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Spanish fisheries in NAFO Subarea 3

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Abstract

The aim of this paper is to characterize the different Spanish fisheries in NAFO Subarea 3 during the period 2005-2011 base on the catch composition, depth and gear used by the Spanish fleet. Normally a fishery is determined by its catch composition, the area where it was took and the fleet and gear used to catch it.

Based on the results, it can conclude that Spanish fleet had six different fisheries in the period 2005-2011 in NAFO Division 3LMNO depending on the target species, area, depth and gear (mesh size). The Spanish fisheries were the following: 1) In Divisions 3LMNO at more than 600 meters depth with demersal 130 mm mesh size gear with Greenland halibut (86%) as target species and the roughhead grenadier (4%) and the redfish (2%) as main by-catch species. 2) In Divisions 3LMNO, mainly in Div 3O and 3M with demersal 130 mm mesh size gear in the 200-600 strata. The target species was the redfish (80%) and the main by-catch species were Greenland halibut (4%), American plaice (4%), cod (3%) and witch flounder (3%). 3) In Divisions 3NO with demersal 130 mm mesh size at depth less than 200 meters. This is a mix fishery with different catch composition in Div. 3N (56% American plaice, 26% yellowtail flounder, 10% cod and 6% skates) than in Div. 3O (57% redfish, 14% American plaice, 12% skates and 7% witch flounder). 4) In Divisions 3NO with 280 mm mesh size at less than 200 meters depth. The target species was the skates (63%) with American plaice (19%), yellowtail flounder (10%) and cod (6%) as main by-catch species. 5) In Division 3LM with 40 mm mesh size at depth between 300-500 meters. The target species of this fishery was the shrimp with 98% of the catches and only a 2% of redfish as by-catch. 6) In Division 3M at depth between 150-550 meters targeting cod with 130 mm mesh size gear. The target species of this fishery was cod (92%) and the most important species in the by catch was redfish (7%).

Introduction

Normally a fishery is determined by its catch composition, the area where it was took and the fleet and gear used to catch it. This document analyzes the Spanish fisheries in NAFO Regulatory Subarea 3 during the period 2005-2011. Spanish fleet used three different mesh sizes to catch different objective species in the analyzed period: Mesh size 40 mm is used to catch shrimp, the 280 mm is used for catch skates and the 130 mm is used to catch different demersal species.
The aim of this paper is to characterize the different Spanish fisheries in NAFO Subarea 3 during this period base on the catch composition, depth and gear used by the Spanish fleet.

Data

The period examined in this document is 2005 to 2011. The reason to choose this period was that the Spanish fleet activity in NAFO Subarea 3 was more or less similar and has not changed very much after the implementation in 2004 of the Greenland halibut recovery plan by the NAFO Fisheries Commission. Table 1 presents the percentage of the effort for the different mesh sizes by year based on the NAFO Observers information. It can be observed that the percentage between mesh sizes by year is quite stable. The major change during this period was the reopening of the Cod fishery in Division 3M in 2010. This fishery uses a 130 mm mesh size as the general demersal fishery but the vessels need a special license to exploit the cod. The special license has permitted to work these data separate from the general demersal 130 mm mesh size gear.

Effort and hauls in this document are based on information from NAFO observers on board. The hauls depth distribution is analyzed based on the haul shoot depth. This information has more than 95% of coverage of the total Spanish effort in Subarea 3 each year of the period, except in 2010 where it was 72%. Catch composition was based on the Spanish Scientific Observers program. Species with catches less than one ton in the whole period were eliminated of the analysis. Table 2 shows the NAFO *alfa* 3 code, the scientific name and the English name of the species with more than 1% in the catches based on the Spanish Scientific observers data. This information has coverage between 13 and 26% of the Spanish total effort in Subarea 3. Table 3 shows the percentage of the Spanish total effort cover by year of the NAFO observers and the Spanish Scientific observer data.

Results

As it can observe in Table 1, the mesh size more used by the Spanish fleet in NAFO Subarea 3 is the demersal 130 mm, around the 80% of the total Spanish effort was made with this mesh size. The 280 mm mesh size was the second more used, around the 16% of the total effort. Cod 135mm mesh size was around the 1% of the total effort in 2010-2011 and 40 mm mesh size was used around 5% of the total effort for the Spanish fleet.

Figure 1 presents the depth box plot of the hauls by mesh size and Division for the whole period based on the NAFO Observers information.

Around the 80% of the Spanish effort was carried out with demersal 130 mm mesh size. These hauls have a very wide depth. The wide depth range can be explained because hauls are directed to different species that habit at different depths. Based on biological information of the depth distribution of the species objective of the Spanish fleet it was decided to analyze the demersal 130 mm mesh size information in three different depth strata. The depth strata are: less than 200 meters, between 200-600 meters and more than 600 meters.

Table 4 presents the percentage of the Spanish effort in NAFO Subarea 3 with demersal gear 130 mm mesh size by year, and Division. Most of the effort with this gear war carried out in Div. 3L (55%), in Div 3M was 30%, in Div. 3N was 11% and in Div. 3O was only the 4%. The depth range was very similar in Div. 3L, 3M and 3N, most of the hauls were in the 300-1,500 meters depth, with the interquartile range between 900-1100 meters and a median around 1000 meters depth. In Div. 3O the range was different, most of the hauls were made in the 200-600 meters strata, with a median around 350 meters depth and a long tail distribution in more than 600 meters strata.

Table 5 shows the percentage of the Spanish effort in NAFO Subarea 3 with demersal gear with 130 mm mesh size by Division and depth strata. The biggest part of the effort with this gear (91%) was carried out in the +600 meters strata. Table 6 and Figure 2 present the catch composition in weight by Division of the hauls made in the +600 meters strata based on the Spanish Scientific observers data. The 97% of the effort with this gear made in Division 3L was carried out in the +600 meters strata. The catch composition was the following: 91% of the catch weight was Greenland halibut, 3% was roughhead grenadier and with 1% of the weight there are other species as redfish, American plaice and roundnose grenadier. In Division 3M, 91% of the effort was made with this gear in the +600 meters strata. The catch composition present as main species the Greenland halibut (80%) and the main by catches species area compose by grenadiers (10%) and redfish (3%). In Division 3N, 91% of the effort was made with this gear and in this stratum. The main species in the catch was the Greenland halibut (66%). The by catch composition is quite different than the observed in Div. 3LM. The main species in the by catch were cod, which flounder, roughhead grenadier, American plaice and redfish with the 5% each one. In Div 3O only the 4% of the effort was

made with this gear and 16% of this percentage was carried out in the +600 meters stratum. The main species in the catch was also the Greenland halibut with the 68% and the main by catches species were the roughhead grenadier (8%), the black dogfish (8%) and witch flounder (5%). In a nutshell, the 79% of the total Spanish effort in NAFO Divisions 3LMNO in the period 2005-2011 was carried out with demersal 130 mm mesh size gear and the 91% of this effort was made in the +600 meters stratum. The target species in the catch was the Greenland halibut (86%) and the main by-catch species of this fishery were the roughhead grenadier (4%) and the redfish (2%).

The 8% of the effort made with the demersal 130 mm mesh size was carried out in the 200-600 meters stratum (Table 5), most of them in Div. 3O. Table 7 and Figure 3 presents the catch composition in weight by Division of the hauls made in the 200-600 meters stratum based on the Spanish Scientific observer data. The effort made in Div. 3L with this gear and in this stratum was the 3% and there is not catch data available to determine the catch composition. In Div 3M, the 8% of the effort made with this gear was carried out in the 200-600 meters stratum. The principal species in the catch was the redfish with the 61% of the catch weight and the main species in the by-catch were Greenland halibut (23%), cod (9%) and skates (4%). The percentage of the Div 3N demersal 135 mm mesh size effort carried out in the 200-600 stratum was the 8%. The principal species in the catch was the redfish (78%) and the main by-catch species were the Greenland halibut (7%), yellowtail flounder (6%) and American plaice (3%). In Div. 3O, the 74% of the effort with the demersal 130 mm mesh size was carried out in the stratum 200-600 meters. The principal species in the catch was the redfish with the 84% of the total catches and the main species in the by catch were the American plaice (5%), witch flounder (3%) and cod (2%). In Divisions 3LMNO, only the 8% of the effort was made with this gear in the 200-600 strata, mainly in Div 3O and 3M. The target species in this fishery was the redfish with the 80% of the catch weight and the main by-catch species were Greenland halibut (4%), American plaice (4%), cod (3%) and witch flounder (3%).

Only the 1% of the effort made with the demersal 130 mm mesh size was carried out in depth less than 200 meters in Div 3N and 3O (Table 5). Table 8 and Figure 4 presents the catch composition in weight by Division of the hauls made in the less than 200 meters stratum based on the Spanish Scientific observer data. Only the 1% of the effort made with the demersal 130 mm mesh size gear in Division 3N was carried out in the stratum less than 200 meters depth. This fishery seems to be a mix fishery with many important species in the catches. The main species were American plaice (56%), yellowtail flounder (26%), cod (10%) and skates (6%). In Div. 3O, 10% of the effort made with this gear was carried out in this stratum. Figure 4 shows in Div 3O a mix fishery but with a different catch composition than in Div. 3N. The species catch composition of this Division, gear and stratum were: redfish (57%), American plaice (14%), skates (12%) and witch flounder (7%). Briefly, a small part of the effort (1%) made with demersal 130 mm mesh size was carried out in Div. 3NO at less than 200 meters depth. Catch composition shows that this effort form part of a mix fishery with different catch composition in Div. 3N (56% American plaice, 26% yellowtail flounder, 10% cod and 6% skates) than in Div. 3O (57% redfish, 14% American plaice, 12% skates and 7% witch flounder).

Around the 16% of the total Spanish effort in the period 2005-2011 was conducted with 280 mm mesh size (Table 1). This effort was developed in Divisions 3NO and most of the hauls were carried out at depths less than 200 meters although there are some hauls at greater depths. Figure 5 and Table 9 presents the species catch composition (%) by Division of the hauls carried out by the Spanish fleet with 280 mm mesh size during the period 2005-2011. In Div. 3N most of the hauls were at depth less than 100 meters (Figure 1) with a very narrow depth range. The most important species in the catch of the hauls made with 280 mm mesh size in this Division was the skates with the 63% in weight. The main by-catch species were American plaice (19%), yellowtail flounder (10%) and cod (6%). In Div. 3O most of the hauls were carried out between 100-200 meters depth and the catch composition was quite similar to the Div 3N. The principal species in the catch was the skates with the 61% in weight. The main by-catch species were American plaice (15%), yellowtail flounder (10%) and witch flounder (6%). In brief, the 16% of the Spanish effort in the 2005-2011 period was carried out with 280 mm mesh size in Divisions 3NO at depths less than 200 meters targeting skates (63%) with American plaice (19%), yellowtail flounder (10%) and cod (6%) as main by-catch species.

A percentage of the 5% of the total Spanish effort was realized with 40 mm mesh size in depth between 300-500 meters in Divisions 3LM (Table 1). In Div 3L the hauls depth range is more narrow around 300 meters. In Div. 3M the hauls depth range is more wide than the Div 3L and the mean depth appears to be around 400 meters (Figure 1). Figure 6 and Table 10 presents the species catch composition (%) by Division of the hauls carried out by the Spanish fleet with 40 mm. mesh size during the period 2005-2011. The catch composition is very similar in Div. 3L

and Div. 3M. The principal species was the shrimp with 100% of the catches in Div. 3L and 98% in Div. 3M. In Div. 3M there was 2% of the redfish as main by-catch. The 5% of the total Spanish effort was carried out with 40 mm mesh size in depth between 300-500 meters of the Divisions 3LM. This is a clean fishery with a 98% of the shrimp catches and only a 2% of by-catch of redfish.

The cod fishery in Div. 3M was reopened in 2010. In 2010 and 2011, the 1% of the total Spanish effort was carry out in Div 3M at depth between 150-550 meters (Table 1 and Figure 1) with a gear with 130 mm mesh size. Most of the hauls were at depth between 300-400 meters. Figure 7 and Table 11 presents the species catch composition of the hauls carried out by the Spanish fleet in Division 3M with 130 mm cod mesh size during the period 2010-2011. The target species of this fishery was cod with 92% of the catches in weight and the most important species in the by catch was the redfish with a 7% of the catches.

Conclusions

Based on the results, it can conclude that Spanish fleet has six different fisheries in the period 2005-2011 in NAFO Division 3LMNO depending on the target species, area, depth and gear (mesh size). The Spanish fisheries were the following:

The 79% of the total Spanish effort in NAFO Subarea 3 was carried out with demersal 130 mm mesh size gear in Divisions 3LMNO. These hauls have a very wide depth distribution (150-1,500 meters). Based on biological information of the depth distribution of the species objective of the Spanish fleet it was decided to analyze the demersal 130 mm mesh size information in three different depth strata. The depth strata were: less than 200 meters, between 200-600 meters and more than 600 meters.

In Divisions 3LMNO a more than 600 meters depth was carried out the 91% of the effort with demersal 130 mm mesh size gear. The target species of this fishery was the Greenland halibut (86%) and the main by-catch species of this fishery were the roughhead grenadier (4%) and the redfish (2%).

Only the 8% of the effort was made with demersal 130 mm mesh size gear in the 200-600 strata, mainly in Div 3O and 3M. The target species in this fishery was the redfish with the 80% of the catch weight and the main by-catch species were Greenland halibut (4%), American plaice (4%), cod (3%) and witch flounder (3%).

A very small part of the effort (1%) was carried out with demersal 130 mm mesh size in Div. 3NO at depth less than 200 meters. Catch composition shows that this effort form part of a mix fishery with different catch composition in Div. 3N (56% American plaice, 26% yellowtail flounder, 10% cod and 6% skates) than in Div. 3O (57% redfish, 14% American plaice, 12% skates and 7% witch flounder).

The 16% of the Spanish effort in the 2005-2011 period was carried out with 280 mm mesh size in Divisions 3NO at less than 200 meters depth. The target species were the skates (63%) with American plaice (19%), yellowtail flounder (10%) and cod (6%) as main by-catch species.

The 5% of the total Spanish effort was carried out with 40 mm mesh size in depth between 300-500 meters of the Divisions 3LM. The target species of this fishery was the shrimp with 98% of the catches and only a 2% of redfish as by-catch.

The 1% of the total Spanish effort in 2010-2011 was carry out in Div 3M at depth between 150-550 meters targeting cod with a gear with 130 mm mesh size. Most of the hauls were carried out at depth between 300-400 meters. The target species of this fishery was cod with 92% of the catches in weight and the most important species in the by catch was redfish with a 7% of the catches.

Table 1.- Spanish effort in NAFO Subarea 3 percentage for the different mesh sizes by year based on the NAFO Observers information.

Effort %	**Year**							
mesh size	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2005-2011**
Cod 130 mm	0%	0%	0%	0%	0%	1%	1%	0%
40 mm	3%	5%	7%	6%	7%	6%	2%	5%
Demersal 130 mm	88%	83%	74%	70%	68%	80%	73%	79%
280 mm	9%	12%	19%	24%	25%	12%	23%	16%
	100%	100%	100%	100%	100%	100%	100%	100%

Table 2.- List of *alfa* 3 NAFO code, the scientific name and the English name of the species with more than 1% in the catches based on the Spanish scientific Observers data.

Code 3	Scientific_name	English_name
ANG	*Lophius americanus*	American angler
ANT	*Antimora rostrata*	Blue antimora
CAT	*Anarhichas spp*	Wolffishes(=Catfishes) nei
CFB	*Centroscyllium fabricii*	Black dogfish
CLX	*Bivalvia*	Clams, etc. nei
COD	*Gadus morhua*	Atlantic cod
CRQ	*Chionoecetes opilio*	Queen crab
CUX	*Holothurioidea*	Sea cucumbers nei
CVP	*Cottunculus microps*	Polar sculpin
DGH	*Squalidae, Scyliorhinidae*	Dogfishes and hounds nei
ELZ	*Lycodes spp*	Eelpouts
GDE	*Gaidropsarus ensis*	Threadfin rockling
GHL	*Reinhardtius hippoglossoides*	Greenland halibut
GPE	*Phycis chesteri*	Longfin hake
GSK	*Somniosus microcephalus*	Greenland shark
HAD	*Melanogrammus aeglefinus*	Haddock
HAL	*Hippoglossus hippoglossus*	Atlantic halibut
HKW	*Urophycis tenuis*	White hake
KQN	*Actinia equina*	Beadlet anemone
LCT	*Lycodes reticulatus*	Arctic eelpout
NZB	*Nezumia bairdi*	Marlin-spike grenadier
PLA	*Hippoglossoides platessoides*	Amer. plaice(=Long rough dab)
PRA	*Pandalus borealis*	Northern prawn
RED	*Sebastes spp*	Atlantic redfishes nei
RGH	*Argyrosomus thorpei*	Squaretail kob
RHG	*Macrourus berglax*	Roughhead grenadier
RNG	*Coryphaenoides rupestris*	Roundnose grenadier
SAN	*Ammodytes spp*	Sandeels(=Sandlances) nei
SKA	*Raja spp*	Raja rays nei
SQI	*Illex illecebrosus*	Northern shortfin squid
STF	*Asteroidea*	Starfishes nei
SWO	*Xiphias gladius*	Swordfish
URX	*Echinoidea*	Sea urchins, etc. nei
WIT	*Glyptocephalus cynoglossus*	Witch flounder
YEL	*Limanda ferruginea*	Yellowtail flounder

Table 3.- Coverage by year of the NAFO observers and the Spanish Scientific observers in percentage of the Spanish total effort.

	Year						
Observed Effort %	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NAFO Obs	95%	98%	100%	98%	99%	72%	97%
Scientific Obs	15%	13%	17%	21%	16%	26%	20%

Table 4.-Spanish effort in NAFO Subarea 3 with demersal gear with 130 mm mesh size by year and Division based on the NAFO Observers data.

% Effort demersal 130 mm	Year							
Division	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2005-2011**
3L	51%	59%	59%	57%	59%	56%	45%	55%
3M	35%	25%	27%	32%	27%	27%	29%	30%
3N	10%	10%	9%	8%	9%	13%	22%	11%
3O	4%	5%	4%	3%	5%	4%	4%	4%
Total general	100%	100%	100%	100%	100%	100%	100%	100%

Table 5.-Spanish effort in NAFO Subarea 3 with demersal gear with 130 mm mesh size by Division and depth strata based on the NAFO Observers data.

% Effort demersal 130 mm	Division				
Depth Strata	**3L**	**3M**	**3N**	**3O**	**3LMNO**
+600	97%	91%	91%	16%	91%
200-600	3%	8%	8%	74%	8%
-200	0%	0%	1%	10%	1%
Total general	100%	100%	100%	100%	100%

Table 6.-Catch composition (%) by Division of the hauls carried out by the Spanish fleet with demersal 130 mm. gear in depth strata more than 600 meters during the period 2005-2011.

Species	3L	3M	3N	3O	3LMNO
GHL	91%	80%	66%	68%	86%
RHG	3%	7%	5%	8%	4%
RED	1%	3%	5%	0%	2%
PLA	1%	0%	5%	2%	1%
RNG	1%	3%	0%	1%	1%
WIT	0%	1%	6%	5%	1%
SKA	1%	1%	2%	1%	1%
GDE	1%	1%	0%	1%	1%
COD	0%	0%	6%	0%	1%
CAT	1%	1%	0%	0%	1%
NZB	0%	0%	1%	2%	1%
ANT	0%	1%	1%	2%	1%
GSK	0%	0%	0%	0%	0%
HKW	0%	0%	0%	1%	0%
CFB	0%	0%	0%	8%	0%
YEL	0%	0%	1%	0%	0%
GPE	0%	0%	0%	0%	0%
HAL	0%	0%	0%	1%	0%

Table 7.-Catch composition (%) by Division of the hauls carried out by the Spanish fleet with demersal 130 mm. gear in depth strata 200-600 meters during the period 2005-2011.

Species	3M	3N	3O	3LMNO
RED	61%	78%	84%	80%
GHL	23%	7%	0%	4%
PLA	0%	3%	5%	4%
COD	9%	1%	2%	3%
WIT	0%	1%	3%	3%
SKA	4%	1%	1%	1%
YEL	0%	6%	0%	1%
DGH	0%	0%	1%	1%
SQI	0%	0%	1%	1%
HKW	0%	0%	1%	0%
RGH	1%	1%	0%	0%
CAT	0%	0%	0%	0%
HAL	0%	0%	0%	0%
GSK	0%	2%	0%	0%

Table 8.-Catch composition (%) by Division of the hauls carried out by the Spanish fleet with demersal 130 mm. gear in depth strata less than 200 meters during the period 2005-2011.

Species	3N	3O	3NO
PLA	56%	14%	47%
YEL	26%	3%	21%
RED	0%	57%	13%
COD	10%	3%	8%
SKA	6%	12%	7%
WIT	1%	7%	2%
HKW	0%	1%	0%
CAT	0%	0%	0%
GHL	0%	1%	0%

Table 9.-Catch composition (%) by Division of the hauls carried out by the Spanish fleet with 280 mm. mesh size gear during the period 2005-2011.

Species	3N	3O	3NO
SKA	63%	61%	63%
PLA	19%	15%	19%
YEL	10%	10%	10%
COD	6%	3%	6%
CUX	1%	0%	1%
WIT	0%	6%	0%
ANG	0%	1%	0%
RED	0%	3%	0%

Table 10.-Catch composition (%) by Division of the hauls carried out by the Spanish fleet with 40 mm. mesh size gear during the period 2005-2011

Species	3L	3M	3LM
PRA	100%	97%	98%
RED	0%	3%	2%

Table 11.-Catch composition (%)of the hauls carried out by the Spanish fleet with 130 mm. cod mesh size gear during the period 2010-2011

Species	Div. 3M
COD	92%
RED	7%

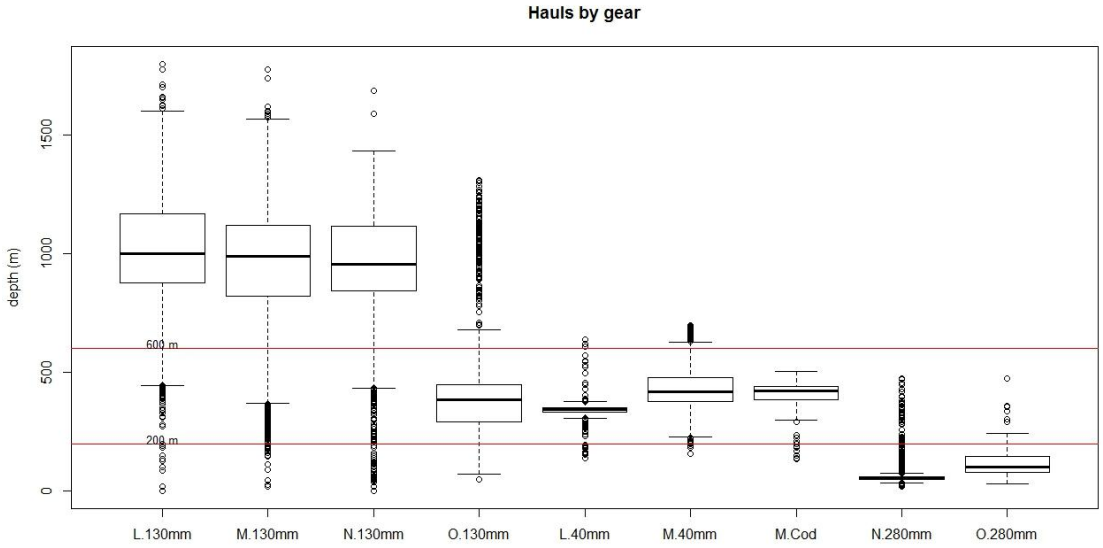

Figure 1.- Depth box plot of the Scientific observed hauls by Division and mesh size for the whole period in Subarea 3.

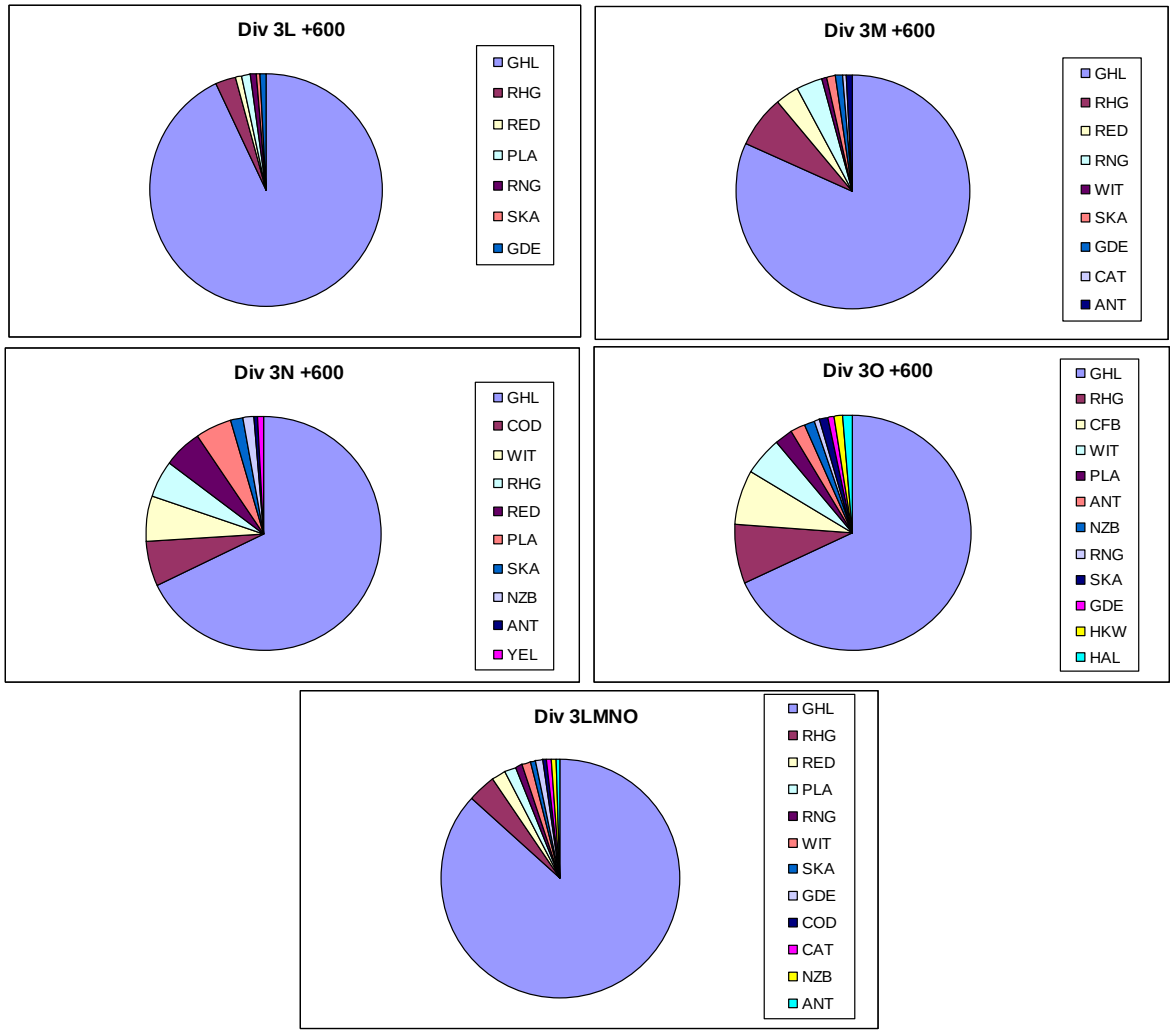

Figure 2.- Catch composition (%) by Division of the hauls carried out by the Spanish fleet with demersal 130 mm. gear in depth strata more than 600 meters during the period 2005-2011.

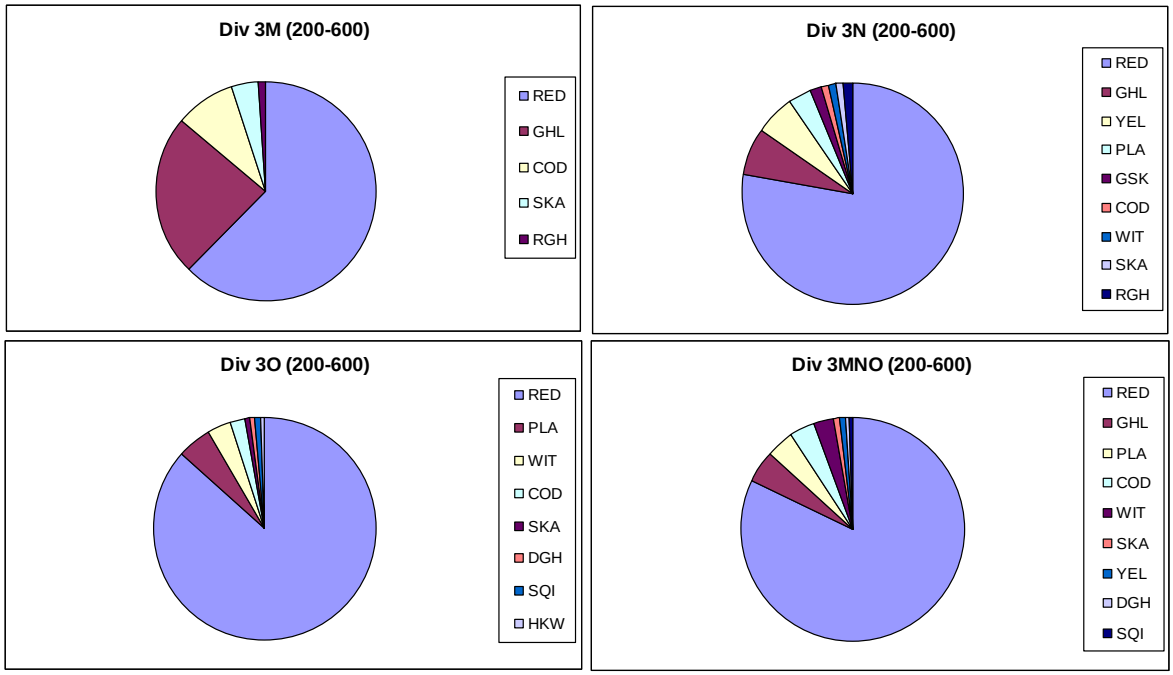

Figure 3.- Catch composition (%) by Division of the hauls carried out by the Spanish fleet with demersal 130 mm. gear in depth strata 200-600 meters during the period 2005-2011.

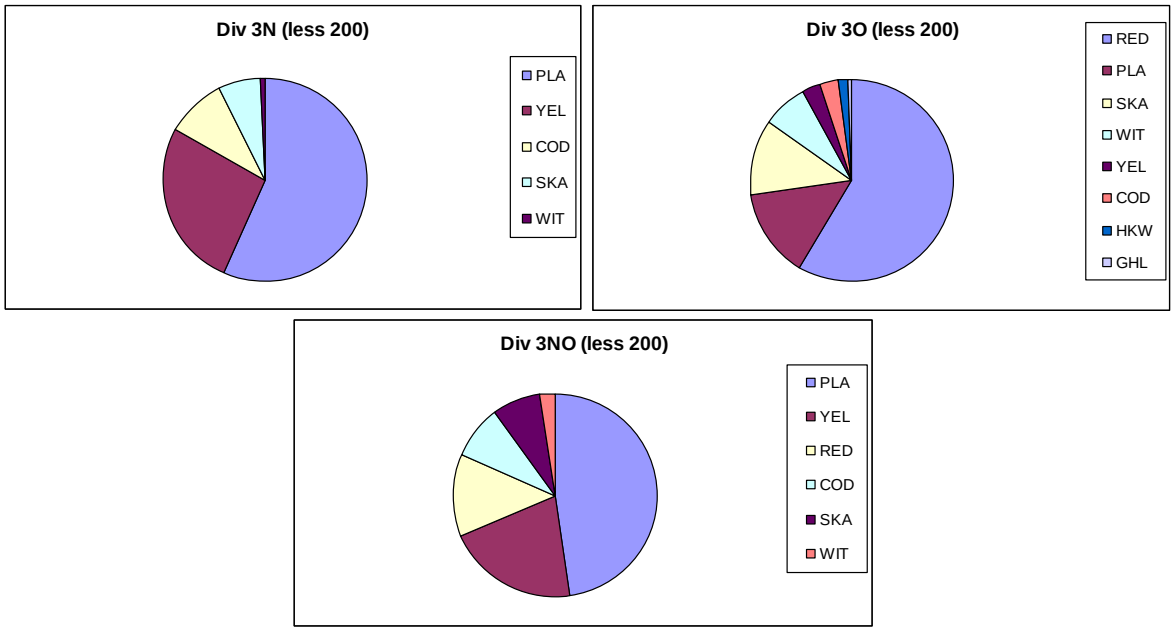

Figure 4.- Catch composition (%) by Division of the hauls carried out by the Spanish fleet with demersal 130 mm. gear in depth strata less than 200 meters during the period 2005-2011.

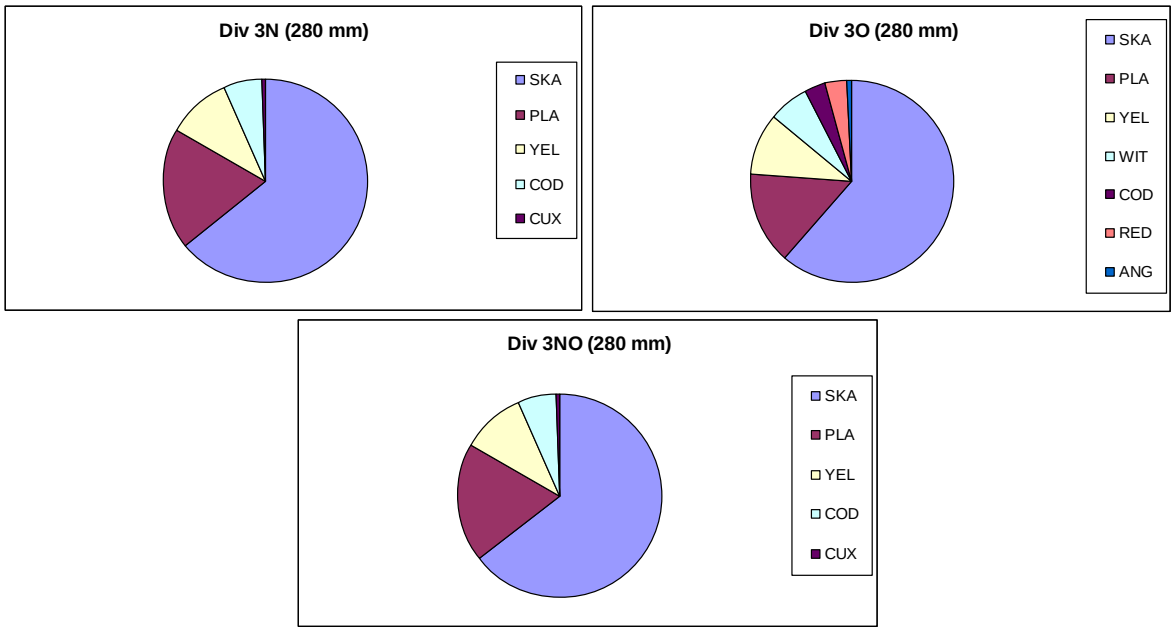

Figure 5.- Catch composition (%) by Division of the hauls carried out by the Spanish fleet with 280 mm. mesh size during the period 2005-2011.

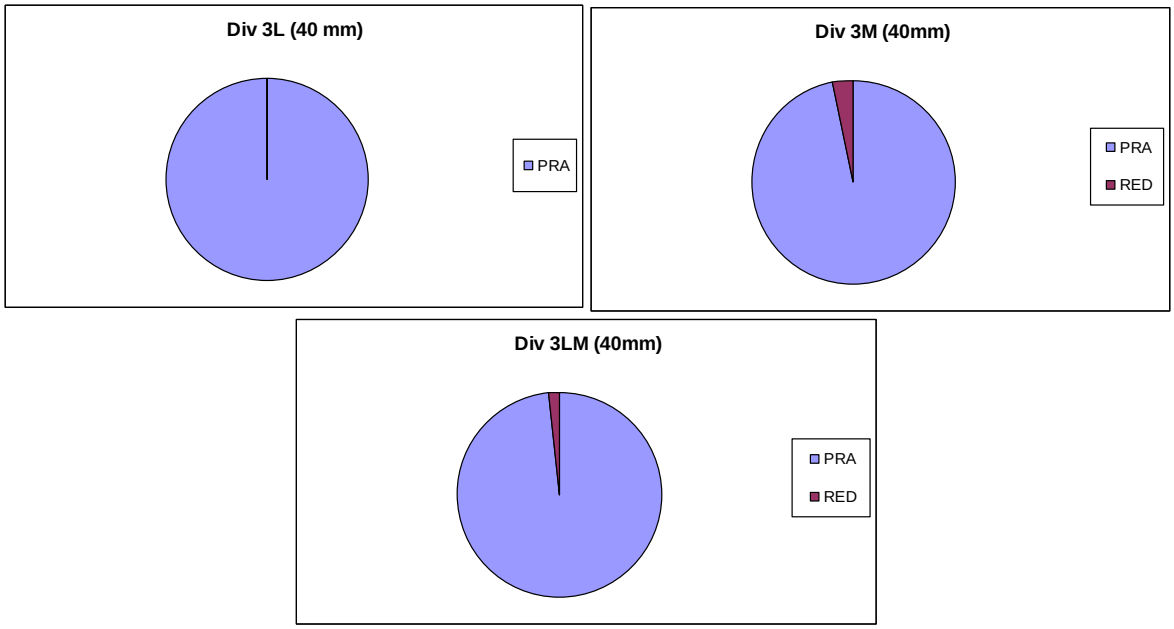

Figure 6.- Catch composition (%) by Division of the hauls carried out by the Spanish fleet with 40 mm. mesh size during the period 2005-2011.

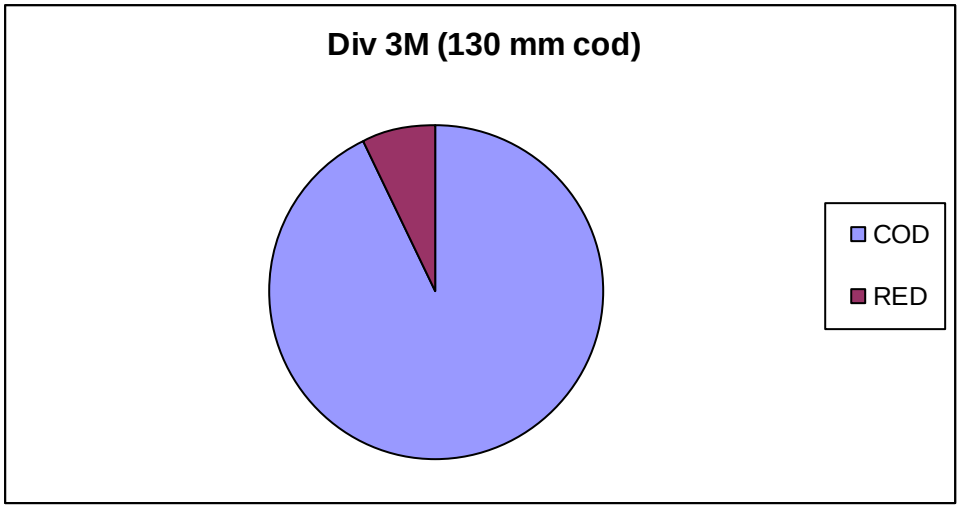

Figure 7.- Catch composition (%) of the hauls carried out by the Spanish fleet with 130 mm. cod mesh size during the period 2010-2011 in Division 3M.