Behaviour of fish aggregations assessed using fishers' echosounder buoys

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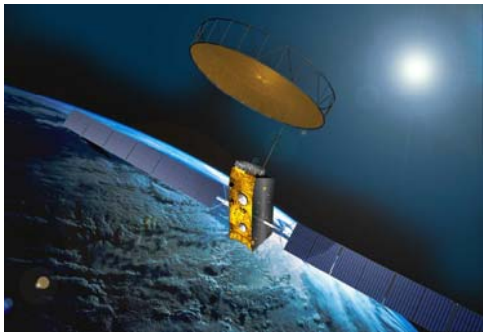
CONCEPTUAL TROPICAL TUNA FAD FISHERY

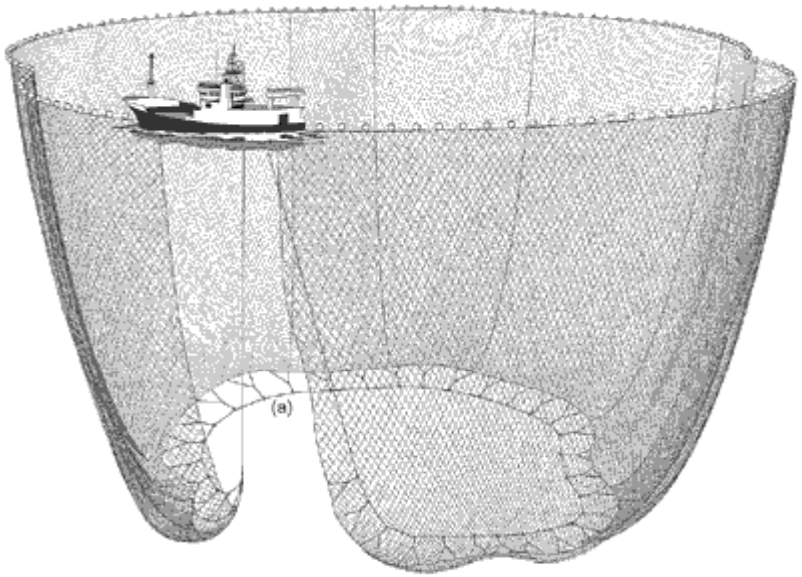
4000-5000 buoys/year IO

30% Sounder Buoys



5 tons

Biomass estimates



15 tons

60 tons

OBJECTIVES

1) To study the **BEHAVIOUR OF DIFERENT SPECIES** associated to FADs and possible relationship with both abiotic and biotic factors.

2) Use this knowledge to help **MINIMAZING BYCATCH**.

MATERIAL AND METHODS

HOW IS THE DATA THREATED?

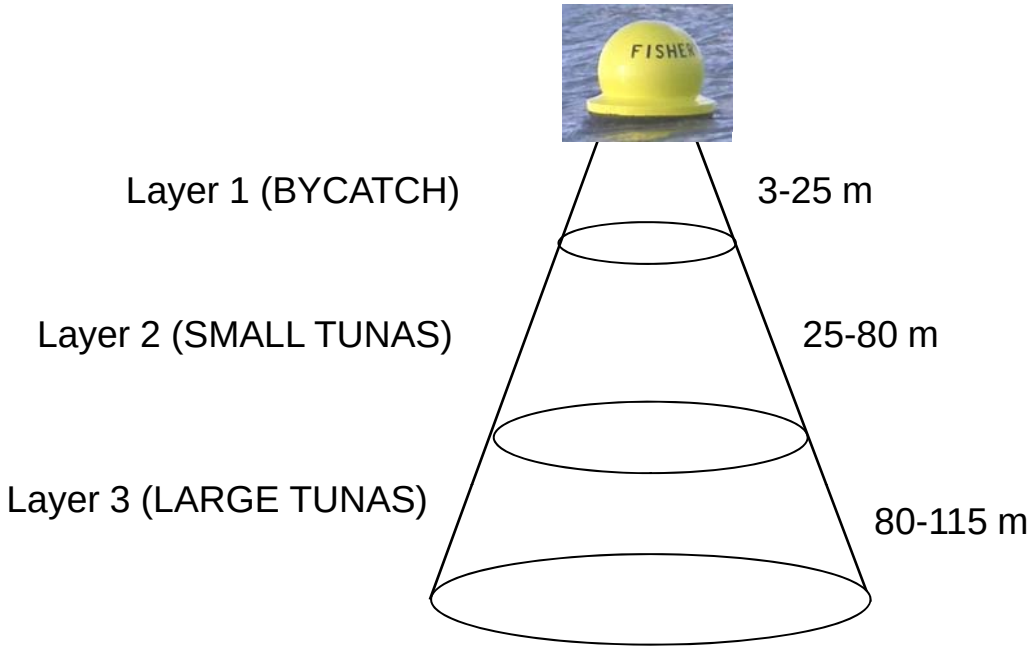
DATA COLLECTION

↓

QUALITY CONTROL

↓

DATA ANALYSIS



ADD OCEANOGRAPHYC DATA:

- ABIOTIC:
  - SST / SubTemps / Thermocline data.
  - SLA
  - WG /WT
- BIOTIC:
  - Chl.A / Chl.A 14
  - P/A of other species/groups

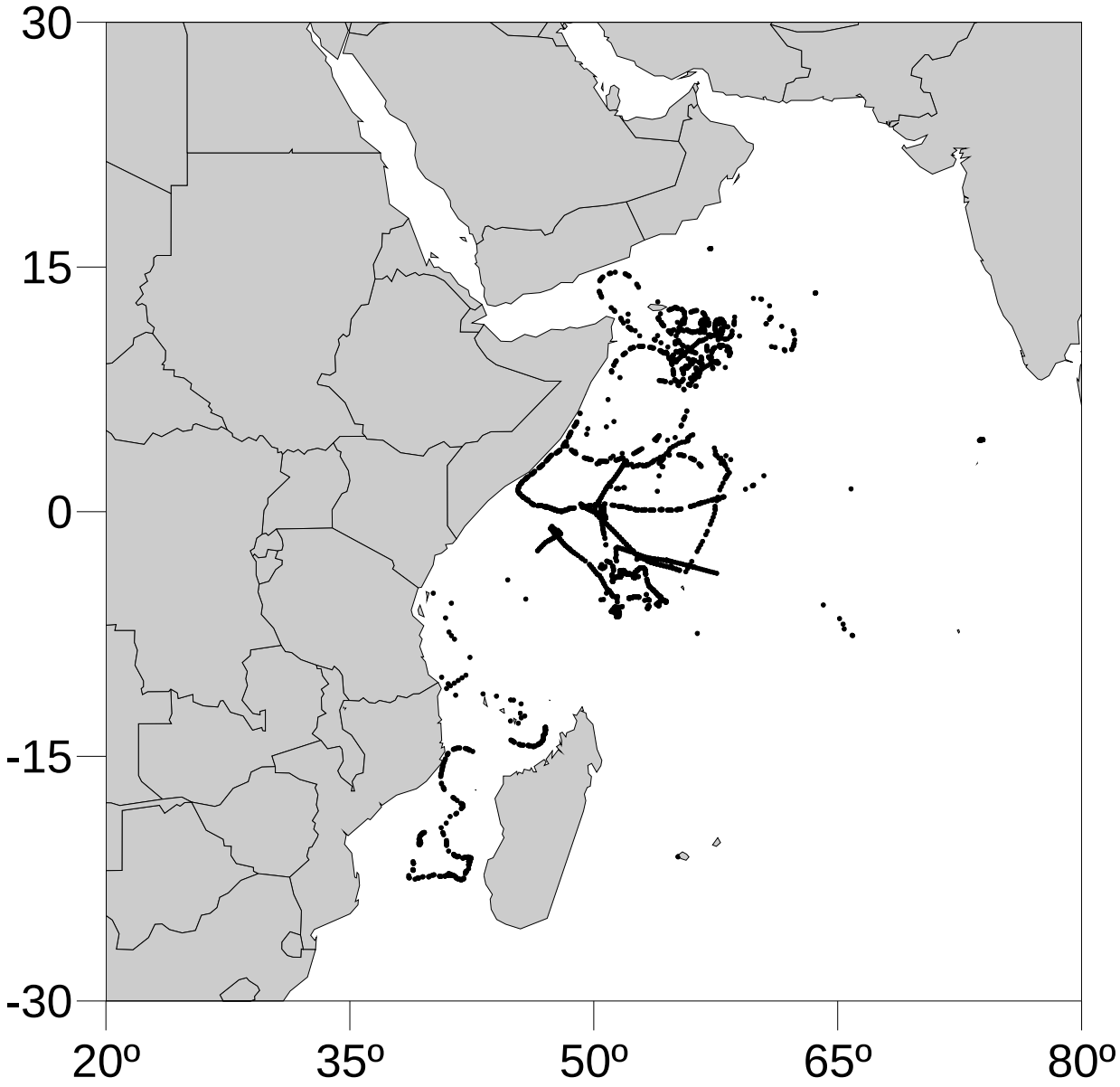
GENERAL ADDITIVE MODELS (GAMs)

- PRESENCE/ABSENCE
  - Binomial
  - Logit link function
- BIOMASS AMOUNT:
  - Gaussian
  - Identity link function

MATERIAL & METHODS

DATA COLLECTION: INDIAN OCEAN

- Nb of buoys: 25
- Nb of samples: 3300
- Observation days: 500
- Period: 2008-2011
- Oceanographic data:
  - ➢ ABIOTIC:
    - SST / SubTemps / Thermocline data.
    - SLA
    - WG /WT
  - ➢ BIOTIC:
    - Chl.A / Chl.A 14
    - P/A of other species/groups



MATERIAL & METHODS

DATA COLLECTION: ATLANTIC OCEAN

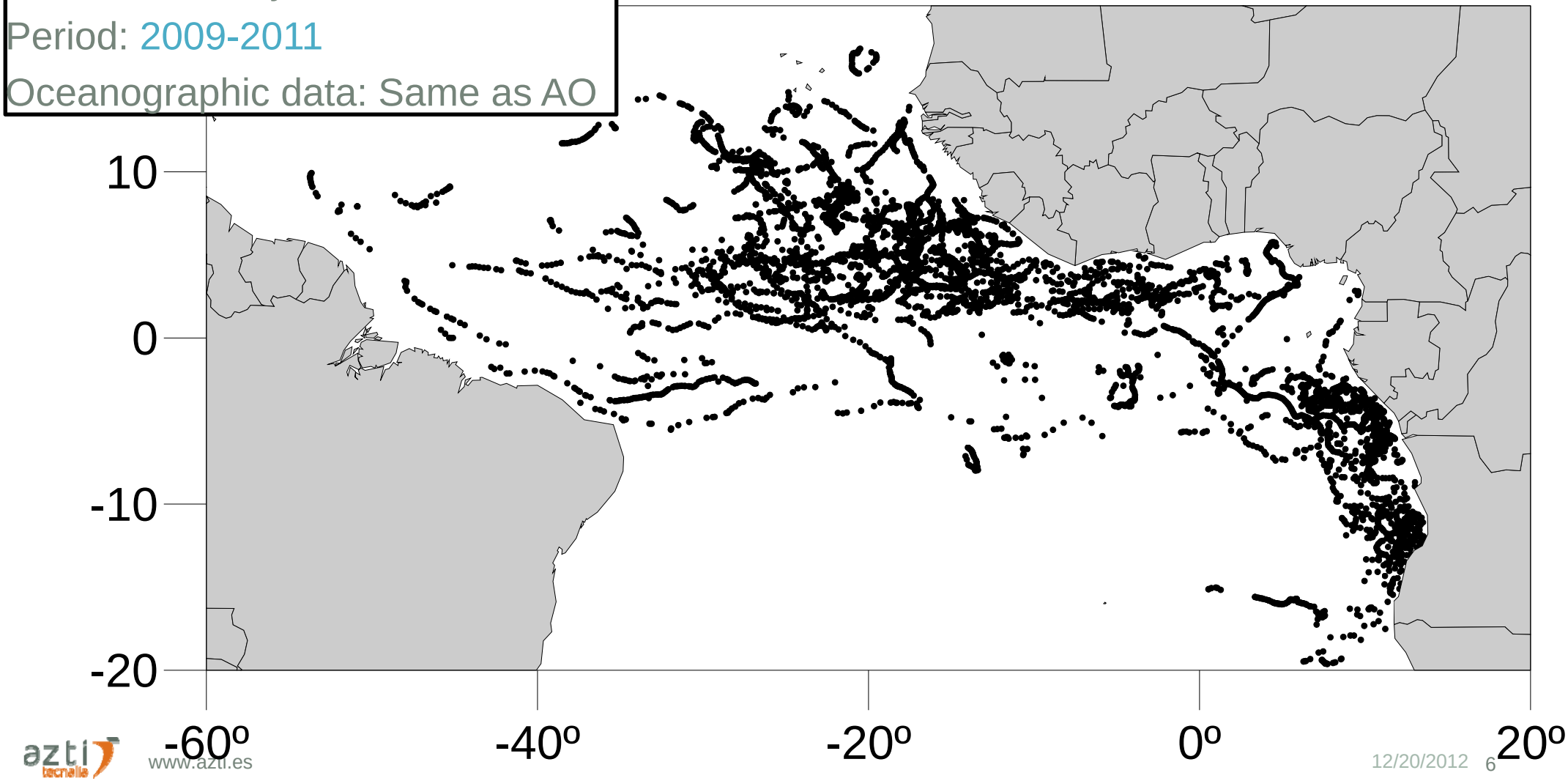
Nb of buoys: 250

Nb of samples: 5100

Observation days: 4000

Period: 2009-2011

Oceanographic data: Same as AO



RESULTS / DISCUSSION

PRESENCE / ABSENCE VS ENVIROMENTAL FACTORS

INDIAN OCEAN

	PAL1	PAL2	PAL3	PASum
Buoy	21.90%	36.00%	37.90%	42.10%
Month	3.60%	19.40%	12.80%	24.30%
Time	1.60%	13.80%	3.50%	13.00%
Lat	19.00%	20.00%	24.00%	22.40%
Long	14.00%	15.10%	8.90%	16.00%
SST	5.70%	16.00%	4.40%	23.10%
SLA	5.60%	8.90%	12.00%	6.60%
TimeSea	5.50%	12.40%	5.70%	7.60%
Depth	4.00%	7.30%	4.90%	7.70%
WG	1.10%	7.40%	12.50%	3.90%
WT	1.30%	7.20%	2.60%	3.60%
ChlA	2.90%	9.00%	9.40%	11.00%
ChlA14	4.80%	8.70%	8.10%	7.50%
Therm.Depth	2.90%	6.40%	7.90%	5.30%
Therm.Grad	2.10%	9.80%	8.20%	4.10%
T30	3.30%	9.70%	14.90%	15.50%
T75	0.90%	9.70%	7.10%	6.20%
T100	1.70%	7.10%	4.50%	3.60%
L1	NA	0.30%	0.00%	NA
L2	NA	NA	3.90%	NA

ATLANTIC OCEAN

	PAL1	PAL2	PAL3	PASum
Buoy	22.90%	24.30%	39.50%	37.30%
Month	2.80%	5.20%	8.70%	7.30%
Time	2.50%	9.70%	8.10%	34.40%
Lat	7.70%	9.40%	9.30%	1.70%
Long	5.40%	12.60%	17.20%	4.70%
SST	7.00%	11.00%	13.20%	1.40%
SLA	2.00%	7.00%	6.90%	1.60%
TimeSea	1.30%	3.80%	4.50%	9.90%
Depth	1.30%	4.30%	3.20%	2.10%
WG	0.40%	0.40%	0.80%	0.30%
WT	0.20%	0.60%	1.20%	0.90%
ChlA	6.20%	12.00%	12.10%	1.90%
ChlA14	4.40%	10.80%	11.70%	1.90%
Therm.Depth	3.00%	2.90%	2.50%	0.50%
Therm.Grad	5.00%	6.40%	10.20%	1.70%
T30	9.30%	10.20%	10.80%	1.70%
T75	2.10%	2.50%	4.40%	2.50%
T100	0.10%	0.40%	3.00%	2.80%
L1	NA	1.00%	0.10%	NA
L2	NA	NA	11.50%	NA

RESULTS / DISCUSSION

BIOMASS AMOUNT VS ENVIROMENTAL FACTORS

INDIAN OCEAN

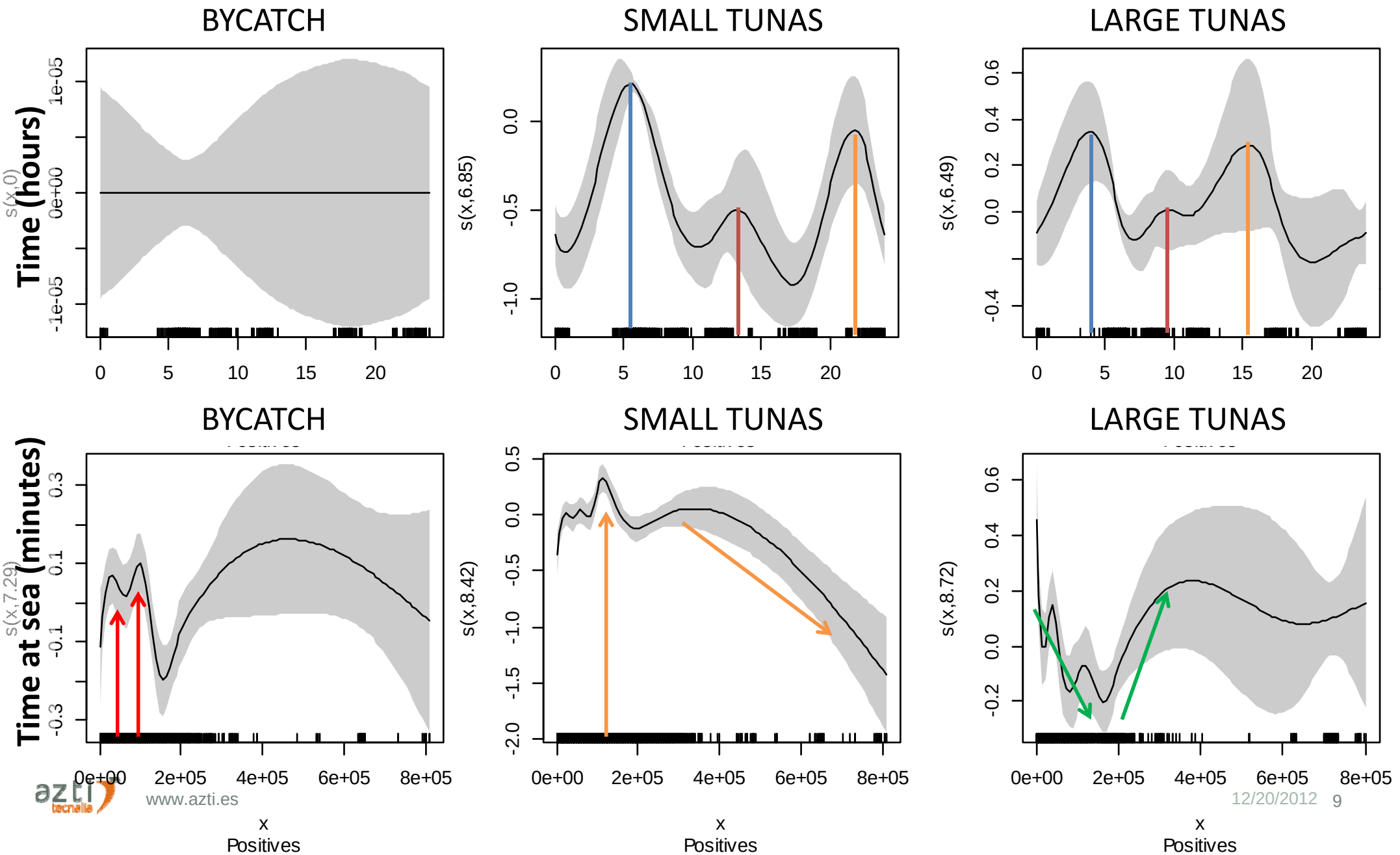
	lL1	lL2	lL3	lSum
Buoy	3.40%	12.40%	52.30%	40.50%
Month	3.20%	8.40%	10.20%	11.00%
Time	2.60%	2.70%	5.20%	12.50%
Lat	1.90%	10.60%	29.70%	22.00%
Long	2.60%	11.60%	25.80%	20.80%
SST	1.80%	10.40%	18.50%	20.10%
SLA	2.40%	5.80%	5.90%	6.30%
TimeSea	4.20%	4.10%	11.60%	8.80%
Depth	0.00%	5.70%	9.60%	5.70%
WG	0.70%	1.70%	1.60%	5.50%
WT	0.20%	1.70%	6.00%	6.20%
ChlA	3.20%	1.90%	4.60%	7.80%
ChlA14	2.60%	2.30%	15.40%	11.60%
Therm.Depth	2.60%	7.50%	12.40%	7.90%
Therm.Grad	0.20%	2.00%	9.10%	7.00%
T30	0.00%	6.20%	10.60%	9.30%
T75	1.10%	1.30%	7.50%	8.00%
T100	0.60%	5.90%	8.60%	9.40%
PAL1	NA	4.30%	5.10%	NA
PAL2	NA	NA	31.60%	NA

ATLANTIC OCEAN

	lL1	lL2	lL3	lSum
Buoy	10.90%	34.80%	42.60%	48.20%
Month	2.30%	5.00%	8.50%	13.90%
Time	0.00%	8.30%	1.60%	14.20%
Lat	0.40%	9.20%	4.50%	15.10%
Long	0.90%	10.20%	5.10%	17.60%
SST	0.40%	2.00%	4.50%	12.60%
SLA	1.10%	3.40%	7.00%	10.90%
TimeSea	3.30%	2.40%	3.40%	5.90%
Depth	1.40%	4.10%	10.40%	4.80%
WG	0.40%	0.00%	1.90%	0.20%
WT	0.60%	2.40%	1.10%	2.20%
ChlA	1.60%	2.10%	3.20%	14.20%
ChlA14	1.10%	2.30%	2.30%	14.20%
Therm.Depth	1.20%	7.10%	7.40%	7.90%
Therm.Grad	0.20%	3.70%	2.30%	8.30%
T30	2.50%	1.60%	1.10%	12.20%
T75	0.50%	6.50%	6.50%	6.40%
T100	1.30%	4.00%	6.80%	2.40%
PAL1	NA	1.10%	0.30%	NA
PAL2	NA	NA	4.50%	NA

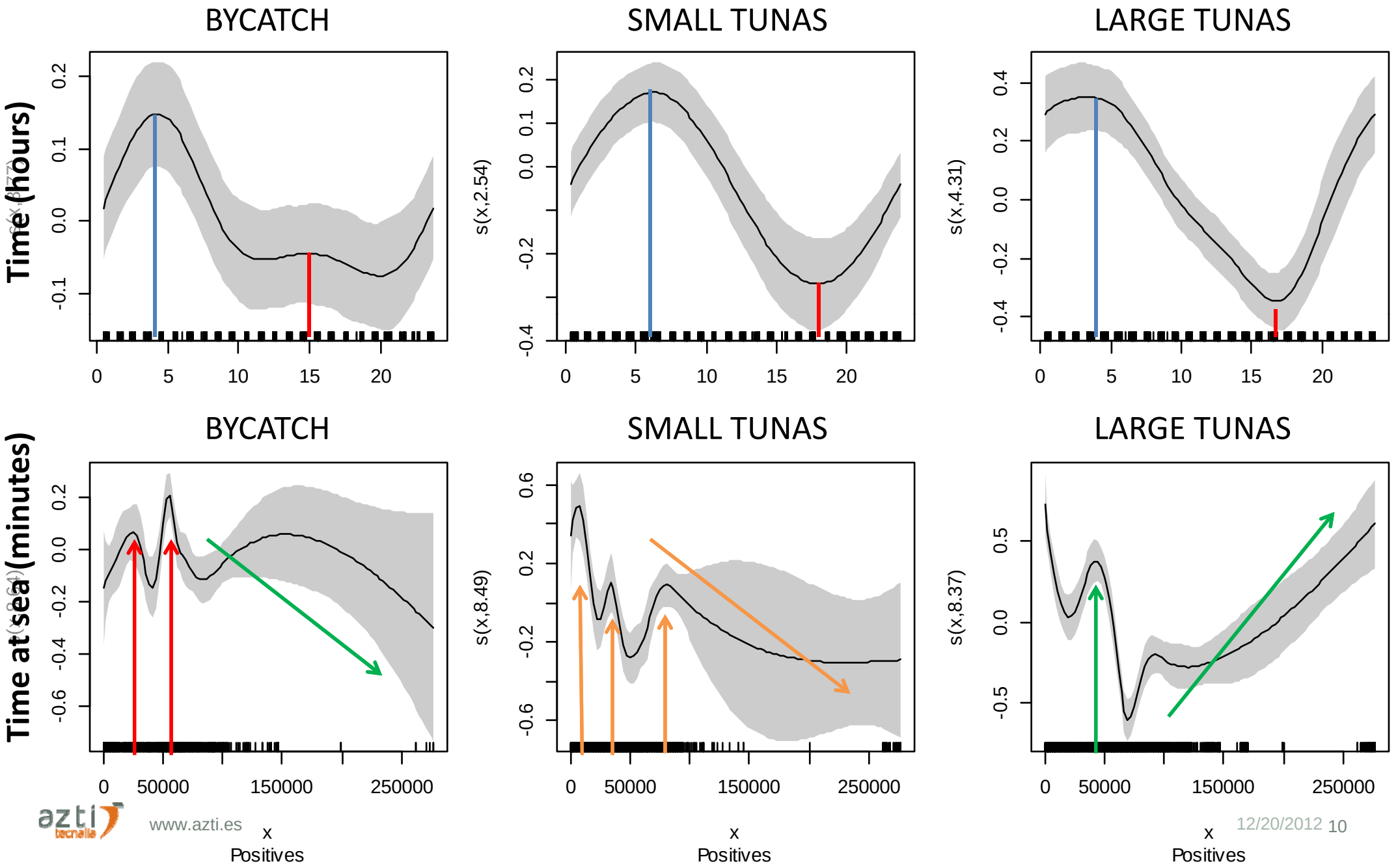
RESULTS / DISCUSSION

TEMPORAL VARIABLES EXPLAINING BIOMASS CHANGES IN THE ATLANTIC OCEAN



RESULTS / DISCUSSION

TEMPORAL VARIABLES EXPLAINING BIOMASS CHANGES IN THE INDIAN OCEAN



CONCLUSIONS

SUMMARY OF MAIN CONCLUSIONS ON FISH BEHAVIOUR RELATED TO ENVIRONMENT

- Abiotic factors seem to explain better the presence/absence of the fish in deeper layers (both AO/IO).
- Biotic variables explain better biomass variability of fish in deeper layers (IO).
- By-catch presence and amount was not driven by environment factors.

CONCLUSIONS

SUMMARY OF MAIN CONCLUSIONS ON POTENTIAL BY-CATCH MITIGATION

- By-catch mitigation measures should be ocean specific since behaviour is ocean-dependent.
- By-catch/Tuna biomass ratio variability during the day could be used as a potential mitigation measure in the Indian Ocean.
- FAD underwater structure could be relevant for the attraction of large tunas.
- Young objects (<30 days) seem to aggregate both bycatch and small tunas. Large tunas could present a stronger relationship with older objects.

WHAT'S NEXT?

FUTURE STEPS

- Buoys is always a good descriptor. Does it mean that we are losing some important variable?
- Improve models and, make predictions?
- Further investigation on:
    - Bycatch. Identify Hotspot.
    - Areas/seasons?
- Increase sampling in Indian Ocean.
- Continue collaboration with fishers and industry.
- Keep on looking for best fishing practices.