Reduction of discards in the bottom trawl fishery: fishing selectivity and effect of the morphology and size of the species

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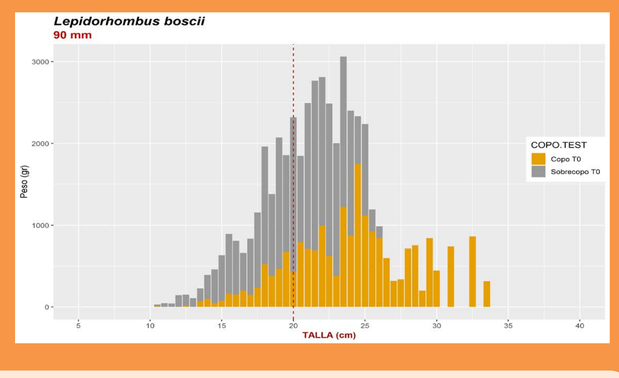
Read the QR and watch the movie!

The problem: fishing discards

It is widely accepted that discards are a waste of resources from the perspective of the exploited stocks and from a macro-economic human perspective. There is thus a strong commitment to reduce the discards of European fisheries by enforcing the landing obligation of the unwanted catch. The European Common Fisheries Policy (CFP) aim to eliminate the discards of managed species. In Iberian waters waters (ICES Divisions VIIIc and Ixa) , some fishing fleets currently discard a significant proportion of their catch and by the discard-limiting regulation they must reduce their discards. This can be achieved by reducing unwanted catches, by landing a larger proportion of the unwanted bycatch that is currently discarded or by a combination of the two. In northwestern Iberian waters, technical measures research has focused on the bottom trawl fisheries, as most of the discard choke situations affect these fleets and there are difficulties in improving selectivity.



Fishing selectivity

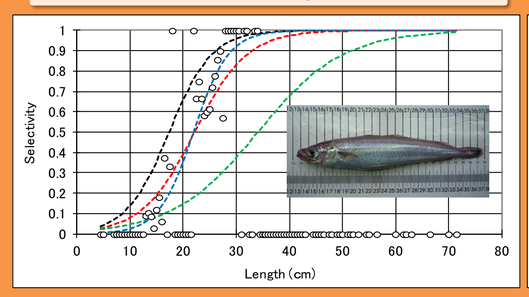
Research of fish stocks requires the study of the composition of species, sizes and ages of the catches, which should be similar to those of the population. Therefore, it is very important to know the selectivity of the gear and of the species, since in this way it is easier to establish regulatory measures in the fisheries and allows studies on the populations and their degree of exploitation to be more precise.

The DESCARSEL project works on the aim to improve fishing strategies, gear selectivity and discard survival through the use of better practices and technological development of more selective fishing gears, to improve compliance with the landing obligation under the reformed CFP. This research follows a collaborative approach, working with fisher associations and the stakeholders related to landing obligation rules.

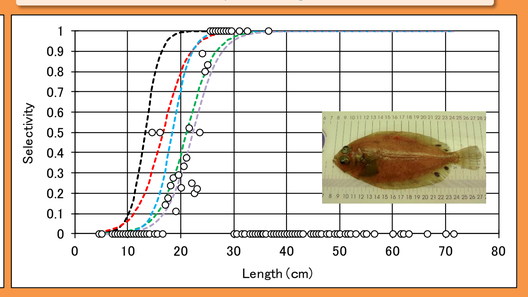
Selectivity trails have been conducted focused on mesh netting geometry (T90), square mesh panels and mesh size able to balance the roundfish by-catch avoidance. The aim is to test and to compare the configurations of meshs that are more suitable (mesh size and number of meshes) and study the effectiveness of the T90 codends mainly for hake as well as for blue whiting, horse mackerel and megrims. Selectivity parameters are presented here for codends using different mesh sizes, both diamond and 90º turned mesh (T90).

Selectivity curves for codends using different mesh sizes, both diamond and 90º turned mesh (T90).
---T0_55: diamond mesh size 55 mm
---T0_70: diamond mesh size70 mm
---T0_80: diamond mesh size 80 mm
---T90_70: turned 90º size mesh 70 mm
---T90_80: turned 90º size mesh 80 mm

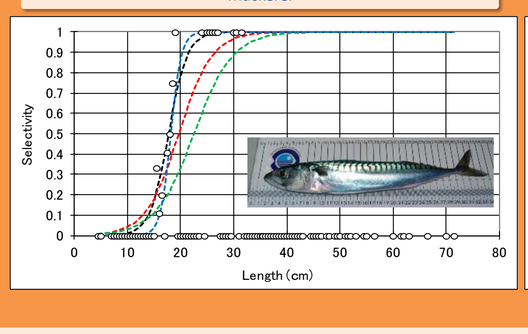
Blue whiting



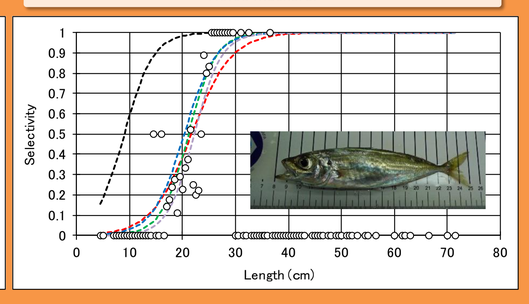
Four spotted megrim



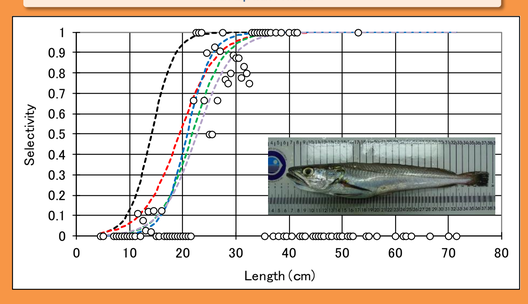
Mackerel



Horse mackerel



European hake



		T0_55	T0_70	T90_70	T0_80	T90_80
HKE	**L50**	14.11	19.40	20.81	21.78	22.72
	R.S.	4.67	7.64	4.95	6.56	7.40
	L25	9.44	11.76	15.86	15.22	15.32
	L75	18.78	27.04	25.76	28.34	30.12
WHB	**L50**	17.37	22.15	22.00	34.08	-
	R.S.	8.84	10.87	7.18	17.60	-
	L25	8.53	11.28	14.82	16.48	-
	L75	26.20	33.02	29.18	51.68	-
MAC	**L50**	17.76	19.68	18.22	22.53	18.22
	R.S.	3.82	6.82	2.18	7.98	2.18
	L25	13.93	12.86	16.04	14.55	16.04
	L75	21.58	26.50	20.40	30.51	20.40
HOM	**L50**	9.04	21.71	20.31	21.08	20.91
	R.S.	5.93	8.27	6.47	5.67	9.04
	L25	3.11	13.44	13.84	15.41	11.87
	L75	14.97	29.98	26.78	26.75	29.95
LDB	**L50**	13.28	16.62	18.42	21.13	22.26
	R.S.	3.10	5.45	3.82	5.63	5.57
	L25	10.18	11.17	14.60	15.50	16.69
	L75	16.39	22.07	22.24	26.76	27.83

Selectivity parameters for codends using different mesh sizes, both diamond and 90º turned mesh (T90). HKE: European hake (*Merluccius merluccius*), WHB: blue whiting (*Micromesistius poutassou*), MAC: mackerel (*Scomber scombrus*), HOM: horse mackerel (*Trachurus trachurus*) and LDB: four spotted megrim (*Lepidorhombus boscii*)

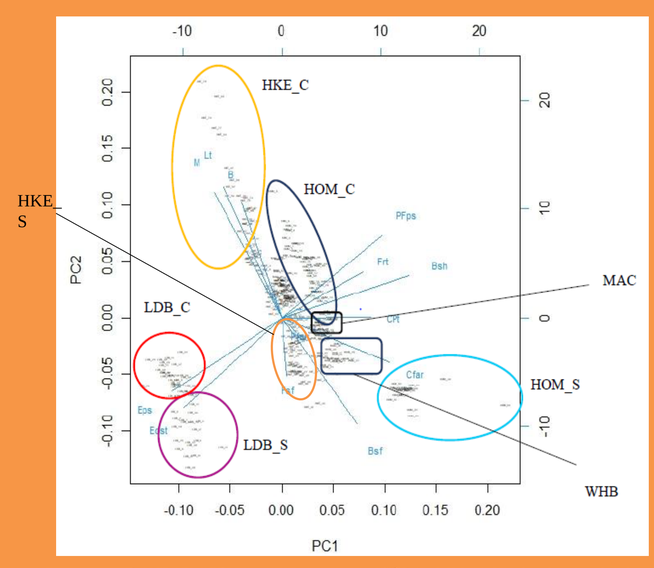
Fish morphology: functional traits

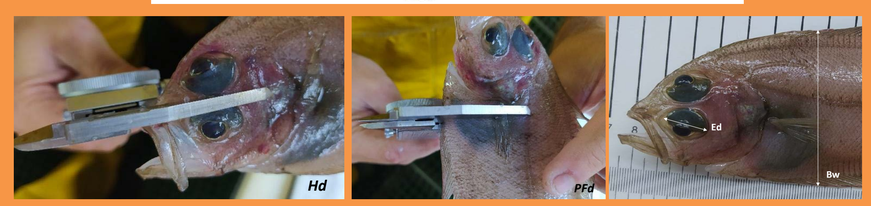
The objective of this work has been to study whether the morphology and size of the individuals of the different species studied European hake (*Merluccius merluccius*), blue whiting (*Micromesistius poutassou*), mackerel (*Scomber scombrus*), horse mackerel (*Trachurus trachurus*) and four spotted megrim (*Lepidorhombus boscii*) is related to the selectivity of the fishing gear. Therefore, we analyzed the shape of the fish, its size and features related to swimming capacity which influence their catchability and, therefore, the selectivity of the gear. We tested the functional traits (individual morphological, physiological, or behavioral characteristics that influence growth, reproduction, and even individual survival) of five species subject to TACs Functional traits of 301 fish were analysed by PCA. The results suggest that the morphological traits are related to the type of species (benthic or pelagic in this case), and to the ability to escape through the net, although it would also be interesting to consider the behavior of the fish inside the net.

- Horse marckerel was characterized by traits of body surface (Bsf, Bsh)
- Megrim was characterized by traits of visual acuity (Eps, Edst)
- Hake was characterized by traits of traits related to body size (length and weight) (M, Lt, B)

Functional traits (Mouchet et al., 2017)		
Eye size	Edst	Ed/Hd
Eye position	Eps	Eh/Hd
Body transversal shape	Bsh	Bd/Bw
Body transversal surface	Bsf	$\frac{\log\left(\frac{\pi}{4} \times Bw \times Bd\right) + 1}{\log(B+1)}$
Pectoral fin position	PFps	PFi/PFd
Aspect ratio of the pectoral fin	PFar	PFi^2/PFs
Caudal peduncle throttling	CPt	CFd/CPd
Aspect ratio of the caudal fin	Cfar	CFd/CFs
Fins surface ratio	Frt	2*PFs/CFs
Fins surface to body size ratio	Fsf	$\frac{(2 \times PFs) + CFs}{\frac{\pi}{4} \times Bw \times Bd}$
Biomass	M	log(B+1)
Total length	Lt	Absolute Lt

List of functional traits (Mouchet et al., 2017). The abbreviations mentioned in the quantification of functional traits refer to the ecomorphological features used and are presented in Supplementary Information Fig. S2. Bd:maximal body depth; Bw: maximal body width; CFd: maximal caudal fin depth; CFs: caudal fin surface; CPd:peduncle minimal depth; Ed: eye diameter; Eh: eye position; Hd: head depth; Lt: total length; PFd: body height at the pectoral fin insertion; PFi: position of the pectoral fin; PFl: maximal fin length; PFs: pectoral fin surface. B: body weight. Lt is considered as an ecomorphological feature as well as a functional trait. All traits are dimensionless, excepted M (in grams) and Lt (in millimetres).





Key Results

- Selectivity of fishing codends used in the fishery is a updated in this work with curves and selectivity parameters (baseline selectivity in the fishery).
- Comparative selectivity trials indicate a better selectivity of larger mesh sizes and by turned mesh T90 codends Results indicates a L50 larger for T90 and a lowest escape of small hake, horse mackerel and blue whiting in diamond mesh. More trials must be carried out to analyze better the most suitable mesh shape and size gear and study efficiency of codends about the economic loss of commercial fish, to best adapt the regulatory requirements in relation to the landing obligation.
- Losses of a fraction of the commercial catch must be taken into account to assess their influence on the economic viability of codends.
- Knowledge of the selectivity-related characteristics of the different species (flat fish, circular shape, pelagic swimming) is important for the establishment of adequate technical measures in mixed fisheries that target a large number of demersal species.

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