Métiers of the Northern Spanish coastal fleet using fixed gears

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Abstract

Logbooks from the set longline and set gillnet fleets operating in ICES Divisions VIIIc and IXa North during the 2003-2005 period were analysed in order to identify métiers with specific catch profiles. The CLARA method, a non-hierarchical cluster analysis, was used to classify the fishing trips. From the resulting clusters in set longline fleet, only 4 métiers were found to be consistent enough through the time series: 1) targeting conger, 2) targeting hake, 3) targeting pollack, and 4) targeting seabass. Regarding the set gillnet fleet, 2 significant métiers were found: 1) targeting hake and 2) targeting monkfish.

Introduction

The fixed gear fleet operating in the ICES Divisions VIIIc and IXa North is a multispecific and multigear fleet, using mainly gillnet, trammel net, longline and hand line. Except for this last one, whose monoespecific catch profile makes it easier to be studied (Punzón *et al*, 2004), they have been scarcely statistically analysed in the past due to their complexity. As a consequence, a scientific project was requested to the EC in order to deal with this issue in depth: "*Identification and segmentation of mixed-species fisheries operating in the Atlantic Iberian Peninsula waters"* (DG FISH/2004/03-33-IBERMIX).

A **longline** (SLL) consists of a mainline with a number of branch lines of variable length spaced several meters apart. Each branch line carries a baited hook. The gear is fixed on or near the bottom with weights and attached to a buoy. The number of hooks, distance of branch lines on the mainline and length depends on the target species. The Spanish regulations fix the maximum legal number of hooks is 4000.

The **gillnet** (SGN) modality consists of a single netting wall, formed by several rectangular pieces linked to each other, kept vertical by a float line and a weighted groundline. There are three main types of gillnet operating in the area (Pereda *et al*, 1998; Punzón and Gancedo, 1998):

- '*volanta'*: gear targeting hake using a mesh size of 90 mm in depths between 100 and 400 m.
- "*rasco*": gear targeting monkfish using a mesh size of 280 mm in depths between 100-800 m.
- "*beta*": gear with a general mesh size of 60 mm, extended to 80 mm when is targeting sole and hake. It is set in depths less than 150 m.

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The **trammel net**, known by the local name of '*trasmallo'*, is formed by two/three layers of netting with a slack small mesh inner netting between two layers of large mesh netting. The Spanish regulations establish a minimum mesh size of 60 mm for the inner netting and 400 mm for outer nettings. The trammel netters operate on depths lesser than 150 m (Pereda et al, 1998; Punzón and Gancedo, 1998).

The aim of the present analysis is to identify the most important metiers of the Spanish fleet using fixed gears in ICES Divisions VIIIc and IXa North according to the basis and métier definition established by the "ICES Study group on the Development of Fishery-based forecast" (SGDFF, 2003).

Material and Methods

The data comes from the official logbooks (vessels larger than 10 m) for the period 2003-2005, provided by the Spanish Ministry of Agriculture, Fisheries and Food (MAPA). The original database was depurated for the analysis, and the information used was fishing ICES statistical rectangle, effort (number of fishing trips), date of landing, landed weight by species, and type of gear. The technical fleet characteristics are also compiled from official census. Due to the lack of WGHMM stocks in the trammel net landings, analysis were focused on set longline and set gillnet. The numbers of fishing trips were 19762 for SLL and 65488 for SGN for the period 2003-2005. The species selection was based on three criteria: higher landings, important accompanying species and greater probability of correct identification.

A non-hierarchical cluster analysis, the CLARA (Clustering Large Applications) method, was performed to classify the catch profiles in order to obtain the most appropriate métiers. This analysis is based in the "Partitioning Around medoids" method (PAM), identifying from the dissimilarity matrix as many medoids as the number of clusters to be extracted and assigning each element to the nearest medoid, but it is adapted to large data sets (Kaufman and Rousseeuw, 1990). The PAM method could be directly used in vessel segmentation based on technical characteristics because sample data is much more reduced. Both the methods provide a coefficient (ASW: average silhouette width) which indicates the cluster consistency.

The multivariate analysis was made with R software.

Results

Previously to the multivariate analysis, an exploratory analysis of landings shows that SGN total landings are around the double of the SLL landings along the time series. However, the SGN effort is more than three times the SLL effort. Regarding the catch composition, the SGN strategy seems to be more efficient catching monkfish, hake, mullets, mackerel, horse mackerel, and Norway pout. On the other hand, SLL takes most of the landings of conger, blue whiting, and forkbeards.

In relation to the technical features, an average of 250 and 350 vessels have used the SLL and SGN gear modalities respectively. On one hand, the SLL fleet presented an average of 14 m length, 133 HP, and 21 GRT. On the other hand, the SGN vessels show an average of 14 m length, 120 HP, and 18 GRT.

Set longline (SLL)

The number of species was reduced to 15 species or species groups and one category called 'others' that joins the rest of species. The multivariate analysis was carried out by year separately, obtaining ASW coefficients higher than 0.6 in all of years (Figures 1 and 2). In spite of obtaining a different number of clusters each year (Table 2a-c, Figure 3), six common trip types can be followed trough the time series:

- 4 "clean" clusters:
  - **SLL-COE**: Trips targeting conger.
  - **SLL-HKE**: Trips targeting hake.
  - **SLL-POL**: Trips targeting pollack.
  - **SLL-BSS**: Trips targeting seabass.
- 2 mixed clusters:
  - Trips targeting sharks, forkbeards, and mackerel.
  - Trips targeting a high variety of species ('others').

Two clusters more are obtained in 2003, however their catch profiles indicate they are a subdivision of the trip targeting sharks, forkbeards and mackerel mentioned above. This trip type shows the lowest SC from all the clusters in all the years (Figure 2). As a consequence, this trip type could be merged into the "others" trip type without losing consistency (**SLL-mixed**). In 2005, one cluster more is obtained besides the 6 permanent clusters, in which Atlantic pomfret represents more than 93%. This "clean" trip type is a sporadic fishery whose activity depends on the migration of the species, reaching so high latitudes only under specific oceanographic conditions.

A monthly analysis (Figure 4) shows the higher effort to be concentrated on spring (particularly in May and June) and autumn (including the last month of the summer). SLL-HKE and SLL-COE are concentrated in spring, while the autumn fisheries are those from SLL-BSS and SLL-POL. Effort reduction observed during the first half of 2003 was due to several fishing restrictions established as a consequence of the Prestige oil spill occurred in the study area.

The geographical distribution of the trip types obtained show that the highest effort is mainly located in the Cantabrian waters (Map 1). SLL-POL has a distribution located in western Galician waters while SLL-HKE and SLL-BSS are more abundant in the central Cantabrian Sea.

Regarding the multivariate analysis of the technical features of the SLL fleet, two clusters were obtained (figure 9). The value of SC in the second cluster, very close to 0, indicates low consistency. Taking account this, the SLL fleet can be considered as a homogenous group.

Set gillnet (SGN)

The number of species was reduced to 18 species or species groups and one category called 'others' that joins the rest of species. The multivariate analysis was carried out by year separately, obtaining ASW coefficients around 0.5 in all of years (Figures 5 and 6). However, a different number of clusters was obtained by year (Table 3a-c, Figure 7), being kept constant only two of them along the time series, trips targeting monkfish (**SGN-MNZ**) and trips targeting hake (**SGN-HKE**). The rest of clusters are mixed clusters compounded by a different combination of species where, if a some

type of pattern was needed to be defined, they could be divided into trips targeting benthonic species (as crustaceans, cuttlefish, and benthonic sharks), and trips targeting a combination of demersal and pelagic species as mackerel and horse mackerel. The only clusters with enough significance through all the period are SGN-MNK, SGN-HKE and trips targeting "others", with ASW>0.7. The rest of the clusters can not be considered consistent enough to keep independent and could join "others" cluster.

In Figure 8 an increase in number of fishing trips can be observed from May to September. Nevertheless, SGN-HKE and SGN-MNZ do not show any clear seasonal pattern.

The effort level is more uniformly distributed along the coast, however trips targeting monk seem to be more concentrated in the Cantabrian Sea while the trips targeting hake are more common in the North Galician waters (Map 2).

Regarding the multivariate analysis of the technical features of the fleet, two clusters were obtained (Figure 9). As in SLL, the second cluster gives a very low SC. Taking into account this, fleets have been considered as one group. Information about gear type ("volanta", "rasco"…) is not on logbooks. In consequence, a correspondence analysis between this and technical features is not possible.

Discussion and Conclusions

Taking into account diagnostics and results, only those trip types with high SC values and a regular continuity along the time should be included in monitoring programmes and identified if management plans had to be implemented. As a result, the following SLL trip types have been identified as feasible to be followed in the time:

1. Trips targeting conger.
2. Trips targeting hake.
3. Trips targeting pollack.
4. Trips targeting seabass.
5. Mixed trips.

Regarding the SGN fleet, it could be split into the following trip types that show the consistency enough to be monitored along time:

1. Trips targeting monkfish.
2. Trips targeting hake.
3. Mixed trips.

Although a correspondence analysis can not be realised, the historical behaviour of the fleet shows that SGN-MNZ is related to "rasco" and SGN-HKE to "volanta".

On the other hand, the categorization of the fleet by using their technical features is limited as long as the official logbooks do not include information from vessels smaller than 10 m. The small scale fleet is probably very important in the fisheries considered, especially in the coastal areas. If it was included, two clear vessels groups could have resulted from the analysis as it was observed analysing other artisanal fleets (Punzón et al, 2004).

References

Kaufman, L. and Rousseeuw, P. J. (1990) Finding Groups in Data: An Introduction to Cluster Analysis. A Wiley-Interscience Publication. John Wiley & Sons, Inc. New York.

Pereda, P., A. Punzón and J. Landa (1998) The "rasco": a gillnet fishery for Anglerfish (*Lophius piscatorius* L., 1758 and *L. budegassa* Spinola, 1807) in the Cantabrian Sea (ICES Division VIIIc). ICES CM 1998/O:46.

Punzón, A. and R. M. Gancedo (1998) Specific characterisation and identification of the fishing gears in use in the Cantabrian Sea (NE Atlantic, Northern Spain). ICES CM 1998/U:7.

Punzón, A., Villamor, B., Preciado, I., 2004. Analysis of the handline fishery targeting mackerel (Scomber scombrus, L.) in the North of Spain (ICES Division VIIIbc). Fish. Res. 69,189–204.

SGDFF (2003) Report of the Study Group on the Development of Fishery-based Forecasts. ICES CM 2003/ACFM:08 Ref. D.

Table 1. Contribution by fleet to the catches of the most important species managed in the ICES Divisions VIIIc and IXa North for the period 2003-2005: **SLL** (setlongline fleet) and **SGN** (setgillnet fleet).

	2003		***2004***		***2005***	
	SLL	**SGN**	**SLL**	**SGN**	**SLL**	**SGN**
Conger conger	99.3	0.7	97.8	2.2	99.1	0.9
Dicentrarchus labrax	78.8	21.2	78.6	21.4	58.0	42.0
Elasmobranchii	72.8	27.2	65.5	34.5	58.4	41.6
Lophius spp	0.1	99.9	0	100	0	100
Merluccius merluccius	10.9	89.1	13.8	86.2	12.6	87.4
Micromesistius poutassou	98.9	1.1	84.9	15.1	87.7	12.3
Mullus spp	9.1	90.9	2.1	97.9	1.8	98.2
Phycis spp	96.6	3.4	98.2	1.8	98.4	1.6
Pollachius spp	60.8	39.2	72.3	27.7	67.9	32.1
Scomber spp	20.5	79.5	32.7	67.3	25.3	74.7
Trachurus trachurus	4.9	95.1	3.0	97.0	2.8	97.2
Trisopterus spp	5.8	94.2	5.8	94.2	3.8	96.2
Others	30.1	69.9	26.9	73.1	23.9	76.1
TOTAL LANDINGS (t)	1115	2024	1481	2903	3383	4183
EFFORT (days)	4868	17468	7517	22983	7377	26986

Tables 2a, 2b, 2c. 2003-2005 catch profiles of each trip type identified in the setlongline fleet (**SLL**) operating in the Northern Spanish coastal waters.

2003	Clus 1	Clus 2	Clus 3	Clus 4	Clus 5	Clus 6	Clus 7	Clus 8
Belone belone	0	0.94	0	0	0	0	0	0
Beryx spp	0	9.33	0.03	0.63	0.12	0	0	0.04
Brama brama	0	7.74	0	0.33	0.04	0	0	0.08
Conger conger	**94.62**	**15.31**	1.22	9.00	0.92	0.44	0.23	0.03
Dicentrarchus labrax	0.10	0.61	0	0	0.57	0	**77.18**	1.07
Elasmobranchii	0.05	0.60	0.02	3.36	0.82	**96.11**	0.07	0
Merluccius merluccius	0.01	1.34	**83.58**	0.17	1.55	0	0	0
Micromesistius poutassou	0	6.85	2.33	0.32	1.73	0	0	0.14
Phycis spp	1.72	2.60	0.30	**70.82**	2.85	1.65	0	0
Pollachius spp	0.03	1.95	0.28	0.03	0.38	0	3.95	**89.27**
Polyprion americanus	0.06	2.18	0.02	0.88	0.25	0.09	0	0.02
Scomber scombrus	0	**12.50**	3.17	0.01	0.01	0	0	0
Sparidae	0.24	**19.61**	2.79	0.04	0.54	0.09	**11.64**	2.89
Trachurus spp	0.07	2.03	0.94	0	0.07	0.00	0	0.35
Trisopterus spp	0.09	3.41	0.55	0.04	0.38	0.01	0.01	0
Others	3.02	**12.99**	4.76	**14.37**	**89.77**	1.62	6.93	6.10
TOTAL LANDINGS (t)	362	191	92	115	95	187	20	53
EFFORT (days)	1284	1052	278	498	614	205	488	449

2004	Clus 1	Clus 2	Clus 3	Clus 4	Clus 5	Clus 6
Belone belone	0	0	2.35	0	0	0
Beryx spp	0.07	0.35	4.81	0	0.12	0
Brama brama	0	0.02	2.46	0	0.00	0.05
Conger conger	**93.19**	0.63	6.36	0.27	2.08	0.05
Dicentrarchus labrax	0.08	0	0.01	**59.68**	0.28	0.81
Elasmobranchii	0.22	0.12	**28.65**	0.01	0.30	0.00
Merluccius merluccius	0.04	**82.87**	0.67	0.25	0.67	0.07
Micromesistius poutassou	0	1.32	2.78	0	2.45	0
Phycis spp	2.05	0.16	**22.55**	0.02	0.59	0
Pollachius spp	0.06	0.16	0.28	2.77	1.00	**89.69**
Polyprion americanus	0.09	0	0.95	0	0.22	0.05
Scomber scombrus	0.02	8.40	**13.91**	0.06	0	0.01
Sparidae	0.56	1.06	5.15	**32.47**	0.84	2.30
Trachurus spp	0.01	0.75	0.83	0.57	0.00	0.02
Trisopterus spp	0.52	0.79	0.83	0.12	0.88	0.01
Others	3.11	3.37	7.41	3.77	**90.56**	6.94
TOTAL LANDINGS (t)	539	146	504	52	122	118
EFFORT (days)	1772	705	1638	1260	1032	1110

2005	Clus 1	Clus 2	Clus 3	Clus 4	Clus 5	Clus 6	Clus 7
Belone belone	0	1.99	0	0	0	0	0
Beryx spp	0.35	**11.56**	0	0	0	0	0.02
Brama brama	0.31	0.01	**99.46**	0	0	0	0
Conger conger	0.53	4.13	0.03	3.14	0.11	0.13	**93.06**
Dicentrarchus labrax	0	0.20	0	0.24	**85.36**	1.38	0.04
Elasmobranchii	0.01	**19.52**	0	5.10	0	0	0.11
Merluccius merluccius	**87.12**	1.42	0.38	3.87	0.01	0.12	0.03
Micromesistius poutassou	1.46	1.85	0.02	0.56	0	0	0.02
Phycis spp	0.52	**20.01**	0	2.95	0	0	3.28
Pollachius pollachius	0.36	0.36	0.04	1.24	1.50	**89.69**	0.07
Polyprion americanus	0.02	0.80	0	0.35	0	0.04	0.06
Scomber scombrus	3.06	**26.07**	0	0.04	0.01	0.01	0.01
Sparidae	1.14	6.60	0	0.71	8.87	2.53	0.23
Trachurus trachurus	0.31	0.89	0	0.08	0	0.13	0.02
Trisopterus spp	0.18	0.56	0.01	0.72	0	0.03	0.34
Others	4.63	4.03	0.04	**81.00**	4.14	5.94	2.71
TOTAL LANDINGS (t)	181	543	1837	111	28	104	579
EFFORT (days)	850	1798	422	683	727	952	1945

Tables 3a, 3b, 3c. 2003-2005 catch profiles of each trip type identified in the setgillnet fleet (**SGN**) operating in the Northern Spanish coastal waters.

2003	Clus 1	Clus 2	Clus 3	Clus 4	Clus 5	Clus 6	Clus 7	Clus 8	Clus 9	Clus 10
Beryx spp	0.52	0.27	0	0	2.21	0	0.47	0.00	0	0
Crustaceans	**13.76**	0.02	0	0.31	0	0.20	2.90	0.06	0	0.08
Dicentrarchus labrax	1.63	0.01	0.08	0.17	0.11	0	0.24	0.13	0	0.10
Dicologlossa cuneata	0.58	0	0	0.05	0.01	0.01	0.33	0.01	0	0.04
Elasmobranchii	**13.87**	0.24	0.43	0.73	0.65	1.02	**68.04**	0.64	0.02	1.01
Loliginidae	0.36	0.05	0.22	0.02	0.08	0	0.05	0.04	0	0.03
Lophius spp	**19.72**	0.38	0.84	1.14	1.66	**94.08**	**11.29**	1.18	0.06	0.89
Merluccius merluccius	1.90	**63.03**	3.94	1.93	**31.31**	0.24	1.06	**19.41**	**93.12**	**15.57**
Micromesistius poutassou	0.02	0.03	0	0.01	0	0	0	0	0	0.02
Mullus spp	0.62	0.69	**29.97**	1.50	1.82	0.02	0.05	0.48	0.11	1.63
Octopodidae	1.76	0.07	0.61	0.17	0.30	0.03	0.38	0.06	0.00	0.39
Phycis spp	0.44	0.02	0	0.07	0.06	0	0.01	1.16	0.09	0.11
Pleuronectiformes	6.92	0.03	0.16	0.40	0.35	0.61	4.87	0.17	0.00	0.50
Scomber spp	0.32	1.71	0.77	0.22	2.35	0.05	0.14	**61.57**	1.24	1.89
Sepia officinalis	8.27	0.03	0.50	0.36	0.22	0.02	0.90	0.03	0.05	0.37
Sparidae	1.77	0.35	4.62	0.50	7.35	0.05	0.60	0.24	0.29	1.06
Trachurus spp	0.42	0.58	**20.86**	0.65	**29.04**	0.09	0.19	5.90	0.83	4.36
Trisopterus spp	2.03	2.42	**13.17**	1.02	7.75	0.12	1.25	5.34	0.76	**65.85**
Others	**25.10**	**30.07**	**23.82**	**90.76**	**14.73**	3.49	7.23	3.56	3.43	6.11
TOTAL LANDINGS (t)	223	236	104	255	204	288	43	139	423	109
EFFORT (days)	3110	1991	1704	3377	1381	1739	413	481	1981	1291

2004	Clus 1	Clus 2	Clus 3	Clus 4	Clus 5	Clus 6	Clus 7	Clus 8	Clus 9	Clus 10
Beryx spp	0	0.01	2.04	0.04	0	0.24	0.18	0	0	0
Crustaceans	0	0.23	0.50	**19.04**	0.01	0.02	0.12	0.03	4.97	0.08
Dicentrarchus labrax	0	0.03	1.33	1.10	0.06	0.02	0.22	0.02	2.08	0.22
Dicologlossa cuneata	0	0	0.32	0.44	0.02	0	0.06	0	0.30	0.06
Elasmobranchii	0.01	1.91	3.98	**24.99**	0.13	0.33	0.27	0.47	6.00	1.15
Loliginidae	0.02	0.02	0.42	1.13	0.11	0.03	0	0.31	0	0
Lophius spp	0.11	**92.89**	5.36	**14.98**	0.72	1.21	0.89	0.69	3.79	0.54
Merluccius merluccius	**94.02**	0.30	7.28	1.17	**17.48**	**60.52**	1.58	3.22	0.44	**14.70**
Micromesistius poutassou	0	0	0.22	0.02	0.42	0.02	0.02	0.01	0	0.74
Mullus spp	0.12	0.04	5.96	0.29	0.56	0.99	0.28	**59.64**	0.12	1.60
Octopodidae	0.01	0.01	0.81	4.22	0.08	0.19	0.06	0.52	1.92	0.71
Phycis spp	0.04	0.03	0.24	0.15	0.01	0.09	0.08	0	0	0.04
Pleuronectiformes	0	0.54	2.17	6.23	0.09	0.06	0.23	0.04	5.24	0.26
Scomber spp	1.03	0.16	1.34	0.11	**65.07**	4.74	0.11	0.49	0.14	9.48
Sepia officinalis	0.01	0.07	1.54	6.62	0.04	0.06	0.15	0.92	**60.40**	0.52
Sparidae	0.20	0.03	5.31	0.67	0.09	1.07	0.21	2.68	1.12	0.94
Trachurus spp	0.46	0.06	**22.38**	6.98	7.05	7.00	0.45	6.15	0.04	**17.18**
Trisopterus spp	0.38	0.10	8.10	0.43	4.74	1.84	0.12	3.15	0.83	**46.57**
Others	3.57	3.56	**30.70**	**11.39**	3.33	**21.56**	**94.96**	**21.65**	**12.61**	5.20
TOTAL LANDINGS (t)	431	618	364	175	179	461	385	55	24	211
EFFORT (days)	1967	2623	3979	1949	608	3098	5302	1108	331	2018

2005	Clus 1	Clus 2	Clus 3	Clus 4	Clus 5	Clus 6
Beryx spp	0	0.84	0.44	0.07	0.05	0
Crustaceans	**57.34**	2.14	0.03	0	0.29	0.20
Dicentrarchus labrax	0.61	3.58	0.05	0	0.15	0
Dicologlossa cuneata	0.10	0.48	0.01	0	0.04	0
Elasmobranchii	4.43	**12.70**	0.33	0.02	0.31	1.07
Loliginidae	0.68	1.46	0.05	0.02	0.08	0.08
Lophius spp	2.42	8.98	0.77	0.14	0.69	**96.18**
Merluccius merluccius	0.18	5.43	**21.22**	**88.33**	1.30	0.04
Micromesistius poutassou	0	0.06	0.14	0.01	0	0
Mullus spp	0.03	**12.65**	1.40	0.13	0.43	0.03
Octopodidae	0.73	1.00	0.08	0.01	0.03	0
Phycis spp	0.01	0.09	0.07	0.06	0.02	0.01
Pleuronectiformes	2.31	3.96	0.14	0.01	0.33	0.05
Scomber spp	0.04	0.82	**36.94**	1.46	0.06	0.25
Sepia officinalis	**21.01**	4.28	0.13	0	0.19	0.02
Sparidae	0.82	3.81	1.53	0.30	0.28	0.02
Trachurus spp	0.01	2.04	**15.69**	1.59	0.36	0.01
Trisopterus spp	0.58	4.06	**11.50**	0.78	0.50	0.02
Others	8.69	**31.63**	9.47	7.08	**94.90**	2.02
TOTAL LANDINGS (t)	92	503	1116	1078	442	1044
EFFORT (days)	1319	6594	5924	4101	5597	3451

Figure 1. "Average Silhouette Width" (ASW) for 2 to 10 clusters for the SLL fleet by year.

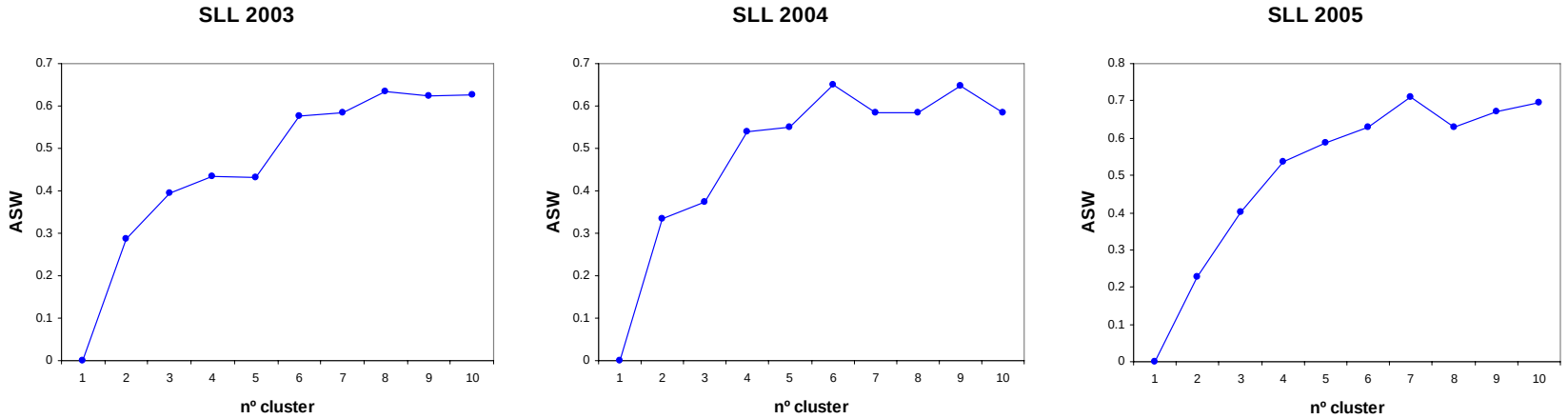


Figure 2. Silhouette plots for the two clusters obtained in the SLL fleet by year.

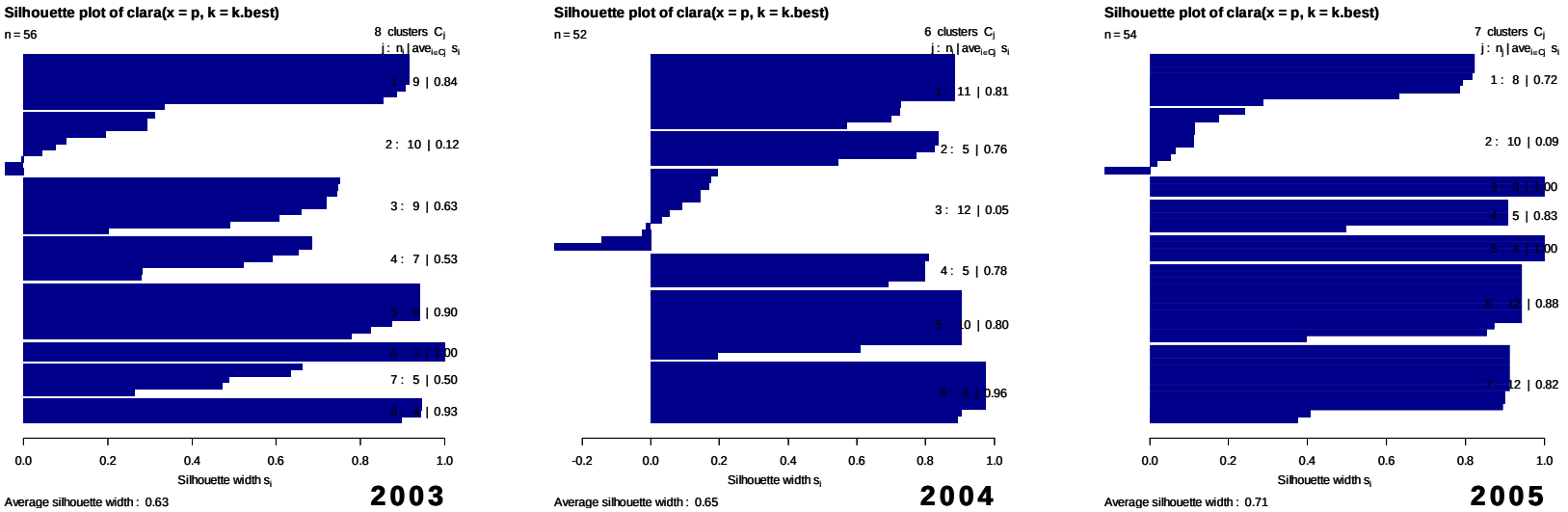


Figure 3. Catch profiles of the clusters obtained in the SLL fleet by year.

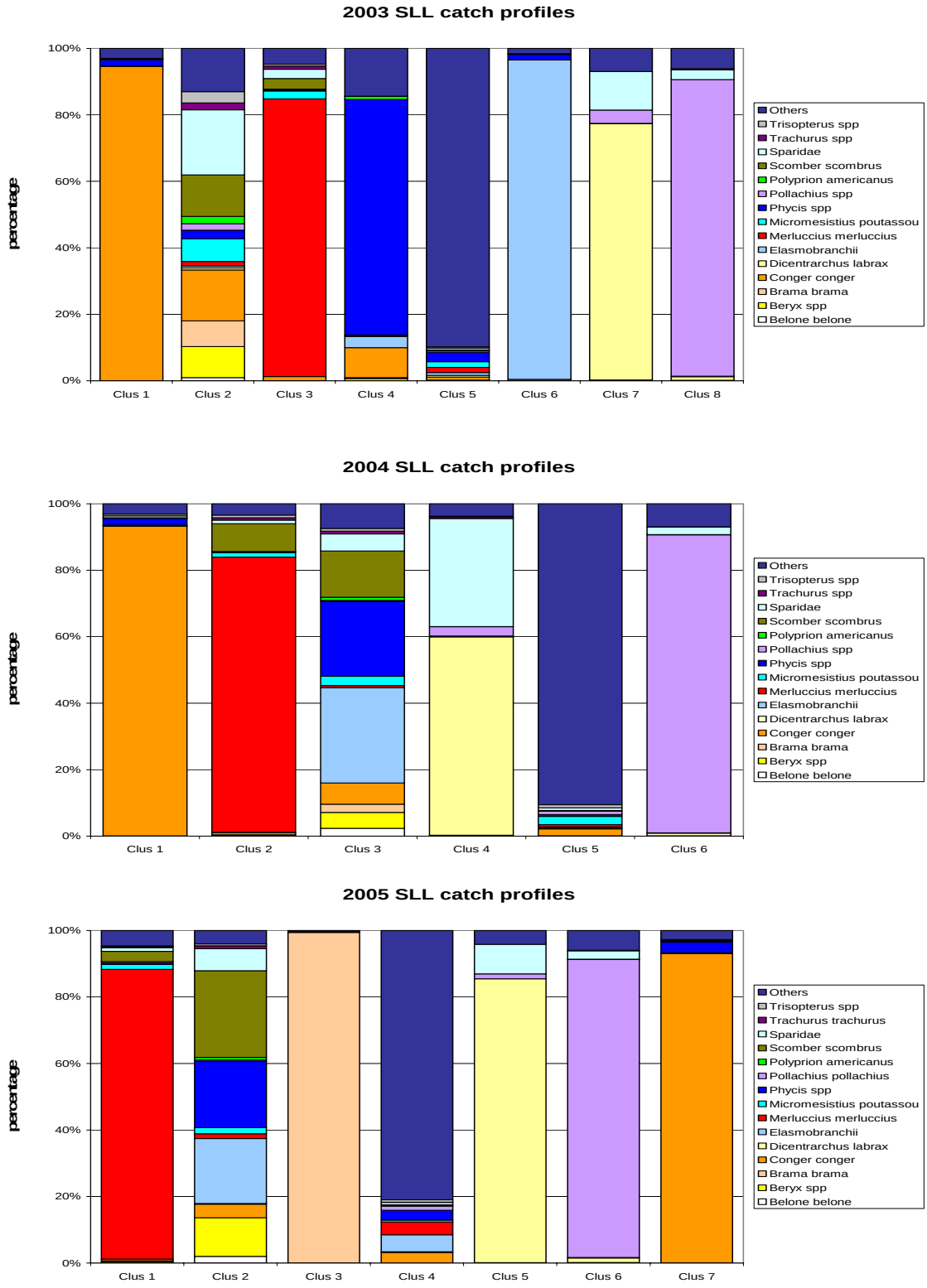
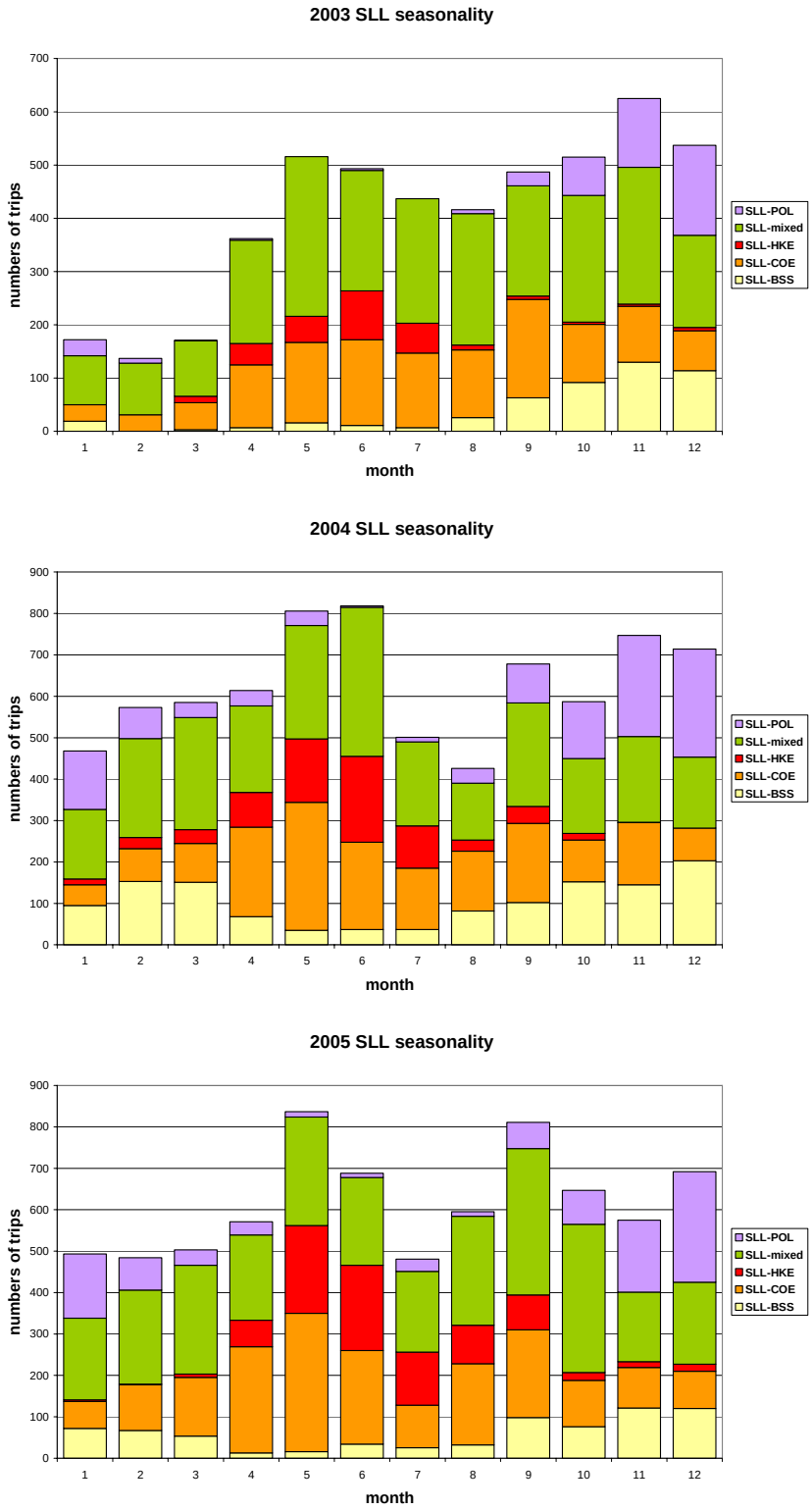
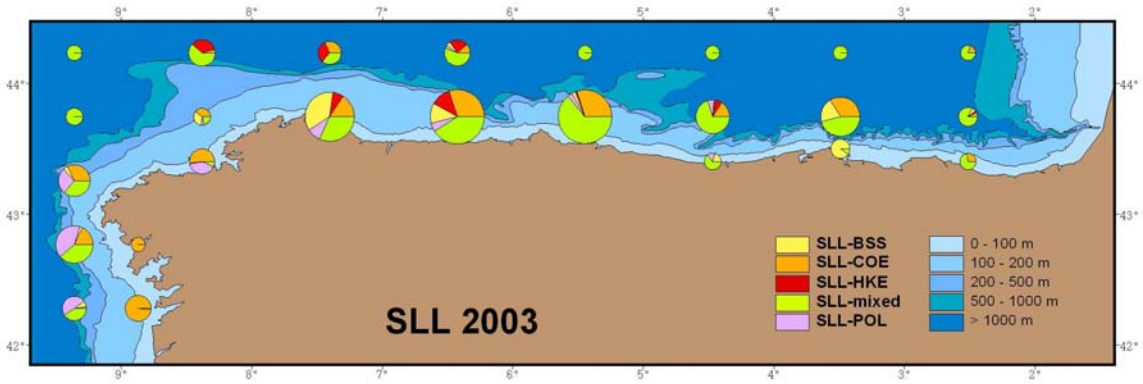
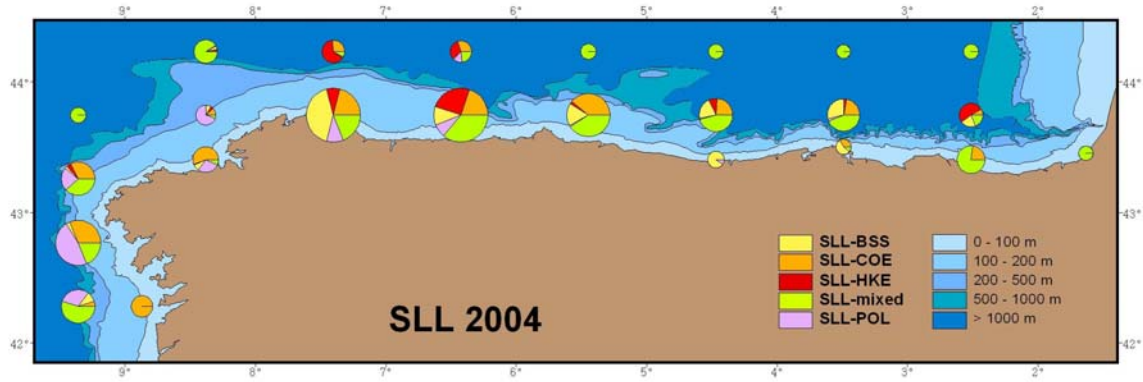


Figure 4. Seasonality for the trip types selected in the SLL fleet by year.



Map 1. Geographical distribution of the trip types selected in the SLL fleet by year.





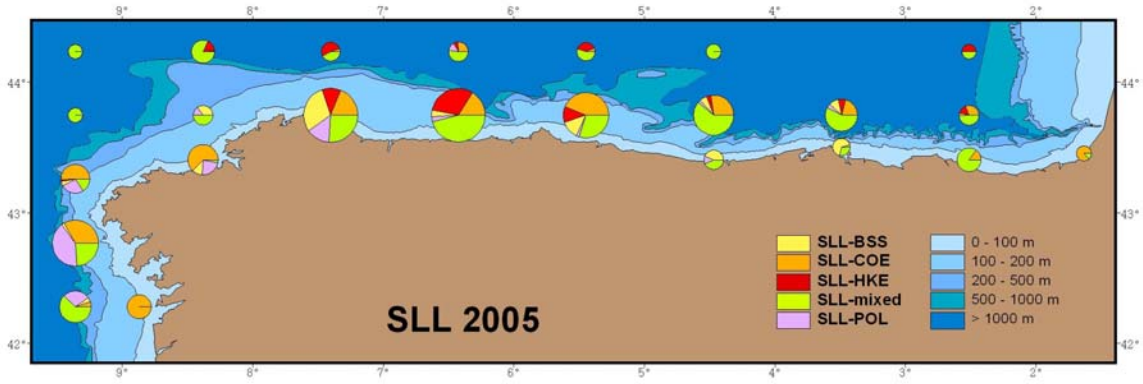


Figure 5. "Average Silhouette Width" (ASW) for 2 to 10 clusters for the SGN fleet by year.

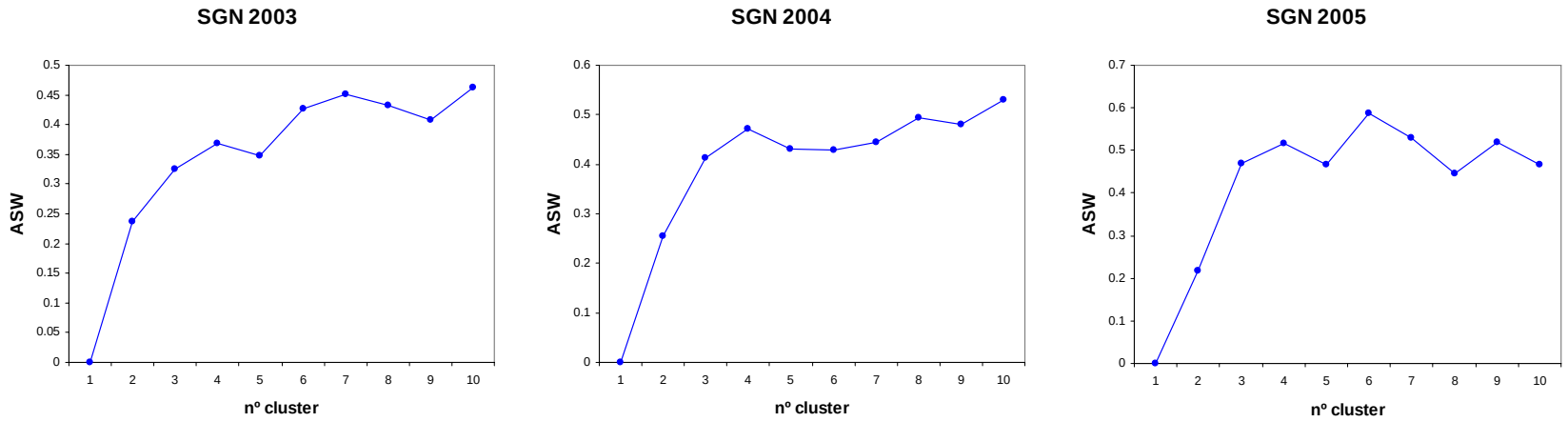


Figure 6. Silhouette plots of the highest ASW for the SGN fleet by year.

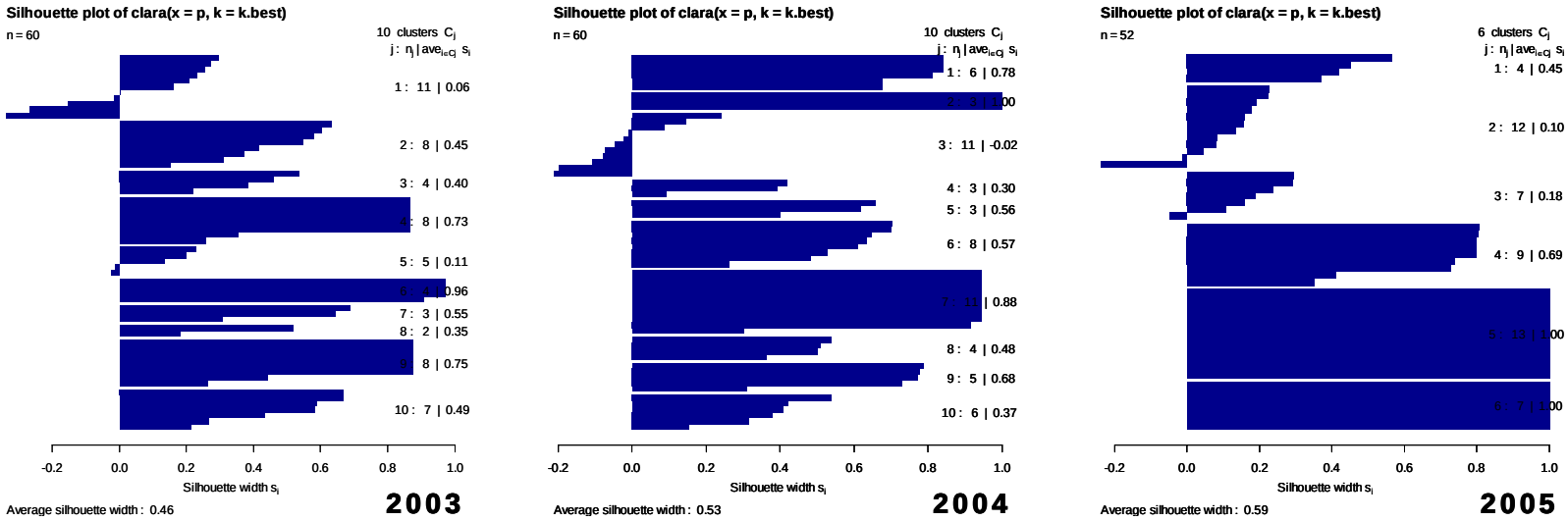


Figure 7. Catch profiles of the clusters obtained in the SGN fleet by year.

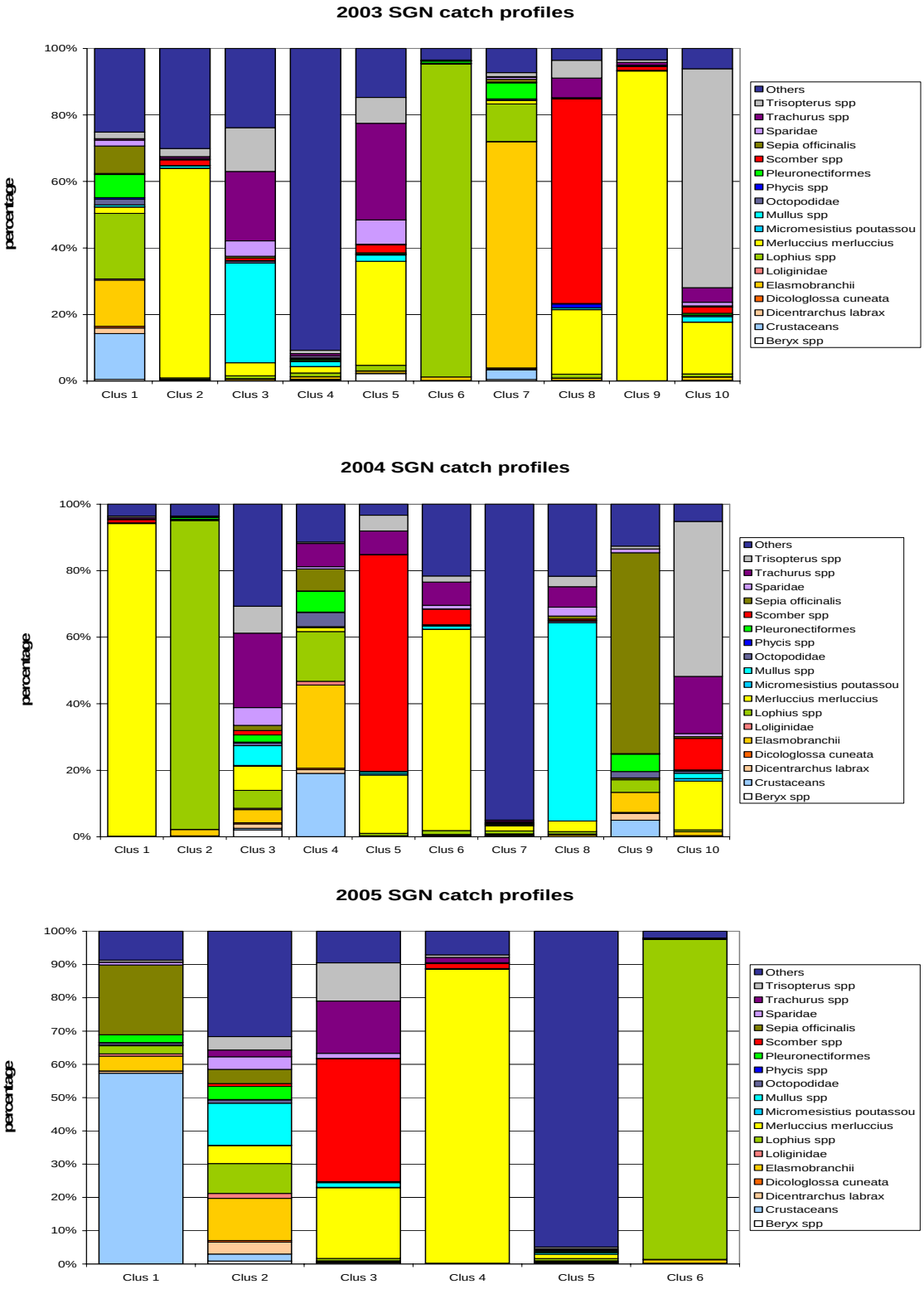
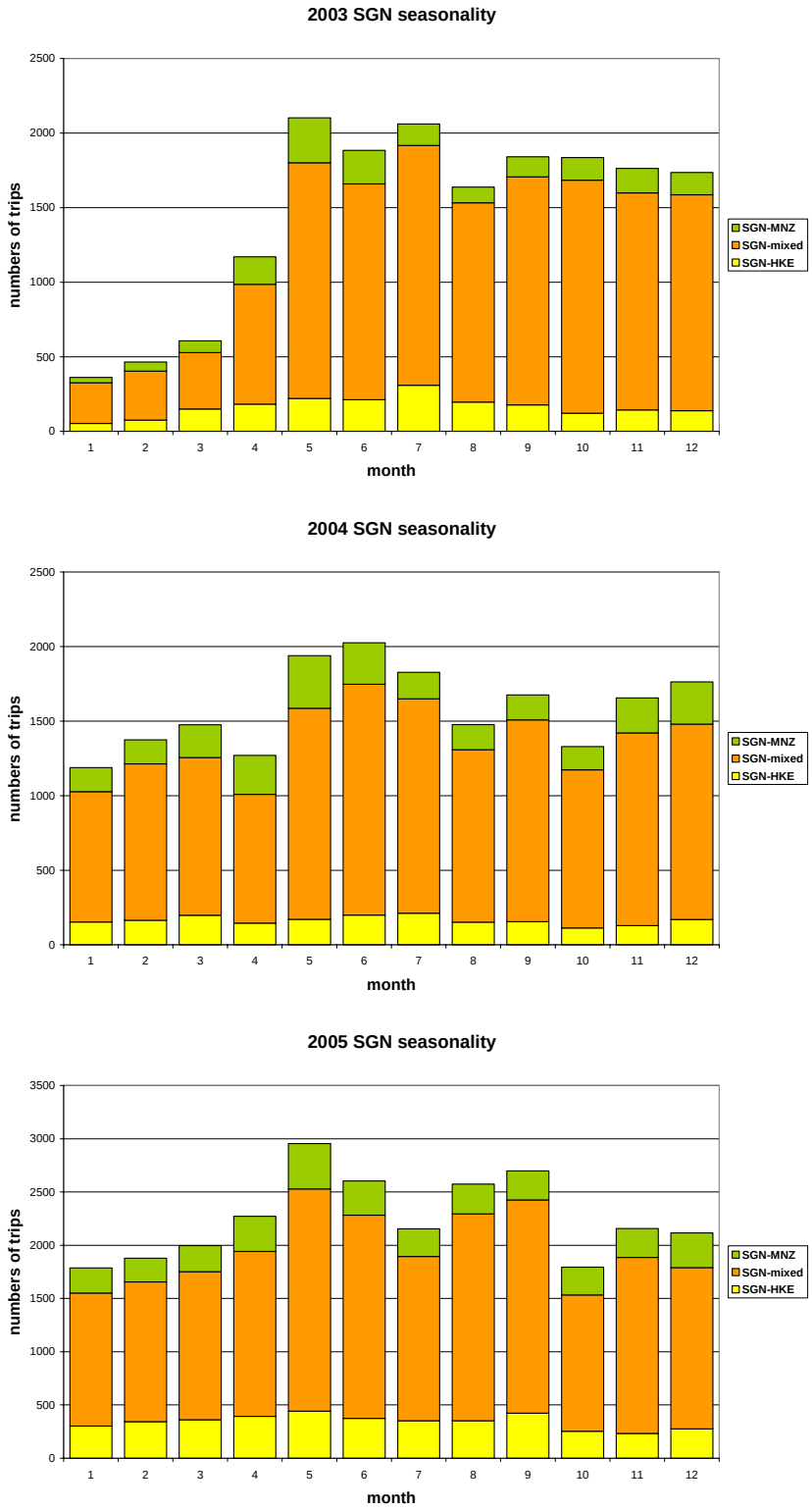


Figure 8. Seasonality of the trip types selected in the SGN fleet by year.



Map 2. Geographical distribution of the trip types selected in the SGN fleet by year.

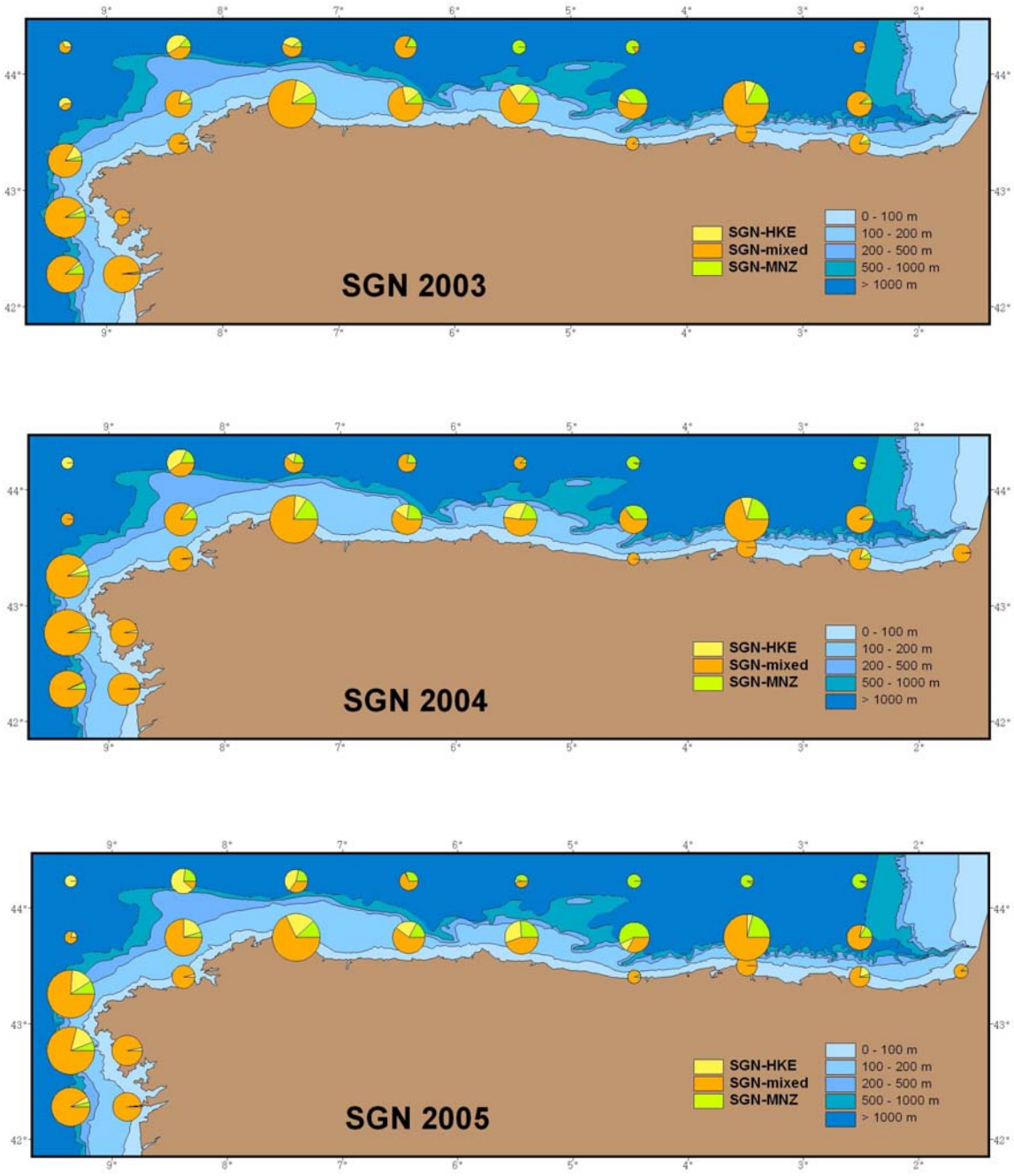


Figure 9. Silhouette plots of the highest ASW for the technical features of SLL and SGN fleets.