

Fishing discards in the Spanish otter-trawl fishery: Discard rates and indicators of bycatch of key species in north Iberian waters.



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INTRODUCTION AND OBJETIVES

Demersal fish and crustaceans assemblages of north Iberian Peninsula are very rich in abundance and biodiversity on the continental shelf and upper slope. A large bottom-trawling fleet operates in these waters exploiting the rich fishing grounds. The target species are several valuable fish including European hake (*Merluccius merluccius*), anglerfish (*Lophius budegassa*), megrims (*Lepidorhombus boscii* and *L. whiffiagonis*), horse mackerel (*Trachurus sp.*), blue whiting (*Micromesistius putassou*) and Norway lobster (*Nephrops norvegicus*). The discards of the trawling fleet amount to about 35-59% of the total catch of the fleet or about 42000 tons of discards per year. Most of the discarded catch by the Galician trawling fishery is undersized commercial species and non-commercial species including fish, cephalopods and crustaceans. Discard data from onboard sampling were analyzed to study spatial distribution and abundance of species in relation to fishing variables. In this work we present pressure indicators describing catch and discards as well as state indicators describing the ecosystem or fish community.

MATERIAL AND METHODS

The study area covers the north Iberian continental shelf and upper slope. Two ICES divisions are used: VIIIc (North Galicia) and IXa (South Galicia). The catch dataset was compiled from the "Spanish Discard Sampling Programme" monitored by IEO for the period 2006-2008. This programme is based on a stratified random sampling, considering the "Fishery Unit" as stratum and the trip as sampling unit. The available biological data were collected on a haul-by-haul basis and consisted of catch and discard observations of both non- and commercially-valuable species (including invertebrates such as crustaceans, molluscs and cephalopods) (2003-2008 data set). Due to the large number of discarded species involved, discard information was wherever possible limited to the ten most discarded species.

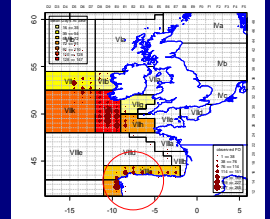


Figure 1. Geographic distribution of sampling effort (proportional circles) and total fishing effort of Spanish bottom trawling fleet in EU waters (ICES divisions in color). Red circle: area of study.

DISCARDED SPECIES

Eight species account for 69.3% of total discards by the trawl fishery. The most discarded species were three non-commercial crustaceans: Henslowi crab (*Polybius henslowi*) and the squat lobsters (*Munida intermedia*, *M. sarsi*). The third bycatch species was the European hake (*Merluccius merluccius*) which has a discard ratio of 51% of the capture. Other important discarded species has a ratio of 22-88%: mackerel (*Scomber scombrus*), blue whiting (*Micromesistius putassou*), grey gurnard (*Chelidonichthys gurnardus*), four-spot megrim (*Lepidorhombus boscii*) and small-spotted catshark (*Scyliorhinus canicula*). The rest of the species are the 23.3% of discarding and most are low or non commercial value and some accompanying species with commercial value.

Table 1. Top discarded species in Spanish bottom otter-trawl fishery.

Table 2. Mean weight (kg; SD) discard by hour and fishing trip for top ten most discarded species by ICES division.

Especie	% Total Discards	Ratio Discards/Captura
<i>Polybius henslowi</i>	30.03	100
<i>Munida spp.</i>	8.39	100
<i>Merluccius merluccius</i>	8.30	51
<i>Scomber scombrus</i>	7.80	65
<i>Micromesistius putassou</i>	6.58	60
<i>Chelidonichthys gurnardus</i>	3.51	69
<i>Lepidorhombus boscii</i>	2.37	22
<i>Scyliorhinus canicula</i>	2.18	69
<i>Gadus melastomus</i>	1.94	100
<i>Halsburus spp.</i>	1.67	100
<i>Trigla spp.</i>	1.49	84
<i>Trachurus trachurus</i>	1.24	6
<i>Boops boops</i>	1.07	100
Otras especies	23.3	65

UIC4	ICES VIIIc	ICES IXa
<i>Scomber scombrus</i> (Wt)	2.8 (8.2)	13.1 (35.8)
<i>Polybius henslowi</i> (Wt)	15.1 (37.5)	52.8 (136.8)
<i>Trachurus trachurus</i> (Wt)	3 (5.7)	0.5 (0.9)
<i>Merluccius merluccius</i> (Wt)	3.5 (10.2)	14.8 (22.2)
<i>Micromesistius putassou</i> (Wt)	6.1 (11.5)	10.1 (16.3)
<i>Lepidorhombus boscii</i> (Wt)	2.4 (6.2)	4.9 (10.2)
<i>Munida spp</i> (Wt)	14.5 (50.5)	6.7 (20.6)
<i>Lophius budegassa</i> (Wt)	0.2 (0.7)	0.2 (0.8)
<i>Lophius piscatorius</i> (Wt)	0.3 (0.9)	0.2 (0.5)
<i>Torpedo japonica</i> (Wt)	0.2 (0.7)	1.3 (4.6)

CHARACTERIZATION OF FISHING HAULS USING DISCARD DATA

A multivariate analysis on abundance data was performed to characterize discard patterns. PAM technique (partitioning around medoids) described above are used in order to find homogenous catch profiles. The clusters obtained are contrasting with the knowledge of the fisheries in order to achieve the most appropriate segmentation. Each cluster identified a group of fishing hauls with similar discard species profile. One or some species are dominant in weight percentage and it characterize a group of hauls.

- Cluster 1 (MIX): 66.7 % of hauls characterized by discarding hake (*Merluccius merluccius*) and blue whiting (*Micromesistius putassou*).
- Cluster 2 (MUN): 6.3% of hauls characterized by discarding squat lobsters (*Munida sp.*).
- Cluster 3 (PHE): 22.9% of hauls characterized by discarding Henslowi's crab (*Polybius henslowi*).
- Cluster 4 (EGU): 4.2% of hauls characterized by discarding gurnards (*Chelidonichthys gurnardus*).

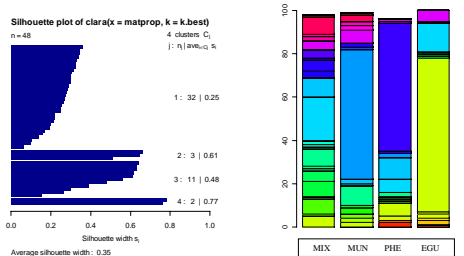


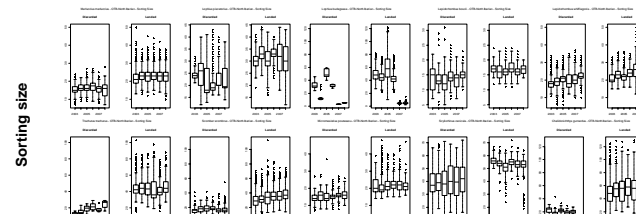
Figure 3. Silhouette plot of the highest average silhouette width cluster analyses: four cluster and partial coefficients.

Figure 4. Species composition of four clusters. Each colour mean top species in each group of hauls.

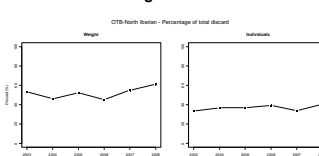
PRESSURE INDICATORS DESCRIBING CATCH AND DISCARDS

Indicators play a key role in gauging the exploitation and state of marine ecosystems and they are required to understanding the effects of fishing on marine ecosystems and to address the ecosystem approach to fisheries (EAF) objectives. Several key indicators have been calculated from discard data of most discarded commercial species:

- Sorting size (Min, Q5, Q25, Median, Q75, Q95, Max, Mean and Sd) , by year, of the whole catch, discards and landings of any species.
- Percentage of discards of any species, by year, in weight and individuals.
- Percentage of discards of the full set of species by year, in weight and individuals
- Simpson Index of diversity of the whole catch, landings and discards by year.



Percentage of total discards



Simpson Index

