



**REPORT OF THE SCRS SUB-GROUP ON ELECTRONIC  
MONITORING SYSTEMS (EMS)**

*Presentation from the SCRS to the WG-EMS  
Meeting of the ICCAT EMS Working Group (online, 15 Feb 2023)*

**ICCAT CICTA CICAA**



# SCRS Technical Sub-group on EMS - Background

- In 2019 ICCAT, established Recs 19-02 and 19-05 (pertaining to tropical tunas and billfishes):

The Permanent Working Group for the Improvement of ICCAT Statistics and Conservation Measures (PWG), in cooperation with the SCRS, shall work to develop recommendations on the following issues for consideration at the 2021 Annual Meeting of the Commission:

a) **Minimum standard for an electronic monitoring** system such as:

- (i) the minimum specification of the recording equipment (e.g., resolution, recording time capacity, data storage type, data protection)
- (ii) the number of cameras to be installed at which points on board

b) **What shall be recorded**

c) **Data analysis standards** (e.g., converting video footage into actionable data by the use of artificial intelligence)

d) **Data to be analyzed** (e.g., species, length, estimated weight, fishing operation details)

e) **Reporting format** to the Secretariat

In 2020 **CPCs are encouraged to conduct trials** on electronic monitoring and report the results back to the PWG and the SCRS in 2021 for their review.



## Technical Sub-group on EMS

- The Technical Sub-group on EMS was created during the 2021 Intersessional Meeting of the Billfishes Species Group (March 2021)
- Multiple online/zoom (1 day) meetings in 2021 and 2022 and much intersessional work done by the Sub-group participants
- 2021 work:
  - Literature revision with main conclusions presented to the SCRS (SCRS/2021/165)
- 2022 work:
  - Comparison between EMS and HO for scientific ICCAT data (from ST-09)
  - Draft proposal for the pelagic LL minimum standards for EMS
  - Presentation and adoption by the SCRS (SCRS/2022/165)



## Summary of the literature revision work

The following points have been NOTED IN 2021 (presented in SCRS/2021/165):

- EM systems **hold promise for resolving some problems with data gaps in fisheries monitoring, but it cannot substitute for a human observer.** As such, integrated EM systems are likely to be **used as a complement rather than a replacement** in at-sea observer programs.
- One limitation is that the **cameras record only what is in their field of view and cannot prioritize** among elements in the images they are recording.
  - However, one advantage is that the images can be reviewed multiple times for data extraction
- It is important to also note that **at-sea observers can perform other tasks not covered by EM Systems, such as biological sampling**



## Summary of the literature revision work

- EM systems need to address the **challenges associated with processing and analyzing very large volumes of data**, which are different to the challenges encountered when dealing with human observers and their data
  - It is possible that **improvements in artificial intelligence, machine learning/deep learning algorithms**, hardware and software can mitigate some of the current limitations with data collection and analysis
- Integrated EM systems must be able to **meet both national and international requirements to ensure data collection, continuity, veracity and precision** are not compromised **and that scientists have the required data to ensure they can continue to provide accurate scientific advice to managers.**





## 2022 work – Started in later 2021 and carried out in 2022

- **Sub-group main tasks during 2022:**
  - Comparison of what can be obtained with human observers versus EMS (using ST-09 data forms);
  - Draft and adoption of the minimum standards (mostly focusing on the technical aspects, such as n<sup>o</sup> and location of cameras, etc.)



# ST-09 – FISHING DATA (Form A)

Most “Fishing characteristics data” can 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	Might 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 might 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



# ST-09 – CATCH DATA (Form B)

Most “Catch data” can be obtained with EMS, but there might be the need for some adaptations

ST-09B DATA FIELDS		Collected by human observers?	Collected by EMS?	Notes	
Catch composition by fishing op	Fish. Oper. (FO)	FO group ID	Not applicable	Not applicable	Coding variable applied post-processing
	Species (attributes)	Species (cod)	Yes	Yes	EMS could have problems with identification of bycatch that are not brought onboard, and in those cases higher level taxa ID is likely needed. As a standard, the EMS system should have one camera for the retained species and another for the area close to the vessel in cases they cut the line for discarding. For the retained catch EMS systems record video that can be seen many times, while human observers have the advantage of being able to look into detailed taxonomic characteristics if needed.
		Targeted (Y/N)?	Yes	Possible	Possible but need integration with additional info from logbooks or the skiper
		Catches (retained)	Weight (kg)	Yes	Possible in some cases
	Product type (cod)		Yes	Possible in some cases	Both HO and EMS could only do in vessels that have scales to weigh individual specimens. Most vessels don't have these onboard (some large LL only). If the vessels have scales, could put cameras facing the scales.
	Number (catch number)		Yes	Yes	
	Discards (Number)	Dead (DD)	Yes	Possible in some cases	Important to be collected (even for some management recommendations and compliance issues). The EMS would need cameras or other systems in specific positions to determine specimen condition at release. Need video and not only still images. Requires review of all relevant video footage to get total numbers
		Alive (DL)	Yes	Possible in some cases	Important to be collected (even for some management recommendations and compliance issues). The EMS would need cameras or other systems in specific positions to determine specimen condition at release. Need video and not only still images. Requires review of all relevant video footage to get total numbers
		Unknown	Yes	Yes	Important to be collected (even for some management recommendations and compliance issues). The EMS would need cameras or other systems in specific positions to determine specimen condition at release.
	Sampling (data)	Nº sampled	Yes	Yes	

Note: Many types of scientific data collected by observers are possible to collect through EMS, but some are much more labor intensive to obtain (e.g., reviewing many hours of video footage, placing catch in specific places for measurements, cameras at specific locations for discards, etc.).





# ST-09 – BIOLOGICAL DATA (form C)

Collection of “**Biological data**” with EMS is more challenging and will need 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
	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 weigh 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 might be possible to put cameras facing the scales, or there might be a way to connect 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 weigh individual specimens. Most vessels don't have these onboard (some large LL only). If the vessels have scales, could put cameras facing the scales. Or there might be a way to connect 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
Injuries (scale)			Possible in some cases	Possible in some cases	Injuries from depredation or from the fishing process can be seen sometimes. But if the specimens are released in the water it might 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

Note: Some scientific important aspects, such as biological samples, are not possible to take with EMS.



## SCRS Minimum Technical Standards for EMS in pelagic LL

- Full/detailed text presented in 2022 in documents:
  - SCRS/2022/165 (Sub-group report to the SCRS)
  - Appendix 17 of the 2022 SCRS Report (minimum standards adopted by the SCRS)
- Here (in the following slides) we provide a summary of the main points



## SCRS Minimum Technical Standards for EMS in pelagic LL

### *Objectives of the EMS*

- At the SCRS level, the priority is **implementing EMS that allow the collection of fisheries data usable for scientific purposes.**
- Should be designed in a way which **compliments, and to the extent possible is consistent, with what is currently collected by human observers.**
- EM systems **may also be used for compliance and other purposes.**
- Scientific data often must be collected at a finer resolution (e.g. spatial, temporal) than would be required for compliance. **In such a situation, meeting the minimum requirements needed for science, would allow use in both scenarios.**



## SCRS Minimum Technical Standards for EMS in pelagic LL

### Structure (who is responsible - Commission to decide details)

#### *Option 1: Decentralized system:*

- **Each CPC is responsible for the EM system implementation in its own fleets**, including the recordings, processing and data extraction, and submission of data to ICCAT.
- **Similar to what currently exists for national human observer programs** for scientific purposes.
- Costs are borne by CPCs programme, so there would be **little financial costs for the Commission and less administrative burden on the ICCAT Secretariat**.
- Potential **issue with inconsistent implementation of the EM requirements across the ICCAT members** – as has been the case with regard to the implementation of ICCAT's minimum standards for scientific observer programs (Rec. 16-14).



# SCRS Minimum Technical Standards for EMS in pelagic LL

**Structure (who is responsible - Commission to decide details)**

***Option 2: Centralized system:***

- A system that would be **coordinated at the Secretariat level.**
- Benefits are **more consistent implementation across the ICCAT membership.**
- More significant challenges associated with this approach, particularly related to the **financial costs to the Commission and the administrative burden on the Secretariat.**
- Issues of data sharing and **confidentiality (e.g., raw videos) would also need to be addressed.**

There are important trade-offs associated with the approach selected, which should be further considered by scientists and managers.

In consideration of data needs and given the significant financial costs and other development and implementation challenges associated with a centralized EM system, the Sub-group has focused on the development of input related to a decentralized system.





# SCRS Minimum Technical Standards for EMS in pelagic LL

## Periodic reviews

- EM systems should have **regular evaluations** to ensure it reaches the objectives outlined.
- These also **give opportunity to incorporate new technologies** (i.e., improved cameras, artificial intelligence) as they become available, as well as updated and incorporate new objectives.
- A **review framework should also allow a faster implementation** of the updated minimum standards, that can be reviewed and adapted as needed in the future.



# SCRS Minimum Technical Standards for EMS in pelagic LL

**Standards described in this presentation in the following slides**

- 1) Standards for onboard EM system technology, including equipment and camera system requirements, installation and maintenance;
- 2) Standards for data storage requirements and what data are subject to those provisions;
- 3) Standards for data collection, review and transmission to ICCAT;
- 4) Standards for data protection and potential privacy issues.



## SCRS Minimum Technical Standards for EMS in pelagic LL

### 1) Standards for onboard EM system technology, including equipment and camera system requirements, installation and maintenance

- Capable to **resist rough conditions at-sea with minimum human intervention.**
- Linked to a **receiver which records for e.g., coordinates, speed, and heading data** (e.g., GPS).
- **Battery backup** with capacity to allow proper shutdown and not corrupt the data if power from the vessel fails.
- **Proof against any manual data input or external data manipulation**, and record any attempt to tamper with the equipment or the archived data.
- **Administrative tools and data must be password protected.** The EMS must be proof against any manual data input or external manipulation.
- Specifications for EMS **should be based on performance standards** rather than being too prescriptive in terms of pure technical requirements.
- Cameras must be placed to **provide clear, unobstructed views of the areas that are being covered.**
- Vessels should be equipped with a **sufficient number of cameras to allow data collection to the required standards** (we provide an example of a 4-camera system next).



# SCRS Minimum Technical Standards for EMS in pelagic LL

- Example of a 4 camera set-up for pelagic LL vessels scientific EMS

Camera location	Action covered	Possible data collected
Aft of the boat	Setting operation	Set position, date, time
		Total number of hooks, hook types, hooks between floats
		Bait type/species
		Bait ratio (%)
		Mitigation measures used (painted bait, tori lines, line weight)
Work deck	Catch at hauling	Species ID/composition
		Specimen sizes
		Condition (dead/alive)
		Fate (retained/discarded)
	Predators observed	
	Discarding (if hauled before discarded)	Discards by set
Processing area	Catch while processing	Discards ID/composition
		Species ID/composition
		Total catch by set
		Specimen sizes
		Sex
Surrounding water area	Discarding (if discarded in the water)	Weights?
		Product type (fresh/processed)
		Discards by set
		Discards ID/composition
		Condition of discards?



## SCRS Minimum Technical Standards for EMS in pelagic LL

### 1) Continuation: Standards for onboard EM system technology, including equipment and camera system requirements, installation and maintenance

- Crew should ensure that all specimens caught, even the discards, are **handled in a manner that enables the video to record such specimens.**
- Assumed that most cases will be **using video are the primary data collection** method, but it **may be possible for some CPCs to collect the data with still images.**
- **Quality of the data must be sufficient to allow species ID and detailed measurements of specimens.**
- Suggested video with a minimum 720p resolution, and a minimum of 5-10 FPS. For still images, suggested a minimum resolution of 2MP, with a rate of image capture determined by the characteristics of each fishery.
- System should be **independent from the crew during the trip** (exception of some basic maintenance such as periodically cleaning the camera lenses).
- Usually not necessary to record 24h/day, but only when relevant operations are taking place, to save storage space. The EM system **could have sensors and be capable of recording** only during the period of gear deployment (aft camera) and gear retrieval (work deck, processing area, surrounding water cameras).





## SCRS Minimum Technical Standards for EMS in pelagic LL

**1) Continuation: Standards for onboard EM system technology, including equipment and camera system requirements, installation and maintenance**

- Include a **control box that receives and stores the raw data provided by the sensors and cameras.**
- Include a wheelhouse monitor with a user interface to **provide information about the functioning of the system and for the vessel operator to monitor the control box, and cameras.**
- The EMS should have a **self-diagnostic test for functionality of the system components**, and record the outcome of the tests.



## SCRS Minimum Technical Standards for EMS in pelagic LL

### 2) Standards for data storage requirements and what data are subject to those provisions

- Must contain **data storage systems adequate for the trip duration** that each national program is designed to cover.
- Regulations relating to **data storage and transmission should be flexible as new technology may allow for different ways of storing or transmitting data** that are less logistically challenging or more efficient.
- System must be **verified to be functioning properly before the start of each trip, remain powered on and positioned correctly for the duration of each trip.**



## SCRS Minimum Technical Standards for EMS in pelagic LL

### 3) Standards for data collection, review and transmission to ICCAT

- In decentralized system, **raw data (i.e, video/images) are managed by each CPC.**
- **Review of the video footage is done by the CPCs authorities and/or by a contracted EM service provider.**
- **EMS should be able to collect, to the extent possible, the observer data that is required to be submitted to ICCAT (ST-09), or any subsequent update of the form.**
- **EMS cannot fully replace all the functions of human scientific observers, such as biological sampling. EMS should be used as a complement or supplement to such programs, and a minimum human observer coverage should still be maintained for scientific purposes.** This is currently 5-10% for most ICCAT fisheries.
- **There may be the need for CPCs to train EM analysts for their programs. ICCAT Secretariat might be involved in providing standardized training** for EM analysts or approve training programmes followed by each CPC.
- **For size measurements to be taken, catch will need to be positioned by the crew onboard in one or more calibrated areas** (example provided in next slide).



## SCRS Minimum Technical Standards for EMS in pelagic LL

### 3) Standards for data review and transmission to ICCAT

- **Example of a calibrated hatch onboard a commercial fishing vessel.** These areas will vary from vessel to vessel, depending on available surfaces and the species (sizes) being measured.







## SCRS Minimum Technical Standards for EMS in pelagic LL

### 3) Standards for data review and transmission to ICCAT

- Once data is collected it should be subject a **quality control (QC) procedure**, as is standard with most observer programmes, to ensure data quality.
- **Any conversion factors (e.g., length-length or length-weight) should be the conversion factors adopted by the SCRS**, when available.
- **CPCs are responsible for reporting EMS data to the ICCAT Secretariat using ICCAT ST-09 forms**, or any other forms that in the future might be developed and approved by the SCRS for EMS data reporting.
- **Submission of EMS data should comply with the Task 1, 2, and 3 data submission deadlines** established by the SCRS and adopted by the Commission.





## SCRS Minimum Technical Standards for EMS in pelagic LL

### 4) Standards for data protection and potential privacy issues

- With a decentralized program, **the aspects relative to potential privacy issues of the crew, depend on national regulations and legislation.**
- In such a system, **only the CPC that is responsible for the collection of the data has access to the original/raw video recordings.**
- **What is submitted to ICCAT is the data extracted from those original recordings.**
- Data submitted to the Secretariat should follow the **ICCAT Rules and Procedures for the Protection, Access to, and Dissemination of Data.**



## Some main conclusions

- **EMS hold promise for resolving some problems with data gaps in fisheries monitoring, but it cannot substitute for human observers.**
  - EMS are likely to be used as a complement rather than a replacement.
  - A minimum coverage with human observers should be maintained (currently 5-10% for some ICCAT fisheries).
- **There are still challenges associated with processing and analyzing very large volumes of data**
  - Improvements in artificial intelligence, machine learning/deep learning algorithms, hardware and software can mitigate some of the current limitations with data collection and analysis.



## Some main conclusions

- **Specifications for EMS should be based on performance standards** rather than being too prescriptive in terms of pure technical requirements.
  - Vessels should be equipped with a sufficient number of cameras to allow data collection to the required standards (we provide an example of 4 camera setup for pelagic LL).
  - Quality of the data must be sufficient to allow species ID and detailed measurements of specimens.
  - EMS should be able to collect, to the extent possible, the observer data that is required to be submitted to ICCAT (ST-09), or any subsequent update of the form.
  - Some adaptations will be needed from the onboard crew, such as the crew positioning the catch in one or more calibrated areas for size measurements.



# Subgroup interactions with the Commission and other RFMOs

- **Interactions with the ICCAT Commission (keeping Commission updated on our work)**

- Coordination with the IMM Chair since 2021
- Presentation to IMM - 1 meeting in 2021 (14-17 June 2021)
- Presentations to the ICCAT WG-EMS in 2022 – 2 meetings (28 Feb 2022; 6-7 June 2022)
- Presentation to the ICCAT WG-EMS in 2023 – 15 Feb 2023 (this meeting)

- **Interactions with other RFMOs (scientific groups)**

- IOTC – Presentations to the Working Group on EMS (15-17 Nov 2021, 5-7 June 2022)
- IATTC – Presentation to the 3<sup>rd</sup> workshop for an EMS in the EPO (25-27 April 2022)



**Thank you**

**Questions?  
Suggestions?**