adhered to, where possible, to protect individuals' privacy. Importantly, any EM system and policy being set up for worker protection should be developed with workers and employers in their respective language. The policy should consider data protection, encryption, data collection and storage, communication to a receiving entity, analysis, and use and access in grievance cases.

Processing and sharing of EM footage will require strict protocols and access limitations given that it may contain sensitive information and the visual identity of the individual. Data generated by EM systems is typically considered the property of the vessel owners, and access to EM data is often very limited, due to concerns around the potential for sensitive information to be misused or shared. Any implementation strategy for EM will need to address these challenges of data accessibility, given that if EM is to be used to identify labor indicators, and help resolve grievance cases, it must be sharable with relevant stakeholders. Accessibility to grievance related EM footage will need to be required, so that requested data could be logged accordingly and support the mediation process. Protecting the recorded data from unauthorized access is essential. This includes implementing robust encryption and secure storage solutions to prevent captains and vessel owners from being able to trace sensitive grievances back to those who filed them.

6.3. Consent

When applying EM for social and labor monitoring, obtaining free, prior and informed consent is crucial. Consent should be informed; therefore employees (crew members, captains and observers) should be trained on:

- What data is collected (such as where the cameras are placed, fields of view, what it observes, how recording is triggered, shown the video control panel so crew can see what is being recorded).
- How data is used and stored.
- Who has access to the data and processes involved, such as grievance reporting.
- Purpose of the monitoring.

Consent should also be given voluntarily, without coercion, and individuals should have the option to opt-out of the monitoring if they choose. This must not jeopardize the employment status of the individual. A suitable time to obtain consent may be during the employment contract, so that employees can be deployed on vessels with or without EM, depending on their consent preference. There should also be a process for individuals to withdraw their consent *between* deployments on fishing vessels. Revocation of consent *during* fishing trips is likely to present practical difficulties where EM systems are already in use, and therefore may not be feasible.

7. Challenges & Limitations

As with any complex project, there are limiting factors to consider. While EM and Wi-Fi present a promising application to support social responsibility, in part because these technologies already exist on-the-water, there are limitations to these technologies which should be noted and addressed in future project scoping. Despite these limitations, several new insights were gleaned from this project and have informed a list of recommended actions in the section below to better support future EM and Wi-Fi project and program development.

7.1. Operational challenges

7.1.1. Sample size limitations

Given the complexities of this new pilot project, it was difficult to identify and secure willing industry partners to participate. While the project team found an industry partner with vessel owners who demonstrated progressive attitudes toward sustainability, via prior involvement in other initiatives, including the FIP, it's important to note that these three vessels may not be representative of other vessels, especially those categorized as higher risk for human rights violations or other reports of illegality. Additionally, three vessels is a limited sample size which can further contribute to inconsistencies with the broader industry. This, coupled with a relatively short pilot project duration of six months, makes it difficult to draw concrete claims about some of the key data findings revealed through this project.

Additionally, while we were pleased to see that there were very few labor indicators indentified, this made it difficult to gather a comprehensive understanding of how the technologies put in place can best support crew welfare for more severe infractions. On top of this, the short review period and limited fishing trip duration (6 months) restricted observations of critical activities, such as transshipment, which could have provided additional insights into operational risks and labor practices. In the future, it will be important to explore opportunities for increasing the sample size and EM data review rate to ensure as many incidents as possible are being captured to help inform future EM programs. Likewise, although labor indicators were included in the EM program created for this project, there was no formal training given to the EM reviewers who are primarily focused on and trained in monitoring environmental catch data. Future projects should ensure that reviewers are properly trained to ensure they are capturing all of the information required to appropriately track labor indicators though EM data.


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7.1.2. Installation challenges

To complete installations, it is common practice for EM providers to work with local capacity like welders and computer technicians. While this approach can be beneficial by reducing costs and leveraging local expertise, it does present logistical challenges in smaller or more remote port states. In the case of Pago Pago, there was only one welder available to complete critical elements of installation. Limited access to and availability of welding services and other technical support meant that some aspects of the installation had to be adjusted or rescheduled, complicating the overall timeline. Furthermore, language translation services were needed for technicians to engage with vessel owners, captains, and crew. The project team was onsite to provide interpretation for English and Mandarin for captains and vessel owners, which required members of the project team to be on the vessels throughout the entire installation process.

7.1.3. Challenges with Wi-Fi

Disruptions to Wi-Fi connectivity, including significant outages during fishing trips, presented significant challenges and remote troubleshooting via satellite phone was often difficult. These gaps in service and outages can restrict the crews' 24/7 access to grievance channels or onshore support. Fortunately, this issue was not reported during crew interviews. Additionally, there were no binding agreements in place related to Wi-Fi access for crews. However, vessel owners and captains agreed that Wi-Fi would be open and available during all hours and were aware of data limits. Furthermore, the router placement in the bridge meant that the Wi-Fi signal was strongest at the center of the vessel, and weaker at the stern of the vessel where the crew sleeping quarters were. The impacts of these Wi-Fi challenges are reported in the interview results section.

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7.1.4. Challenges with EM hardware and service

At sea conditions can be quite challenging for any hardware system to endure. While EM equipment is made to withstand these challenging conditions, some technological failure is expected. In this project, the project team experienced issues with damaged equipment and camera malfunction. However, the selected EM service provider was available to support and troubleshoot these issues in most cases. Another limitation is that EM systems do not capture audio data, only video data, which can limit context and may cause issues in properly assessing situations during video review.

7.2. Limitations of EM for social responsibility

7.2.1. EM is not a meaningful substitute for worker engagement

For EM to effectively protect workers, there needs to be a wider system in place for workers to effectively raise issues and processes to resolve them. In the seafood industry, these systems and procedures are not widely established. There continues to be barriers for crew to report issues and receive timely resolution. Even with the detection of labor issues with EM, gaps in remediation for workers may remain. The application of EM for social responsibility must not be considered in isolation, or as a substitute for other tools to identify labor risks. EM may be a helpful tool to identify some risks, but it should be triangulated with other methods, including meaningful worker engagement to identify risks as part of robust human rights due diligence processes.

Likewise, it is imperative for structured, collaborative EM data sharing agreements to be in place so that EM data can be reviewed, actioned and used to support and protect workers. A key challenge is that there is no precedent for this – currently there are no EM data sharing agreements in place with labor groups or organizations. Uptake may be particularly challenging in cases where vessel operators are responsible for the cost of the EM system, as they may own the data or the potential for worker grievance cases to arise may reduce their incentive to use it. There is little monitoring or public reporting of which vessels have EM, and almost no reporting of which vessels have Wi-Fi. Therefore, it might be easy for companies to claim they are implementing EM for social responsibility, without having the necessary steps in place, as there is little oversight or monitoring of this. Implementing an EM program without consideration for and inclusion of clear grievance mechanisms and remediation procedures, could enable companies to greenwash their operations. A watchdog could serve to oversee implementation.

7.2.2. Current EM data review process isn't tailored to labor indicators

EM data can only capture a limited set of labor indicators, and it cannot capture silent violations, such as verbal abuse or withholding of wages. EM systems can only record what is within their visual frame and may not capture all events. The quality of EM video footage may also impact the ability for labor indicators to be detected, for example if the camera resolution is not high enough to detect injuries or if environmental weather conditions disrupt the camera view. Since EM only includes video, not audio, some actions might be misinterpreted or taken out of context.

Furthermore, not all EM video data is reviewed, therefore even if indicators are recorded, they may not be identified during review. While many environmental programs use a 20% review rate, this may be inadequate for tracking human activity as the number of incidents are far lower than catch and best handling practices observed in standard EM programs. Determining the proper EM data review rates must be a primary consideration when building an EM program, as they comprise anywhere between 2.5 to 39% of the overall associated EM program costs (Pierre et al., 2024). It is important that video data maintains a level of quality that will enable it to be recognized as a form of evidence, to ensure that it holds up in a court of law, so that the EM footage is not dismissed. This is important across all jurisdictions involved, including flag States, port States, coastal States and crewing States.

> **By including a risk assessment using the SRA in this project, additional risks were evaluated including those that could not be captured by EM, like wage disputes, debt bondage, or living conditions. This emphasizes the importance of pairing EM with other approaches to ensure adequate visibility to all elements of working conditions.**

Finally, EM standards for review of labor indicators have not been built into any EM programs to date. In the future it will be important to harmonize these standards for broad-scale use and further ensure that EM analysts are properly trained on how to review EM footage for labor indicators. While this may be offset through the inclusion of trusted labor groups, some basic training should be required to review labor indicators.

7.2.3. EM costs can be high and are heavily dependent on data review rates

EM and Wi-Fi are expensive technologies, and are primarily implemented by large-scale vessels (i.e., industrial purse seine and longline vessels). Despite research to prove the long-term cost savings of EM, in the absence of EM requirements onboard a significant proportion of large-scale fleets, costs may not be feasible for industry to pay for and widely adopt. Applying EM for social responsibility requires a change in review procedures that will incur additional costs for additional data and analysis time, which may further disincentivize its adoption. While AI may help automate the tagging of environmental data, human-on-deck detection is still in early stages of development, and it may be many years until this automation can be implemented to effectively reduce analysis costs.

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8. Recommendations

Bundle EM with Wi-Fi	**Rationale:** Pairing EM with Wi-Fi onboard fishing vessels offers numerous benefits for both fisheries management and crew welfare. It enhances crew communication and safety while enabling real-time reporting of labor violations, and there are cost saving opportunities for installing these systems together. However, EM and Wi-Fi are costly technologies and require financial support to be sustainably implemented.
	Actions: 1. Install Wi-Fi systems alongside EM systems to facilitate timely review of video data and crew access to Wi-Fi at sea. If data costs are prohibitive, consider purchasing Wi-Fi solely for crew and captain access without additional data costs for EM video transmission. 2. Encourage buyers and retailers to support the additional costs of EM and Wi-Fi through their purchasing practices, to reduce harmful downward price pressures. Provide financial incentives to vessel owners for early adoption of these systems.
Develop Comprehensive Social Responsibility Approaches	**Rationale:** For EM and Wi-Fi technologies to effectively protect workers, there needs to be a wider system in place for meaningful worker engagement including risk assessments, effective grievance mechanisms and transparent remediation processes, as part of comprehensive human rights due diligence.
	Actions: 1. Integrate EM into broader human rights due diligence programs to ensure comprehensive visibility of working conditions. 2. Conduct risk assessments to establish a baseline understanding of risks and assess risks not captured by EM, and use EM footage to verify risk assessment findings. 3. Include processes to involve workers in the development, design, and implementation of technologies. 4. Train workers on their rights, accessing grievance mechanisms, safe use of technology, and privacy considerations. 5. Train EM video reviewers on labor issues and indicators in the fisheries sector, and involve third-party labor review groups to access and review relevant EM data, assisting with remediation. 6. For other initiatives like FIPs, identify pathways to utilize EM data to support risk assessments and workplan implementation, and ensure Wi-Fi and grievance mechanisms are available to all fishers.

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Ensure Ethical Use of Surveillance Technologies	**Rationale:** The application of surveillance technologies like EM, carries risks that may harm vulnerable and marginalized communities, such as migrant crew members. These risks include privacy invasion, misuse of data, misinterpretation, psychological impact, technical failures, and marginalization of local knowledge.
	Actions: 1. Implement best practices on the ethical use of video data and adhere to international and local laws to avoid unfair targeting or discrimination against crew members. 2. Minimize Personal Data Collection and use Anonymization Techniques to protect privacy. 3. Develop data protection policies that include encryption, secure storage, and strict access protocols. Ensure data is sharable with relevant stakeholders for grievance resolution while preventing unauthorized access. 4. Obtain informed consent from crew members before they board and begin their work onboard. Consent should be obtained at the time of employment, allowing crew members who do not provide consent to work on vessels without EM. Incorporate training on EM systems into pre-operational training to ensure crew members are fully aware of the use of the EM system and their rights to privacy.
Strengthen Policies and Agreements	**Rationale:** Enforceable agreements ensure compliance with social responsibility standards and facilitate the use of EM and Wi-Fi technologies.
	Actions: 1. Develop enforceable agreements between vessel operators, industry stakeholders, and governments. 2. Implement access agreements that guarantee Wi-Fi access for crew members, and a clear Wi-Fi policy to manage the use of Wi-Fi onboard and prevent misuse. These agreements should outline the terms of use, access times, and any restrictions to ensure fair and consistent access for all crew members. 3. Implement data sharing agreements for EM that enable video data to be part of the process in identifying and resolving labor issues.

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Enhance Cost Efficiencies in EM and Wi-Fi Systems	**Rationale:** Reducing costs associated with EM and Wi-Fi systems can encourage wider adoption. Review rates drive a high percentage of the cost of EM programs so determining the most appropriate review rate for a given project will be critical for collecting key data insights while maintaining realistic costs.
	Actions: 1. Define review rates based on the specific objectives of the EM program. Use extended review periods for social responsibility, such as 24-hour reviews to track worker hours, while minimizing costs. 2. Implement higher review rates for vessels with discrepancies between EM data and logbooks, high levels of accidents and injuries, or high work hour estimates. Conversely, reduce review rates for vessels with consistent reporting as an incentive. 3. Explore automation and AI-assisted video review to automate the detection of fishing operations and labor indicators and reduce the time and cost of data review. 4. Avoid replicating technology already aboard vessels, such as Vessel Monitoring Systems (VMS). Address redundancy issues during the EM procurement process to reduce costs. 5. Conduct a fair request for proposals (RFP) process to select the most feasible EM service provider based on data and technology requirements and budget. 6. Select data storage options that maximize knowledge sharing and retention goals, determined at the onset of the project, while minimizing costs. Implement short minimum retention periods for raw EM data, complemented by long-term archival storage of specific events of public interest.

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Conduct Further Research & Pilots	**Rationale:** Additional research and pilot projects are necessary to refine best practices, and it is critical to evaluate the long-term impact of EM and Wi-Fi on crew welfare by gathering evidence on improvements in labor risk identification, grievance reporting, and remediation.
	Action: Trial these tools across different vessel types, fleets, and geographies. Study the global impact of EM and Wi-Fi adoption on crew wellbeing and retention and evaluate long-term cost-benefit scenarios for integrating EM with broader social responsibility initiatives. **Further research areas include:** 1. Pilots on additional vessels and more fishing trips to increase sample sizes. 2. Pilots on different gear types, geographies and Flags. 3. Wi-Fi pilots to understand crew vs captain data usage, application usage, and times of data usage. 4. Review transshipment and other vessel events during EM review. 5. Improve labor indicator identification, such as work hours estimates (research work hour correlations with fishing operation duration and number of hooks). 6. Wider interviews beyond the 50 stakeholders this pilot engaged with. 7. Statistical modelling of review rates, times and sampling for labor indicators to identify ideal sampling rates and frequency of review. 8. AI development to automate labor indicator detection. 9. Research with national level EM programs, rather than industry led initiatives. 10. Test different EM and Wi-Fi provider capabilities.

9. Scaling Pathways & Future Outlook

Transitioning to EM and Wi-Fi programs demands substantial investments of time, energy, and resources to overcome the limitations and challenges referenced above. These demands are often compounded by external impacts including political uncertainty and stakeholder dynamics. Program development requires activities including: defining objectives, securing legislative and regulatory support, setting data standards, and consulting with local industry partners. As such, there are significant limitations in how quickly and widespread this technology can scale. Despite this, there are several scaling pathways that have the potential to dramatically reduce barriers to entry and should therefore be further explored and piloted. We've divided these scaling pathways into three major areas of interest – industry, policy, and technology.

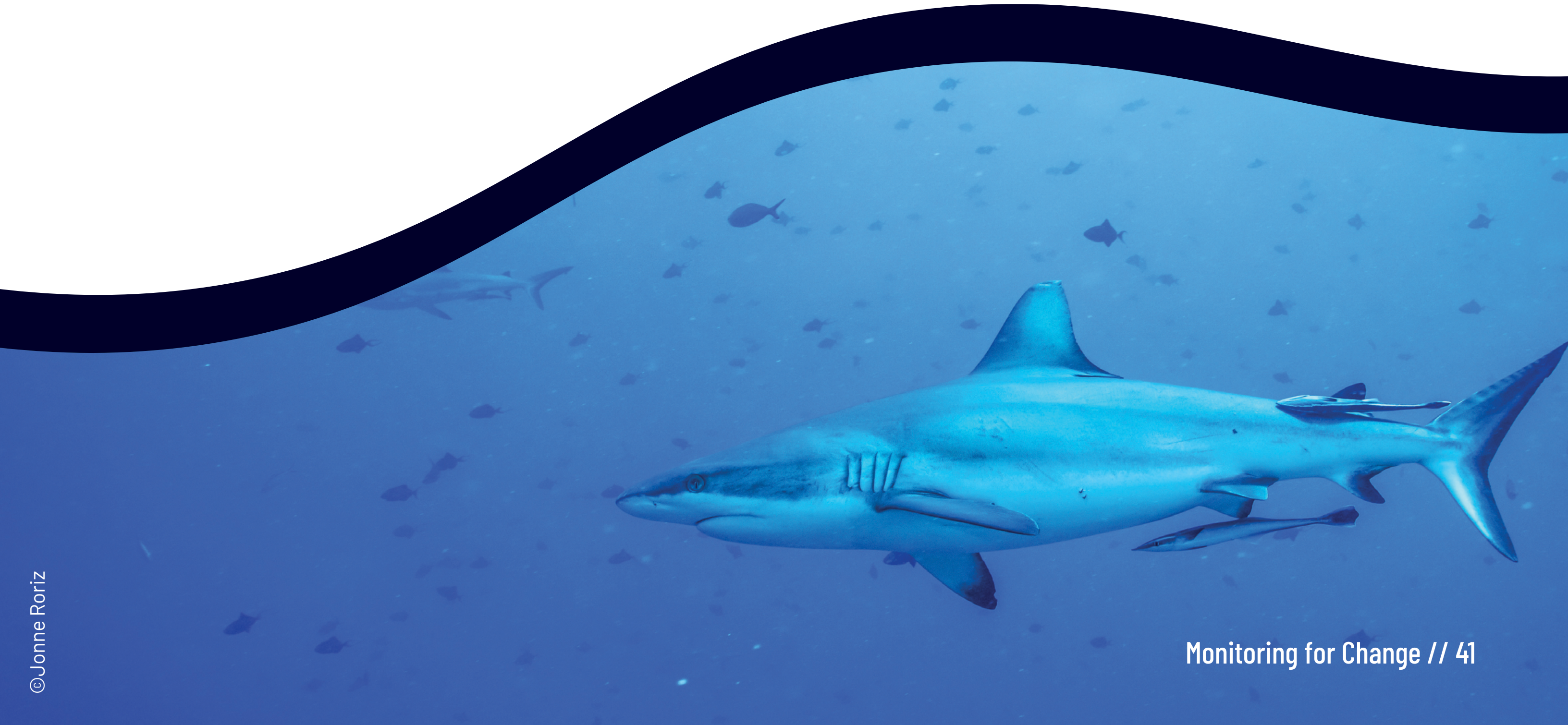
9.1. Scaling with industry

Today, EM has become a proven tool for verifying IUU fishing activity on-the-water. However, information on current EM capabilities and shortcomings, including where economies of scale are likely to kick in, can be difficult to identify and disseminate in the current industry climate. Although several agencies and organizations are working quickly to solve for this information disaggregation, this lack of clarity can drive stakeholder aversion to implementation—especially for something as new as including labor monitoring to those EM programs.

Despite these concerns, several market-based incentives exist that may ultimately be the driving force behind EM and Wi-Fi scalability for social responsibility. For starters, we know that EM can support vessel owners in proving that they are practicing fair and legal fishing practices without needing a human observer on board the vessel. Human observer programs are costly and low workforce capacity limits their feasibility and/or accessibility. EM coupled with Wi-Fi can solve this capacity issue for those looking to build transparency on their fleets and prove themselves to be legal operators—distancing themselves from those possibly engaging in IUU fishing and human rights violations.

This kind of transparency opens the doors to more economic opportunity and better market access by enabling vessels to meet sustainability criteria for achieving certification requirements. For example, EM can support suppliers and vessel owners in meeting Marine Stewardship Council (MSC) certification requirements for independent observation of catches under the evidence requirements framework. Many retailers will only purchase MSC-certified products, giving vessels with EM market leverage. Additionally, the MSC has released a version three of the sustainability certification that will require a minimum of 30% monitoring coverage via EM or human observers on annual fishing operations for fleets that are 1) managed by an RMFO, and 2) operate on the high seas.

Additionally, seafood suppliers and retailers alike are realizing that there is growing market demand for sustainable products that have been harvested without engaging in any IUU fishing activities or human rights violations. To meet consumer demands, several of the world's largest seafood suppliers and retailers (including Walmart, Thai Union, and Albertsons Co) have made public commitments to achieving 100% on-the-water monitoring in their tuna supply chains. In particular, in 2024 The Nature Conservancy launched



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the Tuna Transparency Pledge, a global initiative aiming to unite actors throughout the tuna supply chain to achieve 100% on-the-water monitoring on all industrial tuna vessels by 2027. Eleven industry and government partners have already made this commitment, including the three listed above, and there is hope that more are soon to follow. Similar industry commitments and purchasing practices to also source from vessels with Wi-Fi access for crews could also accelerate Wi-Fi uptake.

Finally, engaging with vessel owners and fishery associations is crucial for scaling EM and Wi-Fi. Currently, vessel owners have limited access to the technical and regulatory support necessary to guide their decision-making processes. Although market requirements incentivize vessel owners to adopt EM onboard, they often do not receive direct market incentives from retailers and do not participate in the policy consultation process, leaving them at a disadvantage. Furthermore, in cases where such requirements have not been mandated by law and/or no punishment would apply for non-compliance, it can be challenging to convince owners to spend additional expenses on installments that do not directly impact their profits or aid in fishing practices. Thus, it is critical to help vessel owners understand the value proposition of EM and Wi-Fi by clearly demonstrating its benefits and overarching applications. Capacity building initiatives should focus on educating vessel owners about how EM and Wi-Fi can support their broader operations, improve compliance with regulations, potentially open new market opportunities, and de-risk their concerns around providing Wi-Fi access for crews onboard.

9.2. Scaling with policy/governments

Public policy plays a pivotal role in the development, adoption, and scaling of technology solutions across sectors. By creating a conducive environment for innovation and ensuring that advancements and adaptations—such as the use of EM for social responsibility, and the adoption of Wi-Fi onboard fishing vessels—align with societal progress, public policy acts as both a catalyst and a regulator that can either accelerate or hinder progress. Governments have historically played a crucial role in scaling fisheries improvements. For instance, the implementation of observer coverage on purse seine fleets has been instrumental in enhancing compliance and data collection. These programs demonstrate the effectiveness of policy-driven initiatives in improving fisheries management and serve as a precedent for scaling EM and Wi-Fi technologies.

Governments can act through a variety of means to facilitate the scaling of the use of a new technology, or the adoption of a current technology for a new use (such as EM for social responsibility). Policy interventions may include:

New law & regulation related to:

- **Tax and subsidy incentives** to encourage private sector adoption and uptake and reduce financial burden for early adopters. For example, Taiwan subsidizes the costs of CCTV and Wi-Fi for vessels, incentivizing the adoption of these systems by vessel owners.
- **Infrastructure investment** to increase access to technology needed to effectively implement electronic monitoring for social responsibility.
- **Ratification and implementation of international human rights and fisheries frameworks and treaties** such as ILO C188, which establishes minimum requirements for work on fishing vessels, including provisions for occupational safety and health, conditions of service, and accommodation and food. It also mandates that fishing vessels provide decent working conditions, which can be supported by the implementation of Wi-Fi to ensure crew members have access to communication with their families and emergency services. Additionally, EM systems can help monitor compliance with labor standards

and detect any violations.

- **Promoting rigorous and strong national ethics and transparency** policies to prevent and address issues of corruption.
- **Funding & Grants**: Governments provide crucial financial support for research programs and pilot projects to understand the implications, risks, and potential benefits of a new technological application.
- **Public private partnerships**: Collaborations between government entities and private companies leverage the strengths of both sectors. Public resources combined with private expertise and efficiency can accelerate technological advancements.
- **Education & Training:** Governments can provide (and/or support) training and educational programs and other incentives to increase awareness among vessel owners, captains, and crew about EM and Wi-Fi, what regulations apply, and what their rights and responsibilities are.

Several national governments have already taken significant strides towards enhancing monitoring in their industrial fleets. Notably, seven countries—Chile, Belize, Ghana, the Federated States of Micronesia (FSM), New Zealand, the Republic of Palau, and Seychelles—have publicly committed to achieving 100% monitoring—via EM or human observers—in their industrial fleets. These commitments underscore a growing recognition of the importance of transparency and accountability in fisheries management.

At the regional level, the five RFMOs have a crucial role to play as a primary policy-focused body where countries can collaborate and advance joint measures, making them an essential policy pathway for scaling EM and Wi-Fi for social responsibility. Progress within these consensus-based organizations, however, is often a slow process. Notwithstanding this fact, there have been some key advancements in recent years including:

1. **The adoption of EM standards by all five tuna RFMOs** as of December 2024 marks a significant milestone. The Western and Central Pacific Fisheries Commission (WCPFC) became the fifth and final RFMO to adopt its own EM standards in early December 2024. This is a massive win for building and guiding future transparency at sea as jurisdictional regulations begin to take shape and require more and more vessels to have either EM or human observers onboard their industrial vessels.
2. **WCPFC's adoption of a new Conservation and Management Measure (CMM) on crew labor standards.** In addition to adopting EM standards, the WCPFC adopted a new binding measure on Crew Labor Standards, set to take effect on January 1, 2028. This measure is the first of its kind among RFMOs and aims to ensure fair and safe working conditions for crew members on industrial fishing vessels. While not as comprehensive as it could be, the CMM represents a critical step forward for protecting human rights at sea.

While several challenges and barriers—including data storage, industry buy-in, outdated policies, sustainable financing, and sectoral diversity—must be addressed to scale EM and Wi-Fi technologies effectively through public policy, it is evident that several policy pathways exist to support the scale and uptake of EM and Wi-Fi for social responsibility. The path forward to move from pilot to broad adoption of these technology systems to support social responsibility and accountability in industrial fisheries is by no means smooth, or likely to be quick. However, by addressing these challenges head-on through additional pilots and research, and continuing to support and learn from advancements at the national and regional levels, momentum will continue to build.

9.3. Scaling with technology innovation

EM systems have significant potential to improve fisheries management, but data review costs and logistics have hindered expansion to entire fleets. Better technology application and workflows are needed to verify catch and flag risky activity in EM footage to focus the sector's limited monitoring resources. Developments in artificial Intelligence (AI), machine learning (ML), and edge computing have been ongoing since the early 2000s, but have only recently gained traction for advancement in the fisheries monitoring and transparency space within the last five years. These early projects have largely focused on advancing models that can identify and monitor catch and species composition data on-the-water, but as we've seen through this project, there's a clear need to support technology that can review more data, faster, to support EM for social responsibility.

Some examples of potential technology advancements for improving the review of EM data for social responsibility include:

- **Developing AI/ML algorithms that can detect human presence**, triggering the EM system to begin recording when the shape of a person is identified in the frame or reduce the video review time by cutting out footage where no people are detected on deck.
- **Developing AI/ML algorithms that can track human activity and movement**, to estimate work hours (model would need to consider all cameras simultaneously to prevent double counting), and human movement detection to identify indicators such as abuse (raising limbs), and accidents (falling and lying horizontal).
- **Using edge and cloud-based computing** to detect the initiation of labor events for near-real time review. This could include activities such as transshipment events.
- **Building a notification system** that takes near-real time data, such as the detection of specific human-related events (i.e., man-overboard, etc.), and generates alerts for land-based reviewers to assess closer to when the incident occurred and ideally address human-related issues at sea as soon as possible.
- **Developing an EM image and video library** for AI/ML training of human activity onboard vessels

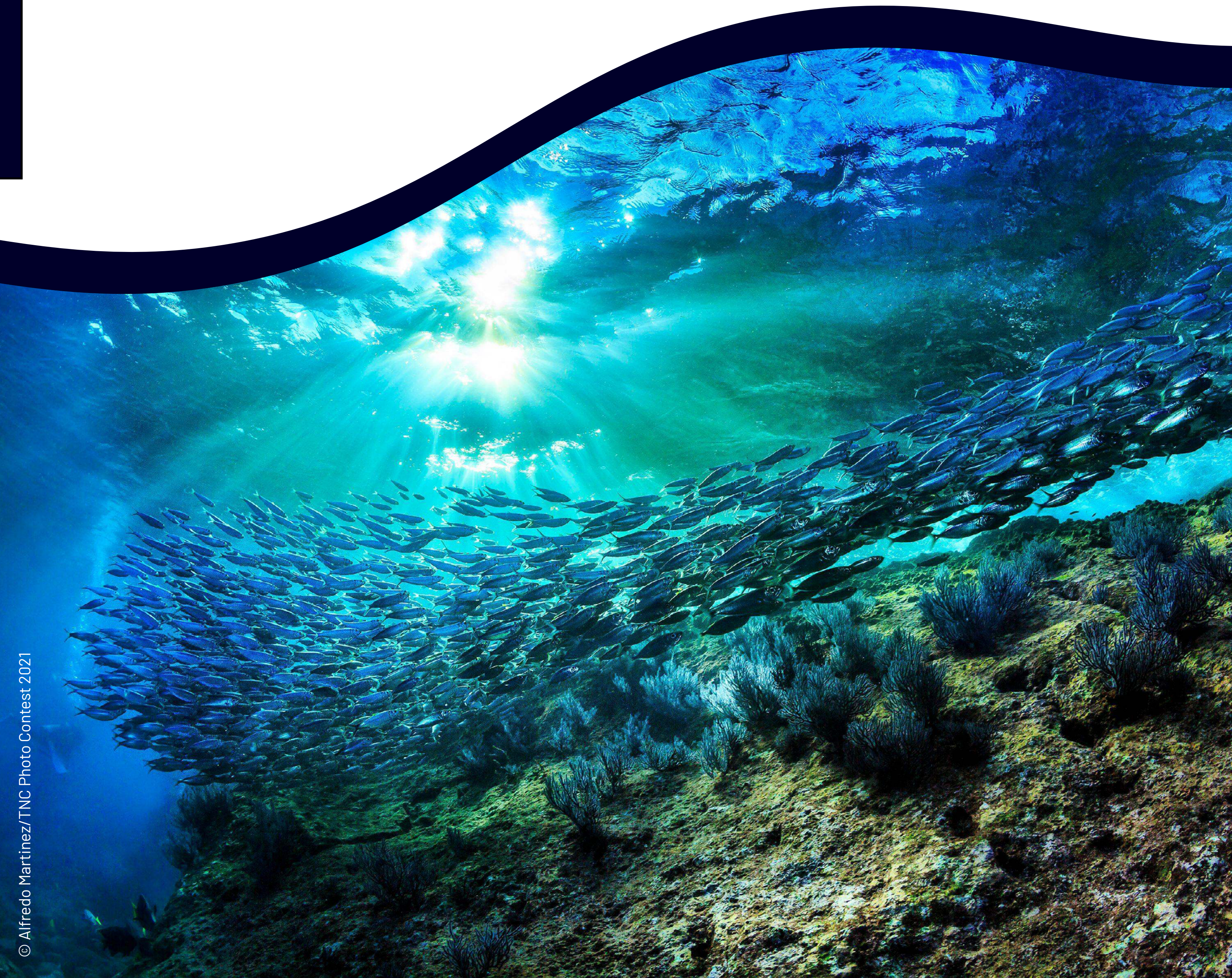
Developing the technology to support these capabilities has the potential to significantly improve the automated detection of labor indicators, such as detecting falling, violence, and tracking work hours. However, these models will require custom training and may take several years to effectively implement. Regardless, edge-assisted EM review can transform the status quo of EM footage review into a strategic workflow to quickly verify catch and identify IUU fishing activities before products enter global supply chains. This kind of early detection and identification can unlock novel business insights, support conservation actions, and drive market access opportunities for early adopters who link edge-based catch verification to first-mile traceability workflows. Likewise, new satellite communication providers like OneWeb and Project Kuiper may help improve and scale satellite communication at sea by offering alternative solutions to Starlink.

9.4. Future outlook & next steps

This first of its kind project generated new and exciting insights into how NGOs, trusted labor groups, industry partners and national and regional governing agencies can take steps to incorporate important mechanisms for monitoring social indicators into future EM programs. Based on project learnings, we now know that EM can be used as a tool for capturing on-the-water labor indicators like accidents and work hours, and can improve crew welfare when coupled with Wi-Fi to provide crew with real-time access to communication channels for connecting with family, grievance reporting and financial management.

While EM review rates and associated costs pose challenges to scaling this technology, several pilot projects aimed at improving EM review speeds while reducing review costs are currently underway as technology innovation continues to expand. Future projects should consider investing in these new technologies including new AI/ML technology to support timelier data review—saving costs and highlighting social indicators in near-real time.

Future scaling will also require stronger policies and industry commitments for improved labor conditions and further consideration around the ethical implementation required for EM programs to minimize privacy concerns and maximize benefits for crew on-the-water. To build on this work, The Nature Conservancy, Conservational International and Ocean Outcomes will be implementing a second phase of this work in the spring of 2025. This new phase will expand EM and Wi-Fi systems to more vessels across a longer timespan, integrate data with grievance mechanisms, and gather evidence on the impact of these technologies for labor risk identification, grievance reporting and remediation, to help shape EM programs for social responsibility and drive wider uptake of Wi-Fi access for crews at sea.



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ANNEX 1 – ADDITIONAL INFORMATION ON EM & Wi-Fi SYSTEMS

Camera Placement:

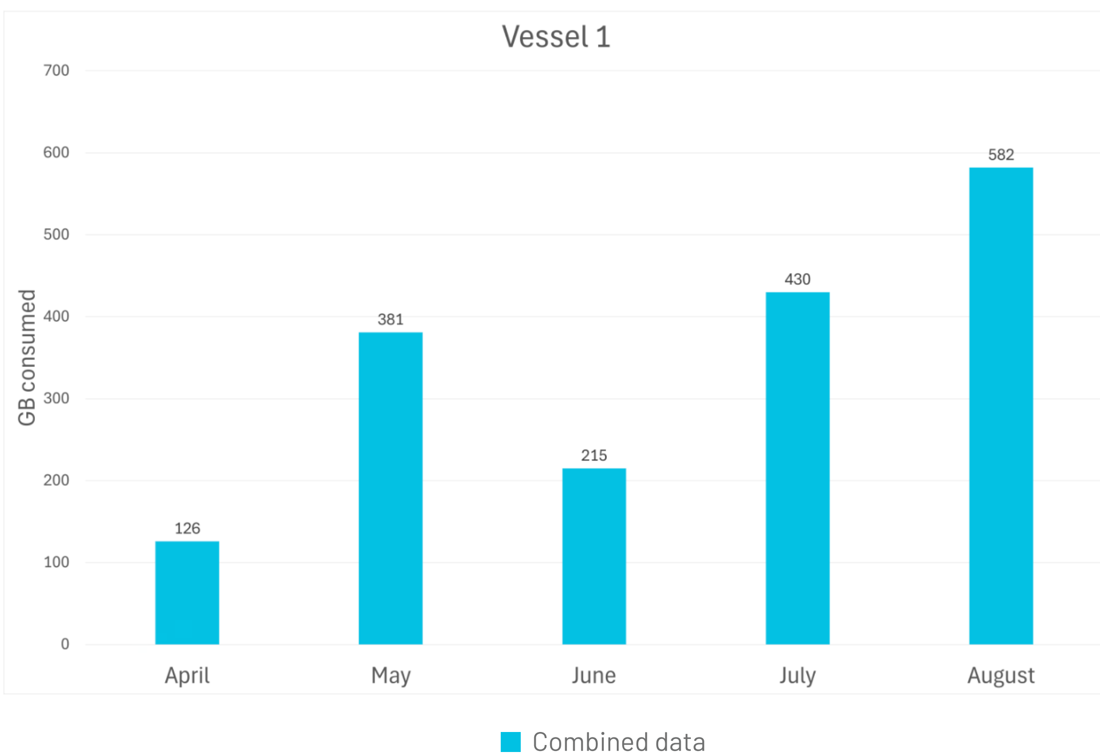
Cameras 1 – 3 (C1, C2, and C3) were primarily used for tracking any kind of human activity and fishing operations. The placement of these three cameras is typical for monitoring fishing activity, including setting, hauling, landing and processing fish on deck.

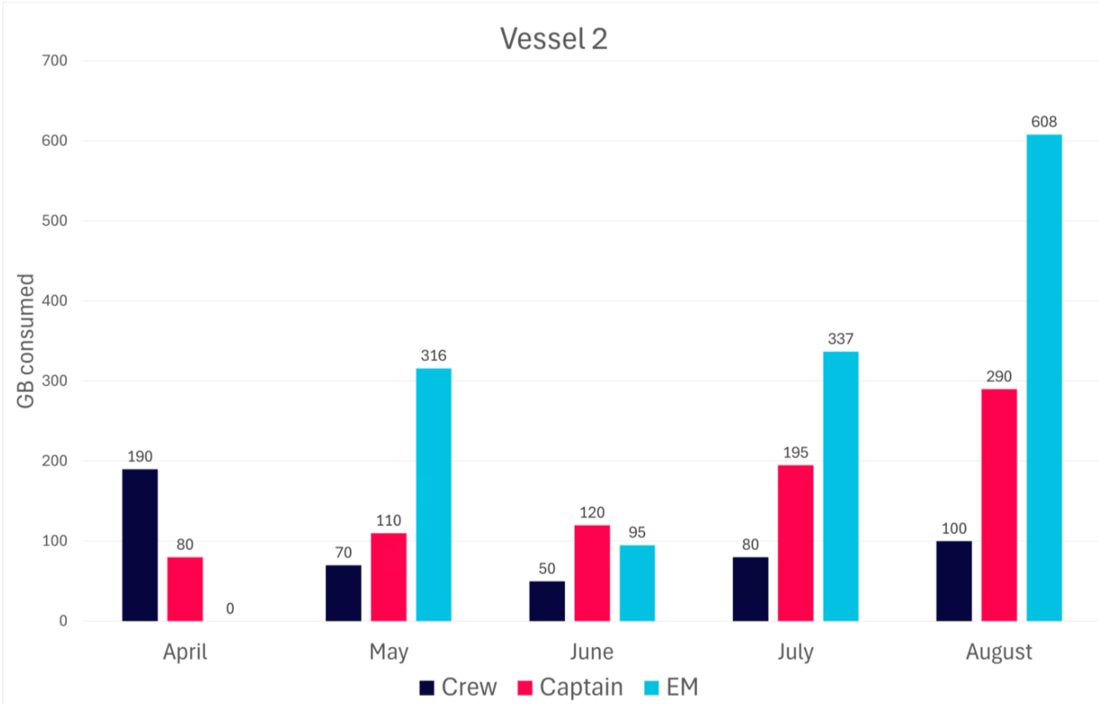
Camera 4 (C4) was strictly used to observe fishing operations, as the field of view was over the rail on the starboard side of the vessel – where crew would actively haul catch. This view provides an excellent overview of which species are being brought on board and what kind of handling practices are being used for the release of ETP species. Aside from serving as another indicator for how long hauling activities took, this camera's angle does not provide enough of a vantage point to view crew members.

Camera 5 (C5) was placed at a high angle towards the bow of each vessel. These cameras had a 180-degree frame geared at being able to view the entire vessel. From this vantage point, it may be difficult to make out individual human movements and actions. However, its height and vantage breadth enable viewers to capture the vessel's surrounding which is helpful for viewing and tracking transshipment events. Additionally, specific crew incidents like man-overboard, for example, could be reasonably tracked using this camera alone, making it a useful camera to have onboard if tracking human activity is the focus of the EM program at hand.

Wi-Fi Usage Reported by EM Service Provider:

The graphs below represent data Wi-Fi data usage across all three vessels. Vessel 1 shows data for combined EM data transmission and crew and captain use. Vessel 2 shows the breakdown of data usage by crew (dark blue), captains (light blue) and EM data transmission (orange). Vessel 3 shows the breakdown of data usage for crew/captains combined and EM data transmission use.





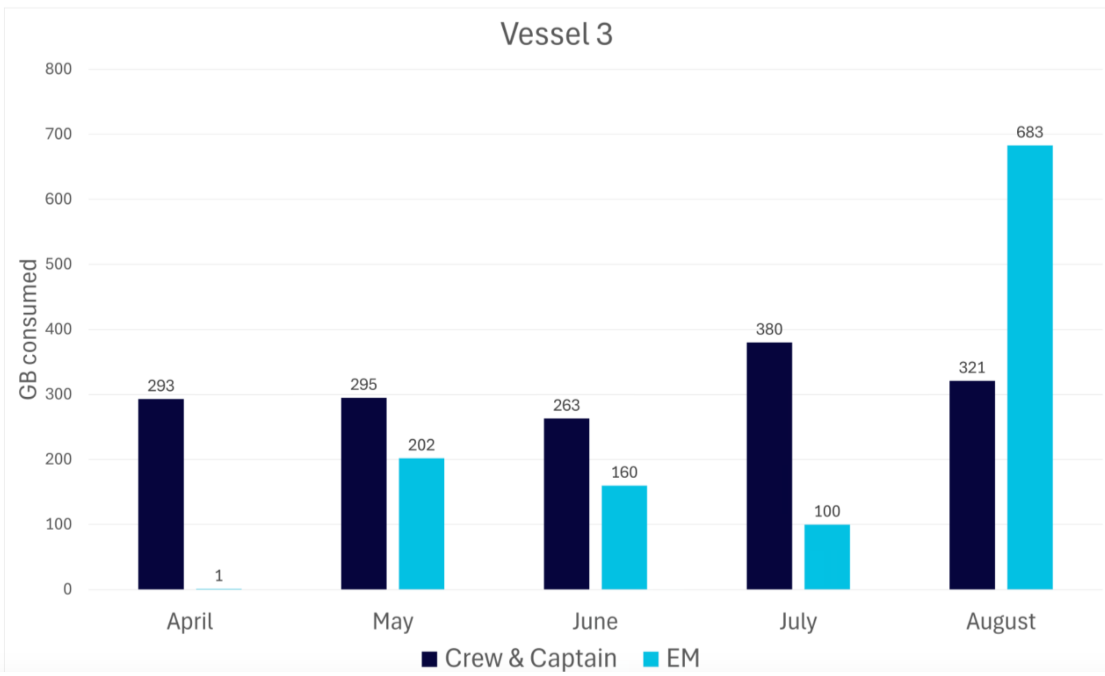


Table 6: This table shows the average monthly data consumed (GB) per crew member per month for vessel 2

	April	May	June	July	August	Average
GB consumed per crew	14.62	5.38	3.85	6.15	7.69	7.54

ANNEX 2 – WORK HOUR FINDINGS CONTINUED

The 24-hour work hours methodology identified all human activities during a 24-hour period, to identify activities that take place outside of normal setting and hauling operations.

Table 7: This table represents the various activities that the EM analysts were able to see the crew engaging in on deck.

Categories	Activities	Activity Descriptions
Fishing Preparation	Arranging bait	Crew prepares and sets up bait for setting
	Arranging wells	Crew arranges captures of wells
Fishing Operations	Setting activities	Activities performed by crew for fishing sets (i.e., preparing the lines, setting the lines, monitoring the lines, etc.)
	Hauling activities	Activities performed by the crew for fishing hauls (i.e., preparing to haul, performing haul, etc.)
Post Catch Operations	Cleaning fish	Crew cleans fish from the well
	Re-supply of equipment	Crew taking new fishing gear or equipment from storage
Vessel Maintenance	Equipment storage	Crew storing buoys and other fishing gear
	Arranging provisions	Crew moves bottles and food cans from one point to another of the vessel
	Cleaning activities	Crew cleans emptied wells or cleans deck
	Equipment maintenance	Crew deals with damaged equipment and repairs equipment as needed
	Equipment storage	Crew stores equipment for future fishing operations
Vessel Operations	Dish washing	Crew washes dishes
	Preparing supplies	Crew moves bottles and food cans from one point to another of the vessel
	Entering port	Crew is entering port
	Leaving port	Crew is leaving port
	Transporting bulks	Crew moves boxes from a point to another of the vessel

CONTINUED ON NEXT PAGE

Categories	Activities	Activity Descriptions
Personal Matters & Activities	Bottle refill	Crew refilling a bottle
	Personal hygiene	Showering, brushing teeth, etc.
	Cutting hair	Crew performs haircuts between each other
	Addressing personal needs	Using the restroom, smoking, doing laundry, etc.
	Meals	Time crew spent eating and/or drinking
	Resting	Crew relaxing, laying down, talking casually with other crew members, etc.
Miscellaneous Activities	Burning something	Crew burns unclear items creating a small bonfire
	Leaving vessel	While on port, crew leaves the vessel
	Return to vessel	While in port, crew returns to vessel
	Unknown activity	Crew is performing an activity that the camera angle does not totally cover, e.g., only half of the body is shown in frame, but the objective of the activity cannot be determined

ANNEX 3 – LABOR INDICATOR MAPPING & REPORTING

Table 8: Mapping of labor indicators to ILO C188 Articles and SRA performance indicators.

Grouping	Labor Indicators	ILO C188 Article	SRA Indicators
Trip-level data	Total number of crew for safe minimum manning	13 (a) their vessels are sufficiently and safely manned for the safe navigation and operation of the vessel and under the control of a competent skipper; and	N/A
	Trip length	N/A	N/A

CONTINUED ON NEXT PAGE

Grouping	Labor Indicators	ILO C188 Article	SRA Indicators
Accident / violence	Incidence of accident and/or injury	(31 (d) the reporting and investigation of accidents on board fishing vessels flying its flag 38 (2a) In the event of injury due to occupational accident or disease, the fisher shall have access to medical care 39 (1) In the absence of national provisions for fishers, each Member shall adopt laws, regulations or other measures to ensure that fishing vessel owners are responsible for the provision to fishers on vessels flying its flag, of health protection and medical care while employed or engaged or working on a vessel at sea or in a foreign port.	SRA 1.1.9S.5 Workers are provided with medical care for workplace injuries and are repatriated, if necessary, at employer's expense
	Incidence of violence and/or harassment	*The Forced Labor Convention, 1930 (No. 29); the Abolition of Forced Labor Convention, 1957 (No. 105); Universal Declaration of Human Rights, article 4 and 5*	SRA 1.1.1S.3 There is no corporal punishment, mental or physical coercion, verbal abuse (significantly different than colloquial banter), gender-based violence, sexual harassment, or any other form of harassment, including excessive or abusive disciplinary action, and fisheries observers (when present) can conduct duties free from assault, harassment, interference, or bribery,
Transshipment / crew transfers	Incidence of crew transfers	N/A	N/A
Vessel observations	Accommodation and sanitary conditions	26 Each Member shall adopt laws, regulations or other measures requiring that accommodation on board fishing vessels that fly its flag shall be of sufficient size and quality and appropriately equipped for the service of the vessel and the length of time fishers live on board	SRA 1.1.7aS.2 Housing and sleeping quarters have adequate fire prevention and air ventilation, meet legal requirements, and meet reasonable levels of safety, decency, hygiene, and comfort,
	Access to water	27 (b) potable water be of sufficient quality and quantity; and	SRA 1.1.7aS.5 Potable water is accessible to workers,
	Access to food	27 (a) the food carried and served on board be of a sufficient nutritional value, quality and quantity;	SRA 1.1.7aS.6 Workers/fishers living on site or on board have access to adequate and sanitary food at fair prices.

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Grouping	Labor Indicators	ILO C188 Article	SRA Indicators
Vessel observations (continued)	Adequate medical supplies	29 (a) fishing vessels carry appropriate medical equipment and medical supplies for the service of the vessel, considering the number of fishers on board, the area of operation and the length of the voyage	SRA 1.1.9S.2 Adequate medical supplies are available (i.e. there is a first aid kit)
	OSH drills training	32 (3, b) ensure that every fisher on board has received basic safety training approved by the competent authority; the competent authority may grant written exemptions from this requirement for fishers who have demonstrated equivalent knowledge and experience 8 (2, c) facilitating on-board occupational safety and health awareness training	SRA 1.1.8S.8 Workers/fishers/farmers and managers are trained in health and safety procedures and on proper use of PPE and safe operation of any equipment they use
	Presence of PPE	32 (3, a) ensure that every fisher on board is provided with appropriate personal protective clothing and equipment; 38 (1) Each Member shall take measures to provide fishers with protection, in accordance with national laws, regulations or practice, for work-related sickness, injury or death.	SRA 1.1.8S.4 Adequate personal protective equipment (PPE) (i.e. lifejackets) is provided on board or in the workplace/farm at no cost (unless self-employed)
Crew work hours	Rest hours	14 (b) for fishing vessels regardless of size remaining at sea for more than three days, after consultation and for the purpose of limiting fatigue, establish the minimum hours of rest to be provided to fishers. Minimum hours of rest shall not be less than: (i) ten hours in any 24-hour period; and (ii) 77 hours in any seven-day period.	SRA 1.1.6S.4 and SRA 1.1.6S.6 Workers have at least 10 hours of rest in a 24-hour period and at least 77 hours in a 7-day period,
Documentation / identification	Crew list	15. Every fishing vessel shall carry a crew list, a copy of which shall be provided to authorized persons ashore prior to departure of the vessel or communicated ashore immediately after departure of the vessel. The competent authority shall determine to whom and when such information shall be provided and for what purpose or purposes.	SRA 1.1.8 S.2 On large vessels, making long trips, vessels carry a crew list and provide a copy to authorized persons ashore at the time of vessel departure [long trips defined as 3 days

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Grouping	Labor Indicators	ILO C188 Article	SRA Indicators
Documentation / identification (continued)	Crew identity verification	N/A	N/A
	Fisher access to work agreement	18.The fisher's work agreement, a copy of which shall be provided to the fisher, shall be carried on board and be available to the fisher and, in accordance with national law and practice, to other concerned parties on request.	SRA 1.1.2 a S.6 All workers /fishers/farmers, including domestic and foreign migrants, have written contracts in a language they understand, with extra provisions made for illiterate workers, so that their rights and terms of recruitment and employment are clearly understood.
	Medical certificate	10.No fishers shall work on board a fishing vessel without a valid medical certificate attesting to fitness to perform their duties.	SRA 1.1.9S.4 On large vessels, making long trips, fishers have a valid medical certificate attesting to their fitness to work
	Child labor	9 (1) The minimum age for work on board a fishing vessel shall be 16 years 9(6) The engagement of fishers under the age of 18 for work at night shall be prohibited	SRA 1.1.3S.2 There is no evidence of hazardous child labor,

Table 9: Event information recorded if labor indicator identified in EM video review

Event Type	Date	Time	Medical Assistance	Severity	Description
Trip Level Data Accident / Violence Transshipment / Crew Transfer Vessel Observations Crew Work Hours Documentation / Identification	DDMMYYYY	HH:MM	Yes / No (applicable only to accidents / violence / injury events)	1-5 (applicable only to accidents / violence / injury events)	Text description

ANNEX 4 – ADDITIONAL RECOMMENDATIONS

Table 10: Additional recommendations not include in the Recommendations section above.

Recommendation	Description
Clearly define the purpose of the EM program	It is essential that the EM program design is clearly defined and that all participating stakeholders agree to adhere to its fundamental objective(s). In many environmentally focused EM programs, we see that the primary objective of the EM program is to increase, for both science and compliance purposes, confidence that self-reported fishing data on retained and discarded catch, particular on interaction with ETP species, is accurate. For the purposes of social responsibility, we recommend working across all involved stakeholders to define a proposed objective that aims to deliver quality insights on human-labor related issues aboard vessels at sea with key feedback provided by a trusted labor rights organization.
Set clear information requirements (IRs) within the EM program standards	Once an EM program's primary objectives have been selected, it is then critical to develop IRs (i.e., the minimum information that is necessary for EM systems to provide in order to achieve the objective(s)). Fishery stakeholders must make choices and consider trade-offs regarding what constitutes "must have" information and whether other information is worth the incremental cost in time and money of securing it.
Define the regulatory requirements early	For many EM programs, the primary objective is enhancing fishery MCS. In this context, governments must set policy and regulatory requirements such that EM data can be utilized for MCS purposes. Further, there may be specific government policies, like those governing privacy considerations, to which EM programs must adhere. Illustrative examples of EM program regulatory requirements include: 1) the use of tamper-evident EM systems aboard vessels; 2) protocols for, and implications of, EM system failure at sea; 3) data storage requirements; 4) data sharing and confidentiality requirements, and 5) data review and auditing requirements.
Related laws and privacy concerns are considered throughout the development of the EM program	Before implementing a new EM program, it is critical that the local and national policies are considered and incorporated where necessary into the program standards. Likewise, program standards should also consider local RFMOs regulations and data/monitoring requirements.
Define market measures and data requirements that support economic growth for the vessels	EM programs have historically been siloed into market-focused designs or policy-focused design. However, as the requirements between market actors and government actors continue to align, it's paramount that emerging EM programs consider market-incentives as well as national and regional regulations.
Research and optimize EM data review times	Identifying optimal EM data review frequencies can enhance the effectiveness of EM programs. It's important to conduct research to determine the optimal frequency for EM reviews and develop maximum time limits for review in collaboration with relevant stakeholders. Ensuring that dedicated review times for worker-reported incidents are based on severity and reviewing data before the vessel returns to port can better inform port inspectors and remediation services.
Provide training for remediation services	Effective remediation requires trained personnel so ensuring that remediation services have the necessary training and skills required to successfully respond to issues identified through EM data is important.
Consider Location of EM Service Providers	Proximity of service providers can reduce installation and maintenance costs. In planning for a new EM pilot project or program, select EM service providers based on their proximity to installation and return ports to minimize travel and shipping costs.
Encourage early adoption through financial incentives	Early EM adoption can reduce costs and improve program uptake. Structure financial incentives to encourage early adoption of EM systems. Collaborate with supply chain and government partners to secure lower rates by adding additional vessels to agreements early on.

ANNEX 5 – ELECTRONIC MONITORING TRIP REPORT TEMPLATE

The following EM trip report is an illustrative example of a trip report that will be created for this program.

ELECTRONIC MONITORING TRIP REPORT

Vessel Name: XXXX

Data Set Reviewed Dates: XXXXXXXX

Purpose: The purpose of the report is to describe the fishing operations carried out from XXX to XXX by the XXXX owned by XXXX.

Publish Date: XXXX

Prepared by: EM Service Provider Analyst Name

Contents

Main Electronic Monitoring Trip Report Takeaways

- *The EM system was operational for all trips and video data was recorded for all fishing operations.*
- *The data review showed that over time accumulated ocean spray and water spots reduced the video quality to the point where some cameras were unusable.*
- *Could the crew ensure the cameras are cleaned more frequently as it would assist the review.*
- *Catch handling was undertaken within camera view and there were no obstruction issues.*

Vessel Details

Vessel Name	
Vessel Owner	
Vessel Operator	
EEZ or high seas area fished	
Hard Drive Disk (HDD) Numbers	

Trip Summary

Map	
Trip date start & port departure	
Trip date end & port return	
# of days in the EEZ	
# of days outside EEZ	
# of sets undertaken in trip	
# of sets successfully recorded in trip	
# of sets analyzed	
Trip Summary *Issues with EM systems or fishing operations (bycatch handling, hardware issues, video loss, difficulties identifying species, etc.)*	

Catch Summary (for each set analyzed)

Set Date, Time, Latitude and Longitude

Common Name	# Retained	# Discarded	#Total	# Retained	# Discarded	# Total
	EM Data			Logbook Data (repeat for Human Observer Data)		
Target Species						
Species X						
Species Y						
TOTAL						
Non-Target Species						
Species X						
Species Y						
TOTAL						
Unidentified Catch Item						
Endangered, Threatened, & Protected Species						
Species X						

Compliance Summary

Events Occurring	# of Instances	Notes & Details	Link to Image & Video File
Improper Catch Handling Techniques			
Garbage Overboard			
Pollution			
Transshipments			
Labor Indicators			

Changes and Improvements Needed by Stakeholders

Change needed	Description	Who needs to be notified?	Responsible party?	Notification date	Confirmation received by who & when	Date problem fixed
INDUSTRY						
Cleaning of lenses						
Adjust cameras						
Bring fish across measurement area of deck						
Bycatch handling procedure						
FISHING AUTHORITY						
EM SERVICE PROVIDER						

Appendix

- Maps
- Methodology
- Detailed trip data
- Detailed catch data
- Detailed compliance data
- Images and Video of target catch
- Images and Video of Bycatch
- Images and Video of compliance events