



DISCATCH: Pilot project Catch and discard composition including solutions for limitation and possible elimination of unwanted by-catches in trawl net fisheries in the Mediterranean

WP2. Data Collection Framework

Task 2.2. Discards Modelling

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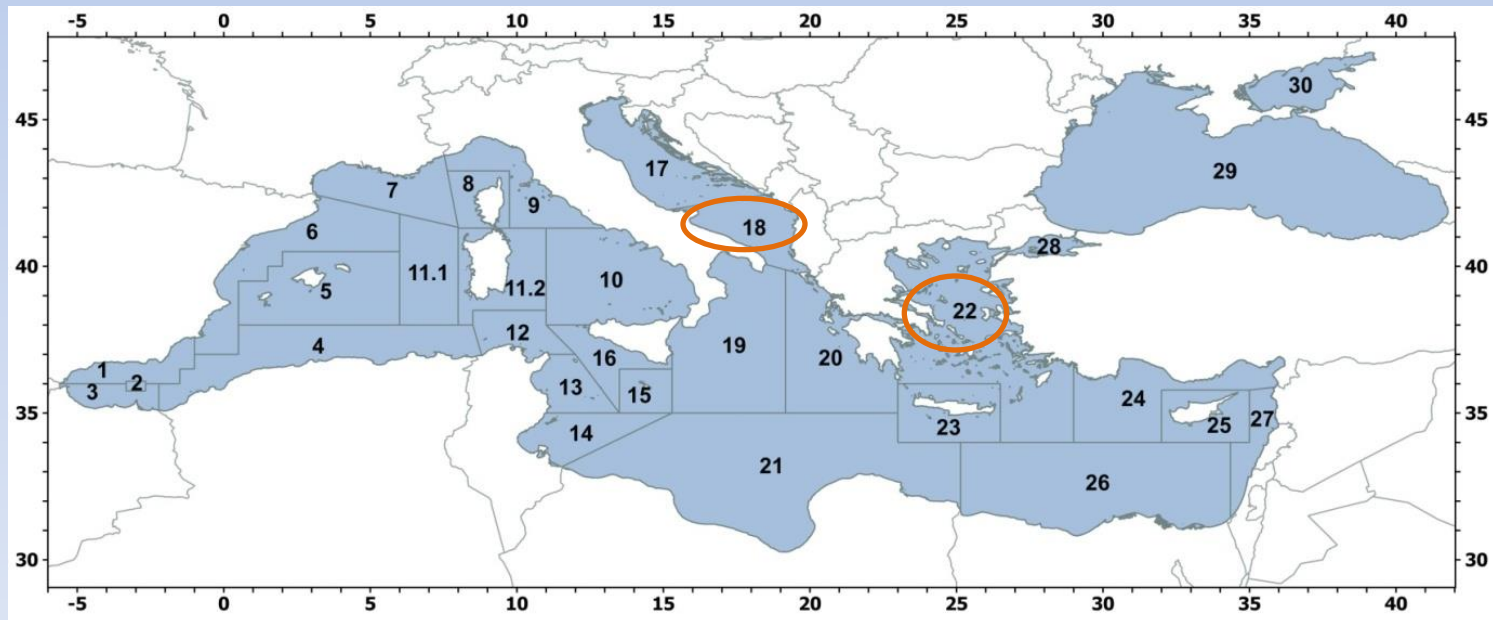
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The aim of the task is to **use modelling to identify factors affecting discarding** based on observer on-board data from the investigated study areas of the Southern Adriatic Sea (General Fisheries Commission for the Mediterranean GFCM - Geographical Sub-Area 18) and Aegean Sea (GFCM - GSA 22).

The modelling was accomplished using Generalised Additive Models (GAMs).

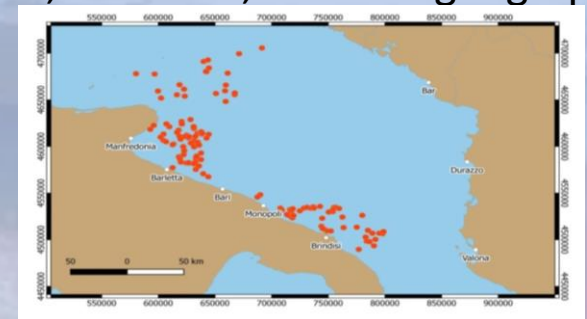


Data and sampling methods for GSAs 18 & 22

For the **Italian Fleet**, data were collected **monthly by observers on board commercial trawlers** (western side fleet) within the Data Collection Framework (DCF).

A total of **17 vessels**, representative for the fishing practices, the sizes, and the geographic locations, were sampled monthly from **2010 to 2013**.

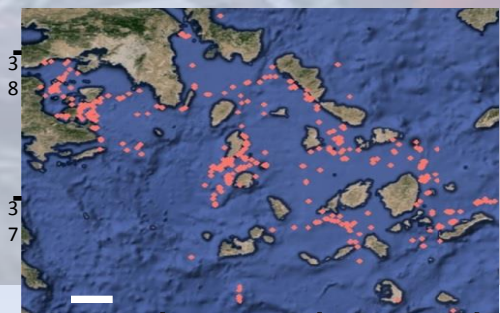
Each fishing trip lasted one or two days.



For the **Greek Fleet**, the analysis was based on data collected **seasonally by observers on board commercial trawlers from 1996 to 2008** in the frame of the data collection programs in Greek waters, while no sampling was carried between 2000 and 2003.

In each sampling period at least two commercial vessels representative of the study area (vessel size & construction) were randomly selected.

Each fishing trip lasted one day.



Sampling records of:

- Total catch (separated to commercial and discards) & faunal composition to species level.
- Duration and position of each haul.
- Total catches standardized to hourly yields (kg h^{-1}) or abundances ($n \text{ h}^{-1}$).
- Individual size

The species under study:

- *Deep-water rose shrimp - Parapenaeus longirostris*
- *Hake - Merluccius merluccius*
- *Red mullet - Mullus barbatus*
- *Horse mackerel - Trachurus trachurus*
- *Norway lobster - Nephrops norvegicus*

Because of the big number of zero discard in the data, *M. barbatus* and *N. norvegicus* have not been further analysed.

Species	Years	Number of fishing trips
<i>M. merluccius</i>	2010-2013	133
<i>T. trachurus</i>	2010-2013	108
<i>P. longirostris</i>	2010-2013	101

Discards volume (DPUE, tons/trip) and **discards ratio** were explored using GAMs.

The analysis was carried out **by fishing trip** each spanning over one or two days.

Explanatory variables used to model the GSA 18 discard data were:

- Year
- Mean length in the catch (of the examined species)
- Mean fishing position (latitude, longitude)
- Mean depth
- Total catch (kg)
- Total catch of the species (kg)
- Month
- Number of hauls performed
- Vessel

DPUE and **discards ratio** were explored using Generalised Additive Models.

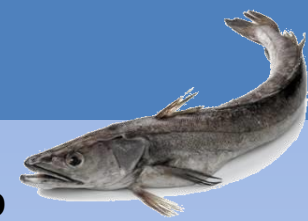
The analysis was carried out **by haul**.

Explanatory variables used to model the GSA 22 discard data were:

- Year
- Mean length in the catch (of the examined species)
- Fishing position (Latitude & Longitude)
- Depth
- Total catch (kg)
- Marketable catch (of the examined species, kg)
- Season (Spring, Summer, Autumn)
- Haul duration

Factors identified as significant in affecting discards of each species

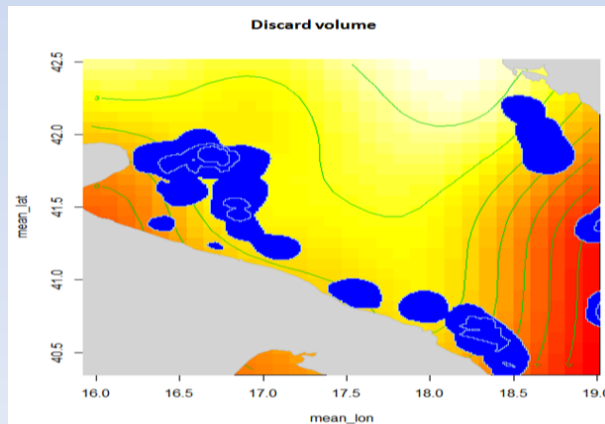
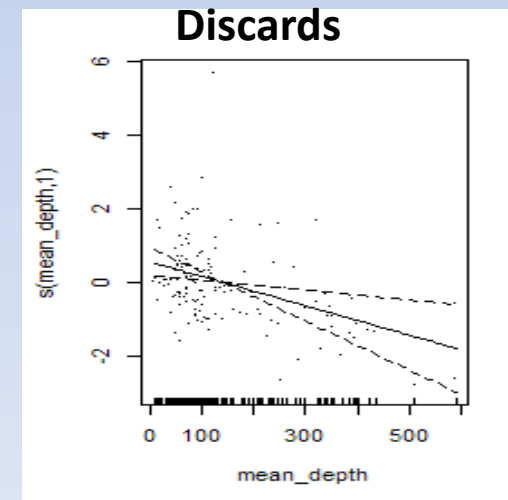
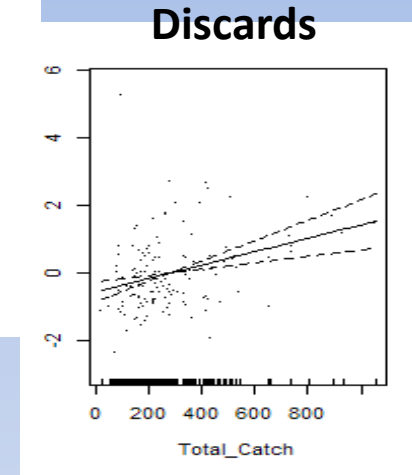
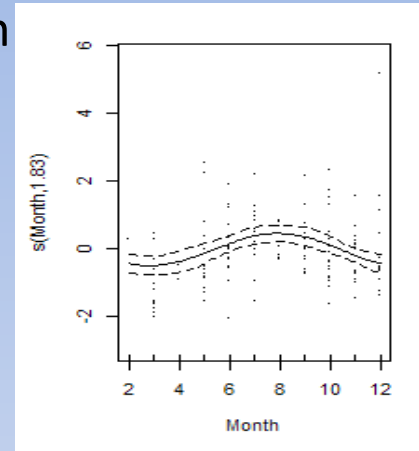
Model Parameters	HKE Discard	HKE Ratio	DPS Discard	DPS Ratio	HOM Discard	HOM Ratio
Year	X	X	X		X	
Month	X	X		X	X	
Latitude	X	X			X	X
Longitude	X			X	X	X
Fishing depth	X	X				
Haul duration						
Mean length in the catch		X	X	X		X
Vessel	X		X	X	X	
Total catch	X		X		X	X
Total catch of the species		X		X	X	X
Number of hauls			X	X		
Dev. Expl. (final model)	73.4%	60.8	50.6%	85.4%	71.1%	62.9%
Number of fishing trips	133	133	101	101	108	108



According to the GAM models :

- The **DPUE** and the **discard ratio increased** from June to August, consistently with the late spring – summer **recruitment peak**.
- The **DPUE increased** with increasing **total catch**.
- the **DPUE increased** in areas where recruits exist (between 100 and 200m).
- The geographical locations of **higher estimated discard volume** seem to have some overlapping with the **nursery area** identified within MEDISEH project.

Discards and Discards Ratio

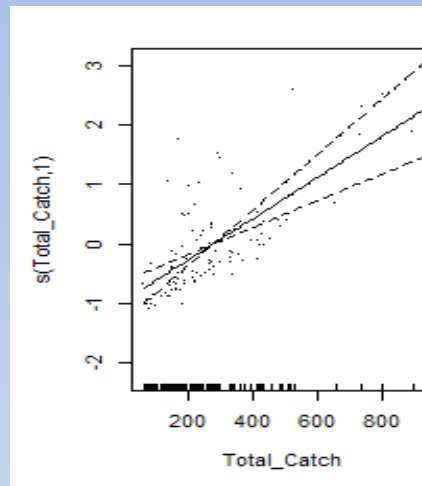




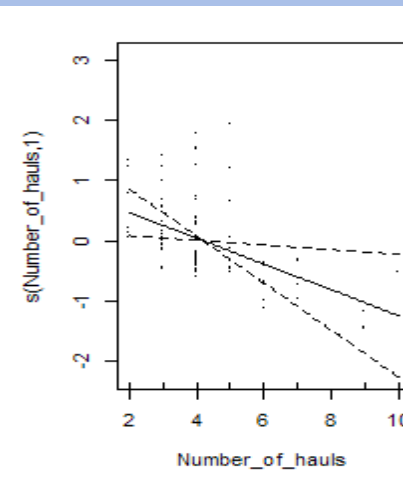
According to the GAM models :

- The **DPUE increased** with **total catch**.
- The **discard ratio increased** from May to July consistently with the **recruitment period** for this species in the area;
- **DPUE decreased** as the **mean length** of the catches **increases**
- **Discard ratio decreased** with the **increasing number of hauls** performed during the fishing trip.

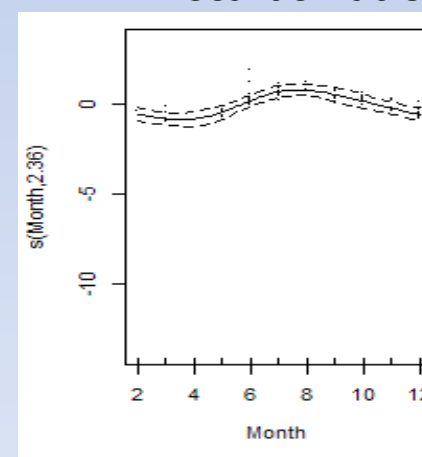
Discards



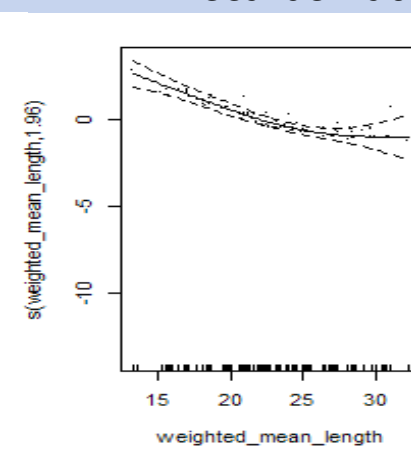
Discards

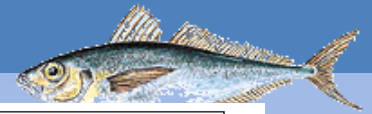


Discards Ratio



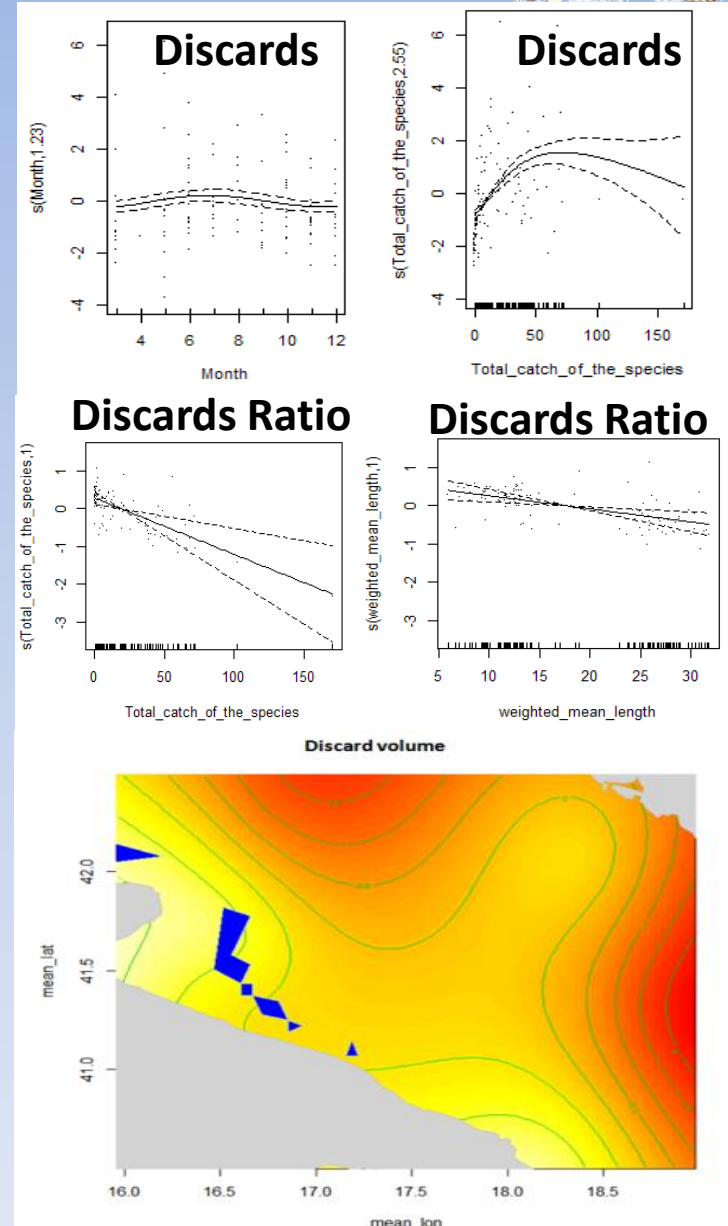
Discards Ratio





According to the GAM model:

- The **DPUE is higher** in summer, consistently with the **recruitment peak** of the species.
- **Positive relationship** between DPUE and **total catch of the species**, but negative relationship between discard ratio and total catch of the species.
- The **discard ratio decreased with increasing mean length** of *T. trachurus* in the catches.
- The geographic locations with **higher discard volumes** estimated by the best GAM seem to be consistent with the **nursery areas** identified by the MEDISEH project.

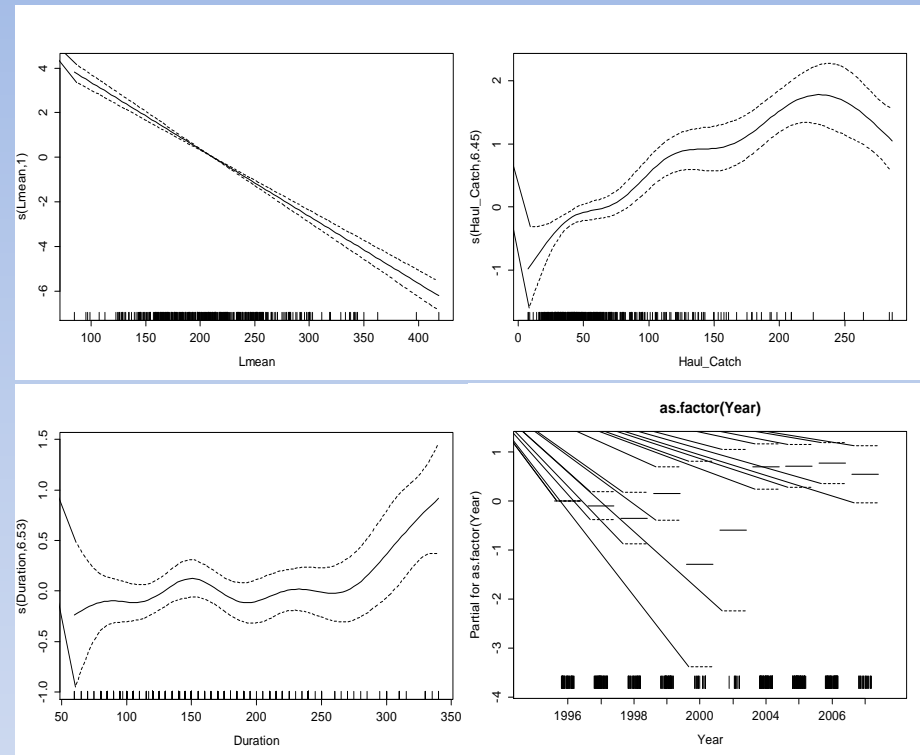


Factors identified as significant in affecting discards of each species

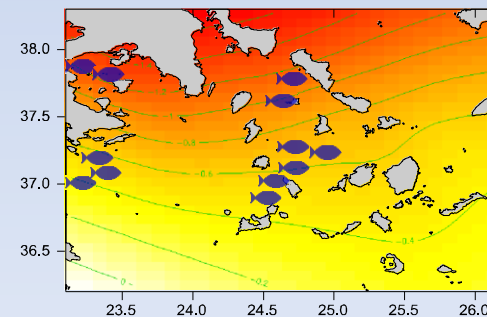
Model Parameters	HKE DPUE	HKE Ratio	DPS DPUE	DPS Ratio	HOM DPUE	HOM Ratio
Marketable catch of species	X	X	X	X		X
Geog. Coordinates (Lat,Lon)	X	X	X	X	X	
Fishing depth			X	X		
Haul duration	X					X
Mean length in the catch	X	X			X	X
Haul catch size	X	X	X	X	X	
Year	X	X	X	X	X	
Season			X	X		
Dev. Expl. (final model)	88.90%	74.90%	81.80%	89.20%	63.30%	67.70%
Number of hauls	426	426	102	102	175	158




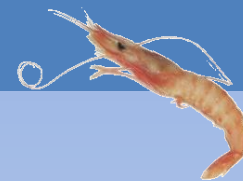
- The **DPUE** and the **discard ratio** decreased as the **mean length** of hake in the catch increased.
- In **hauls of high duration** & of **high total catch** the **DPUE** and **discards ratio** increased.
- An increase in DPUE of hake is identified from 2003 to 2008
- **Spatial differences in hake DPUE** follow a gradual increase in a S-SW direction within the limits of the study area. (Red = less discards)
- Certain **overlap of discard hot spots with nursery areas** (MEDISEH).



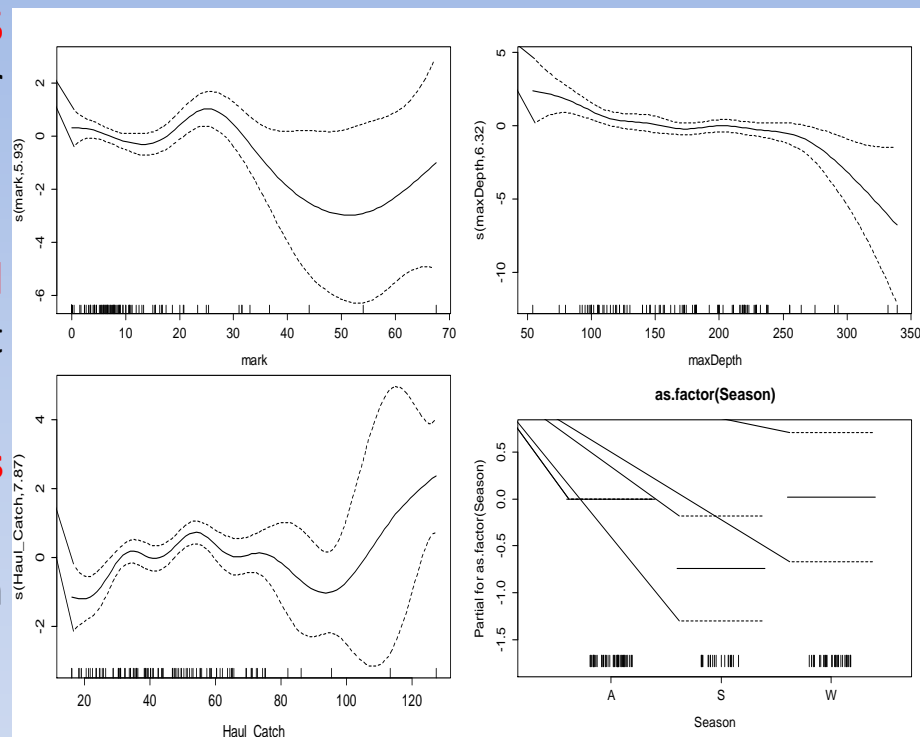
DPUE



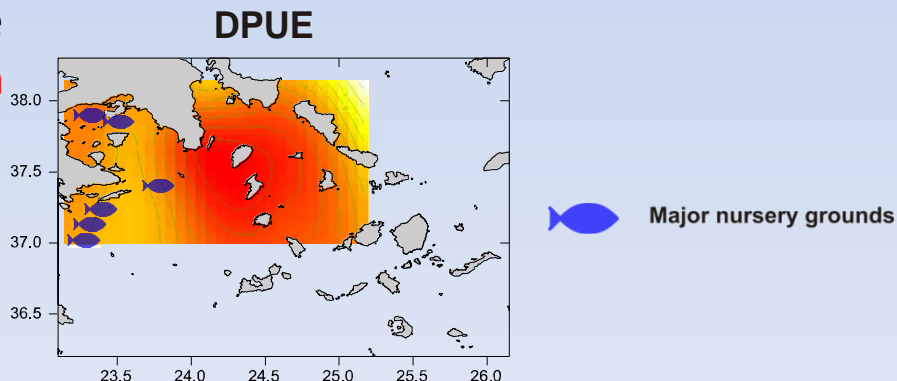
 Major nursery grounds



- DPUE and the discard ratio of DPS decreased as the marketable deep-water rose shrimp (DPS) fraction increased
- DPUE & discard ratio decreased with depth
- Total haul catch as well as inter-annual differences were found significant without however presenting clear patterns.
- There was an indication that less discarding of DPS took place in spring.
- Lower discards of DPS were modelled in the centre of the study area.

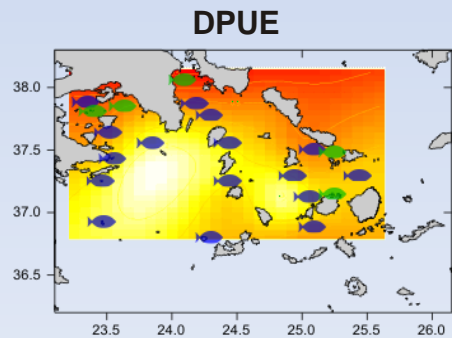
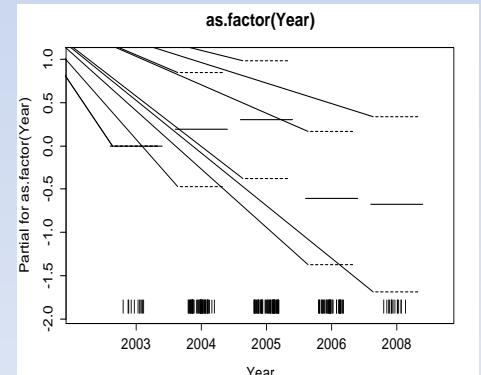
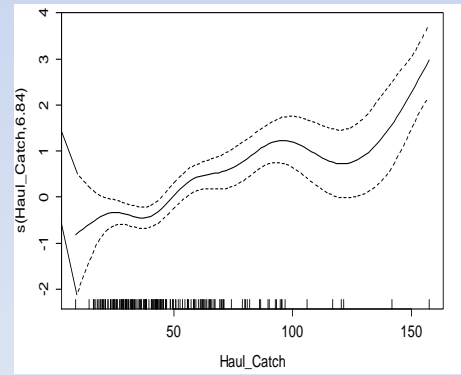
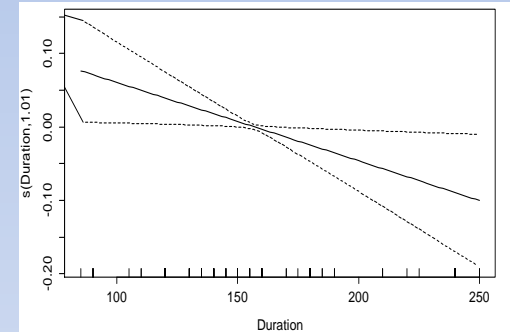
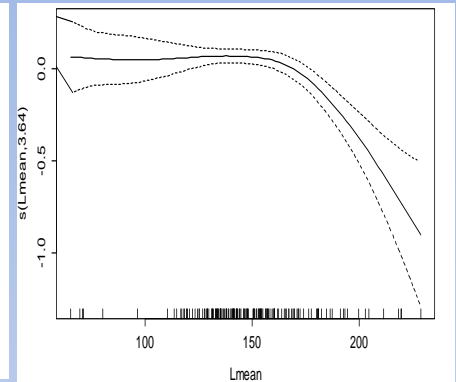
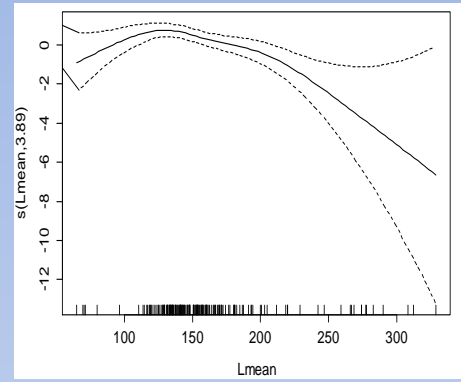


- All major nursery areas are located in the West of the study area, coinciding with increased discards.





- As the **mean length** of horse mackerel in the catch **increased** (after ~14 cm) both **DPUE** and **discards ratio decreased**.
- As the **haul duration increased**, the **discards ratio decreased**.
- DPUE increased** with **total catch**.
- Inter-annual differences were identified
- Major **nursery areas** of horse mackerel species were located along the modelled **discards hotspot** boundaries (blue=T.trach, green=T.med.)



Major nursery grounds

The explanatory variables selected for the GAM modeling seemed to explain a satisfactory level of the deviance in the available data.

The percentage of **explained deviance** ranged from about **50%** to **85%** in Southern Adriatic Sea (GSA18) and **63%** to **89%** in Aegean Sea (GSA 22).

In both areas, as expected, **an increase of the mean length of the species** in the catch resulted to a **decrease of discards** for all species under study.

Also, a significant **positive relationship was detected between discards and total catch** that could be partially explained by possible reduced selectivity due to masking of the meshes and increased number of smaller fish in the catch.

The **haul duration** in GSA 22 and the **number of hauls per trip** in GSA 18 seemed to play an **important role in the discarding process**.

Inter-annual fluctuations of discards appeared.

The models highlighted locations that could be considered as **discards hot-spots**, which appeared to overlap, partly at least, with **nursery areas** identified by the MEDISEH project.

These results could support fisheries managers in the implementation of **discards mitigation measures** connected also to the **protection of juveniles** through **improving technical characteristics of the fishing gears** (e.g. mesh size), and/or **adopting suitable spatio-temporal closures** to avoid fishing in nursery areas during recruitment periods.



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Thank you for listening!

