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INNOVATION I TECHNOLOGY I SUSTAINABILITY

PILOT PROJECT ON REMOTE ELECTRONIC MONITORING (REM) ONBOARD BLUEFIN TUNA PROCESSING VESSELS

EXECUTIVE SUMMARY

Submitted to the 2024 EMS WG Meeting as EMS_02_REV/i2024

PROJECT OVERVIEW

This pilot project took place from November 2022 to May 2024, and as participants had:

- European Union: as funding party.
- ICCAT: as managing party.
- Grupo Ricardo Fuentes: shipowner.
- Satlink: as technology provider.
- Digital Observer Services (DOS): as data managing party.

The purpose of the project was to test REM technology, Satlink's Seatube Nano+ system, onboard bluefin tuna (BFT) processing vessels and check if the systems were able to get enough information to monitor the interaction between the vessel's crew and the fish hauled onboard. In order to be able to compare data, the shipowner accepted sharing the two vessel's (Paloma Reefer and Princesa Guasimara) logbooks with DOS.

Once installed, the vessels were supposed to stay in port enough time each visit for Satlink, or a Satlink's partner, to board the vessel and replace the hard drive with information and then send it to DOS. During both phases, this scenario wasn't the most common, due to the vessels' tight schedules, but all the information recorded was extracted and analyzed by DOS.

The project consisted of two different phases; the first phase only had SeaTube systems without sensors installed onboard, since it wasn't feasible to get the sensors on time. This phase had data analyzed from November 2022 to January 2023 and, even without sensors, DOS proved that the data provided from the SeaTube was enough to have a reliable source of information from these vessels. When this phase ended, both SeaTube systems were decommissioned and shipped to Satlink's warehouse for safekeeping.

The second phase started recording information by August 2023 until January 2024. The SeaTubes were re-installed onboard both vessels, this time sensors included. During the installation we faced some problems with the proposed sensors: inclinometers for the haul doors wouldn't work, since they were lids removed entirely without inclination; and the crane scales had to be installed right under the crew's own crane scales, for they wouldn't accept using ours in stead of them. By the end of the second phase, results proved sensors to be a big help for data analysts and reduced the analysis time considerably (around 40% faster in the worst-case scenario), and weight data became more consistent than through weight estimates with a mean variation of less than 5%.

By the end of the project, the SeaTube systems were gifted to the shipowner, but they were deactivated without signs of interest in keeping them up and running.

LESSONS LEARNED

Although we are aware that scheduling works onboard vessels is logistically complicated, it is dangerous for the project to rush installing this equipment. We have to try to have all the parts onboard REM projects before acting, since with the crew's cooperation smaller issues could have been avoided, as well as more noteworthy problems (like the sensor's issues).

Having constant communication with the systems is key to have a REM system working properly throughout an entire project. Havin a VMS antenna integrated, as was for this project, in the SeaTube, allows for fast solving of minor issues and for an easier diagnosis and plan for reparation when needed.

About having the crew's collaboration, it was proved again that for a good data quality, we need the crew's help in keeping the cameras clean as instructed during installation. Camera maintenance is a simple and fast task, but vital to the analysis. In many reports from DOS was stated that cameras were not clean enough to have a good vision of the BFT being hauled, which might have caused part of the biggest differences between REM and logbook data.

CONCLUSIONS & NEXT STEPS

Reports produced by DOS successfully show how this technology can provide quality information about these types of vessels, so we can conclude that the pilot project has been a success on its own.

As stated in the Final Report, there are still technologies that can be applied to these vessels to enhance the data management:

- Using broadband global satellite communications for live access to the data, as per the use of Starlink antennas.
- Using ML models to speed up analysis time while making tuna haulings detection automatic.

ACKNOWLEDGEMENTS

This work was carried out under the provision of the ICCAT. The contents of this document do not necessarily reflect the point of view of ICCAT, which has no responsibility over them, and in no way anticipates the Commission's future policy in this area.

This work was conducted within the ICCAT Capacity Building initiatives and partially funded by the European Union through the EU Grant Agreement No. EMFAF-2022-VC-ICCAT4-IBA- Pilot project on the implementation of Remote Electronic Monitoring on bluefin tuna processing vessels.

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Annex 1

INNOVATION I TECHNOLOGY I SUSTAINABILITY

PILOT PROJECT ON A REMOTE ELECTRONIC MONITORING (REM) SYSTEM FOR BLUEFIN TUNA PROCESSING VESSELS

FINAL REPORT

PILOT PROJECT ON A REM SYSTEM FOR BLUE FIN TUNA PROCESSING VESSELS

Project Introduction and Scope

At the 2021 Annual meeting of the Commission, a pilot project was proposed by the EU and approved by the International Commission for the Conservation of Atlantic Tunas (ICCAT) by means of the Resolution by ICCAT establishing a pilot project for the implementation of Remote Electronic Monitoring (REM) on bluefin tuna (BFT) processing vessels (Res. 21-17). It aims at:

- exploring the use of REM on a type of vessel (BFT processing vessels) where it has not been tested so far.
- improving control on processing vessels that play a crucial role in several ICCAT fisheries.

The presence of an ICCAT Regional Observer is mandatory for all harvesting operations from farms, but the observer is usually deployed on board the processing vessel at the request of the operator and depends on the operator's means to reach the farm/trap or the processing vessel. It can therefore be difficult for an ICCAT Observer to detect or prevent possible illegal harvesting operations; hence the following objectives were proposed in ICCAT’s call for tenders:

- Test a Remote Electronic Monitoring (REM) system onboard bluefin tuna processing vessels operating in the bluefin tuna fishery in the eastern Atlantic and Mediterranean Sea.
- Evaluate the added value of this technology in improving the monitoring and control of processing vessels, the cost-efficiency of the system and its capacity to collect comprehensive and accurate data and its subsequent analysis.

Project partners

ICCAT is the beneficiary of an European Union call for proposals EMFAF-2022-VC-ICCAT4-IBA (specifically project: 101103829) which co-financed this project (around an 80%) as well as funds granted by the United States of America (the remaining 20%).

Satlink was awarded ICCAT’s project as technology provider while Digital Observer Services, a Satlink group company, was to provide the scientific analysis of the data extracted from the systems installed onboard both vessels.

INTRODUCTION

For this project two different bluefin tuna (BFT) processing vessels were selected to have the SeaTube Nano+ system installed onboard to comply with the project objectives.

BFT processing vessels usually work as a floating factory that give service to multiple fish farms as a mobile factory. In this case, the working season for both vessels takes place from August to January.

The onboard working procedure, followed by both vessels for this project, was:

1. Project's vessels sailed to an anchorage point close to BFT farms.
2. Tuna are extracted from the farms by their own vessels.
3. Tuna are loaded from the farm's vessel to the BFT processing vessels.
4. The crew onboard this project's vessels proceeded to cut them up and separate the parts in sellable pieces and discards (such as heads and tails).
5. The BFT farm's vessels receive the cut-up pieces, both discards and valuable pieces, and sail away.
6. When their service in the area is finished, the processing vessels set sail to a different region.

During both parts of the project, data was collected from farms located near the coast of Spain, Morocco, Tunisia and Malt; in detail analysis of the data was reported to the project partners through different Analysis Reports performed after each vessel trip.

The objective of the pilot project is to try REM technology for the first time onboard BFT processing vessels and check their activity to ensure no irregularities take place onboard, such as the quantity of tuna processed and declared are right.

SEATUBE

The SeaTube Nano+ is Satlink's electronic monitoring system (EM). It is the only EM system that has undergone outside audit by MRAG (Marine Resources Assessment Group) to certify that it complies with the ISSF (International Seafood Sustainability Foundation) requirements (ISSF document 2014/08). It also complies with the UNE 195007:2021 (Electronic Monitoring in fishing vessels. Requirements), EFCA (European Fisheries Control Agency) standards, Spanish Oceanographic Institute, and other governmental agencies standards.

The SeaTube system enables fishing companies, regional fishery management organizations (RFMOs) and governmental observer agencies to improve reporting and build better data gathering programs to improve fisheries' forecasts. Designed and manufactured by Satlink, the Seatube is a fully customizable system that integrates all components involved in an EM program, from setup and installation through to the generation of accurate reports.

The SeaTube can be setup in many different configurations in each of the sections it is made of. This flexibility allows to have a tailor-made solution for each customer.

- On-board data recording
    - 24/7
    - Geofencing
    - Sensor based
    - Speed based
    - Other personalized recording methods
- Data transmission from vessel to shore
    - Manual hard drive extraction
    - Satcom/VMS unit
    - GSM/4G
    - Satellite
    - Other personalized transmission methods
- On-shore solution
    - Satlink View Manager desktop-based review software
    - Horus web-based review software

*Figure **1** - Standard SeaTube configuration*[1]

INSTALLATION

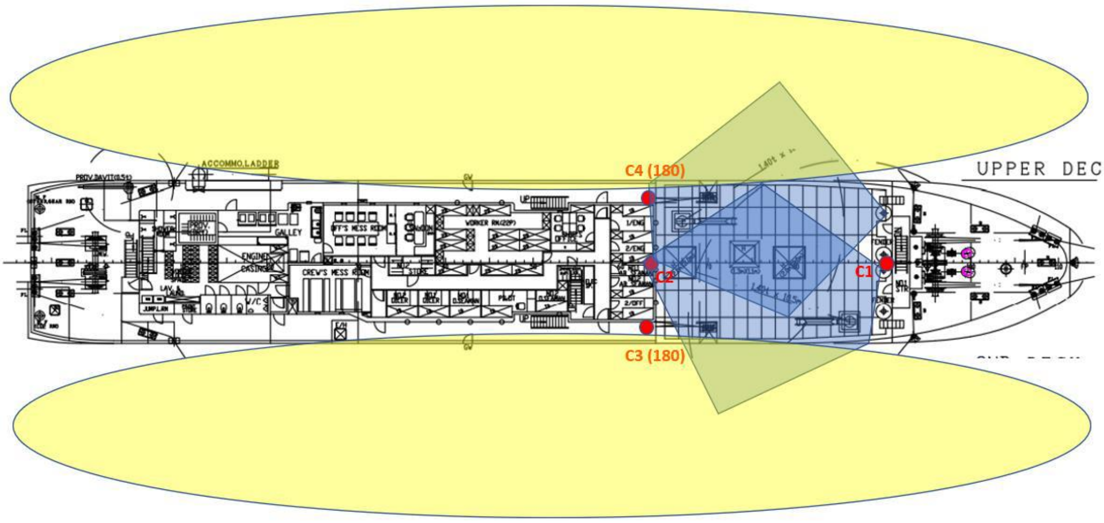
This project consisted of two different phases, each of which was carried out by a Satlink's partner while receiving support from Satlink's HQ. The approximate average cost of the installations came up to around 4.000€ per pilot phase.

PHASE 1

Planning

The objective of the project was to monitor all onboard interactions with BFT. In order to design the system onboard we requested the vessels' prints, which were swiftly provided.

Due to this project objectives the following 4-camera placement was proposed, so all wells and board-side interactions would be monitored:



The complete list of components installed for this first phase was:

- 1 x SeaTube Nano+ Control Unit
- 1 x ELB2020(VMS/Satcom Unit)
- 1 x 4G Router
- 1 x APC UPS
- 2 x 100º Camera
- 2 x 180º Camera
- Total price: approx. 8500€, since they were installed without sensors

Once the camera proposal was ready and the whole solution tailored to the vessels, a Vessel Monitoring Plan (VMP) was redacted and presented to the shipowner of both vessels for their approval.

Equipment installation

The installation of each vessel was made at the port they were working at, since the pilot started in the middle of their working season:

- **Vessel #1**

Vessel #1 was installed at Cartagena, Spain, by Radiobuques S.L.

Installation took place in two different times due to a problem with one of the cameras and the vessel having to go back to work. The first part of the installation was finished on December 1st, 2022, while the fourth camera and a power transformer were added on December 22nd.

- **Vessel #2**

Vessel #2 was installed at La Valletta, Malta, by SeaBrave Boats S.L.

Full installation of the equipment was successfully finished on November 11th 2022.

Satlink Outputs

Due to the tight schedule to organize the installation of the SeaTube systems before the vessels finished their working season, the installation of the sensor array had to be postponed for the second phase of the project, since the delivery times were too long.

This second phase implied the extension of the initial planning in accordance with the contract between ICCAT and Satlink, although an extension of an additional 12 months was already contemplated in the original contract.

PHASE 2

Planning

After data quality was deemed useful with the camera arrangement from phase 1, we used the same disposition for the second phase. For this second installation, we again assisted our partners in installing the SeaTube systems at the ports they were finishing maintenance and, also, shipped the sensor array so the whole solution was installed and the VMPs were updated.

The complete list of components installed for the second phase was:

- 1 x SeaTube Nano+ Control Unit
- 1 x ELB2020(VMS/Satcom Unit)
- 1 x 4G Router
- 1 x APC UPS
- 2 x 100º Camera
- 2 x 180º Camera
- 1 x Sensor Box
- 2 x Door Sensor
- 1 x Crane Scale
- Total full price: approx. 12.400€

- Equipment installation

The installation of each vessel was made at the port they were receiving maintenance before starting the working season:

- **Vessel #1**

Vessel #1 was installed at Gran Canaria, Spain, by Bridgecom S.L.

Full installation of the equipment was successfully finished on August 1st 2023.

- **Vessel #2**

Vessel #2 was installed at La Valletta, Malta, by SeaBrave Boats S.L.

Full installation of the equipment was successfully finished on July 28th 2023.

Satlink Outputs

During the re-installation of both systems, we found that the crew had not been informed of the technology to be installed onboard in this second phase, so our techs had to explain the use and placing of the sensors (door and scale), and found that:

1. The doors to the vessel's hauls couldn't be monitored by the sensors sent. The doors were lids to the hauls and they didn't turn over a side, so the inclinometers sent were not going to activate.

2. The crew already used their own crane scales, and they didn't want to use the ones provided for the project. In the end, the crew accepted setting Satlink's crane scale right below their own.

Both issues could have been avoided if the crew had been informed of the system to be installed, and if they had been willing to add any comments to the VMP.

EQUIPMENT SURVEILLANCE AND MAINTENANCE

During the whole duration of the project, both systems were monitored by Satlink's 24/7 support team. This monitoring consists of having a periodical, rutinary check of all the SeaTubes while they are working properly, and direct maintenance procedures whenever a SeaTube sends an alarm in the case of system failure.

For this project, the communication with the SeaTubes was made through their own VMS antennas.

DATA ANALYSIS

Digital Observer Services (DOS) was responsible for analyzing the data of this project, the in-detail procedure can be checked in Annex 1 (Analysis procedure) and all the reports of analyzed vessel trips.

In summary, once Satlink was informed that the vessels were touching port, we would plan a visit onboard with one of our partners to replace the hard drive with data with a new one; then, the drive with data would be shipped to DOS who would process and analyze them.

For analyzing the hard drives, DOS used Satlink View Manager (SVM) which is the software solution for in-detail scientific analysis of REM data. This software allows to check different data inputs at once through its multiple window display:

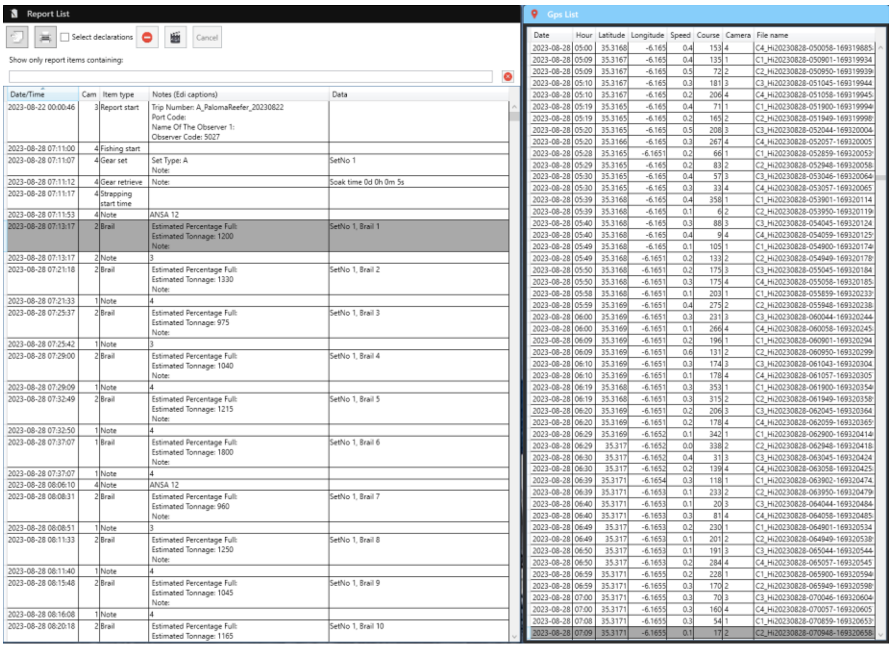
Main video Window

Displays the whole camera array synchronously, while focusing on one of the cameras, which will be the one being analyzed and displayed in the bigger screen:

The buttons below the main video are the custom notes the analyst can use to add information to the analysis. These buttons are fully customizable if the project being analyzed would need any particular information added.

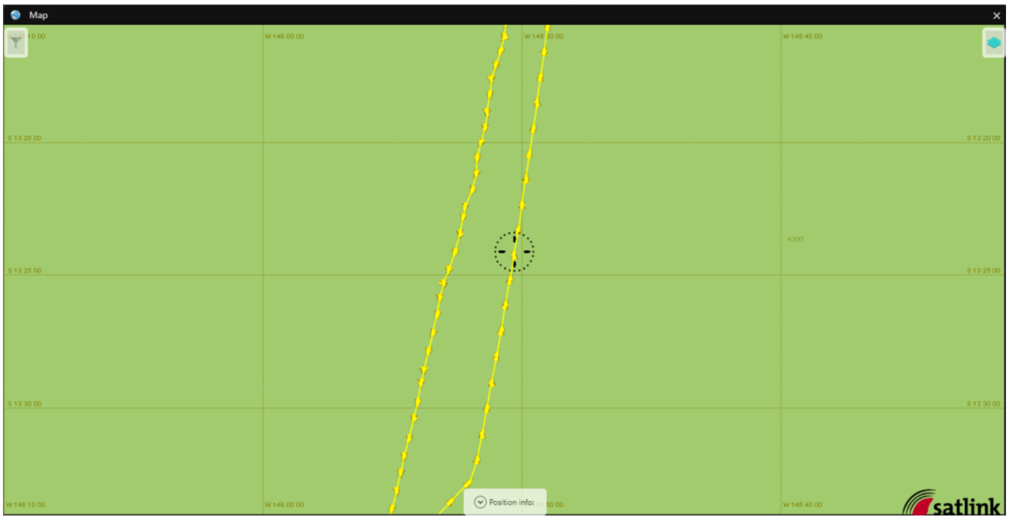
Notes and GPS Windows

The Note Window has the total of notes added to the project and, by default, shows them in chronological order. The GPS Window shows a list of videos and positions as 10-minute items, which can be used to navigate through the information.



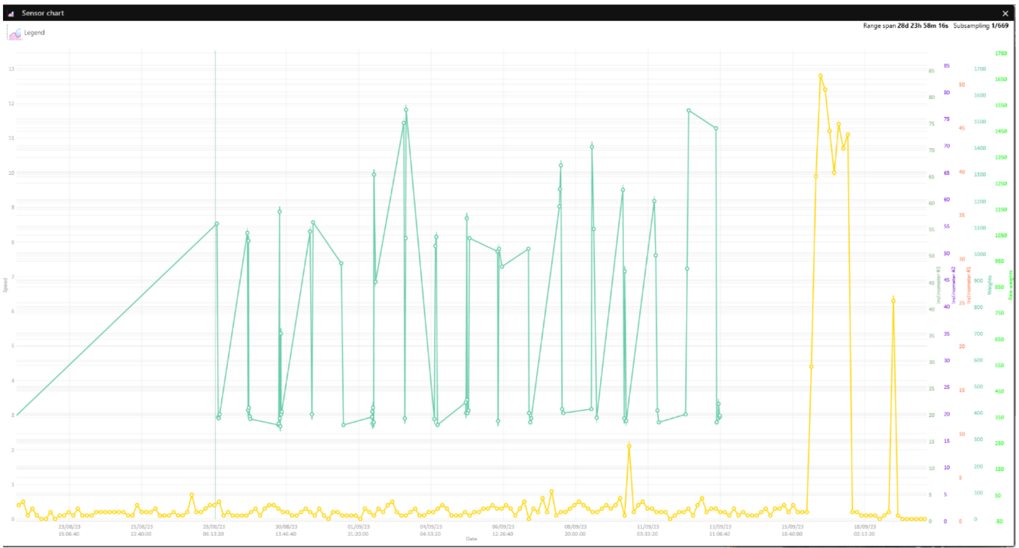
Map Window

The map shows the whole track of the trip being analyzed by DOS.



Sensor data chart Window

In this window the analyst will always find the speed graph of the trip, since it is calculated with GPS data, besides that info (in yellow), if the SeaTube had any kind of sensor input it will appear in the chart.



In this example, we have the speed in yellow and the weight recorded by the crane scale in green. Fluctuations in the weight value could easily come from the balancing of the fish when hauled.

- **Data Recording**

During this first phase, 45 days were recorded onboard Vessel #1 and 54 days onboard Vessel #2, adding up to 1285GB worth of data between raw footage and REM metadata.

The only issue detected since the installation of both systems was a communications blockage for Vessel #2 on December 15th. Which was deemed as uneventful since no evidence of loss of information was found on the checks performed on the SeaTube afterwards.

- **Equipment Decommission**

Once the bluefin tuna season ended, both systems were uninstalled by Radiobuques at Cartagena port, Vessel #1 on January 16th and Vessel #2 on January 25th, 2023, without further issues, and they were shipped to Satlink's premises for safekeeping and data analysis.

- **Data Analysis**

DOS identified and described 28 transshipments for Vessel #1 and 25 events for Vessel #2.

In this phase of the project, the weight of the pieces is estimated using a conversion formula, available in DOS reports.

During the Phase 1 pilot period, Vessel #1 made two different trips totaling 40 at-sea days and 28 transshipments:

- December 2nd to December 22nd: with 14 different transshipment events

	DOS	Logbook
Individuals	2178	2178
Weight (kg)	560780	562498

- December 25th to January 14th: with 14 different transshipment events

	DOS	Logbook
Individuals	2538	2539
Weight (kg)	588577	590676

Vessel #2 performed three different trips, 44 at-sea days with a total of 25 transshipping events:

- November 30th to December 14th: with 8 different transshipment events

	DOS	Logbook
Individuals	1759	1765
Weight (kg)	410780	371241

- December 16th to December 27th: with 9 different transshipment events

	DOS	Logbook
Individuals	1558	1556
Weight (kg)	384815	364697

- January 6th to January 25th: with 8 different transshipment events

	DOS	Logbook
Individuals	1604	1604
Weight (kg)	378899	379826

The table below shows the effort undertaken by DOS' staff to fully, and manually, analyze all the detected transshipments:

Vessel's trip	Analysis hours	Days	Transshipments	Tuna pieces
TOTAL	**140,9**	**82**	**53**	**9.637**
A_Vessel#1_20221202	25,2	20	14	2.178
A_Vessel#2_20221130	25,4	14	8	1.759
A_Vessel#2_20221216	25,5	11	9	1.558
A_Vessel#2_20230106	34,2	19	8	1.604
A_Vessel#1_20221225	30,6	18	14	2.538

- **Data Recording**

The second phase included a whole BFT season for both vessels: 167 days were recorded onboard Vessel #1 and 144 days onboard Vessel #2, adding up to 5984GB worth of data between raw footage and REM metadata.

There was an issue with the central unit of both systems where they were unable to give format to one of the disks onboard. This issue is being checked, but it didn't affect the project normal development, as the unit has 4 different drives installed to avoid critical failures with issues like that. In the monthly Health Reports issued during this phase's months, that disk appears to have zero space available.

Also, the SeaTube onboard Vessel #2 was shut down between October 2nd at 09:35 until October 3rd at 16:10. Our support team didn't find any issues with the equipment, but there were confirmed transshipments during the shutdown that lost data while the equipment was off.

- **Equipment Decommission**

Once the bluefin tuna season ended, both systems were left onboard and gifted to the shipowner. Satlink contacted them to inquire if they were interested in continuing with the service or if they'd want them decommissioned but haven't yet received an answer.

- **Data Analysis**

DOS identified and described 80 transshipments for Vessel #1 and 60 events for Vessel #2.

As the crane scale sensor was available for the second phase of the project, except for last trip of Vessel #2, their readings were used to note the weight of the boarded fish.

During Phase 2, Vessel #1 made six different trips totaling 133 at-sea days and 80 transshipments:

- August 4th to August 21st: with 15 different transshipment events

	DOS	Logbook
Individuals	1745	1745
Weight (kg)	609725	586658

- August 22nd to September 19th: with 17 different transshipment events

	DOS	Logbook
Individuals	2147	2147
Weight (kg)	722155	700344

- October 2nd to October 3rd: with only 1 transshipment event

	DOS	Logbook
Individuals	188	188
Weight (kg)	43693	46404

- October 11th to November 21st: with 20 different transshipment events

	DOS	Logbook
Individuals	3320	3320
Weight (kg)	803876	784437

- November 24th to November 26th: with 3 different transshipment events

	DOS	Logbook
Individuals	497	497
Weight (kg)	128322	121605

- December 4th to January 15th: with 24 different transshipment events

	DOS	Logbook
Individuals	4998	7395
Weight (kg)	1077029	890816

Vessel #2 performed three different trips, 71 at-sea days with a total of 60 transshipping events:

- August 11th to September 2nd: with 21 different transshipment events

	DOS	Logbook
Individuals	3073	3073
Weight (kg)	1009778	967899

- October 1st to October 27th: with 18 different transshipment events

	DOS*	Logbook*
Individuals	4319	4738
Weight (kg)	889198	1047826

*This is the trip where almost a whole day and a half of data was lost

- November 9th to December 1st: with 21 different transshipment events

	DOS	Logbook
Individuals	5435	5637
Weight (kg)	987096*	1171299

*During this trip, the crane scale wasn't able to get through data consistently to the central unit, so the analysts had to estimate the weight often.

The table below shows the effort undertaken by DOS' staff to fully, and manually, analyze all the detected transshipments:

Vessel's trip	Analysis hours	Days	Transshipments	Tuna pieces
Total	**257,5**	**204**	**140**	**25722**
A_Vessel#2_20230811	47,9	17	15	1745
A_Vessel#1_20230804	31,5	29	17	2147
A_Vessel#1_20230822	28,1	1	1	188
A_Vessel#2_20231001	21	41	20	3320
A_Vessel#2_20231109	40,4	3	3	497
A_Vessel#1_20231002	5,4	42	24	4998
A_Vessel#1_20231124	6,1	23	21	3073
A_Vessel#1_20231204	41,1	26	18	4319
A_Vessel#1_20231011	36	22	21	5435

Using this project's prices and case numbers as a guide, considering that only target days with vessel activity are analyzed, we get that between a 65% and 70% of days in a trip will be analyzed which prizes the analysis of a month of footage in, around, 65€ x 20 days = 1.300€, as mean value for a vessel with a SeaTube with sensors incorporated or 75€ x 20 days = 1.500€ for a SeaTube without sensors.

We have to always consider that there are many factors that can affect the speed and price of analysis, such as footage quality, length of the transshipment or the complexity of the analysis or analysis object.

CONCLUSIONS & NEXT STEPS

- **Conclusions**

The first conclusion to draw from the pilot is that REM systems are suitable for monitoring the activity taking place onboard BFT processing vessels. Even though we can see some disparity in the data, during normal transshipping the difference between analyzed data and logbook data is rounding 3%.

Comparing the results from both phases, and considering that the second one had a bigger batch of data analyzed, we can assume that the use of sensors does not only make analysis faster (almost an average of 44% faster), but more accurate:

Since these vessels can take a lot of time overseas before they get close to land to either replace the drives or transmit the information via 4G, which proved to be an efficient yet logistically complex procedure, for further installations a stable, global broadband connection for data management, such as the one provided by Starlink antennas, would be interesting. This option can also be used as an opportunity to get the crew onboard the project since, in case they don't already have one, it can provide the whole crew with internet access for messaging apps and such.

- **Lessons Learned**

Regarding equipment installation, we have been reassured of the importance of having the crew's input into the whole process, since it can avoid facing issues like the ones faced with both sensors.

Constant communication with the equipment has proved its utility in, both, giving remote maintenance through alarms management and assessing the gravity of any small issues; that's why we always suggest installing a VMS antenna aside from any other additional communication device, such as the 4G router installed in these vessels.

Regarding the analysis, although the camera setting provides a bit of redundancy, it was proven worthy since different camera angles proved useful when not all the cameras were kept clean, or due to the vessel's operation part of the framing was obscured for one camera but not the other ones. That aside, camera maintenance is a task that needs to be taken care of for the EM system to provide with quality footage; it is recommended to wipe the cameras with a cloth and fresh water at least once every operation day.

After analyzing the data, we found that the sensors used for the project weren't the best models for the objective at hand. Besides the aforementioned issue with the door sensors, we are now working with crane scales that can take more accurate measurements than the ones installed for this project, which had a far too high threshold between measuring steps, which could have also impacted negatively when measuring the smaller haulings.

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- **Next Steps**

Now that this pilot project has finished and has produced these positive outcomes, we would suggest following up on its steps, adding a few variations:

1. Try setting up the wireless, even satellite, transmission for analysis, which can be made even easier thanks to the input of sensor data.
2. Try to ensure that the crew will proceed with daily camera cleaning.
3. Installing a better version of the sensors to further help analysts and to ensure a more accurate data is procured.
4. There could also be an option to apply Artificial Intelligence / Machine Learning processes for even faster and more cost-effective results.

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ANNEX I: TRANSSHIPMENT ANALYSIS PROCEDURE

The purpose of this procedure is to offer the guidelines to detect, identify and describe transshipment events recorded by Satlink's SeaTube Nano+ system.

The whole data management plan starts with the vessels arriving to port, where a technician replaces the drive or drives to be analyzed and ships them to DOS' office. These HDDs are encrypted by the SeaTube as soon as they are installed in the main unit, and the password (a 20 character, randomized one) is only available to Satlink's staff. Besides, the drives use a format that is not directly readable by Windows or iOS computers, to add an additional security layer.

Once the drives arrive to DOS' office, they are decrypted and analyzed using Satlink View Manager (SVM), which is Satlink's proprietary software for Electronic Monitoring data analysis:

In the analysis of the video of a cargo vessel trip, we separate the effort dedicated to detect the transfer operations made during the vessel's trip (Screening_TR process) and the description of the transferred fish (Standard_TR).

In the second phase of the project, the SeaTube system was complemented with an array of sensors dedicated to monitor 2 main parameters of the cargo vessel's activity: weight of the cargo being hauled onboard/offloaded and hatch door position (open/closed), even though only the weight sensors turned out to be useful in this case.

1. Screening_TR process [2]

1.1 In absence of sensor information, the analyst applies speed filters on 100% of the trip trace looking for drifts and encounters with other vessels. Vessel behavior, drifts and video evidence are considered to determine the periods of each transshipment event. Once installed crane scale sensors gave a faster and more accurate activity ID.

1.2 The analyst identifies the origin of the transferred fish and notes the transshipment type as vessel, farm or cage . Any identification number from those are noted by the analyst.

1.3 The analyst writes down any possible pollution events detected during the identification of drifts or encounters (garbage dumping, oil spillages…), but they won't analyze more in-detail aspects of the vessel's trip.

Results:

- Determination of trip start and trip end.
- Determination of the start and end of transshipment (TS + TE).
- Location of transshipment operations.
- Description of the type of encounters/transshipments.
- Identification of the tuna carrier vessel
- Description of pollution events detected.
- Any other event that is considered of interest to the observer, such as accidents, unusual crew behavior...

[2] Screening protocol supposes the video comply with the following requirements:

1. All the videos contain GPS information.
2. At least, 10 frames per second (FPS) in recording cameras.

2. Standard_TR process

2.1 The analyst goes through the transshipment events detected during the screening process and describes all the operations regarding the fish transfer. No in-detail review is made on the footage screened in the previous process.

2.2 The analyst notes every transshipped load including the description of content to species level when feasible, including:
- Number of individuals (for large size fish) or estimated weight (for medium and small size fish)
- Weight data based on crane weight load cells (when available) or length estimation converted to weight

Results:
- Number of net/sling loaded.
- Number of individuals or tons
- Species identification
- Size measures or weight estimates
- Crane scale weights.

The analyst collects the information through the SVM video analysis software and the result of the work performed are converted into the final report in Excel format through Satlink's "Report Server", a server dedicated to transforming SVM outputs into customized reports for each project.

A final report is issued in pdf format with the written description of the process, results and analyst's comments, complete with notes on the quality of the information received in terms of quantity of videos and quality of the footage.

Annex 1: Parameters monitored in the transshipment analysis procedure.

Analyst's tasks	SVM Output
Screening_TR process	
Determination of the start and end of the trip	Date, time, GPS position
Identification of every transshipment	Date, time, GPS position, vessel identification
Number of transshipments/encounters	Total number
Type of transshipments/encounters	Type code
Description of contamination/other events	Date, time, position, type and quantity
Standard TR process	
Number of nets/slings loaded	Total number
Number of individuals or tons	Number/tons
Species identification	Species code
Size measures or weight estimates	Size (cm)/ weight (Kg)
Crane scale weights	Weight (Tons)