ELECTRONIC MONITORING TRIALS ON THE TROPICAL TUNA PURSE-SEINE FISHERY

International workshop on application electronic monitoring systems in tuna longline fisheries

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EM PS Fishery
BACKGROUND

- The true value of an observer lies in their independence from the commercial fishing industry.
- This holds true for both,
  - scientific data collection, and for

  - any actions related to monitoring, control and surveillance (MCS)

EM PS Fishery
BACKGROUND

- **For some types of data, such as discards, observer programs can be the most reliable, and sometimes the only source of information.**
- **There are, however, several difficulties involved in placing observers onboard fishing vessels; high costs involved in observer placement, the limited availability of space onboard, piracy (Indian Ocean).**
- **Is the technology (EM system) a real option for monitoring the tropical tuna purse seine fishery?**

EM PS Fishery

Two studies have been conducted determining effectiveness of EMS on the tropical tuna purse seine fishery.

ARCHIPELAGO MARINE RESEARCH LTD.

marine instruments

EM system
SPECIFIC OBJECTIVES

I. Compare the data collected using EM to the data collected by observers with respect to

- ❖ Fishing operations: set locations and set-type.
- ❖ Estimation of tuna catches, total amount and by species.
- ❖ Estimation of bycatch (Sharks, billfishes, turtles and other bony fishes)

Cameras Vs. observer
OBJECTIVE

	Observer	EM
Days at sea, Route data	✓	✓
Set position and type	✓	✓
Retained and discarded tunas	✓	✓
Bycatch estimation	✓	✓
Length sampling	✓	X
Fishing aggregating device (FAD) monitoring	✓	X

EM PS Fishery

INTRODUCTION

- In 2012 ISSF carried out for the first time an evaluation test of an electronic monitoring system on the tropical tuna purse seine fishery

  - **VESSELS**
    - Gear: Purse seine
    - Length: 75 - 81m
    - Crew members: 25-30
    - Fishing area: Tropical Areas
    - Target species: Tropical tunas
    - Trip duration: 4-6 weeks

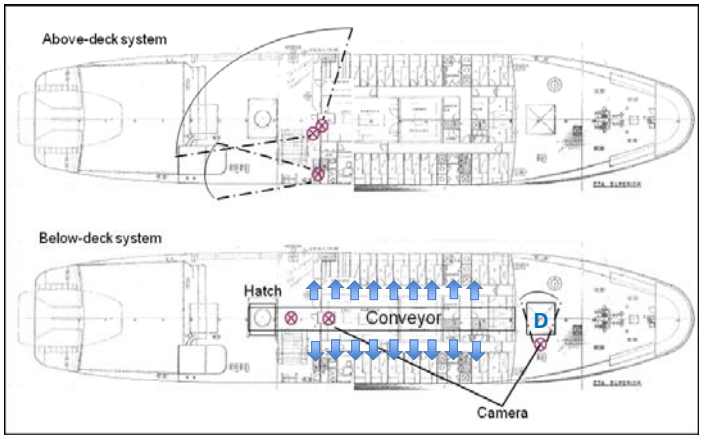
  - **OB & EM simultaneous data collection**

Ocean	Vessel	Trips	Days	Sets
Atlantic	Playa de Bakio	3	108	61
Indian	Torre Guilia	2	74	40
Pacific	Cape Finisterre	3	73	56

EM system

CAMERA PLAN

Cameras
Five cameras above deck
Three cameras bellow deck



GPS receiver
Position signal each 10 sec.

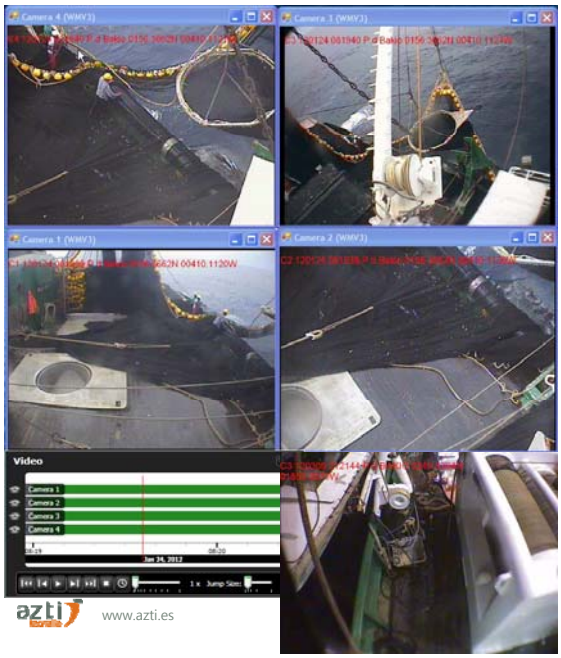
Sensor
Trigger for turning video recording on

- Hydraulic Pressure Sensor
- Drum rotation sensor (activated by movement)

EM system

EM SYSTEM

Above deck system



Cameras

Five cameras

- 2 cameras (wider and narrower angle) oriented to the net (sack)
- 3 cameras oriented to the deck (port side, starboard, a general view)

Hydraulic pressure sensor

Trigger for turning video recording on

Function

- Estimate set type
- Estimate total catch (nº and fullness of brails)
- Estimate large size species bycatch

EM system

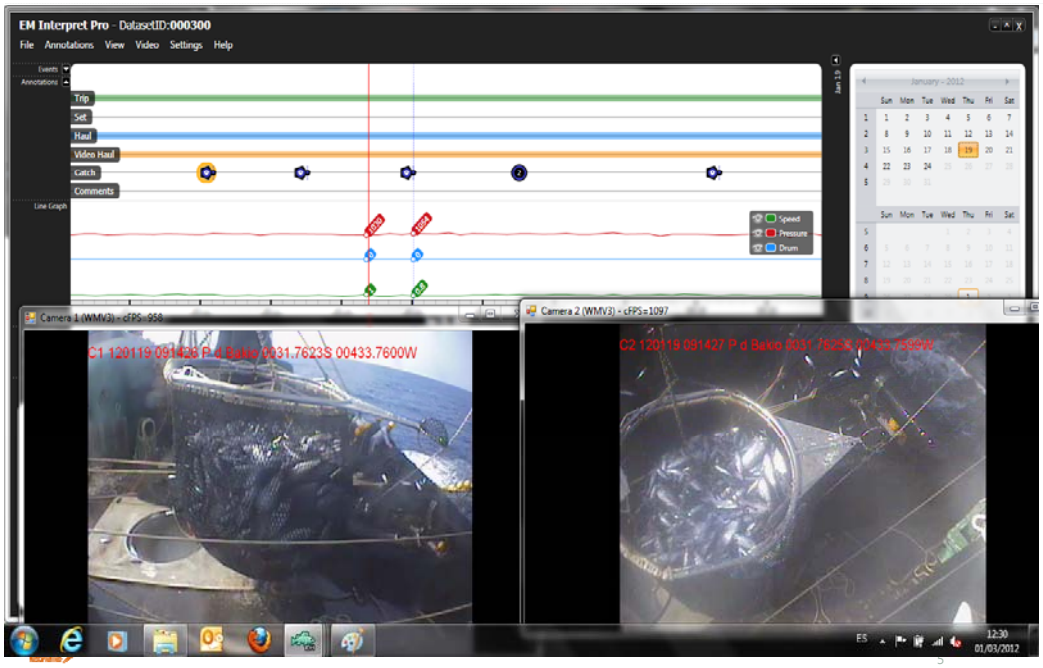
EM SYSTEM

Above deck system

EM system

EM SYSTEM

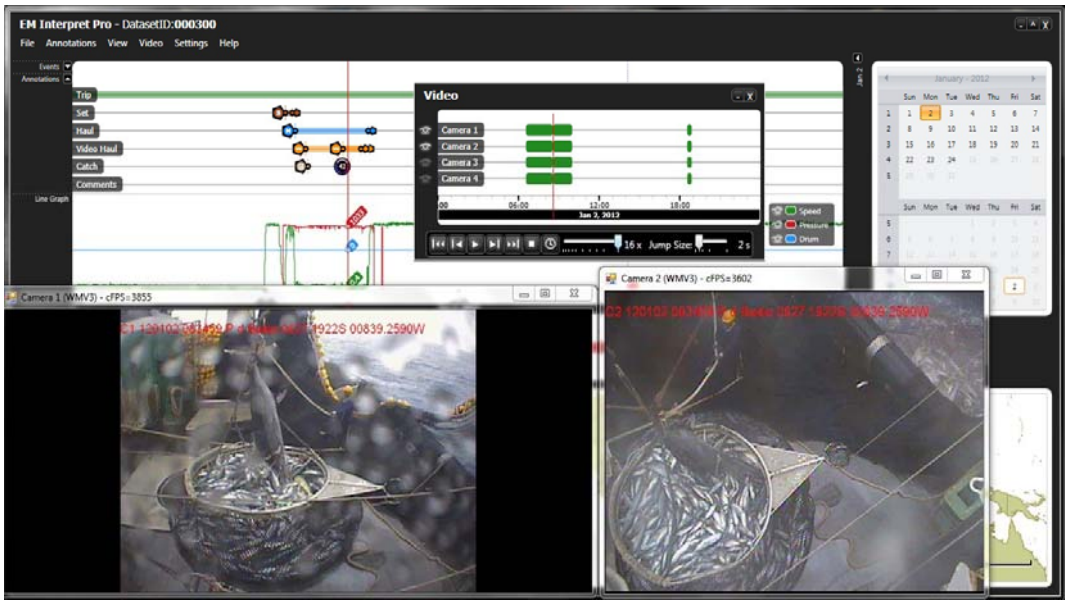
Top deck system



EM system

EM SYSTEM

Top deck system



EM system

EM SYSTEM

Fish factory system

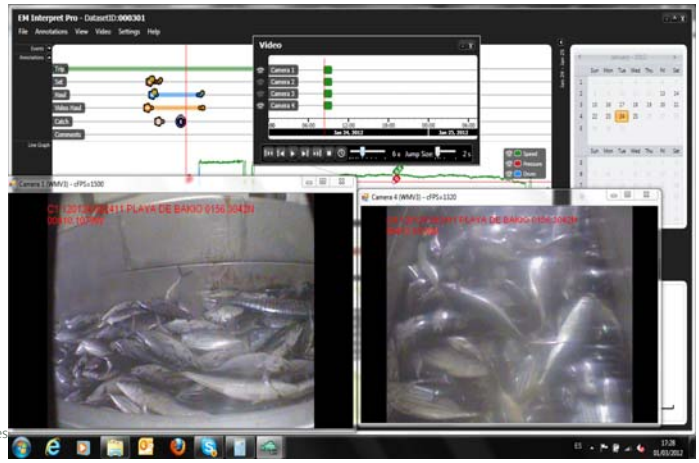
- **Cameras**

Three cameras

  - 2 cameras on the conveyor
  - 1 cameras at the end of the conveyor (discards)

- **Drum rotation sensor**
  - Trigger for turning video recording on

- **Function**
  - Tuna sps. Proportion
  - Estimate small size bycatch



EM system

EM SYSTEM

Fish factory system

- **Cameras**

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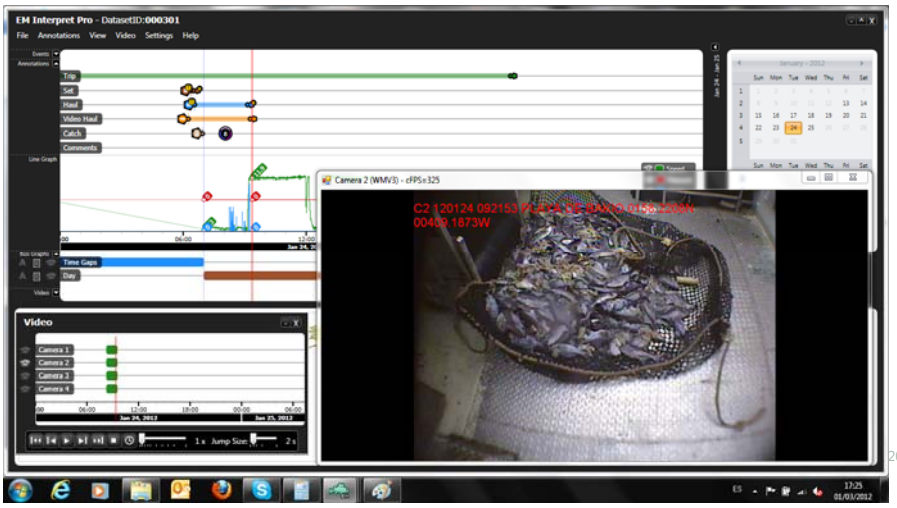


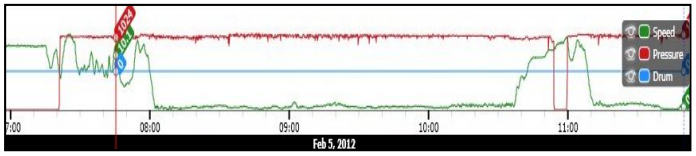
EM system
RESULTS

Set location and type

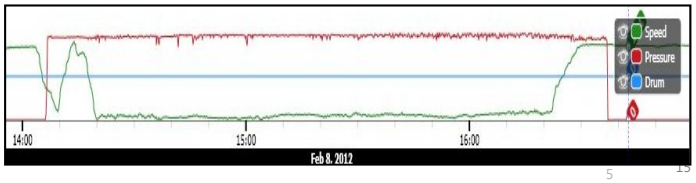
➢EM records allowed identification of 100% of the fishing operations

➢The probability of determining successfully the set type was highly variable among oceans and ranged from 56.33 % in the Pacific to 98.36 % in the Atlantic .

FSC



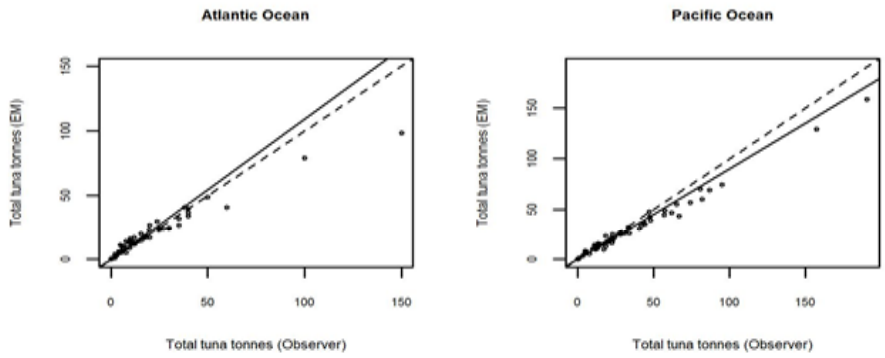
FAD



EM system
RESULTS

Total Tuna catch

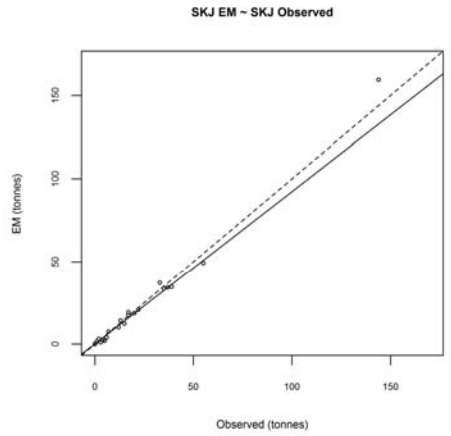
✓Estimated weight of retained **total tuna** per set from EM and observer data indicate that there is **no significant difference**

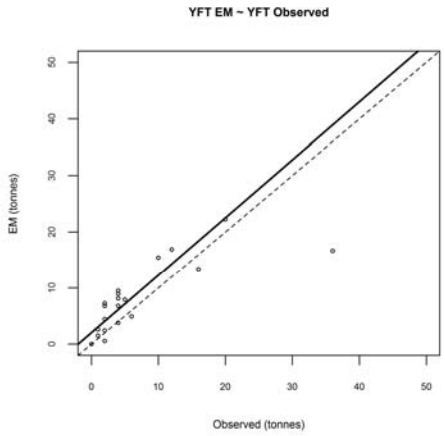


EM system
RESULTS

Tuna catch

✓For the most important tuna species in volume within a set, such as the yellowfin and skipjack, the estimates made by the EM were accurate and statistically undistinguishable from the estimates made by observers.





EM system
RESULTS

Bycatch (Sharks, billfishes and turtles)

➢Larger bycatch species were well documented by EM, but the bycatch for most other species was underestimated.

- ✖ For most shark species the EM estimates were significantly lower
- ✓ However, EM detected similar or larger number of billfishes

	Sharks		Billfish	
	EM	Obs	EM	Obs
Atl. Ocean	58	109	20	29
Pac. Ocean	184	234	17	7
Ind. Ocean	114	116	4	4

EM system
RESULTS

Bycatch (Sharks, billfishes and turtles)

✓One benefit of EM is that it allows the simultaneous analysis of the fishing deck and the well deck.

✖Another challenge for the EM technology was the coarser grade of taxonomic identification of the catch.

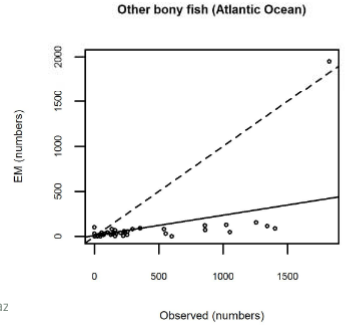
Observer → reached species level in most of the cases.
EM → In most cases species identification only reached order/family level

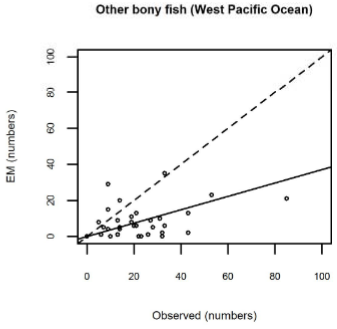
EM System
RESULTS

Other bony fishes

➢Although some minority bony fish species were never observed or identified using EM, the main species were observed by both methods

➢Nevertheless, the estimated total number of other bony fishes was significantly lower in EM than in observers data.





EM System
RESULTS

Summary

	Observer	EM	Result	
Route data (track and days at sea)	✓	✓	☺	
Nº of sets and type (Free or FAD)	✓	✓	☺	
Retained tunas	✓	✓	☺	
Discarded tunas	✓	✓	😐	
Bycatch info	✓	✓	Billfish	☺
			Sharks	☹
			Turtles	😐
			Other bony fishes	☹

EM System
WHY WERE OBSERVER AND EM ESTIMATES DIFFERENT ?

- Both observer and EM results are estimates
- Main differences came from the below deck area (small size bycatch)
  - Why ??
    - main challenge is the large volume of fish that enter the conveyor at once, thus hiding a large portion of the fish under the top layer
    - Complex catch handling used by the crew, with many different handling points. This is a disadvantage for the EM if we have limited number of cameras.
    - Image quality. Some times EM was limited by external factors (scales, water drops, etc.), but it is also limited by the quality of cameras itself (analog cameras).
    - Analog cameras are sturdy but of relatively low resolution. Digital cameras have much higher image resolution and frame rates, but this supposes higher data storage cost. Balance between resolution needs and data storage duration is needed.

Electronic Eye
BACKGROUND

- This technology showed great potential for the monitoring of the tuna purse seine fishery; As complement or alternative to observers

- Since then, there have been new systems developed by various commercial vendors

- The company **Marine Instruments S.A**. developed the system Electronic Eye (EE), which is based on automatic high definition photo cameras.

Electronic Eye
EQUIPMENT

Electronic Eye (EE), an electronic monitoring equipment which is based on automatic high definition photo cameras.

Totally integrated and autonomous. Easy installation, only needs External power supply.

2MP CAMERA	2 megapixels camera.
	GPS Position linked to the images.
	Image download via Wi-Fi or USB.
	4 security levels with password.
	Iridium communications. Global coverage.
	Back-up batteries.

Electronic Eye
EQUIPMENT

Camera shot (24 h /day)

depends on the vessel's speed:

➢Above 4 knots (sailing/searching) ➔ 5 min
➢Below 4 knots (fishing operation) ➔ 5 sec.

GPS :

•Each 10 '' vessel track

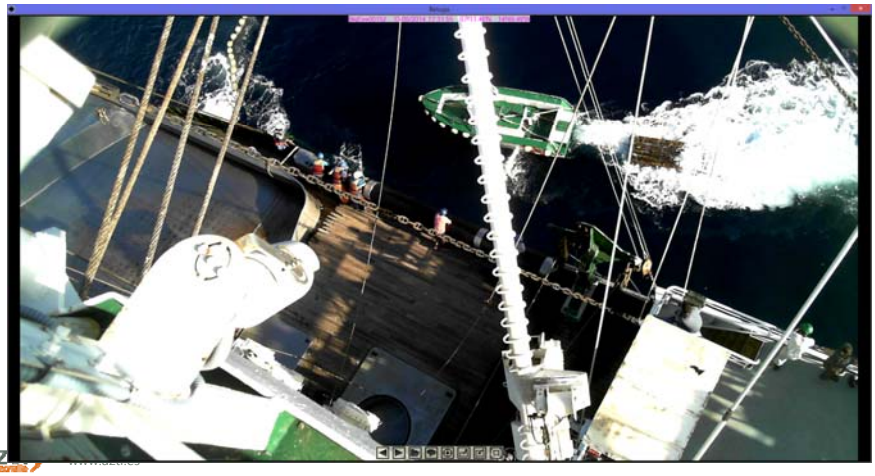
Health statement

•Hourly, position & system status sent to a land station

Electronic Eye
CAMERAS

EE 1 on the crow's nest portside

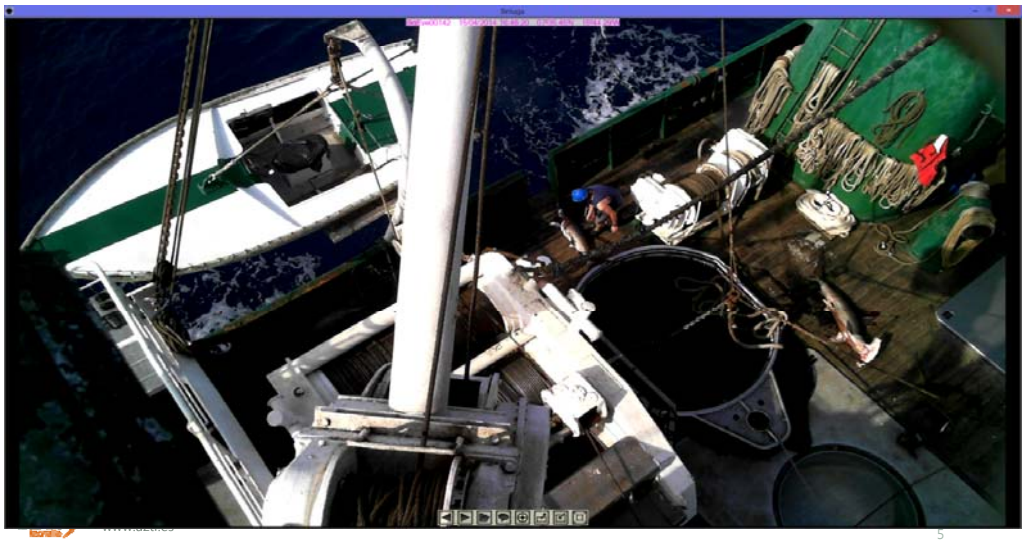
- area where the sack is emptied during brailing
- speedboat taking the FAD out from the net



Electronic Eye
CAMERAS

EE 2 on the crow's nest starboard side

release of the large size bycatches



Electronic Eye
CAMERAS

EE 3 on the top deck

- view of the brailing to estimate the total catch

Electronic Eye
CAMERAS

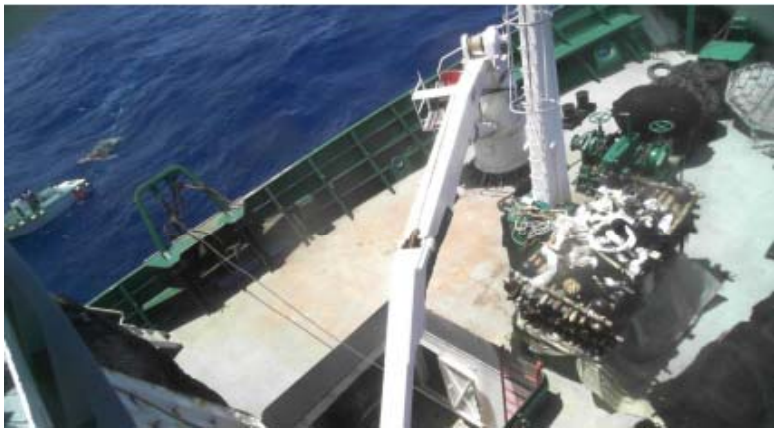
EE 3 on the top deck

- This camera also permits the detection of bycatch species if they are removed from the brail

Electronic Eye
CAMERAS

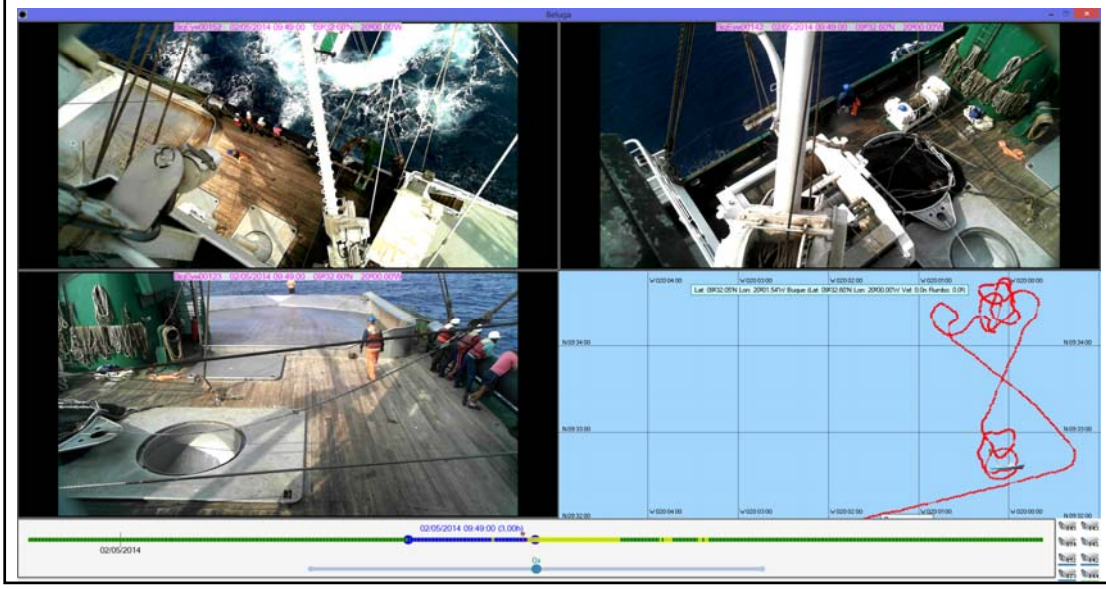
EE 4 on the bow

- discarded tunas when the bow crane is used
- FAD monitoring



Electronic Eye
DATA ANALYSIS

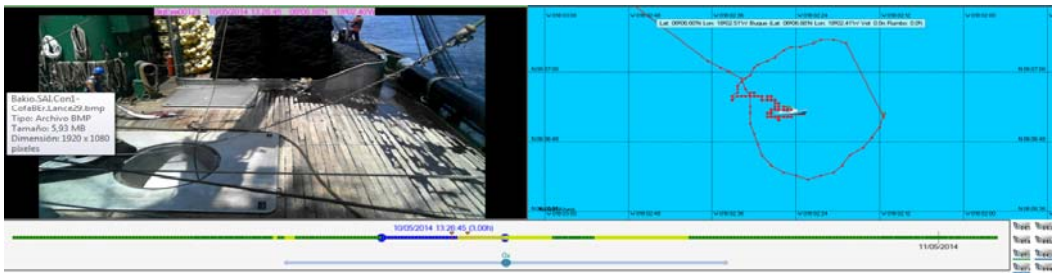
Beluga Software for image analysis. GPS position (each 10' and linked to photos)



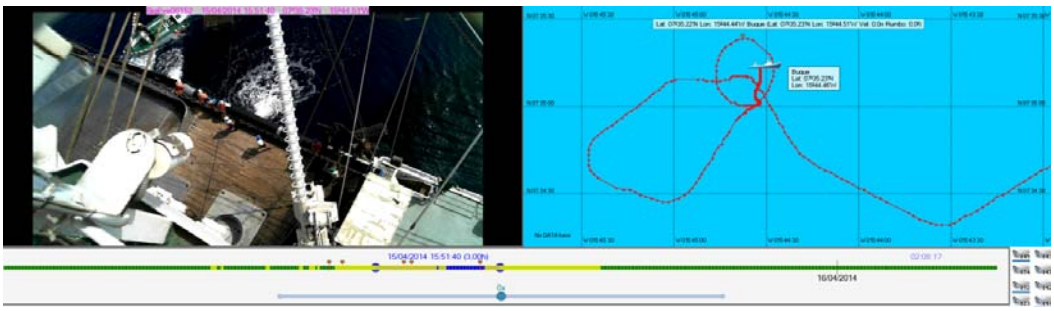
RESULTS (SET TYPE)

97.67 % of success : 42 of 43 were correctly classified using EE (21 FAD & 22 FSC).

FSC



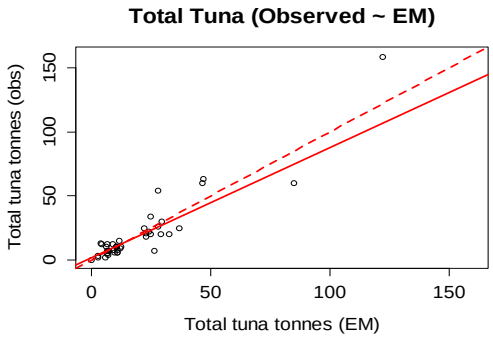
FAD



RESULTS (TOTAL TUNA CATCH)

Total catch 863 (OBS) vs 856 (EE)

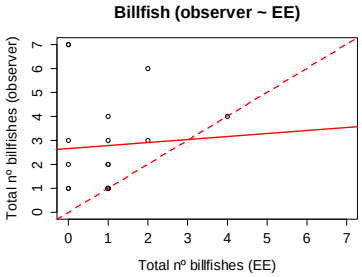
✓☺ There were good indications that EM and observer data were equally reliable methods for estimating total catch per set

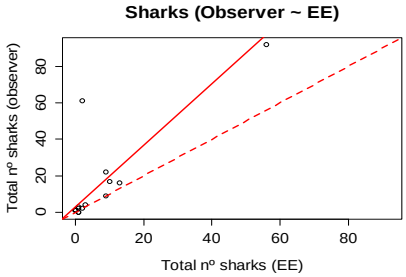


RESULTS (BYCATCH)

Billfish: 50 (obs) vs 17 (EE) / Shark: 233 (obs) vs 107 (EE)

•☹ Same sps. were identified, but EE constantly underestimated bycatch counts. EE and Observer were not equally reliable methods for estimating large size bycatch species..

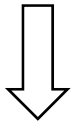




Electronic Eye
RESULTS

Why these differences on bycatch estimates?

➢bycatch species could correctly be assessed if they were handled on the fishing deck. But if the catch was brailed aboard and transferred directly to the below deck, that fraction of the catch fell outside the scope of the EE.



An EE system on the below deck (conveyor belt) will improve substantially results.

EM System on PS fishery
CONCLUSIONS

MAIN CONCLUSIONS

EM System on PS fishery
CONCLUSIONS

- There are some activities that EM cannot accomplish compared to an experienced human observer. However main required tasks can be achieved if; a) the right equipment is used, b)and if there is close alignment between cameras and vessel catch handling operations.

- The main deck operations were generally well covered by camera angles. EM can be used to determine, as reliably as observers:
  - ✓ fishing effort (number of days at sea and fishing operations)
  - ✓ set-type and location
  - ✓ tuna catch
  - ✓ Large size by catch

EM System on PS fishery
CONCLUSION

- Improvements needed:
  - Bycatch estimation and length sampling; For the moment, EM can be used only as complementary tool to observers.

- EM is a useful alternative that could significantly increase the sampling coverage, even if there are clearly still some limitations.

- According to the final goals of a monitoring program, EM systems could be a complement to observers or even a real alternative. For scientific monitoring purposes, EM will be valuable complement to the port sampling to gather target species catch statistics when these data are not, or are poorly, collected. For bycatch investigation, the use of EM could be a complementary tool to observers during the data collection process

EM System on PS fishery
CONCLUSION

➢Even if EMs effectiveness is proved/validated, it is recommended to maintain certain human observer coverage; This will allow continuous calibration of the EM systems and collection of some type of data such as biological samples and data on fishing activities at fine scale.

EM System on PS fishery
FUTURE STEPS

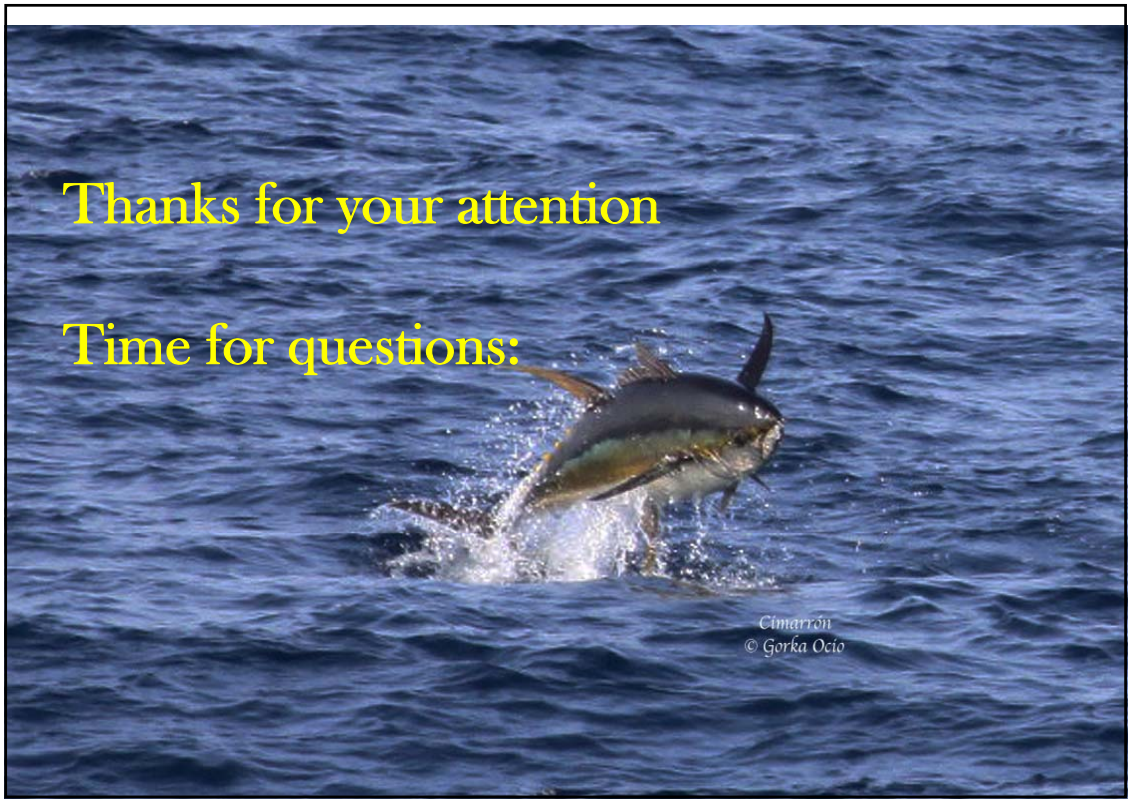
- At this stage, after the promising results obtained in different pilot studies, minimum standards and submission protocols for EMS should be developed (RFMOs).

ISSF' s technical report 2014-08 "*Updated guidance on Electronic Monitoring Systems for tropical tuna purse seine fisheries*" could be used for this objective.

http://iss-foundation.org/download-monitor-demo/download-info/issf-technical-report-2014-08-updated-guidance-on-electronic-monitoring-systems-for-tropical-tuna-purse-seine-fisheries/

- These would aim to standardize the implementation of electronic monitoring systems across different vendors, and to ensure that the systems can result in collecting useful information for fisheries monitoring

- Recognize and adopt as legitimate by stakeholders(RFMO, coastal states, ..)


Thanks for your attention
Time for questions:
Cimarron
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