Pilot study of an electronic monitoring system on a tropical tuna purse seine vessel in the Atlantic Ocean

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o **For some types of data, such as discards, observer programs can be the most reliable, and sometimes the only source of information.**

o **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).**

o **Is the technology (EM system) a real option for monitoring the tropical tuna purse seine fishery?**

o **PROJECT**

- Funding: ISSF, European Union and Basque Government.
- Execute: Archipelago
- Collaboration: Pevasa and Azti-Tecnalia

o **VESSEL (**Playa de Bakio)

- Gear: Purse seine
- Length: 75.6 m
- Crew members: 26
- Fishing area: Atlantic Ocean

o **Trip**

- Entry port: Abidjan (Ivory Coast)
- Equipment installation: 3 days
- Data collection at sea: 3 trips

    108 days

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)

II. **Examine operational aspects of implementing Electronic Monitoring**
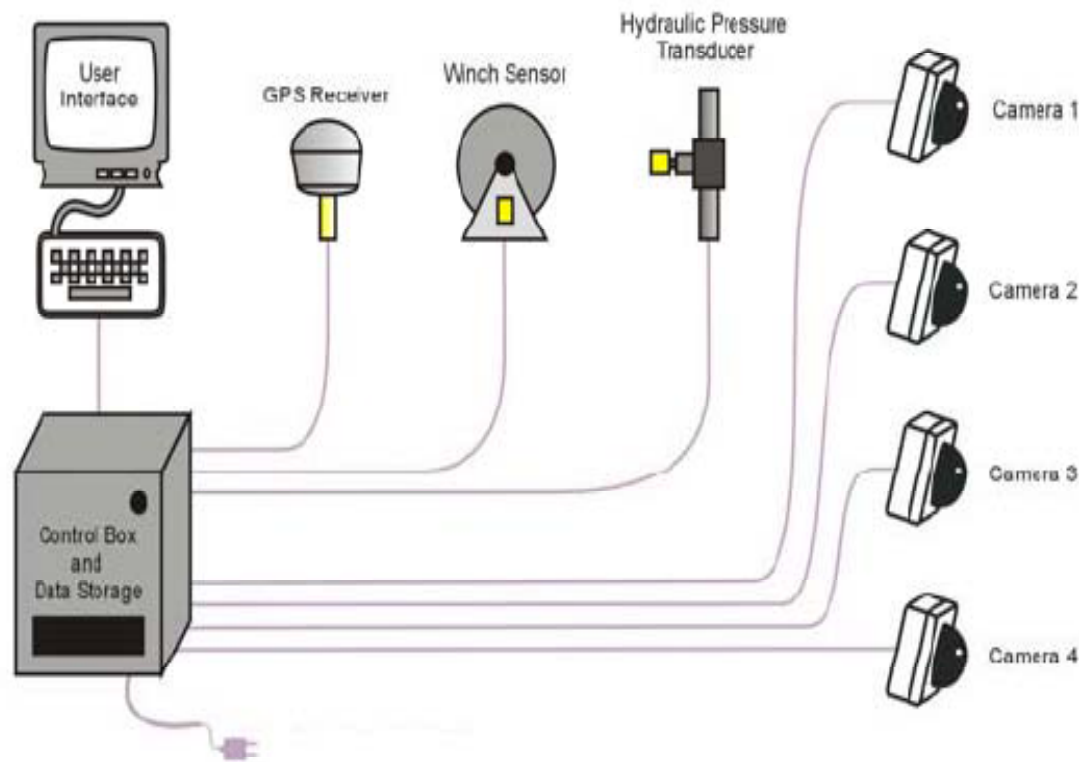
Control Box

Receives inputs from several sensors and stores images and sensor data in a **hard drive**

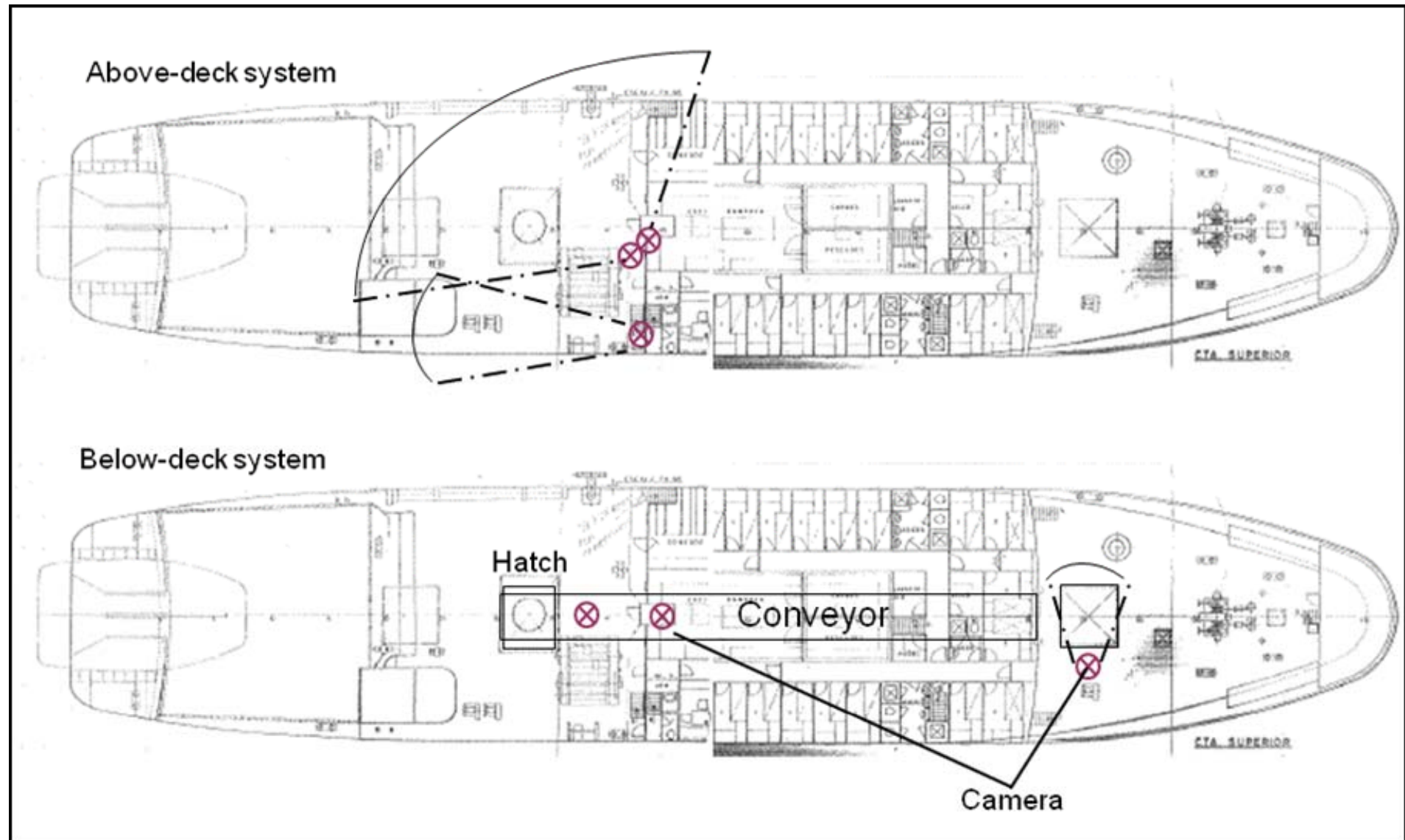## Cameras

Four cameras by box

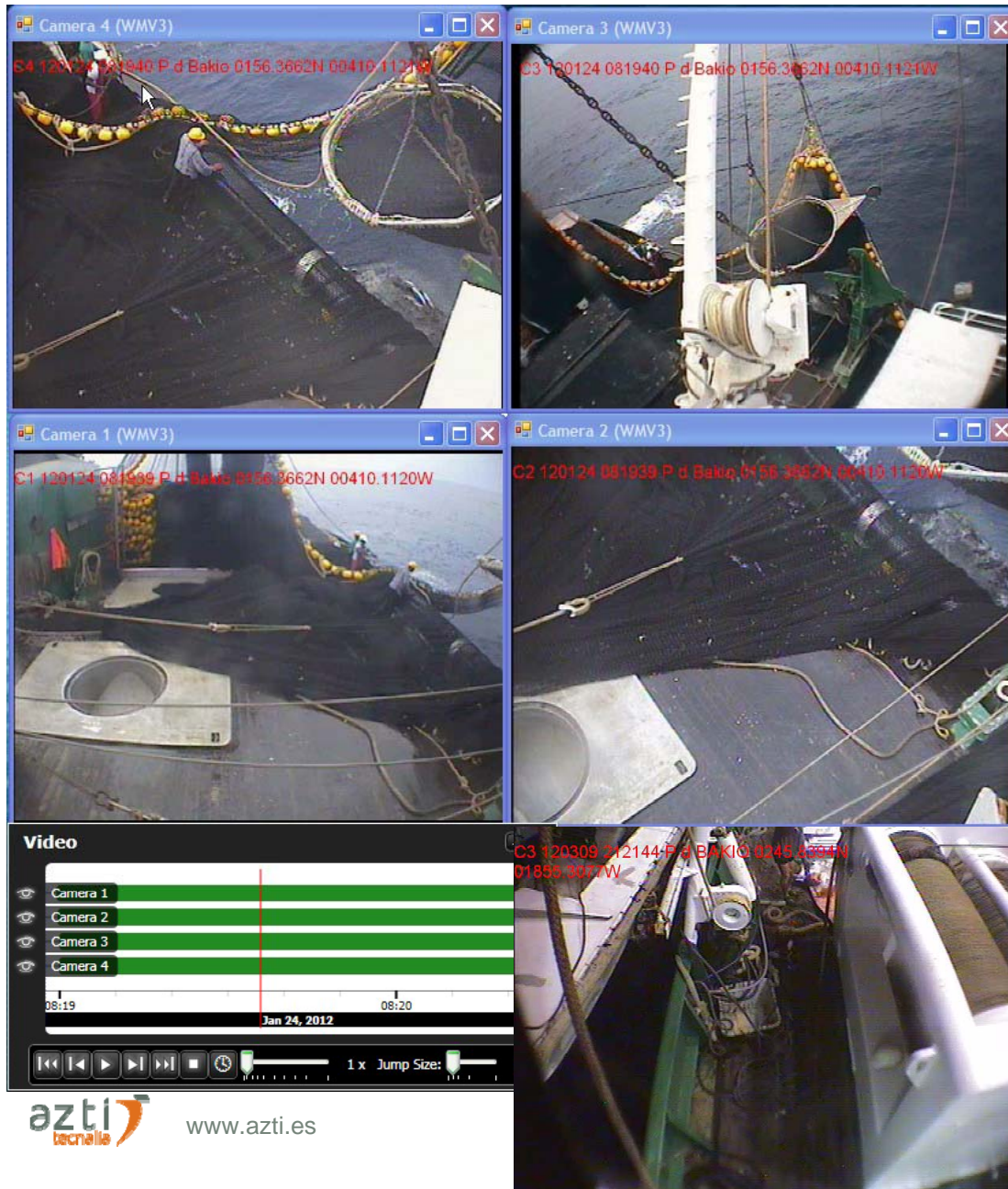## GPS receiver

Position signal each 10 sec.

Sensor

Trigger for turning video recording on

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

EM system

Above-deck system

Below-deck system

Hatch

Conveyor

Camera

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

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Above deck system

EM system

Top deck system

EM system

Top deck 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

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Fish factory system

- **Cameras**

Three cameras
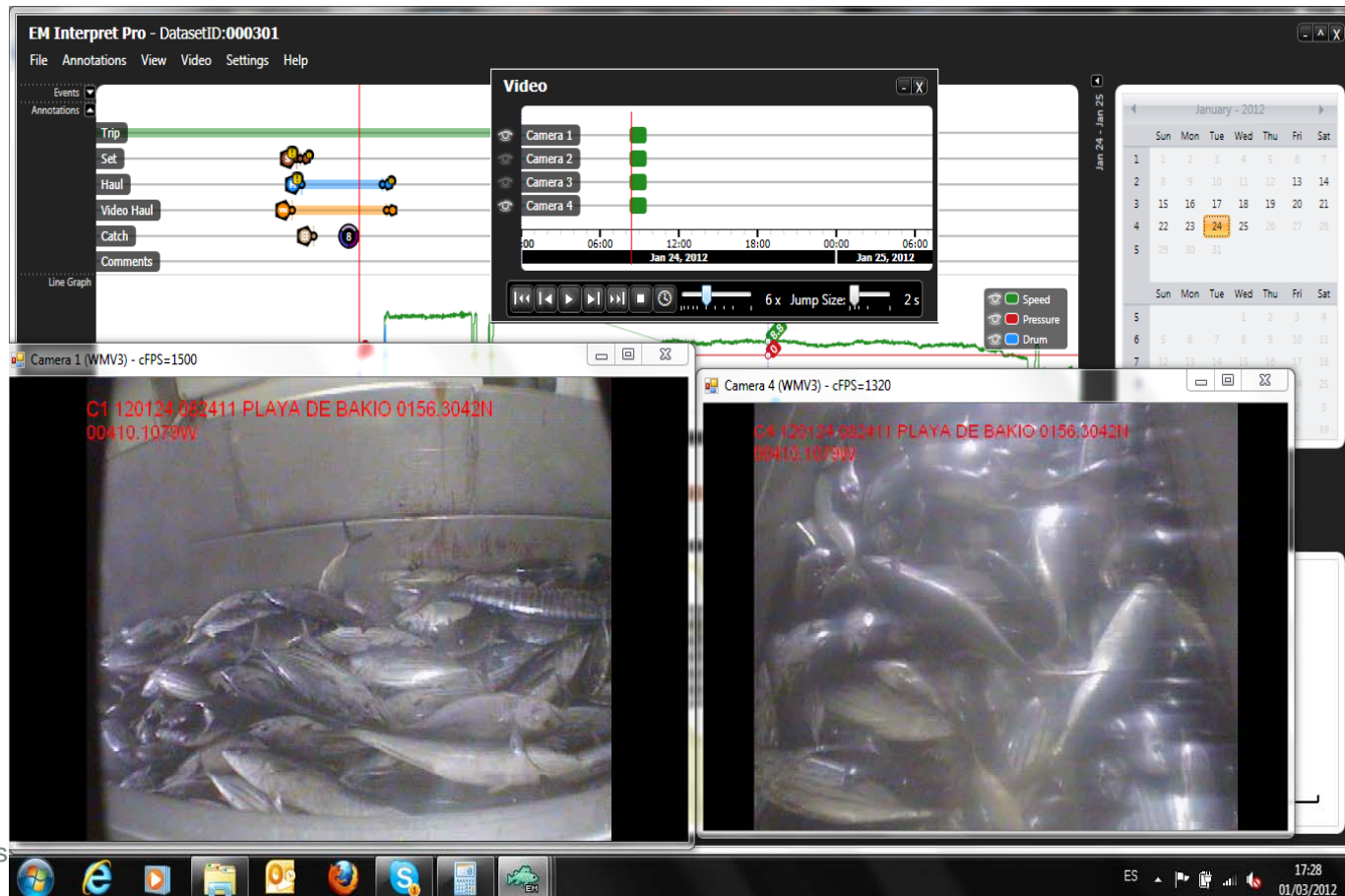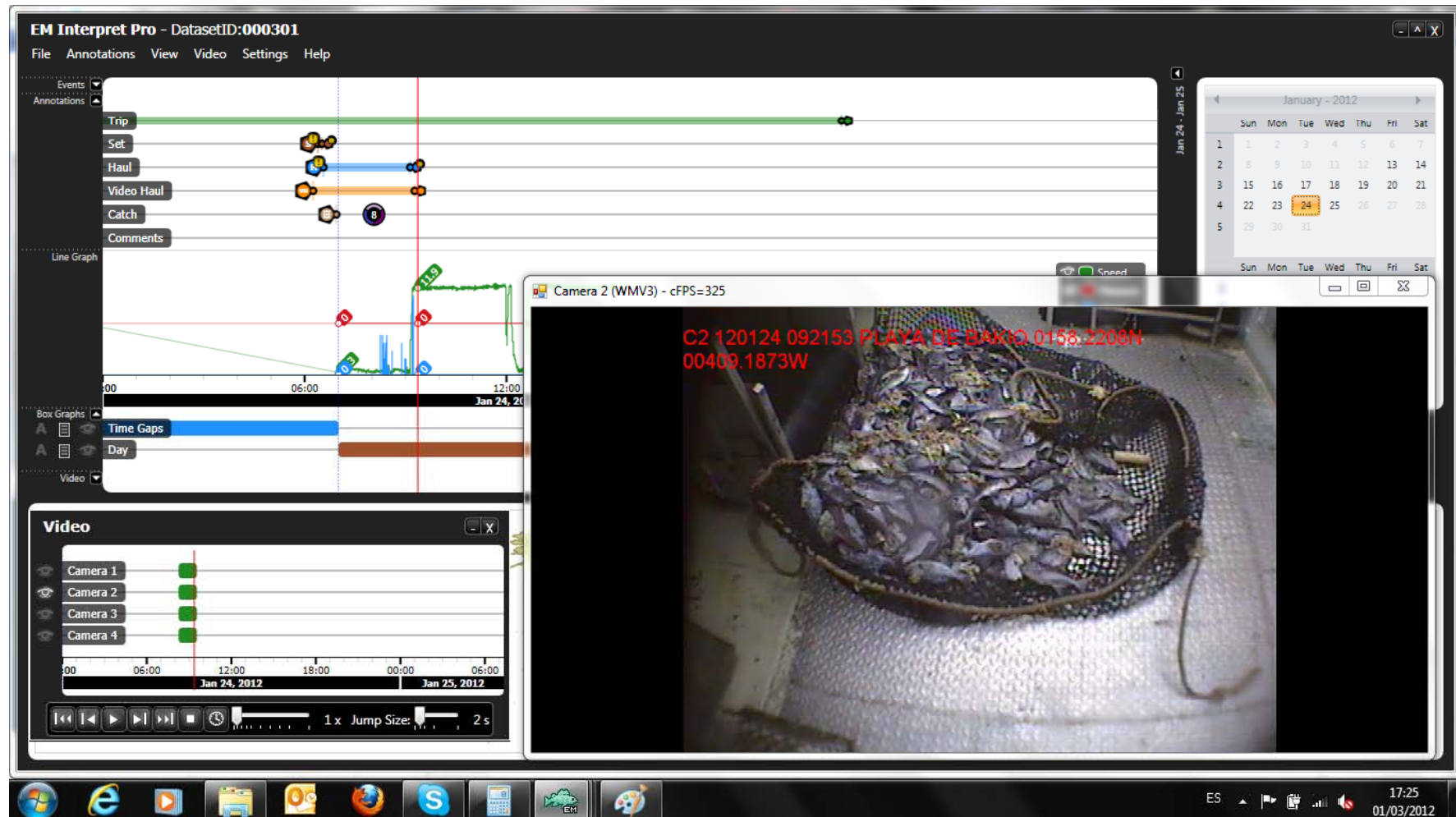
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- **Drum rotation sensor**

  ➢ Trigger for turning video recording on
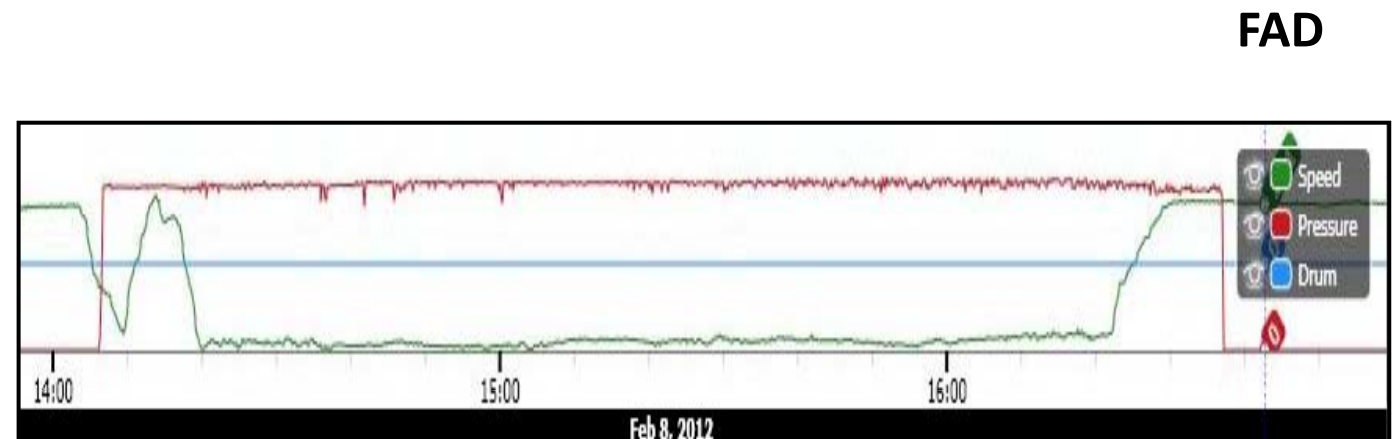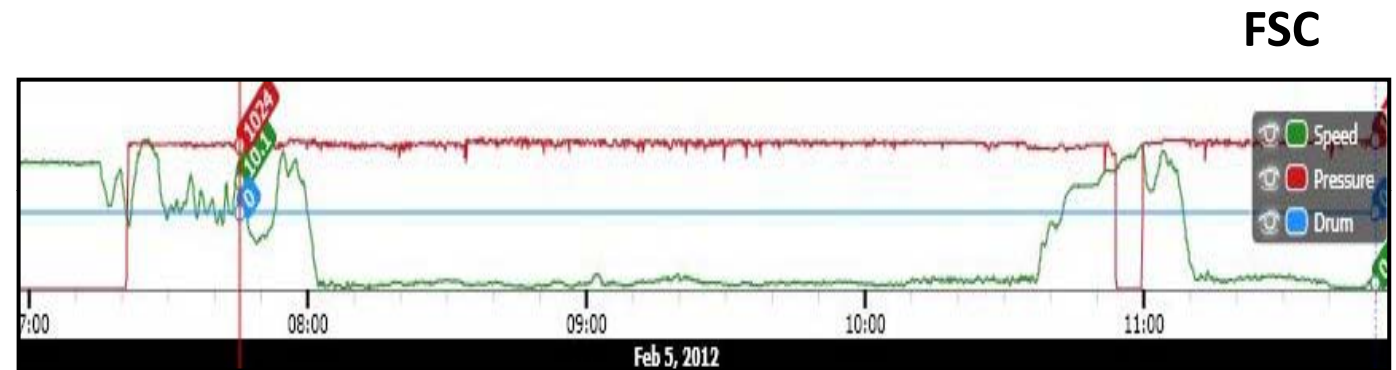
- **Function**

  ➢ Estimate tuna sps. proportion

  ➢ Estimate small size bycatch

Set location and type

EM detected all the sets (61). 60 of them were correctly classified using EM (38 FAD & 23 FSC).

FSC

FAD

Tuna catch

- Estimated median weight of retained **total tuna** per set from EM and observer data indicate that there is **no significant difference** (*n*=61, *p-value* = 0.9202>0.05)

- Estimates of SKJ were overestimated with EM while the estimates of YFT were underestimated. There is a negative correlation, suggesting that the underestimation of YFT could be due to an overestimation of SKJ

- There were significant differences between the estimated proportions of YFT tuna weight from observer and EM in FAD sets, when YFT was a minority species, but there were no differences in free-school sets

Large Bycatch

- There are not significant differences for total **billfishes** (29 obs Vs. 20 EM)

- The estimated median number of individuals of **sharks** were significantly lower from EM (109 obs Vs. 58 EM)

- Same number of **turtles** (2 ind.) were identified with both methods

- Observer constantly identified to higher taxa than EM reviewer.

- McNemar's test results shows that the estimate of presence of *Carcharinidae* (CFA + FCA) species is significantly lower from EM.

	BUM (Makaira nigricans)	SAI (*Istiophorus albicans*)	CFA +FCA (*Carcharinidae*)
statistic.McNemar's chi-squared	0.3333	3	6.4
p.value	0.5637	0.08326	**0.01141***

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 (p = 5.404^{e-07}<0.05) (15,007 obs Vs. 3,801 EM).
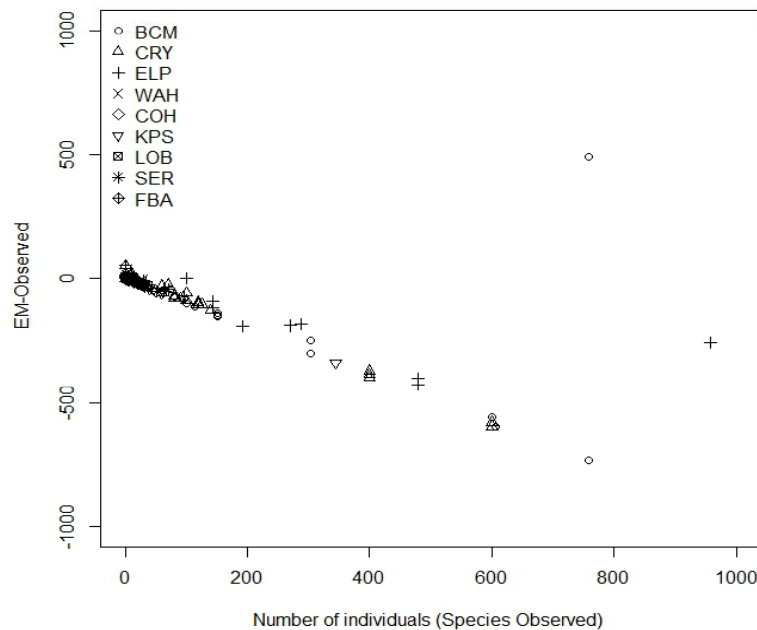
Why Were Observer and EM Estimates Different ?

- Both observer and EM results are estimates

- Main differences came from the below deck area (small size bycatch & retained tuna sp %)
  - ➢ 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).
    - ✓ 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.

Reviewing time

- The review of EM data in the project was done by recently trained Azti-technalia staff, who had experience as observers, but no previous experience with EM.

- Although viewer experience was not tested in this project, it is a third factor that likely affects review time. In any case, the mean review time per set did not exceed 1.25 hrs. for any sets, suggesting that EM may be an economical monitoring method, provided that high quality data are collected.

- EM can be used to determine, as reliably as observers:
  - ✓ fishing effort (number of sets)
  - ✓ set-type
  - ✓ tuna catch
  - ✓ Large size by catch

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

- The development of an EM program would require a set of monitoring objectives that are based on the capabilities and limitations of the technology.

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