DISCATCH 2nd Stakeholder Meeting, Madrid 11 June 2015

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

WP 2. Data Collection Framework analysis

Participants: IEO, HCMR, COISPA.

Why a WP on discard data analysis?

- By the Data Collection Framework (DCR, 2009-onwards: EC Reg., 2008) the coverage of discard sampling programmes has considerably expanded in the recent years to all the European Mediterranean countries.

- Despite this, discard data all over the Mediterranean are still poorly explored and only for some species/areas are used in the assessment processes.

- Difficulties in analysing discard data have been often underlined, given the inherent characteristics of these data as the sampling strategy is often opportunistic, with side effects for precision estimates and accuracy.

WP2 Objectives

- To identify gaps and weaknesses in monitoring programmes recording catches, landings and discards, and focusing particularly on those implemented through the DCF;

- To improve the understanding of the characteristics of the discards data collected through the DCF in pilot GSAs of the western, central and north-eastern Mediterranean (e.g. GSA5, 6, 10, 16, 17, 18, 22); to compare the characteristics of shelf- and upper slope-discards in the GSA16.

- To predict the effects of factors related to changes in selectivity/fishing pattern;

- To study discards in a spatial scenario by a Bayesian model which can provide estimates of discards, shifts and factors driven discards in a spatial scale;

WP2 Structure

- WP leader: Jose Mª Bellido (IEO)

- Task 2.1. Analysis of the discards data in pilot GSAs of the western, central and north-eastern Mediterranean (e.g. GSA6, 5, 18, 16, 10, 22 or other)

  Task responsible : Ana Carbonell (IEO),

  Participants: Partner 2 (HCMR), Partner 3 (IEO).

- Task 2.2. Discards modelling

  Task responsible: Isabella Bitetto (COISPA).

  Participants: Partner 2 (HCMR), Partner 5 (COISPA).

- Task 2.3. Bayesian spatial modelling of discards and by catches

  Task responsible: Jose Maria Bellido (IEO).

  Participants: Partner 3 (IEO).

WP2 Calendar

- From month 3 to month 17.

WP 2: Data Collection Framework analysis																			
2.1	Analysis of the discards data in pilot GSAs of the western, central and north-eastern Mediterranean (e.g. GSA6, 5, 18, 16, 10, 22 or other)							M2.1					D2.1						
2.2	Discards modeling												M2.2				D2.2		
2.3	Bayesian spatial modeling of discards and by catches																D2.3	M2.3	

- Deliverables

D2.1. A review document on assessment of Mediterranean fishery monitoring programmes and implementation, focusing particularly in discards and bycatch issues –Month 12

D2.2. Draft paper for a peer-reviewed journal on GAM multivariate analysis and other advanced statistics to identify drivers of discards and bycatch in selected Mediterranean European fisheries –Month 16

D2.3. Draft paper for a peer-reviewed journal on Bayesian predictive discards abundance and identification of factors driven discards in a spatial-scale in selected Mediterranean European fisheries –Month 16

WP2 Tasks

- Task 2.1. Analysis of the discards data in pilot GSAs of the western, central and north-eastern Mediterranean (e.g. GSA6, 5, 18, 16, 10, 22 or other)
  - Assessment of observer coverage (days at sea), spatial coverage, and temporal coverage will be evaluated
  - To evaluate potential source of bias sampling frame and observer procedure. The use of a scorecard, traffic light criteria.

- Task 2.2. Discards modelling
  - Generalised Additive Models (GAMs) to account for the unbalanced sampling design between explanatory variables, and describe the main spatial distribution changes over time

- Task 2.3. Bayesian spatial modelling of discards and by catches
  - Hierarchical Bayesian spatial-temporal model to estimate and predict the distribution of discards by incorporating the environmental and technical features of each fishing location.

Task 2.1 Analysis of discards data in GSAs

- Subtask . Assessment of observer coverage (days at sea), spatial coverage, and temporal coverage will be evaluated.

Mediterranean trawl fishery can be considered integrated in the Data Collection Framework for Spain, Italy and Greece, and still in the first steps of their integration for Bulgaria, Rumania, Croatia, and other neighboring Mediterranean countries including Turkey and Maghreb countries

A review of the observer onboard Mediterranean programmes, in the different GSA case studies of the Western, Central and Eastern Mediterranean Sea were carried out.

- Common data base ex-change format in the Mediterranean Sea

- Checking the quality of the data gathered of the National onboard trawling programmes.

Task 2.1 Analysis of discards data in GSAs

- Subtask . Assessment of observer coverage (days at sea), spatial coverage, and temporal coverage will be evaluated.

Sea	Area	GCFM sub Area	Country	EU EC	Onboard Sampling	OTB onboard sampling	Sampling
MED	WEST	**1**,2, **5**,**6**,7	Spain	√	√	√	DCR DCF
		7,8	France	√	√	√	DCR DCF*
		9, 11.1, 11.2	Italy	√	√	√	DCR DCF
		3	Morocc				
		4	Algerian				
	CENTRAL	**10**,**16**,17,**18**,19	Italy				
		15	Malta				
		17	Slovenia				
		17	Croatia				

Species	**Scientific name**	**Area**
Anchovy	*Engraulis encrasicolus*	1.1, 1.2, 1.3, 2.1,
Anglerfish (two	*Lophius piscatorius, L. budegasa*	1.1, 1.3, 2.2, 3.1
Hake	*Merluccius merluccius*	1.1, 1.2, 1.3, 2.1,
Norway lobster	*Nephrops norvegicus*	1.3, 2.1, 2.2, 3.1
Red mullet (two	*Mullus surmuletus, M. barbatus*	1.1, 1.2, 1.3, 2.1,
Red shrimp (two	*Aristeus antennatus, Aristeomorpha*	1.1, 1.3, 2.2, 3.1

- Results show that countries with stable and ongoing onboard sampling programmes are still few in comparison with North Atlantic and Baltic Seas.

- Data on the regional and interregional level and métier level could be problematic for fleets that split their effort between regions and/or different metiers.

- It could be most appropriate use sampling strata within national sampling programmes and only do aggregation data after them have been collected.

Task 2.1 Analysis of discards data in GSAs

- <u>Subtask . To evaluate potential source of bias sampling frame and observer procedure. The use of a scorecard, traffic light criteria.</u>

We explore the possibilities to use fishframe format and cost scripts.

Fishframe data exchange format and COST scripts are difficult to apply as many Mediterranean DCF countries do not follow this standard format for matrices.

The main inconsistencies with the COST format were:

1) statistical sub polygon spatial aggregation level, what do not exist in the Mediterranean Sea,
2) No homogenous commercial size categories at Mediterranean level.
3) Different availability of data for raising discards (landings or fishing effort)

Data ex-change format should be adapted to the Mediterranean sampling scheme and data availability; also data ex-change could adopt similar formats of COST matrices, after revision and adaptation to the Mediterranean data end users needs.

Tasks 2.1 Analysis of discards data in GSAs

- Subtask . To evaluate potential source of bias sampling frame and observer procedure. The use of a scorecard, traffic light criteria.

Several tables are proposed to summarize the quality of sampling programmes, bias and accuracy and precision of Data Collection Framework. Traffic ligth criteria.

Table A. Bias in Species identification by observer onboar Information not available (NA). ... RISK OF BIAS, Red= CONFIRN

	GSA
Species identification	
Species confus.& train.	
Species misreporting	
Taxonomic change	
Grouping statistics	
Identification key	

Table B. Landing Weight. ... fishery. Information not a... Yellow= RISK OF BIAS, Red=

	GSA 1
Missing part	NA
Area misreporting	NA
Quantity misreporting	NA
Population of vessels	
Source of information	NA
Conversion factor	NA
Percent. mixed landing	

Table C. Discards Weight. Information not available (NA). Green= NO BIAS, Yellow= RISK OF BIAS, Red= CONFIRMED BIAS.

	GSA 1, 5, 6	GSA 10, 16, 18	GSA 22
Sampling allocations scheme			
Raising variable	NA		NA
Size of the catch effect	NA		
Damaged fish discarded			
Non response rate	NA		NA
Temporal coverage	NA		NA
Spatial coverage	NA		NA
High grading			
Slipping behaviour			
Management measures			
Working conditions			

Weakness and gaps of the sampling onboard protocols seem small. However, the use of protocols of sampling best practices still need further detailed.

Task 2.1 Analysis of discards data in GSAs

For more info please refer to:

DISCATCH Deliverable 2.1. A review document on assessment of Mediterranean fishery monitoring programmes and implementation, focusing particularly in discards and bycatch issues

Main contributors: A. Carbonell, K. Tsagarakis, M.T Facchini, P. Carbonara, S. Vitale, T. García, M. González, A. Edridge, A. Machias, V. Vassilopoulou, J.M. Bellido.

Month 12 – Submitted in January 2015.

Task 2.3. Bayesian spatial modelling of discards and by catches

- Discard occurs for a range of reasons and is influenced by an even more complex array of factors that are still poorly understood due, among other things, to incomplete knowledge on the spatio-temporal pattern of discards, which tend to be highly variable in space and time.

- The current literature on discards has mainly been descriptive, with a focus on understanding discard rates of specific species, estimating the amount or proportion of total catch discarded from particular fisheries, as well as global discard estimates.

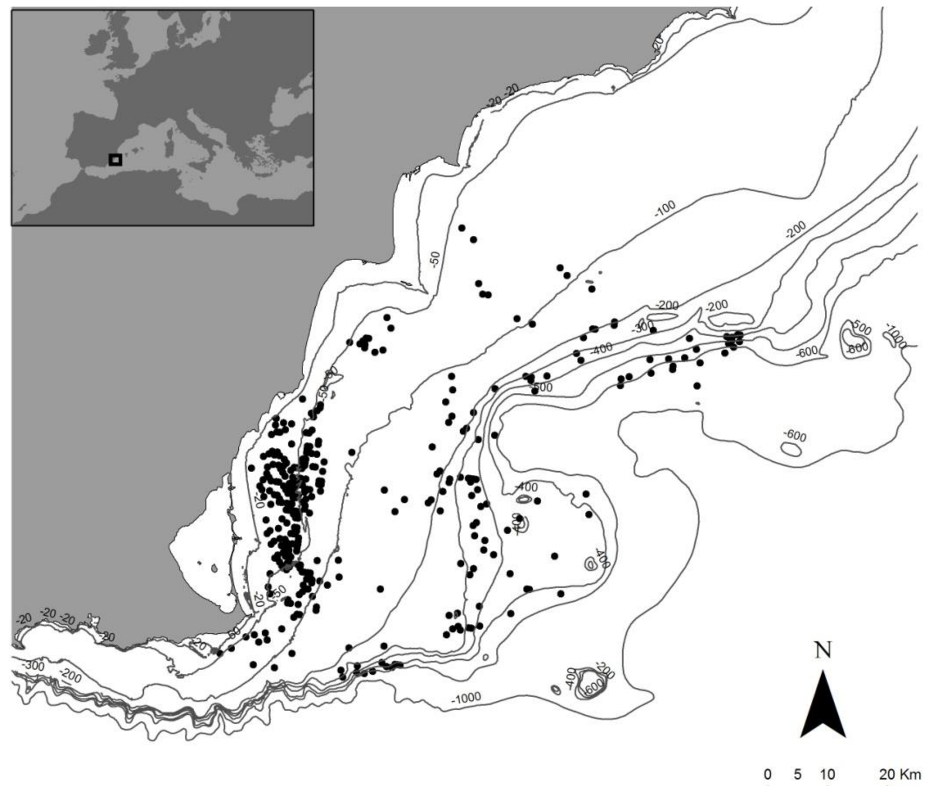
- While these studies help provide a better understanding of the discarding problem, there is a need of more quantitative studies regarding discarding behaviours.

- Therefore, further knowledge of the factors that influence discard rates and of their spatio-temporal pattern is needed.

Task 2.3. Bayesian-spatial discards model
Study area

The trawl fishery observer on-board database in the Spanish Mediterranean Geographic Sub-Area 06 contains a total of 9219 entries that correspond to 392 fishing operations divided in two metiers (OTB-DES and OTB-DWS).

The data set contains a large number of variables related to environmental conditions, vessel characteristics and catch composition.



Task 2.3. Bayesian-spatial discards model
Modelling discards

- The most common approach to statistically analyze data that are perceived to be related to other variables is through regression modelling. Discard data are often modelled with well-established techniques. These methods include generalized linear models (GLMs), generalized additive models (GAMs) and, to a lesser extent, generalized linear mixed models (GLMMs) and generalized additive mixed models (GAMMs).

- Many fisheries spatial studies represent space in a gridded surface or geographical fishing boundaries. More sophisticated models treat latitude and longitude as continuous variables fitting smooth effects onto them using GAM or GAMM models. However, these variables are still included as fixed effects and do not include the spatial correlation that biological processes tend to have.

- When dealing with a continuous field and spatial correlation is expected, the most appropriate approach is geostatistical analysis. To this respect, hierarchical Bayesian models may be the best because it allows both the observed data and model parameters to be random variables, resulting in a more realistic and accurate estimation of uncertainty.

Task 2.3. Bayesian-spatial discards model
Modelling discards

• Hierarchical Bayesian spatio-temporal models were used to account for discard dependency with respect to explanatory variables, as well as to describe the main spatial distribution changes over time. The expected values of the response variables in each haul were related to the spatial, temporal, technical and environmental covariates.

• In this study, such hierarchical Bayesian geostatistical models have been applied using the Integrated Nested Laplace Approximation (INLA, Rue et al. 2009) through the INLA package for R (Rue et al. 2014).

• **Bayesian kriging -** Once the inference is carried out, the next step is to predict the DPUE in the rest of the area of interest, especially in unsampled locations. Here, we adopted a Bayesian kriging approach to calculate posterior predictive distributions of the DPUE for the whole region. Using Bayesian kriging, we incorporated parameter uncertainty into the prediction process by treating the parameters as random variables.

Task 2.3. Bayesian-spatial discards model
Total discards by metiers

Figure 1: The posterior mean (left) and standard deviation (right) of the spatial effect of the OTB-DES metier. The spatial component represents the intrinsic spatial variability of the data without variables.

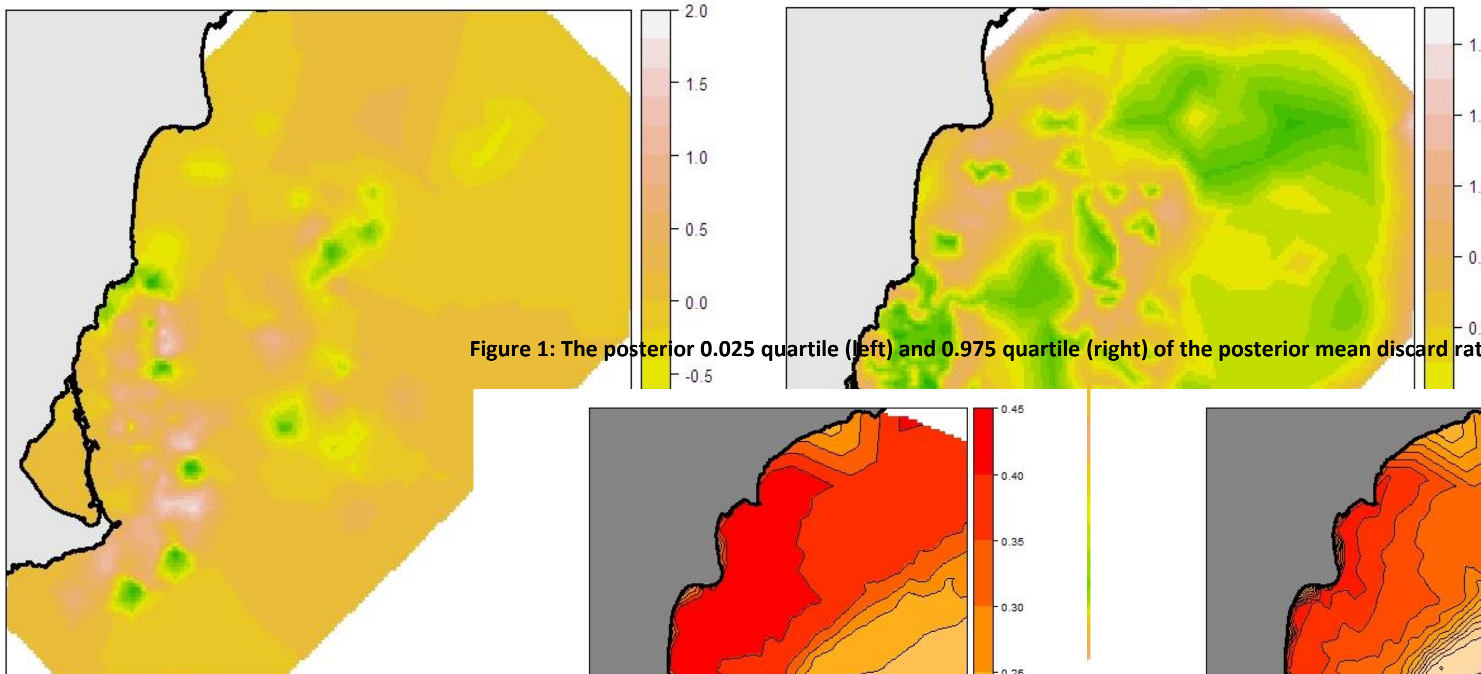
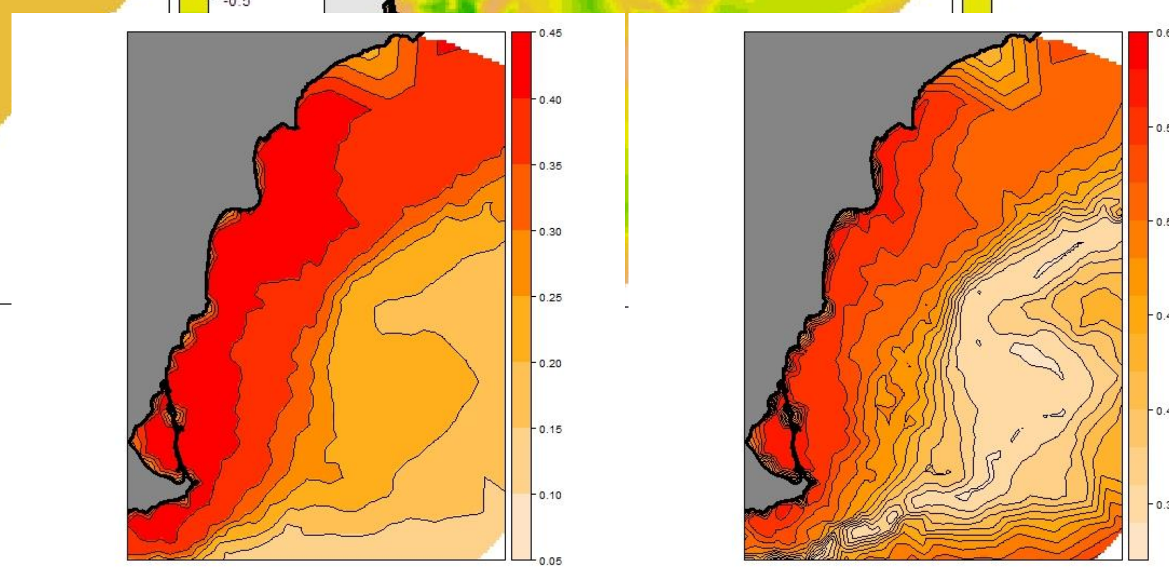


Figure 1: The posterior 0.025 quartile (left) and 0.975 quartile (right) of the posterior mean discard ratios.



Task 2.3. Bayesian-spatial discards model Discards by species

Discards by species analysis (*Boops boops, Trachurus sp., Scyliorhinus canicula* and *Pagelus acarne)*

Figure 1: Occurrence distribution of *Scyliorhinus canicula* in the study area.

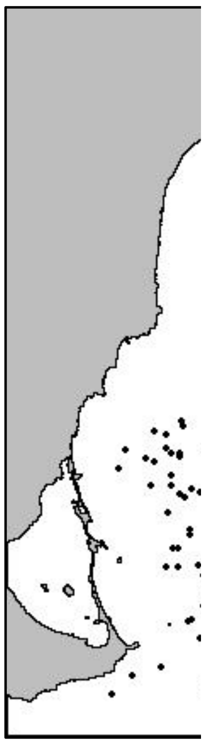
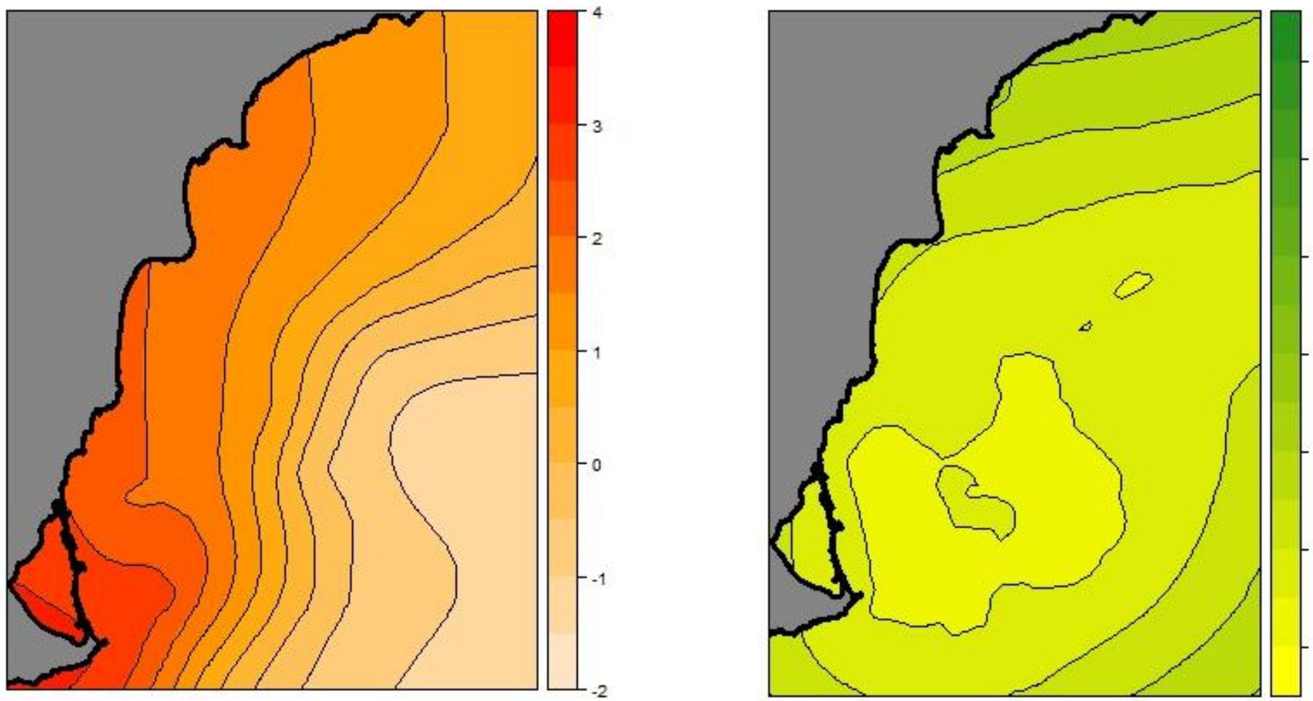


Figure 1: Posterior mean (left) and standard deviation (right) of the predictive small-spotted cat shark volume of discards.



Task 2.3. Bayesian-spatial discards model Conclusions 1

✓The present study analyses discards of the Spanish Mediterranean bottom trawl reference fleet according to technical and environmental factors.

✓This analysis has been performed using three different approaches: total DPUEs, discard ratios and species specific DPUEs. DPUE models tackle the expected amount of discards per unit effort and have been fitted at two different levels:

1) total discarded volumes, which give a general description of the discards in the region and

2) species specific models, which provide a more in detail information of the discard patterns. Discard ratio models approach the expected proportion of discards for a given haul and have only been fitted at the overall level.

✓Four of the most discarded species (*Boops boops, Trachurus sp., Scyliorhinus canicula and Pagelus acarne) were selected for the specific studies and results vary considerably both in distribution of discards and effects of the environmental factors.*

Task 2.3. Bayesian-spatial discards model Conclusions 2

✓Some species show neither spatial correlation nor relation with the selected environmental variables (*Boops boops and Trachurus sp.) while Pagellus acarne show certain relations with the environment and Scyliorhinus canicula show a spatial pattern. The volume of the catch, included as CPUE in the modelling, is positively related with the expected amount of discards in the mid-low priced species (trachurus sp. and Pagellus acarne). A similar CPUE effect is observed in the total discard models, suggesting that a good catch may result in higher discards of mid priced species. However, total discard models should reflect the sum of all the marginal species specific models, thus the selected environmental effects only give an overall behaviour of all the non marketable fish species and sizes.*

✓For management purposes it might be interesting to consider species specific discard patterns to better understand the whole picture.

Task 2.3. Bayesian-spatial discards model Conclusions 3

✓Discard ratios maps show a smoother pattern than the total volume of discards and show a clear bathymetric pattern that acquaint for the transition between both metiers. In general, discard ratios may also be a better approach than DPUEs for management purposes since it allows the optimisation of landings against its ecological impact. Moreover, discard ratios as opposed to DPUEs, do not require haul duration data, which may be absent in certain datasets such as fishermen log-books.

✓The vessel effect has proved to be a very important factor in most of the presented models. Skippers may have different discarding behaviours, suggesting that the anthropogenic factor is an important source of variability in the discarding patterns.

Task 2.3. Bayesian spatial modelling of discards and by catches

For more info please refer to:

DISCATCH Deliverable 2.3. "Bayesian spatial modelling of discards and by catches"

Main contributors: Jose Mª Bellido, Iosu Paradinas, Antonio López and Ana Carbonell.

Month 12 – Submitted in May 2015.

DISCATCH 2nd Stakeholder Meeting, Madrid 11 June 2015

Many Thanks

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

WP 2. Data Collection Framework analysis

Participants: IEO, HCMR, COISPA.