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MINIMUM STANDARDS FOR ELECTRONIC MONITORING SYSTEMS IN TROPICAL TUNA PURSE SEINE AND LONGLINE FISHERIES

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Abstract

In addition to commercial fishing vessel catch-and-effort information collected through logbooks and/or port-sampling, observer data are key to determining and verifying fishery activities. Electronic monitoring (EM) using cameras and other sensors is a proven technology widely used for various purposes on fishing vessels, primarily in industrial fleets.

EM systems include equipment that tracks a vessel's position and activity and cameras that record key aspects of the fishing operations. While EM systems are not strictly intended for collecting observer data, they have been used extensively to obtain reliable information on fishery activities (including data collected usually by observers), such as on catches and their composition, bycatch (including of Endangered, Threatened and Protected species [ETP]), and vessel compliance with management measures.

EM pilot tests in different regions on tuna purse seiners and longline vessels, as well as in small-scale artisanal fisheries, have demonstrated the technology's capability to improve the collection of tuna fishery data. However, before considering the wide application of EM, and particularly in tuna fisheries, minimum standards for the installation, collection, analysis, and storage of data in EM systems are needed. Moreover, it is also important to investigate the capability of EM systems to collect fishery data required (for scientific and/or compliance purposes) by the fishing authorities and tuna RFMOs.

This document aims to help advance the development of such minimum standards, including specifications and procedures, for the implementation of EM systems in tropical tuna purse-seine and drifting pelagic longline fisheries.

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INTRODUCTION

Electronic monitoring (EM) systems installed in fishing vessels integrate a set of components, such as video technology and other sensors, for continuously recording information during fishing trips. EM systems include equipment that tracks a vessel's position and activity and cameras that record key aspects of fishing operations. The camera and sensor systems do not allow external manipulation of data. These systems, if properly designed and installed, are considered a reliable and accurate method for estimating catches and their composition; monitoring and collecting data on bycatch, including of Endangered, Threatened and Protected species (ETP); and independently assessing vessel compliance with management regulations.

EM is a proven technology widely used for various purposes on fishing vessels, primarily in industrial fleets. In recent years, the tuna RFMOs have been considering applying electronic reporting (for basic logbook data and transshipment data) and electronic monitoring (for types of data like those typically collected by observers) for fisheries monitoring — including minimum standards for its implementation, with different rates of progress among the organizations (**Table 1**).

Table 1 – ER and EM minimum standards for tropical tuna fisheries in tuna RFMOs as of March 2022

TUNA RFMO	ER STANDARDS	EM STANDARDS
IATTC	None	Draft standards prepared by IATTC staff for **PS/LL**
ICCAT	None	EM minimum standards for **purse seine** vessels were endorsed by the Commission in 2017 (Ruiz et al., 2017). However, this endorsement is in the record of an annual meeting and does not form part of a conservation measure. However, ICCAT Rec. 16-14 on Minimum standards for fishing vessels scientific observer programs asks CPCs to consider any applicable guidelines that are endorsed by SCRS for the use of electronic monitoring systems.
IOTC	Guidelines for electronic reporting of Regional Observer Scheme were developed by the Secretariat	EM minimum standards for **purse seine** vessels were endorsed by the Commission in 2017 (Ruiz et al., 2016). However, this endorsement is in the record of an annual meeting and does not form part of a conservation measure. Preliminary draft EM minimum standards were developed (Murua et al., 2020) for discussion.
WCPFC	Standards, Specifications and Procedures for Electronic Reporting in the WCPFC - operational catch, effort data and observer data were adopted in 2018	Draft standards **for all gear types** have been prepared by EM/ER Working Group. They have not yet been discussed by the Commission.

ISSF developed EM minimum standards in tropical tuna purse seine fisheries, published as an ISSF Technical Report in 2018, which were adopted in ICCAT/IOTC for purse-seine vessels willing to implement EM. Those minimum standards were adopted by ICCAT/IOTC in the Commissions' meeting report but not in a management resolution.

The following sections describe the EM minimum standards and requirements that vessels should comply with.

An EM system installed in fishing vessels integrates a set of components that can continuously record information during fishing trips using video technology and other sensors.

Several pilot studies have been conducted to determine the effectiveness of EM technology in purse seiners and longliners. Although the systems developed by different vendors showed diverse strengths and weaknesses, in general they demonstrated that EM technology is a valid tool to be used in both tuna purse-seine and longline fisheries. However, to provide accurate and usable data for fishery management and to ensure that the data is collected consistently across EM system providers, an EM system should meet several minimum standards or requirements.

EM minimum standards describe the procedures and minimum technical specifications of EM systems for (i) EM equipment and installation before the trip, (ii) collection of EM records (i.e., images and sensor data) and EM equipment maintenance during the trip, and (iii) revision and submission of EM data outputs to research institutes/fishing authorities and/or tuna RFMOs after the trip.

EM standards indicate the technical specifications and requirements that an EM system needs to record, review and report data to the tuna RFMO, and they define the entire flow of EM data from installation and image collection to data submission. In the following sections, we detail the main minimum standards related to EM equipment and installation (i.e., before the trip), EM operations (i.e., during the trip), and EM data review and report to authorities (i.e., after the trip) based on ISSF's Technical Report 2018-04 on minimum standards for electronic monitoring systems in tropical tuna purse seine fisheries and Murua et al. (2020a). More detailed EM minimum standards for each of the steps are also presented in **Appendix 1**.

1.1. EM equipment and installation – BEFORE THE TRIP

The specifications for selecting, installing, operating, and maintaining EM systems and their equipment (cameras, sensors, data storage devices, etc.) as well as the associated software deployed onboard vessels should be based on performance standards rather than prescribe pure technical requirements (e.g., number and type of cameras) (European Fisheries Control Agency, 2019; Michelin et al., 2020). For example, the standards need to specify what the system should be recording rather than dictate the number and placement of cameras.

Considering the objective and minimum data requirements of Regional Observer Programs across tuna RFMOs, an EM system should be designed to record information on gear configuration, vessel fishing activities, and retained catches and discards as well as the fate of the catch (**Table 4**). **Appendix 2** lists the minimum data requirements for EM systems to collect, some of which will be gathered in combination with another data source (e.g., vessel information collected prior to the trip by EM providers). These requirements were developed by harmonizing tuna RFMO minimum data requirements. All EM records should always be linked to a specific vessel geographic position, date and time. Thus, the EM system installed in each vessel should include a geolocation device or a Global Navigation Satellite System (GNSS) and a number of digital cameras to cover the areas specified below and collect the minimum data requirements required.

On purse seine vessels, the minimum areas and activities that cameras should cover are (**Table 2** and **Figure 1**):

- The working deck (both port and starboard sides)
- The net sack and the brailer (e.g., in-water purse seine area)
- The foredeck or amidships (e.g., FAD activity)
- The well deck and conveyor belt (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.
- 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 (see **Table 2**).
- In large purse seiners, at least 6 cameras are needed to cover fishing and fish-handling operations; however, fewer cameras (e.g., 4 cameras) could cover the activity to collect the data required of smaller purse seiners (i.e., 300-400 tonnes capacity).

Table 2 – General configuration and areas/activities to be covered by the EM system onboard tropical tuna purse seine vessels

AREA COVERED	ACTION COVERED	MONITORING PURPOSE
Work deck (port side)	Brailing	Total catch by set
	Tuna discards	Total tuna discards by set
	Bycatch handling	Bycatch estimation
Work deck (starboard side)	Bycatch handling	Bycatch estimation
	Bycatch release	Total bycatch released. Species condition and fate.
In-water purse seine area	Brailing	Total catch by set
	Bycatch handling and safe-release of big individual animals (e.g., whale sharks, manta rays)	Total bycatch by set. Application of handling and safe-release best practices.
Foredeck or amidships	FAD activity (deploying, replacement, reparation, etc.)	Total number of FAD deployments, FAD design and FAD activities by trip
Well deck and conveyor belt	Catch well sorting	Species composition
	Estimation of bycatch discards, releases or retention	Total bycatch by set and species composition
		Species condition and fate

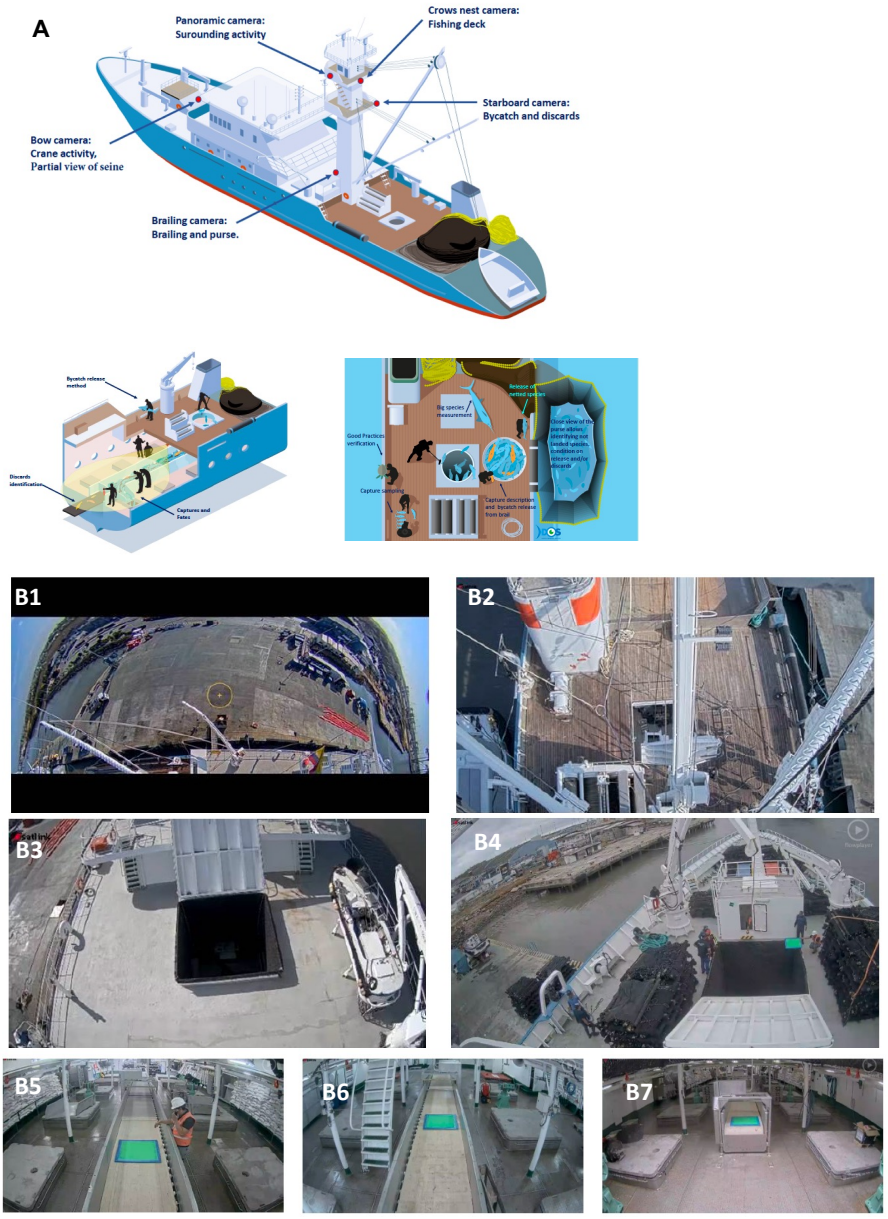

Figure 1 - (A) 6-camera EM system installed in a purse seiner covering main areas of fishing and fish handling operations (from Murua et al., 2020b), and (B) 7-camera EM system (4 in the upper deck and 3 in the well deck) installed in a purse seiner covering main areas of fishing and fishing handling operations, including 1 more camera in the conveyor belt, (B1) 360˚ Panoramic view camera (e.g., port side view), (B2) Crow's nest stern view camera, (B3) Working deck crane camera view , (B4) Foredeck view camera, (B5) Conveyor belt stern camera view, (B6) Conveyor belt middle camera, and (B7) Conveyor belt bow camera (source: Digital Observer Services).

On **longline vessels**, the minimum areas and activities that cameras should cover are (**Table 3** and **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
- 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 longliners, 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).

Table 3 – General configuration and areas/activities covered by the EM system onboard tropical tuna longline vessels

AREA COVERED	ACTION COVERED	MONITORING PURPOSE
Stern camera of the boat	Start and end setting operation	Position, date, and time
		Total number of hooks set and between floats
		Total number of floats set
		Bait type
		Bait species
		Bait ratio (%)
		Mitigation measures/marine pollution
Work deck	Catch onboard	Length and weight[1] by capture
		Condition
		Fate
		Predator observed
	Bycatch discarded, released, or retained	Total bycatch by set and species composition
Processing area	Catch	Total catch by set
		Length and weight[1] by capture
		Sex
		Fate
Surrounding water area	Start and end hauling operation	Position, time and date
	Estimation of bycatch discards, releases or retention	Total bycatch by set and species composition
		Species condition and fate

[1] Estimated through length-weight relationships.

Figure 2 - 3-camera EM equipment installed on a longline covering main areas of fishing and fish handling operations. View of the 3 cameras: (left panel) Stern camera - setting longline providing information on hooks, floats, mitigation techniques and bait; (middle panel) Fishing deck 1 - hauling information, captures and discards, species ID, size and fate; and (right panel) Fishing deck 2 - fate of the species, size, species ID (source: Digital Observer Services).

The vessel should prove that the EM system has been customized to the vessel to collect the required data on fishing activities, as described above (and summarized in Tables 2 and 3).

1.2. EM operations and data collection– DURING THE TRIP

During the trip, the EM system should be operational and must automatically record the sensor data and images of all fishing activities (**Table 4**). For that purpose:

- The system needs to be self-governing and independent from the crew, with the exception of minimal maintenance performed by crew (e.g., cleaning lenses).
- EM systems should be capable of withstanding rough and adverse conditions at sea with minimum human intervention.
- The system should incorporate a self-test function to allow remote verification of its functionality at all times to collect all information.
- The fishing master should ensure that the system is working properly before leaving port, and a protocol (checklist) should exist for that purpose.
- The master should report to the competent authority and/or vendors when the system is malfunctioning in port or at sea and should record any failure in the logbook so the system is repaired as soon as possible.
- The EM system components and data need to be tamper-resistant and tamper-evident, with encrypted data, such that attempts at unauthorized modification are difficult to hide.
- The EM system should have its own uninterruptible power supply to ensure that it can work even in the event of a vessel power outage.
- The EM system should have enough autonomy and storage capacity to store all recorded images and sensor information for a certain period of time, which should be at minimum a complete trip. The duration will depend on the vessel's operational characteristics and that could range from 4 months (in the case of purse seiners) to 12 months or more (in the case of longliners).

- The EM system should include separate, duplicate backup devices to ensure that data are not lost if a storage device fails.

All fishing activities should be recorded by EM. The vessel/vendor/EM record analysis company should verify that the EM system is operational and recording 100% of the fishing activities, as described above (and summarized in Tables 2 and 3).

1.3. EM data review and report to national authorities and/or tuna RFMOs – AFTER THE TRIP

While the EM system should be implemented to record 100% of the fishing activities, it is recommended to randomly review by qualified reviewer centers/institutions at least 20% of the fishing sets (and activities). This 20 % review rate can increase based on risk-based assessment (e.g. bycatch of non-target and/or ETP species are larger than the average for a similar vessels/fishery) or depending on the variable to be monitored (e.g., compliance with management measures). To meet EM program goals, it is recommended that the vessel data and video footage review is based on risk analysis.

After the trip, the EM records (i.e., raw images and sensor data) should be extracted and analysed by third parties. The EM data results should be reported to research institutions (which, in some cases, can also review the records to produce the EM data), national authorities, or tuna RFMOs. For that purpose:

- EM records should be extracted (or hard drives should be replaced) between fishing trips. A protocol to recover the hard drives and send them to the designated review and analysis centers also should be implemented. EM records should be in storage for at least 1 year by the vessel/company/vendors or for the period established in the EM programs.
- The EM system must ensure traceability of every hard drive and all information recorded onboard. The chain of custody of the EM system hard drives should be assured. Ideally, to ensure the chain of custody of the hard drives, they should be retrieved and submitted by a third party with no conflict of interest.
- The EM records should be reviewed by institutions, organizations, independent companies with proven expertise and experience (e.g., with onboard observers programs), and/or recognized research institutions.
- The EM system should have a specific analysis software, which ideally should be capable of analysing EM records collected from different EM systems or vendor. This software allows EM records to be managed efficiently. EM record analysis should be quality controlled, including through data entry checks, automatic error identification, and debriefing as required. EM data analysis should be checked for inconsistencies, quality, and accuracy prior to reporting to the research institutions (either national or international), national authorities, and/or tuna RFMO. ISSF has held preliminary conversations with the tuna RFMO Secretariats, who seem willing to receive this data. However, if national authorities and/or tuna RFMOs are not capable or not willing to receive EM data outputs, the vessel/vendor/authorized research institution should store the EM data outputs for 3 years.
- The vessel/vendor/authorized third party should submit an EM trip report and the resulting EM data to the research institutes, national fishing authority, and/or relevant tuna RFMO (except in the case described above) after all fishing trips, including:
    - Information on the entire trip and 100% of fishing activities (i.e., start/end of the trip, number of sets, position of sets, use of mitigation measures)
    - Information on 20% of randomly selected sets (position; catch of target species, non-target and ETP species; fate of target/non-target/ETP species; use of FADs; use of bait; and use of mitigation measures). See **Appendix 2** for the information to be included in the fishing trip reports.

The vessel/vendor/EM record analysis company should verify that at least 20% of fishing operations in a trip, selected randomly, have been reviewed/analysed and that the resulting data outputs are submitted to the research institutes, national fishing authority and/or relevant tuna RFMO, as described above and summarized in Table 4.

Table 4 – Summary of EM minimum standards and requirements and means of verification of those standards that vessels should comply with for Electronic Monitoring

STANDARD	EXPLANATION	SUGGESTED MEANS OF VERIFICATION
1. EM equipment and installation – BEFORE THE TRIP		
The EM system is customized to the vessel level and based on performance standards. The number and types of cameras are sufficient and well placed to collect the required data. All EM records should always be linked to a specific vessel position, date and time.	EMS installation should ideally be tailored to each individual vessel. There is not a standard configuration that will cover all vessels in the fleet. Each installation must be customized at the vessel level, or at least to vessels of similar characteristics, and based on performance standards to collect the required data. Vendors should ensure that sufficient cameras are placed to collect the required data and cover the main working areas of the PS/LL vessels as specified above. **For Purse Seiners**: Work deck (portside & starboard side), well deck & conveyor belt, in-water purse seine area, foredeck and/or amidships, depending on FAD-deploying area. The cameras and sensors (if any) must cover the following actions: fishing sets, brailing, net hauling, FAD activities, bycatch handling and release, tuna discards, and catch well sorting (process of putting the catch in the hold or wells). **For Longliners**: 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. The cameras must cover the following actions: setting and hauling of the longline, bait type information, whether mitigation techniques are being used (e.g., tori lines for seabirds), all hooked species (both retained and discarded), the fate of the catch, and the size of the specimens.	The vendor should provide proof that the system is customized to collect the required data on fishing activities (e.g., a report from the EM vendor with vessel layout, location of the cameras and camera type(s) and explanation of the rationale for system configuration).
2. EM operations and data collection – DURING THE TRIP		
The EM system is robust, operates largely independently from the crew, ensures data security, and is capable of adequate data storage and autonomy to monitor 100% of fishing activities.	The EM system is independent from the crew with the exception of minimal maintenance performed by crew (e.g., cleaning lenses); capable of withstanding rough and adverse conditions at sea with minimum human intervention. The EM system incorporates a self-test function to allow remote verification of its functionality at all times to collect all information; is tamper-proof (or at least tamper-resistant)	The vessel/vendor/EM analysis center should verify that the EM system is operational and recording 100% of the fishing activities, as required.

STANDARD	EXPLANATION	SUGGESTED MEANS OF VERIFICATION
	including the ability to encrypt data and designed to prevent access or manipulation of information by unauthorised persons, to ensure full system and data security. The EM system has its own uninterruptible power supply to ensure system works even in the event of a vessel power outage. The EM system should have enough autonomy and storage capacity to store all recorded imaged and sensor information for a certain period of time, which should be at minimum a complete trip, whose duration will depend on the vessel operational characteristics, and that could range from 4 months (in the case of purse seiners) to 12 months or more (in the case of longliners); and should include separate, duplicate backup devices to ensure that data are not lost if one storage device fails. The master/vendors should ensure that the system is working properly before the vessel leaves port. And the master/vendors should report to the competent authority when the system is malfunctioning in port or at sea and should record any failure in the logbook so it is repaired as soon as possible.	
3. EM data review and reporting to national authorities and/or tuna RFMOs – AFTER THE TRIP		
The EM system's hard drive chain of custody is guaranteed, and the EM record analysis and reporting are done by a qualified third party and are quality controlled. At a minimum, 20% of the fishing sets are analysed, and the resulting data outputs are submitted in the requested format to the research institutions, national fishing authority, and/or relevant tuna RFMO.	EM records should be extracted (or hard drives replaced) between trips, ensuring the traceability of every hard drive and information recorded onboard. The chain of custody of the EM system hard drives should be assured. The EM records should be reviewed by institutions, organizations and/or independent companies with proven expertise and experience (e.g., with on-board observers programs). They also should be quality controlled, including through data entry checks, automatic error identification, and debriefing as required. The vessel/vendor/authorized research institution should submit an EM trip report and the resulting EM data to the research institutions, national fishing authority, and/or relevant tuna RFMO after all fishing trips — including: • Information about the entire trip and 100% of fishing activities (i.e., start/end of the trip, number of sets, position of sets, use of mitigation measures) • Information about at least 20% of sets randomly selected (position, catch of target species, non-	The vessel/vendor/EM analysis centers should certify that at least 20% of fishing operations in a trip, selected randomly, have been reviewed/analysed and that the resulting data outputs are submitted to the research institutions, national fishing authority and/or relevant tuna RFMO.

STANDARD	EXPLANATION	SUGGESTED MEANS OF VERIFICATION
	target and ETP species, fate of target/non-target/ETP species, use of FADs, use of bait, and use of mitigation measures). See **Appendix 2** for the information to be included in the fishing trip reports. If national authorities and/or tuna RFMOs are not capable/willing to receive EM data outputs, the vessel/vendor/authorized research institution should store the EM data outputs for 3 years.	

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APPENDIX 1 - Minimum requirements for a standard EM system

EM EQUIPMENT and INSTALLATION – BEFORE THE TRIP

- **Customized to vessel level**: EM system installation must be customized at the vessel level. An EM system to be installed onboard a fishing vessel should consist of a control unit connecting a number of different sensors and cameras to collect and record data and images to address the objectives of the EM program. The number of cameras and sensors should be tailored to each vessel based on performance.
- **Include sensor**: If necessary, include sensors that monitor gear usage and fishing activity to show when fishing occurs. This will facilitate image revision and analysis.
- **Include Global Navigation Satellite System (GNSS)**: Install a GNSS to monitor vessel position, route, and speed and to provide information on date/time and location of fishing activities.
- **Tested by a third party**: EM systems should be validated by a third party (e.g., CPC, RFMO) to ensure that the adopted minimum standards to achieve the objectives of the EM program for a particular type of fleet (e.g., longline, purse seine, etc..) are met.
- **Compatibility**: The EMS should be compatible with other onboard Monitoring, Control and Surveillance (MCS) tools (e.g., Vessel Monitoring System).
- **Robust system**: EMS components installed outdoors (such as cameras/camera housing and sensors) should be able to resist rough conditions at sea and harsh weather environments.
- **Secure system**: The EMS must be a tamper-resistant and tamper-evident system with encrypted data, near-real-time remote online "status checks," and geopositioned data/imagery. It should have its own uninterruptible power supply to ensure it works even in the event of a vessel power outage.
- **Cameras**: Digital cameras (high-resolution, when possible) should cover all areas of interest on the vessel during fishing operations. Camera view and image collection must show both catch and bycatch species, correct species identification, and other fishing activities. The system also should be able to record activities in low natural light conditions.

EM OPERATIONS & DATA COLLECTION – DURING THE TRIP

- **Independence**: The system needs to be self-governing with the exception of minimal maintenance performed by crew (e.g. cleaning lenses). It should incorporate a self-test function to allow remote verification of its functionality to collect all information. The master should ensure that the system is working properly before leaving port.
- **Data storage and autonomy**: The system should have enough autonomy and storage capacity to store all recorded images at minimum for the duration of any trip (around 4 months for purse seiners and 12 months for longliners).
- **Maintenance**: The master should report to the vendor/relevant authority (e.g., EM program manager, flag state) when the system is malfunctioning in port or at sea, and any failure should be recorded in the logbook. Rules of Procedures should be established for the vessels when the system fails. Some equipment component replacements should always be onboard (GPS, camera, hard drives).

- **Data retrieval**: Ideally, data are automatically transmitted via mobile networks, Wi-Fi, or satellite. When video footage files are too big, they should be transferred via data storage service exchange. Hard drive exchange and transmission should also follow an agreed-upon protocol.
- **EM records backup**: If data are automatically transmitted electronically, operational procedures for the receipt and back-up of EM records should be implemented, taking into account any necessary chain of custody arrangements.
- **Hard drives chain of custody**: The system must ensure traceability of every hard drive and all information recorded onboard.

EM DATA REVIEW & REPORTING – AFTER THE TRIP

- **Dedicated image analysis software**: The EM program should use software designed to facilitate the analysis of EM records and to produce a common output format for exchange/submission to research institutions, national authorities, and/or tuna RFMOs. It is also recommended that the analysis software be able to analyse data collected from different EM systems or vendors.
- **EMS data analysis and reporting**: Data analysis and reporting should be done by institutions, organizations, and independent companies with proven expertise and experience (e.g., work experience with onboard observers).
- **EMS data analysis quality check**: EM record analysis should be quality controlled, including through data entry checks, automatic error identification, and debriefing as required. EM data should be checked for inconsistencies, quality, and accuracy prior to reporting to the national fishing authorities and/or tuna RFMOs.
- **EM record review coverage and risk based review analysis**: An EM system should record information on the entire trip and 100% of fishing activities. At minimum, it should review information on 20% of randomly selected fishing sets; that percentage can be increased based on risk assessment.
- **EM data**: The EM system should collect, at a minimum, the Regional Observer Scheme Minimum Standard Data Fields of the tuna RFMOs as detailed in **Appendix 2** (i.e., fishing activities, fishing set information, catch and effort, catch of target species, catch of non-target and ETP species, fate of non-target species, use of mitigation measures, and bait type).
- **EM data analysts' training**: EM data analysts must have specific qualifications, which should be integrated in the EM program standards. The data analyst/reviewers should participate in specialised and regularly updated training courses to ensure high-quality EM data analysis standards and a level playing field.
- **Land-based "observers" qualifications**: EM data analysts must have the ability to review and record data accurately, be familiar with fishing activities, and be able to identify target/non-target species and species of special interest.
- **Compatible with ongoing standardized data flow and databases**: A compatible data output format (including usage of standardized, well-established code lists) should be used to exchange collected information with tuna RFMOs that meets their data reporting format and standards. EM records should be submitted in an approved electronic data reporting format to the tuna RFMOs (e.g., ICCAT ST09, WCPFC SSP for observer data).

APPENDIX 2 - EM minimum data field standards to be collected (or estimated) by EM systems[2]

EM minimum data fields	Description	LL	PS
EM Reviewer Information			
EM Review Company		✓	✓
EM Reviewer		✓	✓
Date and Time Review Start	Coordinated Universal Time (UTC) date and time of review start	✓	✓
Date and Time Review End	Coordinated Universal Time (UTC) date and time of review end	✓	✓
Vessel Information Data			
Trip Identifier	Record unique trip identifier. This is the observed trip unique identifier. For example, begin with trip's start date (YYYY-MM-DD), followed by vessel identifier and vessel main gear code.	✓	✓
Vessel Identifier	Vessel tuna RFMO number as per the tuna RFMO Record of Authorized Vessels and crosschecked with the number recorded on vessel certificates.	✓	✓
Vessel Name	Record the vessel full name as listed on vessel official documentation and crosschecked with the name recorded on the RFMO's authorized list	✓	✓
Vessel Flag State	Record the name of the country in which the vessel is registered as shown on its registration documents. Where chartering occurs, record name of the chartering country.	✓	✓
Vessel IMO or Lloyd's number	Record vessel IMO number. This is the number allocated to the vessel when registered to the International Maritime Organization of the United Nations (e.g., IMO8814275).	✓	✓
International radio call sign (IRCS)	Record vessel radio call sign if available. This is the number displayed prominently on the vessel's side or superstructure.	✓	✓
Vessel port of registration	Record the name of vessel's port of registry (also called home port) as shown on its registration documents and lettered on the stern of the ship's hull – also include the country.	✓	✓
Vessel registration number	Record the number issued by the country in which the vessel is registered, shown on its registration documents, and written on the hull of the vessel. This may be a combination of characters and numbers; record them all (e.g., CBG303).	✓	✓

[2] Although the different tuna RFMOs have their own minimum data field standard to be collected by observer programs, the comprehensive list below should be used globally.

EM minimum data fields	Description	LL	PS
Vessel phone and email	When available, record vessel contact details, taking note of the ocean region code. A vessel may have several contact numbers and email addresses depending on the satellite communications systems installed onboard.	✓	✓
Registered owner	Record the owner's name, nationality, and contact details in full.	✓	✓
Charterer / operator	Where the vessel has been chartered and is operated and managed by a company other than the owner, record the operator's full name (company or individual as appropriate), nationality, and contact details.	✓	✓
Trip-Level Data			
Trip number	The trip number for the vessel for the year starting at 1 for the first trip of the year	✓	✓
Gear type	LL - Longline, PS - Purse Seine	✓	✓
Port of departure	Record the name and/or geographical coordinates of the port from where the vessel sailed – also include the country. If the vessel started a new trip at sea following transshipment, record "at sea" plus the geographical coordinates corresponding to the location the trip started.	✓	✓
Date and time of departure from port	The date and time the vessel leaves port to start its fishing campaign, or the date and time of the departure from a carrier vessel immediately after an at-sea transshipment event.	✓	✓
Date and time of port return/unloading	The date and time the vessel returns to a port after a fishing trip, or the date and time of the arrival at the carrier vessel just before an at-sea transshipment event.	✓	✓
Port/place of return/unloading	Port where the vessel returns, or the arrival at the carrier vessel just before an at-sea transshipment event (Coordinates of at-sea transshipment). This field will be "AT SEA."	✓	✓
Primary target species	Indicate the primary target species for the trip	✓	
Total Fishing Events or Sets	Indicate the total number of sets for the trip	✓	✓ by set type
Fishing Events or Sets reviewed	Indicate the total number of sets reviewed for the trip	✓	✓ by set type
Number of days searching	Record the total number of days that the vessel was engaged in actively searching for fish (this includes active fishing days).		✓
Number active fishing days	Record the total number of days that the vessel actually fished (i.e., when the vessel had gear in the water).		✓
Fishing Activity			
Trip Identifier	Internally generated trip identifier (see above)	✓	✓
Set Identifier	Internally generated activity identifier (e.g., trip identified – vessel-number of set)	✓	✓
Selected for Review	Yes or No if the set was selected for review (either in initial 20% or as a replacement for an unreviewable set)	✓	✓
Set Reviewed	Yes, No, or Partial if the set was only partially reviewed	✓	✓
Set type	Free school set, FAD set, etc.		✓

EM minimum data fields	Description	LL	PS
Start date and time of set	Date and time the first buoy enters the water to start the setting of line (LL) Date and time the skiff is launched to start the setting operation (PS)	✓	✓
Latitude of start of set	GPS reading at time first buoy enters water (LL) GPS reading at time the skiff is launched to start the setting operation (PS)	✓	✓
Longitude of start of set	GPS reading at time first buoy enters water (LL) GPS reading at time the skiff is launched to start the setting operation (PS)	✓	✓
Date and time at end of set	UTC date and time the last buoy enters the water (LL) UTC date and time when the net is fully pursed. All rings are up (PS)	✓	✓
Latitude of end of set	GPS reading at time last buoy enters water (LL) GPS reading at time when the net is fully pursed (PS)	✓	✓
Longitude of end of set	GPS reading at time last buoy enters water(LL) GPS reading at time when the net is fully pursed (PS)	✓	✓
Date and time start of start haul	UTC date and time first buoy is hauled from the water	✓	
Latitude and longitude of start of haul	GPS reading at time first buoy is hauled from the water	✓	
Date and time of end of haul	UTC date and time the last buoy of the mainline is hauled from the water onto the deck to indicate the end of the haul	✓	
Latitude and longitude of end of haul	GPS reading at time last buoy is hauled	✓	
Time start brailing	Record the time that brailing starts (hh:mm).		✓
Time end brailing	Record the time that brailing ends (hh:mm).		✓
Time skiff onboard	Record the time when the skiff comes on board and the set is over (hh:mm).		✓
Total number of hooks set	Record the total number of hooks deployed for the set. Usually calculated by multiplying number of baskets by the average number of hooks between the baskets. This information can be obtained from the Fishing Master and cross-checked against observer calculations.	✓	
Total number of floats set	Record the total number of floats deployed during the set (this should not include the radio/dhan buoys). Usually calculated by subtracting the number of buoys in their holders before setting by the number of buoys in their holders after setting.	✓	
N° of hooks set between floats	Record the number of hooks set between floats. This will correspond to the number of hooks stored in each basket/tub, or on a reel, and will be equivalent to the number of branch lines set.	✓	
FAD Type (if possible)	Type of floating object (flotsam, natural object, FAD)		✓
Floating structure: dimensions and materials (if possible)	Length, width and height of the floating structure		✓

EM minimum data fields	Description	LL	PS
Object encounter	Date, time, position		✓
FAD activity: deployment	Date, time, position		✓
FAD activity: visit	Date, time, position		✓
FAD activity: hauling	Date, time, position		✓
FAD activity: retrieving/removed	Date, time, position		✓
Target species	Primary target species of the set	✓	
Bait type	Record bait type/condition used	✓	
Bait species	Record the species of bait used (FAO spp. 3-alpha code)	✓	
Strategic Offal Discharge	Recorded at the SET level whether the vessel used strategic offal disposal (Y/N)	✓	
Tori lines deployed	If a tori line deployed during setting of gear was deployed	✓	
Number of tori lines deployed	The total number of tori lines deployed during the setting of gear. To be checked twice during each setting event.	✓	
Presence of wire trace	Presence of wire trace (Y/N)	✓	
Other mitigation measures used	Record any other mitigation measures observed (Y/N)	✓	
Other mitigation measures used	Text description of other mitigation measures observed	✓	
Observer present	Yes or no	✓	✓
Catch Identification			
Trip Identifier	Internally generated trip identifier	✓	✓
Set Identifier	Internally generated set identifier	✓	✓
Catch identifier	Internally generated catch identifier	✓	
Catch Date	Date of catch event	✓	
Catch Time	Time of catch event	✓	
Species code	FAO code of species caught (http://www.fao.org/fishery/static/ASFIS/ASFIS_sp.zip)	✓	✓
Latitude of catch event	GPS reading at catch event (as recorded by EM equipment)	✓	
Longitude of catch event	GPS reading at catch event (as recorded by EM equipment)	✓	
Catch in number	Record/estimate the number of individuals per species for each specified fate (when possible).	✓	✓

EM minimum data fields	Description	LL	PS
Catch Length	Record the length corresponding to the specified species and fate category.	✓	
Catch weight	Record the weight corresponding to the specified species and fate category. If number of individuals is recorded, insert NA here (for small fish, record weight).	✓ (estimated from Length)	✓
Catch in numbers	Record the number of individuals per species for each specified fate. If weight is recorded, insert N/A here (for large fish, record number of individuals).	✓	✓
Fate	If the fish is retained or discarded	✓	✓
Condition at capture (if possible)	State the condition of the specimens at capture. For species of special interest only.	✓	✓
Condition at release (if possible)	State the condition of the specimens at the time of release. For species of special interest only.	✓	✓

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