Western and Central Pacific Fisheries Commission

SCIENTIFIC COMMITTEE
TWENTY-FIRST REGULAR SESSION

Tonga
13 – 21 August 2025

Report of the Electronic Monitoring Minimum Standards Harmonization Workshop

WCPFC-SC21-2025/ST-WP-12

H. Murua, *et al.*
(Common Oceans Tuna Project)

Food and Agriculture Organization of the United Nations

COMMON OCEANS PROGRAM

Tuna project

Report of the Electronic Monitoring Minimum Standards Harmonization Workshop

Donostia – San Sebastián, Spain, December 10-12, 2024

Report of the Electronic Monitoring Minimum Standards Harmonization Workshop

2025

Required citation:
Murua H., Harley S., Ruiz J., Coelho R., Roman M., Brian K., Canive I., Cocas L., Darcy R., Gibbon J., Gilmete D., Godefroy R., Isaac-Lowry J., Kawashima T., Legorburu G., McBride H., Meere F., Menchaka M., Moffett J., Moran G., Moreno G., Nuñez A., Pierre L., Wiersma J. 2025.
FAO Fisheries and Aquaculture Technical Paper, No. xxxx.
Rome. FAO.

Disclaimer:
The recommendations presented in this report reflect the views of the participants and do not represent an official position of any organization. Furthermore, these recommendations do not necessarily reflect unanimous agreement and may not represent the consensus of all participants involved in each specific recommendation.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2025

Contents

Executive Summary

The Electronic Monitoring (EM) Minimum Standards Harmonization Workshop, held in Donostia – San Sebastián, Spain in December 2024, brought together 24 experts representing regional fisheries management organizations (t-RFMOs), EM technology providers, and industry observers under the Common Oceans Tuna Project. The primary objective of the workshop was to conduct a technical review of existing EM standards across t-RFMOs, explore best practices, and identify areas for potential harmonization. This initiative aimed to enhance the implementation of EM systems, particularly in under-monitored fisheries, while maintaining high data integrity and compliance standards.

Over the course of the workshop, participants examined the EM standards adopted by the IATTC, ICCAT, IOTC, WCPFC, and CCSBT. Although each t-RFMO has developed EM frameworks tailored to its own priorities, the workshop revealed significant commonalities. However, it also identified inconsistencies in definitions, data requirements, technical specifications, and implementation approaches that could hinder effective cross-jurisdictional EM deployment. For example, while all t-RFMOs treat EM as a voluntary monitoring tool, only some currently allow EM data to fulfil Regional Observer Scheme (ROS) obligations. The role of EM alongside human observers and the integration of alternative data sources such as port sampling also varied significantly among organizations.

Technology providers emphasized the importance of modernizing EM standards to reflect advances in AI, wireless transmission, and cloud-based data storage. The workshop underscored the need to shift from rigid technical mandates toward performance-based standards that prioritize outcomes over prescriptive specifications. This approach would foster innovation, improve cost-efficiency, and promote broader adoption across diverse fleets. Participants also recognized the need for clearer, harmonized definitions, particularly around EM coverage metrics, and recommended developing a universal template for Vessel Monitoring Plans (VMPs) that could be applied across multiple RFMO jurisdictions.

Data management was another critical area of discussion. Participants called for flexible, secure, and standardized protocols for data submission, storage, and review. The importance of defining data ownership, ensuring digital traceability, and supporting interoperability between different EM systems was emphasized. To ensure consistency and accountability, the group strongly recommended the development of a unified audit and assurance framework applicable to all t-RFMOs.

The workshop concluded with agreement on a set of practical recommendations aimed at harmonizing EM standards, improving technological integration, clarifying roles and responsibilities, and ensuring long-term sustainability of EM programs. Participants emphasized that the success of future EM implementation will depend on continued collaboration among RFMOs, member states, and EM providers. A second workshop,

scheduled for early 2026, will serve as a follow-up to assess progress, refine strategies, and finalize audit and compliance protocols.

Overall, the workshop marked a critical step forward in aligning EM practices across global tuna fisheries. It reinforced the value of shared standards, flexible frameworks, and transparent processes in enhancing monitoring, control, and compliance while supporting sustainable ocean governance.

1. Overview

Under the auspices of the Common Oceans Tuna Project, 24 Electronic Monitoring (EM) experts comprising representatives from tuna-RFMO (t-RFMO) Secretariats, chairs of relevant t-RFMO working groups, EM technical providers, and other experts who participate in t-RFMOs EM discussions, met at the Aquarium of Donostia-San Sebastián (Spain) 10-12 December 2024.

The workshop was an opportunity to share knowledge and experience, including getting feedback from EM providers on how to successfully rollout EM in t-RFMOs. The meeting Agenda is attached as **Appendix 1**. The list of participants is provided in **Appendix 2**. The recommendations are highlighted in the report and compiled in **Section 5**.

2. Introduction

2.1. The Common Oceans Tuna Project

The Sustainable Management of Tuna Fisheries and Biodiversity Conservation in the Areas Beyond National Jurisdiction Project, commonly referred to as the Common Oceans Tuna II Project (the Tuna II Project), is dedicated to promoting responsible and sustainable tuna production while conserving biodiversity in international waters. The project is structured around three components: (i) enhancing tuna fisheries management, (ii) improving monitoring, control, and surveillance (MCS) to ensure compliance with conservation measures and combat illegal, unreported, and unregulated (IUU) fishing, and (iii) minimizing the environmental impacts of tuna fisheries.

An important goal of the Tuna II project is to strengthen MCS through various capacity-building efforts, the use of innovative tools and technologies, such as Electronic Monitoring (EM), and the sharing of experiences and lessons learned, with the aim to improving fisheries data and enhancing compliance with CMMs to combat IUU fishing.

Tuna RFMOs (IOTC, ICCAT, IATTC and WCPFC) have already adopted EM standards with CCSBT having adopted High Level EM Guiding Principles. With this progress, there is now a need to review these standards to identify commonalities, gaps, and best practices, or in other words, to explore how to harmonize EM standards across t-RFMOs. In the Tuna II project, a key initiative is supporting t-RFMOs in implementing EM programs either as a complement to, or as an alternative to, at-sea human observer programs, particularly in poorly monitored fisheries. The project places strong emphasis on developing standardized

protocols, such as minimum data requirements and technical standards, for EM across various t-RFMOs.

2.2. Workshop Objectives

The objective of this workshop was a technical review of existing EM standards (including, inter alia, standards for data, technical requirements, audit and assurance processes) across t-RFMOs. The workshop aimed to identify similarities, differences, and best practices among these standards and highlight key areas for potential harmonization without lowering EM standards in any region. A key feature of the workshop was the inclusion of EM Providers and they were given the opportunity to share their unique perspectives on EM standards as ones who would need to build systems to meet these requirements.

This workshop report includes numerous recommendations which individual t-RFMOs could consider in any future revisions of their EM standards, ensuring a more cohesive approach to electronic monitoring across the world's tuna fisheries. Further, it includes recommendations for work that would be expected to benefit all t-RFMOs.

3. Context Setting

This part of the meeting provided an opportunity for meeting participants to get an update from the five t-RFMOs on their progress on EM and for the invited EM providers and EM data review centers to share their thoughts on the process to date and their thoughts on the risks and opportunities in the future.

3.1. Tuna-RFMO EM Standards

The Chairs of EM Working Groups or tuna RFMO Secretariats presented the adopted EM standards of each t-RFMO. The presentations are attached as **Appendix 3.** A short summary of each presentation is presented below.

Commission for the Conservation of Southern Bluefin Tuna (CCSBT)

CCSBT is currently working on EM but is some distance behind other t-RFMOs due to somewhat unique arrangements, as it manages southern bluefin tuna in its entire distribution but has no convention area and, therefore, seeks to harmonize with the t-RFMOs where southern Bluefin tuna are distributed and caught – most important in this regard is IOTC.

High Level Guiding Principles for EM were developed by the Compliance Committee and endorsed by the Commission in 2023. They are broadly based on IOTC definitions and accept that the use of EM is voluntary and, if used, can complement or supplement human observer programs. They should be compatible with the EM utilised in other relevant RFMOs and can be used to contribute to meeting the scientific observer coverage requirements as described in the CCSBT Scientific Observer Program. The Principles acknowledge that there is potential for EM data and information to be used to assist with

the assessment and reporting of Members' compliance with CMMs in future if agreed by Members. This does not prevent Members choosing to use their own EM data and information to support compliance with CCSBT CMMs.

Inter-American Tropical Tuna Commission (IATTC)

This presentation covered the IATTC-adopted minimum standards for Electronic Monitoring Systems (EMS) in IATTC fisheries (Resolution C-24-09). It outlined the scope and interim character of the Resolution, emphasizing its interim nature, and that a mandatory EM program is yet to be adopted. The IATTC EM Working Group (EMWG) is tasked to review these interim standards in 2027 and at least biennially thereafter, or until final EMS standards are adopted. The EMWG will also assess the feasibility for EM to be used as substitute for human observers to increase IATTC observer coverage (e.g., longline, and unobserved purse-seine vessels).

A key feature of C-24-09 along with its annexes with provisions and EM minimum standards, is its hybrid approach to language: "Shall", which are items that an EM System or EM Program must have to meet minimum data quality requirements; "Should", which are items that could be very useful to have, but not strictly required, and "May", which are items that are much less critical to observe.

International Commission for the Conservation of Atlantic Tunas (ICCAT)

Dr. Rui Coelho, Convener of the ICCAT/SCRS Sub-Group on EMS, provided an overview of the progress and adopted EM standards at ICCAT. This SCRS Sub-Group on EMS worked since 2021 on the scientific component of ICCAT EM standards, with the ICCAT Commission adopting EM minimum standards for ICCAT fleets in November 2023. Those minimum standards currently adopted include EM standards for both scientific and compliance purposes, and cover pelagic longline and purse seine fisheries.

One important point to note from the ICCAT adopted EM minimum standards is that currently there is still a need to maintain a minimum human observer coverage for scientific purposes and that EM can be used to complement this. The CPCs must develop and describe their EMS domestic program, and submit the data to ICCAT using the electronic formats developed in line with procedures in place for other data reporting requirements. Another point to note is that the standards include a provision for periodic reviews of the standards, starting in 2026 and then least every 4 years thereafter, to evaluate the effectiveness of the systems in fulfilling their purpose and also to consider the need for revisions, allowing for the incorporation of new technologies as they are developed over time.

The next steps of this EM Sub-Group should be to start working on EM possibilities and standards for smaller vessels (e.g., coastal longlines, gillnets, etc), which are usually fleets and vessels more complicated to take onboard observers (due to lack of space, security, etc). Currently, there is very limited data from those fleets in general, so there is a need to plan for and establish alternative data collection methods, and some types of simplified EM systems might be a possibility.

Indian Ocean Tuna Commission (IOTC)

Dr. Hilario Murua, IOTC WGEMS Chair, provided an update of the process of Electronic Monitoring standards development and adoption in the IOTC. The implementation of EM in the IOTC began around 2014, with initial EM trials conducted. In 2016, Resolution 16/04 was introduced to promote a pilot project under the Regional Observer Scheme (ROS) and tasked the Scientific Committee (SC) with developing minimum EM standards.

Building on these efforts, a technical paper outlining minimum EM standards for installation, data collection, analysis, and storage was prepared and discussed by the SC in 2020. This was followed by the establishment of a dedicated Working Group (WG) on Electronic Monitoring Standards in 2021, which further advanced the discussion on EM standards. In 2022, Resolution 22/04 on a Regional Observer Scheme (ROS) requested the IOTC Scientific Committee to develop EM standards and, once adopted, allowed members to fulfil ROS mandatory data collection requirements using EM. These efforts culminated in 2023 with the adoption of Resolution 23/08 on Electronic Monitoring Standards for IOTC Fisheries, marking a significant step towards integrating EM into IOTC fisheries management.

Resolution 23/08 establishes clear requirements to ensure that IOTC Members implementing Electronic Monitoring Systems (EMS) in the IOTC area of competence meet the minimum data requirements of the Regional Observer Scheme (ROS) under Resolution 22/04. It defines key terms and sets out EM Program Standards, as well as EM System and Data Standards that vessels should comply with. Additionally, Members are required to submit a Vessel Monitoring Plan to the IOTC Secretariat, detailing the EMS setup for each vessel in their fishery. Furthermore, CPCs are required to submit a fleet-level ROS data collection table annually, outlining the data fields required under the ROS, their descriptions, reporting requirements, and the methods used for data collection (EMS, port sampling, and/or others) and reporting. These provisions ensure that all mandatory data fields required by ROS are consistently collected by EMS or in conjunction with other data sources (port sampling, etc.) and the reliability in EMS implementation across the IOTC fisheries.

Western and Central Pacific Fisheries Commission (WCPFC)

Dr Shelton Harley provided an update on Electronic Monitoring in the WCPFC. At its 20th Regular Session in 2023 the WCPFC agreed that Electronic Monitoring could be used by certain longline fleets to increase monitoring and verification and obtain increases in their longline bigeye tuna catch allocations. This was done before EM standards had been agreed so this led to a strong push within the Commission to adopt interim EM standards.

At its 21st Regular Commission meeting in late 2024, just prior to this workshop, the WCPFC adopted a set of Interim EM data requirements, EM technical standards, and EM reporting requirements (https://www.wcpfc.int/doc/data-08/interim-electronic-monitoring-minimum-standards-covering-technical-data-and-reporting). Like the IATTC, the WCPFC took a multi-level approach to interim EM technical standards, using “Must” (mandatory),

"Should" (recommended), and "Could" (optional) to characterize the different requirements.

It also agreed to a forward workplan for its EM working group, with a focus on (1) harmonization as appropriate (based on the outcomes of meetings such as this), (2) further consideration of EM data standards based on the parallel work being undertaken in the WCPFC on observer data standards, (3) consideration of an audit and assurance process for EM programs, and (4) initiating work on the application of EM for longline transshipment (on the receiving vessel).

3.2. EM Providers presentations

A representative from each EM technology provider and/or EM data review center gave a short presentation on the gaps, risks, challenges and opportunities that each saw in the development of EM standards across the t-RFMOs. The presentations are attached as **Appendix 4,** a short summary is presented below, and a summary of key recommendations from EM providers is found in section 3.3.

Satlink/DOS

As EM expands globally, it brings both significant opportunities and critical policy challenges. EM enhances transparency, accountability, and data quality across diverse fisheries. Advances in 4G/5G and satellite transmission have made wireless systems more accessible, enabling near real-time data transfer and faster, more responsive analysis. While satellite connectivity can involve higher operational costs, it offers unmatched coverage and reliability—making it a strategic investment for remote and high-priority fisheries where timely data is critical. The integration of artificial intelligence (AI) and machine learning (ML) further boosts EM's potential—accelerating data processing, automating video review, and supporting timely, evidence-based decision-making.

To fully harness these benefits, clear and well-aligned standards play a key role. They support consistent implementation; help maintain data quality and encourage innovation. As technology continues to evolve rapidly, policy and regulatory frameworks need to adapt to keep pace, or they might inadvertently slow progress. Differences in standards—whether overly prescriptive or too broad—can lead to inconsistent practices across fleets and regions. Greater harmonization between national authorities and RFMOs could help simplify compliance, improve interoperability, and reduce costs for vessels operating across multiple jurisdictions. Legal and administrative considerations also pose significant challenges. Questions around data ownership, confidentiality, and compliance with and varying data protection laws remain unresolved in many jurisdictions. Overlapping regulatory requirements can increase the administrative burden on vessel operators, while inconsistent reporting formats hinder the comparability and aggregation of EM data at broader scales.

Despite these hurdles, the path forward is clear. Adaptive, outcome-based standards—designed to be flexible and future-ready—can accelerate EM adoption, encourage innovation, and maximize the value of collected data. Harmonized and forward-looking

frameworks not only reduce complexity but also lay the groundwork for EM to thrive as a cornerstone of sustainable fisheries management.

Integrated Monitoring

The presentation titled "*RFMO Minimum EM Standards – Integrated Monitoring's Analysis and Recommendations*" critically examines the existing landscape of electronic monitoring (EM) standards across regional fisheries management organizations (RFMOs), identifying significant inconsistencies and systemic shortcomings that hinder effective implementation and scalability. It underscores the fragmentation of standards, which results in operational inefficiencies, limited cross-jurisdictional data interoperability, and delayed compliance actions due to the reliance on post-trip video review. Current frameworks often overlook modern advancements in wireless transmission, AI-based automation, cloud storage, and cybersecurity. Moreover, few RFMOs have adopted protocols that support real-time monitoring capabilities or standardized metadata and video formats such as ISO 22311:2012, which are essential for facilitating collaboration and ensuring traceability in the seafood supply chain.

To address these challenges, the presentation proposes a set of practical and forward-looking recommendations aimed at harmonizing EM standards and accelerating adoption of next-generation technologies. These include the inclusion of wireless video/data transmission requirements, integration of AI tools for automated species identification and compliance flagging, secure cloud-based data management systems, and clear benchmarks for system encryption and interoperability. Additionally, it emphasizes the importance of building capacity among RFMO member states (CPCs) through targeted support for backend infrastructure and integration with electronic logbook systems. The presentation calls for a global framework of minimum EM standards, rooted in interoperability, timeliness, and transparency, to strengthen enforcement, streamline data sharing, and support the broader goals of sustainable fisheries management under international cooperation.

Thalos

Without standardized requirements, particularly for data, EM providers face significant challenges. It becomes inherently difficult to study and meet each program's specific needs across different oceans and regions. This results in inefficiencies, hinders interoperability, and prevents the smooth integration of data from various sources. The transition from small-scale pilots to large EM deployments hinges on having common, stable, minimal requirements and standards. The most important component of any EM standard is robust data requirements – defining precisely what data is collected, in what format, and at what level of quality. This emphasis on data over purely technical specifications is crucial for achieving truly effective, scalable, and interoperable EM systems globally.

Zunibal

Zunibal presentation underlined that the harmonization of Electronic Monitoring standards is a key step towards achieving effective scalability across fleets and regions. They

emphasized that this process should focus on practical functionality while carefully considering the cost implications of each decision, especially as standards become more prescriptive. They also stressed the importance of flexible and scalable EM systems and standards that can adapt to different operational contexts and economic realities.

Furthermore, they highlighted the crucial role that standards play in the promotion of innovation. In their view, clear and consistent definitions of visualization goals and data quality are essential for the development of technologies such as artificial intelligence, edge computing, and connectivity solutions. Finally, they acknowledged the challenges these innovations may bring—such as the integration of AI—which still need to be addressed.

Flywire

As an organization in the effort to meaningfully incorporate digital data into fisheries management systems at scale, FlyWire values the Minimum EM Standards products developed by the participating RFMOs. It is encouraging that different RFMO Standards are already loosely compatible – and this harmonization process is an opportunity to create a streamlined common standard that any EM provider and fleet, in any RFMO jurisdiction, can operate under successfully.

Given the fastest way to kill innovation is to regulate it out of existence by accident, to succeed in proper harmonization FlyWire recommends resolving the identified areas of disagreement among regional Standards by: (1) redoubling focus on “what” a proposed EM program needs to accomplish, (2) discarding bespoke stipulations controlling “how” individual tasks are to be adjudicated and (3) seeking input from stakeholders who fish.

Datafish

Electronic Monitoring (EM) has been used in Spain since 2014 to collect scientific data through both onboard and on-land observers. Various providers of electronic technologies have installed their EM systems on more than 150 vessels in Spain over the years. The work and developments carried out by these different providers must be considered when aiming for standardization and interoperability—both within Spain and globally across all EM system providers.

Furthermore, to review EM records effectively, personnel need to have a scientific background. This requirement should be aligned with RFMO standards and, in the case of Spain, it should be consistent with ISO 195007.

For every vessel, EM providers must supply a Vessel Monitoring Plan detailing the system specifications and configurations. Some providers are advancing tools that enable real-time data transmission and recording via satellite connection, eliminating the need for hard drives; which will facilitate data transmission and chain of custody.

3.2.1 EM Provider perspectives

Across the EM Provider presentations, and subsequent discussions, a range of issues were raised by EM providers and these are summarized below.

Policy & Governance

- Concern at the absence of universally accepted EM standards and policy guidance across t-RFMOs.
- Concern at the added complexity in navigating national, sub-regional, and t-RFMO standards.
- Absence of provisions for small-scale fisheries and developing nations in EM policies.
- Strong need for globally recognized EM certification programs (i.e., once approved in one t-RFMO then approved for all).
- T-RFMOs should recognize the benefits of harmonized standards for improving compliance and reducing costs.
- Recommended greater cooperation between technology providers and regulatory authorities.
- Recommended the establishment of a multi-stakeholder working group to define core EM standards.
- Recognition of the benefits of financial and technical support to accelerate the transition to harmonized EM systems.

Data Management & Technology

- The lack of interoperability between EM systems continues to be a big impediment to EM programs that cross multiple jurisdictions.
- Lack of harmonized data minimum requirements across EM programs that will facilitate interoperability and EM implementation.
- Clear guidelines needed on data security, ownership, and accessibility.
- Reduce differences in data collection, transmission, and storage requirements across t-RFMOs as these are best harmonized.
- Lack of standardized EM record (i.e., EM footage) review methodologies.
- Recognize the technical limitations in integrating EM solutions with existing vessel monitoring systems.
- Need to develop modular and flexible EM systems adaptable to different regulatory requirements.

Innovation & Implementation

- If EM standards are too prescriptive, they may delay technological innovation so focus on what you want the system to do – not how it must be done.
- Recommend the inclusion of artificial intelligence and machine learning advancements into EM standards
- Recognize that varying environmental conditions, fleet composition and operational practices affect EM system performance.

- Recommend the creation of a central repository for best practices and lessons learned in EM implementation.

4. Tuna RFMO EM Standard Comparison

The focus of the meeting was then the detailed comparison of EM standards across the t-RFMOs. The comparison was guided by a detailed analysis conducted by CEA Consulting, with support from The Nature Conservancy (TNC), in collaboration with the International Seafood Sustainability Foundation (ISSF). This analysis document is attached as **Appendix 5**.

The EM standards comparison was structured by component of the EM standards. For each section, Jenny Moffett (CEA Consulting) gave a brief high-level summary overview of the elements covered in the comparison and high-priority areas for alignment or discussion (**Appendix 6**). Then, the workshop was split into three discussion groups and each group presented their findings to the plenary. Each small group reviewed each of the EM standards component for corrections, reflections, and recommendations based on the comparison analysis. The outcomes of these discussions are summarized below.

4.1. High-level observations

When considering each t-RFMOs set of EM standards the meeting noted that:

- That IATTC and ICCAT's general requirements are most similar. In many cases, elements of the standards are nearly or entirely identical.
- WCPFC's standards are the most distinct in format from the other three (e.g., WCPFC standards are not formatted narratively). WCPFC includes entire categories of requirements the others omitted and omits many other requirements all the other t-RFMOs include.
- There is less variance across the IOTC, ICCAT, and IATTC standards.
- All t-RFMOs have proposed EM voluntary standards, with WCPFC limiting EM to longline (LL) vessels, ICCAT/IATTC to longliners and purse seiners (PS), and IOTC includes gillnet (GN) in addition to LL/PS.
- All t-RFMOs, except IATTC, currently allow the use of EM to collect data under their Regional Observer Schemes or Programs (ROS/P). IATTC, however, does not yet permit the use of EM to meet ROS data collection requirements.
- The approach to integrating EM alongside human observers also varies across t-RFMOs. For example, the IOTC allows EM to serve as an alternative or full replacement for human observers, while ICCAT maintains that a minimum level of human observer coverage, specifically 5%, is necessary for tasks such as biological sampling.
- In the case of IOTC, EM data could be used to collect the data required under their Regional Observer Scheme, provided that all EM data mandatory requirements are collected through EM or in conjunction with supplementary monitoring tools (such as port sampling, etc.).

- All t-RFMOs EM programs are proposed to operate at a national or sub-regional level rather than a centralized RFMO-level.
- In the IOTC and IATTC, the scope of the EM programs only includes science, while in the others, both scientific and compliance information can be collected.

Following the plenary discussions, including the discussions of the small working groups, the **group recommended that:**

- t-RFMO be encouraged to clearly state the objectives of their EM programs, e.g., whether EM is intended for scientific research, compliance, or both;
- t-RFMOs consider, as appropriate, the potential for EM programs to be used to evaluate compliance with Commission requirements;
- t-RFMOs recognize the potential to use a range of monitoring tools (e.g., port and at-sea inspections, market sampling), alongside EM and at-sea observers, to achieve their data and verification requirements, and consider providing flexibility to those responsible of EM programs (e.g., flag states or RFMOs under a regional program) to decide a preferred approach for certain data fields; and
- t-RFMOs recognize that for EM, that the additional cost for each field is likely to be greater than it is for at-sea observers (where the primary cost is having the observer on the vessel).

4.2. EM Definitions

The establishment of standardized definitions for EM across t-RFMOs is crucial to ensuring consistency, interoperability, and common understanding for EM monitoring fisheries activities.

During discussions, it was noted that all t-RFMO EM standards include a section of EM definitions, except ICCAT EM standards. Overall, there was alignment among the definitions of the different t-RFMOs. Therefore, **the group recommended that ICCAT also consider developing EM definitions aligned with those used in other t-RFMOs to avoid confusion**.

The group also agreed the need of standardized definitions to streamline EM implementation and data usage among t-RFMOs. The agreed-upon definitions provide a foundation for future collaboration and improvement in EM implementation. Further efforts should focus on refining these definitions and ensuring their adoption across all relevant organizations.

The group recommended that the following terms/definitions be harmonized across t-RFMOs:

- **EM Records**: to refer to the electronic data (footage and other information such as ancillary data and metadata) captured during a fishing trip[1].

[1] This recommendation specifically relates to ICCAT

- **EM Data**: The processed information derived from EM records after analysis
- **Fishing Trip**: A defined period during which a vessel engages in fishing activities, requiring consistent delineation across RFMOs (see WCPFC for an example).
- **EM Review Center**: A designated facility responsible for reviewing and analyzing EM records.

A significant discussion centered on the need to standardize the format and conventions of EM records. There was a strong push for interoperability between EM providers to ensure seamless integration and data sharing across t-RFMOs (see below section on data) as well as the possibility to review EM records with different EM data review software.

One of the most debated topics was the definition of "EM coverage," as different t-RFMOs currently interpret this term in varying ways. **To create consistency, the group recommended the following definitions be harmonized across t-RFMOs (for application to a fleet or fishery of interest)**:

- **Installation Coverage**: The percentage of vessels equipped with EM systems.
- **EM Record Coverage**: The percentage of total fishing effort (trips/events) for which EM records are available.
- **Analysis Rate**: The percentage of EM records that have been analyzed to produce EM data.
- **EM Coverage**: A composite metric calculated as EM Record Coverage multiplied by Analysis Rate.

The group also recommended t-RFMOs ensure clear and consistent terminology between terms used in EM standards and those included in relevant resolutions/management measures/decisions.

The group also suggested minor changes to be considered by different t-RFMOs when reviewing their definitions in the future. For example:

- Include the definition of "fishing trip",
- Delete the word "System" from EM as it is creating some confusion
- EM process instead of EM Systems,
- EM Program instead of EM System Program,
- Although all included a type of definition for the "EM Review Center", the term used is different among tuna RFMO. The term should be standardized, for example, using the IOTC term "*Electronic Monitoring Review Center*"
- IATTC to add a definition for Vessel Monitoring Plan
- WCPFC has additional definitions and suggest if these terms are used by other t-RFMOs in their resolutions/recommendations they should also be defined.

4.3. EM Minimum Data Requirements

During the workshop, participants engaged in extensive discussions regarding EM minimum data requirements. While there were differences in perspectives, a consensus emerged on key approaches to refining data collection through EM.
The workshop underscored the importance of viewing EM as one of several data collection methods, rather than as a standalone solution. **The group reiterated its recommendation that EM be used in conjunction with port sampling, port-interviews, and other methods, to collect the mandatory ROS data fields following the model established by the IOTC.**

Although EM cannot capture all observer data fields on its own, providing the ROS required data fields helps providers understand the full range of data each RFMO needs and develop more cost-effective advanced technological solutions, such as edge computing and geofencing, to improve EM capabilities. This helps providers and CPCs design more effective monitoring programs using a mix of tools like EM, dockside sampling, and logbooks.

The group recognized that when considering data fields currently collected by at-sea observers (often the starting point for EM discussions) there are many factors to consider, e.g.:

- Some fields can be easily collected using EM (e.g., number of fishing operations or longline retained catches);
- Some fields can still be collected using EM, but at the cost of specific ad hoc cameras and/or human review time (e.g., bait types);
- Some could more easily be collected through modifications to fishing practices (e.g., handling practices);
- Many fields could become easier to collect over time with improvements in AI or other camera-related technologies (e.g., length measurements);
- Some fields could be collected using other means (e.g., fish size data through unloads or market sampling, or bait types through interviews or port inspections)
- Some fields that might not be required to be collected all the time, e.g., sub-sampling; and
- Some data fields which might not be feasible to collect through EM or other existing tools, such as line-weighting requirements for seabird mitigation in longline fisheries. For these fields a needs assessment would be required to determine the data collection approach.

The group recommended that t-RFMOs consider using a framework that contemplates factors such as those listed above, when determining data requirements to ensure that EM programs are cost effective.

Participants agreed that the work already done by Regional Fisheries Management Organizations (RFMOs) through EM pilot tests to assess what could be collected via EM is very informative. EM service providers could review these assessments, validate data collection feasibility, and provide cost-efficiency analyses to enhance EM data collection. Providers emphasized that RFMOs should not pre-emptively decide what EM can or cannot

collect without allowing for EM providers innovation and feedback. The group identified the following key tasks in relation to potential EM data fields that RFMOs or the Tuna II project could address:

- Collating existing t-RFMO assessments of data fields based on feasibility of collection through EM.
- Engaging EM providers to validate these assessments through pilot projects and direct feedback.
- Presenting these findings to the relevant subsidiary bodies of each t-RFMO for further deliberation on suitability as an EM data field or whether supplementary data collection methods were needed.

In conclusion, the group recognized that a flexible, collaborative approach to EM data requirements—one that allows for technological advancement, stakeholder input, and integration with existing t-RFMO data collection frameworks was likely to achieve the best outcomes.

4.4. EM Technical Requirements

During the workshop, participants discussed the need to refine and streamline the technical requirements for EM systems. There was broad agreement on the opportunities to simplify, align, and establish performance-based standards while promoting innovation in the field.

The discussion emphasized the importance of shifting from rigid specifications to performance-based standards. EM providers highlighted the need to balance innovation and efficiency, ensuring that requirements for aspects such as frame rate and resolution focus on what is necessary for species identification rather than prescribing fixed settings. Accuracy benchmarks should be oriented towards performance outcomes rather than rigid technical specifications. EM technical requirements based on performance standards will foster innovation while very prescriptive requirements will limit it.

There was significant concern that existing storage, backup, and transmission protocols are overly restrictive and misaligned with modern technological capabilities. Many current requirements were designed around hard drive storage rather than modern wireless transmission and cloud-based solutions. The group suggested a more flexible approach that ensures data is securely stored and backed up without dictating specific methods. The group agreed that the most important issue is to ensure traceability of the EM records (hard drive, data). Most EM technical standards do not specify how the data should be stored or backed up, but the group considered that it is important for EM standards to include it.

Regarding EM records security and traceability, the group underlined that digital signatures and end-to-end encryption to ensure EM record security, traceability and chain of custody should be included in the EM technical minimum requirements, which are crucial to protect sensitive EM records and maintain confidence in EM systems.

Workshop participants agreed that camera requirements should not be tied to specific settings but should align with what is required to observe/collect (i.e., data standards or

requirements) and data quality thresholds (i.e., images should be of enough quality to allow species identification and produce required EM data). This would allow EM providers to set frame rates based on performance needs.

The ability for the vessel operator to view camera feeds in real time was identified as a key requirement. However, it was noted that this does not necessarily mean a dedicated “EM Control box” display must be included; alternative solutions such as phone apps or tablets could fulfil this need. Therefore, the **group recommended that RFMOs considers changing the term "control box" by “control center and an interface” to avoid prescribing specific hardware solutions and allow other alternatives**. The requirement should focus on ensuring the presence of a control center and interface rather than mandating a particular type of physical control box.

The discussion also emphasized minimizing manual interaction by fishers with the EM system, ensuring a streamlined process where the system operates independently, with service provider assistance available when needed. One possible exception would be allowing fishers to replace hard drives when necessary or clean the cameras.

The workshop emphasized that key components of an EM system, such as location tracking and communication equipment, must be fully integrated into the overall EM solution. These elements should not be treated as standalone devices outside the control of the EM provider. It was also considered essential to have the ability to remotely and in real-time monitor the equipment’s health status and to ensure there is no interference with other onboard equipment. Additionally, it was suggested that illumination standards be included in Vessel Monitoring Plans (VMPs) to support better documentation and implementation.

To enhance efficiency and consistency in EM, providers emphasized that compatibility and interoperability of EM systems depend on the establishment of standard formats. This ensures that EM records can be reviewed across different providers, enhancing efficiency and consistency in monitoring efforts.

In conclusion, the workshop discussions underscored the need to modernize and simplify technical requirements for EM systems. By adopting performance-based standards, reducing prescriptive hardware mandates, and ensuring seamless integration of key components, the industry can foster innovation while maintaining high standards of data quality and system reliability.

Based on these discussions, the **group recommended that t-RFMOs consider:**

- Setting performance standards for cameras, rather than specifying technical inputs. For example, focusing on the ability to collect specific data fields instead of requiring a certain number of cameras with specific frame rates and resolutions at designated locations;
- Requiring that location tracking and communication equipment be fully integrated into the EM solution, to ensure system compatibility and allow the EM provider to manage all necessary components for a robust EM solution;

- Encouraging EM providers to continue developing interoperability features that would allow video footage to be viewed across different review platforms; and
- Establishing data storage and transmission requirements that allow for flexibility; for instance, avoiding implicit mandates for hard drive use when other transmission methods may be more cost-effective depending on the context.

In addition to the above, there were specific suggestions on how to improve some of the individual t-RFMO standards, for example:

- IOTC/WCPFC adopting IATTC/ICCAT language for "Uninterruptable Power Supply" and "Controlled shutdown",
- IOTC/WCPFC making mandatory the need of "Near-real-time Automatic System Malfunction/Tampering Alerts",
- Require "Remote Verification of System Health",
- All t-RFMOs work to develop harmonized EM Record format standards to ensure EM Records Interoperable between Reviewers

4.5. EM Layout, and Vessel Monitoring Plans (VMPs)

The discussion highlighted the multifaceted role of VMPs and the necessity of defining their purpose to guide the EM structure and implementation. The purpose of the VMPs should be clear, as the VMP will guide the EM implementation. **The group agreed that the purpose of the VMP should be to describe the EM system specifications that will allow the system to comply with and allow the collection of the mandatory EM data fields.**

The group recognized significant value in developing a universal VMP that would allow vessels operating under multiple t-RFMOs to use a single document that meets all relevant requirements. This universal VMP should be designed to fulfill the following key functions:

- **Agreement Framework**: Establishing obligations of EM system (including cameras) installation and handling practices among the vessel, the RFMO/Coastal State/Port Control (CPC), and the EM provider as well as access to or publication of the VMP.
- **Operational Guide**: Providing a duty of care list for crew members/vessels detailing onboard EM requirements and what to do in case of malfunctioning.
- **Compliance and Enforcement Tool**: Potentially might serve as a reference for high-seas inspections.

Some t-RFMO allow fleet level VMPs, but the group considered that VMP should be developed for each vessel as, otherwise, it would be difficult to ensure correct implementation of EM at vessel level. **The group recommended that VMPs are developed for each specific vessel and that this requirement be considered by each t-RFMO in the next revision of their EM standard.**

<u>Harmonization and Universal Template</u>

The group identified the need for a standardized VMP template incorporating all mandatory requirements. The following **recommendations** were made to achieve harmonizations and a universal template with harmonized content:

- Adoption of a single VMP format/template across t-RFMOs to prevent vessels operating in different regions from managing multiple versions. This VMP template should be incorporated in the EM standard document;
- Inclusion of mandatory required VMP elements as stipulated by IOTC as an example of current best practice;
- Integration of best practices from existing VMPs under ICCAT and IATTC, with IOTC and WCPFC incorporating similar structures;
- Consideration of harmonization of those key operational procedures, including catch handling/fishing operations[2] and all other crew responsibilities and requirements, and vessel survey requirements, which enable more efficient and effective application of EM; and
- A framework should be developed to define what types of changes necessitate VMP updates, and the required timelines for such updates (e.g., before the next trip or some other period).
- The group agreed that vessels in collaboration with EM Providers are best placed to develop the VMP.
- IOTC should consider making VMP elements mandatory, currently the elements included IOTC VMP are not mandatory but recommended to be included.
- Until vessel-fleet VMPs are agreed, clear guidelines should be established for fleet-level VMPs (i.e., IATTC), ensuring consistent camera placement and tracking of installed views.
- Vessel measurement calibration should remain optional.

The discussion emphasized the necessity of assurance and verification processes for VMP compliance, and more broadly for EM standards. The group proposed the development of an audit protocol for this purpose, and suggested that the meeting planned for early 2026 to discuss EM implementation could be used for this purpose.

By implementing these recommendations, the harmonization of VMPs will facilitate streamlined compliance, improved monitoring efficiency, and enhanced trust in Electronic Monitoring Systems across global fisheries. By ensuring interoperability, security, and harmonization, VMPs will become more effective tools in monitoring and managing fisheries operations worldwide.

4.6. EM Data Management and Review

EM data management and review processes are influenced by varying timeframes across different fishing operations and the type of review undertaken. For example, it was noted that in some cases a maximum of 100 days after a trip is completed by longliners (LL) is required to analyse the data, though retrieving hard drives from LL presents challenges.

[2] Alternatively these could be included as t-RFMO specific appendices if these required practices vary across t-RFMOs.

This can be expedited if EM records are submitted electronically via cloud-based systems or by utilizing transshipment events as was demonstrated in an IATTC trial. Purse seine (PS) trip data is typically available earlier than LL data, though hard drive recovery and analysis from extended PS trips may take 3-4 months after the trip.
It was also noted that longline operations reviews involve 1 day in the office for every 4-7 fishing days, with a typical review encompassing approximately 200 fish per five fishing events. If analysis rates are set at 20%, this process can be shortened.

The group recommended EM providers/data reviewers to assess timeframes for retrieving, reviewing, and submitting EM data to the relevant RFMOs based on fleet operations and strategies; which could then be used to establish data revision and submission timelines by RFMOs. The EM providers/data reviewers can provide this data during the next planning workshop.

Data Storage and Retention

Aligning data storage and retention requirements is necessary, but it was noted that decisions on audit and assurance frameworks (e.g., which EM records must be retained and available for review and for how long) are likely to drive policy decisions. Ownership of EM records and data should also be clarified to ensure accountability and adherence to t-RFMO regulations (currently only IOTC EM standard includes the notion of ownership).

Review Software and Data Output Format

There was consensus that review software requirements should not be overly prescriptive to allow flexibility, particularly for CPCs piloting EM programs in smaller fisheries. However, defining minimum requirements was considered valuable to help stakeholders and CPCs understand essential functionalities versus additional features and associated costs. Certification of systems and reviewers may provide further clarity. It was noted that ideally the generated EM records collected by different EM providers should be interoperable with multiple review providers. As such, EM records can be reviewed by different EM analysis software.

To enhance consistency, submission frequency, review timelines, and reporting deadlines should be aligned with data retention policies. **It was recommended that t-RFMOs consider establishing clear requirements and standardized EM data forms for submitting EM data. CPCs should adhere to these adopted formats when submitting their EM data.**

Chain of Custody and Observer Qualifications

A clear definition of the chain of custody is needed, specifying key components such as ownership and accountability, which may vary based on CPC determinations. Ensuring buy-in from CPCs will reinforce adherence to chain of custody protocols. This should be included in current/future EM standards. Furthermore, harmonizing EM review analyst

qualifications across CPCs and t-RFMOs is critical to maintaining review consistency and data integrity.

The group provided the following recommendations in relation to Data Management and Review:

- Conduct a survey of EM providers and data review centers to determine timeframes for data retrieval, review, and submission across different fleet operations.
- Encourage quick retrieval of hard drives, particularly for long LL trips, potentially leveraging transhipment events.
- Establish clear guidelines for data security, including encryption and digital signatures, while balancing t-RFMO and CPC-specific requirements.
- Develop interim data retention policies until audit and assurance mechanisms are established; once these are in place, finalize the data retention policies;
- Align reporting and submission timelines with data retention policies to streamline workflows.
- Maintain flexibility in review software requirements to accommodate smaller fisheries and emerging EM initiatives.
- Develop t-RFMO best practices and guidelines to assist CPCs in implementing EM programs.

By implementing these recommendations, EM data management and review processes can be optimized, ensuring timely and secure submission of high-quality data to support fisheries management and compliance efforts.

4.7. Roles and Responsibilities in EM Programs

All t-RFMOs EM Programs operate at a national level rather than through a centralized regional approach, which affects the roles and responsabilities of t-RFMOs, CPCs, and other stakeholders. Therefore, at RFMO EM program level, CPCs hold responsibilities related to program design, management, and reporting. Among the t-RFMOs, WCPFC has the fewest individual responsibilities assigned to CPCs. There are opportunities for harmonization in approval processes and program management responsibilities, which are currently misaligned.

Common requirements across all t-RFMOs for CPCs include: (i) Annual reporting, (ii) Establishing procedures for system failure, (iii) Ensuring EMS implementation complies with t-RFMO standards.

RFMOs are responsible for program management, program review, and supporting CPC EM programs. However, WCPFC does not specifically define t-RFMO-level responsibilities, while IOTC has the most program management responsibilities, all of which are mandatory. ICCAT has similar responsibilities, though not all are required. In general, the definition of t-RFMO roles in program management could benefit from greater alignment.

The requirements for enabling data collection vary across t-RFMOs. ICCAT and IATTC have the most direct and similar crew duty of care requirements, whereas IOTC mandates that CPCs ensure crew duty of care, and WCPFC includes duty of care requirements in Vessel Monitoring Plans (VMPs). The discussion highlighted that most onboard responsibilities should be incorporated into VMPs rather than as standalone elements.

Additionally, it is recommended that VMPs include explicit provisions ensuring that camera views remain unobstructed. The EMS installation should either be part of VMPs or mandated as a requirement for IOTC. The duty of care for cameras must also be defined, either as a standalone requirement or within VMPs. Furthermore, it is recommended to include a requirement in the VMP stating that a designated person is responsible for ensuring the system is not tampered with. Specifically, the vessel Master shall ensure that, unless authorized and instructed by the flag CPC, the EMS remains intact and operational at all times (e.g., cameras must not be disconnected, repositioned, manually switched off, or intentionally damaged).

Currently, only WCPFC explicitly mentions EM service provider responsibilities related to installation and technical support. While IOTC does not explicitly include EM service providers, VMP development requires engagement with EM providers. A recommendation is made that CPCs should submit their Electronic Monitoring Program (EMP) to the t-RFMO, even though IOTC currently only requires submission of a VMP for each vessel.

The workshop noted the following key points regarding EM roles and responsibilities:

- Program review, annual reporting, and collaboration responsibilities are well aligned across t-RFMOs, except WCPFC.
- Only IOTC currently mandates an audit of CPC programs.
- ICCAT, IATTC, and IOTC require t-RFMOs to suggest improvements to CPC programs.
- RFMOs should collaborate with CPCs to implement national EM programs, as required in IOTC/ICCAT and recommended in IATTC. However, no established process exists for this collaboration. A recommendation is made that t-RFMOs develop a structured process to facilitate CPC EM program implementation.
- The group recommended establishing a framework for cross-RFMO certification where one t-RFMO-approved EM systems can gain recognition across multiple t-RFMOs and organizations.

The workshop underscored the need for better alignment across t-RFMOs in defining roles and responsibilities related to Electronic Monitoring. Incorporating responsibilities into VMPs, clarifying the roles of EM service providers, ensuring CPC accountability, and establishing a structured t-RFMO collaboration process are key recommendations moving forward. The proposed audit and assurance process should be a primary focus, with early drafting efforts facilitating smoother integration across t-RFMOs.

It was suggested that drafting the audit and assurance process in advance could minimize the need for harmonization later and provide a framework that t-RFMOs can refine rather

than create from scratch. The group considered that it could take about 18-months to develop of an audit and assurance process suitable for t-RFMOs.

4.8 Summary of the EM Standard Comparison

The key findings from EM standard comparison are summarized below:

- **Objectives**: WCPFC/ICCAT EM standard objectives encompass both science and compliance, while IOTC and IATTC only science. CCSBT High Level EM Guiding Principles could also be used for both, science and compliance. Tuna RFMO objectives should be explicitly stated in its EM standards (i.e., science, compliance, or both).
- **Common definitions and terminology harmonization**: There are benefits to be made in further standardizing definitions, especially around the concept of 'EM coverage'. ICCAT should include EM definitions in its EM standard recommendation. ICCAT should align its terminology (e.g., "EM records" instead of "data"). Priority should be given to defining "EM Coverage" consistently using, as example, IOTC approach.
- **Compulsory EM Requirement**: No t-RFMO currently mandates EM usage across the board.
- **EM standards**: EM standards should be performance-based to encourage innovation by focusing on the outcome rather than prescribing rigid elements, characteristics, and implementation methods. Avoid legacy technologies that hinder scalability and cost-effectiveness. Consider cross-RFMO certification for EM systems.
- **Application to Regional Observer Scheme (ROS)**: All t-RFMOs except IATTC allows using EM to comply with ROS requirements, with IATTC preferring their current human observation to achieve observer data requirements. In those that allow EM however, the role of observers in relation to EM differs across t-RFMOs. For instance, in the IOTC, EM can serve as an alternative or a full replacement, whereas ICCAT emphasizes the necessity of maintaining a minimum level of human observer coverage
- **Development of a Universal Vessel Monitoring Plan (VMP) Template**: Recognizing that many vessels fish under the jurisdiction of multiple t-RFMOs, it is critical that a standardized VMP template that incorporates all mandatory requirements is developed;
- **Alternative Data Collection Methods**: IOTC allows the use of alternative data collection methods to achieve the data requirement under the ROSs, while other don't. It is recommended that alternative data collection methos are used in conjunction with EM to collect the required minimum data fields.
- **Standardization Across t-RFMOs**: Most t-RFMOs have proposed voluntary standards. WCPFC limits EM to longline (LL) vessels. IOTC includes guidelines for gillnet (GN).
- **Data Confidentiality and Ownership**: CPC-led programs can manage confidentiality, whereas regional-level approaches face greater complexity.

- **Audit and Assurance Process**: Implement systematic auditing to verify data accuracy and consistency across different EM programs is necessary. The group recognized the need for an audit and assurance framework tailored to EM programs used to meet obligations within t-RFMOs. A potential next step could see the development of a draft audit and assurance process based on existing t-RFMO audit models, e.g., the audit an assurance process used within the WCPFC Regional Observer Program (ROP); and
- **Interoperability**: EM providers are encouraged to continue work around common standards for EM systems to support the exchange of EM records between different EM systems.

5. Summary of Main Recommendations

The Electronic Monitoring (EM) workshop was productive, fostering a collaborative and focused discussion. The contributions of EM providers were particularly valuable, enhancing momentum and confidence in the process of aligning and simplifying EM standards.

Technological Requirements: The group recognized that existing technological requirements might become overly restrictive over time. Many standard elements were also found to be overly wordy and unclear. A consensus emerged on the need to move away from a narrative-style format towards a structured approach, such as the one used in the comparison document, with streamlined sections and bullet points.

Clarity in Language and Requirements: Extensive discussion took place regarding the appropriate use of terms like "shall," "must," "should," and "could." It was noted that requirements were often misaligned within the documents, leading to confusion and potential risks for EM providers and RFMOs. The group agreed that future standards should distinctly separate mandatory requirements from guidelines as done in IATTC standards.

Audit and Assurance Protocols: The risk of lacking harmonization in audit and assurance protocols was recognized as a critical issue. The group acknowledged the need to proactively develop such protocols to stay ahead of t-RFMO requirements.

Emerging Technologies: The need to adapt standards to accommodate AI, cloud-based, and wireless technology was a recurring theme. EM providers stressed the urgency of integrating these advancements into the EM standard framework.

Voluntary vs. Mandatory Requirements: Concerns were raised about the inclusion of mandatory elements in an EM program intended to be voluntary. For example, requiring vessels to remain in port if EM is malfunctioning contradicts the voluntary nature of the program, unless the vessels intend, and are permitted, to use EM to meet the data reporting requirements.

Several key recommendations were identified and agreed during the workshop:

- **Outcome-Oriented Approach:** EM standards and/or regulations should focus on desired outcomes (e.g., performance-based) rather than specific technological specifications to encourage innovation.
- **Scalability Consideration:** EM programs should avoid legacy systems that limit expansion and cost-efficiency.
- **Enhanced Security Measures:** Encryption and digital signatures, and real-time system health checks should be mandatory components to safeguard EM records.
- **Clarification of Objectives:** t-RFMOs should explicitly state whether EM is intended for scientific research, compliance, or both; and consider, as appropriate, the potential for EM programs to be used to evaluate compliance;
- **Use of Multiple Data Sources to achieve ROS requirements:** t-RFMOs should recognize the potential to use a range of monitoring tools (e.g., port and at-sea inspections, market sampling), alongside EM and at-sea observers, to achieve their data and verification requirements, and consider providing flexibility to those responsible of EM programs (e.g., flag states or RFMOs under a regional program) to decide a preferred approach for certain data fields;
- **Harmonized Definitions:** t-RFMOs should include, align, and harmonize EM terminology and definitions to ensure consistency across regions. T-RFMOs should also ensure that the terminology used in EM standards is consistent with that used in relevant EM Resolutions and Management Measures.
- **Roles and responsabilities**: incorporate roles and responsabilities into EM standards and VMPs, clarifying the roles of EM service providers, ensuring CPC accountability, and establishing a structured t-RFMO collaboration process
- **Data Confidentiality, Ownership and Sharing:** If an EM program transitions to a regional level, a structured approach for data confidentiality, ownership, sharing and security must be established.

<u>Harmonization of Key Minimum Requirements</u>

- The purpose of the Vessel Monitoring Plan (VMP) should be to describe the EM system specifications that will allow the system to comply with and allow the collection of the mandatory EM data fields.
- Develop a universal VMP that would allow vessels operating under multiple t-RFMOs to use a single document that meets all relevant requirements, including a set of core minimum requirements, such as those included in the IOTC Vessel Monitoring Plan (VMP), while placing lower-priority issues in an appendix as best practices (e.g., dedicated software) as well as timelines for revisions and updates.
- Develop VMPs for each specific vessel and that this requirement be considered by each t-RFMO in the next revision of their EM standard.
- Differentiate VMPs minimum requirements based on program objectives (science vs. compliance), as audit and EM records storage requirements will differ accordingly.
- Ensure the ability of EM systems to remotely and in real-time monitor the equipment's health status and to ensure there is no interference with other onboard equipment.

- Request EM providers to continue developing interoperability features that would allow EM records (i.e., video footage) to be reviewed across different EM review platforms; and
- Establish data storage and transmission requirements that ensures traceability of EM records but allows for flexibility; for instance, avoiding implicit mandates for hard drive use when other transmission methods may be more cost-effective depending on the context.

EM Data Management and Review

- Request EM providers to assess timeframes for retrieving, reviewing, and submitting EM data to the relevant flag states and/o RFMOs based on fleet operations and strategies; which could then be used to establish data revision and submission timelines by RFMOs.
- T-RFMOs to establish clear requirements and standardized EM data forms for submitting EM data. CPCs should adhere to these adopted formats when submitting their EM data.

Audit and Assurance Process Development

- Initiate the development of a unified audit and assurance process for EM implementation among Tuna RFMOs.
- Ownership of EM records and data should be clarified to ensure accountability and adherence to t-RFMO regulations.
- Conduct a survey among t-RFMOs to assess existing audit processes in other areas and use this as a basis for harmonization.
- Establish a framework for cross-RFMO certification where one t-RFMO-approved EM systems can gain recognition across multiple t-RFMOs and organizations.
- Organize a dedicated workshop in approximately 18 months focusing on EM implementation and audit protocols. The agenda should include reviewing audit processes, discussing harmonization strategies, and recommending a standardized audit protocol for Tuna RFMOs.

Enhancing Standards Format and Language

- Transition to a more structured format for EM standards, replacing narrative descriptions with bullet points and clearly defined sections.
- Ensure clear distinction between mandatory requirements and guidelines to avoid confusion and misinterpretation.
- Reevaluate the use of "shall/must/should/could" terminology to align with intended regulatory and operational objectives.

Integration of Emerging Technologies

- Update EM standards to reflect advancements in AI, cloud-based, and wireless technologies.

- Engage with EM providers and technology experts to ensure standards remain adaptive to technological progress.

This comparative analysis underscores the need for harmonization, scalability, and secure data management in EM programs while balancing scientific and compliance requirements. By implementing these recommendations, stakeholders can ensure that EM standards remain clear, flexible, and aligned with evolving technological and regulatory needs.

6. Next Steps

The ABNJ 2, Common Oceans Project provided the long overdue opportunity for EM leads from across the five t-RFMOs to meet with EM providers to talk about EM standards and the steps necessary to ensure the successful roll-out of EM across the world's tuna fisheries.

Participants found the meeting extremely valuable, especially due to the groundwork undertaken by TNC and the ISSF in undertaking a comparative analysis of EM standards across the t-RFMOs.

Recommendations were made for the consideration of t-RFMOs, and these are provided in section 5.

To maximize the dissemination of workshop outcomes, the steering committee will seek opportunities to present the outcomes through the appropriate forum for each of the t-RFMOs.

The Common Ocean Project has funding for a second workshop which is planned early 2026. The focus of this workshop will be to review progress on EM implementation, assess advancements in EM implementation, refine strategies moving forward, and address the recommendations by this working group.

7. Appendices

7.1. Appendix 1 - Agenda

DAY ONE – 10 December 2024

0900 – 0915	**OPENING and WORKSHOP INTRODUCTIONS** • Official Welcome • Chair's Introduction • Introductions	Dr. Hilario Murua (ISSF) Dr. Shelton Harley (Chair)
0930 – 1015	**CONTEXT SETTING – Tuna RFMO standards** • CCSBT EM progress and EM Standards • IATTC EM progress and adopted EM Standards • ICCAT EM progress and adopted EM Standards • IOTC EM progress and adopted EM Standards • WCPFC EM progress and in discussion EM Standards	Frank Meere Marlon Román Rui Coelho Hilario Murua Shelton Harley
1015-1100	**CONTEXT SETTING – the view of providers and data analyst** • Satlink/DOS • Integrated Monitoring • Thalos • Zunibal • Flywire • Datafish	
1100 – 1130	BREAK	
1130 – 1200	**EM STANDARDS COMPARISON (General)** • Similarities and differences among adopted/in progress EM Standards.	CEA Consulting
1200 – 1300	**EM PROGRAM standards comparison:** • Introduction of the comparison • Group exercise: compare EM Program Standards • Report to the plenary	CEA Consulting Group exercise Plenary
1300 – 1430	LUNCH	
1430 – 1545	**EM PROGRAM standards comparison: DEFINITIONS** • Introduction of the comparison • Group exercise: compare EM Standards definitions • Report to the plenary	CEA Consulting Group exercise Plenary
1545 – 1615	BREAK	

1615 – 1645	**EM standards comparison: LOGISTIC/TECHNICAL STANDARDS**
	• Introduction of the comparison
	• Group exercise: participants compare the EM logistic/technical standards
	  ○ Onboard systems,
	  ○ EM installation/operation/maintenance minimum
		CEA Consulting
		Group exercise

	requirements, ○ Vessel Monitoring Plans, ○ Data storage • Report to the plenary	Plenary
1645 – 1700	WRAP UP DAY 1 - CLOSE	Shelton Harley

DAY TWO – 11 December 2024

0900 - 0915	OPENING - Day 1 reflections	Shelton Harley
0915 - 1100	**EM standards comparison: LOGISTIC/TECHNICAL STANDARDS (continued)** • Group exercise: participants compare the EM logistic/technical standards ○ Onboard systems, ○ EM installation/operation/maintenance minimum requirements, ○ Vessel Monitoring Plans, ○ Data storage, • Report to the plenary	Group exercise Plenary
1100 - 1130	BREAK	
1130 - 1300	**EM standards comparison: MINIMUM DATA REQUIREMENTS** • Introduction of the comparison • Group exercise: participants compare the EM data requirements standards ○ Are the requirements similar/different?, ○ Is EM able to collect all data requirements? ○ What are the alternatives?, ○ How to ensure collection of all data requirements? • Report to the plenary	CEA Consulting Group exercise Plenary
1300 - 1430	LUNCH	
1330 - 1500	**EM standards comparison: EM RECORD ANALYSIS STANDARDS** • Introduction of the comparison • Group exercise: participants compare the EM records analysis ○ Data transfers, ○ Data management, ○ Training quality, ○ Data review & review centers, ○ Software for data review, ○ AI • Report to the plenary	CEA Consulting Group exercise Plenary
1545 - 1645	BREAK	

1530 - 1645	**EM standards comparison: EM DATA AND PROGRAM REPORTING**
	• Introduction of the comparison
	• Group exercise: participants compare the EM data reporting standards
	  ○ Data quality assurance ,
	  ○ Data format,
	  ○ Reporting guidelines,
	  ○ Databases,
	• Report to the plenary
		CEA Consulting
		Group exercise
		
		Plenary

1645 - 1700	WRAP UP DAY 2 - CLOSE	Shelton Harley

DAY Three – 12 December 2024

0900 - 0915	OPENING - Day 2 reflections & Day 3 overview	Shelton Harley

0915 - 1030	**EM standards comparison: ROLES and RESPONSABILITIES**
	• Introduction of the comparison
	• Group exercise: participants compare the EM PROGRAM ROLES and RESPONSABILITIES
	  ○ CPCs,
	  ○ Secretariats,
	  ○ Vessels/Companies,
	  ○ EM providers
	• Report to the plenary
		CEA Consulting
		Group Exercise
		
		Plenary

1100 - 1130	BREAK	
1130 - 1300	**EM standards comparison: REVIEW and OUTCOME** ○ Summary of EM STANDARD comparison, ○ Similarities/differences, ○ Way forward and recommendations, ○ Future steps ○ Next workshop ○ Report	Plenary
1300 - 1430	LUNCH	
1430 - 1530	**EM standards comparison: REVIEW and OUTCOME (continued)**	Plenary
1530 - 1600	WORKSHOP CLOSING	S. Harley & H. Murua

7.2. Appendix 2 - List of Participants

Name	Affiliation
Álvaro Núñez	Zunibal
Dan Gilmete	NORMA
Frank Meere	CCSBT
Gala Moreno	ISSF
Gonzalo Legorburu	DOS
Guillermo Moran	Tunacons (IATTC WGEMS Co-Chair)
Hilario Murua	ISSF (IOTC WGEMS Chair)
Holly McBride	NOAA
Itziar Canive	Datafish
Jacob Isaac-Lowry	Flywire
Jamie Gibbon	The Pew Charitable Trusts
Jenny Moffett	CEA Consulting
Jon Ruiz	AZTI
Josh Wiersma	Integrated Monitoring
Karine Brian	IRD
Lucia Pierre	IOTC
Luis Cocas	Gobierno de Chile
Manuel Menchaka	Satlink
Marlon Roman	IATTC
Rebecca Darcy	AFMA
Romain Godefroy	Thalos
Rui Coelho	IPMA (ICCAT SCRS EMS-Subgroup Chair)
Shelton Harley	WCPFC WGEM Chair
Tetsuya Kawashima	Fisheries Agency Japan

7.3. Appendix 3 - Tuna RFMOs EM Standard presentations

Electronic Monitoring minimum standards harmonization workshop

Context Setting – Tuna RFMO standards

CCSBT EM Progress and EM Standards

- We are working on EM but are some distance behind other tRFMO
    - Somewhat unique arrangements, no convention area (show map) so frequently seek to harmonise with the tRFMOs where SBT are located/caught – most important in this regard is IOTC.
    - 8 Members of the Extended Commission, Australia, European Union, Fishing Entity of Taiwan, Indonesia, Japan, New Zealand, Republic of Korea, South Africa.
    - Two distinct fisheries, purse seine for ranching in Australian southern waters, longlining by all other Members including Australia in ICCAT, IOTC and WCPFC waters.

- The Compliance Committee held a virtual EM Workshop in May 2023 where High Level Guiding Principles for Electronic Monitoring (EM) & Electronic Monitoring Systems (EMS) were developed.
    - Broadly based on IOTC definitions.
    - The use of EM is voluntary and, if used, can complement or supplement human observer programmes.
    - Should be compatible with the EM/S utilised in other relevant RFMOs.
    - Can be used to contribute to meeting the scientific observer coverage requirements as described in the CCSBT Scientific Observer Program Standards (SOPS).
    - There is potential for EM data and information to be used to assist with the assessment and reporting of Members' compliance with CMMs in future if agreed by Members. This does not prevent Members choosing to use their own EM/S data and information to support compliance with CCSBT CMMs.

- The Guiding Principles were endorsed by the Commission in October 2023 as was the Commission's 2023 – 2028 Strategic Plan which requires that the Commission further increase efforts, including analysis on the application of electronic monitoring, to improve and supplement observer coverage in accordance with Scientific Observer Program Standard.
    - No Technical Standard, but part of the Observer Standard.
    - Subsequently the Scientific Committee and the ERS Working Group have been asked to further consider how best EM can be used in SBT fisheries.

- 2 Members (Australia and New Zealand) currently use EM to meet observer requirements.
- COVID caused a rethink by Members, particularly given low or no observer coverage during the pandemic

- EM is embedded in the Compliance Action Plan (2025-2029)

Compliance Action Plan (for 2025 to 2029 inclusive)

Risk Item Ref. No.	Risk Item No. & Matrix Score (H/M/L)	Action Required to Address Risk/ Draft Strategic Plan/ Seabird Strategy	Responsibility (Members and/or the Secretariat)	2025	2026	2027	2028	2029
9. Insufficient scientific observer data to manage target and nontarget species.	**M/H**	a) Consider methods for enhancing the reliability of logbook information and scientific observer data through appropriate verification methods, including the use of EM, for target and non-target species.	Members		*			
		b) Consider the costs and benefits of increasing scientific observer percent coverage levels and/or the EM review rate taking into account consideration by ESC regarding data collection through EM and report back to the CC.	Members and Secretariat			*	*	
		c) Support Members who are considering using EM as a source of scientific data observations where it may be difficult to employ human observers.	Members and Secretariat	Ongoing				

Electronic Monitoring Minimum Standards Harmonization Workshop

10 - 12 December 2024

San Sebastián (Spain)

C-24-09: Scope and Character (provisional)

Scope:

- **Purse-seine and longline vessels** (small-sized LL (<20m LOA), medium-sized LL (20–24m LOA), and large-sized LL (>24m LOA)

Character:

- **Voluntary** in the IATTC, **currently**
- A **mandatory** EM Program: yet to be adopted. Will be based on a work plan developed during the **EMWGs**
- **C-24-09 and annexes with provisions and standards** such as technical, logistical, data collecting and reporting -when adopted, **follows a hybrid approach** using language as follows:
  - **SHALL/MUST**
  - **SHOULD**
  - **MAY**

EMWG, **shall review** these interim standards in **2027** and at least every two years thereafter, or until a final set of EMS standards are adopted

EM as observers' replacement or extra monitoring

- **Not to replace observer coverage already required** (e.g., Class-6 PS vessels – 100%).
- **2027**: **Discuss feasibility** for EM to be used as **substitute for human observers** to increase IATTC observer coverage (e.g., **LL, and unobserved PS vessels**).

C-24-09: CPC role once EMS is adopted

SHALL:

Mandatory basis

- EM programs **developed**, **designed** and **implemented** transparently, and the resulting data verifiable
- **EM analysis** made by **CPC institutions/authorities** or, by **CPC-authorized companies**, with training, knowledge, skills and abilities to ensure effective EM analysis; this includes sufficiently accurate species identification
- Health status of EM equipment reported by the **EM service provider** or by the **EM equipment itself**
- **Establish/follow rules and procedures** when EM equipment is defective
- CPCs shall ensure that their programs meet the requirements in C-24-09 and prior to submitting EM data to the IATTC **shall submit an EM program description** to the Director detailing, at a minimum, with information of:
  - an example of **VMP** used (March 30, previous year)
  - responsibilities of fishing authorities and vessel owner/crew with respect to **installing and maintaining EM equipment**, including routine cleaning of cameras, and responses to mechanical or technical failure of the EMS.
  - **protocols for data** storage, retrieval and transfer.

Voluntary basis

- An appropriate follow-up by flag authority is undertaken in instances where actions inconsistent with EM standards are detected in EM records or data, but **submitted voluntarily** to the IATTC
- Reporting of additional processes of capturing operational health status of the system (e.g., system shutdown planned, unplanned, etc.)

C-24-09: CPC role once EMS is adopted (cont.)

SHALL:

EM equipment

- Include location, date, and time stamps, and to the extent possible, vessel ID, and to integrate with other data collection and monitoring tools (e.g., sensors).
- Be tamper-evident/resistant and record automatic alerts (e.g., malfunctions), provided in near real-time.
- Cameras sufficient in no./quality, high-res images that allow the species id, specific fishing activities and vessel's surroundings. Capable of recording video and/or still images, as appropriate to the recording purpose.

EM data requirements

- **Minimum EM data fields** for PS and LL activities to be generated and reported each year by CPC **per tables 1-2, Annex 3 of C-24-09**

Data storage

- Enough blank data storage devices in case these must be replaced at sea
- Sufficient capacity to store all EM records, including sensor information, for the duration of a fishing trip

Data analysis and submission

- Conducted by **qualified** EM analysts (with experience in fishing activities)
- **Dedicated software**, routines flagging potential errors
- Software allowing the **reporting** of minimum **EM data requirements**

C-24-09: CPC role once EMS is adopted (cont.)

SHOULD:

EM equipment

- Reporting a log file of additional processes of capturing the system operational health status
- Protected against onboard power outage, with a backup power system capable to operate until the vessel power is restored (e.g., 30 minutes). Capable of saving EM records collected when the vessel power is down for longer periods

Vessel monitoring Plan

- Physical changes to the vessel, modifications in fishing gear/operations, including those resulting in a vessel no longer belonging to its original group, should be reported to Flag CPC and updated before next trip

Data storage

- EM equipment have included separate **duplicate backup devices**, to avoid data lost if malfunctions

Logistical requirements

- Protocol established to retrieve the data from the vessel to the authorities or to the EM review center

Electronic Monitoring Minimum Standards Harmonization Workshop

10 - 12 December 2024

San Sebastián (Spain)

ICCAT EM progress and adopted EM Standards

Rui Coelho

IPMA - Portuguese Institute for the Ocean and Atmosphere
Convenor of the ICCAT SCRS Sub-group on Electronic Monitoring Systems (EMS)

ELECTRONIC MONITORING MINIMUM STANDARDS HARMONIZATION WORKSHOP
SAN SEBASTIÁN AQUARIUM (SPAIN), 10-12 DEC 2024

Structure of the EMS working groups within ICCAT

ICCAT Commission

- Composed of Contracting Party Delegations, the Commission carries out the objectives set forth in the 1966 ICCAT Convention
- Composed of various Pannels and Working Groups
- Working group on Integrated Monitoring Measures (IMM) - Identifies, develops or modifies technical measures to ensure effective collection and reporting of data
- **EMS-WG responsible for the technical development of EMS, more focused on the compliance aspects**

SCRS (Scientific Committee)

- Provide **advice to the Commission**, including recommendations on procedures for the collection, compilation, analysis and dissemination of fisheries statistics.
- Organized into various Species-Groups (by species/stocks)
- **Subcommittee on Statistics**, from which there is a Sub-Group on EMS
- **SCRS EMS Subgroup - tasked to provide advice on EMS standards and specifications, mostly related with science**.

SCRS EMS Sub-group

- Created in 2021, to answer a specific ICCAT Commission request from 2019 on EMS data collection
- Currently a **Sub-Group for the Sub-Committee on Statistics (SC-STATS)**, within the SCRS.

- 2021 work (Planning):
  - Literature revision with main conclusions presented to SCRS (SCRS/2021/165)

- 2022 work (focus on longline):
  - Proposal for the **Pelagic Longlines** minimum standards for EMS
  - Presentation and adoption by the SCRS (SCRS/2022/165) – Sep 2022

- 2023 work (focus on purse seine and finalizing the work):
  - Prepare the **Purse Seine (tropical tunas)** EMS minimum standards
  - Presentation and adoption by the SCRS (SCRS/2023/165) – Sep 2023
  - ICCAT **Commission developed and agreed the final EMS minimum standards** - Nov 2023

SCRS EMS Sub-group – EMS capabilities revision

- **Review work for comparing data that is usually collected by observers vs EMS**

E.g., "**Fishing caracteristics data**" can mostly be obtained with EMS

ST-09A DATA FIELDS			Possible to collect by human observers?	Possible to collected by EMS?	Notes
Fishing operations & fleets	Fish. Oper. (FO)	FO group ID	Not applicable	Not applicable	Coding variable applied post-processing
	Fleet attributes	Flag of Vessel (cod)	Yes	Yes	Obtained from EMS instalation ID
		Base port/zone	Yes	Yes	Obtained from EMS instalation ID
		Vessel (size class)	Yes	Yes	Obtained from EMS instalation ID
Temporal attributes	Year, month/trimester	Year	Yes	Yes	Need to assure the EMS system has a GPS or VMS included as standard
		T. Period (ID)	Yes	Yes	Need to assure the EMS system has a GPS or VMS included as standard
Geographical attributes	Resolution and position (Lat, Lon)	Square type (cod)	Yes	Yes	Need to assure the EMS system has a GPS or VMS included as standard
		Lat (centroid) (± dd.ddd)	Yes	Yes	Need to assure the EMS system has a GPS or VMS included as standard
		Lon (centroid) (± dd.ddd)	Yes	Yes	Need to assure the EMS system has a GPS or VMS included as standard
Effort attributes	All fishing gears	Gear group (cod)	Yes	Yes	
		Nº vessels	Not applicable	Not applicable	Grouping variable applied post-processing
		Nº Fish. Oper. (observed)	Not applicable	Not applicable	Grouping variable applied post-processing
		Fish Oper. Type (cod)	Yes	Yes	
		School type (cod)	Not applicable to LL	Not applicable to LL	Not applicable to LL
	Longline (LL) only	LL type	Yes	Yes	Possible with additional info from logbooks or the skiper. Should also be possible to detect the LL type/configuration with a camera recording the deployment
		Nº hooks (total)	Yes	Yes	Migth be possible to get from logbooks. Could also count at deployment, as hooks/floats are seen with a deployment camera (but could be time consuming to count all hooks)
		No. hooks (observed)	Yes	Yes	
		Hook type (main)	Yes	Possible	Possible but need integration with additional info from logbooks or the skiper
		Set depth (hooks per basket)	Yes	Yes	Need to put cameras during deployment to count hooks between floats. Will also allow for total set effort (n hooks). Note that HBF migth not be the best proxy for depth of setting
Mitigation measures (MM) on bycatch species	Seabirds	MM 1	Yes	Yes	Possible for EMS to detect some MM, like for example Tori line, night setting or painted bait.
		MM 2	Yes	Yes	Possible for EMS to detect some MM, like for example Tori line, night setting or painted bait.
	Other bycatch	MM 3	Yes	Yes	Possible for EMS to detect some MM, like for example Tori line, night setting or painted bait.
	Additional notes	Description (MM)	Yes	Yes	Optional field in ST-09. Possible to add information with any complimentary information

SCRS EMS Sub-group – EMS capabilities revision

- **Review work for comparing data that is usually collected by observers vs EMS**

E.g., "**Biological data**" is more challenging and will need some adaptations

ST-09C DATA FIELDS			Collected by human observers?	Collected by EMS?	Notes
Specimens & fishing operations	Specimen Identifier	Unique specimen ID	Not applicable	Not applicable	Coding variable applied post-processing
		FO group ID	Not applicable	Not applicable	Coding variable applied post-processing
		Species (cod)	Yes	Yes	
Biological data (observed)	Sex	Sex (cod)	Yes	Possible in some cases	With observers it is possible for elasmos (externally) and bony fishes when they are eviscerated; With EMS might be possible for elasmobranchs with specific specimen position by the crew and cameras
	Size	Length (cm)	Yes	Yes	Possible if the crew positions the specimens in front of a specific camera for measurements. Need for calibrated areas
		Size class type (cod)	Yes	Yes	
	Weight	Weight (kg)	Yes	Possible in some cases but need adaptations	Both HO and EMS can only do in vessels that have scales to weigth individual specimens. Most vessels don't have these onboard (some large LL only). If the vessels have scales the HO can take weights directly. For EMS migth be possible to put cameras facing the scales, or there might be a way to conect the scales to the EMS directly
		Product type (cod)	Yes	Possible in some cases but need adaptations	Both HO and EMS could only do in vessels that have scales to weigth individual specimens. Most vessels don't have these onboard (some large LL only). If the vessles have scales, could put cameras facing the scales. Or there might be a way to conect the scales to the EMS directly
	Samples obtained (Y/N)	Genetics (YN)?	Yes	No	Collection of samples by HO depends on the logistics onboard, specific studies objectives, etc
		Otoliths (YN)?	Yes	No	Collection of samples by HO depends on the logistics onboard, specific studies objectives, etc
		Stomach (YN)?	Yes	No	Collection of samples by HO depends on the logistics onboard, specific studies objectives, etc
		Gonads (YN)?	Yes	No	Collection of samples by HO depends on the logistics onboard, specific studies objectives, etc
Release attributes and others	Condition (external injuries)	Released (YN)?	Yes	Possible in some cases	The operation is visualized by seeing the surrounding water. If the catch is not hoisted but part of the body is seen, it is sometimes possible to reach the level of the genus (e.g., Alopias, Sphyrna). Also in leatherback turtles. In other species (e.g., hardsheel turtles, other fishes), if they are not hoisted to remove the hook it is more complicated to reach the species or even genus. Depends also on the cleanliness of the cameras and the release maneuver.
		Injuries (scale)	Possible in some cases	Possible in some cases	Inuries from depredation or from the fishing process can be seen sometimes. But if the specimens are released in the water it migth be difficult for both HO and EMS
	Others	Tag number	Yes	No	
		Notes	Yes	Yes	Any additional notes can be input both by HO and EMS visualization

ICCAT Commission EMS minimum standards

23-18 **GEN**

RECOMMENDATION BY ICCAT TO ESTABLISH MINIMUM STANDARDS AND PROGRAMME REQUIREMENTS FOR THE USE OF ELECTRONIC MONITORING SYSTEMS (EMS) IN ICCAT FISHERIES *

- Adopted by the ICCAT Commission in **November 2023** (annual plenary meeting)
- Overall, there was a **considerable collaboration** between the SCRS/EMS Subgroup and the Commission EMS WG and EMS drafting group.
- Contains Tables in Annexes that specify the minimum areas to be covered and data to be collected (specific tables for **LL and PS**, both for **science and compliance purposes**).

: In accordance with Article VIII of the ICCAT Convention, and with common usage since the inception of ICCAT,* ***all Recommendations adopted by the Commission become binding on all Contracting Parties* *(with the exception of those who have lodged an objection through the formal procedures) six months following official transmission.*

ICCAT EMS standards: Some of the main points

- **Purpose**: established for **both LL and PS**, including **compliance and science** (providing separate tables of data to be collected) for each purpose
- **Maintain a minimum human obs. coverage**: CPCs shall ensure that they **continue to meet the human observer coverage required** in accordance with paragraph 4 of Rec. 16-14. If they choose to implement EMS for scientific purposes, it **shall be used to complement the required level of human observer coverage**.
- **EMS domestic programme**: CPC that choose to implement EMS in LL or PS for either scientific or compliance purposes, must **develop and describe an EMS domestic programme**.
- **Data submission**: **CPCs need to report each year**, using the electronic formats developed, information collected through domestic EMS programmes, in line with procedures in place for other data reporting requirements
- **Periodic reviews**: Revision of **EMS standards in 2026, and at least every 4 years thereafter**, to evaluate its effectiveness in fulfilling its purpose and consider the need for revisions.

Longline vessels – Areas to be covered

Table 1. General configuration and areas/activities covered by an EMS onboard longline vessels.

Area covered	*Action covered*	*Data fields*
Setting area (usually stern camera)	Setting operation	Setting date, time, and position Use of bycatch mitigation measures or techniques Total number of hooks set, where applicable Hook type, where applicable
Hauling area	Hauling operation	Hauling date, time, and position
Catch handling area – Working deck	Retained catches, including bycatch	Number of individuals by species Length and weight, where applicable
Surrounding water area near hauling area	Estimation of discards, including bycatches	Number of discards by species Condition of discards

Longline vessels – Data fields to be collected

Example on data to be collected on LL vessels, for science purposes

Specific data fields for:

- 1. Temporal and geographical attributes
- 2. Effort attributes
- 3. Mitigation measures on bycatch species
- 4. Catch composition by fishing operation
- 5. Biological data (optional)

Table 3. Data fields for ICCAT longline activities to be collected and reported when a CPC chooses to implement an EMS programme for ICCAT scientific data collection purposes. These data can be identified by the EMS or estimated through data analysis.

Data field name	*Data field description and notes*
1. Temporal and geographical attributes	
Flag of vessel	Flag of the vessel. Reported to ICCAT in A3ISO coding.
Base port/zone	Base port/zone of the vessel that the set(s) refers to.
Vessel (size class)	Vessel LOA Class. Usually aggregated in 10m size classes for reporting to ICCAT.
Vessel (carrying capacity)	Carrying capacity of the vessel.
Year	Year that the set(s) data refers to.
Time period	Time Period. Data reported set-by-set, monthly or quarterly.
Square type	Grid Resolution. Data reported in: exact location (latitude & longitude in decimal degrees), aggregated in 1x1 degrees, or aggregated in 5x5 degrees.
Latitude	Centroid of the latitude of the set(s) that the data refers to. Reported as the centroid in decimal degrees (±dd.ddd).
Longitude	Centroid of the longitude of the set(s) that the data refers to. Reported as the centroid in decimal degrees (±dd.ddd).
2. Effort attributes	
No. fishing operations (total)	Total number of fishing operations that were carried out.

(…)

Purse seine vessels – Areas to be covered

Table 1. Minimum areas and actions that shall be monitored.

Area covered	*Action covered*	*Data fields*
Work deck (port side)	Brailing	Total catch by set Species composition
	Discards	Total discards by set
	Bycatch handling	Bycatch estimation
Work deck (starboard side)	Bycatch handling	Bycatch estimation
	Bycatch release	Total bycatch by set
In-water purse seine area	Fishing set. Brailing. Net hauling	Total catch by set
	Bycatch handling of big species (whale sharks, manta rays…)	Total bycatch by set Bycatch condition Application of handling and safe release best practices
	Bycatch release of big species (whale sharks, manta rays…)	Total bycatch by set Bycatch condition Application of safe-release best practices
Foredeck or amidships	FAD activity (deploying, replacement, reparation…)	Total number of FAD deployments, FAD design and FAD activities by trip
Well deck and conveyor belt	Catch well sorting	Species composition
	Bycatch handling	Best practices
	Bycatch discarded, released or retained	Total bycatch by set Species composition Application of handling and safe-release best practices

Purse seine vessels – Data fields to be collected

Example on data to be collected on PS vessels, for science purposes

Specific data fields for:

- 1. Temporal and geographical attributes
- 2. Effort attributes
- 3. Mitigation measures on bycatch species
- 4. Catch composition by fishing operation
- 5. FAD activities
- 6. Biological data (optional)

Table 3. Data fields for ICCAT purse seine activities to be collected and reported when an EMS is to be implemented for science purposes. These data can be identified by the EMS or estimated through data analysis.

Data field name	*Data field description and notes*
1. Temporal and geographical attributes fishing operation	
Flag of Vessel	Flag of the vessel. Reported to ICCAT in A3ISO coding.
Base port/zone	Base port/zone of the vessel that the set(s) refers to.
Vessel (size class)	Vessel LOA Class. Usually aggregated in 10m size classes for reporting to ICCAT.
Vessel (carrying capacity)	Carrying capacity of the vessel.
Year	Year that the data refers to.
Time period	Time Period. Data reported set-by-set, monthly or quarterly.
Square type	Grid Resolution. Data reported in: exact location (latitude & longitude in decimal degrees), aggregated in 1x1 degrees, or aggregated in 5x5 degrees.
Latitude	Centroid of the latitude of the set(s) that the data refers to. Reported as the centroid in decimal degrees (±dd.ddd).
Longitude	Centroid of the longitude of the set(s) that the data refers to. Reported as the centroid in decimal degrees (±dd.ddd).
2. Effort attributes	
No. fishing operations (total)	Total number of fishing operations that were carried out.
No. fishing	Number of fishing operations that were recorded by the EM System.

(…)

Future of the SCRS EMS Subgroup

Starting work on EMS possibilities and standards for smaller vessels (e.g., coastal LL, gillnets, etc)

- More complicated to take onboard observers on those fleets (lack of space, security, etc).
- Alternatives such as port sampling are not sufficient (do not cover bycatch/discards).
- Currently there is very limited data from those fleets.
- Need to think about and establish good alternative data collection measures. Idea is to explore the feasibility of using some simplified EMS systems.

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
iotc ctoi

IOTC EM Standards

Hilario Murua, WGEMS Chair

EM Workshop, Donostia, 10 – 12 December, 2024

IOTC EM Process

- 2014-2017 trials in PS (EU) and LL (Australia), lessons learned.
- In 2016, Resolution 16/04 on a Pilot project to promote the ROS requested SC to develop EM minimum standards.
- In 2017 the SC recommended that the EMS standards presented for purse seine fisheries (IOTC-2016-SC19-15) be adopted. Preliminarily adopted by the Commission in 2018.
- In 2018 IOTC SC recommended developing minimum standards for EMS for all IOTC tuna fisheries.

IOTC EM Process

- 2014-2017 trials in PS (EU) and LL (Australia), lessons learned.
- In 2016, Resolution 16/04 on a Pilot project to promote the ROS requested SC to develop EM minimum standards.
- In 2017 the SC recommended that the EMS standards presented for purse seine fisheries (IOTC-2016-SC19-15) be adopted. Preliminarily adopted by the Commission in 2018.
- In 2018 IOTC SC recommended the development of minimum standards for EMS for all IOTC tuna fisheries.
- In 2020, a technical paper on EM minimum standards for the installation, collection, analysis and storage of data was prepared and discussed at the SC.
- In 2021, the ad hoc WG on EMS was created to further advance EM in 2021.

IOTC EM Process

- Started around 2014
- 2014-2017 trials in PS (EU) and LL (Australia), lessons learned.
- In 2016, Resolution 16/04 on a Pilot project to promote the ROS requested SC to develop EM minimum standards.
- In 2017 the SC recommended that the EMS standards presented for purse seine fisheries (IOTC-2016-SC19-15) be adopted. Preliminarily adopted by the Commission in 2018.
- In 2018 IOTC SC recommended the development of minimum standards for EMS for all IOTC tuna fisheries.
- In 2020, a technical paper on EM minimum standards for the installation, collection, analysis, and storage of data was prepared and discussed at the SC.
- 2021, WG on Electronic Monitoring Standards
- In 2022, Resolution 22/04 on a Regional Observer Scheme was adopted.

RESOLUTION 22/04

ON A REGIONAL OBSERVER SCHEME

4. The IOTC Scientific Committee, in collaboration with the Compliance Committee, shall develop and agree on minimum standards for the use of EMS for purse seine, longline, bait boat (pole and line), handline, and gillnet fleets by 2023 at the latest, including on modalities of the substitution of the human observer coverage by an EMS, taking into account factors such as, the principles and regulations regarding minimum safe manning requirements. The Commission may consider and adopt these standards by 2024 in a separate Resolution.

5. Once the EMS standards are adopted and providing CPCs meet the minimum mandatory ROS data reporting standards, the minimum human observer coverage provided for in paragraph 3 may be complemented or substituted by means of an EMS. To ensure the minimum mandatory ROS data reporting standards are met, the EMS may be complemented by port sampling and/or other Commission approved data collection methods. CPCs are encouraged to use an EMS to improve the collection of scientific data before the standards mentioned in paragraph 4 are adopted.

IOTC EM Process

- And finally, the Commission adopted IOTC EM minimum standards in 2023

Food and Agriculture Organization of the United Nations

Indian Ocean Tuna Commission
Commission des Thons de l'Ocean Indien
iotc ctoi

RESOLUTION 23/08
ON ELECTRONIC MONITORING STANDARDS FOR IOTC FISHERIES

Food and Agriculture Organization of the United Nations

Indian Ocean Tuna Commission
Commission des Thons de l'Ocean Indien
iotc ctoi

RESOLUTION 23/08
ON ELECTRONIC MONITORING STANDARDS FOR IOTC FISHERIES

- Terms and definitions of EMS,
- EM Program Standards, and
- EM System and Data Standards as per IOTC SC recommendation, that allow CPCs to meet the minimum ROS data requirements under Resolution 22/04 using EMS.

Food and Agriculture Organization of the United Nations

Indian Ocean Tuna Commission
Commission des Thons de l'Ocean Indien
iotc ctoi

RESOLUTION 23/08
ON ELECTRONIC MONITORING STANDARDS FOR IOTC FISHERIES

CPCs who choose to implement EMS in the IOTC area of competence **shall**:

a) ensure that the implementation of their National EM Programs (NEMPs) and EM systems on their flagged vessels **meets the requirements of the EM Program Standard (Annex 1) and EM System and Data Standards (Annex 2)**.

ANNEX 2

IOTC ELECTRONIC MONITORING SYSTEM AND DATA STANDARDS

EM TECHNICAL MINIMUM STANDARDS

The Technical Minimum Standards shall describe the requirements of the EM. CPCs shall ensure all EM equipment installed in their national or subregional programs are consistent with these technical specifications.

No interference: EM equipment should not generate or cause radio frequency interference with other on-board vessel communication, navigation, safety, geolocation devices (e.g. VMS) or fishing equipment.

Food and Agriculture Organization of the United Nations

Indian Ocean Tuna Commission
Commission des Thons de l'Ocean Indien
iotc ctoi

RESOLUTION 23/08
ON ELECTRONIC MONITORING STANDARDS FOR IOTC FISHERIES

CPCs who choose to implement EMS in the IOTC area of competence **shall**:

b) submit to the IOTC Secretariat by 1 July each year, a **Vessel Monitoring Plan**, that covers each vessel in their IOTC fishery utilizing EMS, outlining the EMS setup on each vessel, consistent with the requirements in the EM Program Standard (**Annex 1**) and making use of guidance in **Annex 3** (Vessel Management Plan Guide).

ANNEX 3

VESSEL MONITORING PLANS (GUIDE)

Each vessel should develop a "Vessel Monitoring Plan" so as to define how many and where cameras are located to collect the required ROS minimum data fields. Vessel Monitoring Plans should be reviewed by the CPCs fishery management agency and presented to the WGEMS/WPDCS to ensure it meets IOTC REMP Program and EM System and Data Standards.

Food and Agriculture Organization of the United Nations

Indian Ocean Tuna Commission
Commission des Thons de l'Ocean Indien
iotc ctoi

RESOLUTION 23/08
ON ELECTRONIC MONITORING STANDARDS FOR IOTC FISHERIES

CPCs who choose to implement EMS in the IOTC area of competence **shall**:

d) submit to the IOTC Secretariat by 1 July each year, a fleet level ROS data collection table, clearly specifying for each ROS minimum required data field as specified:

i. the data field name and description,

ii. the data field reporting requirement level (i.e, mandatory collection and reporting, mandatory reporting if collected, not mandatory etc),

iii. the data collection method used to collect data for that field, and

iv. a brief description of the data collection method.

SUMMARY

Food and Agriculture Organization of the United Nations

Indian Ocean Tuna Commission
Commission des Thons de l'Ocean Indien
iotc ctoi

RESOLUTION 23/08
ON ELECTRONIC MONITORING STANDARDS FOR IOTC FISHERIES

- Objectives and Scope
  - CPC/Member programs,
  - Scientific,
  - All gears: LL, PS, PL and GN
  - 5% of fishing effort,
  - Voluntary,
  - Performance-based standards (not very prescriptive)
  - Can be used to fulfill ROS requirements
  - Can replace human observers provided that all ROS data fields are collected & reported
  - Review in 2025-2026
- EMS definitions ✅
- EM Data Standards ✅
- EM Program Standards ✅
- Expert WS ❌

Western and Central Pacific Fisheries Commission

WCPFC21

EM in WCPFC

Shelton Harley (New Zealand)

ER and EM IWG Chair (past)

Framework for EM Standards

Western and Central Pacific Fisheries Commission

WCPFC21

1. • **Objective** (what we want EM to achieve)
2. • **Scope** (which fishing activities to cover)
3. • **Data requirements** (what data to collect) 
4. • **Technical requirements** (What is needed to get that data) 
5. • **Coverage** (how much EM needed)
6. • **Reporting requirements** (tell us what you did) 
7. • **Assurance / audit process** (confirming what you said you did)

Objective and initial scope

Western and Central Pacific Fisheries Commission

WCPFC21

Objective

"The objectives of the Commission Electronic Monitoring Programme (EMP) ***shall be to collect verified catch and effort data, other scientific data****, and additional information related to the fishery from the Convention Area* ***and to monitor the implementation of the conservation and management measures adopted by the Commission****"*

[paragraph 555 of the WCPFC19 Summary Report]

[Initial] Scope

Initial focus on ***longline vessels****, particularly those operating on the high seas*

EM data requirements

Western and Central Pacific Fisheries Commission

WCPFC21

- Based off the Regional Observer Program data fields
- Note:
  - Proposals to remove some ROP fields (through the ROP IWG)
  - Further review of Measures needed as there may be gaps in the ROP fields

WCPFC ROP Minimum Standard Data Fields.

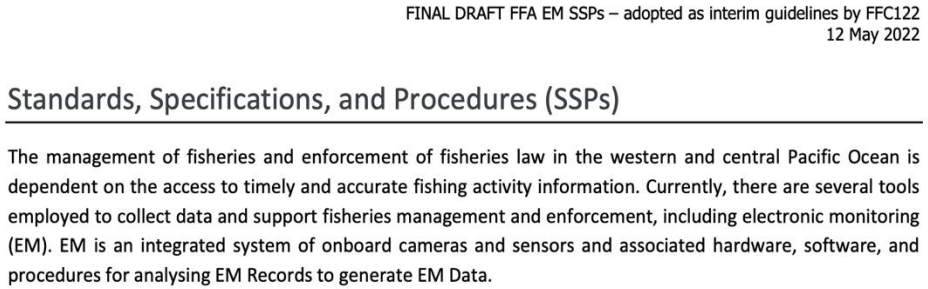
The format of how the WCPFC ROP Minimum Standard Data Fields will be presented for collection by observers is up to the individual observer programmes to develop; however if providers need a format to use as a guide that includes all the fields and suggested instructions for this set of minimum data standard fields. The FFA/SPC have developed forms and formats that are used by many programmes already, these are available on the SPC Website under the Oceanic Fisheries Programme (OFP) and could be adapted to suit your programme.

Unless otherwise instructed when entering any field on any observer form, please make sure all fields are clearly printed in English, do not abbreviate unless told to do so;

- **use the best codes where indicated;**
- **make sure every forms is labelled with at least your name and trip number;**
  if there is no information available for a field or its not applicable, please place a dash in this field, leaving it blank does not tell the data entry persons if you just forgot to fill the field in, or if there is no available information;
- **make sure that all Yes/No are circled;**
- **all units of measure or power should be clearly indicated (circled);**

GENERAL VESSEL AND TRIP INFORMATION FOR ALL VESSEL TYPES	
VESSEL IDENTIFICATION	
Name of vessel	Name must be clearly written, make sure any numbers connected with the name are included. i.e. "Moonlight No 6"
Flag State Registration Number	This number will be sourced from the vessel papers. You can normally get this information during the briefing.
International Radio Call Sign	The vessel call sign is usually issued to the vessel by the flag State in accordance with IMO regulations and procedures. This can become the WCPFC identification number of the vessel

EM technical requirements



FINAL DRAFT FFA EM SSPs – adopted as interim guidelines by FFC122
12 May 2022

Standards, Specifications, and Procedures (SSPs)

The management of fisheries and enforcement of fisheries law in the western and central Pacific Ocean is dependent on the access to timely and accurate fishing activity information. Currently, there are several tools employed to collect data and support fisheries management and enforcement, including electronic monitoring (EM). EM is an integrated system of onboard cameras and sensors and associated hardware, software, and procedures for analysing EM Records to generate EM Data.

- Definitions
- Onboard system
- Installation, operation, and service …
- Data review centres
- Annex: Guidelines for administration of an EM program
- Annex: Existing WCPFC catch handling procedures

- **MUST** (mandatory) – features that an EM System or EM Program must have or meet, i.e., they represent bottom-line requirements
- **SHOULD** (recommended) – features that could be very useful to have, but are not strictly required ……
- **COULD** (optional) – features that are much less critical …

EM program reporting requirements

Western and Central Pacific Fisheries Commission

WCPFC21

- A description of the EM program
- Attestation that mandatory requirements have been met
- Details of the implementation of the EM Program each year
- Utilizing Annual Report Part 1

Adopted Future Workplan

Western and Central Pacific Fisheries Commission

WCPFC21

Table 2: Proposed future workplan for the ER and EM IWG endorsed at TCC20.

Task	Working approach	Timing	Date to WCPFC
Proposed minimum EM data fields and standards	EREMIWG intersessional and **SSP**	Oct-Nov 2024	WCPFC21 **(Nov-24)**
Interim EM standards paper	EREMIWG intersessional	Oct-Nov 2024	WCPFC21 (**Nov-24**)
Review and/or develop templates for Part 1 EM program reporting and other parts of the EM standards where standardized reporting would be of value to members.	EREMIWG with SC and TCC review	Feb-Oct 2025	WCPFC22 (**Dec 25**)
Advice on potential changes to the interim EM standards to **improve harmonization** across RFMOs (based on outcomes of the ABNJ Tuna II "*Electronic Monitoring Tuna RFMO Minimum Standards Harmonization Workshop*" to be held in Dec-2024)	EREMIWG with SC and TCC review	Feb- Oct 2025	WCPFC22 (**Dec 25**)
Review EM data requirements based on relevant CMM requirements not already covered in the ROP minimum data fields	EREMIWG and **ROP IWG** with SC and TCC review	Feb- Oct 2025	WCPFC22 (**Dec 25**)
Develop a proposed **assurance / audit process for EM standards** for longlining based on ROP audit model	EREMIWG / **WCPFC-Secretariat** with SC and TCC review	TBC	**TBC**
Initiate work on **EM standards for carrier vessels** conducting transshipment for longline vessels.	EREMIWG and **TS IWG** with SC and TCC review	TBC	**TBC**

WP 11 - TCC20 Outcomes, Annex 2

7.4. Appendix 4 - EM provider and data review center presentations

ISSF EM minimum standards harmonization workshop

San Sebastián

December 2024

About Us

- Founded in 1992, Satlink is a **technology company** that develops solutions that assist in improving the **management of ocean resources**, working closely with industry, governments, and NGOs.
- Over the past 11 years, Satlink has gained **extensive experience in REM projects**, having installed systems on more than **350 vessels worldwide**.
- Satlink's **headquarters are in Madrid (Spain).** Through its own offices (Canada, Ecuador, Seychelles, South Korea, Fiji, etc.) and international distribution network, enabling Satlink to deliver tailored, reliable services and close support to its customers.
- Satlink employs over **170 professionals** worldwide. A passionate team of engineers, scientists and technologists.
- Satlink's **strong R&D platform [+35 in-house people in the R&D team]** creates 98% of the in-house designed hardware and software solutions.

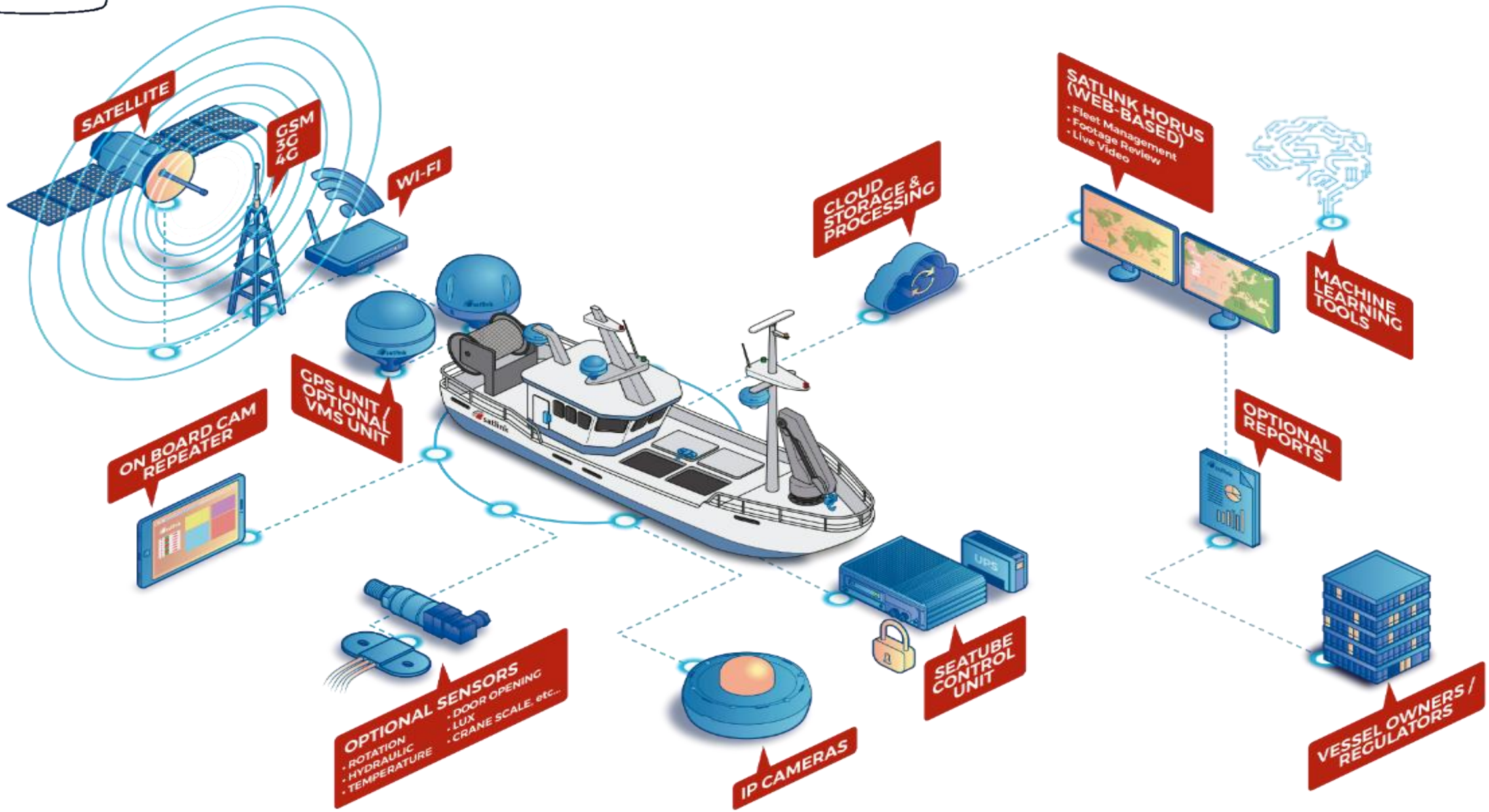
DIGITAL OBSERVER SERVICES (DOS)

DOS (Digital Observer Services), founded in 2014, based in Bilbao (Spain) is a company of the Satlink Group **specialized in the review and analysis of EM footage and the generation of EM reports**, having carried out this work for the last 10 years.

Formed by biologists, on-board observers and trained EMAs (Electronic Monitoring Analysts) the company also performs audits on established DRCs (Data Review Centers) with on board experience in the tuna purse seine fisheries in the Pacific, Indian and Atlantic oceans.

DOS has managed to conduct EM footage analysis from the verification of compliance of fishing closures to exhaustive digital samplings of captures for the obtention of scientific data.

The next generation EM system



Questions

- What are you concern about EM standards?
- What do you think EM standards/implementation are doing wrong?
- What do you miss in the EM standards?
- What are the gaps?

- What future opportunities are?
- What do you think about standardization/harmonization process?
- Difficulties in adjusting the systems and review to different oceans/regions and complying with different standards?

- Could you think of a way to make the standards compatible?
- What do you need from this process or EM implementation on tuna RFMOs?

Questions (I) / EM Standards

New Opportunities arise…

- EM standards open to increase the **Observer coverage**
- Development of unified global EM standards reduce duplication of effort and **enhance interoperability**.
- **Integration with AI**: Leveraging technologies to automate data analysis and enhance decision-making.

Standardization brings…

- **Advantages:** Harmonization would make life easier for multinational fleets, cut costs, and make it easier to compare data.
- **Challenges:** Balancing regional needs and global consistency requires significant coordination and negotiation among RFMOs.

Questions (II) / EM Standarda

What We Think…

- Standards could **stop innovation after** its implementation (“Why I should innovate if I’m OK”)**.** Indeed, EM standards needs of a **periodical update** to cover last technology innovations.
- **Variability in specificity**, with some standards being vague and others overly detailed, leading to uneven implementation.
- **Potential lack of harmonization between RFMO standards** and **future national/regional EM standards** will creates complexity for vessels operating in multiple jurisdictions, which limits interoperability and scalability.
- Increased **administrative burden** on fishermen due to overlapping standards, which means r**isk of non-compliance** -or enforcement challenge
- More important is the required **final output type and format,** rather than the way/method it is collected, based on minimum technical requirements as stated in the EM standards.
- **Inconsistent reporting metrics** make it difficult to aggregate and analyze data across regions.

Questions (III) / EM Standards

A way to make the standards compatible:

- **Interoperability Frameworks**: Establish protocols to ensure different systems can exchange and interpret data.
- “Consensus”: Facilitate **regular forums** for RFMOs to align standards and share best practices.
- **Clear Guidelines and Timelines**: Defined implementation roadmaps with achievable milestones.
- Establishing a **certification process for systems, suppliers, and processes** is critical to ensure uniform compliance with EM standards across regions.

dos@digitalobserver,org emsales@satlink.es

RFMO Minimum EM Standards

Integrated Monitoring's Analysis and Recommendations

Integrated Monitoring

1. Concerns About EM Standards

Fragmentation:

EM standards vary significantly across RFMOs, leading to inefficiencies in system deployment, data handling, and compliance monitoring.

Slow Adoption of Advanced Technology:

Many standards focus on legacy systems like mechanical sensors and physical data storage, while advanced cloud-based systems and AI remain underutilized.

Lack of Real-Time Monitoring:

Most RFMOs rely on post-trip analysis, which delays compliance actions for critical events like transshipments.

2. What EM Standards/Implementation Are Doing Wrong

Insufficient Integration of Wireless Technology:

Standards do not discuss real-time data uploads/video streaming (only for system health or snapshot cameras are functioning, limiting scalability and rapid compliance response.

Minimal Use of AI:

Most standards have current reliance on sensors and manual reviews hampers efficiency.

Inadequate Data Security:

Encryption protocols are inconsistent, with few standards requiring full disk encryption or end-to-end data protection.

Limited Cloud Adoption:

Most standards focus on local storage, or onboard storage, missing the scalability and access benefits of cloud solutions.

3. What Is Missing in EM Standards

Wireless Transmission:

Real-time live stream uploads via Starlink offshore (or cellular nearshore) are crucial for rolling review, rapid compliance alerts, and supply chain traceability (MSC, GDST).

AI Automation:

Standards lack clear benchmarks for AI in specie identification, gear activity detection, and compliance monitoring.

Real-Time Analysis:

Missing protocols for real-time detection and notification of critical events like transshipments.

Interoperability:

ISO-standardized metadata and file formats (e.g., ISO 22311:2012) are not universally adopted.

4. Identified Gaps

Timeliness:

Post-trip analysis delays regulatory actions and undermines supply chain confidence and integration.

Data Retention and Storage:

Inconsistent requirements for cloud storage, designated video review, and onboard raw footage retention.

Cross-RFMO Collaboration:

Standards lack alignment to facilitate data sharing and joint monitoring efforts across regions.

5. Future Opportunities

Wireless Transmission Mandates:

Include language preferring continuous wireless upload requirements for real-time monitoring and improved scalability.

AI Integration:

Expand AI use for species identification, event detection, and automated compliance checks.

Harmonization:

Create globally accepted standards for interoperability, such as ISO 22311:2012 for metadata and file formats.

Cloud-Centric Solutions:

Shift to encrypted cloud storage for secure, scalable access and data sharing.

6. Standardization/Harmonization Across Regions

Current Challenges:

- RFMOs prioritize internal frameworks, leading to incompatibility between regions.
- Varying data formats and metadata structures hinder collaboration.

- **Recommendations**:
  - Adopt universal standards for video encoding, file naming, and metadata for sharing video post analysis across jurisdictions (e.g. ISO 22311:2012)
  - Continue to organize cross-RFMO working groups to align minimum standards for EM implementation

7. Difficulties in Adjusting Systems

Regional Variability:

Adapting cloud-based, AI-driven systems to RFMOs with diverse requirements could increase costs and complexity to some companies.

Compliance Barriers:

Varying encryption and storage standards could require additional system customization and backend development costs for RFMOs.

Interoperability Gaps:

Current lack of harmonization forces duplication of efforts in data processing and integration.

8. Making Standards Compatible

Proposed Solutions:

- Mandate ISO 22311:2012 compliance for metadata and video formats for post analysis video/metadata sharing.

- Include language for wireless capabilities for real-time data uploads, rolling review, and supply chain integration (digital signatures, GDST key data elements).

- Look to New Zealand—risk-based approach to video review, integration of electronic logbooks, single tenancy AWS for data security, haul by haul reporting requirements for logbook audit.

- Establish universal AI accuracy benchmarks for compliance monitoring, activity recognition, and catch/species identification.

9. Needs From EM Standards/Implementation in Tuna RFMOs

Clear Guidelines for Installation and Verification Process:

Sensitivie information such as system admin keys being outside control of fishing companies. Clear understanding of liability if system breaks (e.g., process for exemptions, level of onboard inspection, limitation of liability for service providers.

Capacity Building:

Support for CPCs to adopt advanced technologies, including funding for backend infrastructure (cloud-storage, integration with existing FIMS, and video review training) .

Real-Time Focus:

Prioritize standards that enable real-time compliance monitoring and rapid response capabilities.

Data Integration:

Integration with electronic logbooks--support JSON-based exports and API integrations electronic logbooks, like iFIMS, TUFMAN2, etc.

10. Must-Have Components of EM Standards

Wireless Transmission:

Real-time uploads for compliance-critical events, using Starlink or equivalent networks.

AI/API Integration:

Automated species identification and compliance monitoring with defined accuracy thresholds; API integration with supply chain/e-logbooks—haul by haul reporting and review (e.g. % of hauls not trips).

Cloud Storage:

Mandatory for reviewed footage, with onboard retention of raw footage for 4-6 months.

Encryption:

Full disk encryption for onboard servers and end-to-end encryption for transmitted data. Encryption to extend to the onboard camera feeds (https)

Interoperability:

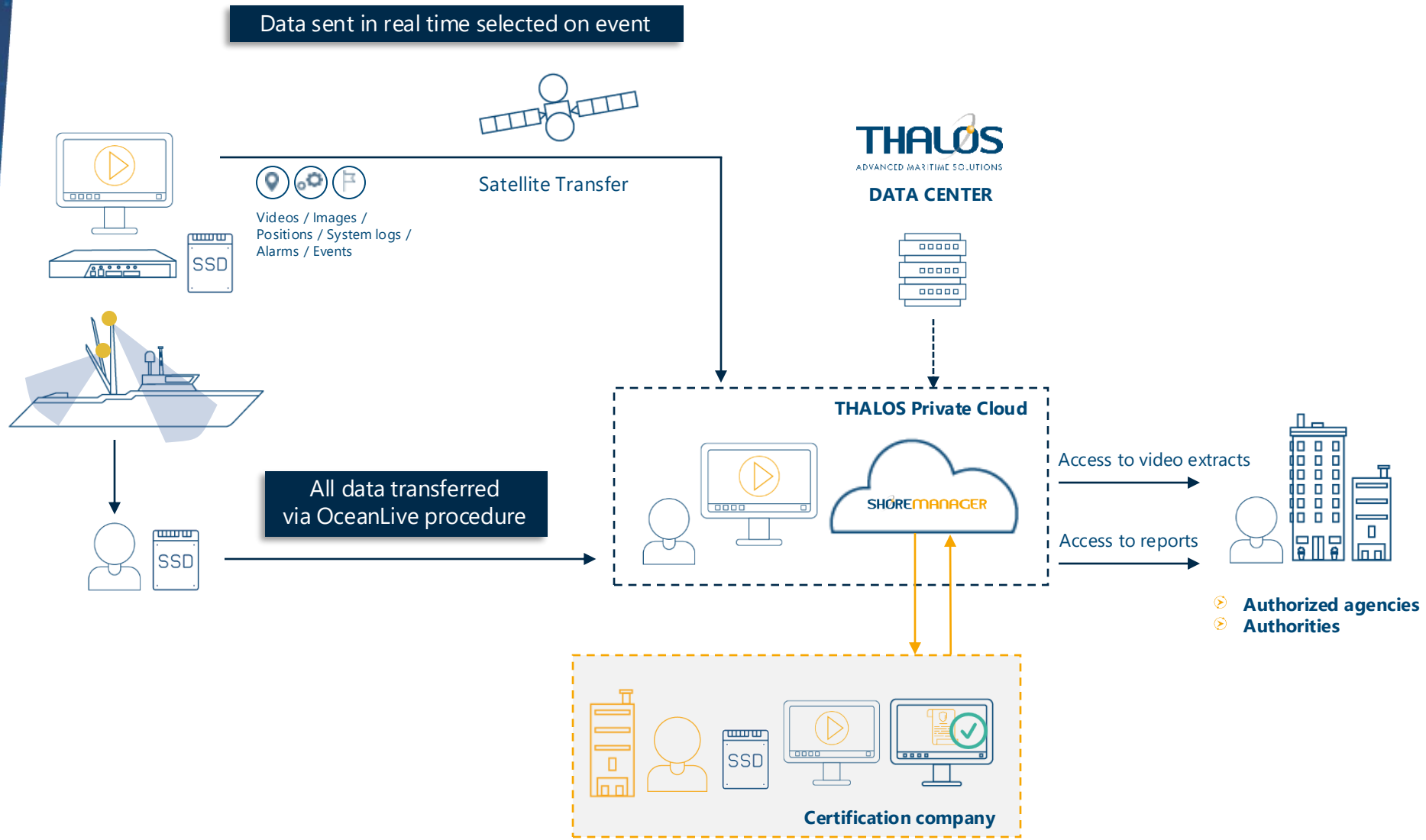
ISO-standardized formats for metadata and video to enable cross-RFMO collaboration.

THALOS
ADVANCED MARITIME SOLUTIONS

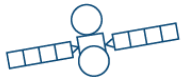
OCEANLIVE

EM standards
ISSF meeting december 2024

SYSTEM DIAGRAM



DATA MANAGEMENT



- **OceanLive system handles all the data transmission**
  - Through satellite link – in real time
  - Through terrestrial link – asynchronous

- **OceanLive system integrates a secure onshore data store**
  - Saved, stocked and secured data in our data center for 3 years

- **OceanLive data accessible through ShoreManager portal**
  - Monitor fleet operations
  - Go back on the timeline

OPERATIONAL PURPOSES

CERTIFICATION & CATCH VALUATION

- FAD-free fishing
- Compliance with MSC rules

REGULATORY USES

- Rejects monitoring
- Catch estimation
- Transshipment monitoring
- MARPOL law compliance
- Social and environmental behavior

SUPERVISION & SAFETY

- Control of fishing operations
- Alarms on human presence in dangerous areas
- Vessel environment control

SCIENTIFIC APPLICATIONS

- By-catch assessment
- Best practice for fish reject on board

FLEET OPERATION MONITORING

- Real-time information on fishing activity
- Monitoring
- Management & strategy

EM standards

EM standards harmonization

- What are your concerns about EM standards?
  *Define programs frame and program compliance. Do not focus on how the system work but on which **data** should be reported*
- What do you think EM standards/implementation are doing wrong? And the advantages/benefits?
  *Many pilot projects! We need **harmonization and stability** to have large deployment projects.*
- What do you miss in the EM standards?
  *Target level of **performance** that allow AI integration?*
  ***Data format** to be provided*
- What difficulties do you face in adjusting the systems, reviewing the data in/for different oceans/regions and complying with different standards?
  ***System is flexible** and can be adapted*
  But it's complicated to tudy each program needs
  *New onboard system parts are **long to deploy onboard***
- What do you need from this process or EM implementation in tunaRFMOs?
  *Data requirement harmonization and a **comparaison sheet** (already done!)*
- In your opinion, what are the most important components/elements and requirements of EM standards? What are the musts of any EM standards?
  ***Data requirements** more than technical requirements*


THALOS
ADVANCED MARITIME SOLUTIONS

zunibal

Electronic Monitoring
Minimum Standards Harmonization Workshop

10/12/2024

From a technological provider's perspective

What concerns us?

- Homogeneity across RFMOs and CPCs
- Focus on real functionality
- Flexibility for different contexts
- Scalability
- Accessibility
- Barriers to innovation

Is a control unit a requirement?

Does it impose a specific installation typology?

Can it adapt to all contexts?

Could cameras take on this role in the future?

Should we focus more on...

- What types of alerts?
- Continuous video display aboard?
- Ensure timely access?

If we want to reduce the gap between the event and its analysis by migrating to cloud solutions without compromising observation quality…

… it requires Edge Computing developments and reaching a compromise on the required quality (resolution and FPS)

- **Extensive and Complex Installations:** In installations with many weak points that are difficult for ship officers to control, prioritizing **Tamper-Evidence measures** is essential.

- **UPS**: We need to consider the objective: ensuring a **controlled shutdown** or recording for the **maximum amount of time**.

  We must also take into account the **impact on cost and space** that it may have on certain types of vessels

Remote Fleets with Long Trips

For fleets operating in remote areas and relying solely on disks, it's crucial to be cautious with **storage and transmission requirements**.

Ships with Communication Systems

On vessels equipped with advanced communication systems, **high back-up requirements** become less relevant.

Post-Trip Data Storage

Minimize storage time and/or prioritize the most valuable data.

- **System Health Check and Alert Sending:** a common point but with significant disparity. This is an area where harmonization efforts can provide valuable insights.

- **Areas and Activities to Cover:** the first fundamental point where we should aim for complete harmonization, as it is the root of functionality. **What do we want to see?**

- **Vessel Monitoring plan (VMP):** RFMOs and CPCs, have the opportunity to create a unified platform for document management.

- **Responsibilities:** an area where there is an opportunity to establish a common guideline while considering the potential cost impact (e.g., 24/7 technical support).

Interoperability

Providers have moved from adding value to raw videos/data through review software to **creating value on the vessel**, capturing valuable data at the source.

AI as a Major Gap

Likely the most overlooked aspect in standards and the one that will require the most oversight as its implementation progresses.

Thank you!

zunibal

Datafish Technology Solutions

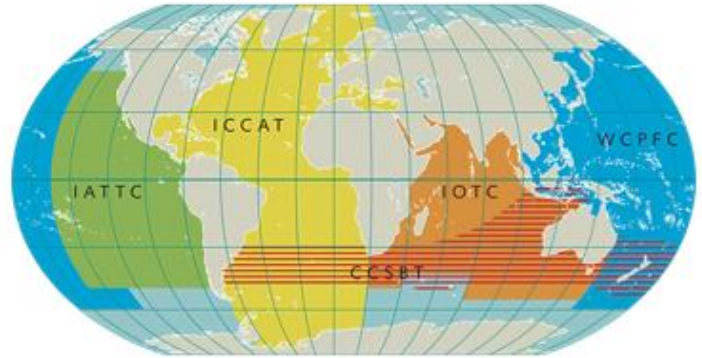
RFMO EM minimum standards harmonization workshop

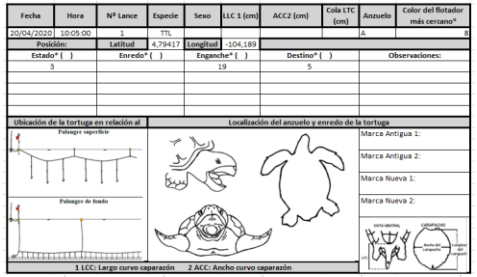
San Sebastian, 10th December 2024

Itziar Canive Pinedo

Background, what do we do?

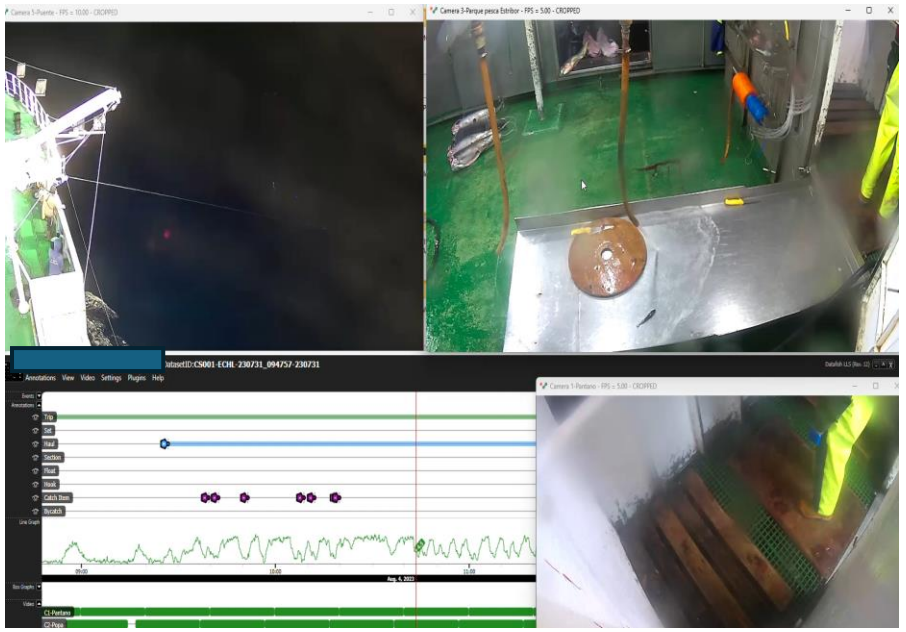
- Collect scientific data on board and on land EM.
- Involved in PNDB, BBPP, LO (compliance), FOS, mammals, scientific campaigns IEO and AZTI…
- **VMP:** Installed >100 vessels (BB, PS, LL, TW) → different providers.





REGISTRO DE LANCE PALANGRERO

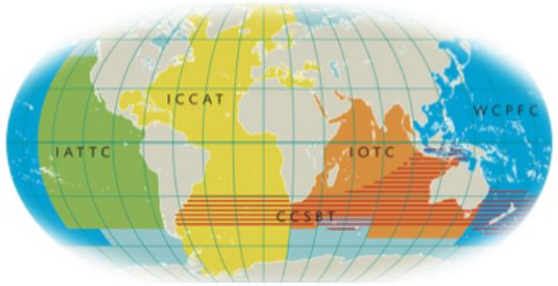
EMBARCACIÓN: SIEMPRE JUAN LUIS		MUESTREO: ESP-TRP-02444120200409172939				OBSERVADOR: OBSERVACION ELECTRONICA					
N° Lance	1	LANCE		RECOGIDA		Número de anzuelos al mar por tipo:	Anz. A	Anz. B	Anz. C	Carnada 1	tipo de carnada	% del total
		Inicio	Fin	Inicio	Fin							
↓ Fecha ↓	LAT	4,811	4,1995	4,853167	4,338		960				CABALLA	100
	LON	-104,1048	-104,6323	-104,1147	-104,7005	N° total anzuelos al mar:		960		Carnada2		
19/04/2020	HORA	19:51:00	1:45:00	8:56:00	18:17:00	N° anzuelos perdidos:				Carnada3		
Pesca objetivo	Lance	Sí	Dirección recogida		Temp. agua	N° anz. entre flot.	Profundidad de los anz.	¿Palangre de fondo?				
	¿Especial?		Inicio a fin	X				Sí	No			
7	¿Patrullado?		Fin a inicio			4						
Observaciones:												



Concerns about EM standards:

- Videos+**GPS** (+sensors): that only IOTC specifies as a requirement.
- **EM data:** it is important to know first the programme(s) for which the fishing data need to be collected→verify that the EM installation is suitable for this purpose.
  - What could we do if something is moved or not working?
- EM recordings **custody** period, or only raw data custody, or only data collected → need more specifications about what information to store and for how long.
- EM data: Requirements/**qualifications** for on board observers and electronic observers are not detailed, not well defined (UNE 195007).

EM implementation:



- **What do you think EM standards/implementation are doing wrong?** Requiring different levels of compliance and coverage or data collection accuracy from EMS in different RFMOs.
  - VMP specifications should describe all information about the components, provider, areas covered, configuration of each camera…..and the purpose of the data collection <u>at that time</u>.

- **Realising the importance of detecting system failures in real time** → not to lose recordings → increase coverage and less "failures", lack of evidences (real time connectivity as a must).

EM misses:

- **Electronic reporting and monitoring:** not defined but IOTC → Need to track the EMS status of each vessel to verify that it is recording properly.
- **How to do EM certifier?** More details about how to review analysis with procedures and quality of the data collected →how to do the verification process.
- The importance of an **UPS/backup** in order not to lose fishing activities during a trip (WCPFC only) should be included in the EM components and VMP.
- **Face masking:** specify while analysing or afterwards when sending evidences to RFMOs?

EM gaps and future opportunities:

- Need to develop AI tools to automaticaly detect fishing activities→ reporting faster to RFMOs.
- A common report from different providers to compare same data, using same procedures to collect the fishing activities and details.
- **Harmonization process**: EM data compatibility between reviewers using any software to review any EM recordings or translate them using a **common code** being able to access the information on a disc →compare procedures and different sources of information.

Thank you for your attention!

7.5. Appendix 5 - Tuna RFMO EM Standards and Requirements Comparison document

Comparison of Tuna RFMO Electronic Monitoring Standards and Data Requirements

12/5/2024

Jenny Moffett[1], Mark Michelin[1], Hilario Muria[2]

[1]CEA Consulting
[2]International Seafood Sustainability Foundation

Analysis sponsored by The Nature Conservancy

This document provides a brief overview of the methodology used to develop the comparison of electronic monitoring (EM) standards, which will facilitate discussion at the upcoming workshop in San Sebastian. The analysis compares EM standards and requirements across four tuna RFMOs: IATTC, ICCAT, IOTC, and WCPFC (*note*: this analysis used the draft WCPFC standards, not the adopted version). It summarizes the level of harmonization across the various elements of the standards and identifies notable differences.

Methodology

Two worksheets were prepared to facilitate discussion in San Sebastian, covering EM standards and data requirements. The methodology for preparing these worksheets is as follows:

- **Program Standards**
    1. All four EM standards documents were reviewed individually as a first step. Any requirements or recommendations from the standards documents were identified (generally starting after the resolution and goals sections) and added as a row to a spreadsheet with a simple title for that standard. This step was executed as comprehensively as possible so that most of the language within the standards documents' requirements sections was ultimately included in the spreadsheet.
    2. The spreadsheet describes the standard as required, recommended, or optional based on the exact language used in the standards document (shall/must, should, and may/could, respectively).
    3. All relevant language for a given standard was also pulled directly from the standards documents and included. As such, any language pertinent to a given standard is already included in the spreadsheet, reducing the need to cross-reference multiple documents.
    4. Once all the standards from the four RFMOs' standards documents were pulled into an individual row for that requirement, the rows were consolidated.
    5. In many cases, three or four RFMOs had similar or nearly identical requirements. Where not all four RFMOs mentioned a requirement, the standards documents for those that did not were rechecked to confirm that the standard was not mentioned. If an RFMO's

standards document did not mention a standard mentioned by other RFMOs, “N/A” was written.

6. The standards were reorganized into categories and subcategories to facilitate easier review.
7. A summary column was added to the spreadsheet. This column summarizes notable similarities and differences between the RFMOs for each standard.
8. *Note:* for the Definitions category, “Yes” indicates that that term was defined, “Similar term” indicates that a similar term was defined, and “Split terms” indicates that the term is defined but across multiple more narrow terms.
9. *Note:* for the Program Characteristics category, “Yes” indicates that the program, requirement, or goal is applicable or exists.

- **Data Requirements**
    1. The data requirements listed in each RFMO’s EM standards were added to a separate worksheet, each as an individual row. Data requirements for all vessels, longline, and purse seine are included. *Note*: as IOTC requires collecting the complete ROS minimum standards, the document's structure is primarily derived from the structure of those standards.
    2. In the headers (row 1) for each RFMO, the location of each set of standards is included in parentheses. IATTC, ICCAT, and IOTC’s data requirements are within the EM standards. The headers in row 2 are derived from each RFMO’s data requirements tables. Each RFMO included a field name and description for each requirement. WCPFC included for some data requirements an EM protocol, and ICCAT included whether a data requirement informed scientific or compliance efforts. IOTC also included the requirement level for each data field (i.e., required or optional). Some IOTC data fields are not required, which is not true for the other three RFMOs’ included data fields.
    3. Once all data requirements were pulled into the spreadsheet, the rows were consolidated. The requirements and recommendations were reorganized by category (primarily based on the IOTC categories, with some refinements).

Please refer to the attached Excel workbook for the complete comparison that includes both worksheets.

Category	Subcategory	Type	Standard	ICCAT		IOTC		IATTC		WCPFC		Summary of Level of Harmonization
Definitions			**Electronic Monitoring**	N/A	N/A	Yes	The use of electronic devices to record fishing vessel's activities using video technology linked to a Global Position System (GPS), which may include sensors.	Yes	The use of EM equipment to record a vessel's activities	N/A	N/A	Aligned. IOTC is more specific, noting GPS and potential for sensors.
			Electronic Monitoring System	N/A	N/A	Yes	The system comprising the vessel and shore-based components for collecting, transmitting and reviewing EM records, reporting of EM data and implementing an EM Program.	Yes	A system for implementing EM aboard vessels, and for collecting, processing, and analyzing the resulting EM records	Yes	All the vessel and shore-based components supporting the generation, storage, transmissions, analysis and reporting of EM Records.	Not aligned--WCPFC and IOTC are about infrastructure, whereas IATTC appears to be more about process
			Electronic Monitoring Standards	N/A	N/A	Split terms	"EM Program Standards" -- the agreed standards, specifications and procedures (SSP) governing the establishment and operation of an EM Program, applicable to all components of the EMS. "EM Data Standards" -- the agreed subset of data requirements by the IOTC Regional Observer Scheme (ROS) that could be collected by the EMS	Yes	The agreed standards, rules, and procedures governing the establishment and operation of an EMS, applicable to all components of the system as they may be used for specified vessels in a specific area and/or type of fishing activity	N/A	N/A	Largely aligned in terms of defining the broader EM program/system, with IOTC going one level deeper to specifically defne "data standards".
			Electronic Monitoring System Program	N/A	N/A	Similar term	Called "EM Program" -- a process administered by a national or regional administration that regulates the use of EMS on vessels to	Yes	A national or regional program established for implementing an EMS	Similar Term	Called "Electronic Monitoring Program" -- A national or regional program responsible for managing the use of EM systems to independently collect and generate fisheries	Largely aligned, with a focus on the program that manages and administers EM system, with IOTC

							collect and verify fisheries data and information responsible through an implementation of an EMS in a defined area and/or fishery.				data and information. This is different to the WCPFC EM Program.	noting the Program also "regulates" the EM system
			Electronic Monitoring Equipment	N/A	N/A	Yes	A network of electronic cameras, sensors and data storage devices installed on a vessel and used to record the vessel's activities.	Yes	A network of electronic cameras, sensors and/or data storage devices installed on vessels and used to record these vessels' activities	N/A	N/A	Aligned.
			Electronic Monitoring Records	N/A	N/A	Yes	Imagery, and possibly sensor, raw data linked to positional data collected by an EM equipment that can be reviewed to produce EM data.	Yes	Images and other data recorded by the EM equipment	Yes	Footage (still images and video) and sensor data (if applicable) recorded by an EM System that can be analysed to generate EM Data. Sensors may include any number of sensors (e.g., hydraulic sensors) that are part of the EM equipment and whose data is recorded on the vessel as part of the EM system.	Aligned. IOTC specifies linking this to positional data
			Electronic Monitoric Data	N/A	N/A	Yes	Processed/analysed data produced through review of EM records that conforms with the EM data standards.	Yes	Data resulting from analysis of EM records	Yes	Data generated through analysis of EM records	Aligned.
			Electronic Monitoring Analysis	N/A	N/A	Yes	The review of EM records by EM observers/reviewers to produce EM data.	Yes	The analysis of EM records to produce EM data	Yes	The process of an EM Analyst reviewing EM records to generate EM Data.	Aligned.
			Electronic Monitoring Analyst	N/A	N/A	Similar term	Called "EM Reviewer/Observer" -- a person qualified to review EM records, store and produce EM data in accordance with the EM Data standards and analysis procedure.	Yes	A person qualified to analyze EM records and produce EM data.	Yes	A person qualified by the appropriate EM Programme provider to analyse EM records and generate EM data in accordance with the EM standard and analysis procedures.	Aligned.

			Electronic Monitoring Review Center	N/A	N/A	Yes	Local, national, or regional office facility where EM records are received and reviewed to produce and store EM data.	Yes	A facility where EM records are analyzed to produce EM data	Similar Term	Called "Data Review Center" -- A facility or entity with supporting software platform(s) used to analyse EM records and generate EM data. This could be a standalone facility or a designated space within the premises of the fisheries administration.	Somewhat aligned--describe the same general concept of a facility where records and analyzed into data, but have varying degress of specificity over software, location, jurisdiction, and scope.
			Electronic Monitoring Coverage	N/A	N/A	Split terms	Split into three: "EM Installation Coverage" -- the proportion of vessels by fleet that has EM equipment installed that is operational "EM Record Coverage" -- the proportion of fishing effort for which EM records are collected by installed EM equipment "EM Observer/Review Coverage" -- the proportion of fishing effort for which EM records are reviewed to produce EM data and submitted to the IOTC.	Yes	The proportion of the vessels or fishing activities that is effectively covered by the EMS.	Yes	The proportion of vessels or fishing effort that are recorded by the EM Program. Note that this definition not analogous to the commonly used definition of observer coverage. The analogous quantity can be determined by multiplying the EM coverage rate by the EM analysis rate.	Not very aligned--IOTC specifies different rates for level of installation, level of record generation, and level of data (i.e., records turned into analysis). IATTC is vague, unclear if referring to sensor, record, or data coverage rates. WCPFC specifically notes its definition is for rate of fishing effort with record.s
			Electronic Monitoring Review Rate	N/A	N/A	N/A	N/A	Yes	The proportion of EM records that are analyzed to produce EM data.	Yes	The proportion of e-monitored records that are analysed to produce generate EM data.	Aligned.
			Electronic Monitoring Service Provider	N/A	N/A	Yes	A third-party provider of EM equipment (and/or system), technical and logistical services to maintain the EM	Yes	Provider of EM equipment and/or technical and logistical services.	Yes	A provider of EM technical and logistical services. An EM Programme may have multiple EM Service Providers and they may provide different	Mostly aligned, except that WCPFC does not specify that this includes provider of

							equipment and monitor its proper functioning.				services within the programme (e.g., onboard hardware, DRC software, DRC review services).	equipment, while IATTC and IOTC do.
			Electronic Reporting	N/A	N/A	Yes	The use electronic systems (application, software, form or file) to record, store, receive and transmit fisheries data.	N/A	N/A	N/A	N/A	Only found in IOTC
			Monitoring	N/A	N/A	Yes	The requirement for the continuous collection of fishery-related data.	N/A	N/A	N/A	N/A	Only found in IOTC
			Electronic Tool	N/A	N/A	Yes	Any electronic tool that is used to support fisheries-dependent data collection, both on shore and at sea, including electronic reporting (ER) and electronic monitoring (EM).	N/A	N/A	N/A	N/A	Only found in IOTC
			Vessel Monitoring Plan	N/A	N/A	Yes	The vessel's EM equipment characteristics and how the vessel's EM equipment is installed and configured to monitor fishing activities and meet the EM Program and EM Data Standards as required by the IOTC Regional Electronic Monitoring Program.	N/A	N/A	Yes	A document describing how an electronic monitoring system is specifically positioned and configured on a vessel (e.g. camera placement with images of camera views and types and locations of sensors) to allow effective monitoring of fishing activity and accurate generation of EM Data specified by the EM Program.	Mostly aligned, describing the EM equipment, its installation, and its configuration to properly generate records. WCFPC does not say that this includes the equipment itself, only installation and configuration.

			Electronic Monitoring Review System	N/A	N/A	Yes	Application software used by the EM observer to review the EM records and produce the processed EM data as per the EM data standards.	N/A	N/A	Similar Term	Called "Electronic Monitoring Analysis Software" -- any software used by an EM Analyst to generate EM data. This software is often provided by the EM Service Provider and can include a range of features that facilities the efficient work of the EM Analyst.	Aligned.
			Electronic Monitoring Review Provider	N/A	N/A	Yes	A third-party provider of EM review services to review EM records to produce EM data. The same third-party organization can provide both the EM equipment and EM review services but they can also be supplied by different providers.	N/A	N/A	N/A	N/A	Only found in IOTC
			Ancillary Logs	N/A	N/A	N/A	N/A	N/A	N/A	Yes	Data records from the EM system that are supplemental to the EM Records, such as a record of changes in system configurations and settings and a summary of system health checks performed.	Only found in WCPFC
			Artificial Intelligence	N/A	N/A	N/A	N/A	N/A	N/A	Yes	A machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations or decisions influencing real or virtual environments. Artificial intelligence systems use machine and human-based inputs to (A) perceive real and virtual environments; (B) abstract such perceptions into models through analysis in an	Only found in WCPFC

												automated manner; and (C) use model inference to formulate options for information or action.	
			Control Center	N/A	N/A	N/A	N/A	N/A	N/A	Yes	The EM control centre is a computer and software system that records and stores information from EM System components (e.g., video, sensor data, GPS data, system log data) and also controls the operation of onboard EM system components.	Only found in WCPFC
			Electronic Monitoring Audit Requirements	N/A	N/A	N/A	N/A	N/A	N/A	Yes	The WCPFC agreed standards and procedures to be followed by an EM program in order to support the WCPFC agreed audit and assurance process. The requirements may include standards on processes such as EM record and EM data retention.	Only found in WCPFC
			Electronic Monitoring Certifier	N/A	N/A	N/A	N/A	N/A	N/A	Yes	An individual or organisation which has been approved by the appropriate authority to inspect and approve EM systems for use.	Only found in WCPFC
			Electronic Monitoring Data Requirements	N/A	N/A	N/A	N/A	N/A	N/A	Yes	The WCPFC agreed minimum data fields with associated data standards that must be generated from EM records and ancillary logs.	Only found in WCPFC
			Designated Installer or	N/A	N/A	N/A	N/A	N/A	N/A	Yes	A person or entity authorised by an EM Service Provider to	Only found in WCPFC

			Service Technician									install or service an EM System.	
			Event	N/A	N/A	N/A	N/A	N/A	N/A	Yes	An occurrence in the EM Records that is enumerated into EM data.	Only found in WCPFC
			Fishing	N/A	N/A	N/A	N/A	N/A	N/A	Yes	As defined in WCPFC Convention Article 2(d)	Only found in WCPFC
			Fishing Trip	N/A	N/A	N/A	N/A	N/A	N/A	Yes	The period between either (a) a vessel's departure from port after unloading part or all of the catch to transit to a fishing area, or (b) a vessel recommences fishing operations or transits to a fishing area after transshipping part or all of the catch at sea, and the time that the vessel either (c) returns to port to unload part or all of its catch, of (d) ceases fishing operations to tranship part or all of its catch at sea.	Only found in WCPFC
			Geolocation Device	N/A	N/A	N/A	N/A	N/A	N/A	Yes	A device that is used to capture information on vessel position that can also be used to determine vessel speed and heading.	Only found in WCPFC
			Independent	N/A	N/A	N/A	N/A	N/A	N/A	Yes	With respect to audits - no financial or current employment interest with the DRC	Only found in WCPFC
			Regional Agency	N/A	N/A	N/A	N/A	N/A	N/A	Yes	A regional or sub-regional organisation that may support CCM national EM Programs and EM Systems.	Only found in WCPFC
			Review for Data Quality	N/A	N/A	N/A	N/A	N/A	N/A	Yes	The verification process of re-analysing/interpreting a portion of previously analysed EM records to determine completeness, adherence to protocols, and accuracy of the EM	Only found in WCPFC

												Data produced by the EM Analyst.	
			Sensors	N/A	N/A	N/A	N/A	N/A	N/A	Yes	EM systems may be equipped with a variety of integrated sensors that can provide additional information on fishing activity, trigger activation or adjustment of configurations of cameras, and identify points of interest to expedite EM video review. This may include "synthetic sensors" that use camera imagery used to capture imagery of fishing activities.	Only found in WCPFC
			Uninterruptible Power Supply (UPS)	N/A	N/A	N/A	N/A	N/A	N/A	Yes	Provides power to the system and enables controlled shutdown in the event of a power loss so as to preserve the security and integrity of data 1.	Only found in WCPFC
			User Interface	N/A	N/A	N/A	N/A	N/A	N/A	Yes	A display that communicates EM system status messages and provides views of onboard cameras.	Only found in WCPFC
			Vessel Operator	N/A	N/A	N/A	N/A	N/A	N/A	Yes	Any person who is in charge of, directs or controls a vessel, charterer and master.	Only found in WCPFC
Technical	**EM System**	**Control Box/Center**	**Control Box/Center**	Required	Minimum EMS components shall include an electronic Monitoring (EM) control box/center… The EM control center will be an onboard computer that acquires and stores all	Recommended	An EM equipment to be installed on board of a fishing vessel should consist of a control system connecting a number of cameras, and optionally to a number of different sensors, to collect and record images to address the	Required	N/A	Required	The EM system control centre: a. MUST control all onboard EM hardware components.	All RFMOs require or recommend (in the case of IOTC) a control box/center, though IATTC does not specifically name or lay out technical requirements for a control

				sensor-collected information and imagery footage.		objectives of the EM Program.				box though it is included in the VMP template.
		Onboard Interface/Screen	Required	An on-board screen, or equivalent interface, to allow verification by the Master/crew of the correct functioning of the system, is required.	N/A	N/A	Required	The onboard interface shall include an on-board screen, or equivalent interface, to allow verification by the skipper/crew on correct functioning of EM equipment.	Required	The onboard user interface: a. MUST include a display on the vessel. b. MUST include software or hardware that shows EM system health status and real time images from installed cameras on the display. c. MUST allow only authorised users (e.g., EM Service Providers, EM service technicians) to adjust system configurations. d. COULD Include a keyboard, mouse, touchscreen, or other device to allow user inputs to the system. b. System SHOULD undertake regular system health checks throughout the duration of the fishing trip at a frequency defined by the EM Programme and MUST show malfunction alerts (errors and warnings) on the display of the user interface (Onboard User Interface) of the control centre.	ICCAT and IATTC both require an onboard screen or interface for the purpose of verifying that the EM system is functioning. IOTC does not mention any onboard interface, but does require that someone onboard report system malfunctions, which would require some way for a crew member to identify a malfunction. WCPFC also requires an interface to ensure system health status and that the EM system is functioning but also that shows real-time images from each camera. WCPFC states this should undertake regular health checks and requires that it displays malfunction

												alerts, which ICCAT and IATTC do not specifically mention. Their standards do mention malfunction alerts (covered below), but do not actually specify that the alerts should appear proactively on the onboard interface. There is a difference between ability to verify functioning and being alerted of malfunctions. WCPFC also states the system optionally could have a way to allow user inputs, which no other RFMO mentions, though in "Manual Operation" IATTC recommends manual functionality onboard, which would require some way to allow user inputs.

		Data Storage	Required	EMS shall have sufficient autonomy and capacity to safeguard and store all recorded images and, where appropriate, sensor information for at least the duration of a complete fishing trip. Sufficient data storage capability to store both sensors, where appropriate, and imagery footage for the entire trip.	Recommended	The EM equipment should have enough storage capacity to store all EM records for a certain period of time, which should be at minimum a complete trip. The duration will depend on the vessel's operational characteristics that could range from 4 months (in the case of purse seiners) to 12 months or more (in the case of longliners).	Required	EM equipment shall include sufficient capacity to store all required EM records, including GPS (or equivalent) records position date, time, vessel name and sensor information where applicable at a minimum, for the duration of a fishing trip. Vessels shall have onboard enough blank data storage devices (preferable solid-state drives) in case these must be replaced at sea; a specially trained crew member may need to replace the devices during a fishing trip if the data storage capacity is exhausted, always in coordination with the EM service provider.	Required	The EM system control centre: d. MUST have sufficient storage capacity for all EM Records required to be generated [during a fishing trip] until EM Records are transmitted to a DRC for review.	All RFMOs require (except IOTC, which recommends) enough data storage for a complete trip, though IOTC does specify that this minimum storage capacity may vary depending on gear type. This is implied by trip duration requirements, generally. WCPFC's requirement is actually more vague, in that it doesn't actually state its requirement as a trip length, but as "until EM records are transmitted".
		Data Storage Backup	Required	At least one removable/swappable back-up data storage device, or equivalent data storage mechanism, required to ensure that data are not lost if a storage device fails.	Recommended	The EM equipment should include separate, duplicate backup devices to ensure that data are not lost if a storage device fails.	Recommended	EM equipment should include separate backup devices, to ensure that data are not lost if one device fails. Vessels shall have onboard enough blank data storage devices (preferable solid-state drives) in case these must be replaced at	Recommended	The EM system control centre: e. SHOULD have sufficient backup storage to mitigate potential data loss.	All RFMOs have nearly identical recommendations. ICCAT is the only RFMO that requires this, while the rest commend it. IATTC also requires that vessels have blank storage devices onboard in case they must

								sea; a specially trained crew member may need to replace the devices during a fishing trip if the data storage capacity is exhausted, always in coordination with the EM service provider. \			be replaced at sea.
		Barcoded Hard Drives	N/A	N/A	N/A	N/A	N/A	N/A	Recommended	The EM system control centre: f. SHOULD have unambiguous and unique identification of storage devices (e.g., barcode on hard drives).	Only WCPFC recommends this, though the "Traceable" section may imply a similar level of functionality for other RFMOs.
		Uninterruptable Power Supply	Required	Uninterrupted power supply (UPS) including a battery backup or other backup power system with capacity to provide power if the main power source from the vessel fails and allowing the continuation of recording for relevant timespan (for e.g., 15 minutes) and all recorded data are saved.	Recommended	The EM equipment should have its own uninterruptible power supply or be connected to that of the vessel to ensure that it can work even in the event of a vessel power outage.	Recommended	EM equipment should be protected against onboard power outage, with backup power system capable to keep operating until the vessel power is restored (e.g., 30 minutes).	Recommended	The EM system control centre: b. MUST be able to connect to the vessel's power source and sustain this power source throughout the duration of the fishing trip. The EM system SHOULD include a UPS in the event that the main source of power is interrupted.	All RFMOs require/recommend protection against power outtages that allows continued system operation until power is restored. Only ICCAT and WCPFC require this. ICCAT, IOTC, and IATTC specifically name a UPS, though only ICCAT requires it. IOTC and WCPFC allow instead the EMS could be connected to vessel power. Backup power to keep the system

										operating and recording until power is restored is described by all RFMOs. Only ICCAT names a battery backup, while ICCAT and IATTC name a backup power system, as well as time frames for how long recording should continue after power fails (though these are examples and differ--15 minutes and 30 minutes).
		Controlled Shutdown	Required	Controlled shutdown, preventing the system from being switched off accidentally. Uninterrupted power supply (UPS) including a battery backup or other backup power system with capacity to provide power if the main power source from the vessel fails and allowing the continuation of recording for relevant timespan (for e.g., 15 minutes) and all recorded data are saved.	N/A	N/A	Recommended	EM equipment should also save EM records collected when the vessel power is down for longer periods than the backup system was designed for.	N/A	N/A	ICCAT and IATTC both describe a requirement (recommendation under a requirements section for IATTC) to save EM records even if the backup power system fails, otherwise known as some form of controlled shutdown. Only ICCAT specifically calls for controlled shutdown. IOTC and WCPFC do not have a requirement for a controlled shutdown.

	Cooling System	Recommended	Cooling system, with high temperature cut out.	N/A	N/A	N/A	N/A	N/A	N/A	Only ICCAT recommends a cooling system and high temperature cut out. All RFMOs have durability requirements, detailed under "Durable", but do not mention temperature or mandate use of a cooling system or a high-temperature cutout requirement.
	Manual Operation	Required	Controlled shutdown, preventing the system from being switched off accidentally.	N/A	N/A	Recommended	It should be possible for data recording to be controlled manually in the case the EM equipment fails to start or stop automatically and any manual activation should trigger an alert. Manual shutdown should not be permitted.	Optional	The onboard user interface: d. COULD Include a keyboard, mouse, touchscreen, or other device to allow user inputs to the system. [Cameras] d. COULD be capable of accommodating remote or onboard configuration of parameters to optimise camera functionality throughout a typical fishing trip;	ICCAT requires a way to prevent accidental shutdown onboard, though this statement is vague and references controlled shutdown, which is different in nature. IATTC recommends that manual shutdown should not be permitted. ICCAT only describes this as "accidental" not "manual", which would be a broader requirement. IATTC also recommends data recording be allowed to be controlled manually, though any manual

											activation should trigger a real-time alert. WCPFC states that optionally onboard systems would include a way to allow user inputs, particularly onboard configuration of parameters to optimize camera functionality.
	Cameras	**Cameras**	Required	Minimum EMS components shall include electronic Monitoring (EM) control box/centre, including a satellite positioning system, e.g., the global positioning system (GPS) or equivalent, hereafter referred to as GPS, video cameras... **EMS cameras**, and where appropriate sensors, shall be installed to properly capture all relevant fishing activity.	Recommended	An EM equipment to be installed on board of a fishing vessel should consist of a control system **connecting a number of cameras**, and optionally to a number of different sensors, **to collect and record images to address the objectives of the EM Program**. The number of cameras and sensors should be tailored to each vessel to meet overall objectives of the program rather than being too prescriptive and should include a sufficient number of cameras.	Required	**Cameras shall be in sufficient number and quality to meet the data requirements of the EMS**, with high-resolution images that allow the identification of species, specific fishing activities, and vessel surroundings.	Required	a. An EM system MUST be outfitted with cameras to capture imagery of fishing activity. b. The number and position of cameras MUST be sufficient to capture necessary imagery to allow generation of the data fields set out in the EM data requirements. c. Cameras MUST, capture imagery that meets image quality standards under typical fishing conditions that allow for an EM Analyst to generate the data fields set out in the EM data requirements...	All RFMOs require (except IOTC, which recommends) a number of cameras that is sufficient to meet the requirements of the EM program, although ICCAT's standard is a bit more vague in stating that they must capture all relevant fishing activity.

			Option to Utilize Still Images	Optional	Possibility to set between video and still photographs and to set the time of taking those photographs.	Optional	The preferred EM equipment configuration would be the one that allows a greater number of images (frames) of higher quality/resolution. Digital video is generally preferred, but still images can also be a viable option to capture information during the various phases of the vessel activity. However, considering that storage capacity is limited, an optimal configuration may have video on certain areas/cameras/moments, while still photos on others. In the case of photographs, the minimum requirement should be that a picture is taken by the camera with viewing angle fully covering the fish management areas at least every 2 seconds when fishing action occurs (Restrepo et al., 2018). Image quality should also be adequate enough to allow accurate collection of all required data field, such as species ID, FAD materials and design, or bait used and, hence, achieve the monitoring objectives.	Optional	Digital video is typically preferred for capturing information during the different phases of vessel activity, but still images can also serve as a viable option, especially due to limited storage capacity. An optimal configuration may involve a camera setting, using video for specific areas, cameras, or moments, while utilizing still photos for others.	Optional	WCPFC defines footage as "still images and video".	IOTC and IATTC both make note of a preference for digital video, but allow the option to collect still images especially to optimize data storage. Both describe that an optimal layout may include cameras collecting video in some areas and cameras collecting still photos in others. ICCAT and WCPFC do not specify anything of this nature, but describe footage or camera capabilities in a way that indicates still images are accepted or desired.

		Video Camera Resolution	Required	High resolution and sufficient resolution to meet the purpose of each camera is required. For cameras used for species identification, no less than 720p.	Recommended	Digitial, high-resolution where possible.	Required	For cameras used for species identification, video shall have a resolution no less than 720p.	Required	2. Resolution MUST be no lower than 720p for any imagery requiring identification of species.	IATTC, ICCAT, and WCPFC are aligned in requiring that cameras used for species identification have a resolution of no less than 720p. IOTC only recommends high-resolution video, but does not specify a specific minimum standard for progressive scan ("p").
		Video Frame Rate	Required	For cameras used for species identification, no less than 720p, with a minimum frame rate of 5-10 FPS.	N/A	N/A	Required	For cameras used for species identification, video shall have a resolution no less than 720p, with a minimum frame rate of 5-10 FPS.	Required	1. Frame rate MUST be no lower than 5 frames per second (fps) for any imagery requiring identification of species	ICCAT and IATTC have identical minimum standards of 5-10 FPS for cameras used for species identification while WCPFC requires the rate must be no lower than 5 FPS. IOTC does not name a identify minimum frame rate.
		Still Image Capture Interval	Optional	Possibility to set between video and still photographs and to set the time of taking those photographs.	Recommended	In the case of photographs, the minimum requirement should be that a picture is taken by the camera with viewing angle fully covering the fish management areas at least every 2 seconds when fishing action occurs (Restrepo et al., 2018).	Required	Still images shall have a minimum capture interval of no more than 1 second.	Optional	The EM system COULD be able to capture and store single frame images from each onboard camera on a regular basis (e.g., timed intervals, such as hourly, or on event triggers such as geofences) to show that cameras are operational, not obstructed, obscured, or displaced.	IATTC requires a minimum still image capture interval of 1 second, while IOTC recommends a minimum of 2 seconds. IOTC's standard only apply to a camera fully covering the

										fish management areas. ICCAT and WCPFC do not include a minimum capture interval for still images, though ithey suggest it would be possible to set an interval.
		Still Image Camera Resolution	Required	Still images shall have a resolution of no less than 2MP.	Recommended	Image quality should also be adequate enough to allow accurate collection of all required data field, such as species ID, FAD materials and design, or bait used and, hence, achieve the monitoring objectives.	Required	Still images shall have a resolution of no less than 2MP.	N/A	N/A	ICCAT and IATTC have identical standards of 2MP while IOTC recommends that image quality is adequate to allow accurate collection of all required data fields, but does not specify a minimum megapixel standard. WCPFC does not specify a resolution standard for still images.
		Image Compression	Recommended	The ability to compress sensor and imagery data where necessary is recommended. Compression: supports standard video compression formats. Minimum H264.	N/A	N/A	N/A	N/A	N/A	N/A	Only ICCAT mentions and recommends image compression, with a minimum H264.

		Face Masking	Recommended	Option for automatic face blurring, where needed. Dynamic face masking is recommended and preferred instead of blanking out parts of the field of view, as this would potentially blank out regions of interest.	N/A	N/A	N/A	N/A	N/A	N/A	Only ICCAT mentions and recommends automatic face blurring or dynamic face masking.
		Capable of Recording in Low/Bright Light	Required	If vessels fish at night and use artificial lights to illuminate the deck, the quality of images shall be checked to ensure there is not excessive glare.	Recommended	The system should be able to record activities in low and very bright natural light conditions (low and high contrasts).	Recommended	Cameras should be able to record activities in low and very bright natural light conditions (low and high contrasts). In these cases, the EM service provider should test the image to ensure there is not excessive glare.	N/A	N/A	ICCAT requires, and IOTC and IATTC recommend, that systems to be capable of recording in low and bright lighting conditions. ICCAT and IATTC require testing to ensure there is not excessive glare.
		Adequate Illumination	Required	There shall be sufficient lighting to illuminate the area being recorded and the individual specimens captured.	N/A	N/A	Recommended	Nocturnal fishing activities involving species captured should be illuminated with sufficient lighting (e.g., longlines).	Required	[VMP] iv. A description of the EM setup: ● MUST include the number and location of cameras including images of their installation location and an image from each camera's perspective, and include nighttime images, as appropriate, to demonstrate sufficient lighting.	ICCAT requires, and IATTC recommends, adequate lighting to illuminate species captured. WCPFC requires that VMPs include, in the description of EM setup, nighttime images for each camera to demonstrate

											sufficient lighting.
		Day/Night Automatic Switching	Recommended	Automatic switching between day/night lighting conditions.	N/A	N/A	N/A	N/A	N/A	N/A	Only ICCAT recommends or mentions automatic switching between day/night lighting conditions.
	Sensors	**Satellite Positioning System (e.g., GPS)**	Required	Minimum EMS components shall include electronic Monitoring (EM) control box/centre, **including a satellite positioning system, e.g., the global positioning system (GPS) or equivalent, hereafter referred to as GPS... A GPS sensor or equivalent capable of automatically recording the position and**, unless the EMS uses cameras that will record continuously, the speed and course of the vessel, shall be required. GPS sensor or equivalent should be able to automatically record data at	Required	Include Global Positioning System (GPS): to monitor vessel position, route, speed and provide information on date/time and location of fishing activities.	Required	A GPS sensor or equivalent shall be capable of automatically recording the position and, unless the EM equipment uses cameras that will record continuously, the speed and course of the vessel.	Required	a. A geolocation device MUST record vessel location coordinates and the associated date and time in a format capable of integration with EM Records b. The geolocation device MUST be installed and remain in a location in accordance with the manufacturer's guidelines such that the device can reliably function.	Aligned. ICCAT also specifies that the GPS optionally should be able to record data at configurable time intervals from 1 minute. Note that WCPFC is the only RFMO that does not specify GPS must be capable of collecting route and speed.

				configurable time intervals from 1 minute.							
		Sensor or Other Fishing Activity Recognition Tool	Optional	Minimum EMS components shall include…sensors or other fishing activity recognition tools, unless system video cameras will run continuously… Sensors and/or other fishing activity recognition tools (e.g., winch rotation, hydraulic sensors, GPS, computer vision, artificial intelligence) shall automatically identify a fishing related activity, including setting and hauling gear, sorting catch, etc., and if image recording of the EMS is not continuous, trigger the start of the image recording, as well as assisting	Optional	An EM equipment to be installed on board of a fishing vessel should consist of a control system connecting a number of cameras, and optionally to a number of different sensors, to collect and record images to address the objectives of the EM Program. The number of cameras and sensors should be tailored to each vessel through a Vessel Monitoring Plan to meet overall objectives of the program rather than being too prescriptive. EMS may therefore include sensors, and other procedures (Computer Vision, Artificial Intelligence), to detect when fishing or other activities of interest occur on board. This will ensure proper EM record acquisition	Optional	EM equipment may also include sensors for recording non-visual data (e.g., vessel movement, hydraulic pressure, environmental information), and also possibly mechanisms for activating/disacti vating cameras so as to focus visual data collection during activities of interest.	TBD	EM systems [SHOULD/COULD] be outfitted with sensors, which may include the use of camera imagery as a synthetic sensor, to determine whether fishing activity is occurring, e.g., hydraulic or drum rotation sensors. a. If the EM system is outfitted with sensors, then it SHOULD be capable of generating and recording a log file of readings from system sensors stored in a similar manner to time and geolocation information.	Sensors beyond GPS are generally described as optional in text in all RFMO standards (WCPFC is TBD on requirement level, but would not be mandatory). Only in the case of ICCAT is a scenario in which sensors would be required--if video cameras do not run continuously--named. In general, sensors are described as useful to meet the performance requirements needed, especially as they would aid in detecting when relevant activity is taking place to ensure proper

					in the revision and analysis of the video footage.		(e.g. trigger video recording when fishing operation starts) and facilitate EM record reviewing.				EM record acquisition. WCPFC recommends that if sensors are used they generate a log file of readings.
		Functionality	**Automatic**	Required	EMS shall automatically and autonomously collect required data for each fishing trip.	Required	The system needs to be self-governing with the exception of minimal maintenance by the crew (e.g., cleaning sensors and cameras).	Required	EM equipment shall automatically and autonomously collect EM records to generate the required EM data.	N/A	N/A	It is required by all RFMOs (except WCPFC) that the EMS detects and acquires all necessary EM records automatically or with minimal crew maintenance. WCPFC does not state this specifically but it is implied by the rest of the requirements.

			Durable	Required	The cameras shall be capable to resist rough conditions at-sea on board. IP66 Rating is recommended. A higher IP for cameras exposed to heavy weather conditions is recommended.	Required	The EM equipment components installed outdoors (such as cameras/camera housing and sensors) should be capable to resist rough conditions at-sea and harsh environment on board the vessels. Cameras must be water-resistant and in a self-contained, weather resistant box.	Required	Onboard EM hardware components shall be sufficiently dust and water resistant and durable enough to operate reliably under the range of conditions expected in their location on vessels.	Required	EM hardware components that are utilized on deck and are exposed to the elements (e.g., sensors and cameras) MUST be sufficiently dust and water resistant (e.g., IP66) and durable (e.g., corrosion, impact, and vibration resistant) to operate reliably under the range of conditions expected in their location on fishing vessels. IP67 or IP68 SHOULD be used for those locations where significant water contact is expected.	All RFMOs require that EM equipment (though ICCAT only names cameras specifically) be capable of resisting rough/expected conditions at sea. Water resistance is specifically mentioned by IOTC, IATTC, and WCPFC (the latter two also mention dust resistance). None give a specific threshold, but IATTC and WCPFC require that strength will be sufficient to operate reliably. IOTC specifically requires cameras must be in a self-contained box. ICCAT and WCPFC recommend, but donot require, a Ingress Protection rating. ICCAT recommends IP66, noting that even higher is recommended if conditions are expected to be harsh. WCPFC recommends IP67 or IP68 in

											locations where significant water is expected.
			Tamper-Evident	Required	Required. EMS shall be tamper-evident. Control box shall prohibit tampering with registered vessel information and system setup. Administration rights shall be required to access and modify these settings. The cameras shall be capable to resist rough conditions at-sea on board, and be resistant to tampering to the extent possible, and be tamper-evident. Near-real-time remote online alerts when there is evidence of tampering are recommended.	Required	The EM equipment components and data need to be tamper-resistant and tamper-evident, ideally using encrypted data, such that attempts at unauthorized modifications are not possible.	Required	EM Equipment shall be tamper-evident/resistant and record automatic alerts which should be provided to the appropriate EM Coordinator and EM provider in near real-time in cases of malfunctions, manual activation/shutdown, manual data input, external data manipulation, or attempts to tamper with the equipment or EM records. If these recorded automatic alerts cannot be sent in near real-time to the EM program coordinator and EM provider they shall be provided as soon as possible, along	Required	The onboard user interface: c. MUST allow only authorised users (e.g., EM Service Providers, EM service technicians) to adjust system configurations. a. The onboard hardware MUST be robust and tamper evident to mitigate the risk of intentional sabotage or malfunctions. This shall include physical and/or software features. b. The EM System SHOULD feature a login history tool which allows the tracking of information on when and by whom system configuration settings have been accessed offering insights into possible tampering attempts.	All RFMOs require that EM systems be tamper-evident. IOTC and IATTC require that EMS systems be tamper-resistant (WCPFC implies this), while ICCAT requires that control boxes and cameras be tamper-resistant. ICCAT and WCPFC require that administrative rights/authorization be required to modify EMS information. Encryption, which is mentioned by IOTC in this context, is discussed in

								with other EM records at the end of the corresponding trip. EM equipment shall be tamper-evident (i.e., any attempts to tamper with the equipment will be detectable to the EM service provider/vessel owner, and reported to the respective vessel flag authority).			"Encryption". ICCAT and IATTC recommend remote alerts if tampering is attempted. IATTC additionally suggests that EM service providers/vessel owners be responsible for reporting tampering attempts to the vessel flag authority. WCPFC recommends a login and activity log.
			EMS Integration with Other Monitoring Tools	N/A	N/A	Recommended	EMS ideally should, where possible, integrate with other data collection and monitoring tools.	Recommended	EM records shall, to the extent possible, integrate with other data collection and monitoring tools (e.g., sensors).	N/A	N/A	Both IOTC and IATTC recommend ideally/to the extent possible, that the EM system be capable of integrating with other data collection and monitoring tools (e.g., other sensors). However, both include these standards under the minimum requirements headers. IATTC's standard states that "EM records" should integrate with these tools. This implies that the EM Records data

										should integrate with data from other monitoring tools, but not necessarily allow for hardware/system integration.
			Capable of Spatial Calibration	N/A	N/A	N/A	N/A	N/A	N/A	Recommended	An EM system SHOULD have capability for spatial calibration for accurate image and fish length measurements.	Only WCPFC recommends EM systems be capable of spatial calibration.
			No Interference	Recommended	Radio frequency interference from EMS with other on-board vessel communication, navigation, safety, geolocation devices (e.g., VMS) or fishing equipment should be minimised. The EMS equipment shall not adversely affect vessel stability by posing risk to vessel operations, crew, or environment, nor shall it impede the vessel's safe navigation.	Recommended	EM equipment should not generate or cause radio frequency inference with other on-board bessel communication, navigation, safety, geolocation devices (e.g., VMS) or fishing equipment.	Recommended	The EM provider should ensure that radio frequency interference from EM equipment with other on-board vessel communication, navigation, safety, geolocation devices or fishing equipment is prevented The EM equipment shall not compromise vessel stability, posing risks to vessel operations, crew safety, or the environment. Additionally, it shall not hinder the vessel's safe navigation.	Recommended	The EM System SHOULD be capable of functioning in close physical proximity to other onboard electrical and hydraulic equipment (i.e., EM System operations MUST not be materially impacted by the presence of other onboard electrical equipment and MUST not materially impact the proper functioning of other onboard electrical equipment).	IATTC, IOTC, and ICCAT recommend that EM systems not interfere with vessel communication, navigation, safety, geolocation devices, or fishing equipment ("should" is written for these standards, though they are all under the minimum requirements headers). ICCAT and IATTC additionally require (shall) that the EM equipment not compromise vessel stability or pose risks to

													vessel operations, crew safety, or the environment, or affect safe navigation. WCPFC's requirement is similar, but worded as a recommendation generally, though in the description uses "must". WCPFC's requirement also includes mention that the EM equipment must not be affected by other equipment onboard.

	Remote Connectivity	**Alerts**	**Near-real-time Automatic System Malfunction/Tampering Alerts**	Required	Automatic real-time malfunction system alerts required. Automatic real-time malfunction notification to the flag CPC and alerts when there is evidence of tampering recommended.	Optional	The system may include remote verification of its functionality in real time to collect all information.	Required	EM Equipment shall be tamper-evident/resistant **and record automatic alerts which should be provided to the appropriate EM Coordinator and EM provider in near real-time in cases of malfunctions, manual activation/shutdown, manual data input, external data manipulation, or attempts to tamper with the equipment or EM records.** If these recorded automatic alerts cannot be sent in near real-time to the EM program coordinator and EM provider they shall be provided as soon as possible, along with other EM records at the end of the corresponding trip. It should also be possible for data recording to be controlled manually, but only in case the EM equipment fails to start or stop automatically, and any manual activation should trigger an automatic alert. Voluntarily, EM systems should generate a log file	Recommended	a.The EM System SHOULD have or integrate with at least one network communication system that enables the reliable and regular transmission (e.g., daily or weekly, hourly) of near-real-time data on system health (including still images for EM system status verification when prescribed by the programme requirements), sensors (if applicable), and geolocation to DRCs during all fishing activity, and to the extent possible, supports remote access to the EM system by the EM Service Provider or their designated service technicians. b. The network communication system(s) SHOULD be a widely used and globally recognized technology, such as i. 3G, 4G, or 5G cellular networks. ii. Wi-Fi iii. Satellite communications. c. The EM system COULD be able to verify whether transmissions of data on system health (including still images), sensors, and geolocation to DRCs are successful. The system SHOULD execute a system health test either automatically or when initiated by user and MUST provide a visual	Both ICCAT and IATTC require near or real-time (ICCAT states automatic real-time) alerts in the case of malfunction. WCPFC recommends near-real-time system health data transmission regularly and the ability to confirm successful transmission onboard (in addition to requiring that the onboard system show malfunction alerts). IATTC recommends these alerts be reported to the EM Coordinator and provider, in addition to listing other, more specific instances where real-time malfunction alerts would be required, which includes tampering attempts. ICCAT only recommends real-time alerts and notification to CPC when there is evidence of tampering. As

									of the operational health status of the system which includes camera and sensor recording errors and unplanned system shutdowns.		signal on the display that the system is operational (i.e., it should be obvious, simply by looking at the display, whether or not the system is working properly). a. The EM system MUST be able to generate a log file that allows an EM program to determine the operational health status of the system. The log file [SHOULD/COULD] include details of EM system processes, including, but not limited to: i. System power up ii. System shutdown planned iii. System shutdown unplanned (e.g., power cut) iv. Camera connectivity v. Camera recording start and stop times (planned) vi. Camera recording error4 vii. Available hard drive space viii. Sensor connectivity, if applicable ix. Sensor recording start and stop times (planned) , if applicable x. Sensor recording error , if applicable xi. Activation and deactivation of recording triggers (e.g., vessel speed, drum rotation sensors, geofencing, and time scheduled), if applicable b. System SHOULD	mentioned in the "Manual Operation" standard, IATTC recommends allowing manual operation if needed but also recommends an alert if this occurs. IATTC goes further to describe that if these alerts cannot be sent immediately they should be sent with final trip data. IATTC suggests and WCPFC requires that systems generate a log file of operational health, which is relevant to "Remote Verification of System Health", but that should also note malfunctions and unplanned shutdowns. WCPFC specifies recommendations for the network communication system. Note that IOTC only optionally (though under the minimum standards header) suggests remote

											undertake regular system health checks throughout the duration of the fishing trip at a frequency defined by the EM Programme and MUST show malfunction alerts (errors and warnings) on the display of the user interface (Onboard User Interface) of the control centre. c. The EM system COULD be able to capture and store single frame images from each onboard camera on a regular basis (e.g., timed intervals, such as hourly, or on event triggers such as geofences) to show that cameras are operational, not obstructed, obscured, or displaced.	verification of functionality, which is more relevant to "Remote Verification of System Health".

		Remote Access	**Remote Verification of System Health**	Recommended	Near-real-time remote online "health statements" that assure that the data are recorded during the trip are recommended. Recommed built in remote access/configuration for system configuration, updates, verification of system health and possible transmission requests of all or parts of recorded sensor data and video footage.	Optional	The system may include remote verification of its functionality in real time to collect all information.	Required	Mandatory that CPCs ensure the health status report of the EM equipment on board each vessel under [CPC] jurisdiction be provided by the EM service provider or by the EM equipment itself. Voluntary that that the EM system can generate a log file capturing the following EM processes and the operational health status of the system: system power up, system shutdown planned, system shutdown unplanned (eg power cut), camera connectivity, camera recording start and stop times (planned), camera recording error, available hard drive space, sensor connectivity, sensor recording start and stop times (planned), sensor recording error, activation and deactivation of recording triggers (eg vessel speed, drum rotation sensors, georeferences, and time scheduled).	Recommended	The EM system control centre: c. MUST store and SHOULD transmit system health status information. a.The EM System SHOULD have or integrate with at least one network communication system that enables the reliable and regular transmission (e.g., daily or weekly, hourly) of near-real-time data on system health (including still images for EM system status verification when prescribed by the programme requirements), sensors (if applicable), and geolocation to DRCs during all fishing activity, and to the extent possible, supports remote access to the EM system by the EM Service Provider or their designated service technicians. b. The network communication system(s) SHOULD be a widely used and globally recognized technology, such as i. 3G, 4G, or 5G cellular networks. ii. Wi-Fi iii. Satellite communications. c. The EM system COULD be able to verify whether transmissions of data on system health (including still images), sensors, and geolocation to DRCs are successful.	All RFMOs indicate a desire for some remote system health verification, though only IATTC requires it but also implies automatic system generation may not be necessary (as in, providers can pull this information upon request). ICCAT recommends near-real-time remote health statements. IATTC requires that the health status of EM systems be made available by either the EM system or provider. IOTC only optionally (though under the minimum standards header) suggests remote verification of functionality. WCPFC recommends near-real-time system health data transmission regularly and the ability to confirm successful transmission onboard. WCPFC also specifies

												The system SHOULD execute a system health test either automatically or when initiated by user and MUST provide a visual signal on the display that the system is operational (i.e., it should be obvious, simply by looking at the display, whether or not the system is working properly). a. The EM system MUST be able to generate a log file that allows an EM program to determine the operational health status of the system. The log file [SHOULD/COULD] include details of EM system processes, including, but not limited to: i. System power up ii. System shutdown planned iii. System shutdown unplanned (e.g., power cut) iv. Camera connectivity v. Camera recording start and stop times (planned) vi. Camera recording error4 vii. Available hard drive space viii. Sensor connectivity, if applicable ix. Sensor recording start and stop times (planned) , if applicable x. Sensor recording error , if applicable xi. Activation and deactivation of	recommendations for the network communication system. WCPFC recommends regular system health checks and captures from cameras throughout the fishing trip at a frequency defined by the EM Program. IATTC suggests and WCPFC requires that systems generate a log file of operational health.

												recording triggers (e.g., vessel speed, drum rotation sensors, geofencing, and time scheduled), if applicable b. System SHOULD undertake regular system health checks throughout the duration of the fishing trip at a frequency defined by the EM Programme and MUST show malfunction alerts (errors and warnings) on the display of the user interface (Onboard User Interface) of the control centre. c. The EM system COULD be able to capture and store single frame images from each onboard camera on a regular basis (e.g., timed intervals, such as hourly, or on event triggers such as geofences) to show that cameras are operational, not obstructed, obscured, or displaced.	

			Remote System Access	Recommended	Recommend built in remote access/configuration for system configuration, updates, verification of system health and possible transmission requests of all or parts of recorded sensor data and video footage.	N/A	N/A	N/A	N/A	Recommended	[Cameras] d. COULD be capable of accommodating remote or onboard configuration of parameters to optimise camera functionality throughout a typical fishing trip a.The EM System SHOULD have or integrate with at least one network communication system that enables the reliable and regular transmission (e.g., daily or weekly, hourly) of near-real-time data on system health (including still images for EM system status verification when prescribed by the programme requirements), sensors (if applicable), and geolocation to DRCs during all fishing activity, and to the extent possible, supports remote access to the EM system by the EM Service Provider or their designated service technicians. b. The network communication system(s) SHOULD be a widely used and globally recognized technology, such as i. 3G, 4G, or 5G cellular networks. ii. Wi-Fi iii. Satellite communications. c. The EM system COULD be able to verify whether transmissions of data on system health	While similar to "Remote Verification of System Health" and "Remote Data Transmission", ICCAT and WCPFC specifically also recommend remote access for system configuration, updates, and optimization, etc.

												(including still images), sensors, and geolocation to DRCs are successful. d. The EM System SHOULD have ethernet or any other communication system allowing data transfer and remote access to the system via the onboard connection.	

			Remote Data Transmission	Optional	Recommend built in remote access/configuration for system configuration, updates, verification of system health and possible transmission requests of all or parts of recorded sensor data and video footage. When EMS records are transmitted (via WI-FI, mobile data network or satellite), the transmission of the data shall be done at the end of the fishing trip where possible. If not possible the data shall be securely stored and transmitted without delay/at the earliest opportunity. This type of transmission shall ensure proper encrypted data, when required/decided by national authorities.	Optional	The EM records should be transmitted via mobile networks, Wi-Fi, or satellite, or storage device (i.e., SSD or HDD) exchange. If EM records are automatically transmitted electronically, operational procedures for their receipt and backup should be implemented taking into account necessary chain of custody arrangements.	Optional	When EMS records are transmitted (via WI-FI, mobile data network or satellite, or hard disk delivery), the transmission of the data should be done at the end of the fishing trip where possible. If not possible the data shall be securely stored and transmitted without delay/at the earliest opportunity. Irrespective of the data transfer method used for EM records, and according to the recommendation in Annex 2, the transmission should ensure the information is properly encrypted.	Recommended	c. The EM system COULD transmit geolocation data and associated date and time, and vessel identification information to DRCs on a regular basis, as defined by the relevant programme requirements, throughout the duration of a fishing trip in a format compatible with DRC software. d. The EM system COULD be able to verify whether transmissions of geolocation data and associated date and time, and vessel identification information to DRCs are successful. e. If the EM system is unable to transmit geolocation data due to a communication error, it SHOULD store geolocation data and automatically send it as soon as practically possible after communication is restored. d. The EM System SHOULD have ethernet or any other communication system allowing data transfer and remote access to the system via the onboard connection.	All RFMOs clearly indicate that remote data transmission is an optional and acceptable manner of data transmission. ICCAT and IATTC also state that if data is transmitted electronically, it shall be at the end of a trip (though ICCAT also is the only RFMO to suggest transmission of data mid-trip upon request). ICCAT and IATTC also state that proper encryption of electronically transmitted data is required (this is covered in "Encryption"). WCPFC suggests some remote data transmission on a regular basis. Only IOTC states that if records are transmitted electronically, there should be procedures for data receipt and backup in place. IATTC

												recommends that data transmission happen at the end of the trip, where possible. This may inadvertantly steer providers away from data transmission during a trip.
	EM Data	**Compatability**	**EM Records Compatability**	N/A	N/A	Recommended	EMS ideally should generate EM records interoperable beween different EM service and review providers. EM data should have compatible output format (including usage of standardized, well-established code lists) to exchange collected information with current IOTC data reporting format and standards, and should be consistent with IOTC data rules	Required	All EM Records generated by the EM system shall be compatible with EM analysis software being used by the EM Review Center where EM Records will be sent to generate EM data. Recorded imagery should be recorded in a widely used and accessible video or image file format, such as MP4 or JPEG.	Recommended	All EM Records generated by the EM system MUST be in a compatible format, or be able to be converted into a compatible format, to allow the ingestion of the EM Records into an analysis software being used. The EM system control centre: h. SHOULD store all EM Records on storage devices and in formats that are compatible or can be readily translated into formats that are compatible with DRC hardware and EM review software. Recorded imagery: e. SHOULD be	IOTC specifically recommends that the EMS generates records interoperable with multiple review providers. IATTC and WCPFC require that the EMS generates records which can be reviewed by the software where the EM records will be reviewed. IATTC and WCPFC recommend

											recorded in a widely used and accessible video or image file format, such as MP4 or JPEG, or other compression standards that are able to be viewed.	that the EMS generate imagery and video in a widely used format, though IOTC recommends a compatible format.
		Record Format	**Include Time & Date, Vessel Information in Records**	Required	EMS video records shall contain at least the following information: the vessel name and vessel ID and trip ID, camera number, geolocation data (date, time (UTC), latitude and longitude), sensor data where appropriate, camera recording status and EM system status, where available, and images. Digital signature, in accordance with domestic legislation (date and time stamp, vessel name, vessel	Required	EM records shall contain the following information: EM record file name including, at a minimum, the vessel name and vessel ID, camera ID, trip ID, geolocation data (date, time (UTC), latitude and longitude), camera recording status, EM health status(when available), images, and sensor data when used. Fishing vessel position and date/time stamps should be incorporated directly on images or in the metadata of images.	Required	EM records shall include, at a minimum, location, date, and time stamps, and to the extent possible, vessel ID…	Recommended	Recorded imagery: f. SHOULD include a timestamp, GPS location, and WCPFC VID (vessel identification information) on the video or image.	All RFMOs require including time and date stamps and vessel position in EM records. IOTC and WCPFC recommend stamping of GPS location and data/time stamps on the images or in the metadata of the images. ICCAT and IOTC further require all EM records also contain vessel name and ID, trip ID, camera ID, camera recording status, EMS status, sensor data, and images.

					registration and GPS coordinates).							WCPFC requires vessel identification as well, while IATTC requests it to the extent possible.
			Digital Signature	Required	Digital signature, in accordance with domestic legislation (date and time stamp, vessel name, vessel registration and GPS coordinates).	N/A	N/A	N/A	N/A	N/A	N/A	Only ICCAT mentions or requires a digital signature.
		Security	**Encryption**	Recommended	The ability to encrypt sensor and imagery data where necessary is recommended. When EMS records are transmitted (via WI-FI, mobile data network or satellite), the transmission of the data shall be done at the end of the fishing trip where possible. If not possible the data shall be securely stored and transmitted without delay/at the earliest opportunity. This type of transmission shall ensure proper encrypted data, when	Recommended	The EM equipment components and data need to be tamper-resistant and tamper-evident, ideally using encrypted data, such that attempts at unauthorized modifications are not possible.	Recommended	Irrespective of the data transfer method used for EM records, the transmission should ensure the information is properly encrypted. Also, an encrypted storage device containing the same EM records information should remain on board as backup.	Recommended	The EM system control centre: g. MUST allow EM records to be transmitted, stored or accessed surely. To secure EM records, the system SHOULD be equipped with applications such as user logins, EM record encryption and firewalls.	None of the RFMOs require encryption, although ICCAT states if data is transmitted electronically it is required to be encrypted. In addition, ICCAT recommends "where necessary" encryption, which is vague. IATTC has a similar recommendation for data transfer. IOTC states that encryption of data would be ideal, and WCPFC recommends it.

					required/decided by national authorities.							IATTC also specifically states that the backup data storage device onboard should be encrypted.
	EMS Layout	**Configuration**	**Recommendations for EMS Configurations**	N/A	N/A	Optional	There is no standard configuration that will cover all vessels from fleets operating in the Indian Ocean region, therefore each EM equipment installation must be customized at the vessel level. An EM equipment to be installed on board of a fishing vessel should consist of a control system connecting a number of cameras, and optionally to a number of different sensors, to collect and record images to address the objectives of the EM Program. The number of cameras and sensors should be tailored to each vessel through a Vessel Monitoring Plan to meet overall objectives of the program rather than being too prescriptive and should include a sufficient number	Optional	General recommendations for configurations of EM equipment (e.g., camera placement and subsequent views) for purse seine and longline are also in Annex 2, but vessels or groups of vessels with similar designs observing these minimum standards shall have a Vessel Monitoring Plan (VMP) (see section on VMP below and Annex 4) based on vessel's designs and specifics. The configuration shall be capable of collecting EM records consistent with all relevant mandatory minimum standards and technical specifications in this document.	N/A	N/A	Both IOTC and IATTC provide examples and recommendations of EMS configurations on vessel, though both state that there is no standard configuration that will cover all vessels and that they will need to be configured.

					of cameras. Although it will depend on the configuration of each particular vessel, as a general setup, cameras shall capture the areas and activities provided in Table 1 and 2 and Figure 1 to 3 of Annex 3. Annex 3 should be taken as a general guide since they are examples of existing EMS installations. The EM configuration (number of cameras, position, and monitoring objectives for each) should then be tailored to each fishery/vessel through a Vessel Monitoring Plan.					
	Harmonization OK	N/A	N/A	Optional	A certain level of harmonization among vessels may be necessary (camera placement and settings).	N/A	N/A	N/A	N/A	Only IOTC notes that a certain level of harmonization, rather than individual tailoring to each vessel, may be necessary.

		Coverage	**Areas Captured (Longline)**	Required	The video cameras shall be mounted and placed to provide clear and unobstructed views of the areas that are being covered. EMS cameras, and where appropriate sensors, shall be installed to properly capture, for longline vessels, the following areas: setting area (usually stern camera), hauling area, catching handling area (working deck), and surrounding water area near hauling area.	Required	Cameras shall capture the areas and activities provided in Table 1 and 2 and Figure 1 to 3 of Annex 3. Recommend to cover all areas of interest on the vessel according to the vessel and fishing operations. On longline vessels, the minimum areas and activities that cameras are recommended to cover (Table, 2, Figure 2): the area of setting the longline (usually vessel stern site camera), the area of hauling the longline, the working deck where catch is handled, and the surrounding water area for those discarded species not brought onboard.	Required	Placement of cameras shall provide clear and unobstructed views of the areas that are being covered including vessels' surroundings. On longliners, the cameras shall provide, at a minimum, a view of all hooked fauna, both those brought aboard the vessel and, when possible, those discarded or released without first bringing them on the vessel. Descriptions and an image for an example of camera locations on longliners that would provide these views is provided in Table 2 and Figure 2..	N/A	N/A	ICCAT, IOTC, and IATTC describe differences in areas to be covered on longline vessels. All three are prescriptive about the minimum areas that are required to be covered. The exception is that IATTC's longline requirement is based on performance (i.e., view of all hooked fauna), than based on prescriptive areas. IOTC and ICCAT require the same areas to be covered for longline vessels. IATTC provides a series of example configurations for longline vessels. WCPFC doesn't specifically name areas to be captured, but they are implied by activities captured in the data fields.

			Areas Captured (Purse Seine)	Required	The video cameras shall be mounted and placed to provide clear and unobstructed views of the areas that are being covered. EMS cameras, and where appropriate sensors, shall be installed to properly capture, for purse seine vessels, the minimum areas that shall be captured include work deck (port side), work deck (starboard side), in-water purse seine area, foredeck or amidships, and well deck and conveyor belt.	Required	Cameras shall capture the areas and activities provided in Table 1 and 2 and Figure 1 to 3 of Annex 3. Recommend to cover all areas of interest on the vessel according to the vessel and fishing operations. On purse seine vessels, the minimum areas that cameras are recommended to cover: the working deck (both port and starboard sides), the net sack and the brailer, the foredeck or amidships (e.g., FAD activity), and the well deck and conveyor belt (Murua et al., 2022; Restrepo et al., 2018): for the conveyor belt, in more than one place (e.g. at the beginning and at the end of the conveyour belt as a minimum). If a discard conveyor belt exists, it should also be covered.	Required	Placement of cameras shall provide clear and unobstructed views of the areas that are being covered including vessels' surroundings. On purse seine vessels, the cameras shall cover, at a minimum, the working deck (both port and starboard sides), the net sack and the brailer, the foredeck or amidships, and (if applicable) the well deck and conveyor belt. Descriptions and image for an example of camera locations in class 2-6 purse-seiners is provided in Table 1 and Figure 1.	N/A	N/A	ICCAT, IOTC, and IATTC describe differences in areas to be covered on purse seine vessels. All three are prescriptive about the minimum areas that are required to be covered. IOTC and ICCAT require the same areas to be covered for purse seine and longline vessels (IATTC recommends the same areas for purse seine as well). IATTC provides a series of example configurations for purse seine and longline vessels. WCPFC doesn't specifically name areas to be captured, but they are implied by activities captured in the data fields.

			Areas Captured (Pole and Line)	N/A	N/A	Required	Cameras shall capture the areas and activities provided in Table 1 and 2 and Figure 1 to 3 of Annex 3. Recommend to cover all areas of interest on the vessel according to the vessel and fishing operations. On pole and line vessels, the minimum areas that cameras are recommended to cover are the area of bait fishing activity, the area of the fishing set and pole and line fishing activity (vessel stern site camera) and the working deck where catch is handled.	N/A	N/A	N/A	N/A	Only IOTC mentions pole and line, and it is prescriptive about the minimum areas that are required to be covered.

			Activities Captured (Longline)	Required	EMS cameras, and where appropriate sensors, shall be installed to properly capture all relevant fishing activity, including, for longline vessels, setting, hauling, catch processing (including bycatch and discards).	Required	On longline vessels, cameras must cover the following actions: setting of the longline, bait type information, whether mitigation techniques are being used (e.g. tori lines for seabirds), hauling of the longline, all hooked species (both retained and discarded), the fate of the catch, and the size of the specimens. On most tuna longlines, at least 3 cameras are needed to cover fishing activities and fish handling operations: one capturing images when setting the longline, one to record the hauling and boarding of the catch, and other mounted over the processing deck to record species, size of specimens and fate (Murua et al., 2020a). And additional camera to cover the surrounding water area for those discarded species not brought onboard is also recommended.	Required	Minimum data fields for longline activities to be collected and submitted, presented in Table 2. TABLE 2. A first example for location of cameras in longliners. The following are examples of camera installation design, which are based on information gathered from EM service providers and international initiatives (e.g., Carnes et al. 2019): Small-sized longline vessels (<20m LOA) • One camera (e.g., 105°) on the work deck to identify species. • One camera (e.g., 105°) mounted outside the side rail to cover the fish door, where the catch is brought aboard. Medium (20-24m LOA) and large-sized longline vessels (> 24m LOA) • One camera (e.g., 105°) at the stern to record the number of floats, hooks and bait used on the	N/A	N/A	ICCAT, IOTC, and IATTC describe activities to be covered on longline vessels. ICCAT and IOTC are prescriptive about the activities to be captured and require roughly the same activities to be covered for longline vessels. IATTC lists the activities to be covered as an example, but states they are required elsewhere. IATTC also provides different lists based on vessel size, though both lists cover similar activities to ICCAT and IOTC. WCPFC doesn't specifically name activities to be captured, but they are implied by activities captured in the data fields.

									setting. • One camera (e.g., 105°) located amidships, covering the total catch and discards by species, size and fate. • One camera (e.g., 105°) located at the bow, covering the retained catch, by species, size and fate, during the hauling. (Optional, if necessary to achieve the required views) • One camera (e.g., 105°) mounted on boom, outside the rail where the line is hauled, to record catch evasion, line cutting, etc. (optional for 20-24m)			

			Activities Captured (Purse Seine)	Required	EMS cameras, and where appropriate sensors, shall be installed to properly capture all relevant fishing activity, including… For purse seine vessels, the minimum activities that shall be captured include brailing, discards, bycatch handling and release, fishing set, FAD activity, and catch well sorting.	Required	On purse seine vessels, cameras must cover the following actions: fishing set, brailing, net hauling, FAD activities, total catch, catch well sorting (process of putting the catch in the hold or wells), bycatch handling and release, and tuna discards (Figure 1 and Table 1). In large purse seines, at least 6 cameras are needed to cover fishing and fish-handling operations; however, less fewer cameras (e.g. 4 cameras) could cover the activity to collect the data required of smaller purse seines (e.g. 300-400 tonnes capacity).	Required	Minimum data fields for purse-seine activities to be collected and submitted, presented in Table 1. TABLE 1. An example for the location of cameras in class 2-6 purse-seine vessels. Class-6 vessels with 6 or more rows of wells • Two panoramic cameras (e.g., 180°) on crow's nest, covering port side (floating object presence/absence for set type determination and FAD interactions, set times) and starboard side (No. speedboats used in the set, FAD deployment, large-sized bycatch identification, discards, set times). • One camera (e.g., 105°) on back of crow's nest, covering the main deck and sack area (catch and bycatch species identification, discards). • One camera (e.g., 105°) on bridge roof, covering the bow (FAD deployments,	N/A	N/A	ICCAT, IOTC, and IATTC describe differences in activities to be covered on purse seine vessels. ICCAT and IOTC are prescriptive about the activities to be captured and require roughly the same activities to be covered for longline vessels. IATTC lists the activities to be covered as an example, but states they are required elsewhere. IATTC also provides different lists based on vessel size, though all lists cover similar activities to ICCAT and IOTC. WCPFC doesn't specifically name activities to be captured, but they are implied by activities captured in the data fields.

									retrievals). • One camera (e.g., 105°) on boom controls roof, covering the brailing area (total catch estimation, bycatch identification, discards). • Three cameras (e.g., 105°), each covering equal numbers of well rows (catch and bycatch identification and estimation by species, discards). Class-5 vessels with less than 6 rows of wells • Two panoramic cameras (e.g., 180°) on crow's nest, covering starboard and port sides. • One camera (e.g., 105°) on back of crow's nest, covering the main deck and sack area (FAD deployments, retrievals). • One camera (e.g., 105°) on boom controls roof, covering the brailing area. • Two cameras (e.g., 105°) covering equal numbers of well rows. Class-2 vessels with no wet deck access • One panoramic			

							camera (e.g., 180°) on crow's nest, covering the port side. • One camera (e.g., 105°) on back of crow's nest, covering the main deck. • One camera (e.g., 105°) on bridge roof, covering the bow. • One camera (e.g., 105°) on boom controls roof, covering the brailing area.			
		Activities Captured (Pole and Line)	N/A	N/A	Required	On a typical Indian Ocean pole and line vessels, this will require at least 2 or 3 cameras to cover main fishing activity areas, fish handling operations and bait fishing (Figure 3).	N/A	N/A	N/A	N/A	Only IOTC mentions pole and line, and requires coverage of fish handling and baiting.

Vessel Monitoring Plan (VMP)	Elements	Vessel Information	Crew Information	Required	The minimum sections to be contained in a VMP are: - Contact information: current contact information for the vessel owner, vessel operator and EMS service provider as long as the contract lasts.	Recommended	The VMP should include information on: • Contact information: contact information for the vessel owner, vessel operator and EM service provider as long as the contract lasts.	Required	The minimum sections to be contained in a VMP shall include: a. Contact information: current contact information for the vessel owner, vessel operator and EM service provider as long as the contract lasts.	Required	d. The Vessel Monitoring Plan: i. MUST include contact information for the EM Service Provider, vessel owner(s), and vessel operator(s), and base manager(s) (if applicable).	All RFMOS request contact information for the vessel owner, operator, and EM service provider as long as the contract lasts. ICCAT, IATTC, and WCPFC require this, and IOTC recommends it.
			Vessel Information	Required	The minimum sections to be contained in a VMP are: - General vessel information: basic information about the vessel and its fishing activities and operations (e.g., vessel name, registration number, target fishery, areas, fishing gear, LOA, etc.).	Recommended	The VMP should include information on: • General vessel information: basic information about the vessel and its fishing activities and operations (e.g., vessel name, registration number, target fishery, areas, fishing gear, LOA…).	Required	The minimum sections to be contained in a VMP shall include: b. General vessel information: basic information about the vessel and its fishing activities and operations (e.g., vessel name, registration number, target fishery, fishing areas, fishing gear, LOA, etc.). c. Fishing gear type and configuration:	Required	d. The Vessel Monitoring Plan: ii. MUST include general vessel information as specified in the EM data requirements	All RFMOS request vessel information, including fishing activities and operations. ICCAT, IATTC, and WCPFC require this, and IOTC recommends it.
			Catch Handling Procedures	Required	The minimum sections to be contained in a VMP are: - Catch handling procedures: description of the crew and their operations.	N/A	N/A	Required	The minimum sections to be contained in a VMP shall include: f. Catch handling procedures: description of the crew and their operations.	Required	d. The Vessel Monitoring Plan: iii. MUST include a diagram, description, and photo(s) of the vessel layout that identifies where key fishing activities will occur on the vessel (e.g., hauling, sorting, discarding) and COULD include measurements of all items, tools, or areas on the vessel that EM to support estimation	ICCAT and IATTC require a description of catch handling procedures. WCPFC requires a description of where key fishing activities occur, which is part of the vessel layout description.

											of lengths of fish caught.	
			Vessel Layout	Required	The minimum sections to be contained in a VMP are: - Vessel layout: equipment of the vessel with detailed information, plan of the vessel disposition and different areas (deck, processing, storage, etc.).	Recommended	The VMP should include information on: • Vessel layout: equipment of the vessel with detailed information, plan of the vessel disposition and different areas (decks, processing area, storage, etc.).	Required	The minimum sections to be contained in a VMP shall include: d. Vessel layout: equipment of the vessel with detailed information, plan of the vessel disposition and different areas (deck, processing, storage - including number of wells, etc.).	Required	d. The Vessel Monitoring Plan: iii. MUST include a diagram, description, and photo(s) of the vessel layout that identifies where key fishing activities will occur on the vessel (e.g., hauling, sorting, discarding) and COULD include measurements of all items, tools, or areas on the vessel that EM to support estimation of lengths of fish caught.	All RFMOS request identical vessel layout descriptions. ICCAT, IATTC, and WCPFC require this, and IOTC recommends it.
			Vessel Measurements for Calibration	N/A	N/A	N/A	N/A	N/A	N/A	Optional	d. The Vessel Monitoring Plan: iii. MUST include a diagram, description, and photo(s) of the vessel layout that identifies where key fishing activities will occur on the vessel (e.g., hauling, sorting, discarding) and COULD include measurements of all items, tools, or areas on the vessel that EM to support estimation of lengths of fish caught.	WCPFC suggests that the VMP could include measurements of the vessel that support the estimation of lengths of fish caught.

		EMS Setup	**EM Equipment Set Up Description**	Required	The minimum sections to be contained in a VMP are: - EMS equipment set up: description of the settings of the EMS, such as time running, number of cameras, settings of the cameras (frame rate and resolution), and areas covered, time recording for each of the cameras, number of sensors, where applicable, software used, control box disposition, etc.	Recommended	The VMP should include information on: EM equipment setup: description of the settings of the EM equipment, such as time running, number of cameras and areas covered, time recording for each of the cameras, number and position of sensors (if any), software used, control box disposition, procedures for checking the proper functioning of the EM equipment installed onboard, etc.	Required	The minimum sections to be contained in a VMP shall include: e. EM equipment set up: description of the settings of the EM equipment, such as time running, number of cameras, settings of the cameras (frame rate and resolution), and areas covered, time recording for each of the cameras, number of sensors, where applicable, software used, control box disposition, etc.	Required	iv. A description of the EM setup: ● MUST include the number and location of cameras including images of their installation location and an image from each camera's perspective, and include nighttime images, as appropriate, to demonstrate sufficient lighting. ● MUST include a description and image of the location of all other components of the installed EM system (e.g., geolocations system, EM control system, sensors, power supply). ● MUST include relevant details of system configuration settings, including: ○ Camera configuration settings (e.g., frame rates, resolution, bitrate) ○ Sensor units and threshold values, if applicable ○ Data recording frequencies and/or sensor triggers for recording, if applicable ○ Software and Firmware versions ○ Spatial calibration settings, if applicable	ICCAT, IATTC, and IOTC request identical EM equipment set-up descriptions. ICCAT and IATTC require this, and IOTC recommends it. WCPFC also requires a description of the EM setup, but its requirements vary slightly (more configuration settings), though they are fundamentally similar.
			Example Shot	Required	The minimum sections to be contained in a VMP are: -A shot and image taken by each camera shall be inserted in the VMP.	Recommended	The VMP should include information on: A snapshot of each camera should be inserted in the VMP.	Required	The minimum sections to be contained in a VMP shall include: g. An example view from each required camera view.	Required	iv. A description of the EM setup: ● MUST include the number and location of cameras including images of their installation location and an image from each camera's perspective, and	All RFMOS request shots taken by each camera, however, ICCAT calls this an "example view", which may be

											include nighttime images, as appropriate, to demonstrate sufficient lighting.	misinterpreted. ICCAT, IATTC, and WCPFC require this, and IOTC recommends it. WCPFC also requires nighttime images to demonstrate sufficient lighting.
			Data Retrieval Protocol	Required	A detailed protocol on how to retrieve the data from the vessel to the authorities or to the data analyst shall be detailed and agreed on the vessel monitoring plan by both the vessel owner, the respective authorities.	N/A	N/A	Recommended	A detailed protocol on how to retrieve the data from the vessel to the authorities or to the EM review center should be established and agreed on in the VMP by both the vessel owners and the vessel authority.	Required	viii. MUST include details of what steps, if any, are required to ensure the transmission of the EM Records to the DRC.	ICCAT and WCPFC require and IATTC recommends including a detailed protocol for data retrieval in the VMP.
	Responsibilities	**Crew**	**Catch Handling Procedures**	N/A	N/A	N/A	N/A	N/A	N/A	Required	[VMP] v. MUST include any catch handling procedures required to ensure that EM Records allow collection of the data fields set out in the EM data requirements (e.g., handling in view of cameras, allowable discard locations).[See Annex 2 for references to existing catch handling procedures]	Distinct from the "Catch Handling Procedures" included in the VMP above, WCPFC requires that the VMP include any catch handling procedures required by the program to ensure proper data collection.

			Duty of Care	N/A	N/A	N/A	N/A	N/A	N/A	Required	[VMP] vi. MUST include vessel duty of care responsibilities to prevent system malfunctions and ensure effective operation of the system, such as: ● Verifying system functionality at the beginning and throughout at regular intervals throughout the duration of each trip ● Instructions for cleaning camera lenses	WCPFC requires that the VMP include any duty of care responsibilities asked of the crew.
			Procedures in Case of Malfunction	N/A	N/A	N/A	N/A	N/A	N/A	Required	[VMP] vii. MUST include vessel responsibilities in the event of system malfunctions that describe the steps that must be taken. The vessel owner/operator:... c. MUST follow vessel responsibilities outlined in the Vessel Monitoring Plan in the event of system malfunctions.	WCPFC requires that the VMP include any vessel responsibilities in the event of a EM system malfunction.
	Requirements		**Vessel Survey**	Required	A survey of the vessel to be fitted with EMS shall be carried out by the EMS provider and/or CPC fishing authorities and the following factors shall be taken into consideration in the development of the VMP, with a view to ensuring the system meets the minimum data collection requirements	N/A	N/A	Required	A survey of each vessel or example vessel for a group of vessels intended for EM equipment installation shall be conducted by either the EM provider or flag CPC fishing authorities. During this survey, the following aspects will be considered in the development of the VMP, aimed	N/A	N/A	ICCAT and IATTC specifically require a survey of each vessel (or example vessel for a group of vessels, for IATTC) to be completed as part of the development of the VMP.

					laid out in Annex 2 or 3: a) Camera positioning and settings. b) Number of cameras to be installed to ensure optimization of the view of the catch-handling area. c) Key areas to be surveyed are catch handling areas for species identification and storage of the individuals and areas of discards or release.				at ensuring that the system meets the minimum data collection requirements outlined in Annex 2: a. Camera placement and settings. b. Number of cameras to be installed to ensure optimization of the view of the catch-handling area. c. Key areas to be surveyed are catch handling areas for species identification and storage of the individuals and areas of discards or release.			

			Required	Required	CPCs shall ensure that a unique Vessel Monitoring Plan (VMP) for each individual vessel flying their flags on which EMS is to be installed is developed that shall allow the installation of the EMS to be adapted to each vessel's characteristics and describe how fishing operations on that vessel will be conducted to ensure effective monitoring of fishing activities onboard. The VMP shall cover all relevant minimum standards and technical specifications in this Recommendation while optimizing the quality of data the EMS collects from the vessel. The VMP shall be developed for each vessel on which EMS is to be installed and shall be delivered to the flag CPC competent authorities.	Required	Each vessel should develop a "Vessel Monitoring Plan" specifying how many and where the cameras are located, and their settings, to collect the required ROS minimum "mandatory" data fields. The vessel's EM equipment characteristics and how the vessel's EM equipment is optimized to meet the EM System and Data Standards must be recorded on a Vessel Monitor Plan (VMP) for each vessel. CPCs: To require that a Vessel Monitoring Plan (see below) is developed for each vessel equipped with EM equipment and delivered to the CPC competent authorities. To ensure that EM equipment are installed in their vessels following a Vessel Monitoring Plan to collect the required data and to comply with the coverage objectives agreed by the Commission.	Required	The VMP shall be developed for each vessel or group of vessels on which EM equipment is to be installed and shall be delivered to the flag CPC competent authorities. The VMP describes how the EM equipment is specifically positioned and configured on board to monitor fishing activities, and through which the CPCs should verify and document that the minimum standards for the use of the IATTC are met. Data obtained from the VMP, and provided by all IATTC EMS observant vessels, would ensure robust assessments on the performance, progress and evolution of the EMS in IATTC fisheries. If a CPC intends to achieve fisheries data submission by EM, such a CPC shall develop] an EM Vessel Monitoring Plan (VMP) for each vessel, or groups of vessels (e.g., all purse-seine, or all longline, or all long-line of a certain size	Required	Vessel owner or EM Service Provider MUST complete a Vessel Monitoring Plan, and submit it to the EM Program for approval.	All RFMOs require the development of a VMP for each vessel (or each group of similar vessels, for IATTC).

									range) fishing for tuna or tuna-like species flagged to the CPC and on which EM equipment is to be operated and applying the IATTC minimum standards for EMS. The VMP will describe the configuration, components and installation of EM equipment on each vessel, and this configuration shall be capable of collecting EM records consistent with all relevant mandatory minimum standards and technical specifications in this document.			

			Validation that System Meets Standards	Required	CPCs shall ensure that a unique Vessel Monitoring Plan (VMP) for each individual vessel flying their flags on which EMS is to be installed is developed that shall allow the installation of the EMS to be adapted to each vessel's characteristics and describe how fishing operations on that vessel will be conducted to ensure effective monitoring of fishing activities onboard. The VMP shall cover all relevant minimum standards and technical specifications in this Recommendation while optimizing the quality of data the EMS collects from the vessel. The VMP shall be developed for each vessel on which EMS is to be installed and shall be delivered to the flag CPC competent authorities.	Required	Each vessel should develop a "Vessel Monitoring Plan" specifying how many and where the cameras are located, and their settings, to collect the required ROS minimum "mandatory" data fields. The vessel's EM equipment characteristics and how the vessel's EM equipment is optimized to meet the EM System and Data Standards must be recorded on a Vessel Monitor Plan (VMP) for each vessel. CPCs: To require that a Vessel Monitoring Plan (see below) is developed for each vessel equipped with EM equipment and delivered to the CPC competent authorities. To ensure that EM equipment are installed in their vessels following a Vessel Monitoring Plan to collect the required data and to comply with the coverage objectives agreed by the Commission.	Required	The VMP shall be developed for each vessel or group of vessels on which EM equipment is to be installed and shall be delivered to the flag CPC competent authorities. The VMP describes how the EM equipment is specifically positioned and configured on board to monitor fishing activities, and through which the CPCs should verify and document that the minimum standards for the use of the IATTC are met. Data obtained from the VMP, and provided by all IATTC EMS observant vessels, would ensure robust assessments on the performance, progress and evolution of the EMS in IATTC fisheries. If a CPC intends to achieve fisheries data submission by EM, such a CPC shall develop] an EM Vessel Monitoring Plan (VMP) for each vessel, or groups of vessels (e.g., all purse-seine, or all longline, or all long-line of a certain size	N/A	N/A	IATTC, ICCAT, and IOTC require that the VMPs describe onboard EM setups and how the setup will allow effective monitoring of fishing activities, as well as how the EM equipment meets minimum standards.

									range) fishing for tuna or tuna-like species flagged to the CPC and on which EM equipment is to be operated and applying the IATTC minimum standards for EMS. The VMP will describe the configuration, components and installation of EM equipment on each vessel, and this configuration shall be capable of collecting EM records consistent with all relevant mandatory minimum standards and technical specifications in this document.			
			Template Provided	Optional	Yes. An example template of a VMP is detailed in Appendix 1. CPCs may choose another template of a VMP.	N/A	N/A	Optional	An example template of a VMP is presented below. CPCs may choose another format of a VMP as long as it contains the minimum requirements described in paragraph number 4.	N/A	N/A	ICCAT and IATTC provide example VMP templates, which may be optionally used.
			Onboard Requirement	Required	A copy of the approved VMP shall be maintained aboard the vessel at all times during fishing operations.	N/A	N/A	Recommended	A copy of the CPC approved VMP should be maintained aboard each vessel at all times when EM equipment is deployed to	TBD	A copy of the Vessel Monitoring Plan [MUST/SHOULD; Chair: This requirement differs across RFMOs but if vessel operator MUST follow the obligations set out in the VMP then	ICCAT requires and IATTC recommends that a copy of the VMP be maintained onboard at all times during fishing

									monitor vessel's activities.		the Chair suggests MUST] be kept on board the vessel.	operations. WCPFC may require or recommend this.
	Procedures	**Collaboration**	**Collaborators**	Required	The VMP shall be developed in collaboration with the EMS service provider, vessel owner and relevant CPC fishing authorities.	Required	The VMP shall be developed in collaboration with the EM service provider, vessel owner and fishing authorities.	Required	The VMP shall be developed in collaboration with the EM service provider, vessel owner and relevant flag CPC fishing authorities.	Required	Vessel owner or EM Service Provider MUST complete a Vessel Monitoring Plan, and submit it to the EM Program for approval.	ICCAT, IOTC, and IATTC require that the VMPs are developed in collaboration with EM service providers, vessel owners, and fishing authorities. WCPFC requires that the vessel owner or EM service provider completes the VMP.
			Approvals	Required	The VMP shall be signed off by the vessel owner and approved by the Flag CPC competent authority.	Recommended	The VMP should be signed off by the vessel owner and finally approved by the flag state competent authority. Vessel Monitoring Plans should be reviewed by the CPCs fishery management agency and presented to the WGEMS/WPDCS to ensure it meets IOTC REMP Program and EM System and Data Standards.	Required	The VMP shall be signed off by the vessel owner and approved by the Flag CPC competent authority or its designated institutions. CPCs should verify and document that IATTC minimum standards are met through VMPs.	Required	Vessel owner or EM Service Provider MUST complete a Vessel Monitoring Plan, and submit it to the EM Program for approval.	ICCAT and IATTC require, and IOTC recommends, that VMPs are signed off on by vessel owners and approved by flag states. IATTC recommends that CPCs should verify that IATTC minimum standards are met. IOTC recommends that CPCs present the plans to the WGEMS to ensure it meets IOTC minimum standards. WCPFC

										requires that the "EM program" approve the VMP. It is not clear whether this refers to the national or RFMO-level program.
		Submit to CPC	Required	CPCs shall ensure that a unique Vessel Monitoring Plan (VMP) for each individual vessel flying their flags on which EMS is to be installed is developed that shall allow the installation of the EMS to be adapted to each vessel's characteristics and describe how fishing operations on that vessel will be conducted to ensure effective monitoring of fishing activities onboard. The VMP shall cover all relevant minimum standards and technical specifications in this Recommendation while optimizing the quality of data the EMS collects from the vessel. The VMP shall be developed for each vessel on	Required	Each vessel should develop a "Vessel Monitoring Plan" specifying how many and where the cameras are located, and their settings, to collect the required ROS minimum "mandatory" data fields. The vessel's EM equipment characteristics and how the vessel's EM equipment is optimized to meet the EM System and Data Standards must be recorded on a Vessel Monitor Plan (VMP) for each vessel. CPCs: To require that a Vessel Monitoring Plan (see below) is developed for each vessel equipped with EM equipment and delivered to the CPC competent authorities. To ensure that EM equipment are installed in their vessels following a Vessel Monitoring Plan to collect the required data and	Required	The VMP shall be developed for each vessel or group of vessels on which EM equipment is to be installed and shall be delivered to the flag CPC competent authorities. The VMP describes how the EM equipment is specifically positioned and configured on board to monitor fishing activities, and through which the CPCs should verify and document that the minimum standards for the use of the IATTC are met. Data obtained from the VMP, and provided by all IATTC EMS observant vessels, would ensure robust assessments on the performance, progress and evolution of the EMS in IATTC fisheries. If a CPC intends to	Required	Vessel owner or EM Service Provider MUST complete a Vessel Monitoring Plan, and submit it to the EM Program for approval.	All RFMOs require the development of a VMP for each vessel (or each group of similar vessels, for IATTC). The VMPs should describe onboard EM setups and how the setup will allow effective monitoring of fishing activities. VMPs must describe how the EM equipment meets minimum standards. VMPs must be delivered to the CPC. WCPFC requires that the "EM program" approve the VMP. It is not clear whether this refers to the national or RFMO-level program.

					which EMS is to be installed and shall be delivered to the flag CPC competent authorities.		to comply with the coverage objectives agreed by the Commission.		achieve fisheries data submission by EM, such a CPC shall develop] an EM Vessel Monitoring Plan (VMP) for each vessel, or groups of vessels (e.g., all purse-seine, or all longline, or all long-line of a certain size range) fishing for tuna or tuna-like species flagged to the CPC and on which EM equipment is to be operated and applying the IATTC minimum standards for EMS. The VMP will describe the configuration, components and installation of EM equipment on each vessel, and this configuration shall be capable of collecting EM records consistent with all relevant mandatory minimum standards and technical specifications in this document.			

		Submit to RFMO	N/A	N/A	Required	In case that CPCs approved the EMS the CPC shall submit to the IOTC Secretariat copies of each vessel's VMP and present to the Scientific Committee, as an annex to CPC National Reports to the Scientific Committee, a fleet level overview of the CPCs VMPs. CPCs, who fish for species under the competence of the IOTC, and who choose to implement EMS in the IOTC area of competence to partially or fully meet the minimum ROS data requirements under Resolution 22/04 (or any subsequent revision), shall: b) submit to the IOTC Secretariat by 1 July each year, a Vessel Monitoring Plan, that covers each vessel in their IOTC fishery utilizing EMS, outlining the EMS setup on each vessel, consistent with the requirements in the EM Program Standard (Annex 1) and making use of guidance in Annex 3 (Vessel Management Plan Guide). c) submit to the IOTC Scientific Committee, as an annex to CPC National Reports to	Required	CPCs shall submit an example of the VMPs used in the program. The VMP shall be delivered to the flag CPC competent authorities. CPCs that decide to implement EMS to collect fisheries data for submission to IATTC shall submit by March 30 of the following year a fleet-level summary of the VMPs to the Commission describing the implementation of their EM program(s) in the previous year, including, at a minimum, the number of vessels implementing EM by gear and fishery type]; the range of EMS configurations implemented within the fleet (including the numbers and placements of cameras for each configuration); a general description of EMS requirements placed upon vessel skippers/crews by the CPC; the percent coverage levels achieved by fishery and	Required	Vessel owner or EM Service Provider MUST complete a Vessel Monitoring Plan, and submit it to the EM Program for approval.	IOTC requires that CPCs submit to the Secretariat copies of each vessel's VMP and present to the Scientific Committee a fleet-level overview of VMPs. IATTC requires that CPCs submit an example of VMPs used in the program. IATTC also requires that CPCs submit by March 30 of the following year a fleet-level summary of the VMPs to the Commission. IOTC requires this as well, but by July 1st each year. WCPFC requires that the "EM program" approve the VMP. It is not clear whether this refers to the national or RFMO-level program.

							the SC, a fleet level summary of the Vessel Monitoring Plans (described in 3b) that specifies at a minimum: i. The number of CPC flagged vessels implementing EM by gear/fishery type. ii. The range of EMS configurations implemented within the fleet (including the numbers and placements of cameras for each configuration). iii. A general description of EMS requirements placed upon vessel skippers/crews by the CPC government.		gear type; details on how those coverage levels were calculated; and, where appropriate, information on compliance monitoring so that these reports can be reviewed by the EMWG or other Commission body, as appropriate.			

	Updates	**Protocol for Changes**	Required	Any physical changes on the vessel, fishery, categorization of the vessel (fleet segmentation), catch handling deck, etc., shall be reported to the Flag CPC authorities, and the VMP should be updated accordingly before the next fishing trip.	Recommended	Any physical changes on a vessel that will affect EMS should be reported to the flag state competent authorities. The VMP should be updated and approved again by the competent authority as soon as possible. Any change on the EM equipment (e.g., installation of a new generation of cameras) should be reported to the flag state competent authorities. The VMP should be updated and approved again by the competent authority as soon as possible.	Required	Any modification to the VMP, including EM equipment, shall be reported to the vessel flag authority for approval. Any physical changes to the vessel, modifications in vessel categorization (fleet segmentation), or adjustments to the catch handling deck, including those result in the vessel no longer belonging to its original group, should be reported to the Flag CPC authorities. Subsequently, the VMP should be updated accordingly before the commencement of the next fishing trip.	Required	c. Vessel Monitoring Plans MUST be updated and submitted to the EM Program at a frequency determined by the EM Program and anytime changes are made to information or requirements outlined in the VMP (e.g., new vessel contact information, change in EM System configuration, change in catch handling guidelines).	ICCAT and IATTC require, and IOTC recommends, that any changes to the vessel that would affect EMS should be reported to the CPC. ICCAT requires and IATTC recommends that the VMP should be updated before the next trip. IOTC recommends that the VMP be updated as soon as possible. WCPFC requires regular updates based on a predetermined frequency or when changes occur. IOTC and IATTC recommend CPC approval of the new VMP. WCPFC requires that the "EM program" approve the changes. It is not clear whether this refers to the national or RFMO-level program.

Data Management and Review	**Data Management**	**Data Transmission**	**Chain of Custody**	Required	The chain of custody of the EMS memory device shall be assured. A detailed protocol on how to retrieve the data from the vessel to the authorities or to the data analyst shall be detailed and agreed on the vessel monitoring plan by both the vessel owner, the respective authorities. When EMS records are transmitted (via WI-FI, mobile data network or satellite), the transmission of the data shall be done at the end of the fishing trip where possible.	Recommended	If EM records are automatically transmitted electronically, operational procedures for their receipt and backup should be implemented taking into account any necessary chain of custody arrangements. The EMS must ensure traceability of every storage device and EM records. The chain of custody of the EMS storage devices should be assured.	N/A	N/A	N/A	N/A	ICCAT requires and IOTC recommends that a chain of custody should be assured during data transmission. IATTC does not specifically mention a chain of custody.
			Traceability	Required	When EMS records are retrieved by extracting the memory device or when a memory device is replaced between trips, traceability of every memory device and information recorded on board shall be guaranteed. CPCs shall ensure that data analysis procedures ensure good traceability and	Required	The EMS must ensure traceability of every storage device and EM records.	Required	CPCs shall ensure that data analysis procedures ensure traceability and effective analysis of data and routines to flag potential errors, and digital measuring tools.	N/A	N/A	All three RFMOs require traceability at various points across the EM record collection, retrieval, and analysis process. ICCAT and IOTC specifically require traceability when transferring EM data as well as during data analysis. IATTC specifically requires traceability

					effective analysis of data.						during data analysis.
			Retrieval Protocol	Required	A detailed protocol on how to retrieve the data from the vessel to the authorities or to the data analyst shall be detailed and agreed on the vessel monitoring plan by both the vessel owner, the respective authorities. When EMS records are transmitted (via WI-FI, mobile data network or satellite), the transmission of the data shall be done at the end of the fishing trip where possible. If not possible the data shall be securely stored and transmitted without delay/at the earliest opportunity. This type of transmission shall ensure proper encrypted data, when required/decided by national authorities.	Recommended	The EM records should be transmitted via mobile networks, Wi-Fi, or satellite, or storage device (i.e., SSD or HDD) exchange. For the latter, a protocol to recover and send the storage devices to the designated EM review center should also be implemented. If EM records are automatically transmitted electronically, operational procedures for their receipt and backup should be implemented taking into account any necessary chain of custody arrangements.	Recommended	The vessel flag CPC authority shall allow for the recovery and secure transmission of EM Records at the end of each trip. A detailed protocol on how to retrieve the data from the vessel to the authorities or to the EM review center should be established and agreed on in the VMP by both the vessel owners and the vessel authority. When EMS records are transmitted (via WI-FI, mobile data network or satellite, or hard disk delivery), the transmission of the data should be done at the end of the fishing trip where possible. If not possible the data shall be securely stored and transmitted without delay/at the earliest opportunity. Irrespective of the data transfer method used for EM records, and	N/A	N/A	Only ICCAT requires that a protocol on how to retrieve the data is created and agreed upon, while IOTC and IATTC recommend this (IOTC simply states it should be implemented, and only for storage device transfer, rather than agreed upon). All three RFMOs state that records can be retrieved manually (via storage device or hard disk) or transmitted (via WI-FI, mobile data networks, or satellite). IOTC and IATTC recommend (directly or indirectly) that in the case of electronic transmission, a backup should be utilized until records have been recieved and converted

									according to the recommendation in Annex 2, the transmission should ensure the information is properly encrypted. Also, an encrypted storage device containing the same EM records information should remain on board as backup. The deletion of records from the vessel's backup devices should only occur once the EM records have been converted to EM data at the EM review center.			at the review center.
			Frequency	Required	When EMS records are transmitted (via WI-FI, mobile data network or satellite), the transmission of the data shall be done at the end of the fishing trip where possible. If not possible the data shall be securely stored and transmitted without delay/at the earliest opportunity.	Recommended	EM programs should include requirements on the method and frequency (e.g. after each trip) of EM records transmission to EM review centers, that should be consistent with the minimum standards established by the CPC or IOTC.	Required	The vessel flag CPC authority shall allow for the recovery and secure transmission of EM Records at the end of each trip. When EMS records are transmitted (via WI-FI, mobile data network or satellite, or hard disk delivery), the transmission of the data should be done at the end of the fishing trip where possible. If not possible the data shall be securely stored and transmitted without delay/at	N/A	N/A	Both ICCAT and IATTC require that if possible, data should be transmitted or retrieved at the end of each trip. If that is not possible, both require that the data should be securely stored and transmitted at the earliest opportunity. IOTC recommends that CPC programs set requirements for the frequency of record transmission

									the earliest opportunity.			to review centers, but does note require a specific timeframe.
		Storage & Retention	**Post-Trip Data Storage and Retention**	Required	Standards for where, how, and how long video footage will be stored after it has been reviewed, shall be specified in the EMS domestic programmes. Storage decisions shall be based on the EM programme's goals and the personnel who will need to access monitoring records, at what frequency, and for what purpose. Once footage is reviewed, it shall be stored for at least 3 years, except if national data retention regulations require a shorter period. When the system is to be used for enforcement purposes, the data collected by the EMS shall be stored for as long as necessary until	Recommended	EM records should be stored by the vessel/company/EM service provider/EM review provider/EM program administrator for at least 1 year or for the period established by the national/regional EMP.	Recommended	Procedures for where, how, and how long the EM records will be stored after EM analysis, should be specified by the flag CPC. Storage decisions should be based on the EM program's goals and the staff who will need to access monitoring records, at what frequency, and for what purpose.	Required	EM records and associated EM data, MUST be retained in accordance with the EM program audit requirements.	IATTC recommends a storage and retention period to be determined by the flag CPC based on program goals. IOTC recommends storage for at least one year or as specified by the national/regional EMP. ICCAT likewise requires the EMP to determine a storage period based on program goals or 3 years (unless national requirements demand a shorter period). ICCAT also requires that if the data will be used for enforcement it be kept as long as needed in proceedings are finalized. WCPFC requires storage but does not

					the possible infringement proceedings have been finalized.							specify a timeframe except for one based on program requirements.
		Ownership	**EM Records**	N/A	N/A	Required	EM records ownership is of the vessel owner/flag state but should provide IOTC with the EM data outputs to incorporate in the IOTC database for use, analysis, and disposal as required by the IOTC observers Resolution on Regional Observer Scheme.	N/A	N/A	N/A	N/A	Only IOTC mentions record ownership and states that vessel owners/flag states shall be the owners (though this is not specific to one entity), but shall provide IOTC with the data as required for the ROS.
			Hardware & Software	N/A	N/A	Recommended	Irrespective of the scope of the EM program, it is recommended that hardware and software license ownership (and maintenance) is of the vessel owner/flag state.	N/A	N/A	N/A	N/A	Only IOTC mentions hardware and software ownership and states the vessel owner/flag state should own this.

		Reporting	**Reporting Requirements**	Required	A CPC that chooses to implement EMS in its longline or purse seine fisheries to meet ICCAT requirements for scientific data collection and/or compliance monitoring purposes, shall also, when EMS is used for scientific purposes, **report to the SCRS each year**, using the electronic formats that are developed by the SCRS, information collected through domestic EMS programmes, **in line with procedures in place for other data reporting requirements** and consistent with domestic confidentiality requirements.	Recommended	EM data collected via EM should be provided in compliance with the requirements established by the Commission in **Resolution 15/01** On the recording of catch and effort data by fishing vessels in the IOTC area of competence, **Resolution 15/02** On mandatory statistical reporting requirements for IOTC Contracting Parties and Cooperating Non-Contracting Parties (CPCs) and IOTC Observer Resolution on Regional Observer Scheme.	Recommended	CPCs that decide to implement EMS to collect fisheries data for submission to IATTC shall report **EM data for each year collected** consistent with these minimum standards to the IATTC Secretariat, preferably **consistent with data reporting deadlines of relevant resolutions or by the end of the following year using the formats and guidelines described in Annexes 2, 3 and 5 consistent with procedures in place for other data reporting requirements** and consistent with the confidentiality requirements of the CPCs. EM datashould be **submitted via a dedicated cloud-based portal** which may be developed by the IATTC Secretariat, or other appropriate means. The portal should be as user-friendly and automated as possible, and include quality control procedures (e.g., format checking,	Required	Any CCM using EM and submission of EM data to meet WCPFC requirements MUST provide the following reporting in their Annual Report Part... By year: Summary of key data included in the EM data submission, e.g., number of captures of species of special interest, number of size measurements.	ICCAT, IOTC, and IATTC have mandatory reporting requirements which apply to EMS data reporting, though IOTC and IATTC make reporting in line with those requirements recommended , rather than required ("should", "preferably"). ICCAT, IATTC, and WCPFC specify that CPC EM program data (summary data for WCPFC) shall be reported annually. IATTC further requests data be submitted via a dedicated cloud-based portal.

									error flagging), as well as automatic reminders for the timely submission of EM data.			
			Confidentiality Requirements	Required	A CPC that chooses to implement EMS in its longline or purse seine fisheries to meet ICCAT requirements for scientific data collection and/or compliance monitoring purposes, shall also, when EMS is used for scientific purposes, report to the SCRS each year, using the electronic formats that are developed by the SCRS, information collected through domestic EMS programmes, in line with procedures in place for other	Required	EM data submitted by Regional or National EMPs are subject to **Resolution 12/02 On data confidentiality policy and procedures** concerning the requirements for sharing data in the public domain (e.g., the level of stratification to apply in order to prevent activity from a single vessel to be clearly identified from the published data) and the **procedures for the safeguard of records**. Data confidentiality requirements outlined in Resolution 12/02, Data Confidentiality Policy and	Required	All information regarding fishing operations of the vessel shall be **treated as confidential** by the IATTC and **subject to IATTC confidentiality rules**. CPCs that decide to implement EMS to collect fisheries data for submission to IATTC shall report EM data for each year collected consistent with these minimum standards to the IATTC Secretariat, preferably consistent with data reporting deadlines of relevant resolutions or by the end of the following year	N/A	N/A	All three RFMOs require treating data in alignment with established confidentiality procedures, policies, roles, and requirements. ICCAT and IATTC specifically state that all information regarding fishing operations be treated as confidential. ICCAT requires this to be accepted in writing by all service providers.

					data reporting requirements and **consistent with domestic confidentiality requirement**s. EM service/technology providers and EM analyst **shall treat as confidential all information with respect to the fishing operations of the vessel and accept this requirement in writing**.		Procedures, or any superseding Resolution, shall apply to all EM data submitted to the IOTC Secretariat.		using the formats and guidelines described in Annexes 2, 3 and 5 consistent with procedures in place for other data reporting requirements and **consistent with the confidentiality requirements of the CPCs**.			
			Data Output Format	Required	EMS records shall have an **output format that is compatible with the standardized electronic codes list developed by the SCRS** to ensure collected information is consistent with current ICCAT data reporting requirements.	Recommended	EM data should have **compatible output format** (including usage of standardized, well-established code lists) to exchange collected information with current **IOTC data reporting format and standards**, and should be **consistent with IOTC data rules**.	Recommended	Recorded imagery should be recorded in a **widely used and accessible video or image file format**, such as MP4 or JPEG. **Standard formats** applicable to human observers reporting should be used for generating EM data fields (e.g., dates as DDMMYY, latitude and longitude in decimal units, speeds in knots, weights in kg, lengths in centimeters) and creating resulting EM data files (e.g., csv, accdb, xlsx).	Recommended	The EM system control centre: h. SHOULD store all EM Records on storage devices and in formats that are compatible or can be readily translated into formats that are compatible with DRC hardware and EM review software.	All RFMOs state that EM records should have an output format that is compatible with RFMO electronic codes lists (ICCAT), reporting format and standards, and data rules (IOTC), that is standard or widely used (IATTC), or that DRC review software and hardware (WCPFC). ICCAT requires this, while IOTC, IATTC, and WCPFC recommend it.

			Data Submission Format	Required	**When EMS is used for scientific data collection purposes**, CPCs shall submit relevant data to ICCAT in **a format that is compatible** with (1) any data collected and reporting pursuant to their domestic scientific observer programmes (including observer's databases), as well as (2) **ICCAT data reporting requirements and templates** for data submission. A CPC that chooses to implement EMS in its longline or purse seine fisheries to meet ICCAT requirements for scientific data collection and/or compliance monitoring purposes, shall also, when EMS is used for scientific purposes, report to the SCRS each year, **using the electronic formats that are developed by the SCRS**, information collected through	Required	EM data will be submitted to the IOTC Secretariat **using IOTC standard forms** according to the time frame specified in Resolution 22/04, or any superseding Resolution. EM data will be submitted in an **approved electronic data reporting format** to the IOTC Secretariat, **using IOTC standard codes and units**. National EM Programs EM data should be submitted to IOTC in accordance with the **electronic data format specifications** provided by the IOTC Secretariat and adopted by the IOTC Commission, in order for data to be incorporated in the IOTC Regional Observer Scheme database. The EM data should be **properly marked in the database** to be distinguished from data collected through onboard human observers.	Required	EM data shall be submitted to the IATTC in a **format compatible with IATTC databases and IT resources** (e.g., data structure, units, species id/other fishing activity codes, etc.).	Required	The DRC MUST use EM analysis software to facilitate the generation of EM Data from EM Records. The EM analysis software: g. MUST be able to produce EM Data into a format compatible (or that can easily made compatible) with agreed EM data requirements for incorporation into WCPFC databases .	All three RFMOs require specific data submission formats. IATTC and WCPFC require that EM data shall be submitted in a format compatible with their databases (mirroring ICCAT and IOTC in "Data Output Format"). IOTC requires the use of standard codes and units (similar to ICCAT and IATTC in "Data Output Format"). ICCAT and IOTC both require the use of standard/approved reporting requirements, formats,and specifications for data. IOTC also specifies the use of standard forms (ICCAT mentions "templates") and recommends that EM data be properly marked separate from HO data. ICCAT has specific qualification around data used for

					domestic EMS programmes, in line with procedures in place for other data reporting requirements and consistent with domestic confidentiality requirements.							scientific purposes.

	Data Review	**Software**	**Review Software**	Required	The EMS shall have **dedicated software** to assist in data review. This software shall permit the analysis of all the stored data, images, and sensor data where appropriate, in a synchronized way... At a minimum, analysis software shall allow for the report of the following: identification of fishing operations date/time; identification of set type; estimation of the catch by set, including bycatch; estimation of species catch composition and sizes; estimation of discards or release species, and its condition; FAD deployment (for purse seine vessels).	Recommended	EMS should **include software** to facilitate the review of EM records and to produce EM data that will allow compiling and reporting in an IOTC common output format for exchange/submission to IOTC.	Recommended	The EM analysis should involve a **dedicated software**, which shall permit the analysis of all the stored data, images, and sensor data where applicable, in a synchronized way. The EM analysis software shall allow reporting the mandatory minimum data fields requirements established in Tables 1 and 2 of Annex 3 (Areas of fishing activities under coverage by EMS and minimum data requirements for vessel type). It may also allow reporting of the voluntary data fields.	Required	The DRC MUST use EM analysis software to facilitate the generation of EM Data from EM Records. The EM analysis software: a. MUST be compatible with the file types, data structures, syntax, and semantics of EM Records that will be analysed with the software. b. SHOULD be the latest version of analysis software, including security patches c. [MUST/SHOULD/COULD] be able to display EM analysed output: i. Display the vessel track on a map based on geolocation data integrated in the EM Records, with an option to display the geolocation data of each vessel. ii. Display synchronised imagery from all cameras simultaneously with zoom capability and other relevant imagery features. iii. Display a visual timeline with sensor readings or status, if applicable. iv. Display synchronised sensor data (including vessel heading and speed) and video imagery simultaneously, if applicable. d. [SHOULD/MUST] be able to spatially calibrate an image and measure the length of species brought onboard as required by the EM Programme	ICCAT and WCPFC require, and IOTC and IATTC recommend, a dedicated software for data analysis that analyses minimum data requirements and produces them in a common/requested format. In the language for this requirement, ICCAT specifically lists individual minimum data requirements, while IATTC states "minimum data rquirements" listed alsewhere. IOTC simply states the software should allow for reporting in IOTC's format. ICCAT and IATTC mention it should allow for analysis in a "synchonized way". IATTC notes that the software "may" allow for reporting of voluntary fields. WCPFC's standards mention (requirement level not defined)

											(e.g. through a digital measuring tool in the EM analysis software). e. [SHOULD/MUST] allow the EM Analyst to create annotations to mark events where fishing activity occurred within the EM records. f. [SHOULD/MUST] be able to extract and save segments of video and sensor data, including extraction and saving of still images and the ability to extract short duration video clips of catch. g. MUST be able to produce EM Data into a format compatible (or that can easily made compatible) with agreed EM data requirements for incorporation into WCPFC databases . h. SHOULD be able to import EM records (and related sensor, if applicable, and annotated data) from systems of other EM Service Providers. i. SHOULD have the ability to change the playback speed of the footage (e.g., 0.5x, 1x, 2x, 6x, 8x, 10x)	numerous other specific capabilities the EM software may have, including displaying the vessel track on a map, synchronized imagery, and a visual timeline. Spatial calibration and interoperability , mentioned by WCPFC, are covered in other areas of this document.
			Interoperability	N/A	N/A	Optional	Ideally, EM review software can be used to review EM records collected from different EM equipment providers.	N/A	N/A	Recommended	The DRC MUST use EM analysis software to facilitate the generation of EM Data from EM Records. The EM analysis software: h. SHOULD be able to import EM records (and related sensor, if applicable, and annotated data) from systems of other EM Service Providers.	IOTC states that ideally the software could be used to review data provided by multiple EM equipment providers, while WCPFC recommends it.

			Automation	N/A	N/A	N/A	N/A	Optional	When feasible, make EM data generation automatic and user-friendly to expedite EM analysis and directly include information in EM data or reports.	N/A	N/A	IATTC makes note that data generation could be as automated as possible to expedite and auto-populate the analysis. Note that IATTC also mentions automation of some of the functionalities of the submission portal named under "Reporting Requirements" . ICCAT, IOTC, and WCPFC do not mention automation of any part of data analysis or reporting.
			EM System Health Monitoring System	N/A	N/A	N/A	N/A	N/A	N/A	Recommended	a. The EM Program SHOULD have a health monitoring system to receive and display near real-time information of onboard EM System health status (System Health Status), this SHOULD include still images to verify functionality of onboard cameras (System Health Status) and geolocation data (Geolocation device). This system may be part of the DRC. b. If applicable, the onshore health monitoring system MUST receive any malfunction alerts (errors and warnings) that have been generated from the onboard health	While something of this nature is implied by other RFMOs that request system health information to be sent to the EM service provider, WCPFC recommends that a "health monitoring system" exist to receive and display EM system health status updates, images, and location data.

											monitoring system. c. The health monitoring system SHOULD be able to display the latest geolocation of all covered EM Systems on a map.	
			Digital Signature	Required	Digital signature, in accordance with domestic legislation (date and time stamp, vessel name, vessel registration and GPS coordinates).	N/A	N/A	N/A	N/A	N/A	N/A	Only ICCAT requires or mentions a digital signature.
		Review	**Risk Assessment**	Required	When the EMS is to be used for compliance monitoring purposes, data analysis shall be based on risk assessment.	N/A	N/A	N/A	N/A	N/A	N/A	Only ICCAT mentions data analysis based on risk assessment and then it is qualified for data used for compliance purposes.

			Analysis Workstations	N/A	N/A	N/A	N/A	N/A	N/A	Required	The DRC MUST have EM analysis workstation(s) where EM Analysts will use EM analysis software to generate EM Data from EM Records. The EM analysis workstation: a. MUST have hardware and software, or cloud-based platforms that enable effective EM analysis b. MUST have reliable data transmission capabilities sufficient for efficient streaming or download/upload of data required for EM Records analysis, reporting of EM Data, and storage of EM Records. c. MUST have proper ergonomics that support analyst well-being, quality, and efficiency. d. MUST be designed to minimize the risks to commercially sensitive information.	Only WCPFC has requirements related to EM analyst workstations. It requires that workstations have the necessary hardware, software, and data transmission capabilities; and are ergonomic and secure.
			Quality Check and Control	N/A	N/A	Recommended	The reviewing process of EM records should include quality controls through EM records quality check, EM data entry checks, possible automatic error identification in EM data (e.g. incorrect fishing set positions on land, etc), debriefing of EM observers. The produced EM data should be checked prior to reporting to the IOTC Secretariat.	Required	CPCs shall ensure that data analysis procedures ensure traceability and effective analysis of data and routines to flag potential errors, and digital measuring tools. EM data should be submitted via a dedicated cloud-based portal which may be developed by the IATTC Secretariat, or	N/A	N/A	IOTC recommends a thorough set of activities for EM data review quality control. IATTC requires routines to flag potential errors during review. It also recommends that the data submission portal discussed under "Reporting Requirements" include quality

									other appropriate means. The portal should be as user-friendly and automated as possible, and include quality control procedures (e.g., format checking, error flagging), as well as automatic reminders for the timely submission of EM data.			control procedures.
		Reviewer	**Qualified Review Institutions**	Required	CPCs that choose to implement EMS to meet ICCAT requirements specified in separate ICCAT recommendations (e.g., regarding observer coverage), shall ensure…that the analysis of the EMS data is done by **CPC-authorized independent companies or by CPC institutions or CPC authorities, with the necessary knowledge, skills and abilities to ensure effective data analysis, including sufficiently accurate species identification.**	Recommended	EM records reviewing and EM data reporting should be done by **institutions, organizations and independent companies with proven expertise and experience** (e.g., work experience with onboard observers). These tasks can be centralized in a "regional EM review center" when implementing a regional program and/or **can be carried out by national or independent organizations**. The same third-party organization **can provide both the EM equipment and EM review services** but they can also be supplied by different providers.	Required	Mandatory that EM analysis is done by **CPC-authorized companies or by CPC institutions or authorities with necessary training, knowledge, skills and abilities to ensure effective EM records analysis and EM data generation, including sufficiently accurate species identification.** Provided that standard protocols and procedures are followed, CPCs may choose whether to contract the work out through a **commercial EM review service provider, authorized contractor, or do it themselves.**	Optional	DRCs may serve individual CCMs, subregional groupings, or the entire WCPFC membership. They may also be administered by individual CCMs members, a sub-regional or regional body, or a third-party (commercial) provider.	ICCAT, IATTC, and IOTC allow that review be conducted by independent companies, CPC institutions, or authorities. ICCAT and IATTC require that independent companies be CPC authorized, while IOTC recommends that they have proven expertise and experience. Both ICCAT and IATTC specifically mention proven skills, abilities, and knowledge to conduct analysis including accurate species identification. IATTC also requires

												training. IOTC notes that the same organization may provide both EM equipment and review services. WCPFC does not give requirements for the EM analysts' institutions but notes that they may be government or regulatory bodies or a commercial provider.
			Regional EM Review Center	N/A	N/A	Optional	These tasks can be centralized in a "regional EM review center" when implementing a regional program and/or can be carried out by national or independent organizations. When necessary, the Commission may contract Regional EM review centers to review EM records obtained in the frame of the REMP.	N/A	N/A	Optional	DRCs may serve individual CCMs, subregional groupings, or the entire WCPFC membership. They may also be administered by individual CCMs members, a sub-regional or regional body, or a third-party (commercial) provider.	IOTC notes that review can occur, optionally, in a regional EM review center and/or be carried out by national or independent organizations. WCPFC also suggests that review centers may serve individual countries or multiple at the regional or sub-regional level.

			Observer Qualifications	Required	The CPC shall appoint analysts that have the following qualifications to accomplish their responsibilities: a) **Sufficient knowledge and experience** to understand relevant fishing operations and catch handling, identify species, and collect information on different fishing activities. In this regard, previous at sea observer experience is valuable. b) **Satisfactory knowledge of the ICCAT conservation and management measures** if the EMS domestic programme is being used for compliance monitoring purposes. c) The ability to use properly the dedicated analysis software and observe and record accurately data to be collected under the programme. d) Not be an employee of a fishing vessel company involved in the observed fishery or have other	Required	EM observers must have specific qualifications related to EM record review which should be integrated into the regional or national EM program standards. EM observers must have the **ability to review EM records and produce EM data according to IOTC requirements**. EM observers should be familiar with fishing activities and be capable of identifying (i) IOTC species and species of special interest, (ii) IOTC fishing methods, and (iii) IOTC mitigation methods.	Required	EM analyses shall only be conducted by qualified EM analysts, ideally possessing **some experience in fishing activities**, with skills on how to use the dedicated analysis software and observe and record accurately data to be collected under the program. EM analysts shall not be employees of a fishing vessel company involved in the observed fishery or have other direct conflicts of interest.	Required	The use of EM software to generate EM Data from EM Records MUST be conducted by EM Analysts. The EM Analysts: OPTION 1 • MUST complete an appropriate training programme which covers materials including (but not limited to): species ID, basic fishing practices, and EM review processes). • EM analysts shall/MUST not be employees of a fishing company involved in the observed fishery or have other direct conflicts of interest. OPTION 2 • EM Analysts MUST be independent and impartial and qualified in accordance with criteria approved by the Commission. • Training should cover the EM analysis process and relevant topics identified from the Agreed Minimum Standards and Guidelines for the Regional Observer Program (https://www.wcpfc.int/wcpfc-regional-observer-programme-standards%20latest ;pg 12).	All RFMOs require analysts be qualified and give specific qualifications. The most basic, which IOTC, ICCAT, and IATTC require, is to be able to review and accurately produce data collected under the program. IOTC and ICCAT specifically recommends capable of identification species and fishing and mitigation methods. All three note that it would be ideal to have some experience or familiarity with fishing operations, ICCAT specifically mentions previous observer experience at sea. IATTC and ICCAT recommend specifically the skills to use the analysis software. ICCAT also requires knowledge of ICCAT conserveation and management

					direct conflicts of interest.							measures if the program is producing data for compliance purposes. WCPFC requires analysis fit into one of two categories: 1) trained and not be an employee or a fishing company or involved in the fishery or have other direct conflicts of interest (ICCAT and IATTC also specifically require this second component) OR 2) be impartial, independent, and qualified based on Commission criteria and trained.

			Observer Training	N/A	N/A	Recommended	The EM observer should participate in specialised training courses that should be updated upon modification of the EM review protocol to ensure EM data high-quality standards.	Recommended	The CPCs should design and organize training courses for EM analysts, with input from IATTC staff, EM service providers and other experts, where necessary.	Required	The use of EM software to generate EM Data from EM Records MUST be conducted by EM Analysts. The EM Analysts: OPTION 1 • MUST complete an appropriate training programme which covers materials including (but not limited to): species ID, basic fishing practices, and EM review processes). • EM analysts shall/MUST not be employees of a fishing company involved in the observed fishery or have other direct conflicts of interest. OPTION 2 • EM Analysts MUST be independent and impartial and qualified in accordance with criteria approved by the Commission. • Training should cover the EM analysis process and relevant topics identified from the Agreed Minimum Standards and Guidelines for the Regional Observer Program (https://www.wcpfc.int/wcpfc-regional-observer-programme-standards%20latest;pg 12).	ICCAT does not mention specific training requirements for analysts. IOTC, IATTC, and WCPFC recommend training courses for analysts. IOTC states the training should be based on the EM review protocol and IATTC states that CPCs should design the courses with input from various stakeholders and experts. WCPFC suggests two training pathways: 1) a program that covers basic review processes or 2) a program that covers the analysis process and relevant topics from the Agreed Minimum Standards and Guidelines for the Regional Observer Program.

Responsibilities	**Onboard Responsibilities**	**Enable Data Collection**	**Handle Catch in View of EMS**	Required	The Master of the vessel shall ensure that the handling of the catch does not hinder the proper identification and estimation of the catch composition by the EMS, including by-catch.	N/A	N/A	Required	The Skipper/Master of the vessel shall ensure that the handling of the catch and bycatch, to the extent practicable, allows EM cameras an adequate view the collection of the relevant data fields specified in Annex 2 (e.g., species identification, catch composition, etc.).	N/A	[VMP] v. MUST include any catch handling procedures required to ensure that EM Records allow collection of the data fields set out in the EM data requirements (e.g., handling in view of cameras, allowable discard locations).[See Annex 2 for references to existing catch handling procedures]	ICCAT and IATTC require that vessel masters catch handling does not hinder EMS visibility or ability to collect data. IATTC notes this "to the extent practicable". IOTC does not specify onboard responsibilities but instead states that it is CPCs' responsibility *To document the roles and responsibilities of fisheries government authorities and vessel owner/crew with respect to inter alia installing and maintaining equipment, routine cleaning of cameras, sending storage devices, access to EM records and EM data, responses to mechanical or technical failure of EMS.* WCPFC requires that the VMP includes any required catch handling

												procedure laid out in data requirements, but doesn't specify any procedures in the program standards, except for those laid out in Annex 2 which are existing catch handling best practices and guidelines and are not specific to EM (except for shark handling procedures which require handling to allow ID).

			Ensure Camera View is Unobstructed	Required	The Master of the vessel shall ensure that in accordance with the VMP and the minimum areas of vessel coverage as specified in Annexes 2 and 3, the cameras have an un-obstructed view, and following pre-established protocols, the camera lenses are kept clean. Crew assistance shall be required to clean the camera lenses when appropriate and necessary.	Recommended	A designated person on board (and/or on land) should be designated to maintain the equipment (e.g., clean of lenses, etc.).	Required	The Skipper/Master of the vessel shall ensure that in accordance with the VMP and the camera views capable of collecting the minimum data identified in this Resolution as specified in Annex 2, the cameras have an un-obstructed view, and that the lenses or lens covers are cleaned, as necessary. Each vessel shall have a designated crew member responsible for routine camera lens cleansing, per a specific protocol, to ensure the clarity of EM records, according to a protocol to be developed by IATTC scientific staff. Appropriate cleaning materials must be used to avoid lens damage and should always be available onboard.	N/A	The vessel owner/operator: a. MUST follow duty of care responsibilities described in the Vessel Monitoring Plan.	IATTC, ICCAT, and IOTC mention keeping lenses clean, but ICCAT and IATTC also require that crew ensure an un-obstructed view and that lenses are kept clean. ICCAT makes this the responsibility of the vessel master, with assistance from the crew. IATTC requires this to be the responsibility of the vessel master, but requires a designated person who can be crew to clean the equipment. IOTC recommends that there should be a "designated person" to maintain equipment, and is more vague in saying that the person should maintain the equipment (which includes lens cleaning, but keeping an un-obstructed view and making that assurance the responsibility of someone are not

												included). ICCAT and IATTC require pre-established protocols for cleaning, and IATTC also specifies that appropriate cleaning materials should be used and requires them to be constantly available onboard. WCPFC only requires that crew/vessel owners follow the duty of care responsibilities in the VMP, but these are not defined.
		Support Installation	**Facilitate EMS Installation**	N/A	N/A	N/A	N/A	N/A	N/A	Required	The vessel owner or their designated representative: a. MUST provide information5 describing the vessel configuration and systems to facilitate EM system installation. b. MUST make the vessel and appropriate personnel (such as engineers, fishing master, multilingual staff, etc.) available and provide the EM Service Provider unfettered access, including to the ship's power supply, to complete EM system installation.	Only WCPFC explicitly requires that the vessel owner support installation. The specific requirements that the vessel owner provide vessel information is similar to the "Vessel Survey" requirement, and the requirement that the owner make the vessel and personnel available requirement is similar to

												"Provide Access to EMS for Inspection".
		Ensure EMS Functionality	**Perform Maintenance**	N/A	N/A	Recommended	A designated person on board (and/or on land) should be designated to maintain the equipment (e.g., clean of lenses, etc.).	Required	At sea, all maintenance, repairs and replacement activities of EM equipment shall be conducted by a designated trained vessel crew member(s), only in coordination and when instructed to do so remotely by the EM service provider.	N/A	The vessel owner/operator: a. MUST follow duty of care responsibilities described in the Vessel Monitoring Plan.	IOTC recommends, and IATTC requires, that a designated person is established to maintain equipment. IATTC further mentions repairs and replacement activities, which go beyond just maintenance, and that that designated person is trained. IATTC also specifies maintenance should only be conducted in coordination with and when instructed to do so by the EM service provider. WCPFC only requires that crew/vessel owners follow the duty of care responsibilities in the VMP, but these are not defined.

			Ensure Proper Transmission and Retrieval of EMS Data	Required	The Master of the vessel shall ensure that the transmission or retrieval of EMS data is carried out in accordance with the provisions of Annex 5.	N/A	N/A	Required	The Skipper/Master of the vessel shall ensure that the transmission or retrieval of EM records is carried out in accordance with the mandatory provisions of Annex 5.	N/A	N/A	ICCAT and IATTC have identical requirements that the vessel master ensure proper transmission and retrieval of EM data. NOTE: IOTC does not specify onboard responsibilities but instead states that it is CPCs' responsibility *To document the roles and responsibilities of fisheries government authorities and vessel owner/crew with respect to inter alia installing and maintaining equipment, routine cleaning of cameras, sending storage devices, access to EM records and EM data, responses to mechanical or technical failure of EMS.*

			Provide Access to the EMS for Inspection	Required	The Master of the vessel shall ensure that on-board physical access to the EMS components is provided if requested by an ICCAT or CPC-authorized observer and/or inspection personnel.	N/A	N/A	Required	The Skipper/Master of the vessel shall ensure that on-board physical access to the EM equipment components is provided if requested by the flag authority or any CPC-authorized personnel.	N/A	The vessel owner or their designated representative: a. MUST provide information5 describing the vessel configuration and systems to facilitate EM system installation. b. MUST make the vessel and appropriate personnel (such as engineers, fishing master, multilingual staff, etc.) available and provide the EM Service Provider unfettered access, including to the ship's power supply, to complete EM system installation.	ICCAT and IATTC have nearly identical requirements that the vessel master ensures access to the EM equipment when authorized personnel request it. ICCAT includes ICCAT personnel specifically. IOTC does not specify onboard responsibilities but instead states that it is CPCs' responsibility *To document the roles and responsibilities of fisheries government authorities and vessel owner/crew with respect to inter alia installing and maintaining equipment, routine cleaning of cameras, sending storage devices, access to EM records and EM data, responses to mechanical or technical failure of EMS.*

												WCPFC requires that the vessel owner provide access for installations, which is similar and covered under "Facilitate EMS Installation".
			Report Malfunctions	Required	The Master of the vessel shall ensure that in case the EMS malfunctions, report the malfunction, including the display of any critical warning, to the flag CPC competent authorities, through automatic real time notification of the malfunction or manually, within a maximum of 24 hours or as soon as practicable;	Recommended	A designated person on board (and/or on land) should be designated to maintain the equipment (e.g., clean of lenses, etc.) and report to the EM equipment provider and the competent authority (e.g., IOTC or flag state) when the system is malfunctioning at port or at sea so the system is fixed as soon as possible, and should record any failure of the EM equipment in a dedicated form.	Required	The Skipper/Master of the vessel shall ensure that in case the EM equipment malfunctions, the malfunctions are reported to the relevant flag authority and, where appropriate, the provider as soon as possible.	Required	The vessel owner/operator: b. MUST report EM system malfunctions to the appropriate contact as outlined in the Vessel Monitoring Plan. This should be done as soon as is practicable, and include details of the date, time, and, if possible, the geolocation when the malfunction was first detected. c. MUST follow vessel responsibilities outlined in the Vessel Monitoring Plan in the event of system malfunctions.	All RFMOs request that someone (master of vessel for ICCAT, IATTC, and WCPFC, designated person for IOTC) report malfunctions. IOTC, ICCAT, and IATTC specify that they are reported to the flag state. WCPFC says reporting shall be made to the contact listed in the VMP. IOTC is the only RFMO that recommends, not requires, this standard. IOTC and

												IATTC also request reporting to the EM service provider. IOTC, IATTC, and WCPFC request that reports are made as quickly as possible. IOTC requests logging EM failures in a dedicated form. ICCAT notes reports can be made manually or through automatic real-time notification, "within a maximum of 24 hours" or as soon as possible. WCPFC also recommends reports include the date, time, and geolocation when the malfunction was detected, as well as follow related responsibilities outlined in the VMP.

			Prevent Tampering with EMS	Required	The Master of the vessel shall ensure that unless authorized and instructed by the flag CPC to take a specific action, the EMS is not tampered with (e.g., disconnect the system, rearrange, or obstruct the view of the cameras, disconnect cameras or sensors, switch-off the EMS manually, intentionally break the system, etc.).	N/A	N/A	Required	The Skipper/Master of the vessel shall ensure that unless authorized and instructed by the flag CPC or CPC-authorized personnel, the EM equipment is not tampered with (e.g., disconnect the system, rearrange or obstruct the view of the cameras, disconnect cameras or sensors, switch-off the EM equipment manually, intentionally break the system).	N/A	The vessel owner/operator: a. MUST follow duty of care responsibilities described in the Vessel Monitoring Plan.	ICCAT and IATTC have nearly identical requirements that require the vessel master to ensure EMS is not tampered with unless authorized or instructed by the flag CPC. IOTC does not specify onboard responsibilities but instead states that it is CPCs' responsibility *To document the roles and responsibilities of fisheries government authorities and vessel owner/crew with respect to inter alia installing and maintaining equipment, routine cleaning of cameras, sending storage devices, access to EM records and EM data, responses to mechanical or technical failure of EMS.* WCPFC only requires that crew/vessel owners follow the duty of

												care responsibilities in the VMP, but these are not defined.
			Prevent Vessel from Leaving Port if the EMS is Not Operating	Required	The Master of the vessel shall ensure that the vessel does not leave port if the EMS is not operating properly unless, the flag CPC authorizes it to do so and ensures that any relevant data collection or other ICCAT obligations, such as minimum observer coverage requirements, can be met through other means.	Recommended	A designated person should ensure that the system is working properly before leaving port and at sea, and a protocol (checklist) should exist for that purpose.	N/A	N/A	N/A	N/A	ICCAT requires, and IOTC recommends, that a designated person (for ICCAT, the master of the vessel), ensures that vessels do not leave port if the EMS is not working properly. IOTC recommends this "at sea" as well and that a protocol should exist for this process. ICCAT notes that this is unless authorized by a CPC, and in the case that it is, that data collection obligations are able to be met

												with other means.
	EM Service Provider	**Installation**	**Comply with Relevant EM Standards**	N/A	N/A	N/A	N/A	N/A	N/A	Recommended	CCMs should ensure that their EM Service Provider or their designated installer complies with the relevant EM standards. To this end, CCMs are encouraged to refer to Annex 1 (voluntary guidelines for EM system installation). The EM Service Provider or their designated installer SHOULD: a. coordinate installation with the vessel owner or their designated representative. b. install an onboard EM system that meets the performance standards described in onboard EM System Component and General Requirements. c. ensure the onboard EM system meets the performance standards described in onboard EM System Component and General Requirements through system tests. d. provide the necessary information for the vessel owner/operator or their designated representative to complete a Vessel	Only WCPFC has recommendations for EM Service Provider responsibilities, which include coordinating installation, installing a system that meets performance standards, providing the information needed to complete or completing a VMP, briefing the vessel owner on their responsibilities, and sending a notification of EM system installation and compliance.

												Monitoring Plan (Vessel Monitoring Plans) or complete the Vessel Monitoring Plan on behalf of the owner/operator. e. brief the vessel operator and crew member(s) and provide documentation on EM system operation, maintenance, and procedures to follow during regular operation and in the event of a system malfunction (Vessel Monitoring Plans). f. MUST submit notification to the relevant EM Programme of system installation in the agreed form that attests to the system functionality and its conformance with the performance standards described in onboard EM System Component and General Requirements.	

		Field and Technical Support	**Comply with Relevant EM Standards**	N/A	N/A	N/A	N/A	N/A	N/A	Required	CCMs shall ensure that their EM Service Provider or their designated installer complies with the relevant EM standards. To this end, CCMs are encouraged to refer to Annex 1 (voluntary guidelines for Field and Technical Support Services). The EM Service Provider, in a timely manner, SHOULD: a. Communicate with vessel operators and the relevant EM Programme to coordinate service needs, resolve specific programme issues, and provide feedback on programme services. b. Provide maintenance and support services, including software and firmware updates, such that all installed EM systems perform according to the performance specifications described in onboard EM System Component and General Requirements and that field services are scheduled and completed with minimal delays to minimise disruption to fishing operations. c. Provide technical assistance to vessels upon request on EM system operations, diagnosing causes of system malfunctions, and providing assistance for resolving	Only WCPFC has recommendations for EM Service Provider responsibilities, which include coordinating service needs, providing maintenance and support, providing 24/7 technical assistance, and submitting to the EM program all technical assistance requests.

											malfunctions. This assistance SHOULD be available 24 hours a day, seven days a week, year-round. This service must be provided in the relevant languages as defined in the programme specifications. d. Submit to the relevant EM Programme, and the EM Certifier, where appropriate, reports of all requests for technical assistance from vessels and service calls that include: i. The name and designation of the vessel point of contact ii. The date(s) and time a request for service was made.	

	CPC Responsibilities	**Program Design**	**Develop and Describe National EMS Program**	Required	A CPC that chooses to implement an EMS program in its longline and/or purse seine fisheries to meet ICCAT requirements for scientific data collection and/or compliance monitoring purposes shall develop and describe an EMS domestic program. Domestic EMS program descriptions shall meet ICCAT requirements and include at least an example VMP, responsibilities of fisheries authorities and vessel owner/crew with respect to installing and maintaining equipment (including routine cleaning of cameras and responses to mechanical or technical failure of the EM), protocols for data storage and retrieval, a list of any ICCAT measures where the use of EMS is necessary for the CPC to meet the requirements of ICCAT	Required	CPCs, who fish for species under the competence of the IOTC, and who choose to implement EMS in the IOTC area of competence to partially or fully meet the minimum ROS data requirements under Resolution 22/04 (or any subsequent revision), shall: a) ensure that the implementation of their National EM Programs (NEMPs) and EM systems on their flagged vessels meets the requirements of the EM Program Standard (Annex 1) and EM System and Data Standards (Annex 2). b) submit to the IOTC Secretariat by 1 July each year, a Vessel Monitoring Plan, that covers each vessel in their IOTC fishery utilizing EMS, outlining the EMS setup on each vessel, consistent with the requirements in the EM Program Standard (Annex 1) and making use of guidance in Annex 3 (Vessel Management Plan Guide). c) submit to the IOTC Scientific Committee, as an annex to CPC National Reports to the SC, a fleet level summary of the	Required	CPCs that decide to implement EMS to collect fisheries data for submission to IATTC shall ensure that their programs meet the requirements in this Resolution and prior to submitting EM data to the IATTC shall submit an EM program description to the Director detailing, at a minimum, the following information: - an example of the VMPs used in the program; - responsibilities of fishing authorities and vessel owner/crew with respect to installing and maintaining equipment, including routine cleaning of cameras, and responses to mechanical or technical failure of the EMS; - protocols for data storage, retrieval and transfer (Annex 5); - protocols for internal reporting and following up on possible actions inconsistent with these standards that are detected. CPCs may voluntarily	N/A	N/A - update in reporting	For CPCs that submit EMS data to the RFMOs, IOTC, ICCAT, and IATTC RFMOs require that they develop and describe their EM programs. Note that IOTC phrases this requirement differently, though is requesting similar documentation to the other RFMOs. However, ICCAT and IATTC's requirements are very similar compared to the overlap between those requirements and what the IOTC requires. In general, all RFMOs require that these programs ensure they are meeting RFMO EM program and data standards and that descriptions include requirements of vessel owners and crew. ICCAT and IATTC require an example VMP; protocols for data storage, transfer, and retrieval; and

					recommendation(s) for monitoring compliance, and the protocols for reporting and following up on potential infringements.		Vessel Monitoring Plans (described in 3b) that specifies at a minimum: i. The number of CPC flagged vessels implementing EM by gear/fishery type. ii. The range of EMS configurations implemented within the fleet (including the numbers and placements of cameras for each configuration). iii. A general description of EMS requirements placed upon vessel skippers/crews by the CPC government. d) submit to the IOTC Secretariat by 1 July each year, a fleet level ROS data collection table, clearly specifying for each ROS minimum required data field as specified [here1]: i. The data field name and description ii. The data field reporting requirement level (i.e, mandatory collection and reporting, mandatory reporting if collected, not mandatory etc) iii. the data collection method used to collect data for that field2, iv. a brief description of the		share information on such instances with the IATTC Secretariat			protocols for reporting internally on infringements of RFMO requirements. ICCAT also requires a list of ICCAT measures where EMS is necessary for the CPC to meet those requirements. In this section, IOTC references several other requirements that are captured (namely b) and c)) elsewhere, such as "Submit to RFMO" under "Vessel Monitoring Plan", and in other standards in the "CPC Responsibilities" section.

							data collection method.					
			Submit National EM Program Description to RFMO Director	Required	The EMS programme description required in paragraph 14 above shall be submitted to the ICCAT Secretariat within 30 days of the adoption of such programme.	N/A	N/A	Required	CPCs that decide to implement EMS to collect fisheries data for submission to IATTC shall ensure that their programs meet the requirements in this Resolution and prior to submitting EM data to the IATTC	N/A	annual report	ICCAT and IATTC require that EM program descriptions be submitted to the RFMO. ICCAT requires this within 30 days of the adoption of an EM program, and IATTC

									shall submit an EM program description to the Director...			requires this prior to submitting EM data to the IATTC. ICCAT requires submission to the Secretariat, and IATTC requires submission to the Director (secretariat)
			Ensure EMS Implementation Complies with RFMO Standards	Required	CPCs that choose to implement EMS to meet ICCAT requirements specified in separate ICCAT recommendations (e.g., regarding observer coverage), shall ensure that the fishing vessels flying their flags meet the EMS minimum standards and requirements established in this Recommendation...	Required	CPCs, who fish for species under the competence of the IOTC, and who choose to implement EMS in the IOTC area of competence to partially or fully meet the minimum ROS data requirements under Resolution 22/04 (or any subsequent revision), shall ensure that the implementation of their National EM Programs (NEMPs) and EM systems on their flagged vessels meets the requirements of the EM Program Standard (Annex 1) and EM System and Data Standards (Annex 2). In case they choose EMP to meet IOTC Observer Resolution on Regional Observer Scheme, to ensure that EM equipment installed on fishing vessels under its flag and the EMS implementation complies with the	Required	CPCs that decide to implement EMS to collect fisheries data for submission to IATTC shall ensure that the vessels flying their flags meet the mandatory elements of the EMS minimum standards and requirements established in this document... CPCs that decide to implement EMS to collect fisheries data for submission to IATTC shall ensure that their programs meet the requirements in this Resolution...	Required	CCMs shall ensure that their EM Service Provider or their designated installer complies with the relevant EM standards. To this end, CCMs are encouraged to refer to Annex 1 (voluntary guidelines for EM system installation). CCMs shall ensure that their EM Service Provider or their designated installer complies with the relevant EM standards. To this end, CCMs are encouraged to refer to Annex 1 (voluntary guidelines for Field and Technical Support Services).	IATTC, ICCAT, and IOTC require that CPCs ensure fishing vessels that implement EMS to meet RFMO requirements ensure EM systems and National EM programs meet their requirements (the standards themselves). WCPFC requires that CCMs ensure EM Service Providers comply with EM standards (this is a slightly more narrow requirement).

							requirements established by the Commission for the purpose of IOTC's REMP. CPCs shall ensure all EM equipment installed in their national or subregional programs are consistent with these technical specifications. CPCs: To ensure that EMS implementation is consistent with IOTC's REMP and its minimum standards.					
			Ensure Transparency	Required	CPCs shall ensure that domestic EMS programmes are developed, and designed and implemented in a manner that ensures they are independent, transparent, and accountable, in accordance with requirements set out in this Recommendation.	N/A	N/A	Required	CPCs that decide to implement EMS to collect fisheries data for submission to IATTC shall ensure that the vessels flying their flags meet the mandatory elements of the EMS minimum standards and requirements established in this document, including the following: - that CPC EM	N/A	N/A	ICCAT and IATTC require that CPCs develop, design, and implement their EM programs in a transparent way.

									programs are developed, and designed and implemented in a manner that ensures they are transparent and the resulting data verifiable			
			Approval of EMS	N/A	N/A	Recommended	EMS should be approved and accredited by an appropriate IOTC body (e.g., IOTC WGEMS/WPDCS) or CPCs to ensure that the minimum standards of the REMP (and ROS) are met, including EM equipment installation (through an EM Vessel Monitoring Plan), collection of data consistent with ROS minimum data standards, EM records reviewed by accredited companies/organizations and independence of EMS are maintained. In case that CPCs approved the EMS the CPC shall submit to the IOTC Secretariat copies of each vessel's VMP and present to the Scientific Committee, as an annex to CPC National Reports to the Scientific Committee, a fleet level overview of the CPCs VMPs. CPCs should apply	N/A	N/A	N/A	N/A	Only IOTC recommends that IOTC or CPCs approve and accredit EMS.

							to the IOTC Secretariat to have its own National EM Program recognized as part of IOTC's REMP so as to comply with ROS data minimum standards.					
		Program Management	**Establish Procedures in Case of EMS Failure**	Required	CPCs that choose to implement EMS to meet ICCAT requirements specified in separate ICCAT recommendations (e.g., regarding observer coverage), shall ensure that the fishing vessels flying their flags meet the EMS minimum standards and requirements established in this Recommendation, including ensuring the following: - that rules and procedures are established in	Required	CPCs: To document the roles and responsibilities of fisheries government authorities and vessel owner/crew with respect to inter alia installing and maintaining equipment, routine cleaning of cameras, sending storage devices, access to EM records and EM data, responses to mechanical or technical failure of EMS.	Required	CPCs that decide to implement EMS to collect fisheries data for submission to IATTC shall ensure that the vessels flying their flags meet the mandatory elements of the EMS minimum standards and requirements established in this document, including the following: - that rules and procedures are established in case of EM equipment failure and are followed CPCs that decide to implement	Required	The EM Program: a. MUST define vessel responsibilities in the event of system malfunctions that describe the steps that must be taken under different failure scenarios.	All RFMOs require that CPCs establish procedures in case of EMS failure. ICCAT requires that this includes procedures to ensure any data or IOTC obligations can be met through other means. IOTC actually requires that that CPCs document a broader list of responsibilities for vessel crew. ICCAT and IATTC further require that these responsibilities are shared with RFMOs as

					case of EMS failure, including to ensure that any relevant data collection or other ICCAT obligations, such as minimum observer coverage requirements, can be met through other means;					EMS to collect fisheries data for submission to IATTC shall ensure that their programs meet the requirements in this Resolution and prior to submitting EM data to the IATTC shall submit an EM program description to the Director detailing, at a minimum, the following information: - responsibilities of fishing authorities and vessel owner/crew with respect to installing and maintaining equipment, including routine cleaning of cameras, and responses to mechanical or technical failure of the EMS;			part of the Program Descriptions, described under "Develop and Describe National EMS Program".
			Ensure Proper Transmission and Retrieval of EMS Data	N/A	N/A	N/A	N/A	Required	CPCs that decide to implement EMS to collect fisheries data for submission to IATTC shall ensure that their programs meet the requirements in this Resolution and prior to submitting EM data to the IATTC shall submit an EM program description to the Director detailing, at a minimum, the following	N/A	N/A	Only IATTC requires CPCs to "allow" for the recovery and transmission of data at the end of each trip.

									information: - protocols for data storage, retrieval and transfer (Annex 5); The vessel flag CPC authority shall allow for the recovery and secure transmission of EM Records at the end of each trip.			
			Provide List of RFMO Measures EMS Will Be Used for to Analysts	Required	Taking into account ICCAT recommendations that authorize or require the use EMS to monitor compliance with certain conservation and management measures, CPCs shall provide a list of relevant ICCAT measures for which it is using EMS for this purpose, to CPC appointed analysts.	N/A	N/A	N/A	N/A	N/A	N/A - particular measure syou need EM for, tell us how you are using EMS - look for	Only ICCAT requires that CPCs provide a list of ICCAT measures for which it is using EMS to analysts. Likely, this is implied by other RFMOs.
			Ensure Installations Comply with Standards	N/A	N/A	N/A	N/A	N/A	N/A	Recommended	CCMs shall ensure that their EM Service Provider or their designated installer complies with the relevant EM standards. To this end, CCMs are encouraged to refer to Annex 1 (voluntary guidelines for EM system installation).	Only WCPFC requires that CCMs ensure compliant EMS installation. Note that the requirement is that CCM's ensure compliance but the recommendations are not mandatory.

			Ensure Appropriate Field and Technical Support	N/A	N/A	N/A	N/A	N/A	N/A	Recommended	CCMs shall ensure that their EM Service Provider or their designated installer complies with the relevant EM standards. To this end, CCMs are encouraged to refer to Annex 1 (voluntary guidelines for Field and Technical Support Services).	Only WCPFC requires that CCMs ensure compliance with field and technical support service recommendations. Note that the requirement is that CCM's ensure compliance but the recommendations are not mandatory.
			Communicate with EM Service Providers and Vessel Owners	N/A	N/A	N/A	N/A	N/A	N/A	TBD	The EM Program: b. [SHOULD /MUST] respond to EM Service Providers or vessel owners/operators in a timely manner.	Only WCPFC mentions the timeline in which service providers must respond to vessel owners.
			Collaborate to Harmonize National EM Programs	N/A	N/A	Required	CPCs: To collaborate to ensure National EM Programs are compatible and harmonized where necessary.	N/A	N/A	N/A	N/A	Only IOTC requires that CPCs collaborate as necessary to harmonize National EM programs.

		Reporting	**Submit Annual Report to RFMO**	Required	A CPC that chooses to implement EMS in its longline or purse seine fisheries to meet ICCAT requirements for scientific data collection and/or compliance monitoring purposes, shall also: a) When EMS is used for scientific purposes, report to the SCRS each year, using the electronic formats that are developed by the SCRS, information collected through domestic EMS programmes, in line with procedures in place for other data reporting requirements and consistent with domestic confidentiality requirements; and b) report to the Commission in its Annual Report other relevant information on the results of the implementation of its EMS domestic programme during the previous year,	Required	CPCs, who fish for species under the competence of the IOTC, and who choose to implement EMS in the IOTC area of competence to partially or fully meet the minimum ROS data requirements under Resolution 22/04 (or any subsequent revision), shall: ... b) submit to the IOTC Secretariat by 1 July each year, a Vessel Monitoring Plan, that covers each vessel in their IOTC fishery utilizing EMS, outlining the EMS setup on each vessel, consistent with the requirements in the EM Program Standard (Annex 1) and making use of guidance in Annex 3 (Vessel Management Plan Guide). c) submit to the IOTC Scientific Committee, as an annex to CPC National Reports to the SC, a fleet level summary of the Vessel Monitoring Plans (described in 3b) that specifies at a minimum: i. The number of CPC flagged vessels implementing EM by gear/fishery type. ii. The range of EMS configurations implemented	Required	CPCs that decide to implement EMS to collect fisheries data for submission to IATTC shall report EM data for each year collected consistent with these minimum standards to the IATTC Secretariat, preferably consistent with data reporting deadlines of relevant resolutions or by the end of the following year using the formats and guidelines described in Annexes 2, 3 and 5 consistent with procedures in place for other data reporting requirements and consistent with the confidentiality requirements of the CPCs. CPCs that decide to implement EMS to collect fisheries data for submission to IATTC shall submit by March 30 of the following year a fleet-level summary of the VMPs to the Commission describing the implementation of their EM program(s) in the previous year,	Required	Any CCM using EM and submission of EM data to meet WCPFC requirements MUST provide the following reporting in their Annual Report Part 1. For any CCM that voluntarily chooses to use EM for WCPFC fisheries and submits EM data to support the work of the Commission, it is recommended that this information be provided to allow the necessary context for the use of any EM data. Attestation EITHER a confirmation that the EM program and EM system meets all the MUST requirements in the EM Standards OR a description of those components that do not and the intended steps to achieve the requirement in the EM Standards. Vessel monitoring plans Examples of the Vessel monitoring plans used in the program to be provided. Would show where camera number and placement differ across vessels in the program (e.g. different sized vessels or vessels fishing in different parts of the Convention Area where different camera configurations are required to achieve the monitoring objectives). Vessel owner / crew responsibilities A description of the	All RFMOs require some form of annual reporting to the RFMO for CPCs who use EM to meet RFMO requirements. ICCAT and WCPFC do not specify a deadline. IOTC has a deadline of July 1, and IATTC has a deadline of March 30. ICCAT requires information collected in the previous year through EM and a report on implementation of the CPC's EM program implementation in the previous year including vessels monitored, coverage levels, and information on compliance monitoring. IOTC requires a VMP for each vessel using EMS, a fleet level summary of VMPs including vessels monitored, EMS configurations, crew requirements, and an ROS "data

					including, at least, the number of vessels or fishing effort monitored; the coverage levels achieved by fishery and gear type; details on how those coverage levels were calculated; and, where appropriate, information on compliance monitoring.		within the fleet (including the numbers and placements of cameras for each configuration). iii. A general description of EMS requirements placed upon vessel skippers/crews by the CPC government. d) submit to the IOTC Secretariat by 1 July each year, a fleet level ROS data collection table, clearly specifying for each ROS minimum required data field as specified [here1]: i. The data field name and description ii. The data field reporting requirement level (i.e, mandatory collection and reporting, mandatory reporting if collected, not mandatory etc) iii. the data collection method used to collect data for that field2, iv. a brief description of the data collection method.		including, at a minimum, the number of vessels implementing EM by gear and fishery type]; the range of EMS configurations implemented within the fleet (including the numbers and placements of cameras for each configuration); a general description of EMS requirements placed upon vessel skippers/crews by the CPC; the percent coverage levels achieved by fishery and gear type; details on how those coverage levels were calculated; and, where appropriate, information on compliance monitoring so that these reports can be reviewed by the EMWG or other Commission body, as appropriate.		obligations on the vessel owner/operator with respect to the EM system and program, e.g., cleaning or maintenance and how to respond to mechanical or technical failures of the EM system. EM record transmission / retrieval Description of how EM records are retrieved from the EM system. WCPFC CMM procedures If applicable, any specific features of the EM system and EM program put in place to monitor the implementation of, and compliance with, obligations under a WCPFC CMM. EM coverage levels By year: EM coverage in terms of both vessel numbers (number and proportion of vessels with operating EM systems) AND Total fishing effort (number and proportion of fishing events for which EM records were collected) EM analysis rates By year: EM analysis rate expressed as a proportion of EM coverage for fishing events (i.e., proportion of EM records reviewed to generate EM data). EM data submission summary By year: Summary of key data included in the EM data submission, e.g.,	collection table". IATTC's requirements are the most expansive, including elements of both ICCAT and IOTC's. IATTC requires a fleet level summary of VMPs including vessels monitored, EMS configurations, crew requirements, coverage levels, and information on compliance monitoring. WCPFC requires a description of the EM program (including an attestation of compliance, example VMPs, vessel responsibilities, procedures for records retrieval, and interface with WCPFC compliance measures) and of the implementation of the EM program (including coverage, analysis rates, data summary, and data review quality summary).

												number of captures of species of special interest, number of size measurements. EM data quality and review summary Summary of observations where issues, which impacted the quality of the EM data, were noted by EM analysts e.g., technical, mechanical, specific circumstances and/or catch handling.	Some of this is covered also under "Submit to RFMO" in the "Vessel Monitoring Plan (VMP)" section.
			Report Changes to CPC EM Programs to RFMO	Required	In addition, CPCs shall report any changes to their EMS domestic programme to the ICCAT Secretariat whenever such changes occur.	N/A	N/A	Required	CPCs shall report any changes to their EM domestic program to the Director whenever such changes occur.	N/A	N/A	Both ICCAT and IATTC require CPCs to report changes to domestic EM programs to the RFMO (Secretariat for ICCAT, Director for IATTC).

			Share EM Program Coordinator Contact Details	N/A	N/A	Required	The CPC shall provide the IOTC Secretariat with the contact details of their EM Program Coordinator(s).	N/A	N/A	N/A	N/A	Only IOTC requires that CPCs provide the IOTC with EM Program Coordinator contact details.
			Report Infringement or Violation of RFMO Standards	Required	CPCs that choose to implement EMS to meet ICCAT requirements specified in separate ICCAT recommendations (e.g., regarding observer coverage), shall ensure that the fishing vessels flying their flags meet the EMS minimum standards and requirements established in this Recommendation, including ensuring the following: - that appropriate follow-up is undertaken if potential infringements of ICCAT conservation and management measures are detected through the CPC's EMS programme. Each CPC shall establish a protocol for reporting and following up on potential	N/A	N/A	Optional	Voluntary that in instances where actions inconsistent with these standards are detected in EM records or data, appropriate follow-up by the competent flag authority is undertaken. CPCs that decide to implement EMS to collect fisheries data for submission to IATTC shall ensure that their programs meet the requirements in this Resolution and prior to submitting EM data to the IATTC shall submit an EM program description to the Director detailing, at a minimum, the following information: - protocols for internal reporting and following up on possible actions inconsistent with these standards that are detected. CPCs may voluntarily share information on	N/A	N/A	ICCAT requires that CPCs establish a protocol for reporting and following up on infringements of ICCAT conservation and management measures and that CPCs ensure appropriate follow-up occurs when detected. IATTC requires protocols for reporting and following up on actions inconsistent with EM standards, but it is voluntary for these to be reported to the IATTC or for follow-up to occur.

					infringements of ICCAT requirements detected using EMS.				such instances with the IATTC Secretariat			
	RFMO Responsibilities	**Program Management**	**Monitor and Provide Oversight of Program**	N/A	N/A	Required	Commission to monitor and provide oversight of the implementation of the REMP, including those implemented through National EM Programs.	N/A	N/A	N/A	N/A	Only ITOC is required to monitor and provide oversight of the regional EM program, including national programs.
			Revise Program Standards	Required	The Commission shall review this Recommendation in 2026 and at least every four years thereafter to evaluate its effectiveness in fulfilling its purpose and consider the need for revisions, taking into account, inter alia, relevant information provided by CPCs on the introduction and implementation	Required	Commission to adopt and revise, when necessary, minimum standards for the EM Program, technical specifications, and associated data collection. The Commission shall upon the advice of the Scientific Committee and Compliance Committee, review the REMP, the EM Program Standard (Annex 1) and the	Recommended	The EMWG should review, with assistance of the IATTC staff where appropriate, the CPC EMS reports submitted pursuant to paragraph 15, as well as the implementation of those programs and, if appropriate, suggest improvements and adjustments to the minimum standards or to meeting the	N/A	Review in 2026	IOTC and ICCAT require, and IATTC recommends, that the program standards be reviewed and revised, if necessary by the RFMO. For IOTC and ICCAT this is the Commission's responsibility. For IATTC, this is the EMWG's responsibility. IOTC specifically

					of their EMS domestic programmes as well as any new technological developments.		EM System and Data Standards (Annex 2) after a period of 1 year from REMP implementation.		minimum standards.			requires this after a period of 1 year after program implementation. ICCAT requires this in 2026 and every four years thereafter.
			Establish EM Coverage Rates	N/A	*ICCAT EMS Rec provides the standards for EMS, but the actual coverage rates (with regards to the fleets total effort) are established in other regulations, specifically in ICCAT Rec 16-14. So there are minimum coverage rates established for each fishery type, but they are elsewhere (Rec 16-14), not directly in the ICCAT EMS standards. In addition to that, and for scientific purposes, in ICCAT a minimum of human observer coverage rates still have to be maintained, and EMS can only be used to complement that. Specifically, in this Rec 23-18*	Required	Commission to agree on overall EM observer/review coverage through IOTC Observer Resolution on Regional Observer Scheme.	N/A	N/A	N/A	N/A	Only IOTC requires that the Commission agree on EM coverage rates through the ROS.

					you can see that explanation in Paragraph 4: "Unless otherwise decided by the Commission based on SCRS advice provided pursuant to paragraph 13 of Rec. 16-14, CPCs shall ensure that they continue to meet the human observer coverage required in accordance with paragraph 4 of Rec. 16-14 and that, if they choose to implement EMS in accordance with this Recommendation for scientific purposes, it shall be used to complement the required level of human observer coverage and the required tasks to be performed by these human observers."							

			Develop and Adopt Program Implementation Plan	N/A	N/A	Required	The Commission shall implement a Regional Electronic Monitoring Program (REMP) as per the objectives, purpose and roles and responsibilities described in the IOTC EM Program Standard (Annex 1) by [1 July 2024]. The IOTC Secretariat shall assist the Commission to establish and implement a REMP. Commission to develop and adopt a REMP implementation plan.	N/A	N/A	N/A	N/A	Only IOTC requires that the Commission develop and implement a REMP implementation plan.
			Finance Administration of the Program	Optional	The Commission shall explore the availability of sufficient financial resources to support, where needed, the effective introduction and implementation of ICCAT's EMS programme requirements, standards and specifications contained in this Recommendation, including by developing CPCs. The Commission may delegate this responsibility to the WG EMS.	Required	Commission to ensure sufficient financial resources to effectively administrate IOTC's REMP.	N/A	N/A	N/A	N/A	IOTC requires that the Commission finance the REMP's administration. ICCAT states that the Commission will explore the availability of financial resources to support the implementation of the REMO, including by developing CPCs. This may be delegated to the WG EMS and is optional.

			Coordinate Activities Regarding EM with Other RFMOs	Required	The Commission shall engage in coordination on EMS activities and programmes with other tuna RFMOs. The Commission may delegate this responsibility to the WG EMS.	Required	IOTC Secretariat to coordinate activities regarding EM with other tuna RFMOs as required by the Commission.	N/A	N/A	N/A	N/A	Both ICCAT and IOTC require coordination with other tuna RFMOs in regards to EM. This is, as required by the Commission, the responsibility of the Secretariat for IOTC. This is the Commission's responsibility that may be delegated to the WG EMS for ICCAT.
		Program Review	**Provide Annual Reports**	Required	The Secretariat shall: - summarize and provide Annual Reports to the Commission about the progress of CPCs in implementing EMS domestic programmes.	Required	IOTC Secretariat to summarize and provide annual reports about the progress of the REMP, including National EM Programs, to the Commission and its Subsidiary Bodies.	Recommended	The Secretariat should to the extent information is available, summarize and provide an annual report to the EMWG about the progress of CPCs in implementing their EM programs.	N/A	N/A	IOTC and ICCAT require, and IATTC recommends, that the Secretariats produce some annual report. IOTC requires the report to summarize the progress of the REMP. IATTC and ICCAT recommends that this summarizes CPCs' progress in implementing their EM programs.

			Recommend Program Improvements	N/A	N/A	Required	IOTC Secretariat to recommend improvements and adjustments to the REMP to ensure that data and monitoring requirements of IOTC Commission are met.	Optional	Notwithstanding the provisions of paragraph 16, the Secretariat may make recommendations to the Commission, its Scientific Advisory Committee and the EMWG on improvements and adjustments to the minimum standards, as well as to the implementation of the EMS in CPC EM programs. The EMWG should review, with assistance of the IATTC staff where appropriate, the CPC EMS reports submitted pursuant to paragraph 15, as well as the implementation of those programs and, if appropriate, suggest improvements and adjustments to the minimum standards or to meeting the minimum standards.	N/A	N/A	IOTC requires that the Secretariat recommend improvements to the REMP. IATTC allows that the Secretariat may recommdn improvements to the minimum standards as well as implementation of CPC EM programs. It is also recommended that the IATTC EMWG sugest improvements to the minimum standards and the implementation of CPC EM programs.

			Review Rrogram after Initial Period	Required	The Commission shall review this Recommendation in 2026 and at least every four years thereafter to evaluate its effectiveness in fulfilling its purpose and consider the need for revisions, taking into account, inter alia, relevant information provided by CPCs on the introduction and implementation of their EMS domestic programmes as well as any new technological developments.	Required	Commission to review IOTC's REMP after an initial period (e.g., 3 years) of IOTC's REMP implementation. The Commission shall upon the advice of the Scientific Committee and Compliance Committee, review the REMP, the EM Program Standard (Annex 1) and the EM System and Data Standards (Annex 2) after a period of 1 year from REMP implementation.	Required	The Commission shall review these minimum interim standards in 2027 and at least every two years thereafter, or until a final set of EMS standards are adopted. The Commission shall evaluate how effectively these standards fulfilled their purpose and, on that basis, consider whether there is the need to revise them, taking into account, inter alia, relevant information provided by CPCs on the inception and implementation of their EM programs as well as any new technological or scientific developments.	N/A	N/A	All RFMOs are required to review the EM program standards and the implementation of them. ICCAT requires that the Commission do this in 2026 and then at least every 4 years thereafter. IOTC requires that the Commission does this after an initial period of 1 year from program implementation. IATTC requires that the Commission do this in 2027 and then at least every 2 years thereafter or until a final set of standards are adopted.
		Support National EM Programs	**Collaborate with CPCs to Implement National EM Programs**	Required	The Secretariat shall collaborate with the CPCs implementing EMS domestic programmes to ensure that they can meet the applicable ICCAT reporting obligations;	Required	IOTC Secretariat to collaborate with the Commission and CPCs to ensure that National EM Programs are consistent and compatible with the REMP and meet IOTC's REMP monitoring minimum standards.	Recommended	The Secretariat should at the request of a CPC and subject to the availability of funding and staff resources, collaborate with the CPCs implementing their EM programs in order to help make their program consistent with these minimum standards, and	N/A	N/A	ICCAT and IOTC require, and IATTC recommends, that the Secretariats collaborate with CPCs to ensure their programs are consistent with the EM minimum standards and that they can meet their monitoring and

								ensure the quality of the EMS data that will be submitted for inclusion in the IATTC data holdings;			reporting obligations.
		Review Implementation of and Recommend Improvements to National EM Programs	Required	The WG EMS shall review, with assistance of the SCRS where appropriate, the EMS domestic programme submitted pursuant to paragraph 15, as well as the implementation of those programmes and, if appropriate, suggest improvements and adjustment to such programmes to ensure that ICCAT scientific data collection and/or compliance monitoring requirements are met or that the EMS standards followed by the domestic programme are, with due consideration to the development status of CPCs, equivalent to those set out in this Recommendation.	N/A	N/A	Recommended	The EMWG should review, with assistance of the IATTC staff where appropriate, the CPC EMS reports submitted pursuant to paragraph 15, as well as the implementation of those programs and, if appropriate, suggest improvements and adjustments to the minimum standards or to meeting the minimum standards. Notwithstanding the provisions of paragraph 16, the Secretariat may make recommendations to the Commission, its Scientific Advisory Committee and the EMWG on improvements and adjustments to the minimum standards, as well as to the implementation of the EMS in CPC EM programs.	N/A	N/A	ICCAT requires, and IATTC recommends, that the EM WGs (and the IATTC Secretariat, optionally) review implementation of and recommends improvements to National EM programs.

			Provide Annual Reports	Required	The Secretariat shall summarize and provide Annual Reports to the Commission about the progress of CPCs in implementing EMS domestic programmes.	Required	IOTC Secretariat to summarize and provide annual reports about the progress of the REMP, including National EM Programs, to the Commission and its Subsidiary Bodies.	Recommended	The Secretariat should to the extent information is available, summarize and provide an annual report to the EMWG about the progress of CPCs in implementing their EM programs.	N/A	N/A	All RFMOs require some form of annual report. ICCAT and IOTC require, and IATTC recommends that the Secretariats summarize and provide annual reports on EM program progress or the progress of the CPCs in implementing National EM programs.
			Audit National EM Programs	N/A	N/A	Required	IOTC shall audit the National EM Programs against the EM minimum standards. National EM Programs shall be reviewed and subject to regular and periodic audits as agreed by IOTC Commission. IOTC could authorize National EM Programs approved by other tRFMOs.	N/A	N/A	N/A	N/A	Only IOTC requires regular audits of the National EM programs.
Program Characteristics	**Scope**	**Program In Operation**	**Regional**	No		No	The Commission shall implement a Regional Electronic Monitoring Program (REMP) as per the objectives, purpose and roles and responsibilities described in the IOTC EM Program Standard (Annex 1) by [1 July 2024].	No		No		None of the RFMOs created a regional REMP in their standards, though IOTC was supposed to implement one by July 1 2024.
			National	Yes		Yes		Yes		Yes		National programs are authorized and allowed under all RFMOs.

			Combination of Regional and National	No		No		No		No		None of the RFMOs have combination regional and national programs.
		Objective	**Scientific Monitoring**	Yes		Yes		Yes		N/A	N/A	All RFMOS have an objective to use EM for scientific monitoring. WCPFC's objectives are not stated.
			Compliance	Yes		No		Yes		N/A	N/A	Only ICCAT and IATTC have an objective to use EM for compliance.
	Requirements	**EM Requirements**	**Compulsoriness**	No		No		No	EM is not mandatory in the IATTC at this time, and these standards do not create any independent obligation for Members and Cooperating non-Members to implement EMS onboard their fishing vessels...A mandatory EM Program for the EPO tuna fisheries is yet to be adopted by the Commission, but is expected in the near future based on a work plan developed during the EM Workshops.	No		EM is not compulsory.
			Installation Coverage	No		No		No		No		No installation coverage recommendations or requirements are made.

		ROS Program	**Applicable to ROS Requirements**	Yes	Unless otherwise decided by the Commission based on SCRS advice provided pursuant to paragraph 13 of Rec. 16-14, CPCs shall ensure that they continue to meet the human observer coverage required in accordance with paragraph 4 of Rec. 16-14 and that, if they choose to implement EMS in accordance with this Recommendation for scientific purposes, it shall be used to complement the required level of human observer coverage and the required tasks to be performed by these human observers.	Yes	IOTC's REMP or any National EMP, under IOTC's REMP, shall ensure that the data collected through EMS are documented and that all ROS minimum data standard requirements (e.g., "Mandatory Reporting"), if necessary complemented with any additional monitoring program (e.g., port sampling, biological sampling, etc.), are collected by EMS.	No	Data derived from electronic monitoring shall not be used to satisfy existing IATTC data requirements, including data submission and observer requirements at this time. CPCs that would like to provide the IATTC scientific staff EM data through pilot programs to develop their EM programs using these minimum standards may do so as long as they apply the mandatory items in these minimum standards. The Commission shall review this Resolution in 2027, consider CPC experiences with the use of EM in IATTC fisheries, and taking into account this review and CPC experiences, discuss the feasibility of allowing for EM to be used as a substitute for human observers to fulfill certain IATTC observer coverage requirements.	Yes	Any CCM using EM and submission of EM data to meet WCPFC requirements MUST provide the following reporting in their Annual Report Part 17…	ICCAT and IOTC (and it seems, WCPFC) allow EM data to be applied towards ROS requirements.

			Supplementation by Other Data Methods	Optional	Unless otherwise decided by the Commission based on SCRS advice provided pursuant to paragraph 13 of Rec. 16-14, CPCs shall ensure that they continue to meet the human observer coverage required in accordance with paragraph 4 of Rec. 16-14 and that, if they choose to implement EMS in accordance with this Recommendation for scientific purposes, it shall be used to complement the required level of human observer coverage and the required tasks to be performed by these human observers.	Optional	IOTC's REMP or any National EMP, under IOTC's REMP, shall ensure that the data collected through EMS are documented and that all ROS minimum data standard requirements (e.g., "Mandatory Reporting"), if necessary complemented with any additional monitoring program (e.g., port sampling, biological sampling, etc.), are collected by EMS.	N/A	N/A	N/A	N/A	As such, ICCAT and IOTC allow EM to complement other observer methods and vice versa.
		Gear Type	**Purse Seine**	Optional	The purpose of this recommendation is to establish minimum programme requirements and technical standards and specifications for EMS used in ICCAT longline and purse seine fisheries to meet ICCAT requirements for scientific data	Optional	Yes, over 24 meters in length and under 24 meters LOA when outside EEZs	Optional	The purpose of this document is to establish a set of interim minimum standards, hereafter called minimum standards, and specifications for the use of Electronic Monitoring Systems (EMS) in the Antigua Convention area, both on board	N/A	N/A	ICCAT, IOTC, and IATTC standards apply to purse seine vessels.

					collection and/or compliance monitoring and ensure that when EMS is used it is effective in achieving its intended purpose.				purse-seine and longline vessels1			
			Longline	Optional	The purpose of this recommendation is to establish minimum programme requirements and technical standards and specifications for EMS used in ICCAT longline and purse seine fisheries to meet ICCAT requirements for scientific data collection and/or compliance monitoring and ensure that when EMS is used it is effective in achieving its intended purpose.	Optional	Yes, over 24 meters in length and under 24 meters LOA when outside EEZs	Optional	The purpose of this document is to establish a set of interim minimum standards, hereafter called minimum standards, and specifications for the use of Electronic Monitoring Systems (EMS) in the Antigua Convention area, both on board purse-seine and longline vessels1	Optional	Only longline gear is mentioned in the document.	All RFMOs' standards apply to longline vessels.
			Gillnet	N/A	N/A	Optional	Yes, over 24 meters in length and under 24 meters LOA when outside EEZs	N/A	N/A	N/A	N/A	Covered by IOTC standards.
			Pole and line	N/A	N/A	Optional	Yes, over 24 meters in length and under 24 meters LOA when outside EEZs	N/A	N/A	N/A	N/A	Covered by IOTC standards.

			Other gear types	N/A	N/A	Optional	Yes, under 24 meters length when fishing in high seas	No	The EMWG expressed an interest in extending the scope of EM in IATTC to carrier vessels engaged in transshipment at sea pursuant to Resolution C-22-03, but noted that this will depend upon developing further technical guidance with respect to, inter alia, technical standards, data requirements, and recommended equipment configurations.	N/A	N/A	Covered by IOTC standards.

7.6. Appendix 6 - Tuna RFMO EM Standards and Requirements Comparison presentation

Comparison of Tuna RFMO Electronic Monitoring Standards and Data Requirements

Electronic Monitoring Minimum Standards Harmonization Workshop

10 December 2024

San Sebastian, Spain

Analysis Sponsored by:

The Nature Conservancy

Jenny Moffett[1], Mark Michelin[1], Hilario Muria[2]

[1]*CEA Consulting*

[2]*International Seafood Sustainability Foundation*

Introduction

Analysis Context

- Introduction
- Analysis commissioned by TNC, completed by CEA
- Comparison for the workshop designed in partnership with ISSF

Analysis Purpose and Goals

Purpose:

- **Facilitate discussion** focused on harmonization of EM Standards

Goals:

- Comprehensively **identify elements of EM standards and data requirements** that could be compared across the tuna RFMOs
- **Gather information about each requirement** in the respective EM Standards, directly quoting all relevant language for easy reference
- **Compare requirements**, identifying similarities, differences, and levels of requirement

Standards Compared

IOTC, IATTC, ICCAT, and WCPFC (draft)

Food and Agriculture Organization of the United Nations

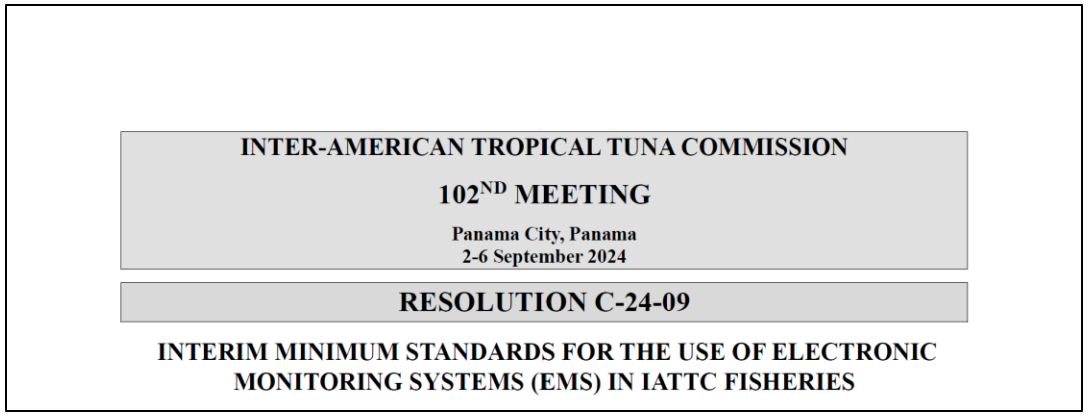
Indian Ocean Tuna Commission
Commission des Thons de l'Ocean Indien
iotc ctoi

RESOLUTION 23/08
ON ELECTRONIC MONITORING STANDARDS FOR IOTC FISHERIES

Western and Central Pacific Fisheries Commission

TO ALL COMMISSION MEMBERS, COOPERATING NON-MEMBERS, PARTICIPATING TERRITORIES AND OBSERVERS

Circular No.: 2024/71
Date: 11 October 2024
No. pages: 45



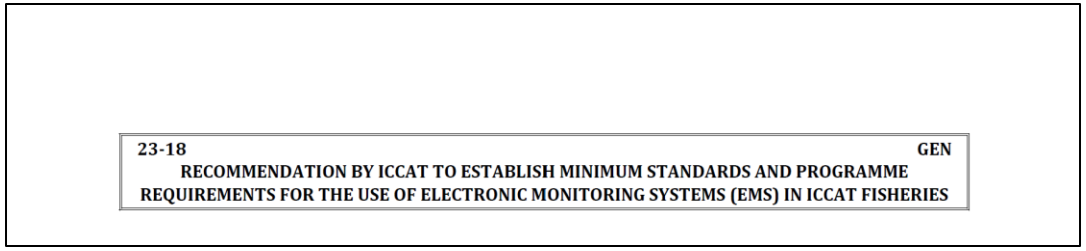
INTER-AMERICAN TROPICAL TUNA COMMISSION

102ND MEETING

Panama City, Panama
2-6 September 2024

RESOLUTION C-24-09

INTERIM MINIMUM STANDARDS FOR THE USE OF ELECTRONIC MONITORING SYSTEMS (EMS) IN IATTC FISHERIES



23-18 **GEN**

RECOMMENDATION BY ICCAT TO ESTABLISH MINIMUM STANDARDS AND PROGRAMME REQUIREMENTS FOR THE USE OF ELECTRONIC MONITORING SYSTEMS (EMS) IN ICCAT FISHERIES

Program Standards

Methodology

1. Full review of all EM Standards
2. Row created for each requirement identified
3. Requirement level noted (shall/must, should, may/could)
4. Gathered and included all relevant language
5. Consolidated and categorized requirements
6. Similarities and differences summarized

Terms Used

N/A = no similar requirement identified

Definitions:

- “Yes” – term defined
- “Similar term” – similar term defined
- “Split terms” – term defined across multiple more narrow terms

Requirements (immediate language):

- Shall/must – required
- Should – recommended
- May/could – optional

Program Characteristics:

- “Yes” – the program, requirement, or goal is applicable or exists

How to Review and Interpret

Categories & Sub-categories | **Requirement** | **RFMO Requirement Details** | **Harmonization Summary**

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**Category**	**Subcategory**	**Type**	**Standard**	**ICCAT**		**IOTC**		**IATTC**		**WCPFC**		**Summary of Level of Harmonization**
39	**Technical**	**EM System**	**Control Box/Center**	**Control Box/Center**	Required	Minimum EMS components shall include an electronic Monitoring (EM) control box/center... The EM control center will be an onboard computer that acquires and stores all sensor-collected information and imagery footage.	Recommended	An EM equipment to be installed on board of a fishing vessel should consist of a control system connecting a number of cameras, and optionally to a number of different sensors, to collect and record images to address the objectives of the	Required	N/A	Required	The EM system control centre: a. MUST control all onboard EM hardware components.	All RFMOs require or recommend (in the case of IOTC) a control box/center, though IATTC does not specifically name or lay out technical requirements for a control box though it is included in the WMP template.
40				**Onboard Interface/Screen**	Required	An on-board screen, or equivalent interface, to allow verification by the Master/crew of the correct functioning of the system, is required.	N/A	N/A	Required	The onboard interface shall include an on-board screen, or equivalent interface, to allow verification by the skipper/crew on correct functioning of EM equipment.	Required	The onboard user interface: a. MUST include a display on the vessel. b. MUST include software or hardware that shows EM system health status and real time images from installed cameras on the display. c. MUST allow only authorised users (e.g., EM Service Providers, EM service technicians) to adjust system configurations. d. COULD include a keyboard, mouse, touchscreen, or other device to allow user inputs to the system. b. System SHOULD undertake regular system health checks throughout the duration of the fishing trip at a frequency defined by the EM Programme and MUST show malfunction alerts (errors and warnings) on the display of the user interface (Onboard User Interface) of the control centre.	ICCAT and IATTC both require an onboard screen or interface for the purpose of verifying that the EM system is functioning. IOTC does not mention any onboard interface, but does require that someone onboard report system malfunctions, which would require some way for a crew member to identify a malfunction. WCPFC also requires an interface to ensure system health status and that the EM system is functioning but also that shows real-time images from each camera. WCPFC states this should undertake regular health checks and requires that it displays malfunction alerts, which ICCAT and IATTC do not specifically mention. Their standards do mention malfunction alerts (covered below), but do not actually specify that the alerts should appear proactively on the onboard interface. There is a difference between ability to verify functioning and being alerted of malfunctions. WCPFC also states the system optionally could have a way to allow user inputs, which no other RFMO mentions, though in "Manual Operation" IATTC recommends manual
41				**Data Storage**	Required	EMS shall have sufficient autonomy and capacity to safeguard and store all recorded images and, where appropriate, sensor information for at least the duration of a complete fishing trip. Sufficient data storage capability to store both sensors, where appropriate, and imagery footage for the entire trip.	Recommended	The EM equipment should have enough storage capacity to store all EM records for a certain period of time, which should be at minimum a complete trip. The duration will depend on the vessel's operational characteristics that could range from 4 months (in the case of purse seiners) to 12 months or more (in the case of longliners).	Required	EM equipment shall include sufficient capacity to store all required EM records, including GPS (or equivalent) records position date, time, vessel name and sensor information where applicable at a minimum, for the duration of a fishing trip. Vessels shall have onboard enough blank data storage devices (preferable solid-state drives) in case these must be replaced at sea; a specially trained crew member may need to replace the devices during a fishing trip if the data storage capacity	Required	The EM system control centre: d. MUST have sufficient storage capacity for all EM Records required to be generated [during a fishing trip] until EM Records are transmitted to a DRC for review.	All RFMOs require (except IOTC, which recommends) enough data storage for a complete trip, though IOTC does specify that this minimum storage capacity may vary depending on gear type. This is implied by trip duration requirements, generally. WCPFC's requirement is actually more vague, in that it doesn't actually state its requirement as a trip length, but as "until EM records are transmitted".
42				**Data Storage Backup**	Required	At least one removable/swappable back-up data storage device, or equivalent data storage mechanism, required to ensure that data are not lost if a storage device fails.	Recommended	The EM equipment should include separate, duplicate backup devices to ensure that data are not lost if a storage device fails.	Recommended	EM equipment should include separate backup devices, to ensure that data are not lost if one device fails. Vessels shall have onboard enough blank data storage devices (preferable solid-state drives) in case these must be replaced at sea; a specially trained crew member may need to replace the devices during a fishing trip if the data storage capacity is exhausted,	Recommended	The EM system control centre: e. SHOULD have sufficient backup storage to mitigate potential data loss.	All RFMOs have nearly identical recommendations. ICCAT is the only RFMO that requires this, while the rest commend it. IATTC also requires that vessels have blank storage devices onboard in case they must be replaced at sea.
				Barcoded Hard Drives	N/A	N/A	N/A	N/A	N/A	N/A	Recommended	The EM system control centre: f. SHOULD have unambiguous and unique	Only WCPFC recommends this, though the "Traceable" section may imply a similar level of

How to Review and Interpret

Categories & Sub-categories | **Requirement** | **RFMO Requirement Details**

Category	Subcategory	Type	Standard	ICCAT		IOTC	
Technical	EM System	Control Box/Center	Control Box/Center	Required	Minimum EMS components shall include an electronic Monitoring (EM) control box/center… The EM control center will be an onboard computer that acquires and stores all sensor-collected information and imagery footage.	Recommended	An EM equipment to be installed on board of a fishing vessel should consist of a control system connecting a number of cameras, and optionally to a number of different sensors, to collect and record images to address the objectives of the EM Program.
			Onboard Interface/Screen	Required	An on-board screen, or equivalent interface, to allow verification by the Master/crew of the correct functioning of the system, is required.	N/A	N/A

In this example, ICCAT requires ("shall") a control box, while IOTC recommends one ("should").

Level of requirement (required, recommended, optional, N/A)

All relevant direct quotes from Standards

For the next requirement, ICCAT requires ("is required") an onboard interface, while IOTC does not mention an interface or screen of any kind.

Data Requirements

Methodology

1. Full review of all EM data requirements
2. Created row for each requirement identified for all vessels, LL, and PS
3. Input field names and descriptions, as well as other relevant RFMO-specific information, for each requirement
4. Consolidated and categorized requirements

Important Notes

- IOTC column includes complete ROS minimum standards
- Data field names and categories primarily based on the structure of the IOTC minimum standards
- All ICCAT, IATTC, and WCPFC data fields are required (some data fields IOTC are not required)

How to Review and Interpret

Data Requirement (general)

RFMO Requirement Details

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Data Requirement	IOTC (ROS Data Standards)			ICCAT (Tables 2, 3, 5, 6)			IATTC (Annex 3)			WCPFC (Appendix 3)		
2									Description				
3		Data Field Name	Data Field Description	Current Reporting Requirement	Data Field Name	Data Field Description	Need	Field Name	Target Species	Non-Target Species	ROP Minimum Standard Data Field	Description	EM Protocol
4	**ALL GEAR TYPES**												
5	**Trip Information (trip level)**												
6	Trip number	Observed trip number	Record trip unique identifier. This is the observed trip unique	MR									
7	Year				Year	Year that the set(s) data refers to.	Scientific						
8	Time period				Time period	Time Period. Data reported set-by-set, monthly or quarterly.	Scientific						
9	Departure location	Port of departure	Record the name and/or geographical coordinates of the	MR				Depart port	Port name and country, date/time, position (latitude and longitude, in		Port of departure	Port of DEPARTURE (UNLOCODE) for when a vessel starts a new trip from	
10	Departure date/time	Date / time vessel sailed	Record the date and time the vessel departed from port or from	MR				Depart port	Port name and country, date/time, position (latitude and longitude, in		Date and time of departure from port	The UTC date and time the vessel DEPARTS a port to start its fishing	
11	Arrival location	Port of return	Record the name and/or geographical coordinates of the	MR				Arrival port	Port name and country, date/time, position (latitude and longitude, in		Port of return	Dates must be ISO 8601 standard and UTC.	
12	Arrival date/time	Date / time vessel returned to port	Record the date and time the fishing vessel finishes its fishing	MR				Arrival port	Port name and country, date/time, position (latitude and longitude, in		Date and time of return to port	Dates must be ISO 8601 standard and UTC.	
13	GPS position/track				GPS position/track	Including a review of whether fishing activity may have occurred	Compliance						
14	Square type				Square type	Grid Resolution. Data reported in: exact location (latitude & longitude	Scientific						
15	Latitude				Latitude	Centroid of the latitude of the set(s) that the data refers to.	Scientific						
16	Longitude				Longitude	Centroid of the longitude of the set(s) that the data refers to.	Scientific						

How to Review and Interpret

Data Requirement (general)

RFMO Requirement Details

	A	B	C	D	E	F	G	H	I	J	K	L	M
1		IOTC (ROS Data Standards)			ICCAT (Tables 2, 3, 5, 6)			IATTC (Annex 3)			WCPFC (Appendix 3)		**Source**
2	Data Requirement								Description				
3		Data Field Name	Data Field Description	Current Reporting Requirement	Data Field Name	Data Field Description	Need	Field Name	Target Species	Non-Target Species	ROP Minimum Standard Data Field	Description	EM Protocol
125	**Setting Operations (set level)**												
126	Set Number	Set Number	Record set number. This should be a four digit numerical code	MR									
127	Start setting date and time	Start setting date and time	Record the date/time the first dhan buoy and/or radio buoy is deployed to start the setting of the line. Note: specify units (preferably hh:mm and YYYY/MM/DD).	MR	Start setting date, time, and position	For those fishing operations that are to be analysed. Date, time and position the first buoy is thrown into the water to start the setting of the line. Use Coordinated Universal Time (UTC). Preferably hh:mm and YYYY/MM/DD.	Compliance	Position and speed	Date/time, position (latitude and longitude, in decimal degrees).		Date and time of start of set	When the first buoy is thrown into the water	Auto-generated by the EM system due to the linking of EM records to time and geolocation data
128	Start setting position	Start setting position	Record the position in latitude and longitude for the start of the setting operation. Note: latitude and longitude to be recorded mentioning if collected South or North of the equator and specifying units (preferably ±(d)dd.dddd°).	MR	Start setting date, time, and position	For those fishing operations that are to be analysed. Date, time and position the first buoy is thrown into the water to start the setting of the line. Use Coordinated Universal Time (UTC). Preferably hh:mm and YYYY/MM/DD.	Compliance	Position and speed	Date/time, position (latitude and longitude, in decimal degrees).		Latitude and Longitude of start of set	When the first buoy is thrown into the water	Auto-generated by the EM system due to the linking of EM records to time and geolocation data

Exact field name

Description

Requirement level

Need

EM Protocol

How to Review and Interpret

Data Requirement (general)

RFMO Requirement Details

	A	B	C	D	E	F	G	H	I	J	K	L	M
1		IOTC (ROS Data Standards)			ICCAT (Tables 2, 3, 5, 6)			IATTC (Annex 3)			WCPFC (Appendix 3)		
2	Data Requirement								Description				
3		Data Field Name	Data Field Description	Current Reporting Requirement	Data Field Name	Data Field Description	Need	Field Name	Target Species	Non-Target Species	ROP Minimum Standard Data Field	Description	EM Protocol
125	**Setting Operations (set level)**												
126	Set Number	Set Number	Record set number. This should be a four digit numerical code	MR									
127	Start setting date and time	Start setting date and time	Record the date/time the first dhan buoy and/or radio buoy is deployed to start the setting of the line. Note: specify units (preferably hh:mm and YYYY/MM/DD).	MR	Start setting date, time, and position	For those fishing operations that are to be analysed. Date, time and position the first buoy is thrown into the water to start the setting of the line. Use Coordinated Universal Time (UTC). Preferably hh:mm and YYYY/MM/DD.	Compliance	Position and speed	Date/time, position (latitude and longitude, in decimal degrees).		Date and time of start of set	When the first buoy is thrown into the water	Auto-generated by the EM system due to the linking of EM records to time and geolocation data
128	Start setting position	Start setting position	Record the position in latitude and longitude for the start of the setting operation. Note: latitude and longitude to be recorded mentioning if collected South or North of the equator and specifying units (preferably ±(d)dd.dddd°).	MR	Start setting date, time, and position	For those fishing operations that are to be analysed. Date, time and position the first buoy is thrown into the water to start the setting of the line. Use Coordinated Universal Time (UTC). Preferably hh:mm and YYYY/MM/DD.	Compliance	Position and speed	Date/time, position (latitude and longitude, in decimal degrees).		Latitude and Longitude of start of set	When the first buoy is thrown into the water	Auto-generated by the EM system due to the linking of EM records to time and geolocation data

In this example, all four RFMOs have required “Start setting date and time” for each set. Descriptions vary, though IOTC and ICCAT both provide date and time formats.

Day One

General Observations

Structure:

- **IATTC and ICCAT's requirements are most similar**. In many cases, elements of the standards are nearly or entirely identical (IATTC standards appear derivative of ICCAT).
- **WCPFC's standards are the most distinct in format** from the other three. Their standards are not formatted narratively. The requirement level is evident with the WCPFC standards (in some cases with the other standards, it wasn't clear whether recommended standards were meant to be required based on the heading or other context).

Requirements:

- **WCPFC's requirements vary significantly from the other three RFMOs**. WCPFC includes entire categories of requirements the others omitted. WCPFC's standards also directly omit many other requirements all of the other RFMOs include.
- **There is far less variance across the IOTC, ICCAT, and IATTC standards**.

General Observations

Requirement Level:

- **ICCAT has the highest number of "required"** elements by far (and a very high proportion of the elements included are required).
- **IOTC has the highest number of "recommended"** elements, at roughly half of the included elements.
- All RFMOs have **very few "optional"** elements, ~5 each

Definitions

- Only those definitions included in a definitions section were included
- ICCAT does not have a definitions section
- WCPFC's definitions section is the most comprehensive
- **WCPFC is missing the following terms defined by IOTC and IATTC:** Electronic Monitoring, Electronic Monitoring Standards, Electronic Monitoring Equipment
- **Only IOTC defines:** Electronic Reporting, Monitoring, Electronic Tool, Vessel Monitoring Plan, Electronic Monitoring Review System, Electronic Monitoring Review Provider
- **Only WCPFC defines:** Ancillary Logs, Artificial Intelligence, Control Center, Electronic Audit Requirements, Electronic Monitoring Certifier, Electronic Monitoring Data Requirements, Designated Installer or Service Technician, Event, Fishing, Fishing Trip, Geolocation Device, Independent, Regional Agency, Review for Data Quality, Sensors
- No major misalignment across shared definitions

Day Two

Minimum Data Requirements

All Vessels:

- ICCAT requests location data in a different structure (GPS track/location) than the other RFMOs.
- WCPFC requires data fields related to the EM observer.
- Not all RFMOs request vessel identification or certain characteristics.
- ICCAT and IATTC do not have waste management data fields.

Minimum Data Requirements

Longline:

- ICCAT and IATTC require few longline equipment description data fields.
- All RFMOs require setting and hauling start and end times and dates.
- ICCAT doesn't include requirements on shark lines.
- IATTC has limited data fields related to bycatch and seabirds.
- ICCAT doesn't ask for tag recovery information
- WCPFC requests catch information at what appears to be both a set and an individual level, while ICCAT appears to request the same information twice for both compliance and scientific purposes.

Purse Seine:

- Data requirements are inconsistent across the RFMOs for purse seine. WCPFC doesn't appear to have data requirements specific to purse seine gear.
- Bouy information, setting, and brailing start times and locations are the most commonly requested data fields.

Logistical and Technical Standards

EM Systems: Only IOTC does not require an onboard EMS interface or a specific minimum camera resolution or frame rate.

Remote Connectivity: Only IATTC requires near-real-time automatic system malfunction tampering alerts and remote system health verification capabilities, which WCPFC and ICCAT recommend.

EM Data: IATTC requires that EM records be compatible with review center software, which comes close to interoperability, while WCPFC recommends something similar, and IOTC recommends interoperability between providers.

EMS Layout: WCPFC did not provide requirements of which areas or activities to capture. Only IOTC did so for pole and line.

Vessel Monitoring Plans: IOTC has very few requirements for VMPs. Most of the other RFMO's elements were required.

Day Three

Data Management and Review Standards

Data Transmission: Requirements are inconsistent across RFMOs. WCPFC does not include data transmission requirements included by other RFMOs. All three other RFMOs require traceability.

Data Storage: Requirements are inconsistent across RFMOs, ranging from 1-3 years often with deference to CPC program requirements.

Ownership: Only IOTC describes ownership requirements.

Software: Software requirements are mixed. ICCAT may require a digital signature, which no other RFMOs mention.

Reporting: There is an opportunity to harmonize data output format and reporting requirements across the RFMOs. Some of these reporting requirements reference other resolutions.

Data Review Software: ICCAT appears to require a digital signature. IOTC requires risk assessment. WCPFC is the only RFMO with workstation requirements.

QAQC: Only IATTC requires EM data review quality control. There is an opportunity to establish recommendations for other RFMOs at a minimum.

Reviewer: There is opportunity to improve harmonization across review centers and even reviewer requirements. Reviewer qualification is required, but training levels and specific requirements vary.

Roles and Responsibilities

Onboard:

- Requirements to enable data collection are mixed, as ICCAT and IATTC have the most direct and similar crew duty of care requirements. IOTC requires that CPCs require crew duty of care, and WCPFC includes its duty of care requirements in VMPs.

EM Service Provider:

- Only WCPFC mentions EM service provider responsibilities related to installation and technical support.

CPCs:

- Responsibilities relate to program design, program management, and reporting. WCPFC has the fewest individual responsibilities listed for CPCs. There are opportunities to harmonize approval processes, and program management responsibilities are largely out of sync.
- All require annual reporting, establishing procedures in case of system failure, and ensuring EMS implementation complies with RFMO standards.

Roles and Responsibilities

RFMOs:

- RFMO responsibilities related to program management, program review, and support for CPC EM programs.
- WCPFC does not specifically define RFMO-level responsibilities. IOTC has the most program management responsibilities, all of which are required. ICCAT has a few similar responsibilities, not all of which are required. In general, the overall role as defined for RFMOs in program management could be more aligned.
- Program review, annual reporting, and collaboration responsibilities are well aligned across the RFMOs except WCPFC. Only IOTC requires an audit of CPC programs.
- ICCAT, IATTC, and IOTC require suggesting improvements to CPC programs.