Alternative approaches to the segmentation of the EU fishing fleets

Workshop II - 28-30th March 2022

Previous experiences, tests for application in the French context and recommendations

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Résumé/ Abstract : Summary of the test of the alternative segmentation tool on the French fleets. Previous experiences and limits of the current EU-MAP fleet segmentation are presented. In light of these issues, the benefits of different alternative fleet segmentations are developed. Issues raised by data limitation for proposed alternative segmentation tool are also raised. Finally, application exercise of the alternative segmentation tool on the French national fleets operating in the supra-region Atlantic are summarised which lead to a flowchart proposal for the segmentation of the EU fleet taking into consideration all the issues highlighted before.	
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1 Executive summary

Context and issues

Since 2001 and the first Data collection Regulation in support of the Common Fisheries Policy (EU Regulation 1639/2001), a segmentation of the EU fishing fleet has been in force to collect data and provide aggregated indicators. The current Multiannual Union Programme (EU Regulation 1004/2017 EU-MAP) segmentation inherited from the former Data Collection Framework (DCF, 2009), based on both the main gear used and the vessels' length is often considered imperfect insofar as it may group together vessels with heterogeneous technical characteristics and/or landing profiles. This situation does not always allow to assess correctly the situation of some of the components of these fleets and their evolution and/or to evaluate the biological, economic and social implications of fisheries management scenarios.

Ifremer, in particular within the framework of its fisheries information system (FIS) but also within the framework of research projects and in support to public policies, has contributed since the 1990s to the development of different approaches to segment the fishing fleets also called "fleet typology". Data collection protocols aiming to better characterise the activity of all fishing vessels in metropolitan France and in the overseas departments have also been developed with particular attention to small-scale fishing fleets (SSF) in order to improve knowledges and segmentation of the fishing fleets.

Within the framework of the RCG ECON in support of the EU-MAP, two workshops were organised in 2021 and 2022 to propose an alternative approach to fishing fleets segmentation, mainly based on statistical methods of clustering vessels using their catch profile by stock. This novel approach to segment the fishing fleets is mainly based on fishing patterns and stock exploitation rather than technical characteristics, as it is the current practice.

Conclusions and recommendations

Current EU-MAP fleet segments, because of the criterion of dominant gear *(notion of 'principal' fishing technique),* aggregate together vessels with different fishing strategy and consequently heterogenous landings profiles, investments levels and cost structures. A significant part of the real polyvalence of the (French) fleets is hidden by this rule, an example being the French fleet typologies "exclusive trawlers" and "trawlers dredgers" belonging to the same segment as long as trawl metiers represent the majority (i.e. more than 50%) of the fishing effort of the vessel considered.

The further split of the vessels per EU-MAP fleet segments and capacity sub-regions based on the rule of majority of fishing effort in a capacity region (*'principal' fishing capacity sub-region*) is a complementary approach of the current EU-MAP fleet segmentation. Applied to the French fleet, it refines the analysis and better considers the spatial distribution of fishing stocks improving the fleet segments separation regarding their contribution and dependencies to the different stocks. Its better highlights also the potential technical interactions between fleets.

An alternative ad-hoc fleet segmentation was also developed by Ifremer at a more detailed scale *(vessels operating in the Bay of Biscay)* in the context of Bay of Biscay' management plan assessment. The basic EU-MAP fleet segmentation was considered by the stakeholders as not

appropriate and not detailed enough to cover the needs, leading to a biased view of the fleets operating in the area. Vessels length categories were considered to develop this alternative fleet segmentation as key variable to reflect revenue and cost structure and more detailed segmentation was carried out based on a set of rules regarding landings profile and/or regulations.

Ifremer-FIS segmentation is another alternative segmentation mainly based on a criterion of gear polyvalence/non-polyvalence *(in other words exclusive or non-exclusive vessels).* It contrasts with the EU-MAP fleet segmentation based on a criterion of dominant gear. The fishing fleet segmentation developed consists in bringing together in fleet segments, vessels having relatively homogeneous annual exploitation strategies. The stated assumption is that fishers do not change easily their strategies because of individual habits, some irreversibility in investment and also fisheries regulations. According to fluctuations in the availability and abundance of resources or market prices, fishers focus more or less on one of the metiers chosen within their fishing strategy. These strategies greatly influence the means of production *(inputs*) used but also the revenue and the costs of production.

For small scale vessels (under 12 meters), allocating vessels into one unique heterogeneous PGP (*Vessels using polyvalent "passive" gears only)* fleet segment under the current EU-MAP segmentation provides a biased representation of the structure of the fleet. Following the high diversity in term of gears used observed in the small-scale French fleets *(could be also observed for the large-scale fleet but to a lesser extent)*, using a more detailed segmentation is crucial to capture the diversity of the fleet (*whatever the region considered)*. This is also true at EU level, smaller are the vessels, higher is the diversity of gears used[12]. For these fleets, complementary data collection scheme like the vessel fishing activity calendar census survey (VFACCS) implemented in France is considered as the most appropriate.

The proposed alternative segmentation tool to be considered in the 2021 and 2022 workshops is not adapted to fleets where completeness of their individual-vessel declarative landings data is poor or insufficient. Even if completeness indicators are correct for the French fishing fleet operating in the supra-region Atlantic *(area 27)*, the data set are not reliable in the Mediterranean Sea *(less than 80% of completeness with a significant part of vessels under 12 meters)* and is below

[1] **For more detail regarding fishing activity data issues for SSF see the following reports:**
* Anon. (2005) Report on the workshop on small-scale fisheries. Kavala, Greece, 12-16 September 2005. A DCF ad-hoc workshop. 25pp. https://archimer.ifremer.fr/doc/00146/25752/23865.pdf
* Demanèche, S., Sabatella, E. et al. (2013) Report of the working group on common understanding and statistical methodologies to estimate/re-evaluate transversal data in small-scale fisheries. Nantes, France, 21-23 May 2013. A DCF ad-hoc workshop. 78pp. https://www.researchgate.net/publication/267006301_Report_of_the_Working_Group_on_Common_understanding_and_statistical_methodologies_to_estimatere-evaluate_transversal_data_in_small-scale_fisheries
* Demanèche, S., Gambino, M., Jackson, E., Malvarosa L. et al. (2017) Report on the PGECON subgroup DCF workshop on small scale fisheries. The Hague, Netherlands, 25-29 September 2017. A DCF ad-hoc workshop.
104pp.https://datacollection.jrc.ec.europa.eu/documents/10213/891027/2017_Workshop_PGECON+small-scale+fisheries.pdf/451907ac-184e-4df6-86a5-5435057a483d?version=1.0

[2] Guyader, O., Berthou, P., Koutsikopoulos, C., Alban, F., Demaneche, S., Gaspar, M.B., Eschbaum, R., Fahy, E., Reynal, L., Curtil, O., Frangoudes, K., Maynou, F., 2013. Small scale fisheries in Europe: a comparative analysis based on a selection of case studies. Fish. Res. 140, 1–13.

50% for the vessels operating in La Réunion and Mayotte *(Indian Ocean, FAO area 51)* and those operating in French Guiana, Martinique and Guadeloupe *(Western Atlantic, FAO areas 31 & 41)* where the fleet is mainly composed of small-scale vessels. For these fleets, segmentation should be based on other data sets than the only declarative data here assessed as incomplete *(and it should be the case as long as it is assessed incomplete)*. In France, vessel fishing activity calendar census survey (VFACCS) are used to derive alternative fleet segmentations for such fleets with incomplete declarative data. The case of outermost Guadeloupe is used to illustrate.

Based on the application of the proposed clustering R-Package to the French fleet operating in the supra region Atlantic, our first conclusion is that the use of Principal Component Analysis and clustering approaches is not appropriate to define fleet segmentation. If the tool is very interesting for a preliminary understanding of the fishing fleets and activities which are complex by nature, one of the issues with PCA analyses is that it is difficult to control how the groups are formed. Moreover, PCA analysis do not produce stable groups/segments over time and across countries and may even change historical perspectives upon addition of new years in the dataset. PCA results can also lead to the definition of groups that are often too large or too small[3], which is also a pitfall to be avoided *(small groups)* for statistical and confidential reasons (see below).

The metric proposed by the tool is the "Catch composition profile in weight" because it is supposed *"to better represent the fishing strategies of the vessels, the stocks used and how mixed or targeted a fishery is"* [4]. Based on our analysis, the landings in value per species or stock seems to be a better metric than weight for the majority of the fleets. Reasons for that are similar as what it was approved in the DCF WK on metier issues[5]. Based on our results, it seems also crucial to better consider the polyvalent/non-exclusive nature of the fleets in terms of fishing gears and métiers. The specific methodology we developed for the analysis of inter/intra-stratum variance also highlights the importance to first segment the dataset by vessel length ranges which concentrate a lot of the variability. Indeed, vessel length ranges present better results than all the other segmentations tested, whatever the variable considered.

[3] This issue is probably linked to the technical statistical parameters considered in the tool as the "distance" or the "segmentation method" *(e.g. hierarchical agglomerative cluster analysis (HAC))*. Maybe should be valuable to propose in the tool an alternative choice 1) for the distance as a "denormalized distance", 2) for the segmentation method as a "k-means clustering method" or 3) to parameter a "minimum cluster size control". Furthermore, it is not obvious if the classification tool considers the "absolute value" or recalculate the data in "percentage". The two different possibilities should be possibly allowed and tested.

[4] Fleet Segmentation - Package Manual. Erik Sulanke Thuenen-Institute for Sea Fisheries, Bremerhaven, Germany.
https://rdrr.io/github/ESulanke/FleetSegmentation/f/vignettes/FleetSegmentation_vignette.Rmd

[5] Anonymous report: DCF Métier Workshop: Sub-group of the RCGs - North Sea and Eastern Arctic and North Atlantic. 22 - 26 January 2018. DTU Aqua, Lyngby, Denmark.
https://webgate.ec.europa.eu/regdel/web/meetings/507/documents/1697

A flowchart proposal for the segmentation of the EU fleet[6]

The following flowchart tries to synthetize the step-by-step approach proposed with the objective to define a set of agreed and objective rules for the improvement of the EU fleet segmentation.

1. Necessary criteria for fleet segmentation

First of all, it is crucial to consider that necessary criteria for fleet segmentation should be i) stabilized and easily replicable over time and ii) harmonized and standardized between member states and fisheries ecoregion. Any segmentation should be stable: This means that segmentation rules cannot be changed every year or too regularly. Obviously, if the segments change regularly, the basis for calculating indicators evolves over time and it is therefore not possible to monitor the economic performance or other indicators related to the vessels and fleets over time and across countries. Furthermore, even if specific fishing activities may be operated in each member state, the same easily identified set rules must be applied in each MS or/and each fishing ecoregion for different member states. Moreover, the segmentation should not be too fine. Indeed, when the segmentation is too fine, vessels can migrate from one fleet/segment to another too easily even with minor changes in their fishing and production strategy. This can result in an instability of the groups, which is also not desirable for the analysis of series. Another consideration is the compatibility with previous DCF time series.

Finally, it is imperative on the one hand to respect the rules relating to confidentiality *(for example at least 5 vessels per segment)* and on the other hand to have segments of sufficiently large size to be able to get economic samples of acceptable *size (in other terms limiting also the number of segments)*.

2. Design of the set of rules

There are different options as soon as step 0: Either to reconsider completely the fleet segmentation at global EU fleet level or to develop a new sub-segmentation of the ongoing EU-MAP fleet segments. Vessels considered could also be regionalized by fishing ecoregion (e.g. Bay of Biscay and Iberian waters, North Sea and Eastern Channel, …). Before any further investigation, vessel length ranges, as key parameter, should be considered and discussed for improvement.

Then, whatever the option adopted, the first step (step 1) is to segment the fleet by fishing gear or combination of fishing gears used by the vessels, then (step 2) by metier DCF level5 *(i.e. principal group of species targeted)* or combination of and then (step 3) by catch composition in value by species/stocks. The benefit of such an approach would be to better consider the different dependencies to species and contribution of fishing mortality to fish stocks as well as the polyvalence of vessels. Based on this analysis, the set of rules need then to be codified to be easily replicable each year *(threshold to be developed)*.

[6] Complementary to fleet segmentation, it is fundamental to keep in mind the “metier * fleet” matrix which gives the possibility to connect vessels to species and stocks through metiers.

All of that, lead to consider the following fleet segmentation flowchart proposal. It takes first (step1) into consideration the fishing gears or combination of, used by the vessels (exclusive or polyvalent vessels), separating vessels by their exclusive (e.g. exclusive trawlers, exclusive netters, …) or non-exclusive/polyvalent nature (e.g. trawlers-dredgers, netters-potters, …). Next step (step2) considers the metiers or combination of metiers practiced (i.e. the principal target species or combination of targeted) for example separating exclusive trawlers vessels between exclusive pelagic trawlers, exclusive demersal trawlers or mixed exclusive trawlers targeting demersal and pelagic fishes. Finally, in a third round (step3) some specificities regarding the catch composition in species/stocks of the vessels considered could be highlighted for example separating exclusive demersal trawlers between Nephrops specialized exclusive demersal trawlers and non-specialized exclusive demersal trawlers. This last step allows to better define/divide the groups established. This should be associate with considering the vessel length ranges and fishing areas. In this method, the alternative fleet segmentation tool developed will be useful as a statistical mean to analyse the dataset and define the set of rules to be applied in application of the flowchart.

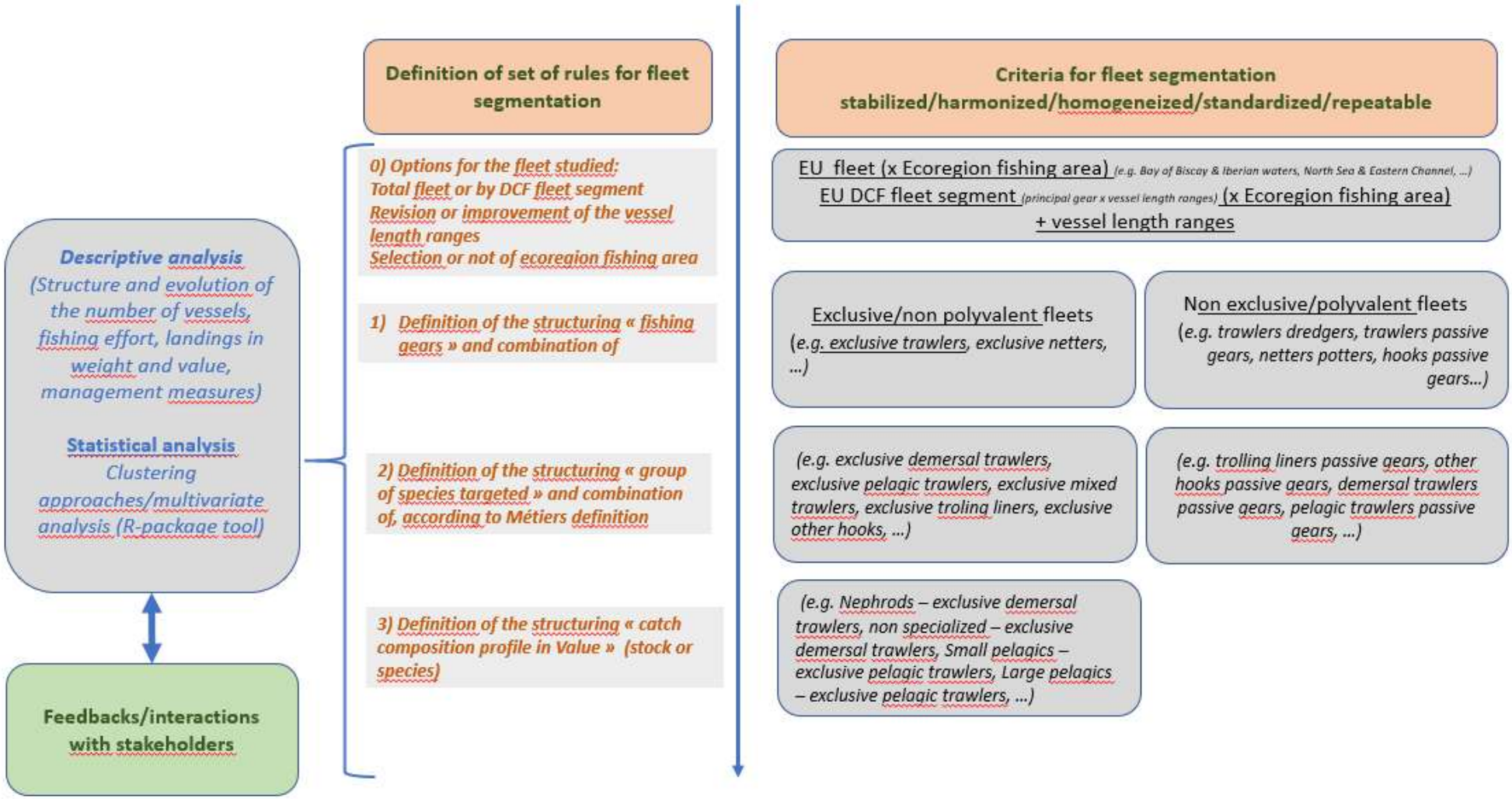

Figure 31 Flowchart proposal to define a set of rules to segment the EU fleet

3. Methodology

To define the set of rules, preliminary analyses of fishing fleets *(by length category including the evolution of the number of vessels, fishing effort and landings by species in weight and value)* including the regulatory contexts should be developed[7]. PCA tools and clustering approaches are very interesting for a comprehension of the fleets and fishing activities which are complex by nature. Based on these different approaches, the results should be translated into stabilized/standardized and harmonized set of decision rules shared between member state, easily reproducible year by year in order a vessel will be allocated to one fleet segment in the same way in each MS for the fishing ecoregion considered**.** Exchange and discussion with stakeholders could be also useful at this stage.

4. Data availability issues and small-scale fleets

As mentioned above, the application exercise of the alternative segmentation tool is only applicable to fleets where vessel (individual) landings data (landings per species and stocks) are available. However, the lack and incompleteness of reliable data at vessel level has been reported in many contexts especially for small-scale fleet. This situation may jeopardise the capacity to carry out alternative segmentation approaches but there is no valid reason not to apply an alternative segmentation as these fleets are economically and socially important and may also be affected by management measures or more broadly by management plans. Because small-scale fleets present regularly a greater diversity in term of fishing gears used than the large-scale fleets, it considered as inadequate to allocate them into one unique heterogeneous PGP (*Vessels using polyvalent "passive" gears only)* Fleet segment. For these fleet, complementary data collection scheme as the vessel fishing activity calendar census survey (VFACCS) is considered as an appropriate approach as soon as declarative data are assessed as incomplete or insufficient to meet the end-users needs.

[7] See the fisheries overviews as a first step to follow: https://www.ices.dk/advice/Fisheries-overviews/Pages/fisheries-overviews.aspx

2 Introduction

Since 2001 and the first Data collection Regulation in support of the Common Fisheries Policy (EU Regulation 1639/2001), a segmentation of the EU fishing fleet has been in force to collect data and provide aggregated indicators. The current Multiannual Union Programme (EU Regulation 1004/2017 EU-MAP) segmentation inherited from the former Data Collection Framework (DCF, 2009), based on both the main gear used and the vessels' length is often considered imperfect insofar as it may group together vessels with heterogeneous technical characteristics and/or landing profiles. This situation does not always allow to assess correctly the situation of some of the components of these fleets and their evolution and/or to evaluate the biological, economic and social implications of fisheries management scenarios.

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Within the framework of the RCG ECON in support of the EU-MAP, two workshops were organised in 2021 and 2022 to propose an alternative approach to fishing fleets segmentation, mainly based on statistical methods of clustering vessels using their catch profile by stock. This novel approach to segment the fishing fleets is mainly based on fishing patterns and stock exploitation rather than technical characteristics, as it is the current practice.

The objective of this document is to

1. Recall and detail the approach used in France to collect in a homogeneous and harmonised way data on the whole population of vessels, whatever their size or the fishing techniques used by these vessels, knowing that these data serve as a basis for the allocation of each vessel in the different fleet segmentations (EU-MAP, Ifremer-FIS or other).
2. Present different complementary or alternative approaches already implemented for French fleets.
3. Identify the data limitations for alternative segmentation arising from incompleteness of vessel individual landings data and present some opportunities for alternative approaches.
4. Apply and test on the French fleets the proposed approach in the workshop using statistical clustering.
5. Propose recommendations for future fleet segmentation.

Conclusions and recommendations are provided at the end of each section.

3 Data used to derive fleet segmentations

This section presents the data used to derive different fleet segmentations in the case of the French fleets.

3.1 Fishing activity calendar survey, annual fleet census

In 2019, 6 509 French vessels were registered to the EU fleet; 2 900 (44%) operating in the supra-region Atlantic (NAO), 1 418 (22%) in Mediterranean (MBS) and 2 191 (34%) in the Other regions *(including outermost regions and the distant fleet, OFR).* For the Atlantic region, the majority of vessels are less than 12 meters vessels *(76%)* when this rate is 92% in Mediterranean[8]. For the other region component, a large majority of vessels are less than 10 meters *(91%)*.

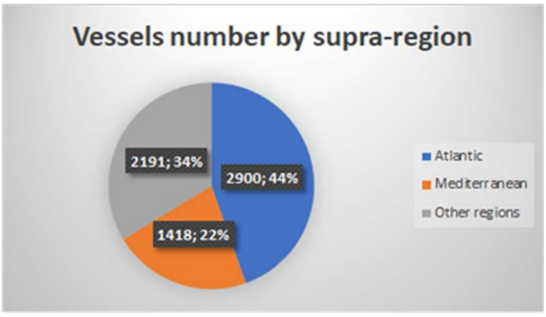


Figure 1: Number of vessels per supra-region in 2019

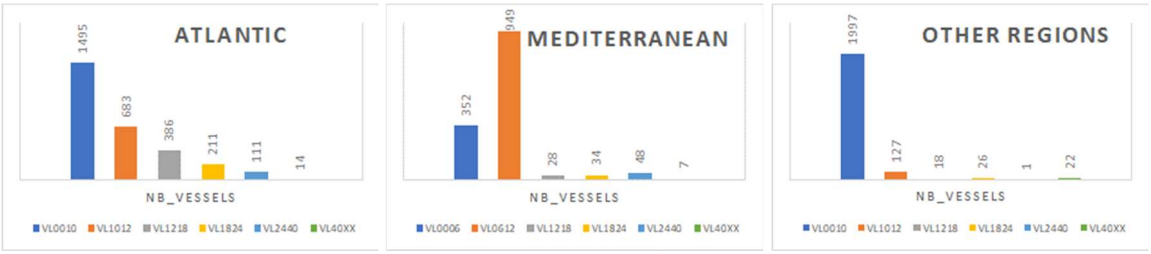


Figure 2: Number of vessels per supra-region and vessel length ranges in 2019

From 2000 up to now, fleet segmentations were derived from **vessel fishing activity calendar census survey** (VFACCS)[9]. The aim of this census is to have a minimum but exhaustive information on all registered vessels whatever their size. Each year, the VFACCS aims at characterizing the inactivity or activity of each vessel by month. When a vessel is active, the metiers practiced and the main fishing areas with the corresponding range of operation *(distance to the coast of the*

[8] For a more detailed description see the following reports:
* Ifremer. Système d'Informations Halieutiques (2021). Eléments de contexte sur la pêche professionnelle française. Façade Atlantique. Synthèse du 19.01.2021, 13 p. https://archimer.ifremer.fr/doc/00678/78997/
* Ifremer. Système d'Informations Halieutiques (2021). Eléments de contexte sur la pêche professionnelle française. Façade Méditerranée. Synthèse du 19.01.2021, 13 p. https://archimer.ifremer.fr/doc/00678/78998/

[9] Berthou, P., Guyader, O., Leblond, E., Demanèche, S., Daurès, F., Merrien, C., and Lespagnol, P. 2008. From fleet census to sampling schemes: an original collection of data on fishing activity for the assessment of the French fisheries. ICES Document CM 2008/K:12 17 pp https://www.ices.dk/sites/pub/CM%20Doccuments/CM-2008/K/K1208.pdf.

fishing operation) are registered[10]. In addition, the VFACCS identifies for each month of the year the main port of exploitation, the number of fishers on board and the number of days at sea and fishing days. The form used for the VFACCS is presented in annex V. Such surveys provide information a) on the part of fishing activity not included in available declarative data *(completeness check)*, b) to assess the reliability, accuracy and pertinence of declarative data available *(quality check)* and c) the basis, if necessary, to re-evaluate or estimate fishing activity data (*in case of dubious or incomplete data)*. The survey bas been carried out yearly since 2000 in France by observers of the fisheries information system of Ifremer (FIS)[11] on the basis of preliminary documentation provided by available control regulation declarative data *(fleet register, logbooks, monthly declarative forms, sales note and geo-location data)*. The vessel data provided by the VFACCS is the basis for fleet segmentations *(EU-MAP, Ifremer, other)* and other metiers classifications. It is also used for EU-MAP sampling schemes *(at-sea sampling, species size structure, economics, …)*[12].

3.2 Current EU-MAP Fleet segmentation

The current EU-MAP fleet segments are detailed on the STECF website[13] and are presented in the following table of the EU regulation:

Table 8 (previously Table 5B)

Fleet segmentation

Active vessels (42)		Length classes (LOA) (41)					
		0 – < 6/8/10 m	6/8/10 – < 12 m	12 – < 18 m	18 – < 24 m	24 – < 40 m	40 m or larger
Using 'active' gears	Beam trawlers						
	Demersal trawlers and/or demersal seiners						
	Pelagic trawlers						
	Purse seiners						
	Dredgers						
	Vessel using other active gears						
	Vessels using polyvalent 'active' gears only						
Using 'passive' gears	Vessels using hooks	(43)	(44)				
	Drift and/or fixed netters						
	Vessels using pots and/or traps						
	Vessels using other passive gears						
	Vessels using polyvalent 'passive' gears only						
Using polyvalent gears	Vessels using active and passive gears						
Inactive vessels							

Table 1: EU-MAP Fleet segmentation (Commission Delegated Decision (EU) 2021/1167[14])

[10] The metier is defined as the use of a gear to target one or several species.

[11] Daures, F., Leblond, E., Berthou, P., Dintheer, C., Merrien, C., Tétard, A., Vigneau, J., Lespagnol, P. 2008. The Fisheries Information System of Ifremer-a multidisciplinary monitoring network and an integrated approach for the assessment of French fisheries, including small-scale fisheries. https://www.researchgate.net/publication/278801743_The_Fisheries_Information_System_of_Ifremer-a_multidisciplinary_monitoring_network_and_an_integrated_approach_for_the_assessment_of_French_fisheries_including_small-scale_fisheries

[12] https://sih.ifremer.fr/Activite-socio-economie/Activite-des-navires/Utilisation-des-donnees-d-activite-des-navires

[13]

[14] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32021D1167&from=EN

Vessels using 'active' gears:
Beam trawlers *(TBB = principal (more than 50%) fishing technique performed by the vessel)*
Demersal trawlers and/or demersal seiners *(DTS = principal (more than 50%) fishing technique performed by the vessel)*
Pelagic trawlers *(OTM = principal (more than 50%) fishing technique performed by the vessel)*
Purse seiners *(PS = principal (more than 50%) fishing technique performed by the vessel)*
Dredgers *(DRB = principal (more than 50%) fishing technique performed by the vessel)*
Vessels using other active gears *(MGO = principal (more than 50%) fishing technique performed by the vessel)*
Vessels using polyvalent 'active' gears only *(MGP = vessels using a combination of the following fishing techniques: TBB-DTS-OTM-PS-DRB-MGO with no principal (all less than 50%) and no other fishing techniques (i.e. 'passive' gears) used)*

Vessels using 'passive' gears:
Vessels using hooks *(HOK = principal (more than 50%) fishing technique performed by the vessel)*
Drift and/or fixed netters *(DFN = principal (more than 50%) fishing technique performed by the vessel)*
Vessels using pots and/or traps *(FPO = principal (more than 50%) fishing technique performed by the vessel)*
Vessels using other passive gears *(PGO = principal (more than 50%) fishing technique performed by the vessel)*
Vessels using polyvalent 'passive' gears only *(PGP = vessels using a combination of the following fishing techniques: HOK-DFN-FPO-PGO with no principal (all less than 50%) and no other fishing techniques (i.e. 'active' gears) used)*

Vessels using 'active' and 'passive' gears:
Vessels using 'active' and 'passive' gears *(vessels using a combination of the fishing techniques: TBB-DTS-OTM-PS-DRB-MGO-HOK-DFN-FPO-PGO with no principal (all less than 50%))*

Finally, each EU-MAP fleet segment is a combination of the 'principal' fishing technique *(or combination of in case there is no principal (all less than 50% of the fishing activity of the vessel))* used by the vessel and its vessel length range. Each registered vessel must be allocated to a unique fleet segment for a given year based on its annual fishing activity i.e. one vessel could use several fishing techniques during a year but belong to only one fleet segment.

To calculate the 'principal' fishing technique used by the vessel during the year, fishing effort *(days at sea, fishing days, number of trips, number of vessel*months, …)* distributed by fishing technique should be considered. A vessel with an effort allocated to a specific fishing technique representing more than 50% of its total fishing effort has to be allocated to the corresponding fleet segment. Other vessels have to be allocated to one of the polyvalent fleet segments depending if they combine only 'passive', only 'active' or 'active' and 'passive' gears.

As specified in the Commission Delegated Decision (EU) 2021/1167, fleet segmentation definition also includes an indication of the supra-region *(defined in Commission Implementing Decision (EU) 2021/1168[15])* and, if available, a geographical indicator to distinguish fleet segments operating in outermost regions and fleet segments operating exclusively in non-EU waters *(international waters + third country – fishing partner agreements, i.e. Long-Distance Fleets).*

Supra Regions		
EU-MAP		
NAO	=	Baltic Sea, North Sea, Eastern Arctic, NAFO; Extended North-Western waters (ICES areas V, VI and VII) and Southern Western waters
MBS	=	Mediterranean Sea and Black Sea.
OFR	=	Other fishing regions.

INACTIVE VESSELS should be assigned to the Supra Region where they are registered or generally operate in.

In cases where a vessel operates in more than one supra region as defined in Table 5C, Member States shall explain in their national programme to which supra region the vessel is allocated.

Table 2: Supra Regions. Table specified in the STECF datacall website[16]

[15] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32021D1168&from=EN
[16] https://datacollection.jrc.ec.europa.eu/web/dcf/wordef/supra-region-dcf

Geographical Indicator

Geo codes to distinguish fleet segments operating in outermost regions and fleet segments operating exclusively in non-EU waters (international waters + third country – fishing partner agreements).

code	name	definitions
NEU	Non EU waters	more the 50% of activity occurs in non-EU waters
IWE	International waters exclusively	100% of activity occurs in non-EU waters
NGI	No geographical indicator	National waters, EU waters
P2	Madeira	Portuguese outermost region (autonomous region)
P3	Azores	Portuguese outermost region (autonomous region)
IC	Canaries	Spanish outermost region (autonomous community)
MA	Morocco Coastal	Most of the activity occurs in 34.1.1
GF	French Guiana	French outermost region (overseas department)
GP	Guadeloupe	French outermost region (overseas department)
MQ	Martinique	French outermost region (overseas department)
MF	Saint-Martin	French outermost region (since 2009) (overseas community)
RE	Reunion	French outermost region (overseas department)
YT	Mayotte	French outermost region (overseas department)

Table 3: Geographical Indicator. Table specified in the STECF data call website[17]

Member states are supposed to collect and provide data including economic indicators according to the EU-MAP fleet segmentation.

3.2.1 Application of the EU-MAP segmentation to the French fleet

Allocation of French vessels to EU-MAP fleet segments are based on the vessel fishing activity calendars census survey *(VFACCS see above)* from which the number of active "vessel*months" distributed by fishing technique are calculated by vessel. The following tables present the distribution of the registered vessels per fleet segments and supra-regions in 2019. The tables show that the fishing gears in used by the vessels operating in the different supra-regions are very diverse as much for small-scale fleets as for large-scale fleets, as much for 'passive' fleets as for 'active' fleets. This leads to a highly distributed fleet regarding the EU-MAP fleet segmentation.

In the Atlantic area, 22% of the fleet was composed in 2019 of demersal trawlers or/and demersal seiners, followed by dredgers (9%) and other active gears (7%). A significant part of the trawlers were also dredgers but the EU-MAP segmentation fails to consider this issue. The passive gear fleet was mainly composed of netters (21%), potters (15%) and vessels using hooks (11%).

[17] https://datacollection.jrc.ec.europa.eu/web/dcf/wordef/geographical-indicator

DCF Fleet segment		VL0010	VL1012	VL1224	VL2440	VL40XX	Nb_vessels	%
Active gears	Beam trawlers (TBB)		1	1			2	0%
	Demersal trawlers and/or demersal seiners (DTS)	83	169	268	56	10	586	22%
	Pelagic trawlers (OTM)	1	5	26	1	4	37	1%
	Purse seiners (PS_)		3	27			30	1%
	Dredgers (DRB)	73	81	87	1		242	9%
	Vessels using other active gears (MGO)	171	8				179	7%
	Vessels using polyvalent active gears only (MGP)	12	56	48	5		121	4%
Passive gears	Drift and/or fixed netters (DFN)	309	151	93	24		577	21%
	Vessels using pots and/or traps (FPO)	296	80	19	1		396	15%
	Vessels using hooks (HOK)	216	49	3	20		288	11%
	Vessels using other passive gears (PGO)	98	4	1			103	4%
	Vessels using polyvalent passive gears only (PGP)	59	12	1			72	3%
Active/Passive gears	Vessels using active and passive gears (PMP)	38	37	5			80	3%
							2713	
Non Active vessels		139	27	18	3		**187**	

Table 4: Number of vessels per EU-MAP fleet segment (supra-region NAO, Atlantic FAO area 27) in 2019

In the Mediterranean area, the 'active' gears fleets were mainly made of demersal trawlers and purse seiners targeting Bluefin tuna. They represent the large majority of the large-scale fleets. The small-scale vessels present more diversity well considered by the VFACCS although the EU-MAP segmentation fails to consider some of their polyvalence. The main component consisted of netters (54%) followed by potters (13%), hooks (7%) and other passive gears (6%).

DCF Fleet segment		VL0006	VL0612	VL1224	VL2440	VL40XX	Nb_vessels	%
Active gears	Beam trawlers (TBB)						0	0%
	Demersal trawlers and/or demersal seiners (DTS)			32	31		63	5%
	Pelagic trawlers (OTM)				1		1	0%
	Purse seiners (PS_)		8	5	15	7	35	3%
	Dredgers (DRB)	1	8				9	1%
	Vessels using other active gears (MGO)		10				10	1%
	Vessels using polyvalent active gears only (MGP)						0	0%
Passive gears	Drift and/or fixed netters (DFN)	135	528	7			670	54%
	Vessels using pots and/or traps (FPO)	78	77	2			157	13%
	Vessels using hooks (HOK)	17	59	8			84	7%
	Vessels using other passive gears (PGO)	34	46				80	6%
	Vessels using polyvalent passive gears only (PGP)	30	87				117	9%
Active/Passive gears	Vessels using active and passive gears (PMP)	1	15	1			17	1%
							1243	
Non Active vessels		56	111	7	1		**175**	

Table 5: Number of vessels per EU-MAP fleet segment (supra-region MBS, Mediterranean FAO area 37) in 2019

In 2019, vessels operating in outermost regions *(supra-region OFR)* presented similar distribution. The 'active' gears fleets essentially consisted of French Guiana shrimp trawlers and swordfish long liners operating from La Reunion Island. The small-scale vessels present more diversity well considered by the VFACCS although the EU-MAP segmentation fails to consider some of their polyvalence. The main component consisted of hooks (35%), polyvalent passive gears (28%), potters (16%) and netters (16%).

DCF Fleet segment		VL0010	VL1012	VL1224	VL2440	VL40XX	Nb_vessels	%
Active gears	Beam trawlers (TBB)						0	0%
	Demersal trawlers and/or demersal seiners (DTS)			13			13	1%
	Pelagic trawlers (OTM)						0	0%
	Purse seiners (PS_)	30					30	2%
	Dredgers (DRB)						0	0%
	Vessels using other active gears (MGO)						0	0%
	Vessels using polyvalent active gears only (MGP)						0	0%
Passive gears	Drift and/or fixed netters (DFN)	182	63				245	16%
	Vessels using pots and/or traps (FPO)	243	3	3			249	16%
	Vessels using hooks (HOK)	504	20	20			544	35%
	Vessels using other passive gears (PGO)	56					56	4%
	Vessels using polyvalent passive gears only (PGP)	428	6				434	28%
Active/Passive gears	Vessels using active and passive gears (PMP)						0	0%
							1571	
Non Active vessels		554	35	8			597	

Table 6: Number of vessels per EU-MAP fleet segment (supra-region OFR - Outermost regions, FAO areas 51-31 & 41) in 2019

Finally, Long Distance fleets were constituted in 2019 by tropical purse seiners targeting large pelagic fishes *(large purse seiners)* operating in the Indian Ocean and Atlantic Ocean around Africa and one pole-and-line tuna vessel operating on the west coast of Africa.

DCF Fleet segment		VL0010	VL1012	VL1224	VL2440	VL40XX	Nb_vessels	%
Active gears	Beam trawlers (TBB)						0	0%
	Demersal trawlers and/or demersal seiners (DTS)						0	0%
	Pelagic trawlers (OTM)						0	0%
	Purse seiners (PS_)					22	22	96%
	Dredgers (DRB)						0	0%
	Vessels using other active gears (MGO)						0	0%
	Vessels using polyvalent active gears only (MGP)						0	0%
Passive gears	Drift and/or fixed netters (DFN)						0	0%
	Vessels using pots and/or traps (FPO)						0	0%
	Vessels using hooks (HOK)				1		1	4%
	Vessels using other passive gears (PGO)						0	0%
	Vessels using polyvalent passive gears only (PGP)						0	0%
Active/Passive gears	Vessels using active and passive gears (PMP)						0	0%
							23	
Non Active vessels							0	

Table 7: Number of vessels per EU-MAP fleet segment (supra-region OFR - Long-Distance Fleets, FAO areas 51-34 & 47) in 2019

3.3 Capacity segmentation

For the report on the balance between the fishing capacity of French fleets and their fishing opportunities *(Article 22 (Adjustment and management of fishing capacity) of Regulation (EU) No 1380/2013[18] and detailed in the guidelines provided in the European Commission Communication COM (2014) 545 final of 2 September 2014[19])*, France refined the current EU-MAP fleet segmentation by subgrouping vessels operating in supra-region Atlantic (NAO) in more detailed regions. The objective was to bring fleet segmentation of French vessels more in line with the distribution of fishing stocks.

Finally, vessels were classified according to the following ten reference regions:

[18] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32013R1380&from=EN
[19] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2014:0545:FIN:EN:PDF

Supra Région (EU MAP)	Geographical_indicator (EU MAP)	Selected regions for the calculation of capacity indicators
NAO	NGI - No geographical indicator	**North Sea - Eastern Channel**
		West Scotland - Celtic and Irish Seas – Iceland
		Bay of Biscay - Iberian Seas
MBS	NGI - No geographical indicator	**Mediterranean**
OFR	IWE - International waters exclusively	**LDF - Africa - Indian Ocean**
	RE – Reunion	**Reunion Island**
	YT – Mayotte	**Mayotte**
	GF - French Guiana	**Guyane**
	MQ – Martinique	**Martinique**
	GP – Guadeloupe	**Guadeloupe**

Table 8: Selected regions for the calculation of capacity indicators

Each vessel was allocated to the capacity sub-region where vessel spent the majority of its fishing time during the year *(i.e. each vessel is allocated to its 'principal' fishing capacity sub-region*). The following table presents the distribution of the registered French vessels per EU-MAP fleet segments and capacity sub-regions in 2019.

	REGION CAPACITE	FISHING ACTIVITY	FISHING TECH	VL0006	VL0010	VL0612	VL1012	VL1218	VL1824	VL2440	VL40XX	Nb vessels
AT	GG_Ib	using 'active' gear	DTS		51		110	110	45	1		317
			OTM		1		4	8	13	1		27
			PS_				3	14	2			19
			DRB		11		5					16
			MGO		157		8					165
			MGP		6		8		5	2		21
		using 'passive' gear	DFN		223		82	31	26	7		369
			FPO		75		10	2	3	1		91
			HOK		137		48	1	2	3		191
			PGO		78		4	1				83
			PGP		37		5	1				43
		using 'polyvalent' gear	PMP		15		11					26
	MC_OE_Is	using 'active' gear	DTS		4		38	14	53	46	3	158
			OTM						5		1	6
			PS_					11				11
			DRB		56		47	17	2			122
			MGO		3							3
			MGP		4		9	3		1		17
		using 'passive' gear	DFN		51		30	25	5	17		128
			FPO		147		43	2	5			197
			HOK		56		1			13		70
			PGO		17							17
			PGP		16		2					18
		using 'polyvalent' gear	PMP		20		24	2				46
	MdN_Mchest	using 'active' gear	TBB				1	1				2
			DTS		28		21	20	26	9	7	111
			OTM				1				3	4
			DRB		6		29	63	5	1		104
			MGO		11							11
			MGP		2		39	38	2	2		83
		using 'passive' gear	DFN		35		39	6				80
			FPO		74		27	4	3			108
			HOK		23					4		27
			PGO		3							3
			PGP		6		5					11
		using 'polyvalent' gear	PMP		3		2	3				8
Total AT					1356		656	377	202	108	14	2713
ME	ME	using 'active' gear	DTS					4	28	31		63
			OTM							1		1
			PS_			8		1	4	14	7	34
			DRB	1		8						9
			MGO			10						10
		using 'passive' gear	DFN	135		528		7				670
			FPO	78		77		2				157
			HOK	17		59		8				84
			PGO	34		46						80
			PGP	30		87						117
		using 'polyvalent' gear	PMP	1		15		1				17
Total ME				296		838		23	32	46	7	1242
OM	AFR_OInd	using 'active' gear	PS_								22	22
		using 'passive' gear	HOK							1		1
	Guadeloupe	using 'active' gear	PS_		26							26
		using 'passive' gear	DFN		77		3					80
			FPO		100		3					103
			HOK		104		6					110
			PGO		8							8
			PGP		209		4					213
	Guyane	using 'active' gear	DTS						13			13
		using 'passive' gear	DFN		41		60					101
			FPO		2							2
	Martinique	using 'active' gear	PS_		3							3
		using 'passive' gear	DFN		61							61
			FPO		147			1	2			150
			HOK		147		10	1				158
			PGO		46							46
			PGP		196							196
	Mayotte PP Hors Senneurs	using 'passive' gear	DFN		6							6
			HOK		108		1					109
			PGP		4							4
	Reunion PP Hors Senneurs	using 'passive' gear	HOK		148		4	15	4			171
			PGO		3							3
			PGP		8		1					9
Total OM					1444		92	17	19	1	22	1595
Nb vessels				296	2800	838	748	417	253	155	43	5550

Table 9: Number of vessels per EU-MAP fleet segment and capacity sub-regions in 2019

3.3.1 *Examples of disaggregation of EU-MAP fleet by capacity region for the Atlantic area*

The figures 3 and 4 below present different examples of EU-MAP fleet segments operating in Atlantic area *(FAO area 27)* disaggregated regarding their capacity regions. Three segments are considered in 2020: DTS-1824, DTS-1218 and DFN-1218. Number of vessels per segment and total value of landings by stock for each capacity region are represented *("Bay of Biscay - Iberian Seas", "West Scotland - Celtic and Irish Seas – Iceland", "North Sea - Eastern Channel")*.

For the DTS-1824, these figures show differences in landings profiles with a higher dependency to anglerfish (MNZ), Haddock (HAD) and Whiting (WHG) in the Celtic sea compared the same type vessels operating mainly in the Bay of Biscay which are more dependent to sea bass (BSS) or Hake (HKE). For the DTS-1218, the difference is far more important with vessels highly dependent to Nephrops in the Bay of Biscay when vessels operating in other capacity regions harvest mainly on scallops' stocks (SCE) with dredges[20].

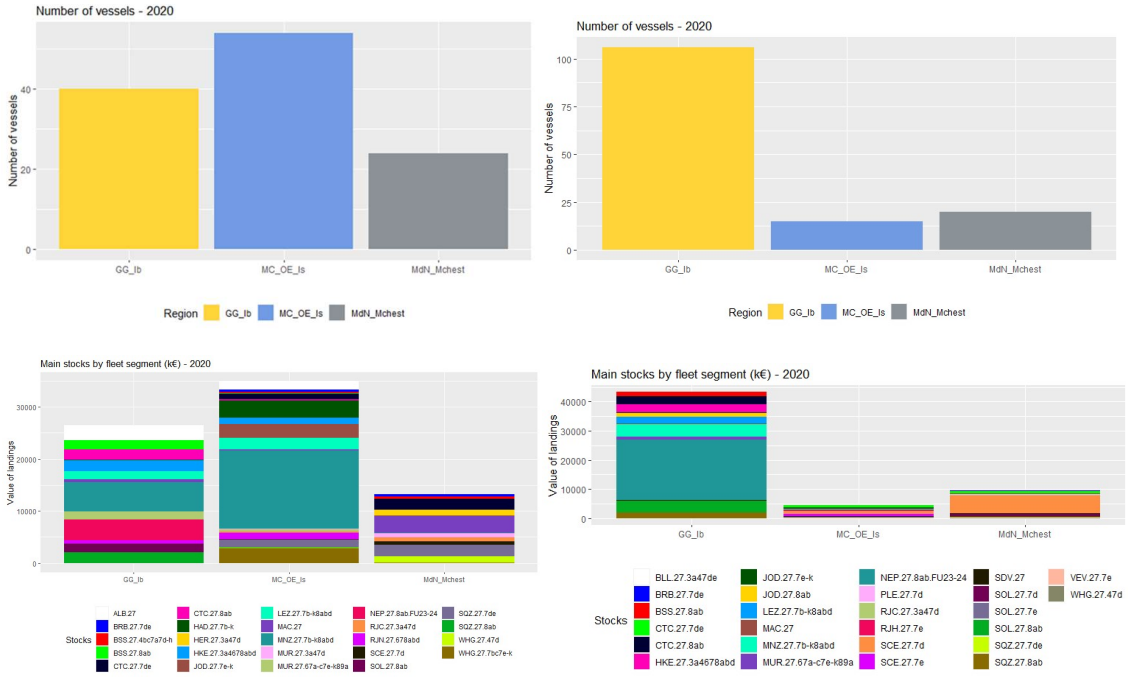


Figure 3: Number of vessels and value of landings per stock in 2020 (left: DTS 18-24m, right: DTS 12-18m) (GG_Ib:Bay of Biscay - Iberian Seas, MC_OE_Is: West Scotland - Celtic and Irish Seas – Iceland, MdN_Mchest :North Sea - Eastern Channel)

[20] As mentioned before, these vessels are considered as trawlers-dredgers for the Ifremer-FIS segmentation.

For the DFN-1218, the difference considered in the capacity region is also evident with vessels highly dependent on Common sole (SOL) in the Bay of Biscay when vessels operating in the Channel target mainly Spinous spider crab (SCR) and whelk (WHE) with pots.

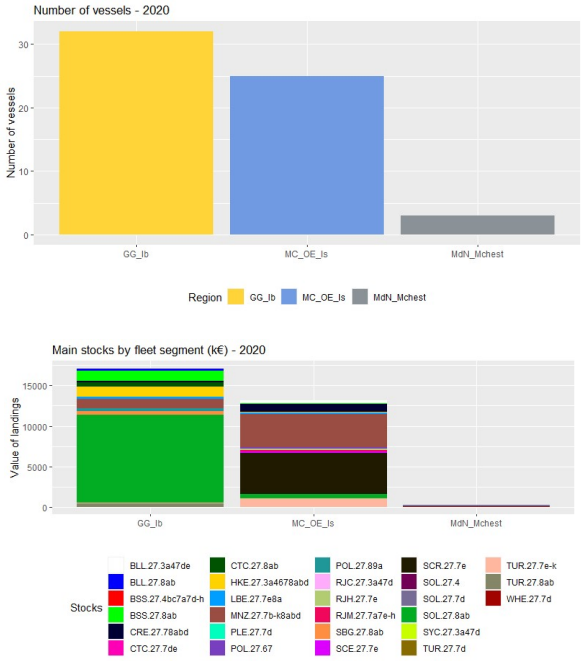


Figure 4: Number of vessels and value of landings per stock in 2020 (DFN 12-18m) (GG_Ib:Bay of Biscay - Iberian Seas, MC_OE_Is: West Scotland - Celtic and Irish Seas – Iceland, MdN_Mchest :North Sea - Eastern Channel)

In terms of economic indicators, table 10 show the differences of the performance of a given selected segment between capacity regions. For the DTS-1824, the days at sea are in the same magnitude, the landings per vessel were far more important for vessels operating in the Bay of Biscay compared to those operating in the Celtic sea and related areas (194 tons vs 302 tons). Average revenue per vessel is slightly better for the Celtic sea (1,6 EUR million vs 1,46 EUR million) which is explained by the different landings and related species prices profile. Average price is significantly higher in the Bay of Biscay than Celtic Sea. Gross value added, gross profit and net profit in value and rate are also higher in the Bay of Biscay highlighting the usefulness of the capacity region segmentation. It is the same conclusion with the segment DTS-1218 for which higher performance were registered in the Celtic Sea and the Eastern Channel compared to the Bay of Biscay.

	DTS1824			DTS1218			DFN1218		
	GG_Ib	**MC_OE_Is**	**MdN_Mchest**	**GG_Ib**	**MC_OE_Is**	**MdN_Mchest**	**GG_Ib**	**MC_OE_Is**	**MdN_Mchest**
Number of Vessels	40	54	24	106	15	20	32	25	3
Engaged crew	175	269	130	324	48	91	144	114	15
FTE national	195	240	149	260	118	72	100	79	
KW (Mean)	394	455	410	255	227	277	212	236	280
Age (Mean)	29	23	22	30	31	25	29	27	22
Length (Mean)	20	22	22	15	15	16	15	15	15
GT (Mean)	107	146	139	47	46	65	48	48	36
Engaged crew (Mean)	4	5	5	3	3	5	5	5	5
Days at sea (Mean)	231	234	187	199	178	203	208	140	68
Landings weight (tons)	7 758	16 333	10 532	9 236	2 065	4 174	2 542	4 411	71
Landings value (k€)	32 604	45 671	18 444	50 541	5 934	10 958	19 249	14 330	305
Average price (€/kg)	4,2	2,8	1,8	5,5	2,9	2,6	7,6	3,2	4,3
Revenue	46 643	51 166	21 550	42 943	17 068	19 726	19 241	18 592	
Gross Value Added	21 722	19 934	9 997	21 360	11 485	12 790	10 484	12 603	
Gross profit	5 530	2 922	1 665	4 516	3 652	4 302	1 774	5 049	
Net Profit	1 840	-3 900	-2 041	-1 569	2 311	3 397	288	3 968	
GVA_Ho	111	83	67	82	98	178	105	160	
NVA_FTE	92	53	41	58	86	165	89	146	
Gross Value Added rate	47%	39%	46%	50%	67%	65%	54%	68%	
Net profit rate	4%	-8%	-9%	-4%	14%	17%	1%	21%	
Landings weight (tons) per vessel	194	302	439	87	138	209	79	176	24
Revenue per vessel	1 458	1 599	673	1 342	533	616	601	581	
Gross Value Added per vessel	151	138	69	148	80	89	73	88	
Gross profit per vessel	26	14	8	21	17	20	8	24	
Net Profit vessel	63	-134	-70	-54	80	117	10	137	

Table 10: Key economic figure for a selection of EU-MAP segments by capacity regions

3.4 An alternative to the EU-MAP segmentation: the Ifremer FIS segmentation.

Based on VFACCS *(see above)* and in complement to the EU-MAP segmentation, the Ifremer FIS developed an **alternative segmentation mainly based on a criterion of gear polyvalence/non-polyvalence** *(in other words exclusive or non-exclusive vessels).* It contrasts with the EU-MAP fleet segmentation based on a criterion of dominant gear.

The fishing fleet segmentation[21] developed consists in bringing together in fleet segments, vessels having relatively homogeneous annual exploitation strategies[22] *(for details see Annex VI)*. The stated assumption is that fishers do not change easily their strategies because of individual habits, some irreversibility in investment and also fisheries regulations[23]. According to fluctuations in the availability and abundance of resources or market prices, fishers focus more or less on one of the metiers chosen within their fishing strategy. These strategies greatly influence the means of production *(inputs*) used but also the revenue and the costs of production.

To define this alternative segmentation and the set of rules associated, two steps were applied:

1) Multivariate analyses were first carried out per region based on individual annual fishing activity calendars with fishing vessels as individuals and vessel' fishing effort *(expressed in number of months)* per metier as active variables. It allowed to explore the French fleets and define the principal fishing strategies in used per region.
2) Then a standardisation of the fleet segmentation process was defined based on a set of rules. A fishing gears hierarchy, based on their impact on the vessel's investments and costs structure, was in particular established taking also into account their importance in the region. For example, the analysis showed a more significant level of investment for vessels using active gears and a different costs structure between passive gears *(higher gear costs)* and active gears *(higher fuel cost)*. The process takes also in consideration technical constraints related to vessel characteristics, e.g. vessels that are equipped for trawling, might also be used for seining with slight modifications, whereas vessels equipped for seining would need large modifications *(larger engine, other equipment)* in order to be able to implement the trawl gear.

[21] Berthou, P., Daures, F., Guyader, O., Leblond, E., Merrien, C., Demaneche, S. and M. Jezequel. 2003. Typologies des flottes de pêche: méthodes Ifremer-SIH, Rapport interne DRV/SIH/N°4/082003 26 https://archimer.ifremer.fr/doc/00705/81686/86242.pdf

[22] Berthou, P. et al. 2008 (Ibidem).

[23] Le Gallic, B., Ulrich, C., Boncoeur, J. – « Modélisation et gestion d'un système complexe d'exploitation de ressouyrces communes renouvelables. Le cas des pêcheries de la Manche. Politique et Management Public. Année 2000. 18-4 pp. 157-182. https://www.persee.fr/doc/pomap_0758-1726_2000_num_18_4_2650

The applied methodology was detailed and presented during the so-called Nantes workshops *(EC 2005, 2006)* on Fleet-Fishery based sampling[24]. First steps of the set rules applied for the French fleets operating in the supra-region Atlantic are presented in the following figure. For instance, it distinguishes vessels using trawl gears from other vessels. These vessels are identified in the **trawler's fleets exclusive** *(for vessels practicing only trawls metiers during the year)* or **non-exclusive** *(for vessels practicing during the year other fishing gear(s) in addition to trawls)* and that whatever the fishing effort deployed in trawls. Such process takes **rather** in consideration the eventual **polyvalence/non-polyvalence** of the vessels **than** the **pre-dominance** *(in terms of fishing efforts deployed)* **of one of the fishing gears** *(which correspond to the EU-MAP fleet segmentation)*.

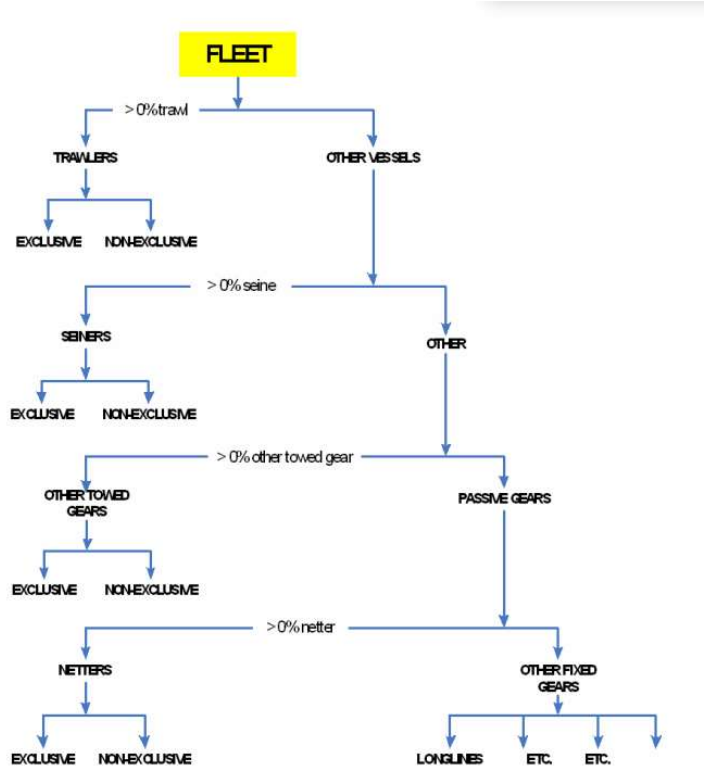


Figure 5: First steps of the set of rules established for the Ifremer-FIS segmentation for vessels operating in the supra-region Atlantic

[24] EC. 2005. Commission Staff Working Paper : Report of the Ad Hoc Meeting of Independent Experts on Fleet-Fishery based Sampling, Nantes (France), 23 - 27 May, 2005. 34 pp. https://stecf.jrc.ec.europa.eu/c/document_library/get_file?uuid=0e5051ef-c029-4e77-ae1b-8fcbad007d33&groupId=43805
EC. 2006a. Commission Staff Working Paper: Report of the Ad Hoc Meeting of independent experts on Fleet-Fishery based sampling. 99 pp.
EC. 2006b. Training Workshop on Fleet-based Approach. EU Data Collection Regulation, 1543/2000 Establishing a Community Framework for the Collection and Management of Data Needed to Conduct the CFP Training. Nantes. 17 pp.
https://stecf.jrc.ec.europa.eu/documents/43805/44857/Training+Workshop+on+fleet-based+approach.pdf

The Ifremer FIS segmentation leads to the division of French fishing vessels operating in the supra-region Atlantic in 19 segments compared to the 13 calculated for the EU-MAP segmentation *(see next table)*. As mentioned before, this segmentation better considers the exclusive vs non-exclusive nature of fishing gears operations of the vessels during the year. For example, the segment "demersal trawlers exclusive" *(313 vessels and 12% of the total fleet)* does not include trawlers also operating dredges, these vessels being included in a group of "trawlers dredgers" *(356 vessels and 13% of the total fleet)*. There is also a "dredgers exclusive" fleet *(106 vessels and 4% of the total fleet)* and a "dredgers-passive gear" fleet *(167 vessels and 6% of the total fleet)*. The landings profiles of the fleets are very different and there is more homogeneity in each of the groups considering the target species than for the EU-MAP segmentation. It gains also homogeneity in term of cost structure and vessel's capital investments.

Ifremer Fleet segment		VL0010	VL1012	VL1224	VL2440	VL40XX	Nb_vessels	%
Active gears eventually combined with passive gears	Demersal trawlers exclusive	21	54	183	45	10	**313**	12%
	Pelagic trawlers exclusive		3	8	1	4	**16**	1%
	Mixed Trawlers exclusive	1	8	58	7		**74**	3%
	Trawlers Dredgers	47	173	135	1		**356**	13%
	Trawlers Glass eel fishing	30	22				**52**	2%
	Trawlers Passive gears	10	18	2			**30**	1%
	Demersal seiners		1	19	9		**29**	1%
	Purse seiners		4	27			**31**	1%
	Dredgers exclusive	43	34	29			**106**	4%
	Dredgers Passive gears	92	69	6			**167**	6%
	Glass eel fishing exclusive	86	4				**90**	3%
	Glass eel fishing Passive gears	165	9				**174**	6%
Passive gears exclusive	Netters exclusive	145	84	82	24		**335**	12%
	Netters Potters/Traps	204	57	9			**270**	10%
	Netters Hooks	63	28	3			**94**	3%
	Potters/Traps exclusive	156	44	14	1		**215**	8%
	Potters/Traps Hooks	77	16				**93**	3%
	Hooks exclusive	136	20	3	20		**179**	7%
	Other passive gears	80	8	1			**89**	3%
							2713	
Non Active vessels		139	27	18	3		**187**	

Table 11: Number of vessels per Ifremer-FIS fleet segment (supra-region NAO, Atlantic FAO area 27) in 2019

Fishing gears hierarchy *(applied for the Ifremer-FIS fleet segmentation)* for vessels operating in the supra-region Mediterranean was structured around following main fishing gears: "bluefin tuna purse seines and other purse seines", "pelagic, demersal and beam trawls", "dredges", "nets", "shell clams hand dredges" and "fyke nets". Following table 12 show the distribution of the active fishing fleet operating in supra-region Mediterranean in 2019 following this fishing gears hierarchy and the Ifremer-FIS fleet segmentation methodology.

Ifremer Fleet segment		VL0006	VL0612	VL1224	VL2440	VL40XX	Nb_vessels	%
Active gears eventually combined with passive gears	Bluefin tuna purse seiners				15	7	22	2%
	Other purse seiners		24	11			35	3%
	Demersal trawlers			31	24		55	4%
	Mixed trawlers			1	8		9	1%
	Dredgers		6				6	0%
	Beam trawlers (gangui)	11					11	1%
Passive gears exclusive	Netters exclusive	30	307	4			341	27%
	Netters Passive gears	22	245	4			271	22%
	Fyke netters	112	39				151	12%
	Shell clams hand dredgers	5	1				6	0%
	Hooks	8	33	4			45	4%
	Divers	16	39				55	4%
	Other passive gears	103	133				236	19%
							1243	
Non Active vessels		56	111	7	1		175	

Table 12: Number of vessels per Ifremer-FIS fleet segment (supra-region MBS, Mediterranean FAO area 37) in 2019

Artisanal vessels operating in outermost regions *(supra-region OFR)* were structured *(in the Ifremer-FIS fleet segmentation)* regarding the importance of nets-based metiers in French Guiana and hooks-based metiers elsewhere *(first structuring gears of the applied hierarchy)*. Ifremer-FIS fleet segmentation identified also the two specific fleets of: "swordfish longliners exclusive" operating from La Réunion Island and French Guiana "shrimp trawlers exclusive" which include the few large-scale vessels operating in these regions. For the large Hooks fleet, other consideration should be considered to better segment it like: 1) the type of metier practiced *(trolling line, handline, longline, …)*, 2) the fishing practice around *(Moored Fishing Agregating Devices (MFADs) or not)* and 3) finally a more disaggregated vessel length ranges *(e.g. VL0006, VL0608 and VL0810)* (see below for an application in the case of Guadeloupe). Following table 13 show the distribution of the active fishing fleet operating in supra-region Other regions / Outermost regions in 2019 following this fishing gears hierarchy and the Ifremer-FIS fleet segmentation methodology.

Ifremer Fleet segment		VL0010	VL1012	VL1224	VL2440	VL40XX	Nb_vessels	%
Active gears	Shrimp trawlers			13			13	1%
Passive gears	Swordfish longliners exclusive	20	5	19			44	3%
	Hooks	788	20	1			809	51%
	Netters	161	62				223	14%
	Driftnetters	36					36	2%
	Potters	225	3	3			231	15%
	Beach seiners	40					40	3%
	Other passive gears	173	2				175	11%
							1571	
Non Active vessels		554	35	8			597	

Table 13: Number of vessels per Ifremer-FIS fleet segment (supra-region OFR – Outermost regions, FAO areas 51-31 & 41) in 2019

Finally, the long-distance fleets are very specific and the Ifremer-FIS fleet segmentation reflected it distinguishing the tropical purse seiners targeting large pelagic fishes *(large purse seiners)* operating in the Indian Ocean and Atlantic Ocean around Africa *(which could be another consideration to consider in order to better segment these vessels*) and the remainder pole-and-line tuna vessel operating in the Atlantic Ocean around Africa.

Ifremer Fleet segment		VL0010	VL1012	VL1224	VL2440	VL40XX	Nb_vessels	%
Long distance fleets	Tropical tuna purse seiners					22	22	96%
	Tropical tuna pole-and-line				1		1	4%
							23	

Table 14: Number of vessels per Ifremer-FIS fleet segment (supra-region OFR – Long-Distance Fleets, FAO areas 51-34 & 47) in 2019

3.5 Issues raised by the EU-MAP fleet segmentation and comparisons with the Ifremer-FIS segmentation

The alternative national Ifremer-FIS fleet segmentation was developed also to avoid one of the major issues discussed regarding the EU-MAP fleet segmentation based on the vessel 'principal' fishing technique. Indeed, the notion of 'principal' fishing technique retained by the EU-MAP for the fleet segmentation implies that vessels belonging to one EU-MAP fleet segment could perform either only the fishing technique considered *(e.g. trawlers)* neither other fishing gears in combination with it unless it represents more than 50% of its total fishing time *(e.g. trawler-dredgers)*. This could have a strong effect *(dissimilarity)* among others regarding the cost structure or the landings profile of vessels belonging to the same EU-MAP fleet segment. It is particularly true for small-scale fleets and French fleets in general for which the combination of two different fishing gears during the year is very common. The next tables present two examples underlying this issue.

DCF Fleet segment	Ifremer-FIS Fleet segments	Nb_vessels	%
Demersal trawlers and/or demersal seiners (DTS)	Demersal trawlers exclusive	313	53%
	Mixed Trawlers exclusive	55	9%
	Trawlers Dredgers	149	25%
	Trawlers Glass eel fishing	44	8%
	Trawlers Passive gears	9	2%
	Demersal seiners	16	3%
		586	

Table 15: 'Demersal trawlers and/or demersal seiners' (DTS) EU-MAP fleet segment disaggregated into Ifremer-FIS fleet segments

The example of the 'Demersal trawlers and/or demersal seiners' EU-MAP fleet segment is interesting as it highlights the heterogeneity of this fleet when disaggregated in to Ifremer-FIS fleet segments. 53% of the fleet segment is composed of pure demersal trawlers, 3% of pure demersal seiners and 9% combine bottom and pelagic trawls metiers. The other 35% vessels are not exclusive trawlers *(25% combine trawls metier with dredges targeting especially scallops, 8% with glass eel fishing and 2% with other passive gears).*

The second example is the “Drift and/or fixed netters” EU-MAP fleet segment. In that segment with 577 vessels, 57% are exclusive netters but 22% combine pots, 6% hooks and 7% glass eel fishing. Some of them (5%) also use active gears in complement such as dredges.

DCF Fleet segment	Ifremer-FIS Fleet segments	Nb_vessels	%
Drift and/or fixed netters (DFN)	Trawlers Passive gears	2	0%
	Dredgers Passive gears	32	5%
	Glass eel fishing Passive gears	43	7%
	Netters exclusive	334	57%
	Netters Potters/Traps	127	22%
	Netters Hooks	38	6%
	Other passive gears	1	0%
		577	

Table 16: ‘Drift and/or fixed netters’ (DFN) EU-MAP fleet segment disaggregated into Ifremer-SIH fleet segments.

3.6 The Bay of Biscay fleet segmentation: an example for assessment of management plans

The Bay of Biscay fleet segmentation was carried out in order to perform a bio-economic analysis of management scenarios. An ad hoc fleet segmentation was developed involving stakeholders in the framework of the partnership bio-economic working group (PBEWG) and the European GEPETO project. The objective was to provide a more detailed approach of fleets’ situation, strategies and to simulate the potential impact of management plans concerning demersal stocks *(Figure 6)*. The starting point was that the EU-MAP fleet segmentation was not appropriate and detailed enough. The issue with current EU-MAP fleet segmentation was that it aggregates vessels operating in various areas and targeting different stocks that can be managed under different management plans. An impact assessment conducted at this level of aggregation does not enable to highlight the stakes. Due to data availability, the starting point were the EU-MAP fleet segments. Twenty-one fleets *(subsets of EU-MAP fleets segments)* were considered in the analysis *(see following figure 7 and table 17)*. Sole netters, Hake gillnetters, Mixed netters, Nephrops trawlers *(specialized/unspecialized)*, Mixed demersal trawlers *(coastal, offshore south or north)*, and Hake long liners were considered. Vessel length (VL) categories were considered to divide the fleets as well as thresholds in terms of landings per species, fishing time by gear/métier or fishing area dependency.

Example of the ‘French DFN 12-18m’ EU-MAP fleet segment illustrates the consequences and limits of impact assessment conducted at this level. ‘French DFN 12-18m’ thus aggregates vessels operating in different area in Western Atlantic in particular in the Bay of Biscay and in the Channel. It aggregates vessels with different fishing behaviors and strategies. Dependency to particular stocks highlights vessels’ average dependency that can be very different and do not highlight the stakes in number of cases. Dependency to sole of the Bay of Biscay *(in percentage of the gross revenue)* is for example of 20% for the total ‘French DFN 12-18 m’ fleet while it can be over 50% for the subset of the fleet operating in the Bay of Biscay.

Table 18 provides information by fleet on the number of vessels, employment, fishing effort, total value of landings and dependence to species in terms of percentage of the value of landing.

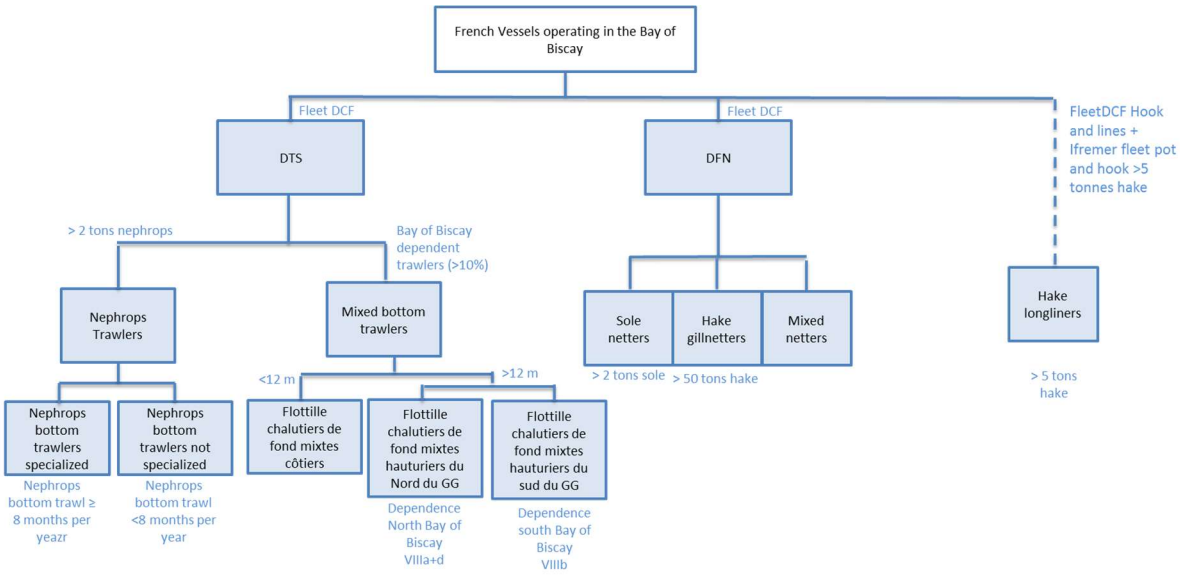


Figure 6: Proposal sub-fleet segmentation of French demersal fisheries operating in the Bay of Biscay[25]

French demersal Bay of Biscay Fleets	Lenght class	Vessels	Crew size	Crew size (% french BoB demersal fisheries	Dep hake (% VL)	Dep sole (%VL)	Dep sole+hake (%VL)	Dep species modelled (%VL)	Total Value of landings VL (Millions euros)	Days at sea
Hake gillnetters	VL1840	21	252	11%	41%	0%	41%	45%	31,1	4967
Hake longliners	VL0010	7	13	1%	73%	0%	73%	94%	0,8	819
	VL1012	4	11	0%	58%	0%	58%	70%	1,0	715
Mixed coastal bottom trawlers	VL0010	56	79	4%	1%	26%	27%	53%	4,7	6340
	VL1012	90	203	9%	3%	12%	14%	61%	18,8	13827
Mixed bottom trawlers North Bay Biscay	VL1218	13	44	2%	2%	5%	7%	73%	5,8	2579
	VL1824	32	142	6%	1%	1%	2%	37%	26,1	7346
Mixed bottom trawlers South Bay Biscay	VL1218	12	41	2%	5%	12%	17%	72%	5,9	2564
	VL1824	7	36	2%	3%	3%	6%	51%	5,1	1545
Mixed netters	VL0010	220	286	13%	1%	9%	10%	41%	11,5	21140
	VL1018	39	118	5%	3%	2%	6%	41%	8,6	5454
	VL1840	4	25	1%	2%	0%	2%	90%	2,9	728
Nephrops bottom trawlers (specialized)	VL0012	25	57	3%	6%	11%	17%	90%	6,0	4308
	VL1224	75	243	11%	6%	9%	14%	91%	31,2	15788
Nephrops bottom trawlers (unspecialized)	VL0012	4	9	0%	3%	6%	9%	59%	0,8	601
	VL1218	35	119	5%	6%	14%	20%	82%	19,4	8627
	VL1824	10	47	2%	3%	14%	17%	80%	8,9	2451
Sole netters	VL0010	18	40	2%	3%	38%	41%	65%	2,9	2285
	VL1012	50	161	7%	4%	51%	55%	74%	14,0	8336
	VL1218	42	198	9%	5%	53%	58%	76%	26,1	9967
	VL1824	21	133	6%	17%	52%	69%	84%	17,1	4866
Total		**785**	**2256**	**100%**	**10%**	**18%**	**27%**	**66%**	**249**	**125253**
				>5%			>50%	>50%		

Table 17: Different characteristics for the selected fleets in 2013 (Source: Macher et al. 2015)

Contributions of the French fleets operating in the Bay of Biscay to the total French landings by species and their dependence in terms of percentage of the gross revenue are represented in the following figure. This figure highlights interactions between fleets targeting and catching similar species and provide information on potential impacted fleets by management measures.

[25] Macher, C., Merzéréaud, M., Bertignac, M., Guyader, O., and C. Le Grand 2015. IFREMER Bio-economic Impact assessment of the MAP in the Bay of Biscay French demersal fisheries. STECF 15-8- annex documents IV. https://stecf.jrc.ec.europa.eu/reports/management-plans/

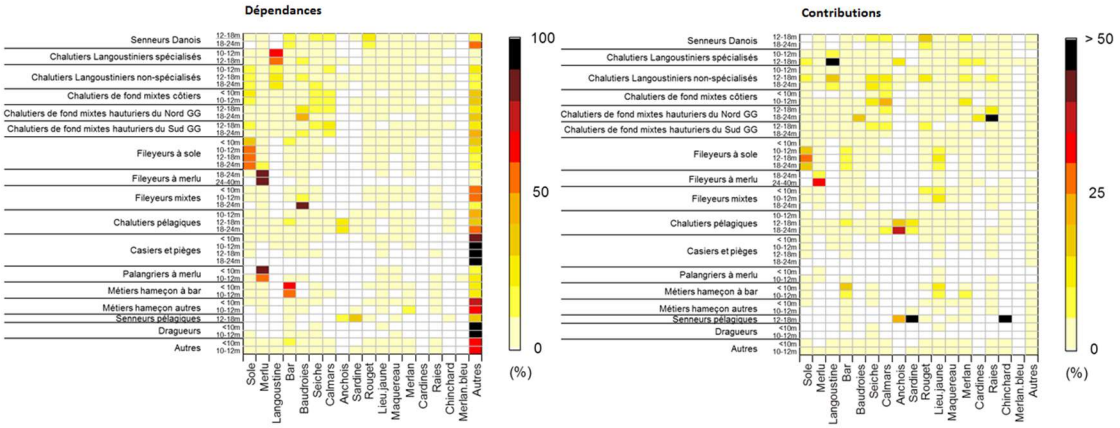


Figure 7: Description of interactions between selected fleets: 1) contribution of the French fleets operating in the Bay of Biscay to the total French landings by species and 2) fleets' economic dependences to the different main species in 2013 (Source: Macher et al. 2015)

Further analysis of the contributions of the French fleets operating in the Bay of Biscay *(including vessel length ranges)* by species highlight, for example, that 'sole netters over 10m' and 'specialized and unspecialized Nephrops trawlers over 12m' are the main French contributors to the Sole fishing mortality. It highlights also that 'hake gillnetters' are the main French contributors in the Bay of Biscay to the Hake fishing mortality but total contribution of French demersal fleets operating in the Bay of Biscay only represent less than 15% of the total fishing mortality on Hake.

Matrix of economic dependences presented in Table 18 highlight that dependent fleets to Sole and Hake are 'sole netters', 'hake longliners', 'hake gillnetters' and to a lesser extent, 'unspecialized nephrops trawlers" and 'coastal mixed demersal trawlers'. Other fleets *('specialized nephrops trawlers', 'offshore mixed demersal trawlers' and 'mixed netters')* are however dependent on a mix of demersal species such as Nephrops or Monkfish that could be also impacted by management. Analysis of the dependence to Sole and Hake by fleet and relative importance of employment by fleet highlight that most probable impacted fleets in terms of employment would be 'sole netters' and 'hake gillnetters'. However, important impacts on mixed fleets are also expected due to joint production and choke effects.

Fleets	ANE	BSS	CTC	HKE	HOM	LEZ	MAC	MNZ	MUR	NEP	PIL	POL	RAJ	SOL	SQZ	WHB	WHG	OTHER
Hake gillnetters_VL1840	0%	0%	0%	41%	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	55%
Hake longliners_VL0010	0%	7%	0%	73%	0%	0%	13%	0%	1%	0%	0%	1%	0%	0%	0%	0%	0%	6%
Hake longliners_VL1012	0%	6%	0%	58%	0%	0%	1%	3%	0%	0%	0%	2%	0%	0%	0%	0%	0%	30%
Mixed coastal bottom trawlers_VL0010	0%	3%	12%	1%	0%	0%	1%	0%	3%	0%	0%	0%	0%	26%	6%	0%	1%	47%
Mixed coastal bottom trawlers_VL1012	0%	5%	19%	3%	0%	0%	4%	1%	2%	1%	1%	0%	0%	12%	9%	0%	2%	39%
Mixed bottom trawlers North Bay Biscay_VL1218	0%	3%	12%	2%	0%	2%	5%	25%	2%	0%	3%	3%	3%	5%	5%	0%	2%	27%
Mixed bottom trawlers North Bay Biscay_VL1824	0%	0%	1%	1%	0%	3%	0%	26%	0%	0%	0%	0%	4%	1%	1%	0%	0%	63%
Mixed bottom trawlers South Bay Biscay_VL1218	0%	5%	13%	5%	0%	1%	1%	10%	7%	1%	0%	0%	1%	12%	16%	0%	1%	28%
Mixed bottom trawlers South Bay Biscay_VL1824	0%	6%	3%	3%	0%	2%	3%	16%	4%	1%	0%	0%	0%	3%	10%	0%	0%	49%
Mixed netters_VL0010	0%	12%	4%	1%	0%	0%	1%	2%	8%	0%	0%	3%	1%	9%	0%	0%	1%	59%
Mixed netters_VL1018	0%	8%	1%	3%	0%	0%	0%	9%	3%	0%	0%	10%	2%	2%	0%	0%	1%	59%
Mixed netters_VL1840	0%	0%	0%	2%	0%	0%	0%	82%	0%	0%	0%	5%	1%	0%	0%	0%	0%	10%
Nephrops bottom trawlers (specialized)_VL0012	0%	2%	2%	6%	0%	0%	0%	5%	1%	58%	0%	0%	0%	11%	3%	0%	1%	10%
Nephrops bottom trawlers (specialized)_VL1224	2%	1%	1%	6%	0%	3%	0%	12%	1%	55%	0%	0%	1%	9%	0%	0%	1%	9%
Nephrops bottom trawlers (unspecialized)_VL0012	0%	6%	4%	3%	0%	0%	2%	1%	2%	26%	0%	0%	0%	6%	6%	0%	2%	41%
Nephrops bottom trawlers (unspecialized)_VL1218	1%	4%	9%	6%	0%	2%	0%	15%	3%	19%	0%	1%	1%	14%	7%	0%	1%	18%
Nephrops bottom trawlers (unspecialized)_VL1824	2%	3%	12%	3%	0%	1%	0%	11%	3%	22%	0%	2%	1%	14%	5%	0%	1%	20%
Sole netters_VL0010	0%	12%	1%	3%	0%	0%	1%	1%	2%	0%	0%	3%	1%	38%	0%	0%	1%	35%
Sole netters_VL1012	0%	9%	2%	4%	0%	0%	0%	3%	2%	0%	0%	2%	0%	51%	0%	0%	1%	26%
Sole netters_VL1218	0%	8%	2%	5%	0%	0%	0%	4%	1%	0%	0%	2%	0%	53%	0%	0%	1%	24%
Sole netters_VL1824	0%	7%	1%	17%	0%	0%	0%	4%	1%	0%	0%	1%	0%	52%	0%	0%	0%	16%

Table 18: Economic dependence to the main species for the selected fleets in % of gross revenue (2013) Source: Macher et al. 2015.

Cost structure for the selected fleets are represented in the figure 8. It shows the relative fleets profitability which is between 5% to 10% for the less profitable *('offshore mixed demersal trawlers over 12m')* and 10% to 20% for the most profitable *('hake longliners')*. Cost Structure highlights also higher fuel costs for 'demersal trawlers' and higher personal costs for 'netters'.

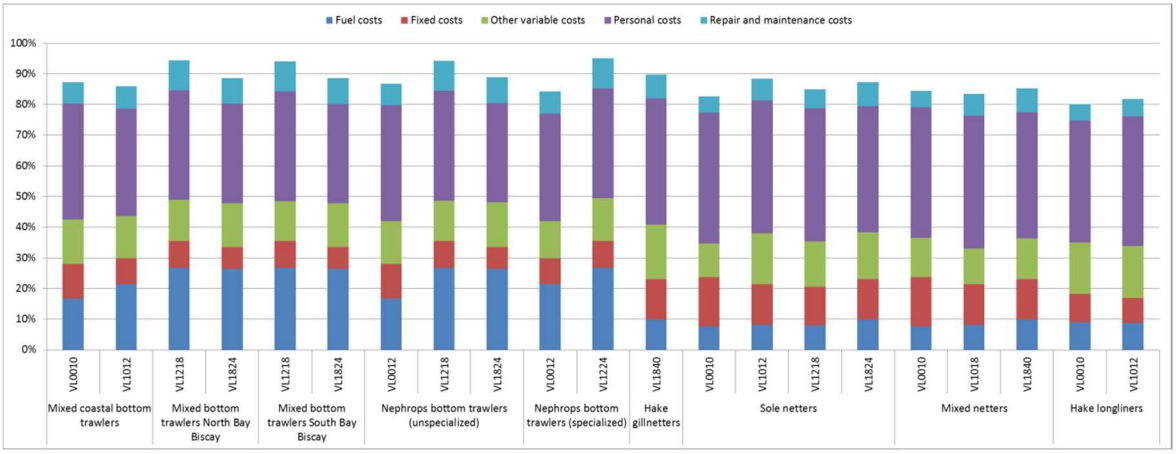


Figure 8: Cost structure for the selected fleets in 2013 (Source: Macher et al. 2015)

3.7 Conclusions and recommendations

Current EU-MAP fleet segments, because of the criterion of dominant gear *(notion of 'principal' fishing technique),* aggregate together vessels with different fishing strategy and consequently heterogenous landings profiles, investments levels and cost structures. A significant part of the real polyvalence of the (French) fleets is hidden by this rule, an example being the French fleet typologies "exclusive trawlers" and "trawlers dredgers" belonging to the same segment as long as trawl metiers represent the majority (i.e. more than 50%) of the fishing effort of the vessel considered.

The further split of the vessels per EU-MAP fleet segments and capacity sub-regions based on the rule of majority of fishing effort in a capacity region (*'principal' fishing capacity sub-region*) is a complementary approach of the current EU-MAP fleet segmentation. Applied to the French fleet, it refines the analysis and better considers the spatial distribution of fishing stocks improving the fleet segments separation regarding their contribution and dependencies to the different stocks. Its better highlights also the potential technical interactions between fleets. The DTS and DFN fleets are good examples of such an improvement.

An alternative ad-hoc fleet segmentation was also developed by Ifremer at a more detailed scale *(vessels operating in the Bay of Biscay)* in the context of Bay of Biscay' management plan assessment. The basic EU-MAP fleet segmentation was considered by the stakeholders as not appropriate and not detailed enough to cover the needs, leading to a biased view of the fleets operating in the area. Vessels length categories were considered to develop this alternative fleet segmentation as key variable to reflect revenue and cost structure and more detailed segmentation was carried out based on a set of rules regarding landings profile and/or regulations.

Ifremer-FIS segmentation is another alternative segmentation mainly based on a criterion of gear polyvalence/non-polyvalence *(in other words exclusive or non-exclusive vessels).* It contrasts with the EU-MAP fleet segmentation based on a criterion of dominant gear. The fishing fleet segmentation developed consists in bringing together in fleet segments, vessels having relatively homogeneous annual exploitation strategies. The stated assumption is that fishers do not change easily their strategies because of individual habits, some irreversibility in investment and also fisheries regulations. According to fluctuations in the availability and abundance of resources or market prices, fishers focus more or less on one of the metiers chosen within their fishing strategy. These strategies greatly influence the means of production *(inputs*) used but also the revenue and the costs of production.

For small scale vessels (under 12 meters), allocating vessels into one unique heterogeneous PGP (*Vessels using polyvalent "passive" gears only)* fleet segment under the current EU-MAP segmentation provides a biased representation of the structure of the fleet. Following the high diversity in term of gears used observed in the small-scale French fleets *(could be also observed for the large-scale fleet but to a lesser extent)*, using a more detailed segmentation is crucial to capture the diversity of the fleet (*whatever the region considered)*. This is also true at EU level, smaller are the vessels, higher is the diversity of gears used[26][27]. For these fleets, complementary data collection scheme like the vessel fishing activity calendar census survey (VFACCS) implemented in France is considered as the most appropriate.

[26] **For more detail regarding fishing activity data issues for SSF see the following reports:**
* Anon. (2005) Report on the workshop on small-scale fisheries. Kavala, Greece, 12-16 September 2005. A DCF ad-hoc workshop. 25pp. https://archimer.ifremer.fr/doc/00146/25752/23865.pdf
* Demanèche, S., Sabatella, E. et al. (2013) Report of the working group on common understanding and statistical methodologies to estimate/re-evaluate transversal data in small-scale fisheries. Nantes, France, 21-23 May 2013. A DCF ad-hoc workshop. 78pp. https://www.researchgate.net/publication/267006301_Report_of_the_Working_Group_on_Common_understanding_and_statistical_methodologies_to_estimatere-evaluate_transversal_data_in_small-scale_fisheries
* Demanèche, S., Gambino, M., Jackson, E., Malvarosa L. et al. (2017) Report on the PGECON subgroup DCF workshop on small scale fisheries. The Hague, Netherlands, 25-29 September 2017. A DCF ad-hoc workshop.
104pp.https://datacollection.jrc.ec.europa.eu/documents/10213/891027/2017_Workshop_PGECON+small-scale+fisheries.pdf/451907ac-184e-4df6-86a5-5435057a483d?version=1.0

[27] Guyader, O., Berthou, P., Koutsikopoulos, C., Alban, F., Demaneche, S., Gaspar, M.B., Eschbaum, R., Fahy, E., Reynal, L., Curtil, O., Frangoudes, K., Maynou, F., 2013. Small scale fisheries in Europe: a comparative analysis based on a selection of case studies. Fish. Res. 140, 1–13.

4 Issues raised by data limitations for proposed alternative segmentation

The processing of the alternative segmentation tool requires individual annual landings species composition data by vessel. As mentioned below, the availability of such data set is not the same over the whole French fleets and this may limit the capacity to carry out alternative segmentation analysis.

4.1 Data sources on landings per vessel

In France, detailed landings and effort data per vessel are available through the SACROIS platform. SACROIS[28] is a cross-validation tool for the fisheries statistics, aiming at providing the best possible fishing statistics data by cross-checking available data from the different declarative control regulation sources, as requested in article 145 of the EU control Regulation *(EC Reg. 404/2011[29])*. The application is crossing information, at the most disaggregated level, from the fishing fleet register, logbooks and coastal logbooks, sales notes data, geolocation data *(VMS)* and vessel fishing activity calendar census survey *(VFACCS)*, in order to build the most accurate and complete dataset compiling French fleet' fishing trips with their associated features *(dates, fishing area, metier, gear and mesh size, total weight and value of landings by species)*. The application verifies and controls the different sources of data, with the aim of displaying validated and qualified landings per species and effort data series. The application provides also several quality indicators and evaluates the completeness of the data flows. A specific algorithm is included into SACROIS to estimate the value of landings based on sales note data available *(sometimes directly deducted from them)* or estimation of an average price. SACROIS includes also the allocation of a single metier to a fishing trip *(see detailed methodology in DCF metier workshop report[30])*.

Individual landings species composition data by vessel could be then be derived from the SACROIS database but the availability of such data set is not the same over the whole French fleets especially regarding the specific features of the small-scale fleets. This issue is not specific to the

[28] * IFREMER SIH (2022). SACROIS - Algorithme de consolidation des données déclaratives. IFREMER https://doi.org/10.12770/6510e8e0-788d-45ba-9792-3d0585fe1009
* IFREMER SIH (2022). https://sih.ifremer.fr/Debarquements-effort-de-peche/Sacrois
* Sébastien DEMANECHE, Eric BEGOT, Antoine GOUELLO, Jérémie HABASQUE, Claude MERRIEN, Emilie LEBLOND, Patrick BERTHOU, Valérie HARSCOAT, Manon FRITSCH, Clément LENEVEU, Martial LAURANS (2010). Projet SACROIS "IFREMER/DPMA" - Rapport final - Convention SACROIS 2008-2010.
* Sébastien DEMANECHE, Eric BEGOT, Antoine GOUELLO, Claude MERRIEN, Jérôme WEISS, Emilie LEBLOND, Céline VIGNOT, Armelle ROUYER (2021). Rapport d'activité Sacrois - Valid & Expertise sur les données d'activité de pêche. Convention Socle Halieutique DPMA-Ifremer 2020. Article 3.3 Accompagnement de la maîtrise d'ouvrage de la DPMA, relatif à son expertise halieutique, dans le cadre des projets Sacrois et Valid.

[29] Commission implementing regulation (EU) No 404/2011 of 8 April 2011 laying down detailed rules for the implementation of Council Regulation (EC) No 1224/2009 establishing a Community control system for ensuring compliance with the rules of the Common Fisheries Policy. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32011R0404&from=FR#d1e32-121-1

[30] DCF metier workshop report, Anonymous, 2018, Annex5 p°75 – 87. https://datacollection.jrc.ec.europa.eu/documents/10213/891027/2018_Workshop_DCF+Metiers.pdf/6b928c8a-c2ac-4507-840c-98155e0f07d9?version=1.0

French fleets[31]. Complementary data collection has been implemented for some fleets for which the coverage of their available declarative data is considered as insufficient. This is the case of A/ the French fishing fleet less than 12 meters length operating in the Outermost regions (French Guiana, Guadeloupe and Martinique, La Réunion and Mayotte) for which complementary on-site sampling data are collected and calculation of their reference fishing activity' estimates is applied on this basis and B/ the French fishing fleet less than 12 meters length operating in the supra-region Mediterranean for which a re-evaluation methodology[32] on the basis of the annual fishing activity calendars survey is applied to calculate their reference fishing activity' estimates.

4.2 Data availability per region

The following figures present indicators to assess the completeness of the available data by supra-region and vessel length ranges *(<12m and >=12m)*. This completeness check is allowed because the vessel fishing activity calendar census survey *(VFACCS)* provide information on the part of fishing activity not included in available declarative data. The indicator used compares the number of active fishing vessel*months in the VFACCS vs the number of active fishing vessel*months with at least one declarative data available for the different regions *(FAO areas 27, 37, 51, 31 & 41)*.

[31] **see references in footnote 26 and also in the following:**
* Demanèche, S., Mugerza, E. et al. (2018) Small Scale, size isn't everything: Issues and progress in monitoring European small-scale fleets. 9th International Fisheries Observer & Monitoring Conference, 11-15 June 2018, Vigo, Spain.
* Demanèche, S., Armstrong, M., Mugerza, E. et al. (2016) Small scale, big deal: Sampling catches from European small-scale fisheries. ICES 2016 Annual Science Conference, 19-23 September 2016, Riga, Latvia.
* Mugerza, E., Álvarez, A., Colina, A., Curtin, R., Demanèche, S., Fernández, MP., García, L., Garcia Flórez, L., Gaspar, M., Gonçalves, JMS., Nuno, S., James, M., Mendo, T., Muench, A., Peón, P., Punzón, A., Ribeiro, A., Sobrino, I ., Sousa, I., Vasconcelos, P., Tobin, D. (2020) Comparative methodologies to monitor Small-Scale Fisheries in the Atlantic Area. CABFishMAN Interreg Atlantic Area project (European Regional Development Fund).
* Anon. (2019) The fishPi² project (Strengthening regional co-ordination in fisheries data collection). Summary report. EU Open Call for proposals. European Contract N° MARE/2016/22.
* Guyader Olivier, Berthou Patrick, Koutsikopoulos Constantin, Alban Frederique, Demaneche Sebastien, Gaspar M. B., Eschbaum R., Fahy E., Tully O., Reynal Lionel, Curtil Olivier, Frangoudes Katia, Maynou F. (2013). Small scale fisheries in Europe: A comparative analysis based on a selection of case studies. Fisheries Research, 140, 1-13. Publisher's official version : https://doi.org/10.1016/j.fishres.2012.11.008 , Open Access version : https://archimer.ifremer.fr/doc/00118/22934/
* Guyader Olivier, Berthou Patrick, Koustikopoulos C., Alban Frederique, Demaneche Sebastien, Gaspar M, Eschbaum R, Fahy E, Tully O, Reynal Lionel, Albert A (2007). Small-scale coastal fisheries in Europe. Final report. CONTRAT NO FISH/2005/10. https://archimer.ifremer.fr/doc/00000/6348/

[32] details about the re-evaluation methodology applied is described in the 9th IFOMC proceedings p°105-108, *https://ifomcvigo.com/wp-content/uploads/2018/08/proceedings-9th-ifomc.pdf*

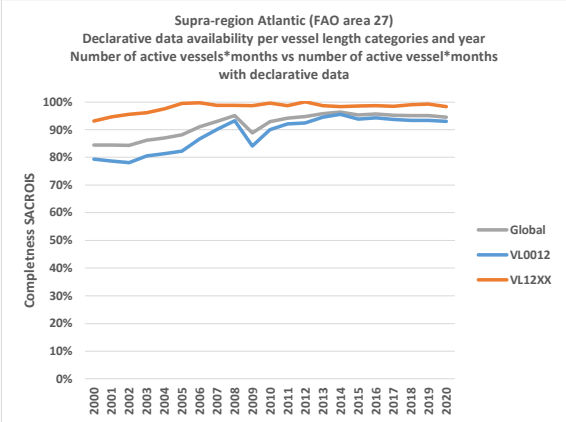


Figure 9: Vessel data completeness – Supra region Atlantic (FAO area 27)

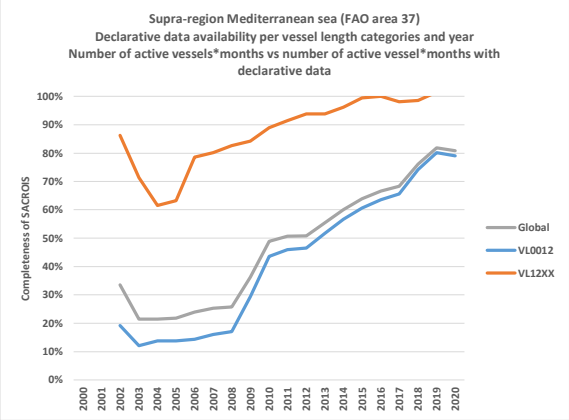


Figure 10: Vessel data completeness – Supra region Mediterranean Sea (FAO area 37)

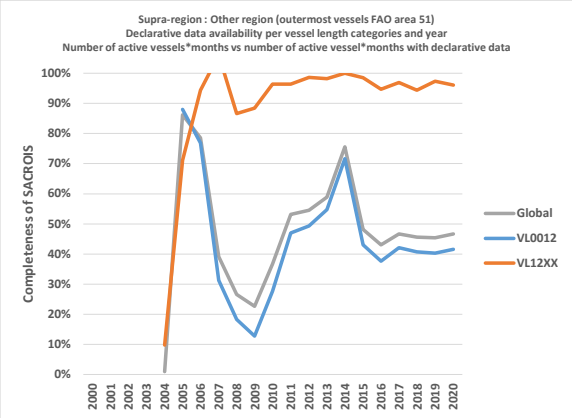


Figure 11: Vessel data completeness – Supra region Indian ocean (FAO area 51)

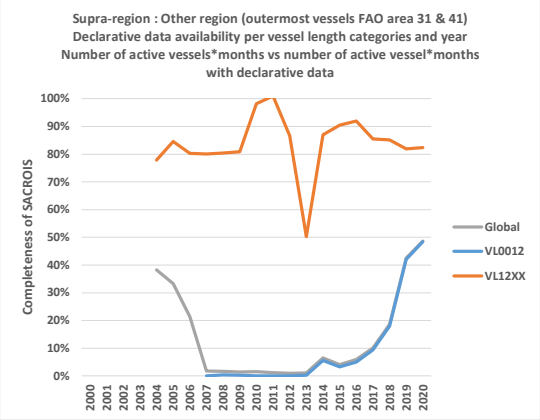


Figure 12: Vessel data completeness – Supra region Western Atlantic (FAO area 31 & 41)

The completeness indicators show that only the French fishing fleet operating in the supra-region Atlantic (area 27) is evaluated as sufficient/complete to meet the end-user's data needs *(e.g. EU-MAP requirements, meet the coverage, resolution and/or quality requirements of the end users)* and especially the clustering analysis that requires individual landings data per vessel. The data set are not reliable in the Mediterranean Sea *(less than 80% of completeness with a significant part of vessels under 12 meters)* and is below 50% for the vessels operating in La Réunion and Mayotte *(Indian Ocean, FAO area 51)* and those operating in French Guiana, Martinique and Guadeloupe *(Western Atlantic, FAO areas 31 & 41)* where the fleet is mainly composed of small-scale vessels.

Consequently, in these outermost regions, complementary on-site sampling data are collected *(catch assessment survey[33])* and calculation of their reference fishing activity' estimates are

[33] Demaneche, S. Berthou, P., Blanchard, F., Cornou, A.S., Daures, F. Deporte, N., Guyader, O., Lespagol, P., Reynal, L. 2013. Methodological issues to estimate catches and fishing effort of small-scale fisheries by sampling fishing trips on-site. Proceedings of the 7th International Fisheries Observer & Monitoring Conference, 8-12 April 2013, Viña del Mar, Chile (p°60–62).

applied on this basis. Accordingly, individual vessels landings data are not available in these regions and the alternative segmentation tool used in the workshop cannot be applied.

4.3 Example of an alternative segmentation without exhaustive vessel landings data: the case of outermost region of Guadeloupe

However, alternative segmentation based on the VFACCS is possible *(see section 3 for a description of the data collection methodology)*. Like in France mainland, the segmentation is governed by a step by step process in which all the vessel operating on MFADs and targeting large pelagic species are separated from vessels operating only in coastal fisheries (see next table)[34]. Not only the landings structure of these fleets is significantly different but the costs are also different in size and structure. For example, the fuel cost is higher due to longer and more distant trips off the Guadeloupe coast, gear costs (hooks and lines) are limited but the equipment for MFADs investment is similar to the investment in a vessel. For vessels operating in coastal fisheries, different fleets are distinguished *(hooks, potters, netters targeting mainly demersal species and crustaceans)* and also encircle netters targeting small pelagics.

Ifremer Fleet segment		VL0006	VL0608	VL0810	VL1012	VL12XX	Nb_vessels	%
Passive gears	Hooks and lines on MFADs large pelagic	Hooks and line on MFADs exclusive	1	11	38	1	**51**	9%
		Hooks and lines on MFADs Passive gear	5	68	87	6	**166**	31%
	Coastal fisheries	Other Hooks	3	15	2	3	**23**	4%
	Coastal fisheries	Potters	14	56	25	3	**98**	18%
	Coastal fisheries	Netters	4	32	33	2	**71**	13%
	Coastal fisheries	Encircle netters	4	14	6		**24**	4%
	Coastal fisheries	Other polyvalent passive gears	13	66	26	1	**106**	20%
							539	
Non Active vessels		23	112	60	14		**209**	

Table 19: Example of alternative segmentation in the case of the outermost region (OMR) Guadeloupe fleet.

This type of segmentation is considered more efficient than the EU-MAP segmentation. For example, the EU-MAP segment called "Vessels using Hooks" includes very dissimilar vessels such as i) vessels operating on MFADs and targeting mainly large-scale species *(Dolphinfish, yellowfin tuna, etc.)* with high yields and costs per day at sea and ii) vessels targeting demersal species like snappers and groupers with low yields and costs per day at sea.

4.4 Conclusions and recommendations

The proposed alternative segmentation tool to be considered in the 2021 and 2022 workshops is not adapted to fleets where completeness of their individual-vessel declarative landings data is poor or insufficient. Even if completeness indicators are correct for the French fishing fleet operating in the supra-region Atlantic *(area 27)*, the data set are not reliable in the Mediterranean Sea *(less than 80% of completeness with a significant part of vessels under 12 meters)* and is below 50% for the vessels operating in La Réunion and Mayotte *(Indian Ocean, FAO area 51)* and those operating in French Guiana, Martinique and Guadeloupe *(Western Atlantic, FAO areas 31 & 41)* where the fleet is mainly composed of small-scale vessels. For these fleets, segmentation should

https://www.ifomc.aq/frequently_asked_questions/proceedings

[34] The Hooks and lines on MFADs fleet is allocated two groups, one with the pure Hooks and lines on MFADs and the other combining passive gears to harvest coastal species.

be based on other data sets than the only declarative data here assessed as incomplete *(and it should be the case as long as it is assessed incomplete)*. In France, vessel fishing activity calendar census survey (VFACCS) are used to derive alternative fleet segmentations for such fleets with incomplete declarative data. The case of outermost Guadeloupe is used to illustrate.

5 Applications of the alternative segmentation tool on the French national fleets operating in the supra-region Atlantic

5.1 *The French fleet operating in the supra-region Atlantic*

As mentioned above, the application exercise of the alternative segmentation tool is applicable only to the French fleet operating in the supra-region Atlantic (FAO area 27) based on the vessel (individual) landings data available in the SACROIS data-set (see before for details). The application exercise is neither feasible for the Mediterranean fleet operating in FAO 37 nor for the Outermost fleet operating in Indian Ocean (area 51) and Western Atlantic (FAO area 31 & 41).

In 2020, French fishing fleet operating in the supra-region Atlantic consisted of 2 900 vessels; 187 being inactive. The 2 713 active vessels presented a high variability in term of vessel length from less than 4 meters to more than 90 meters vessels (see next figure). The majority (52%) were less than 10 meters vessels (1495 vessels) when the more than 24 meters vessels represented less than 5% of the total fleet (125 vessels).

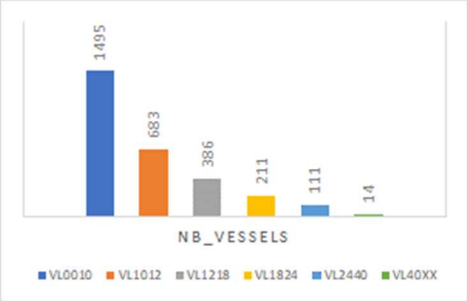


Figure 13: Number of vessels per vessel length ranges (Atlantic area 27) in 2020

In 2020, The Atlantic fleet was distributed as follows according to the EU-MAP and Ifremer-FIS segmentation.

DCF Fleet segment		VL0010	VL1012	VL1224	VL2440	VL40XX	Nb_vessels	%
Active gears	Beam trawlers (TBB)		1	1			2	0%
	Demersal trawlers and/or demersal seiners (DTS)	83	169	268	56	10	586	22%
	Pelagic trawlers (OTM)	1	5	26	1	4	37	1%
	Purse seiners (PS_)		3	27			30	1%
	Dredgers (DRB)	73	81	87	1		242	9%
	Vessels using other active gears (MGO)	171	8				179	7%
	Vessels using polyvalent active gears only (MGP)	12	56	48	5		121	4%
Passive gears	Drift and/or fixed netters (DFN)	309	151	93	24		577	21%
	Vessels using pots and/or traps (FPO)	296	80	19	1		396	15%
	Vessels using hooks (HOK)	216	49	3	20		288	11%
	Vessels using other passive gears (PGO)	98	4	1			103	4%
	Vessels using polyvalent passive gears only (PGP)	59	12	1			72	3%
Active/Passive gears	Vessels using active and passive gears (PMP)	38	37	5			80	3%
							2713	
Non Active vessels		139	27	18	3		187	

Table 20: Number of vessels per EU-MAP fleet segment (Atlantic area 27) in 2020

Ifremer Fleet segment		VL0010	VL1012	VL1224	VL2440	VL40XX	Nb_vessels	%
Active gears eventually combined with passive gears	Demersal trawlers exclusive	21	54	183	45	10	313	12%
	Pelagic trawlers exclusive		3	8	1	4	16	1%
	Mixed Trawlers exclusive	1	8	58	7		74	3%
	Trawlers Dredgers	47	173	135	1		356	13%
	Trawlers Glass eel fishing	30	22				52	2%
	Trawlers Passive gears	10	18	2			30	1%
	Demersal seiners		1	19	9		29	1%
	Purse seiners		4	27			31	1%
	Dredgers exclusive	43	34	29			106	4%
	Dredgers Passive gears	92	69	6			167	6%
	Glass eel fishing exclusive	86	4				90	3%
	Glass eel fishing Passive gears	165	9				174	6%
Passive gears exclusive	Netters exclusive	145	84	82	24		335	12%
	Netters Potters/Traps	204	57	9			270	10%
	Netters Hooks	63	28	3			94	3%
	Potters/Traps exclusive	156	44	14	1		215	8%
	Potters/Traps Hooks	77	16				93	3%
	Hooks exclusive	136	20	3	20		179	7%
	Other passive gears	80	8	1			89	3%
							2713	
Non Active vessels		139	27	18	3		187	

Table 21: Number of vessels per Ifremer-FIS fleet segment (Atlantic area 27) in 2020

A high diversity of the fishing gears in used by these vessels was observed which lead to a high distributed fleet by fleet segment. The Ifremer segmentation allows to assess the exclusive or non-exclusive nature of fishing strategies of the vessels highlighting that the combination of two *(or more)* fishing gears during the year is very common. This should be considered to carry out a fleet segmentation of interest.

5.2 Methodology to tests the alternative segmentation tool

Different tests of the alternative segmentation tool (clustering approach) were applied on the French fleets operating in the supra-region Atlantic based on the "Fleet Segmentation manual"[35]. In a last step, results of the clustering approach obtained by EU-MAP fleet segment were also compared with other alternative pre-existing fleet segmentations using intra vs inter variances indicators and stability indicators over the years.

Two different methods were tested to pre-segment the full dataset by:

1) EU-MAP fleet segment,
2) Ifremer fleet segment

Then the clustering approach *(R-package provided in the context of the workshop)* was tested based on the following metrics:

- Catch composition profiles in weight *(Ldgs/species*sect)* and value *(val/species*sect)*
- Total landings by "fishing gear" *(métier DCF level4)* in weight *(Ldgs/metDCF4)* and value *(val/metDCF4)*

[35] Fleet Segmentation - Package Manual. Erik Sulanke Thuenen-Institute for Sea Fisheries, Bremerhaven, Germany.
https://rdrr.io/github/ESulanke/FleetSegmentation/f/vignettes/FleetSegmentation_vignette.Rmd

- Total landings by "métier" *(métier DCF level5)* in weight *(Ldgs/metDCF5)* and value *(val/metDCF5)*
- Total landings by "métier" * "ICES division" in weight *(Ldgs/metDCF5*sect)* and value *(val/metDCF5*sect)*

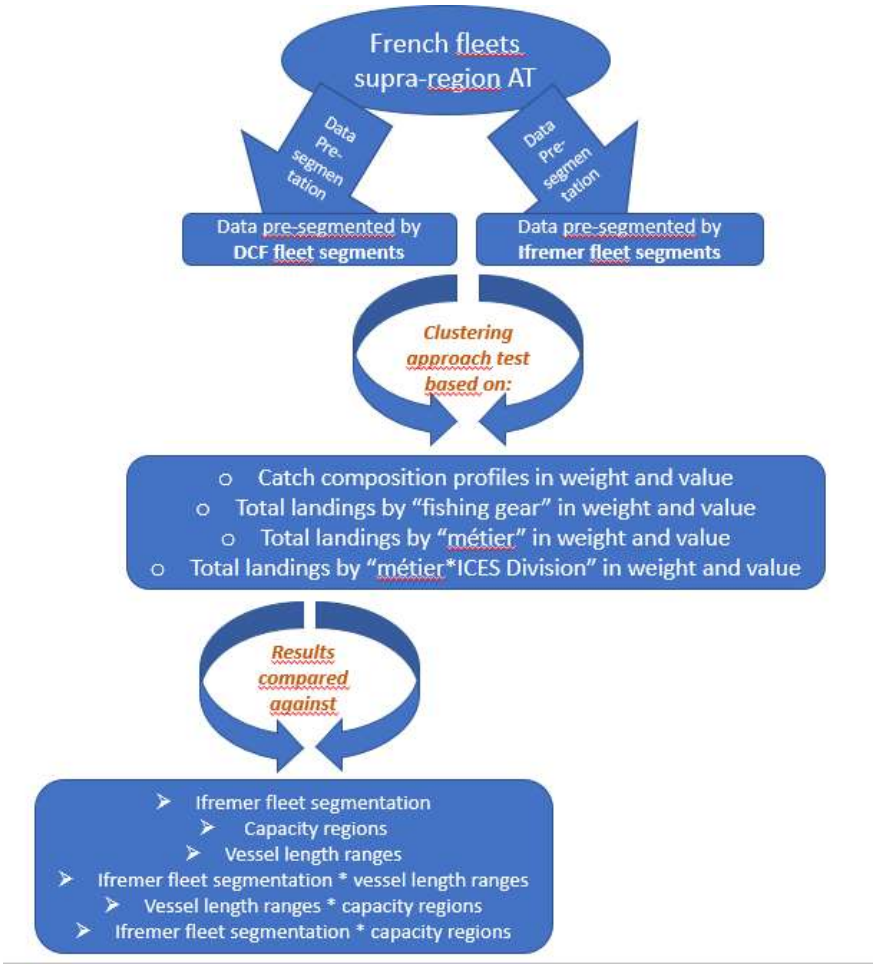


Figure 34: Methodology used to compare different segmentation and different metrics

Finally, the clustering approaches results obtained by EU-MAP fleet segment were compared with the following alternative pre-existing fleet segmentations:

- Ifremer-FIS fleet segmentation *(FLEET_IFR)*,
- Capacity regions of the vessels *(REG_CAP)*,
- Vessel length ranges *(VSL_LGTH)*,
- Ifremer-FIS fleet segmentation * vessel length ranges *(VSL_LGTH/FLEET_IFR)*,
- Vessel length ranges * capacity regions *(VSL_LGTH/REG_CAP)*,
- Ifremer-FIS fleet segmentation * capacity regions * vessel length ranges *(VSL_LGTH/REG_CAP/FLT_IFR)*

At the end, 14 different fleet segmentations were compared.

5.2.1 *"Demersal trawlers and/or demersal seiners (DTS)" EU-MAP fleet segment, metric = catch composition profiles in weight*

First application exercise of the alternative fleet segmentation tool was applied by EU-MAP fleet segment on catch composition profiles in weight *(default approach proposed by the tool)*. The result obtained for "Demersal trawlers and seiners (DTS)" EU-MAP fleet segment is briefly presented hereafter. The results of the other EU-MAP fleet segments are available in *Annex I*.

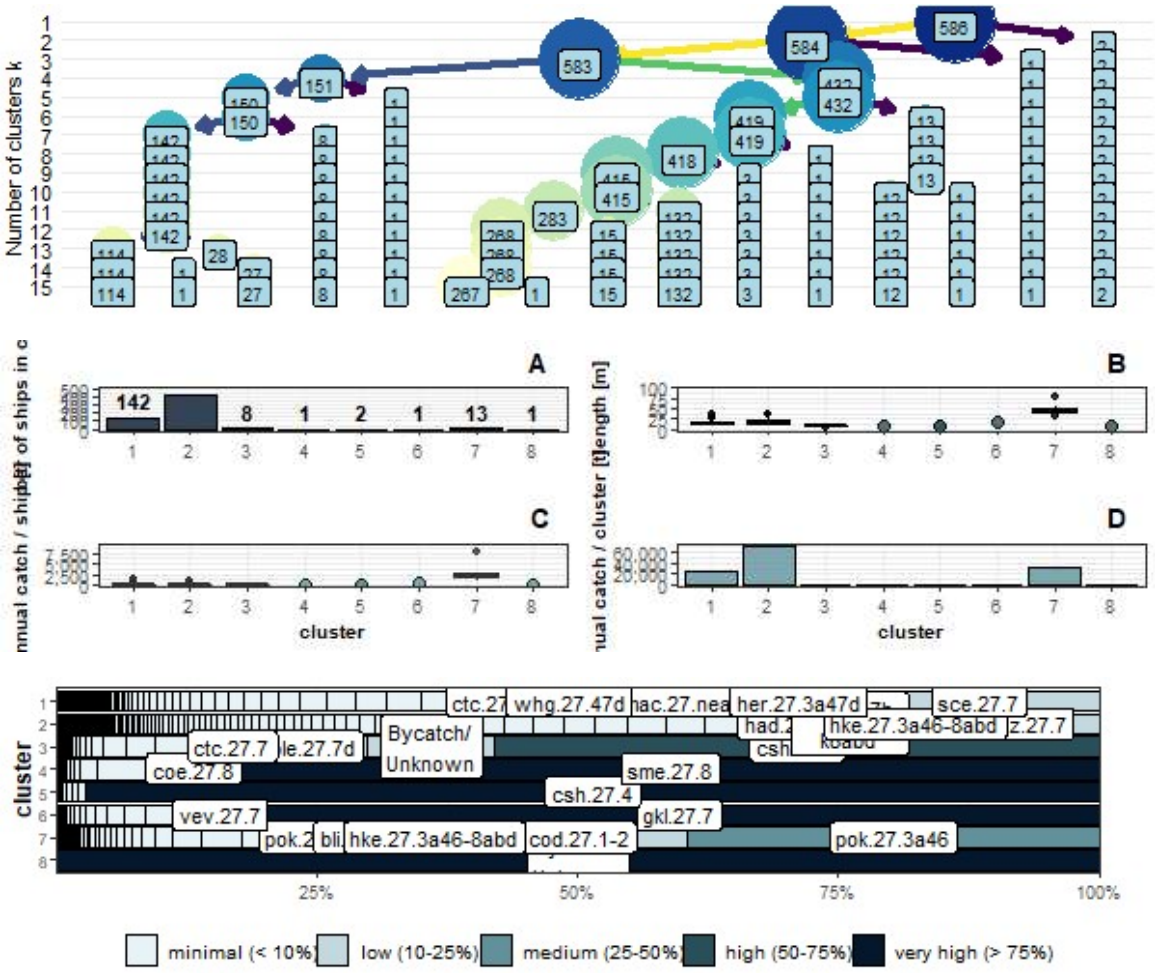


Figure 22: Results for the Demersal trawlers and/or demersal seiners (DTS) EU-MAP segment, metric = catch composition profiles in weight.

A first conclusion of this exercise is that the alternative fleet segmentation tool seems not well adapted to the specificity and the diversity of the French fishing fleets. One of the major issues from this application is that the tool tends to highlight some very specific/specialized vessels designing fishing segments with less than 5 to 10 vessels and keeping the majority of the other fishing vessels in 2 to 3 large diverse groups where the principal stocks landed are grouped. The segmentation carried out with the proposed clustering R-package failed to achieve the objective.

This seems to be linked to the high diversity observed in the different French EU-MAP fleet segments. Pre-segmentation of the data before applying the approach is therefore a key issue to

consider. To try to avoid the issue linked with the polyvalence of the vessels belonging to the same EU-MAP fleet segment, same application exercise was carried out on the pre-segmented data set by Ifremer fleet segment *(segmentation based on gear or combination of gears practiced)*.

5.2.2 *"Demersal trawlers exclusive" Ifremer-FIS fleet segment. metric = catch composition profiles in weight*

The results achieved for the application of the alternative fleet segmentation tool by Ifremer-FIS fleet segment for "Demersal trawlers exclusive" Ifremer-FIS fleet segment is briefly presented hereafter, other segments could be found in *Annex II*.

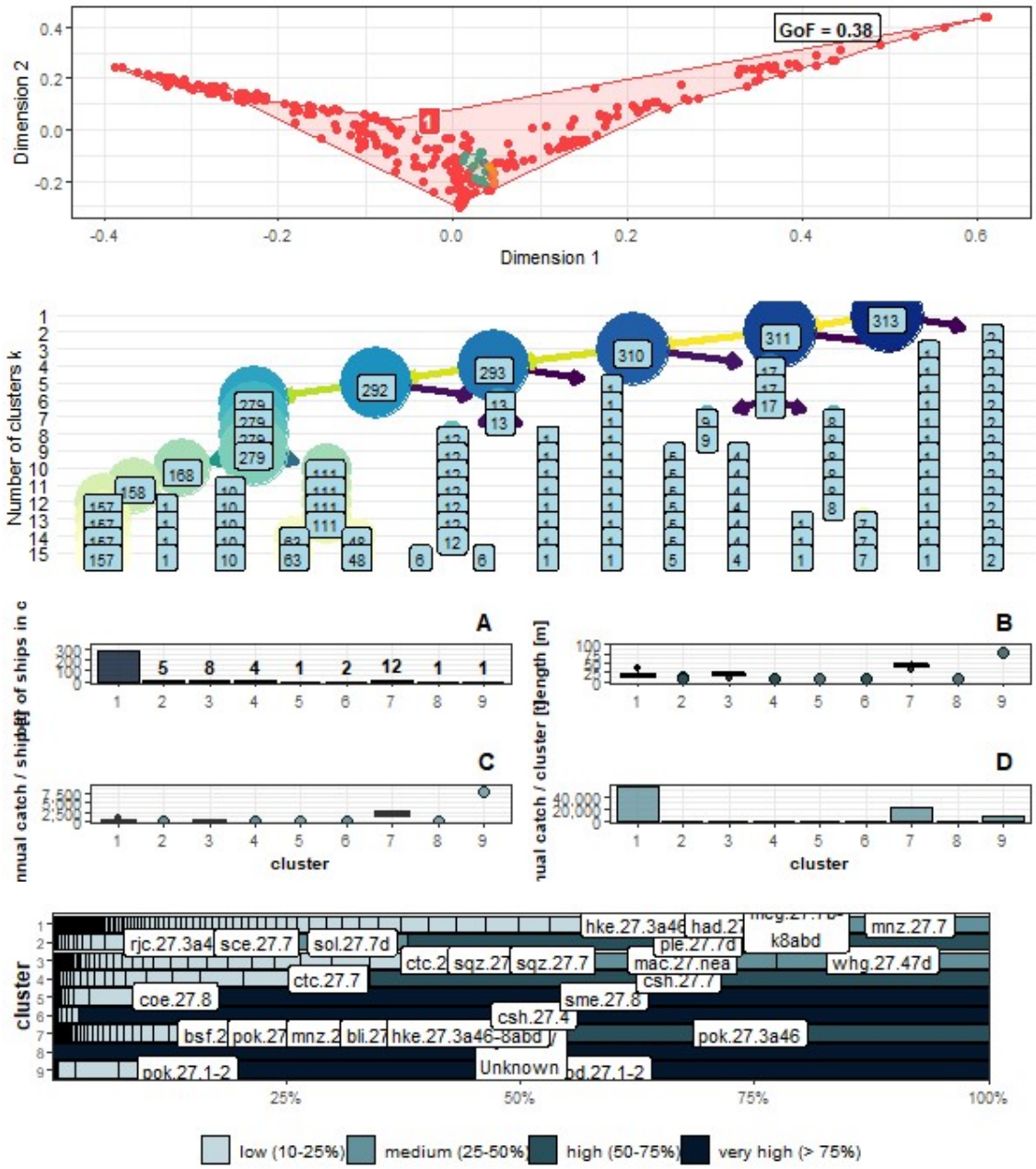


Figure 23: Results for Demersal trawlers exclusive Ifremer-FIS segment, metric = catch composition profiles in weight.

The application exercise gives better results on Ifremer-FIS Fleet segmentations *(especially for specialized vessels e.g. "Demersal trawlers exclusive" or "Netters exclusive")* but the tool seems to have still difficulties to identify a segmentation adapted to the polyvalent/diversified vessels considered and tends to continue to group specific/specialized vessels into small groups and to keep other fishing vessels in 2 to 3 large diverse groups.

This issue should possibly be linked to the technical statistical parameters considered in the tool as the "distance" or the "segmentation method" *(e.g. hierarchical agglomerative cluster analysis (HAC))*. Maybe should be valuable to propose in the tool an alternative choice 1) for the distance as a "denormalized distance", 2) for the segmentation method as a "k-means clustering method" or 3) to parameter a "minimum cluster size control". Furthermore, it is not obvious if the classification tool considers the "absolute value" or recalculate the data in "percentage". The two different possibilities should be possibly allowed and tested.

5.2.3 *"Demersal trawlers exclusive" (Ifremer-FIS-segment)- catch composition profiles in value*

The metric to perform the segmentation could be questioned especially considering the landings weight vs the landings value. To classify the vessels into fleet segment, like to define the metier and for the same reasons, it seems that value landed should be a better metric to consider. Actually, same considerations apply that the ones approved in the DCF WK Métier Workshop[36]:

> *"However, it is the recommendation of this group that if target assemblage is defined as describing the fisher intent then value is the metric that should be used, as fisheries are conducted for economic gain. Likewise, when species with a low weight relative the value is the real target, then value is a better metric. Finally, the use of value as the metric for target assemblage would help to avoid the complication created by the implementation of the landings obligation, where potentially large weights of low economic value could affect any post classification system based solely on weight, resulting in incorrect definition of fishing intention. Despite this, there might be some cases where a combination of value and weight should be used. For example, purse seiners targeting small pelagic fish can catch a school of the target species but if some other valuable species are caught in less weight the output of the trip can be conditioned by the more valuable species although it was not the original target. A combination of the two criteria should be used in these cases."*

In order to test this assumption same application exercise was applied on the French fishing fleet considering the total value landed by species/stocks rather than the weight. See hereafter, an example of the results obtained on the Ifremer fleet segment *"Demersal trawlers exclusive"* using the value to be compared with the previous plot presenting the results for the same vessels with the metric in weight.

[36] Anonymous report: DCF Métier Workshop: Sub-group of the RCGs - North Sea and Eastern Arctic and North Atlantic. 22 - 26 January 2018. DTU Aqua, Lyngby, Denmark. https://webgate.ec.europa.eu/regdel/web/meetings/507/documents/1697

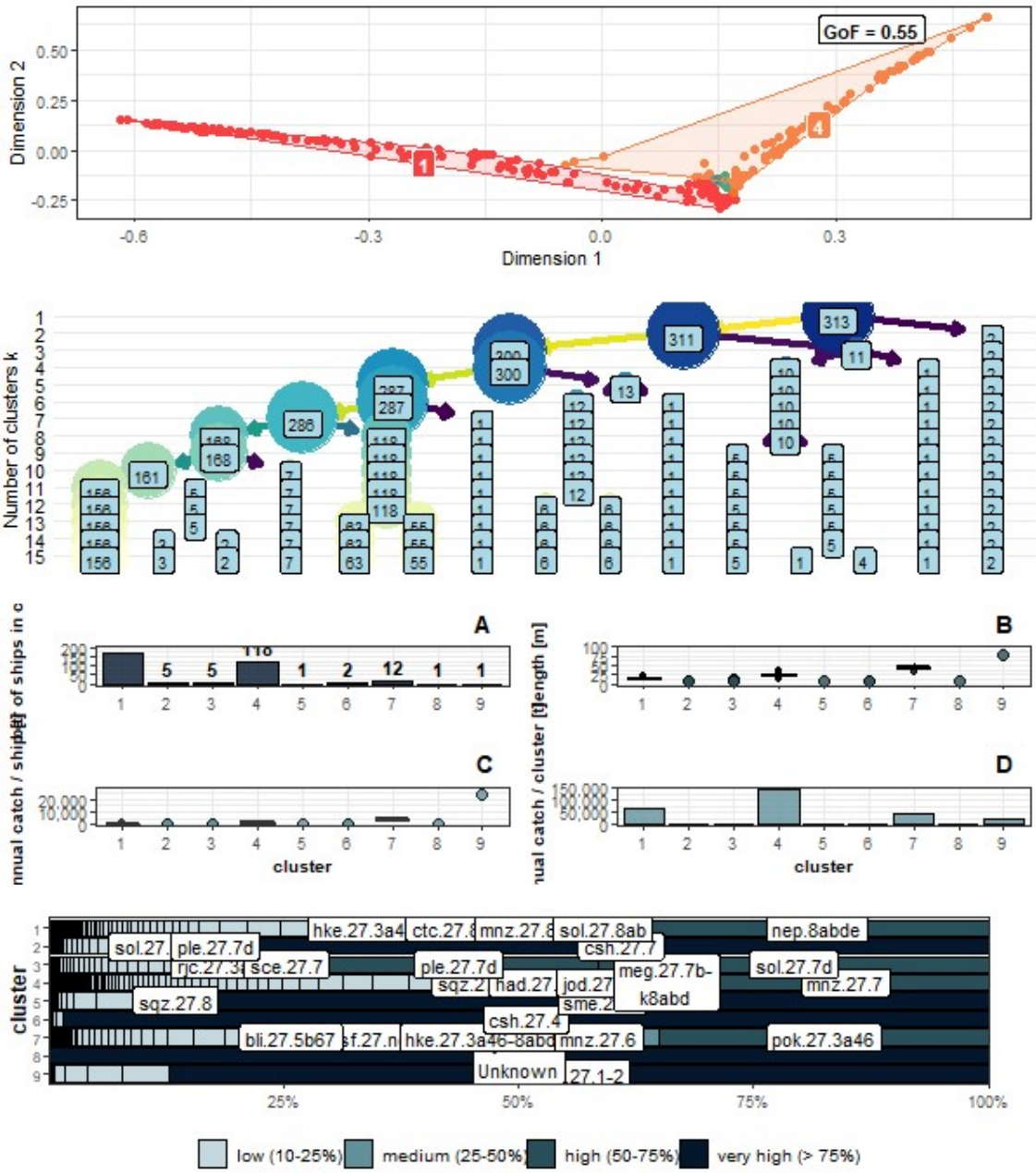


Figure 24: Results for Demersal trawlers exclusive Ifremer-FIS segment, metric = catch composition profiles in value.

Considering the value of species landed allow to better segment the fleet especially into two different 'big' groups and presents a better GoF (0.55 vs 0.38).

However, the two principal groups defined remain relatively big *(168 and 118 vessels, groups 1 & 4)* and the tool still seems to focus on very specific/specialized vessels regrouping them in small groups *(groups 2, 3, 5, 6, 7, 8 & 9)*. For example, the group 9 concerns only one vessel with landings declared in the 27.1.2 which is very specific when the group 1 aggregate 168 vessels with important landings of nephrops (NEP), sole (SOL), anglerfish (MNZ), hake (HKE) and cuttlefish (CTC); all of them being "structuring species" for the exclusive Demersal trawlers fleet operating in the supra-region Atlantic.

5.2.4 *Catch composition in weight vs total landings in value by fishing gear (metier DCF level4) for polyvalent fleets (example of Netters Potters/Traps)*

In order to develop a proposal flowchart to be applied to segment the fishing fleets. Another test was done on the "Netters Potters/Traps" Ifremer fleet segment *(polyvalent fleet)* comparing the results obtained by the tool directly *(based on catch composition)* from another approach considering the vessel' total landings in value by fishing gear practiced during the year *(in order to better take into consideration the polyvalent nature of the vessels considered)*.

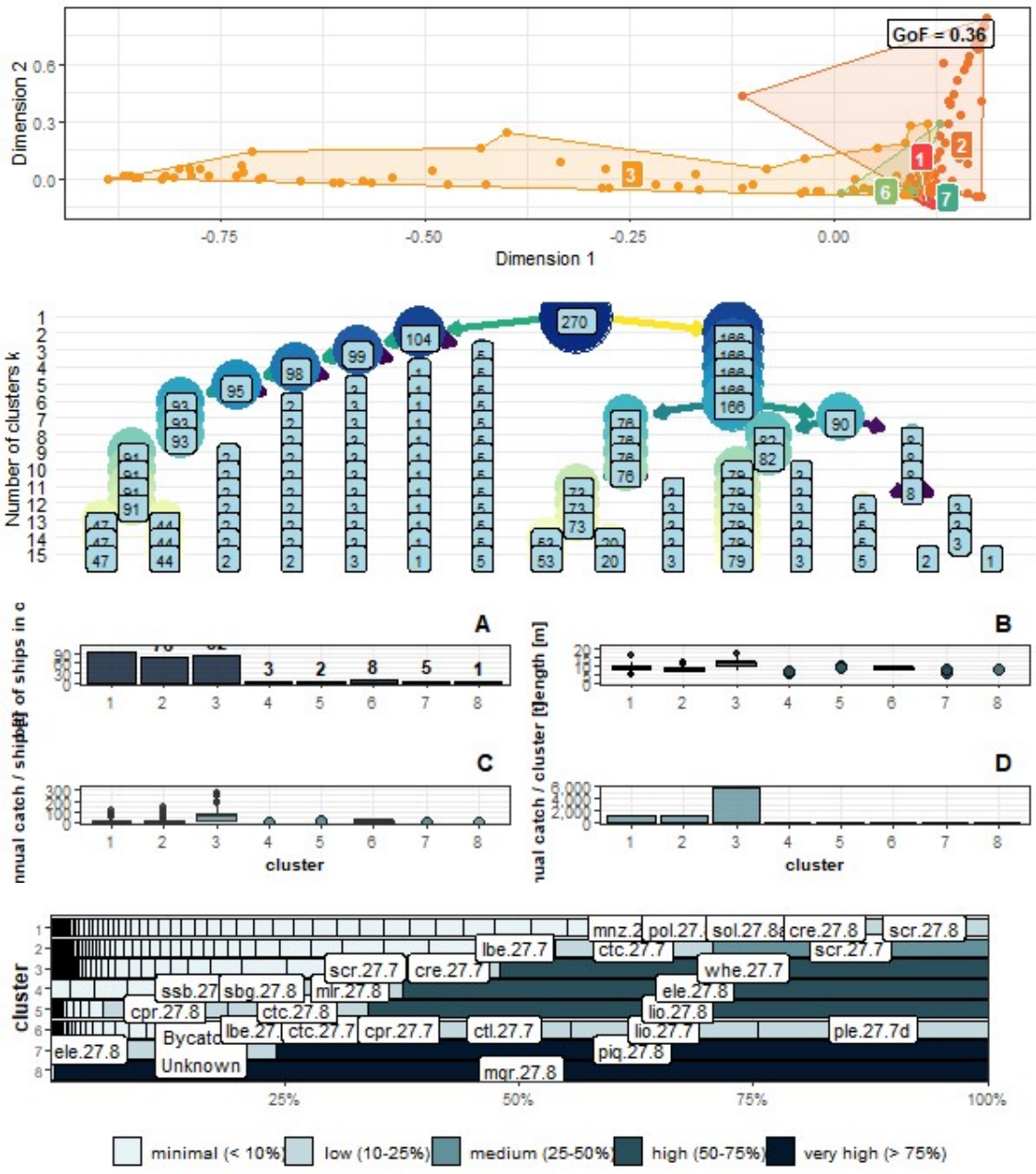


Figure 25: Results for Netters Potters/Traps – Metric: catch composition profile in weight.

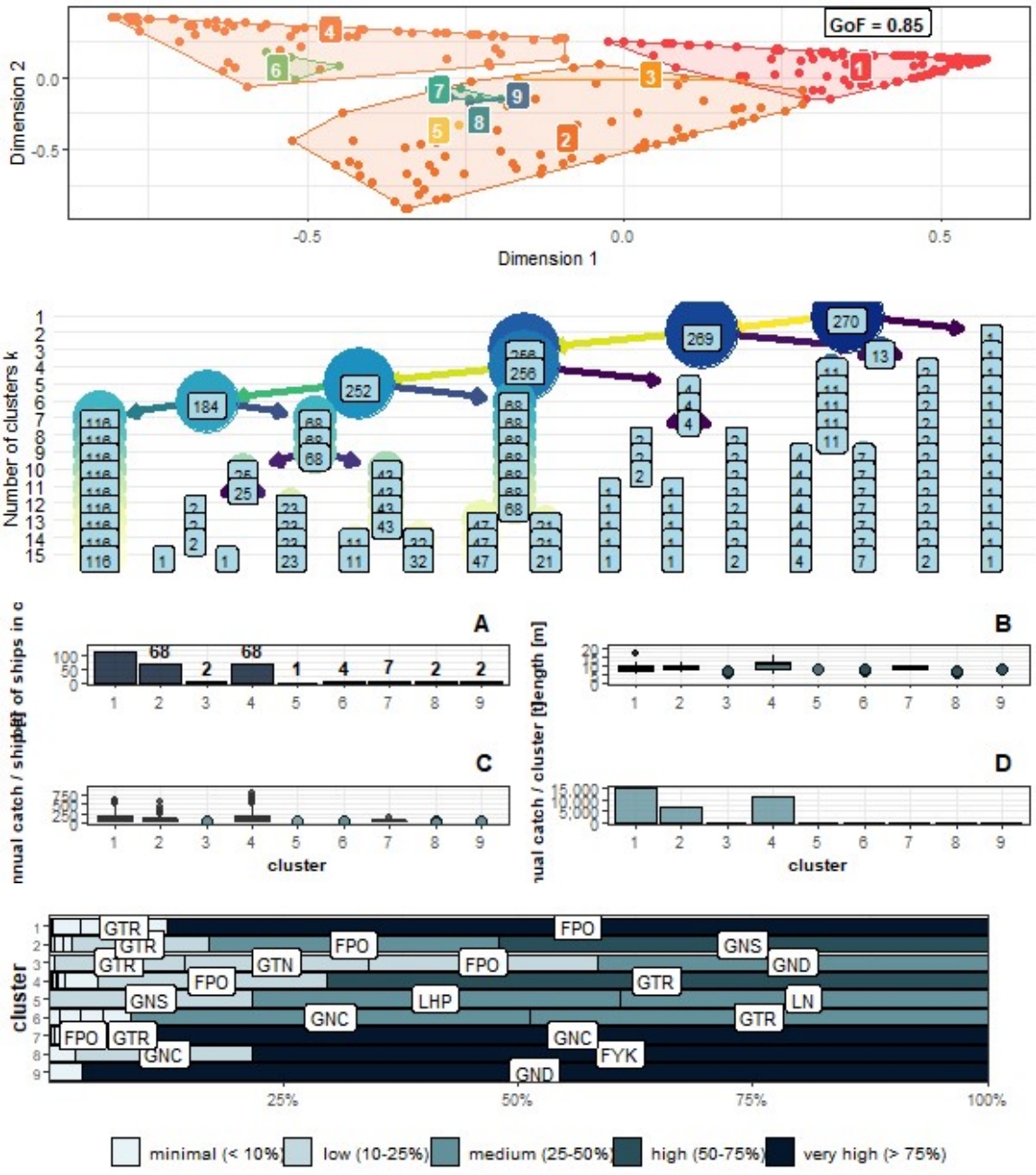


Figure 26: Results for Netters Potters/Traps – Metric: total landings in value by fishing gear (metier DCF level4)

Although the groups are similarly balanced in both analysis with three big diverse groups constituted and other groups being relatively small; it seems that the "big" diverse group are more heterogeneous in the first process *(see dimension1 * dimension 2 maps)*. Therefore, a first step based on the combination of gears used by the vessels seems to better structure the fleet *(pre-segment the dataset)* before getting one step further regarding the group of species targeted *(i.e. the metiers practiced during the year)* and finally the species/stocks composition. For example, here it should be useful to distinguish vessel combining *"nets and pots metiers"* vs *"nets and fike nets (traps)"*.

5.2.5 *"Demersal trawlers exclusive" Ifremer-FIS segment, metric catch composition in weight vs total landings in value by "métier" (metier DCF level5)*

In the same way and also to test the proposal flowchart presented hereunder, a test was applied on the "Demersal trawlers exclusive" Ifremer-FIS fleet segment *(exclusive fleet)* comparing the results obtained by the tool directly *(based on catch composition)* from another approach considering the vessel' total landings in value by métier DCF level5 during the year.

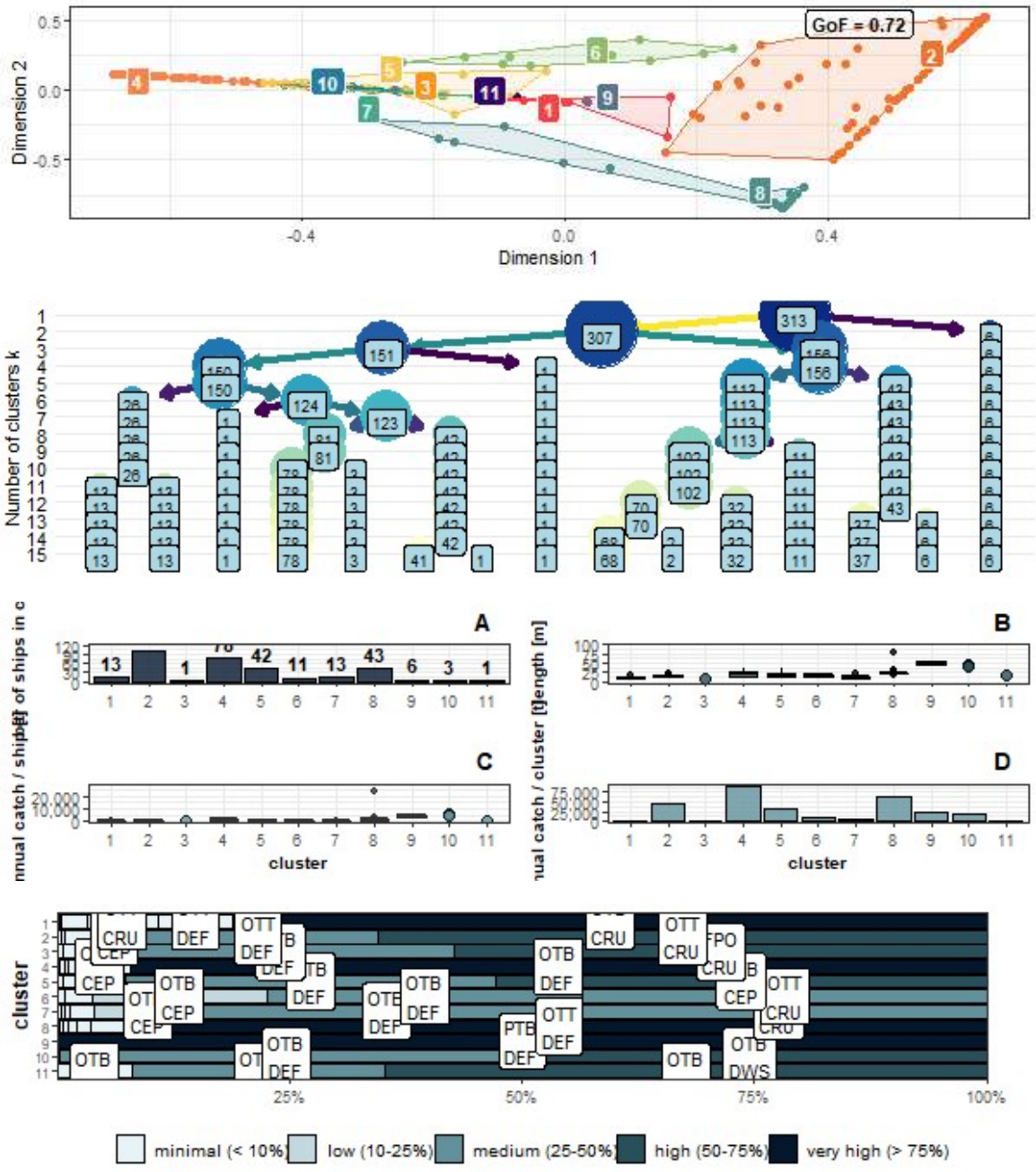


Figure 27: Results for Demersal trawlers exclusive Ifremer-FIS segment, metric = total landings in value by métier DCF level5

The tool *(even if issue stated before remains)* applied on the basis of total landings in value by metier DCF level5 *(i.e. by group of species targeted)* allow here to better divide the fleet into groups more balanced than the groups obtained applying the tool on catch composition profile. For example, considering the metiers for this exclusive fleet allow to divide the *"exclusive demersal trawlers"* between *"exclusive demersal trawlers targeting crustaceans", "targeting cephalopods"* or *"targeting demersal fishes"*. This highlight that further steps should be then required to segment the fleets regarding the species/stocks' catch profile composition i.e. taking into consideration the different métiers operating by the vessels during the years *(their operating strategy)*.

Indeed, métiers *(regrouping fishing activity based on gear type, mesh size & target species/fish stocks)* have been defined to picture the fishing strategies of the vessels and regroup fishing trips according to similar exploitation patterns. See following conclusions stated during the DCF WK Métier Workshop[37]:

"Recently, the recast of the EU-MAP Regulation reaffirms the métier as an important domain of interest. Today fleet and métiers are commonly employed in European fisheries to form the building blocks which describe the heterogeneity of fishing activity in both biological and economic terms. These building blocks allow the partitioning of landings and effort into 'sensible' sized units representing the fishing activities within them (ICES, 2003). The functionality of métiers is evident in the number of groups (i.e. DCF, ICES, RCG, GFCM, RFMO, ...) who now use them for a variety of programs, such as the pre or post stratification/aggregation of national sampling programs, bio-economic modelling (e.g. Ulrich, Reeves, Vermard, Holmes, & Vanhee, 2011) and management strategy evaluations (e.g. Vermard et al., 2008). Ultimately, well-defined métiers provide the building blocks of more effective management (Davie & Lordan, 2011) and constitute a potent tool to improve biological and bio-economic expertise, to move towards an ecosystem-based approach and to better estimate PETS bycatch data. The use of métiers makes it possible to describe the fishing behaviour/fishing practices of fishermen and constitute a sound basis for the typological classifications of vessels by fleet segment, which forms the basis of economic data collection."

Furthermore, the matrix *"metier*fleet"* developed since the inception of the DCF has been defined to consider the fact that fishing activities on a yearly basis *(vessel' operating strategy)* affects the economic performance and the fishing activity at the trip level defines the exploitation pattern to sample, the metiers making the connection between the economic and biologic parts. Finally, métier were harmonized between countries in order that one metier can be used in a region to describe the same types of fishing activities across nations which reinforce the importance and the needs to consider the métiers and eventual combination of in the process of fleet segmentation.

[37] Anonymous report: DCF Métier Workshop: Sub-group of the RCGs - North Sea and Eastern Arctic and North Atlantic. 22 - 26 January 2018. DTU Aqua, Lyngby, Denmark. https://webgate.ec.europa.eu/regdel/web/meetings/507/documents/1697

5.3 Comparison of results achieved through the clustering approaches based on different metrics with the alternative pre-existing fleet segmentations

One of the main objectives of the fleet segmentation is to build homogeneous groups of vessels stable over the years to improve the accuracy and precision of the calculated estimates especially in terms of revenue and cost structure and other related indicators. To test and compare the results obtained from the tool *(clustering approach based on different metrics in weight and value)* against other alternative pre-existing fleet segmentation, inter-stratum variance of key indicators were calculated and analysed. The problem of small size clusters was also considered because of the confidentiality issues at the stage of the estimate's restitution. Finally, the issue of the stability of the clusters was considered in a second step.

5.3.1 Inter and intra variance for different segmentations and metrics

Following graphical outputs were edited by EU-MAP fleet segment *(example for the EU-MAP "Drift and/or fixed netters (DFN)" fleet segment is presented hereafter; other results are available in Annex III).* Each column of the graph illustrates one of the tested segmentations, and each row refers to a particular indicator. The first row presents an indicator assessing the importance of small-size clusters in the result obtained. It describes the number of clusters aggregating only one vessel, aggregating 2 to 4 vessels or aggregating more than 5 vessels. The second row completes the first one presenting the number of vessels allocated by groups with less than 5 vessels.

The other rows present the inter-stratum *(green)* and intra-stratum *(red)* variances calculated by fleet segmentation for some key indicators-metrics: fishing days, days at sea, hours at sea, total landed weights and total landed values[38]. One of the principals aims of a fleet segmentation being to maximize the inter-stratum variance and minimize the intra-stratum variance of economic indicators.

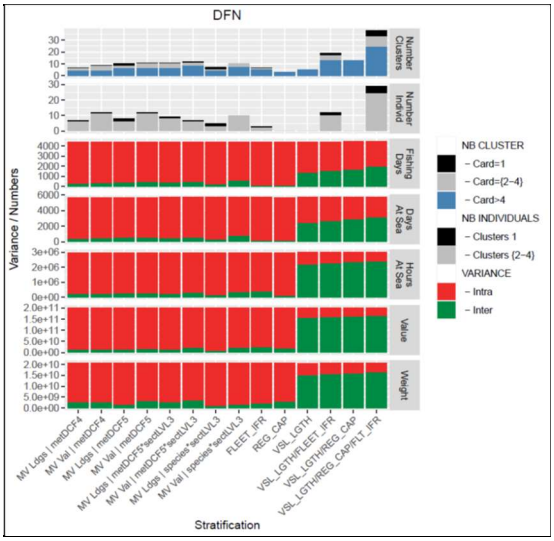


Figure 28: DFN EU-MAP Fleet segment – Comparison inter/intra stratum and small size clusters between results of alternative segmentation tools and pre-existing fleet segmentations

[38] At this stage, cost indicators were not included in the analysis.

Regarding the inter/intra-stratum variance analysis, the graph highlights the importance to first segment the dataset by vessel length ranges which concentrate a lot of the variability *(strong contribution to the inter-stratum variance)* observed between vessels and present better results than all the other segmentations tested, whatever the variable considered. At this stage, the clustering approach *(whatever the metrics considered)* failed to propose a fleet segmentation which explain more variability than first separate vessels by vessel length ranges.

Following that, pre-segment the data set by vessel length ranges could be a way to produce better results and to improve the homogeneity of the fleets segments obtained. Same analysis was carried out by EU-MAP fleet segment * vessels length ranges. Example for the DFN EU-MAP Fleet segment and the VL1012 vessel length range follows:

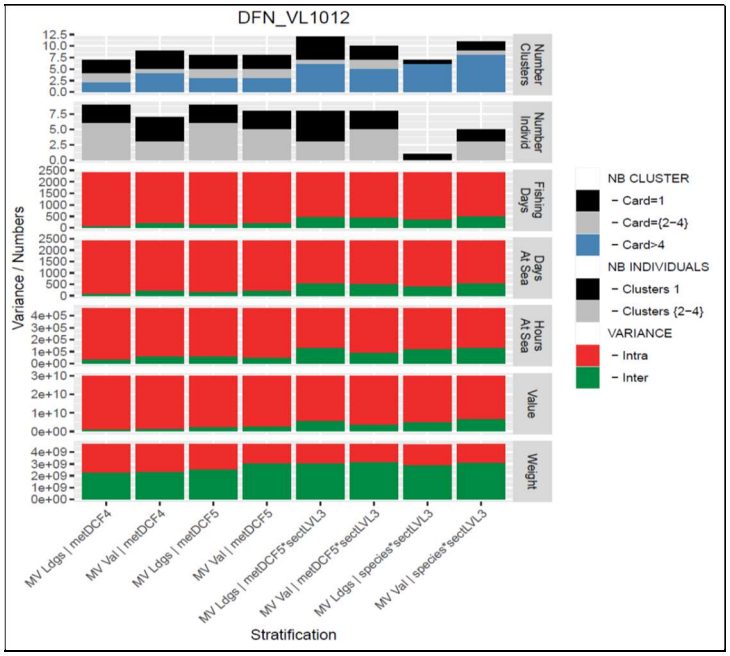


Figure 29: DFN EU-MAP Fleet segment – VL1012 – Comparison inter/intra stratum and small size clusters between results of alternative segmentation tools and pre-existing fleet segmentations

As expected, pre-segmenting the EU-MAP fleet segment first by vessel length ranges allow to decrease the total variance i.e. the process benefit from this preliminary stratification mitigating the negative effects of too much overall heterogeneity in the population considered. This should be regarded also considering the possible threshold issue linked with the predefine vessels length limit to define vessels length ranges and also the usefulness to aggregate vessels from different vessel length ranges presenting similar fishing strategies.

5.3.2 Stability of the clustering approaches

Another issue of the approach is the requirement to compare fleet segments across years. The following graph compare the results obtained for two different years (2018 vs 2019) on the same fleet segment and highlight the instability of the results obtained year to year. The graph presents information about the stability of the results obtained in the two years from the different tested segmentations i.e. segmentation provided by the tool *(clustering approach based on different*

metrics in weight and value) and pre-existing fleet segmentation. Each square present a tested segmentation and compare the results obtained in the two years (2018 & 2019).
For DFN EU-MAP fleet segment (presented as an example in figure 30 hereunder), it highlights a high instability when using the clustering approach which is less the case regarding the pre-existing fleet segmentation. Similar results have been observed for the other EU-MAP fleet segments. It concludes that clustering approaches are a good statistical mean to analyse/explore the fishing fleets studied but it is crucial from their results to define stabilized set of rules which could be applied all along the period, year after year.

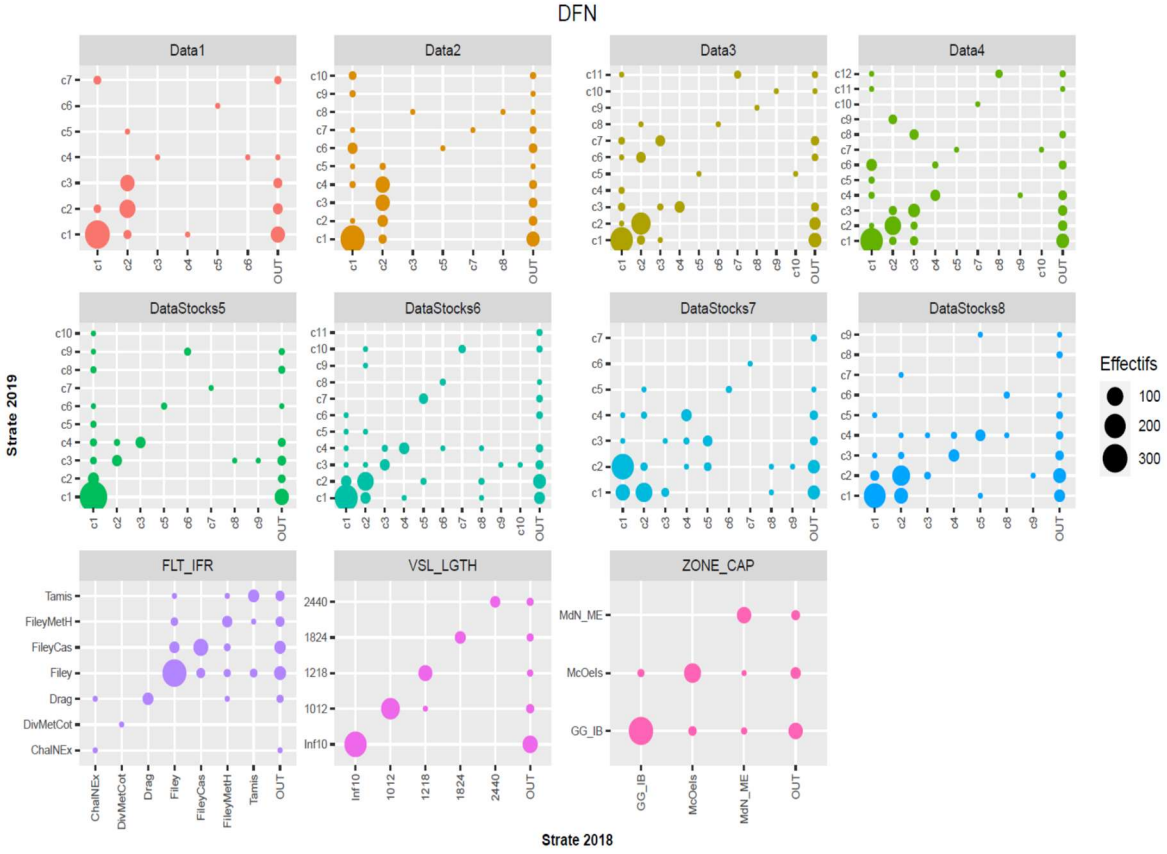


Figure 30: DFN EU-MAP Fleet segment – Comparison of the results obtained in 2018 and 2019 for the different tested fleet segmentations. Indicator of stability/instability of the results obtained.

5.4 Conclusions and recommendations

Based on the application of the proposed clustering R-Package to the French fleet operating in the supra region Atlantic, our first conclusion is that the use of Principal Component Analysis and clustering approaches is not appropriate to define fleet segmentation. If the tool is very interesting for a preliminary understanding of the fishing fleets and activities which are complex by nature, one of the issues with PCA analyses is that it is difficult to control how the groups are formed. Moreover, PCA analysis do not produce stable groups/segments over time and across countries and may even change historical perspectives upon addition of new years in the dataset. PCA results can also lead to the definition of groups that are often too large or too small, which is also a pitfall to be avoided *(small groups)* for statistical and confidential reasons.

The metric proposed by the tool is the "Catch composition profile in weight" because it is supposed *"to better represent the fishing strategies of the vessels, the stocks used and how mixed or targeted a fishery is"*. Based on our analysis, the landings in value per species or stock seems to be a better metric than weight for the majority of the fleets. Reasons for that are similar as what it was approved in the DCF WK on metier issues. Based on our results, it seems also crucial to better consider the polyvalent/non-exclusive nature of the fleets in terms of fishing gears and métiers. The specific methodology we developed for the analysis of inter/intra-stratum variance also highlights the importance to first segment the dataset by vessel length ranges which concentrate a lot of the variability. Indeed, vessel length ranges present better results than all the other segmentations tested, whatever the variable considered.

A flowchart proposal for the segmentation of the EU fleet[39]

The following flowchart tries to synthetize the step-by-step approach proposed with the objective to define a set of agreed and objective rules for the improvement of the EU fleet segmentation.

1. Necessary criteria for fleet segmentation

First of all, it is crucial to consider that necessary criteria for fleet segmentation should be i) stabilized and easily replicable over time and ii) harmonized and standardized between member states and fisheries ecoregion. Any segmentation should be stable: This means that segmentation rules cannot be changed every year or too regularly. Obviously, if the segments change regularly, the basis for calculating indicators evolves over time and it is therefore not possible to monitor the economic performance or other indicators related to the vessels and fleets over time and across countries. Furthermore, even if specific fishing activities may be operated in each member state, the same easily identified set rules must be applied in each MS or/and each fishing ecoregion for different member states. Moreover, the segmentation should not be too fine. Indeed, when the segmentation is too fine, vessels can migrate from one fleet/segment to another too easily even with minor changes in their fishing and production strategy. This can result in an instability of the groups, which is also not desirable for the analysis of series. Another consideration is the compatibility with previous DCF time series.

[39] Complementary to fleet segmentation, it is fundamental to keep in mind the "metier * fleet" matrix which gives the possibility to connect vessels to species and stocks through metiers.

Finally, it is imperative on the one hand to respect the rules relating to confidentiality *(for example at least 5 vessels per segment)* and on the other hand to have segments of sufficiently large size to be able to get economic samples of acceptable *size (in other terms limiting also the number of segments)*.

2. Design of the set of rules

There are different options as soon as step 0: Either to reconsider completely the fleet segmentation at global EU fleet level or to develop a new sub-segmentation of the ongoing EU-MAP fleet segments. Vessels considered could also be regionalized by fishing ecoregion (e.g. Bay of Biscay and Iberian waters, North Sea and Eastern Channel, …). Before any further investigation, vessel length ranges, as key parameter, should be considered and discussed for improvement.

Then, whatever the option adopted, the first step (step 1) is to segment the fleet by fishing gear or combination of fishing gears used by the vessels, then (step 2) by metier DCF level5 *(i.e. principal group of species targeted)* or combination of and then (step 3) by catch composition in value by species/stocks. The benefit of such an approach would be to better consider the different dependencies to species and contribution of fishing mortality to fish stocks as well as the polyvalence of vessels. Based on this analysis, the set of rules need then to be codified to be easily replicable each year *(threshold to be developed)*.

All of that, lead to consider the following fleet segmentation flowchart proposal. It takes first (step1) into consideration the fishing gears or combination of, used by the vessels (exclusive or polyvalent vessels), separating vessels by their exclusive (e.g. exclusive trawlers, exclusive netters, …) or non-exclusive/polyvalent nature (e.g. trawlers-dredgers, netters-potters, …). Next step (step2) considers the metiers or combination of metiers practiced (i.e. the principal target species or combination of targeted) for example separating exclusive trawlers vessels between exclusive pelagic trawlers, exclusive demersal trawlers or mixed exclusive trawlers targeting demersal and pelagic fishes. Finally, in a third round (step3) some specificities regarding the catch composition in species/stocks of the vessels considered could be highlighted for example separating exclusive demersal trawlers between Nephrops specialized exclusive demersal trawlers and non-specialized exclusive demersal trawlers. This last step allows to better define/divide the groups established. This should be associate with considering the vessel length ranges and fishing areas. In this method, the alternative fleet segmentation tool developed will be useful as a statistical mean to analyse the dataset and define the set of rules to be applied in application of the flowchart.

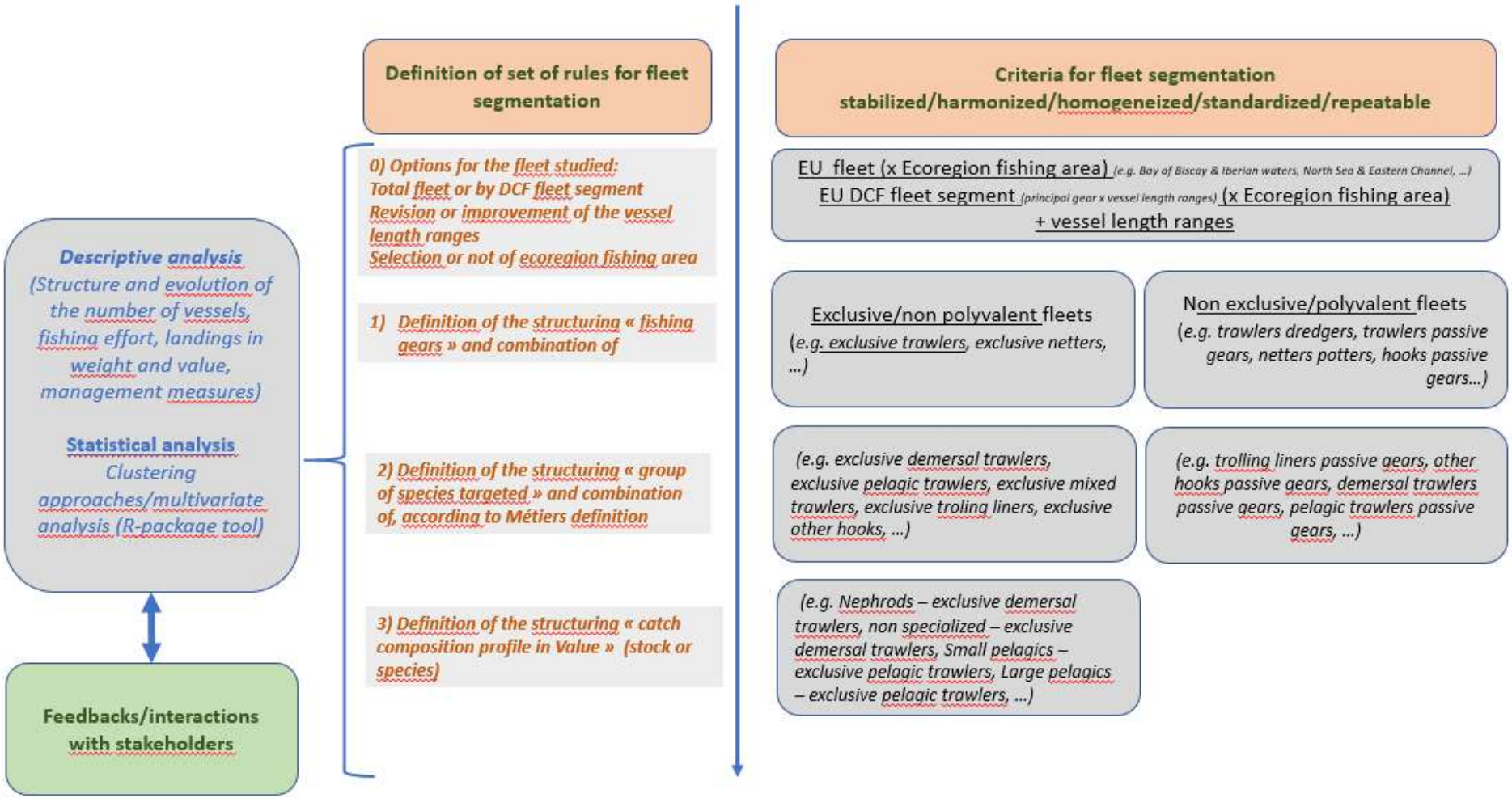


Figure 31 Flowchart proposal to define a set of rules to segment the EU fleet

3. Methodology

To define the set of rules, preliminary analyses of fishing fleets *(by length category including the evolution of the number of vessels, fishing effort and landings by species in weight and value)* including the regulatory contexts should be developed[40]. PCA tools and clustering approaches are very interesting for a comprehension of the fleets and fishing activities which are complex by nature. Based on these different approaches, the results should be translated into stabilized/standardized and harmonized set of decision rules shared between member state, easily reproducible year by year in order a vessel will be allocated to one fleet segment in the same way in each MS for the fishing ecoregion considered**.** Exchange and discussion with stakeholders could be also useful at this stage.

4. Data availability issues and small-scale fleets

As mentioned above, the application exercise of the alternative segmentation tool is only applicable to fleets where vessel (individual) landings data (landings per species and stocks) are available. However, the lack and incompleteness of reliable data at vessel level has been reported in many contexts especially for small-scale fleet. This situation may jeopardise the capacity to carry out alternative segmentation approaches but there is no valid reason not to apply an alternative segmentation as these fleets are economically and socially important and may also be affected by management measures or more broadly by management plans. Because small-scale fleets present regularly a greater diversity in term of fishing gears used than the large-scale fleets, it considered as inadequate to allocate them into one unique heterogeneous PGP (*Vessels using polyvalent "passive" gears only)* Fleet segment. For these fleet, complementary data collection scheme as the vessel fishing activity calendar census survey (VFACCS) is considered as an appropriate approach as soon as declarative data are assessed as incomplete or insufficient to meet the end-users needs.

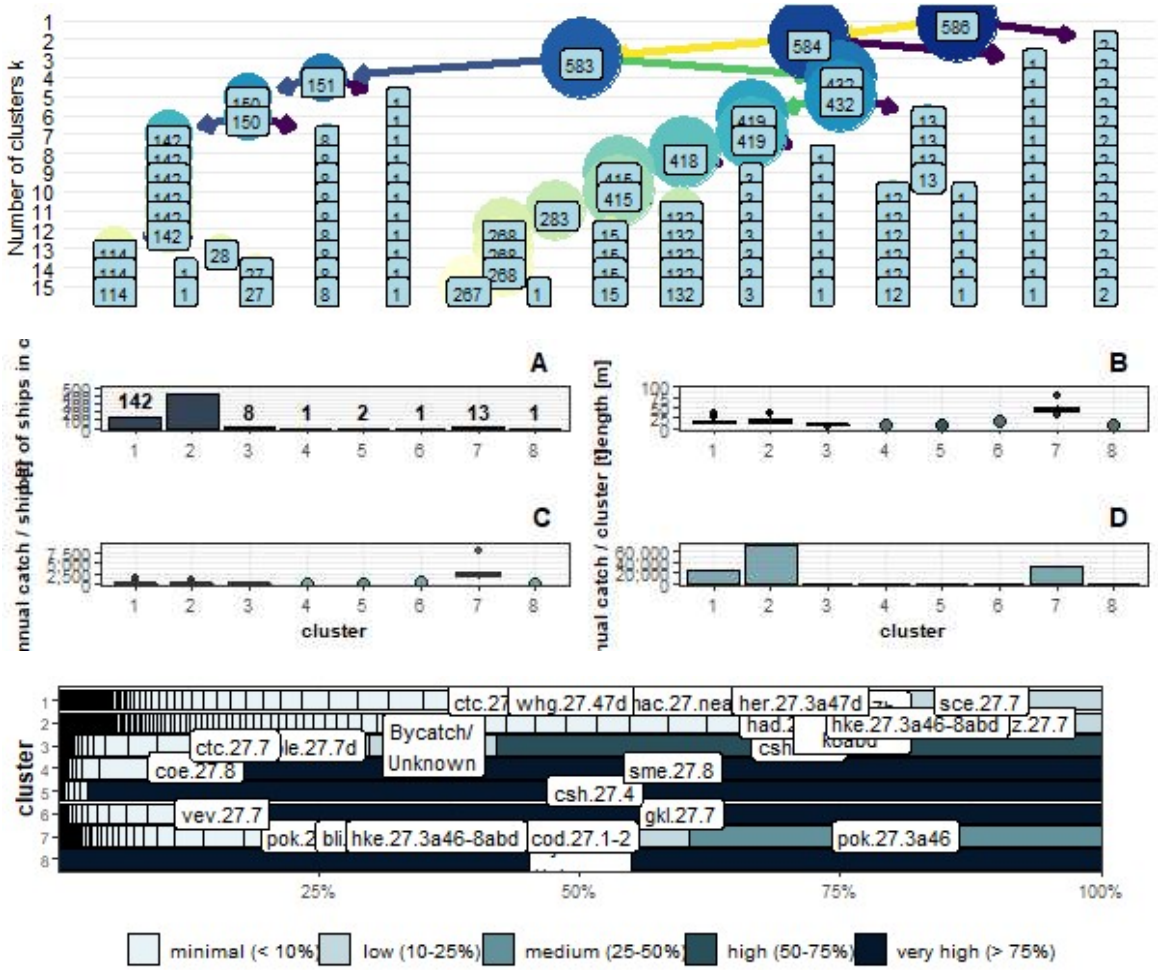
[40] See the fisheries overviews as a first step to follow: https://www.ices.dk/advice/Fisheries-overviews/Pages/fisheries-overviews.aspx

Annex I/ Application exercise on the EU-MAP Fleet segment

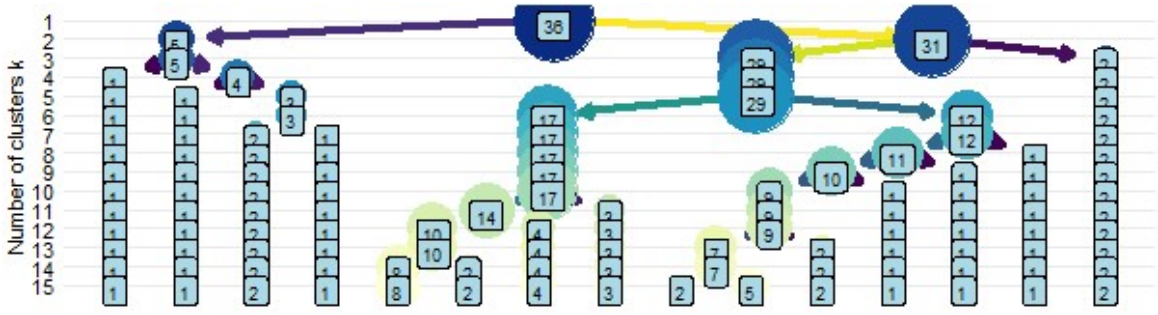
Beam trawlers (TBB)

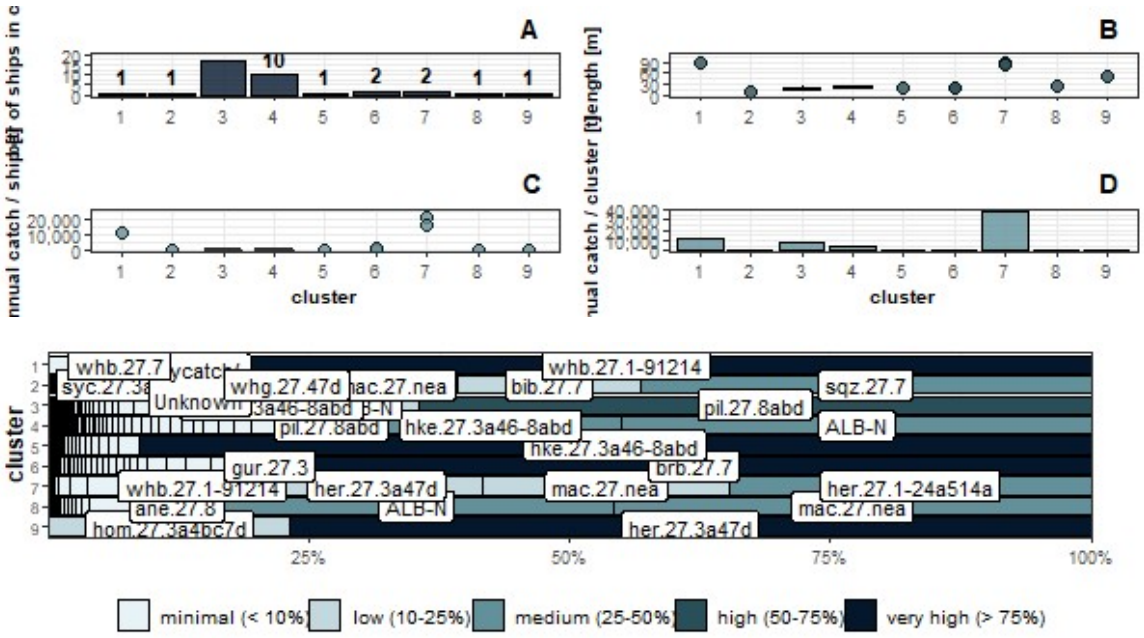
NA. EU-MAP Fleet segment with less than 3 vessels, not classified.

Demersal trawlers and/or demersal seiners (DTS)

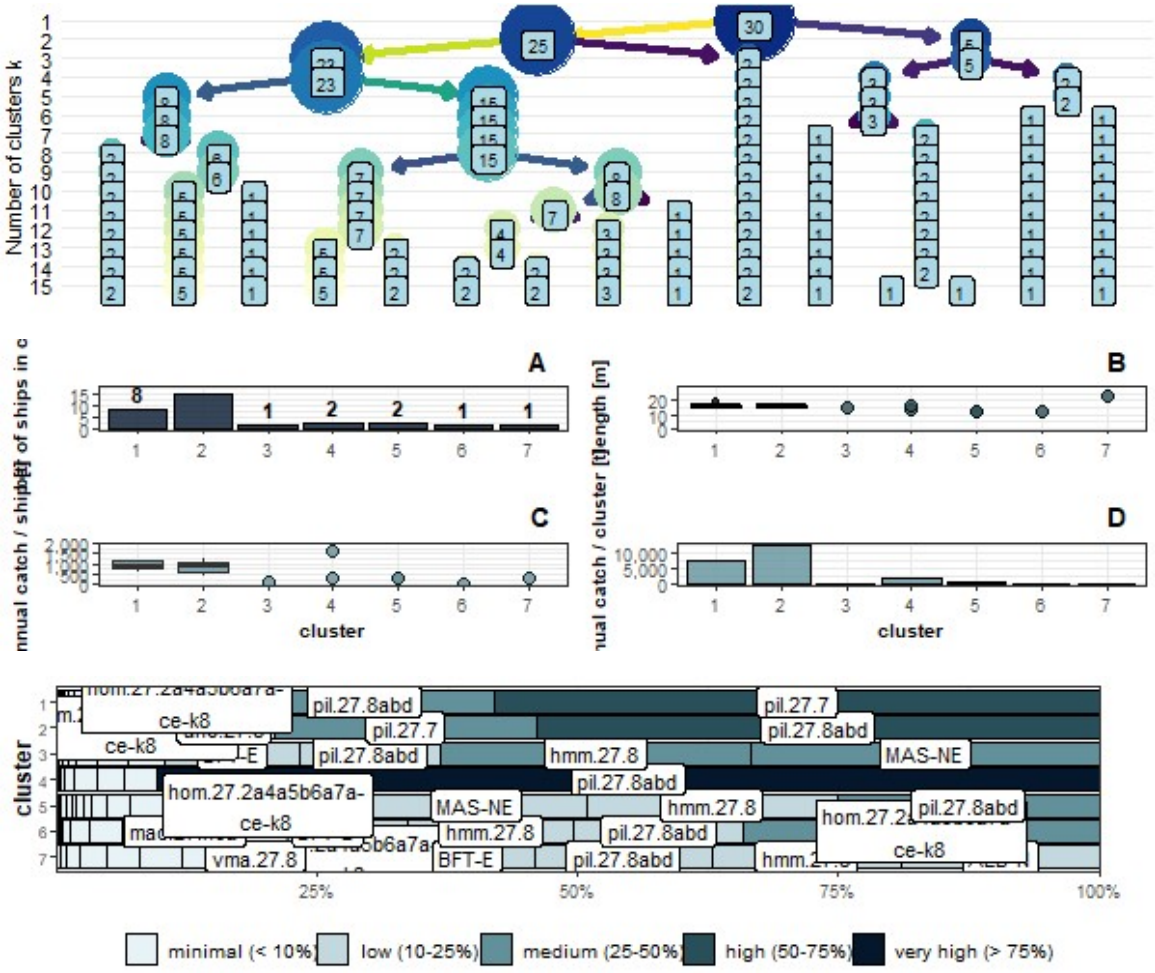


Pelagic trawlers (OTM)

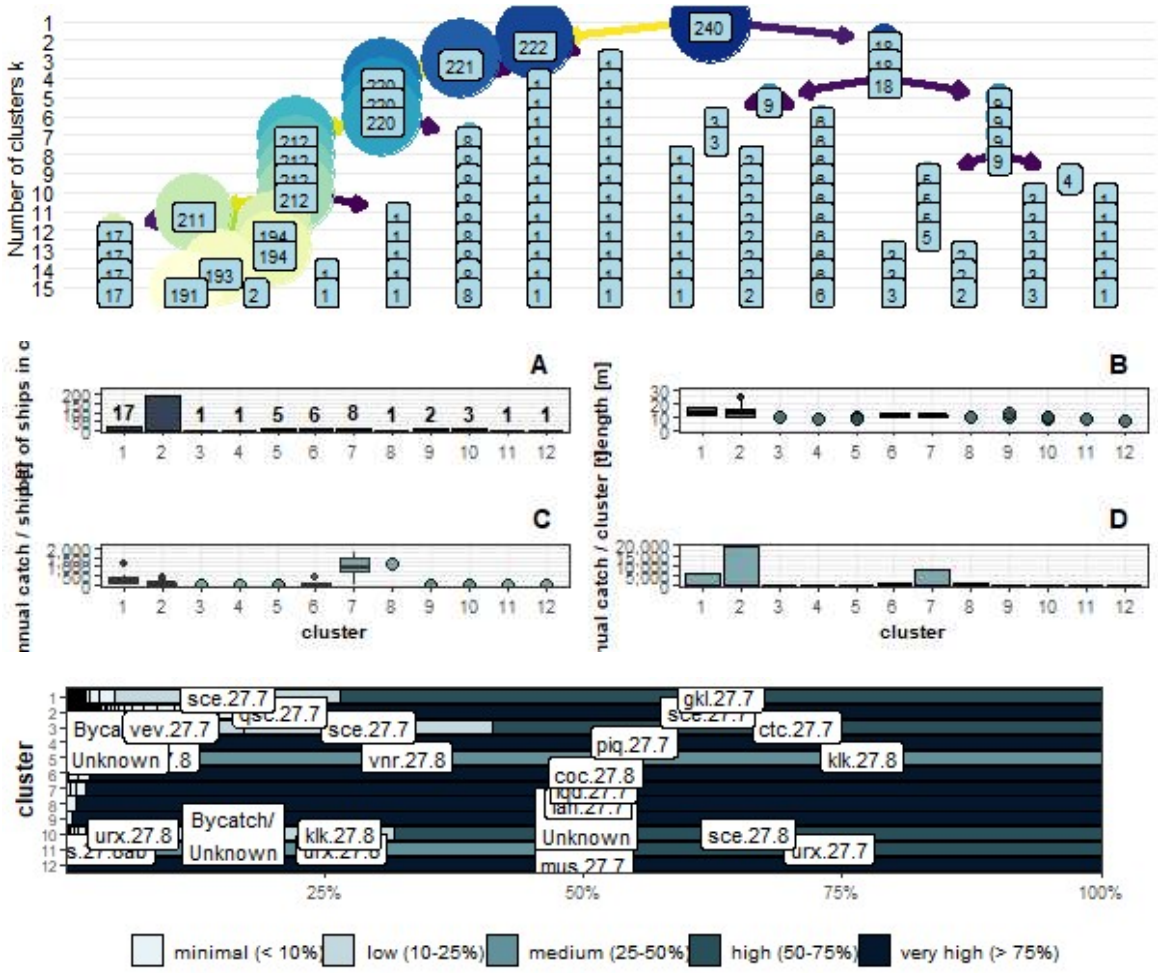




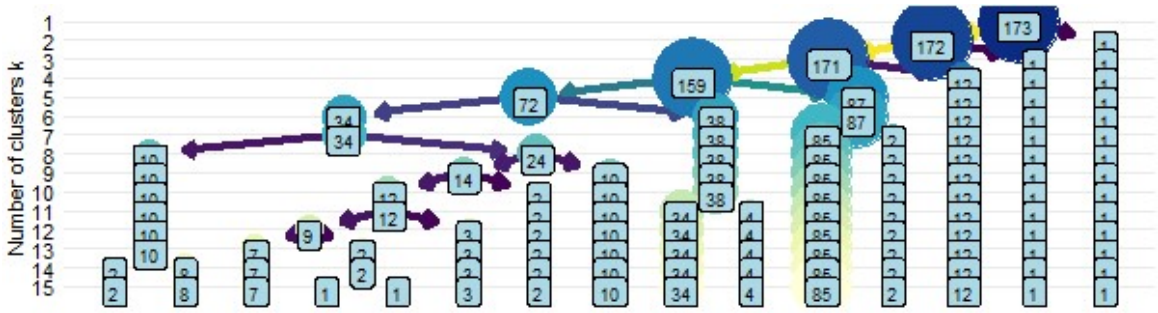
Purse seiners (PS_)

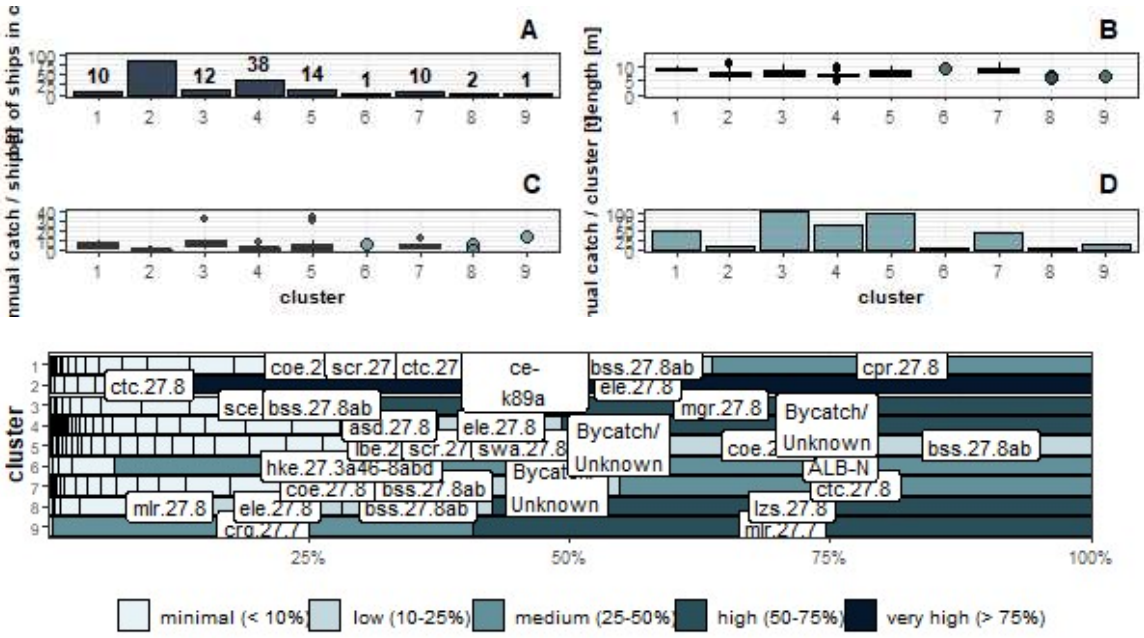


Dredgers (DRB)

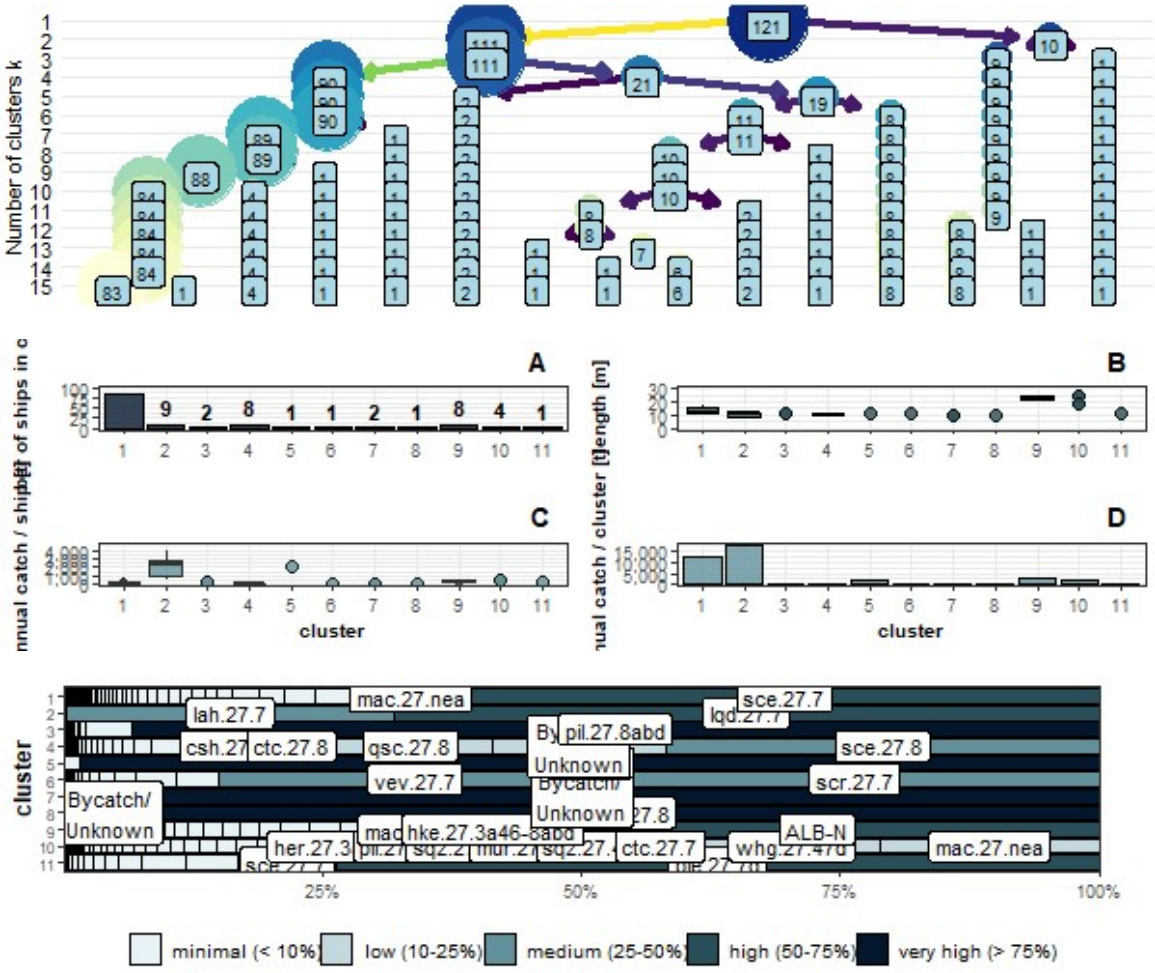


Vessels using other active gears (MGO)

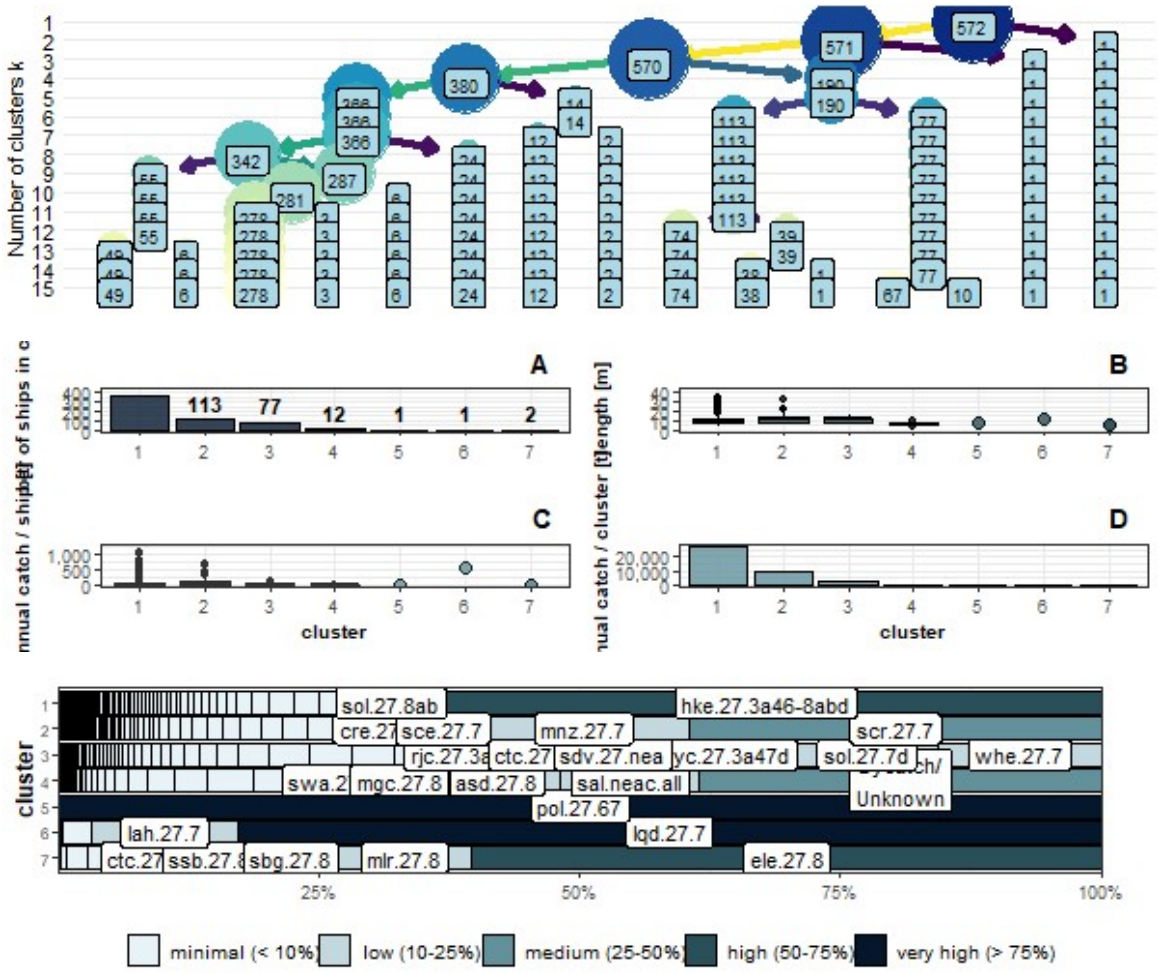




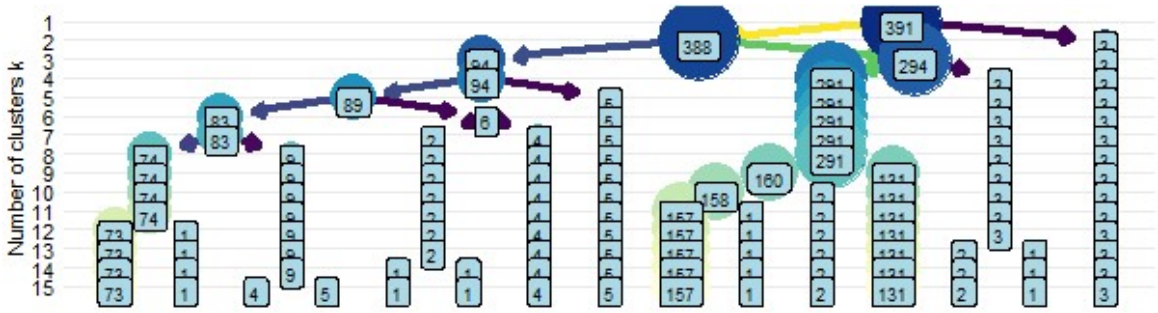
Vessels using polyvalent active gears only (MGP)

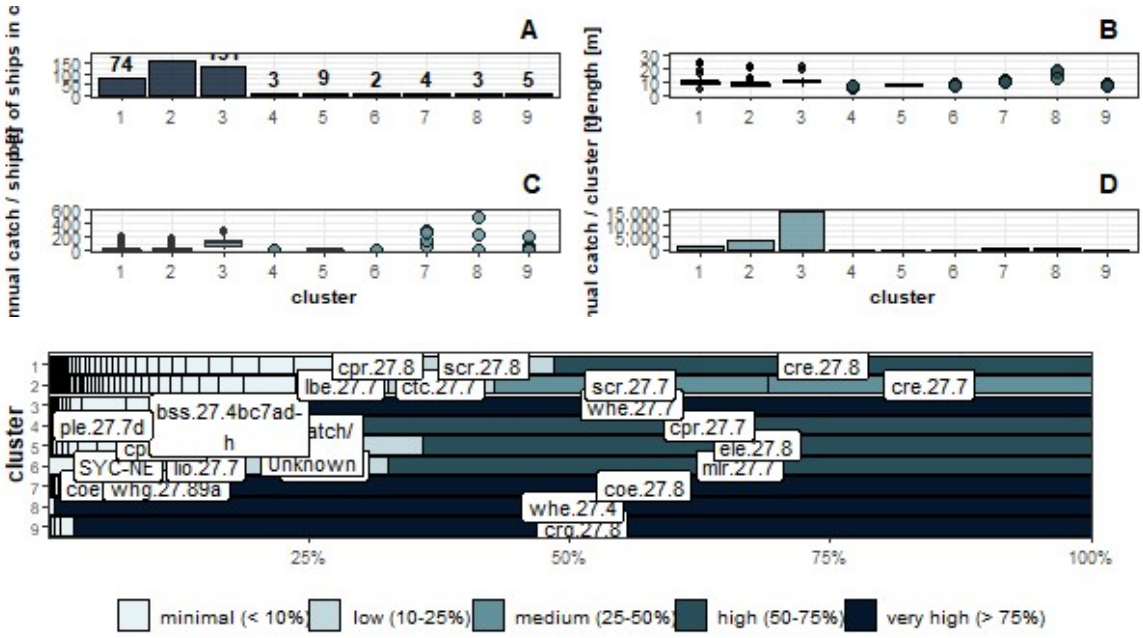


Drift and/or fixed netters (DFN)

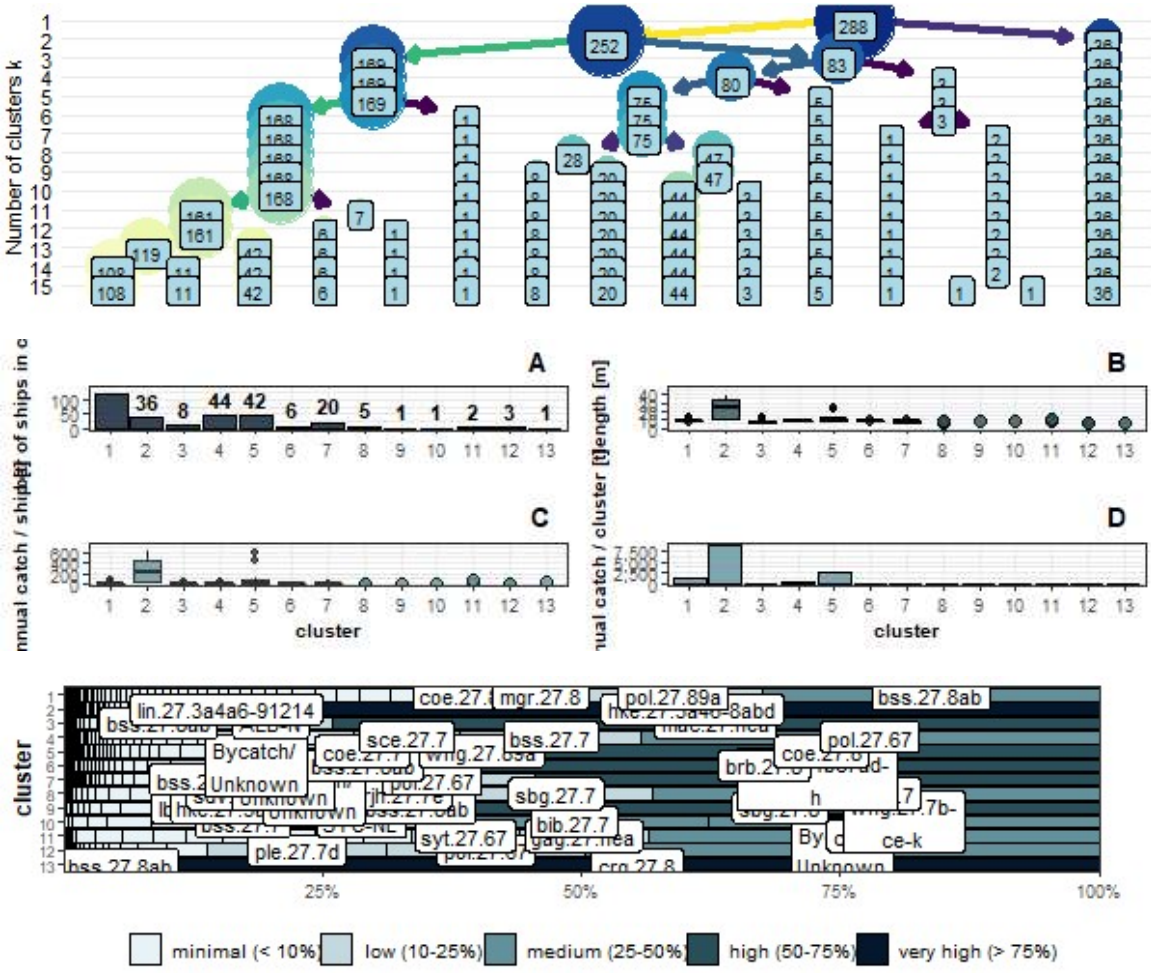


Vessels using pots and/or traps (FPO)

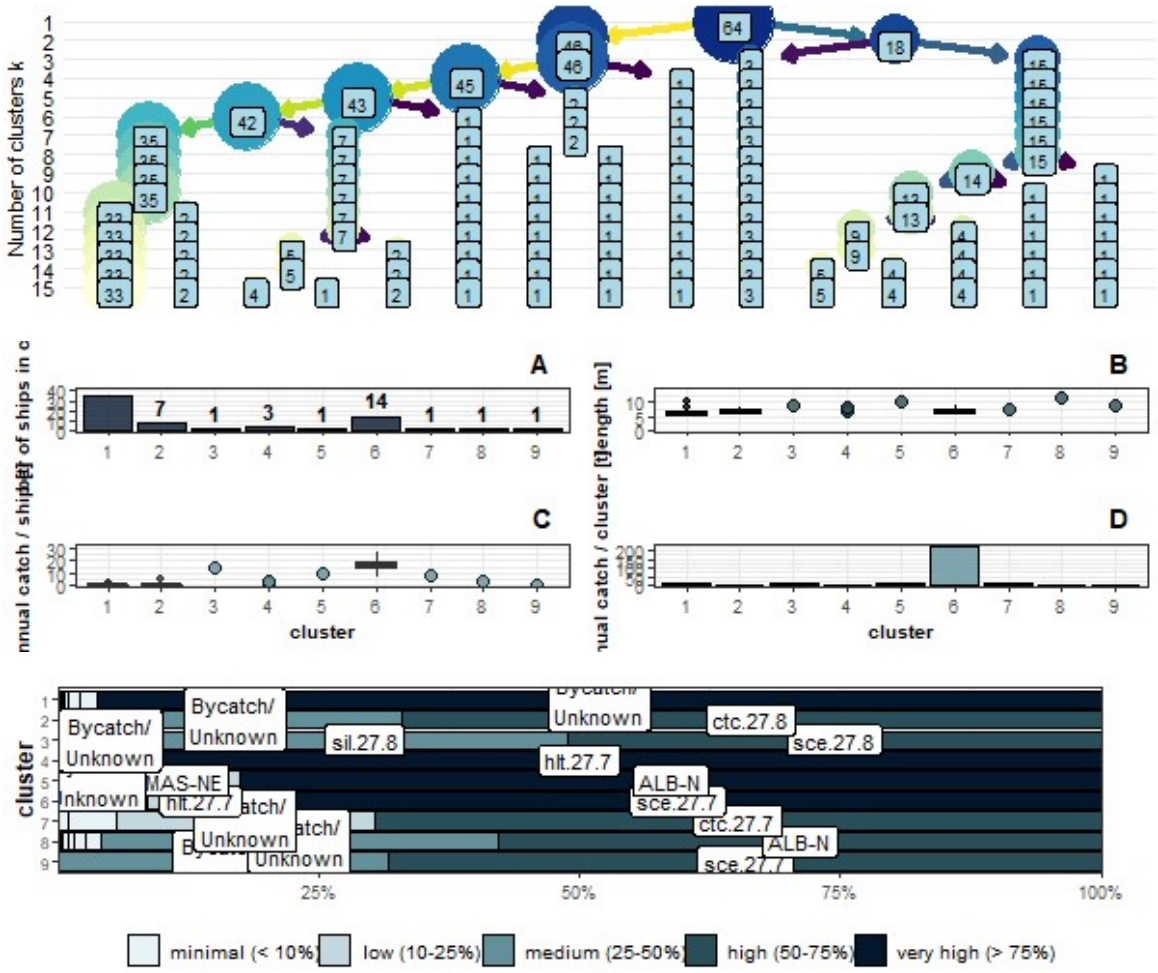




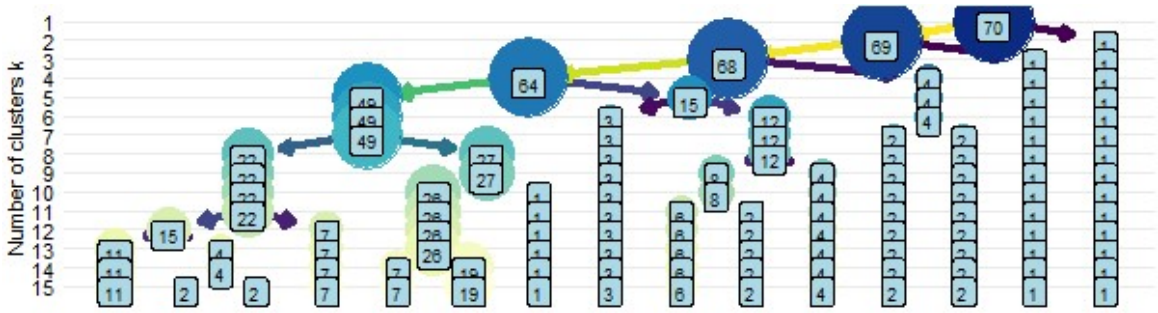
Vessels using hooks (HOK)

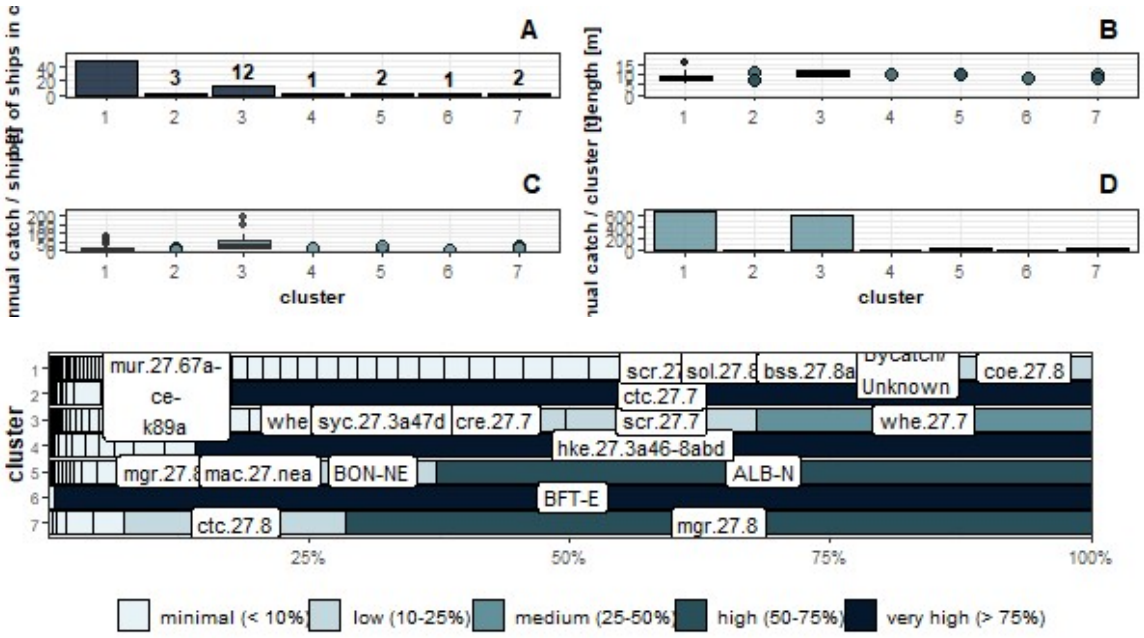


Vessels using other passive gears (PGO)

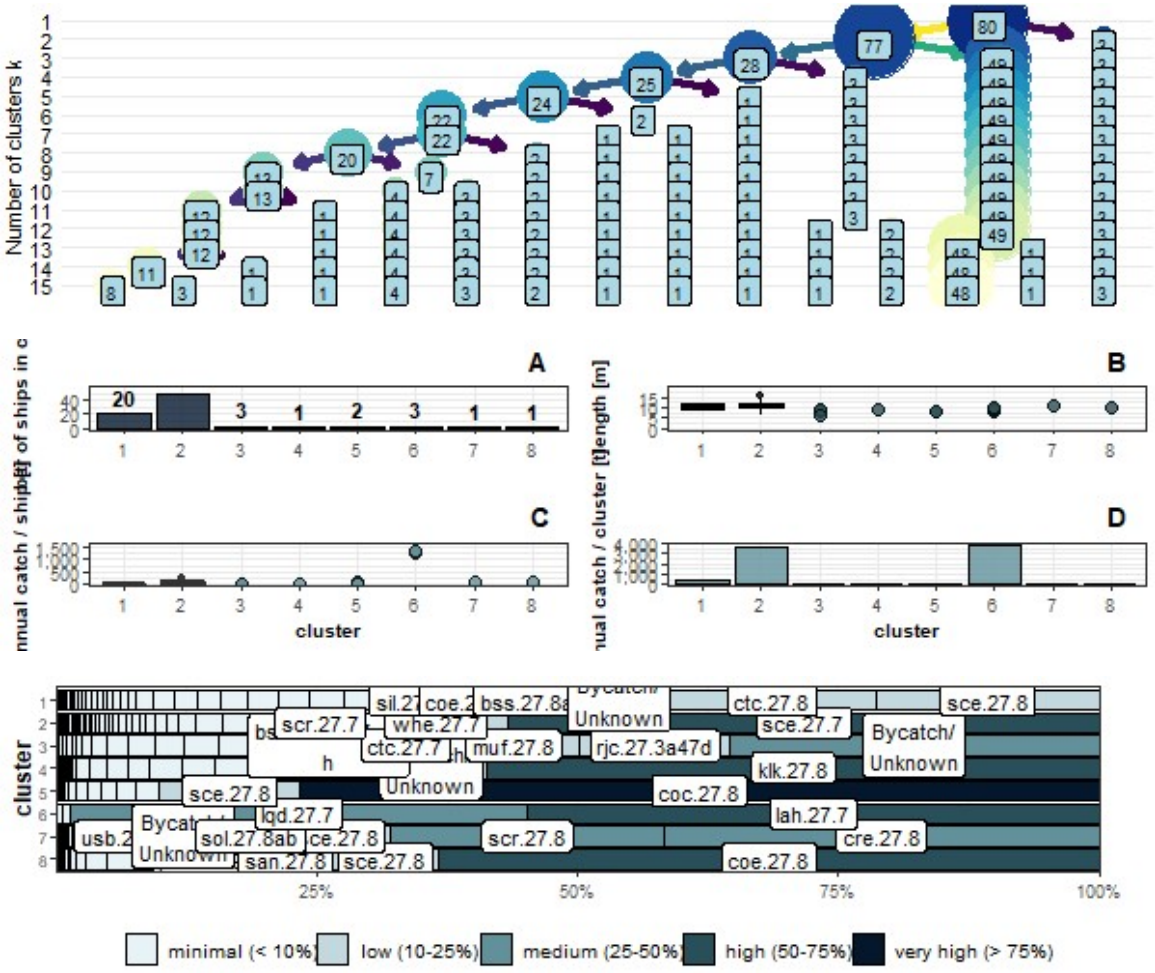


Vessels using polyvalent passive gears only (PGP)



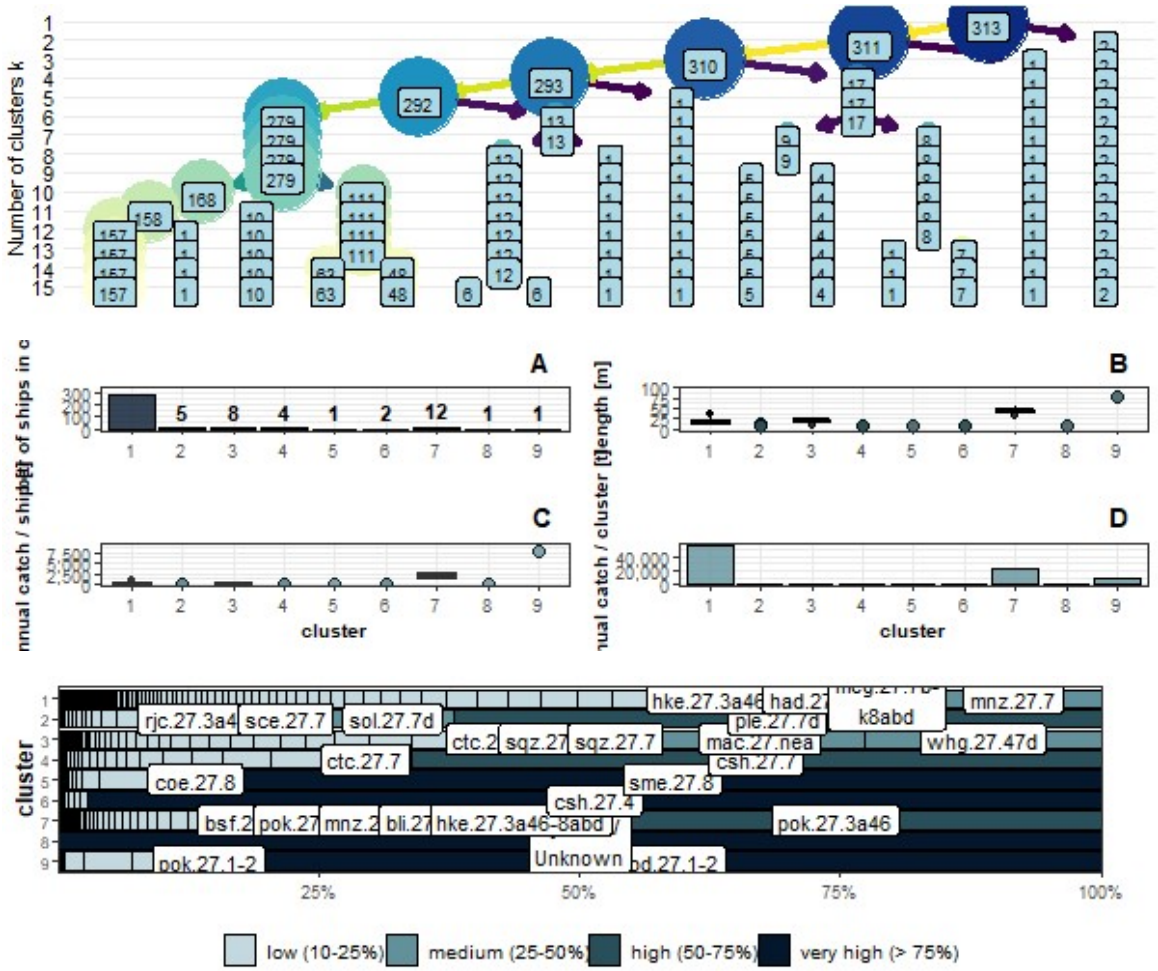


Vessels using active and passive gears (PMP)

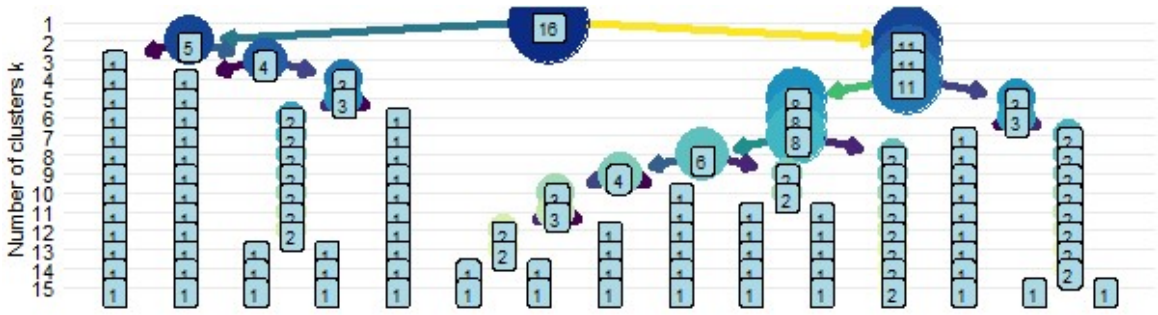


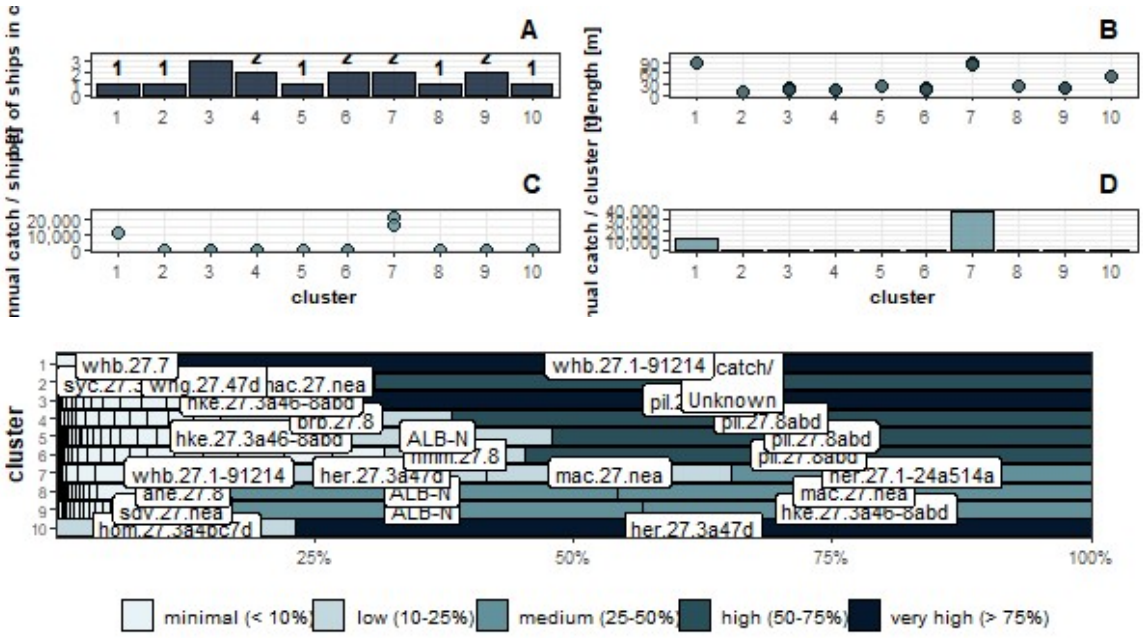
Annex II/ Application exercise on the Ifremer Fleet segment

Demersal trawlers exclusive

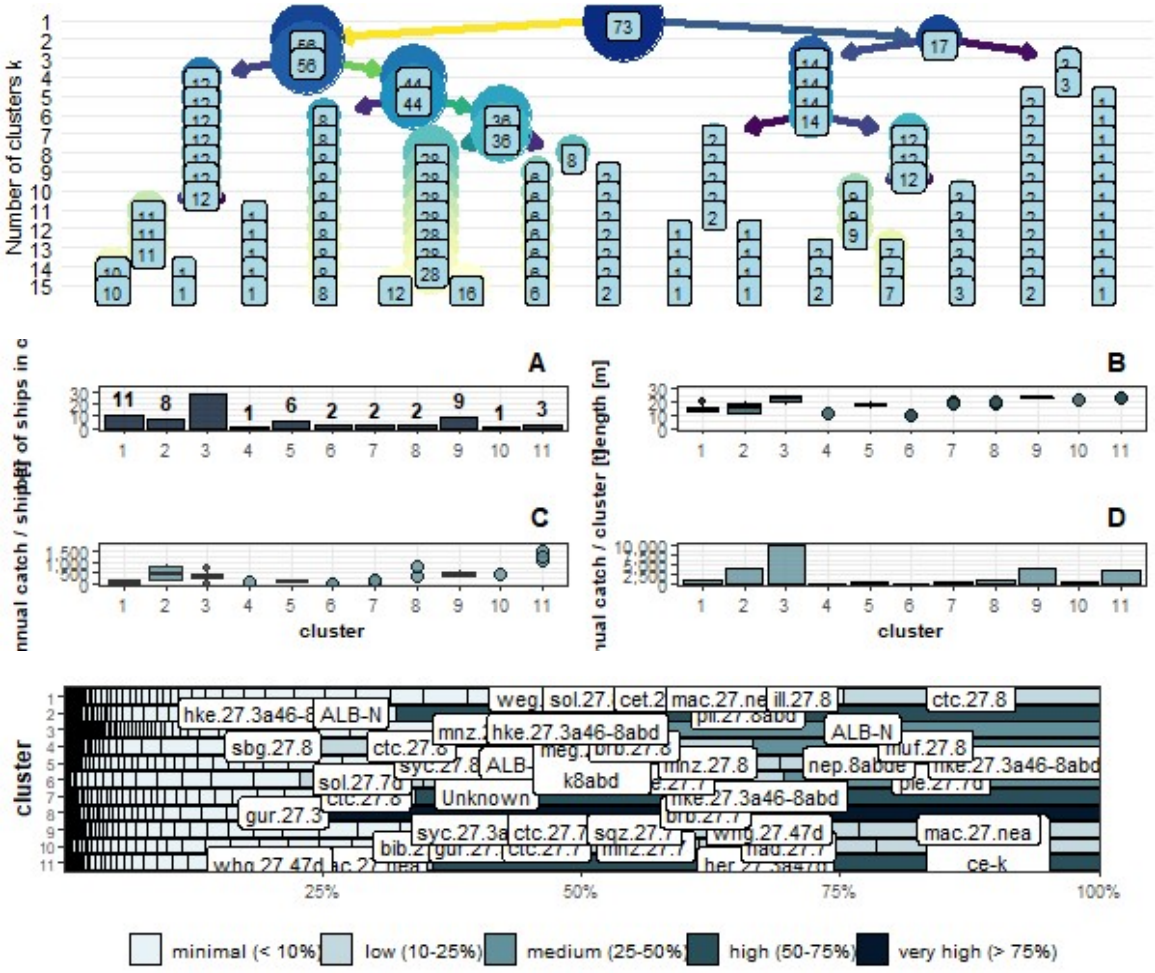


Pelagic trawlers exclusive

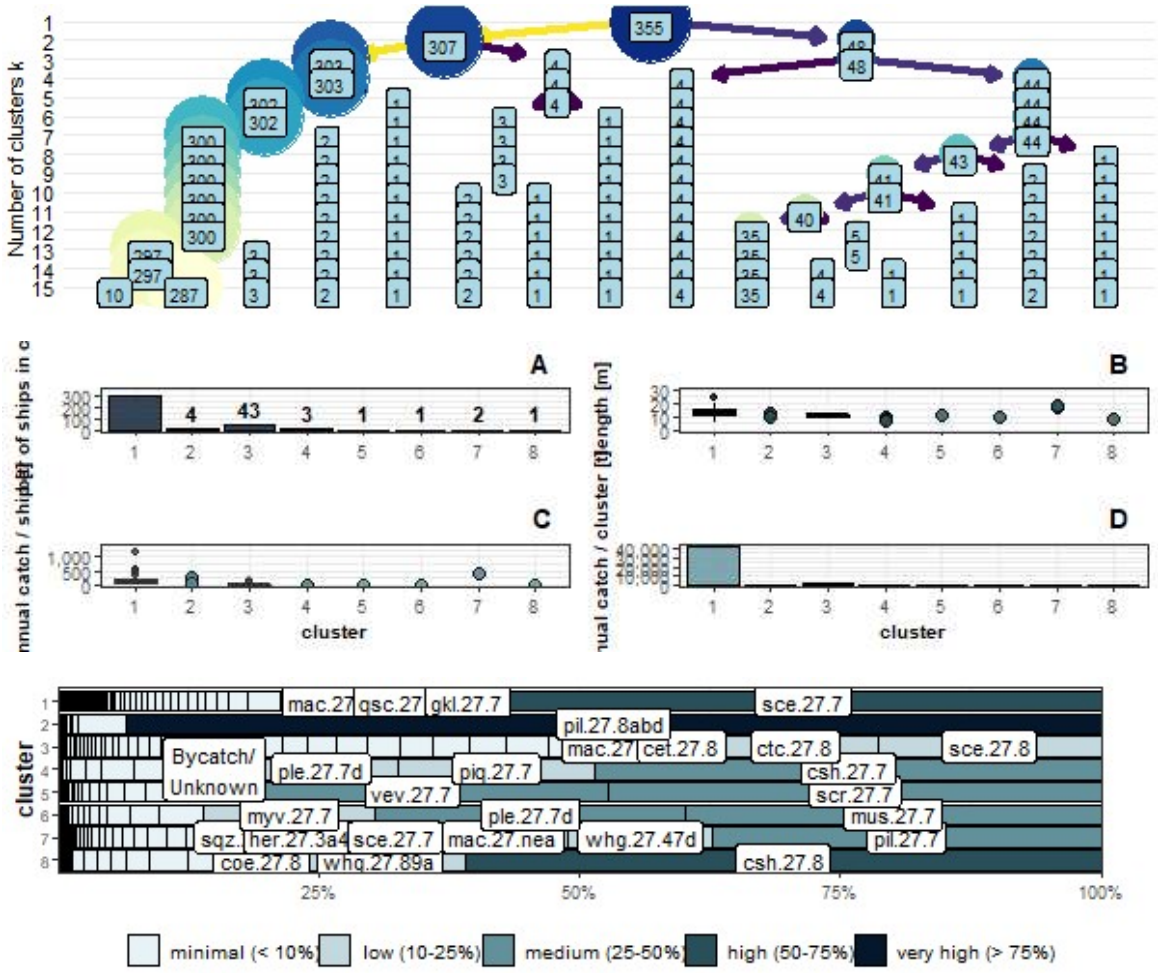




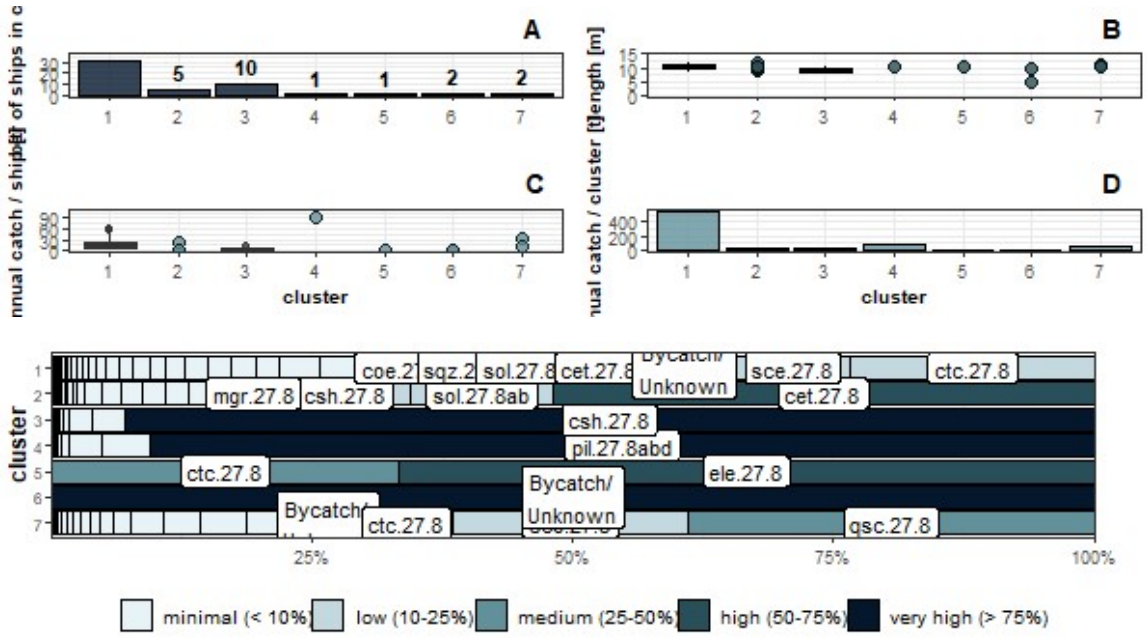
Mixed Trawlers exclusive



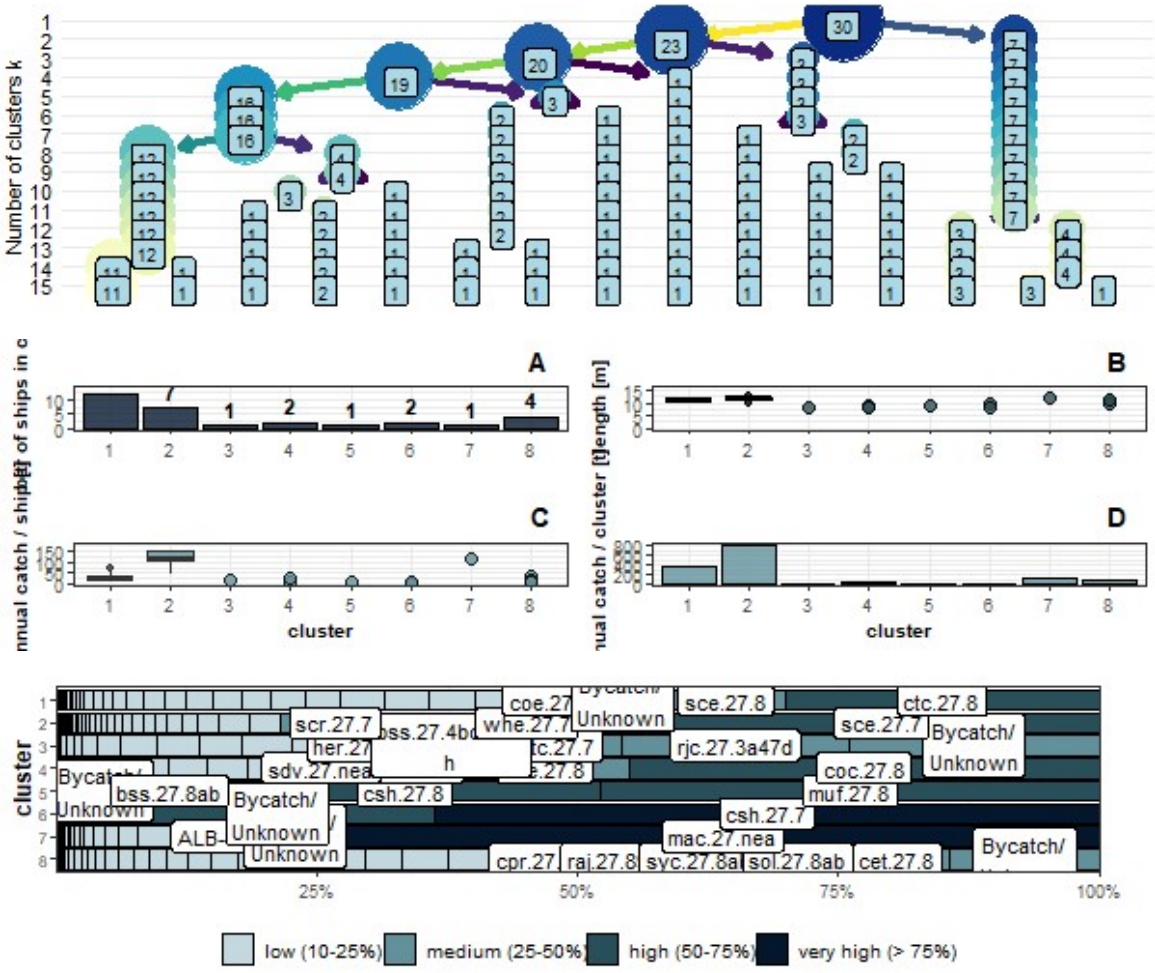
Trawlers Dredgers



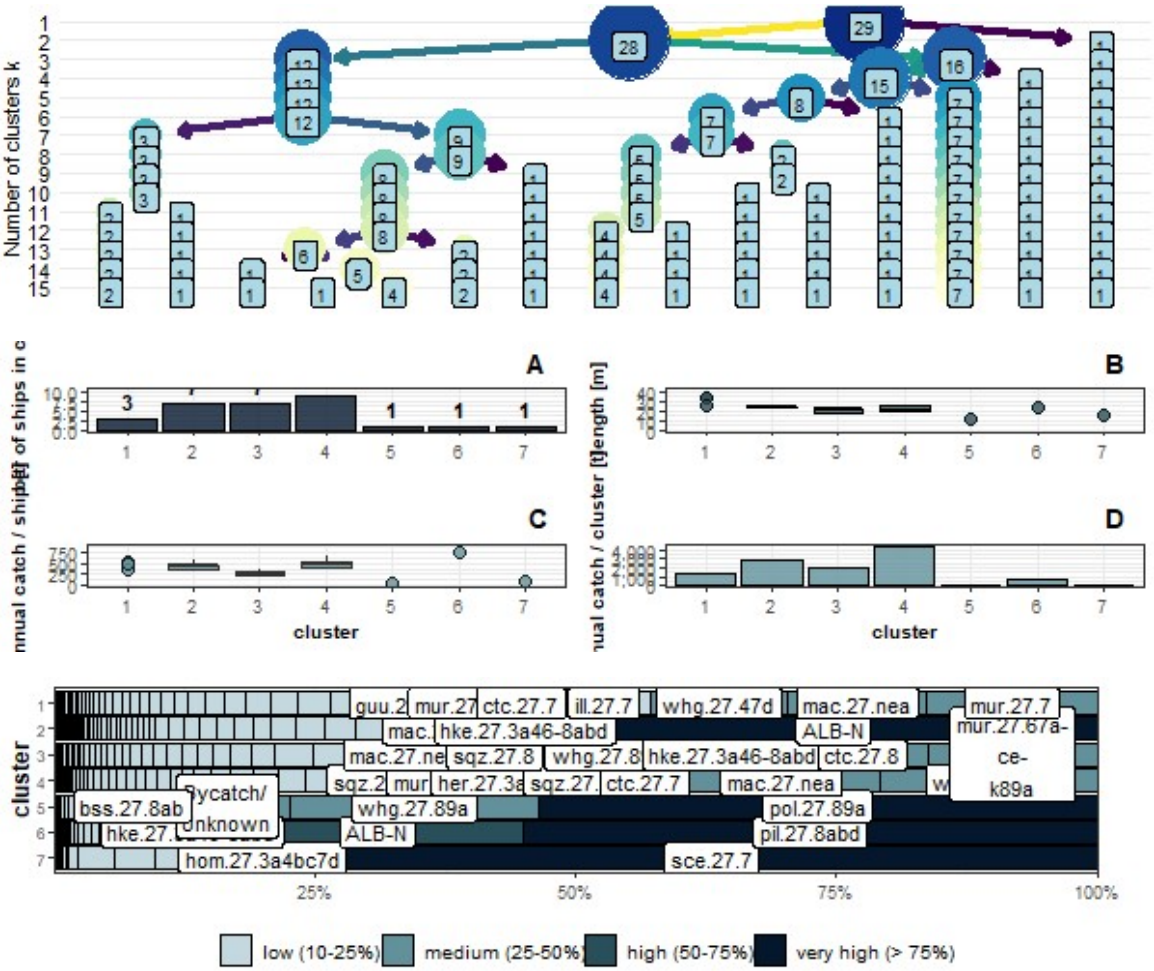
Trawlers Glass eel fishing



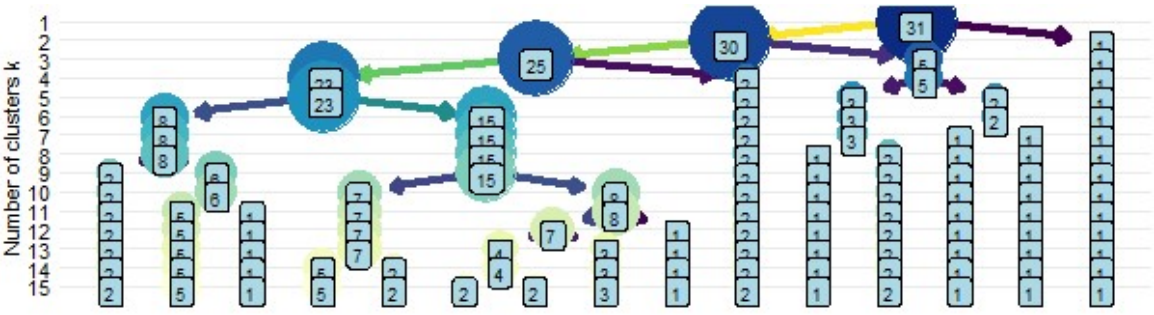
Trawlers Passive gears

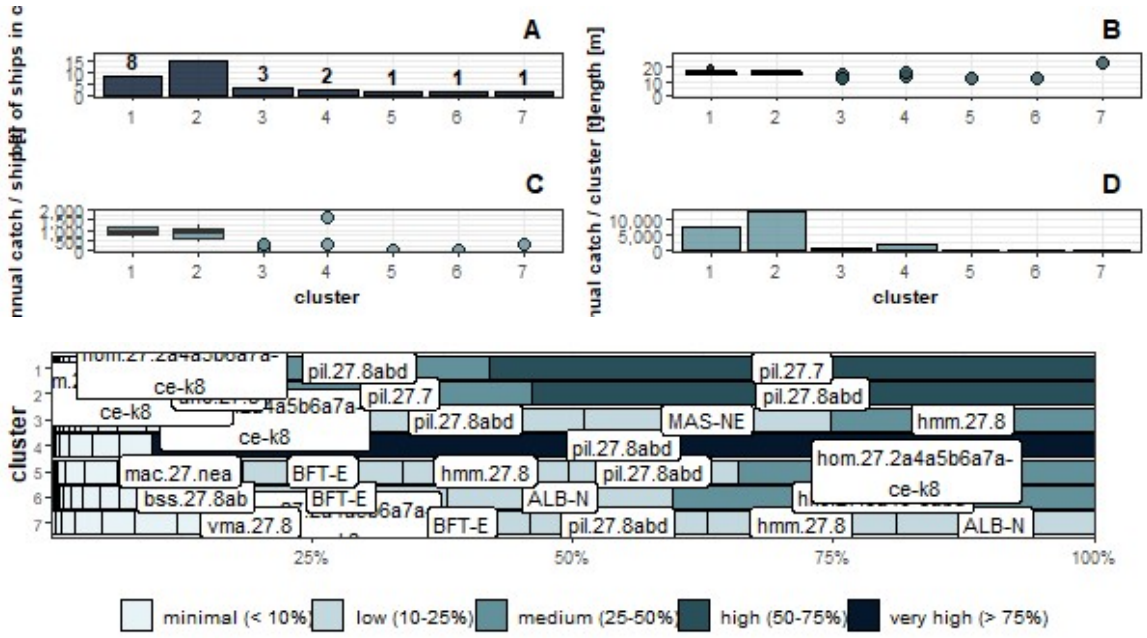


Demersal seiners

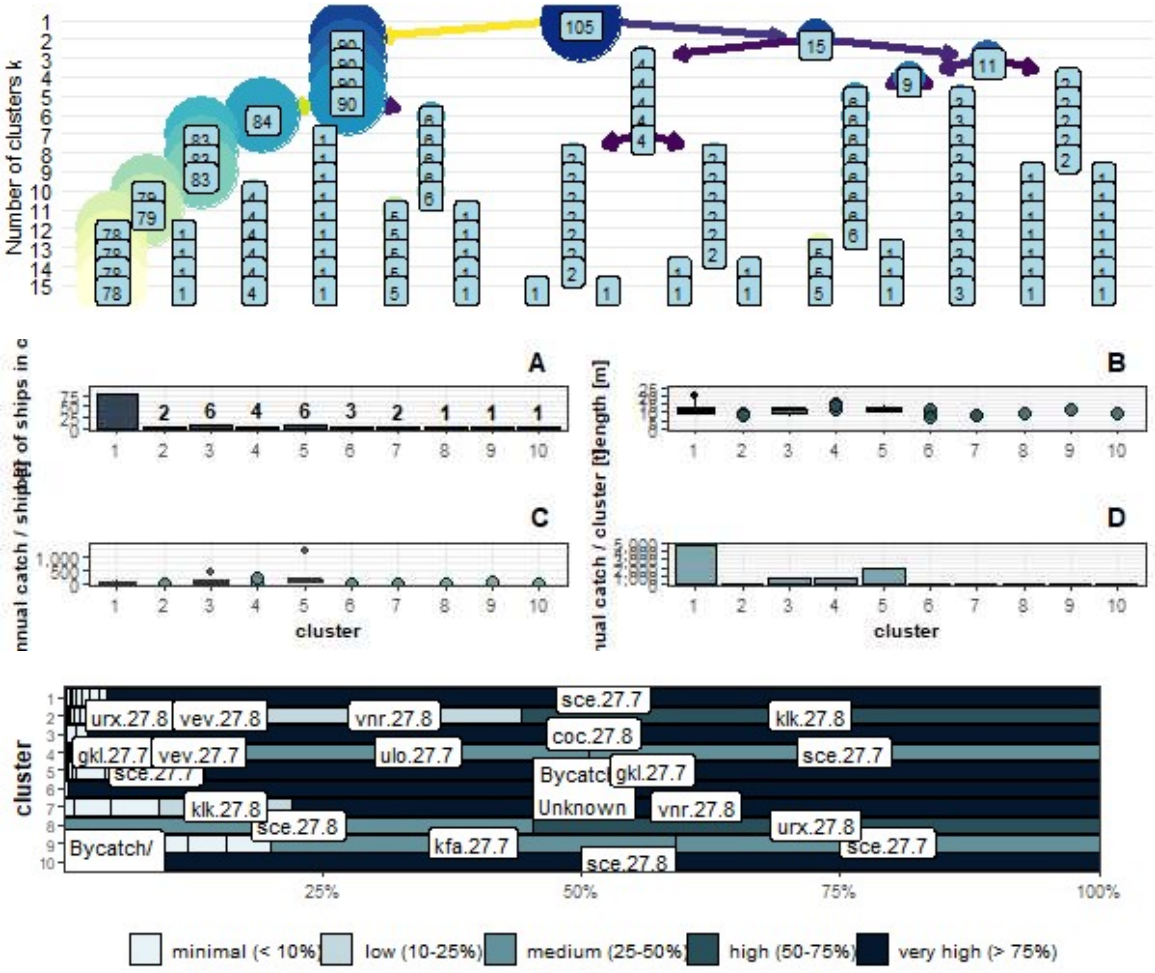


Purse seiners

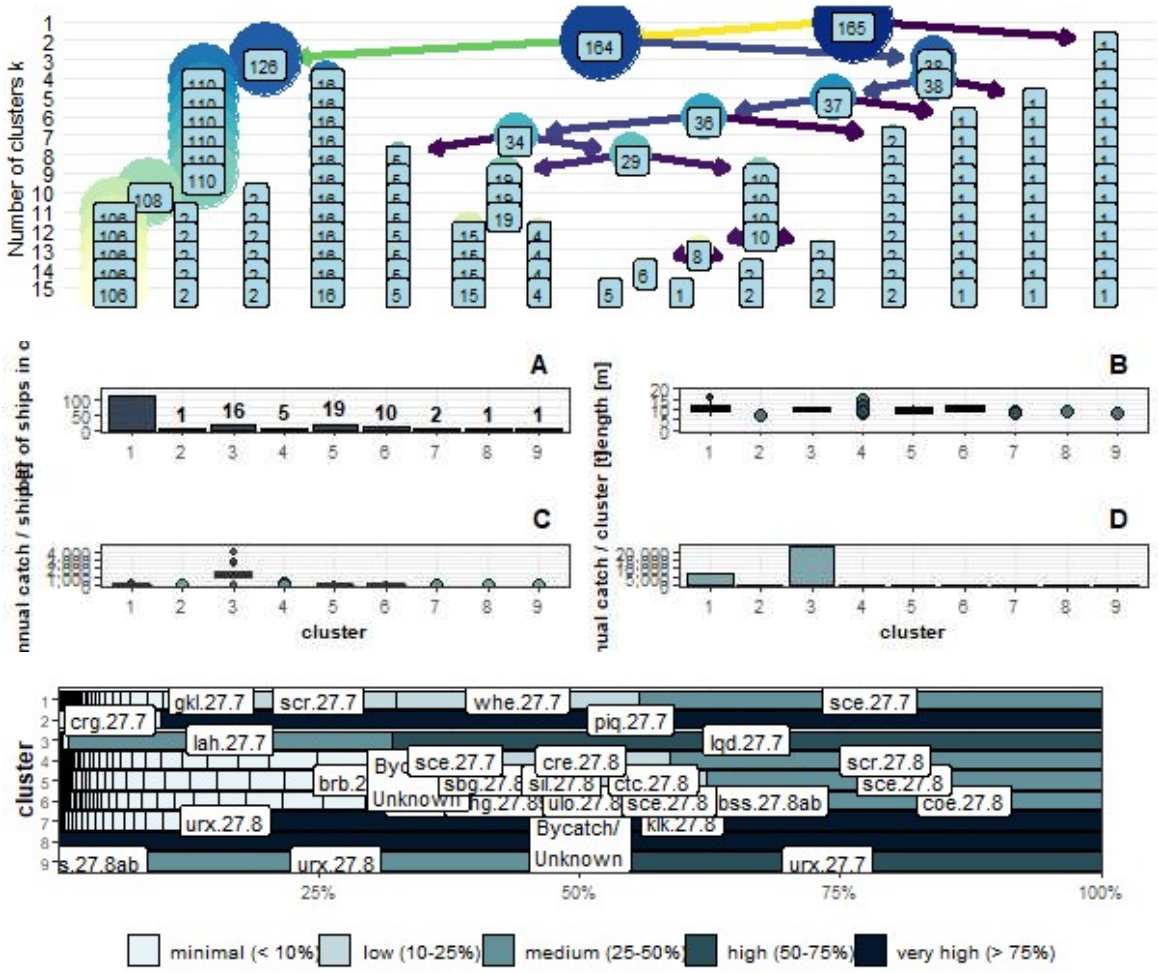




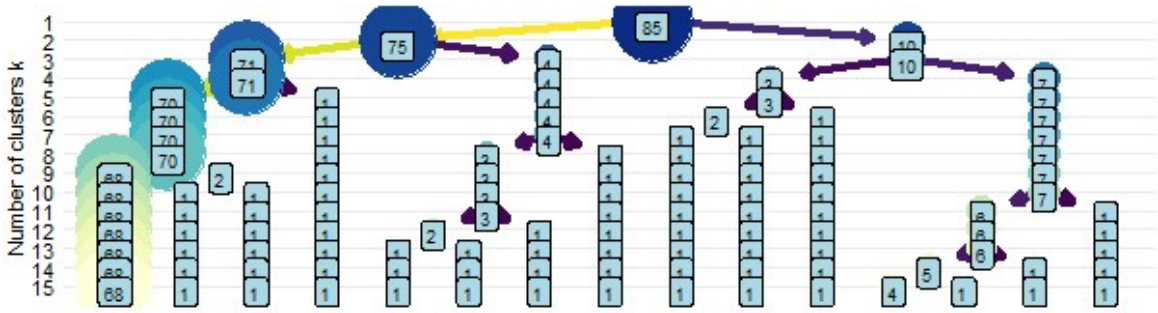
Dredgers exclusive

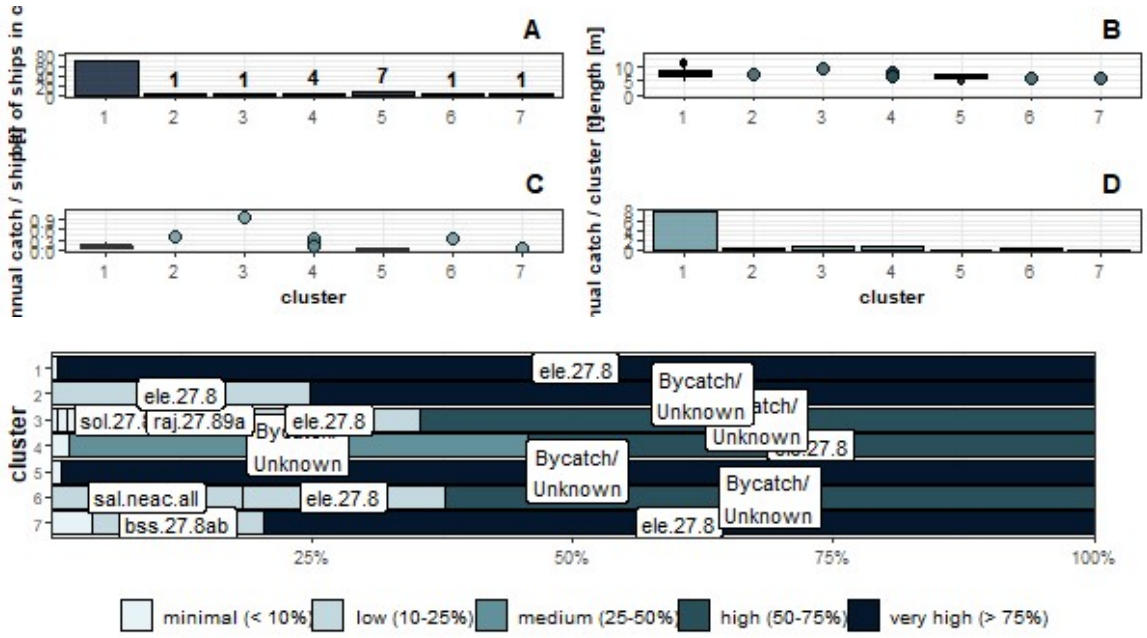


Dredgers Passive gears

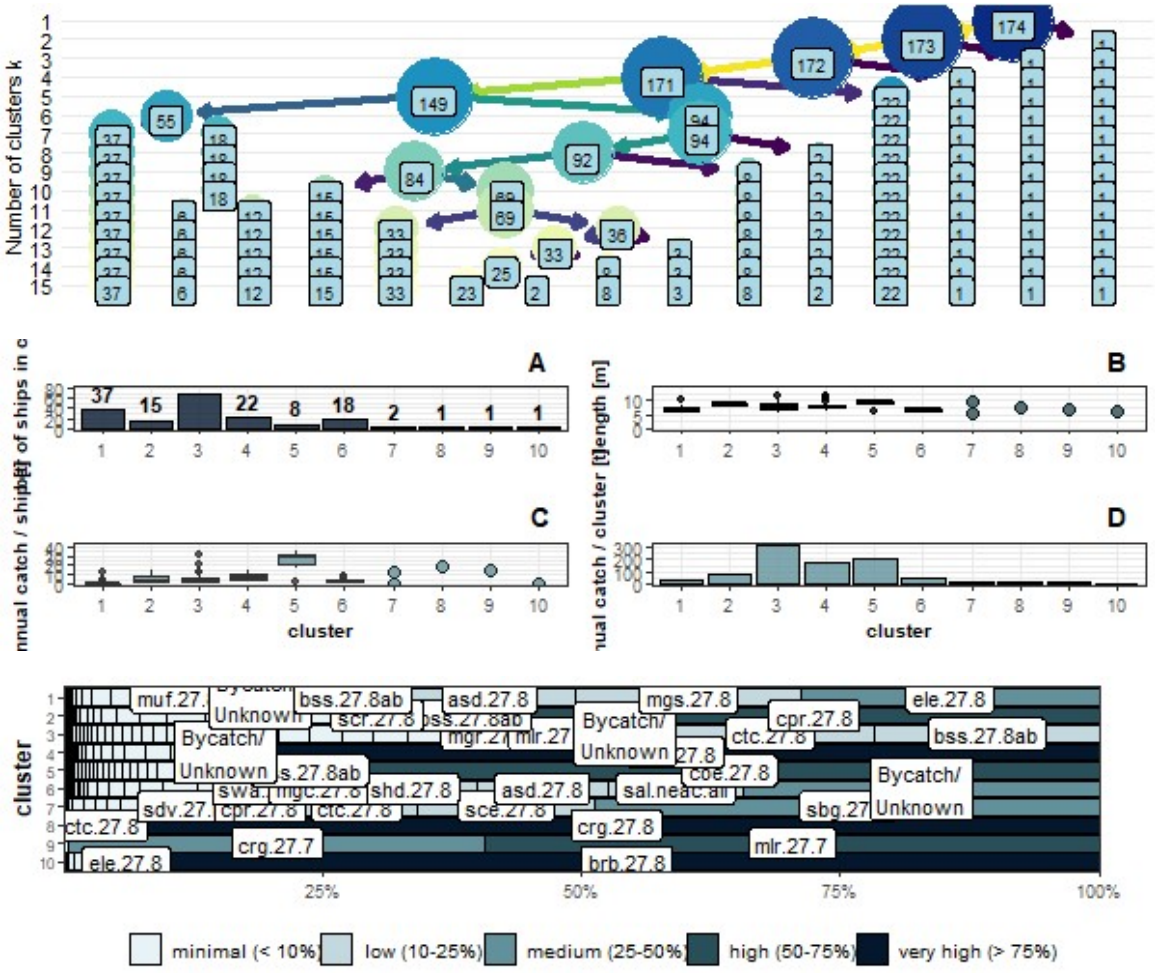


Glass eel fishing exclusive

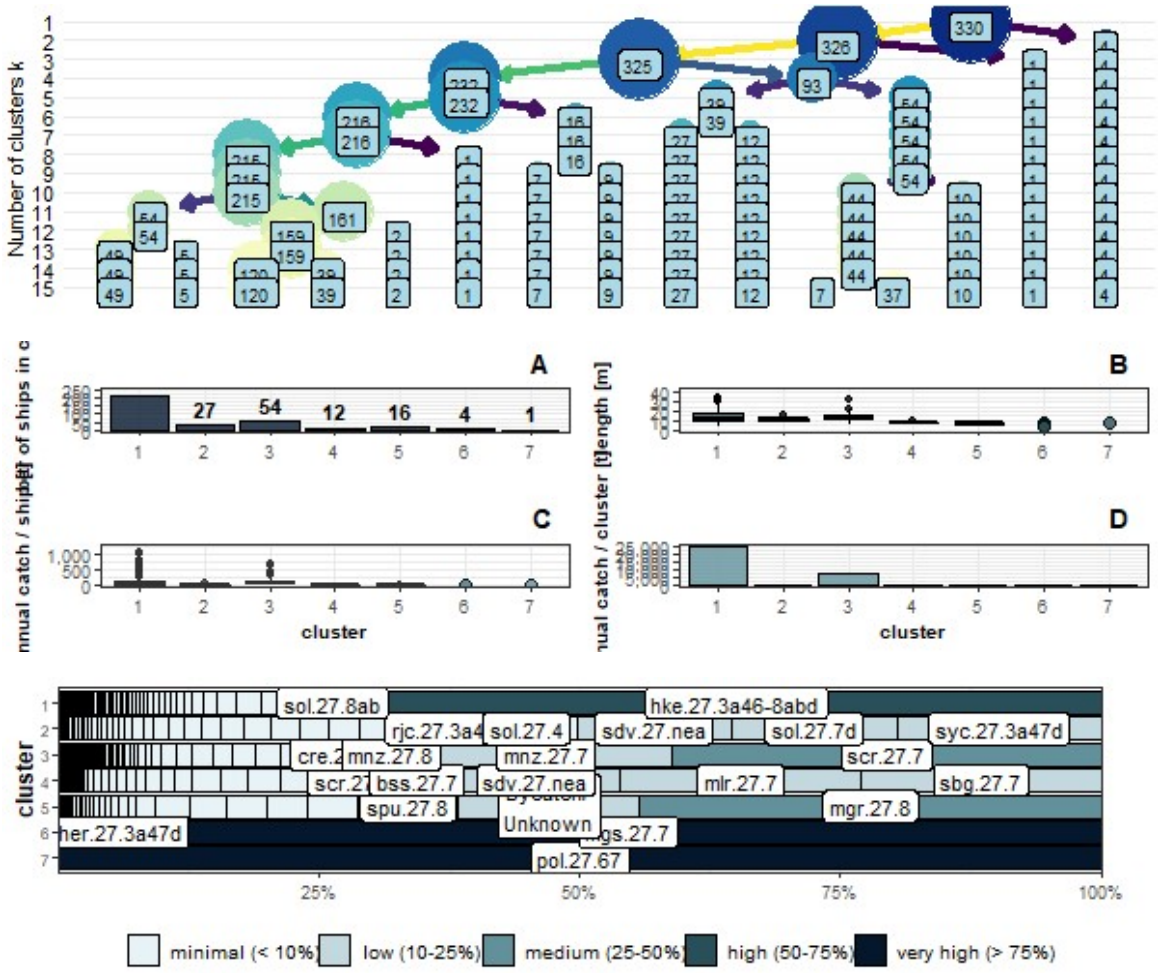




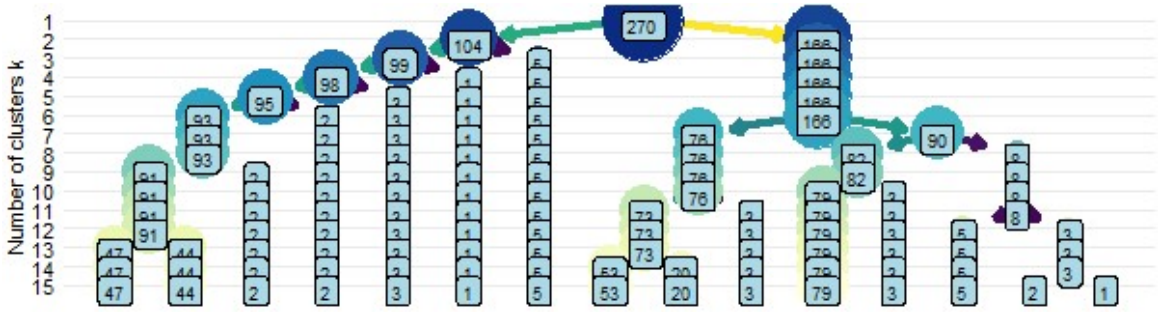
Glass eel fishing Passive gears

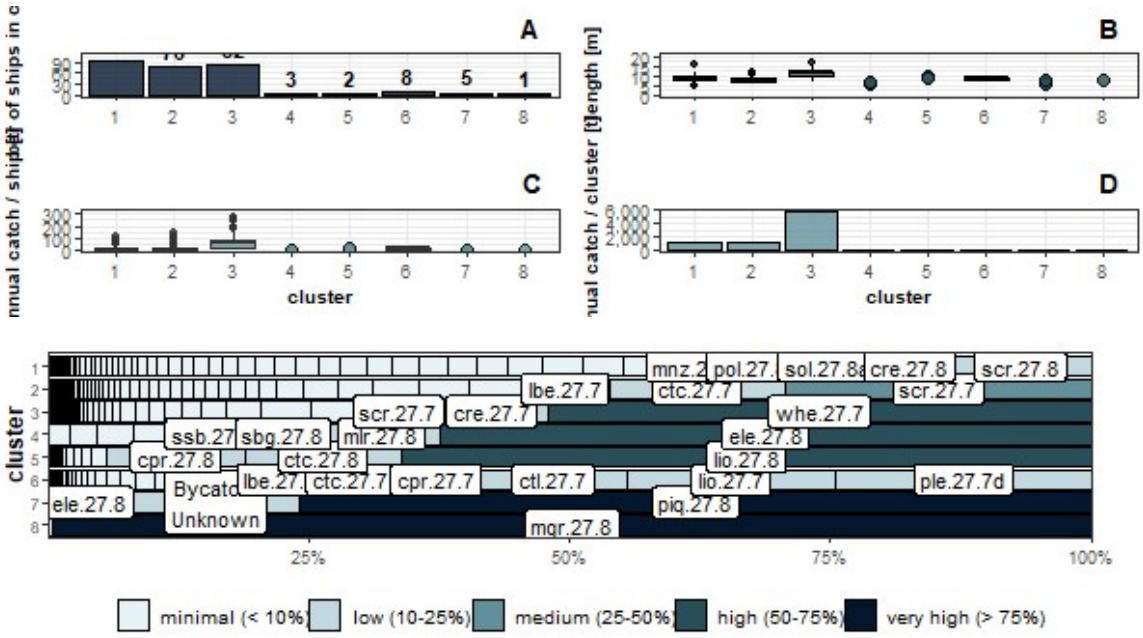


Netters exclusive

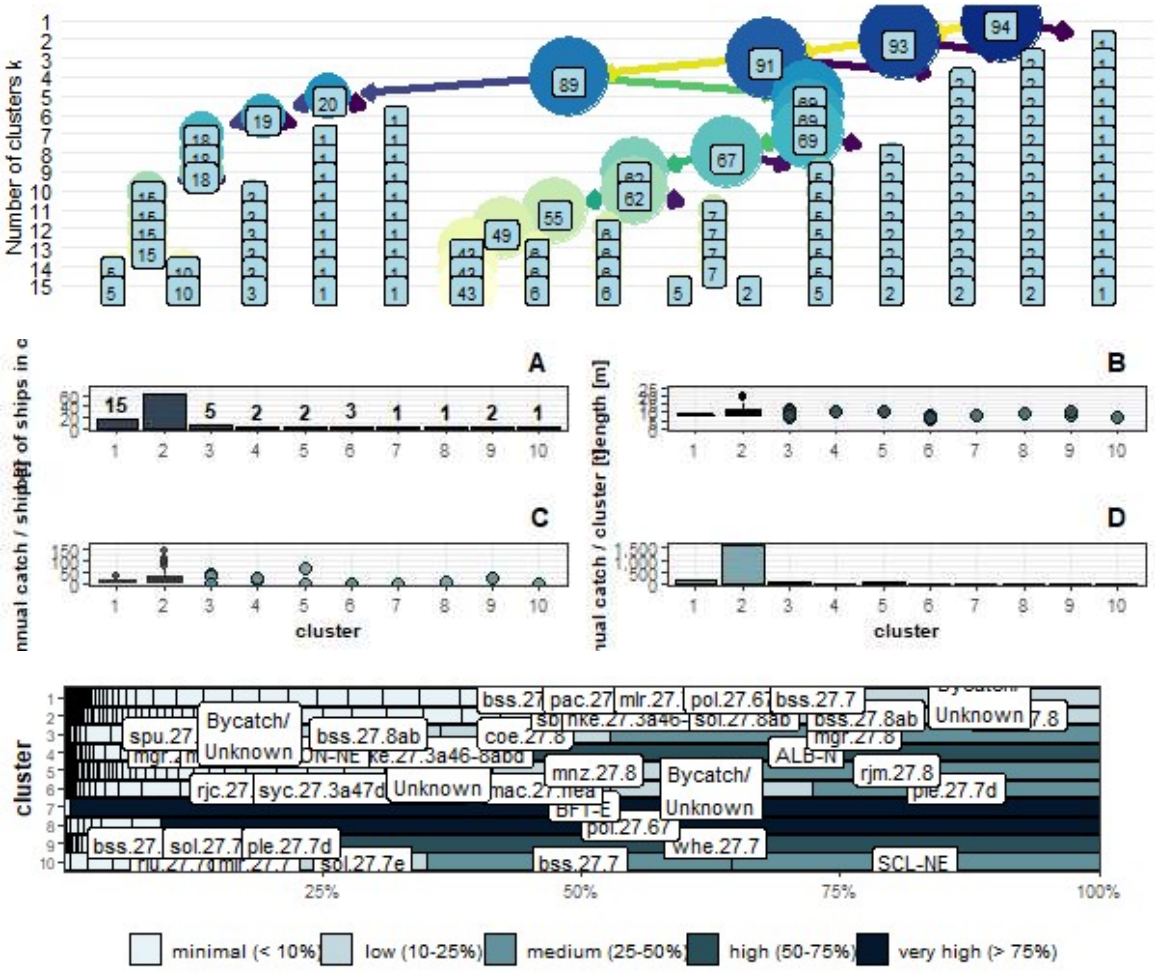


Netters Potters/Traps

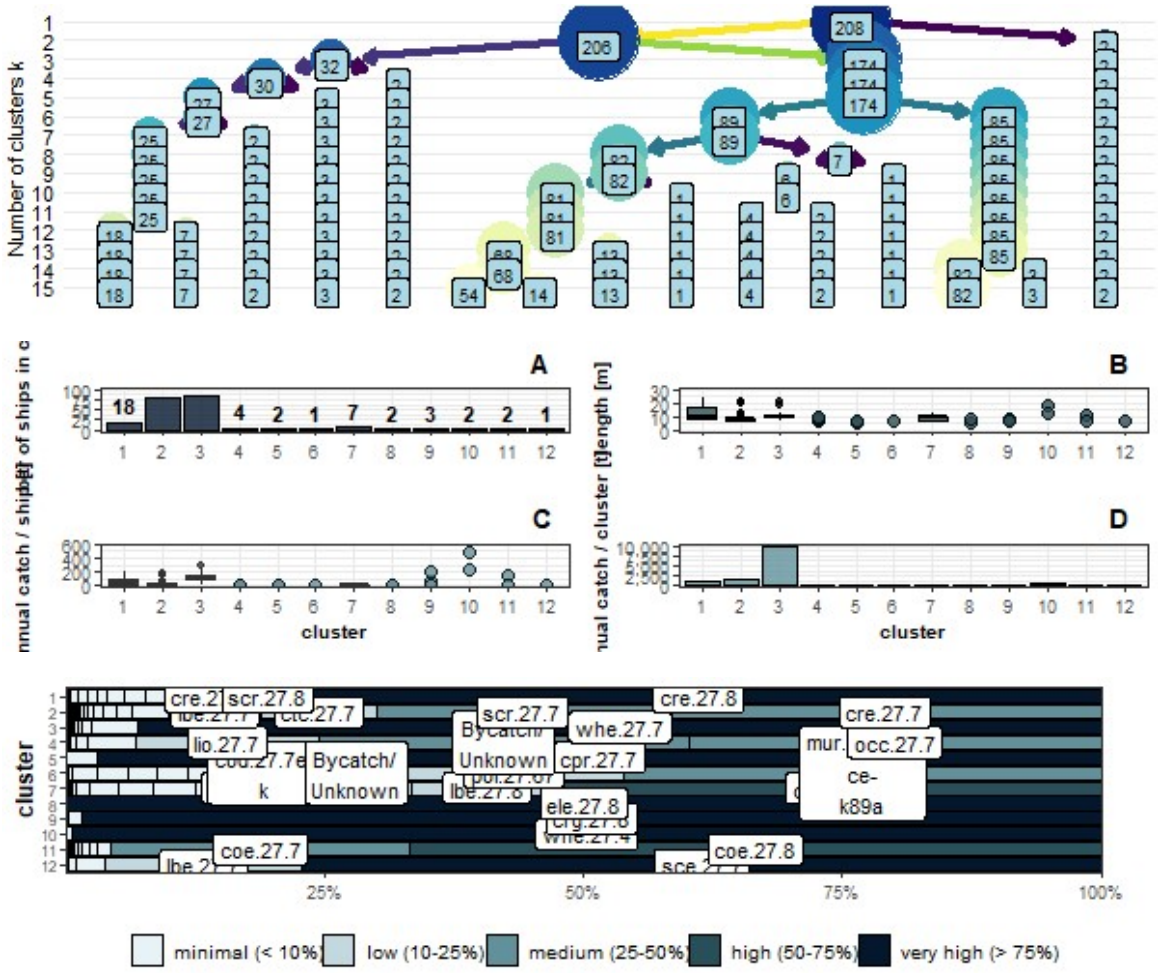




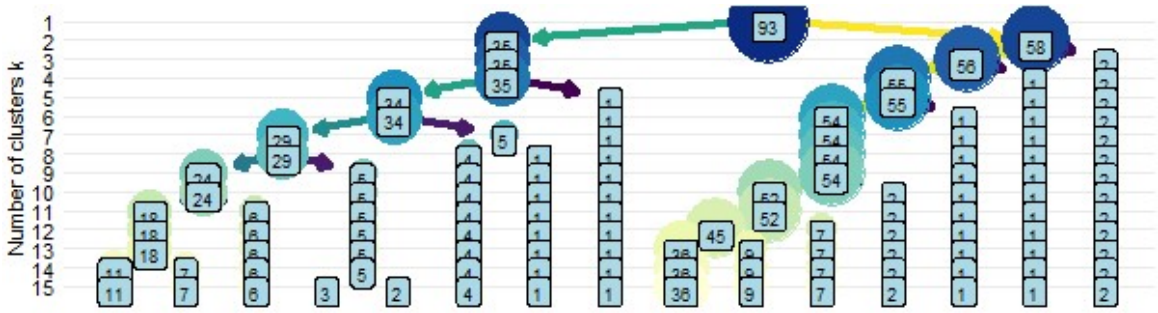
Netters Hooks

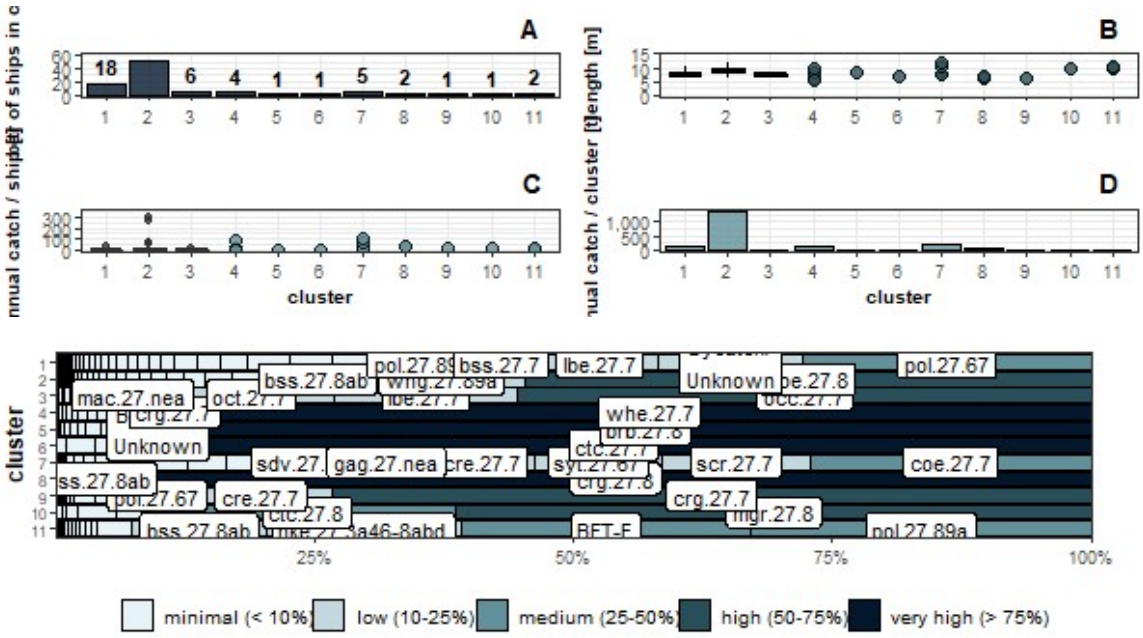


Potters/Traps exclusive

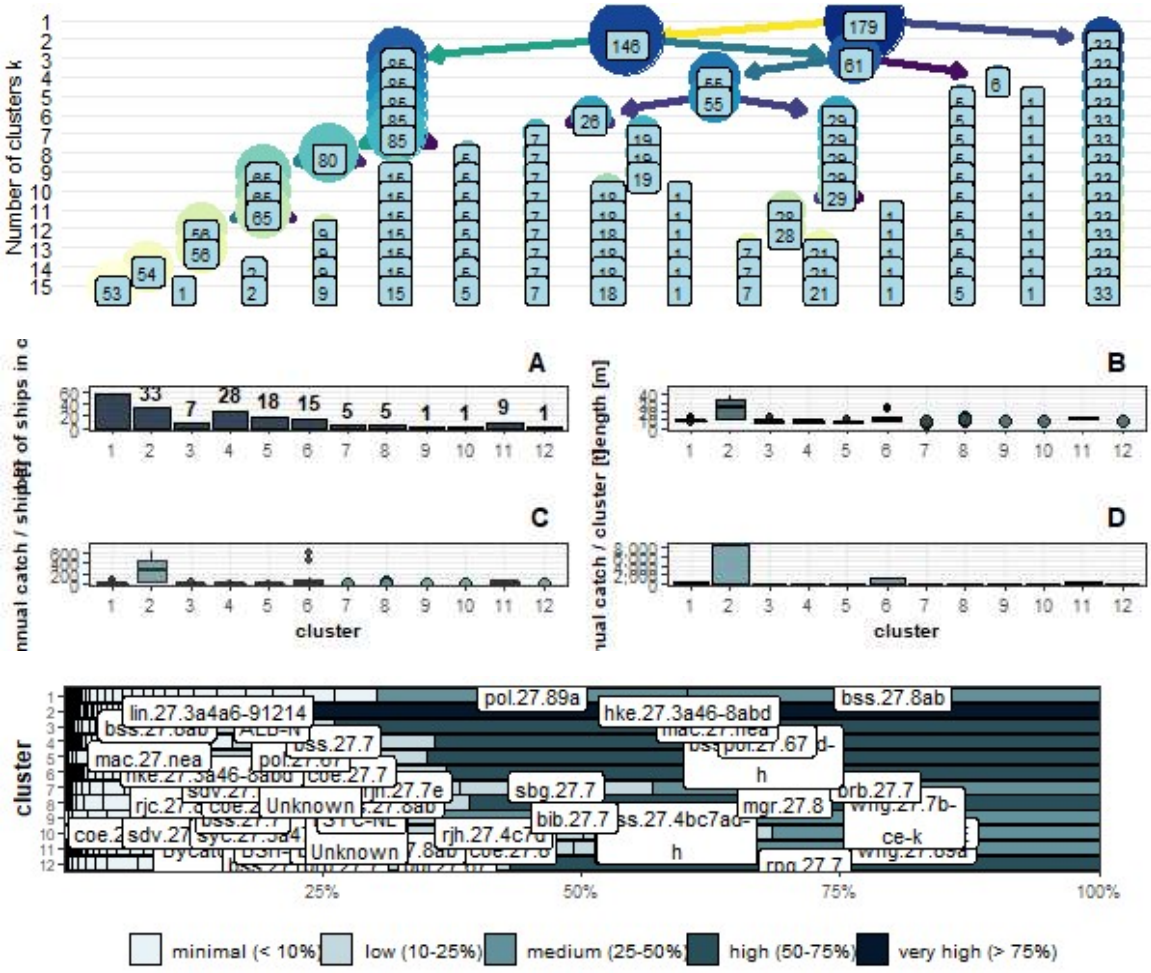


Potters/Traps Hooks

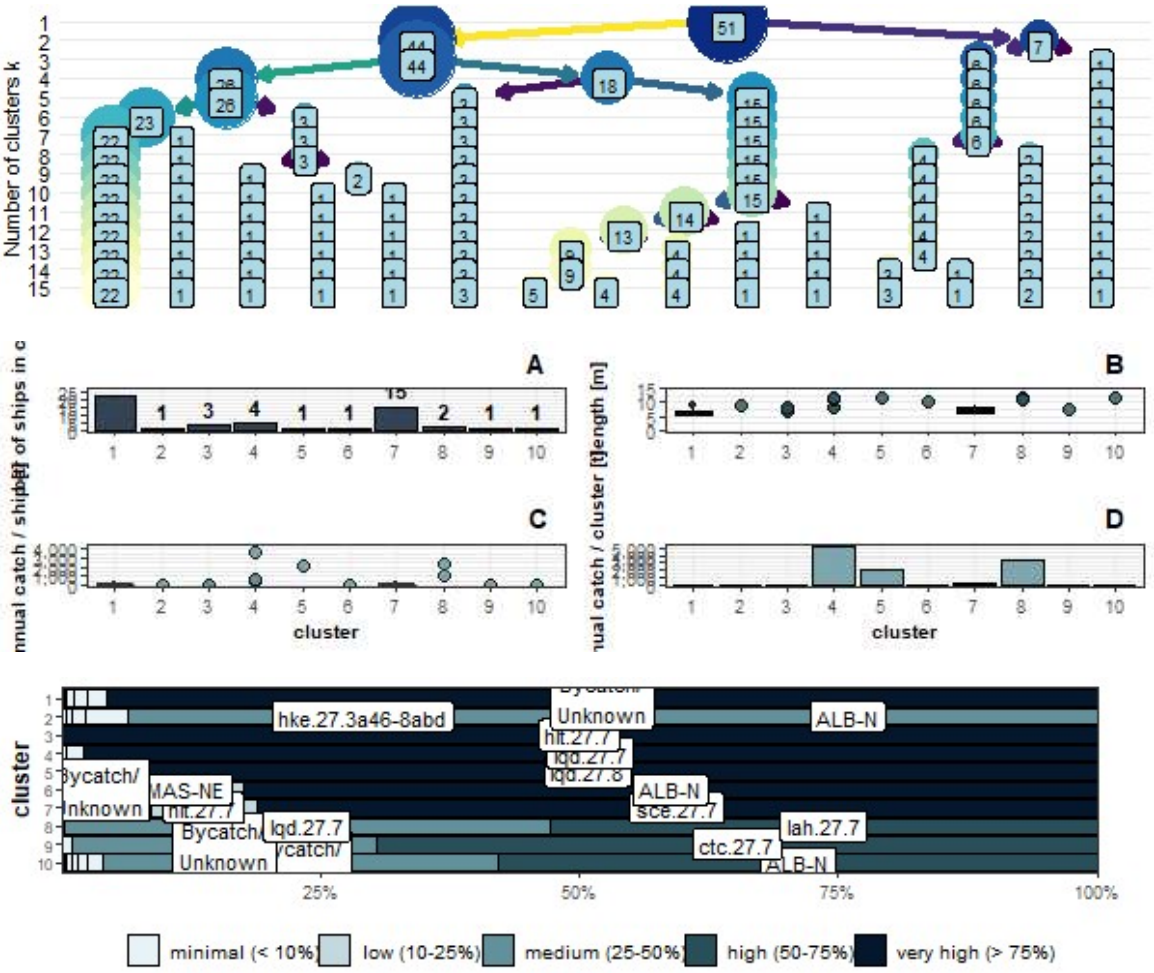




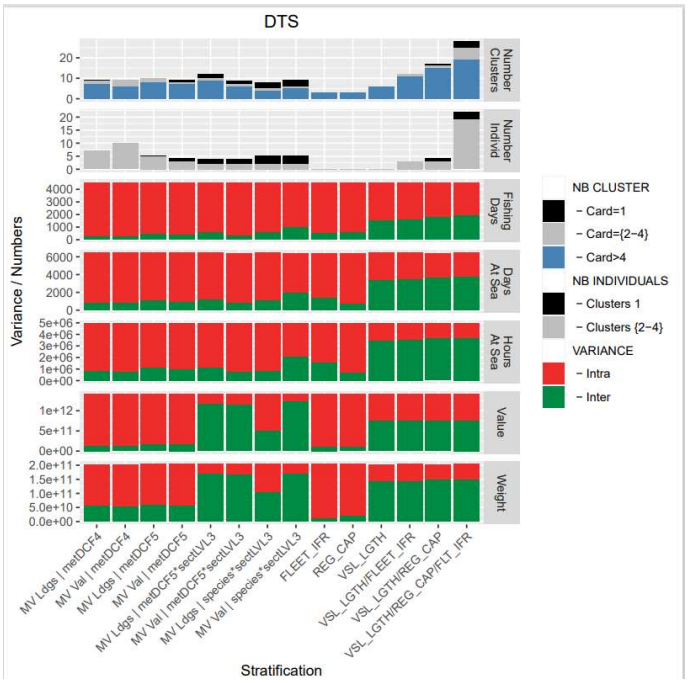
Hooks exclusive

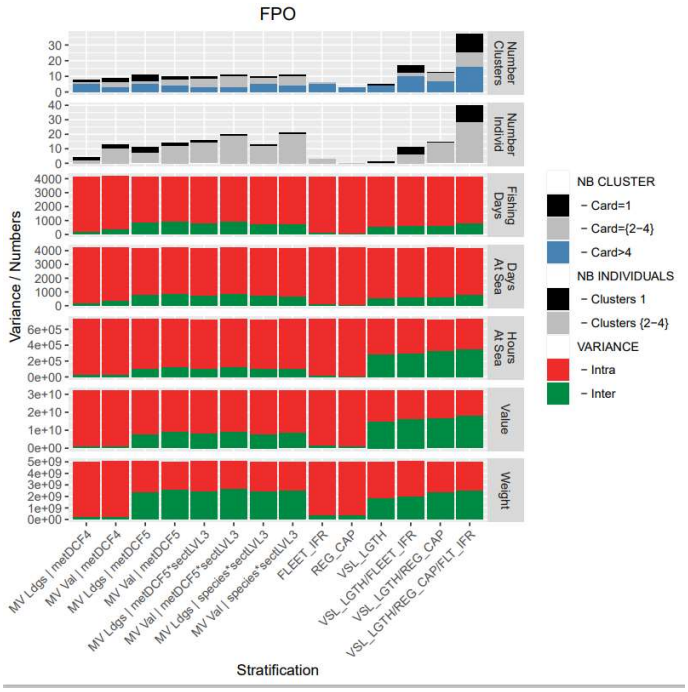


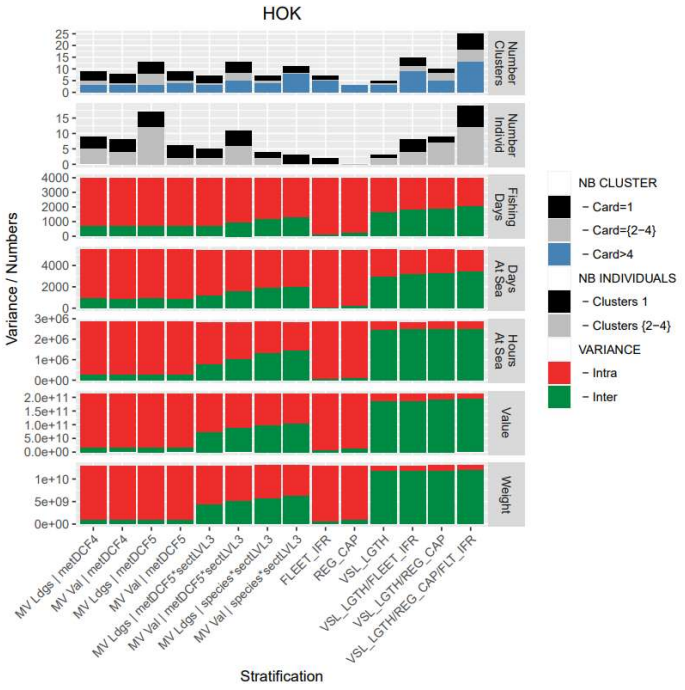
Other passive gears

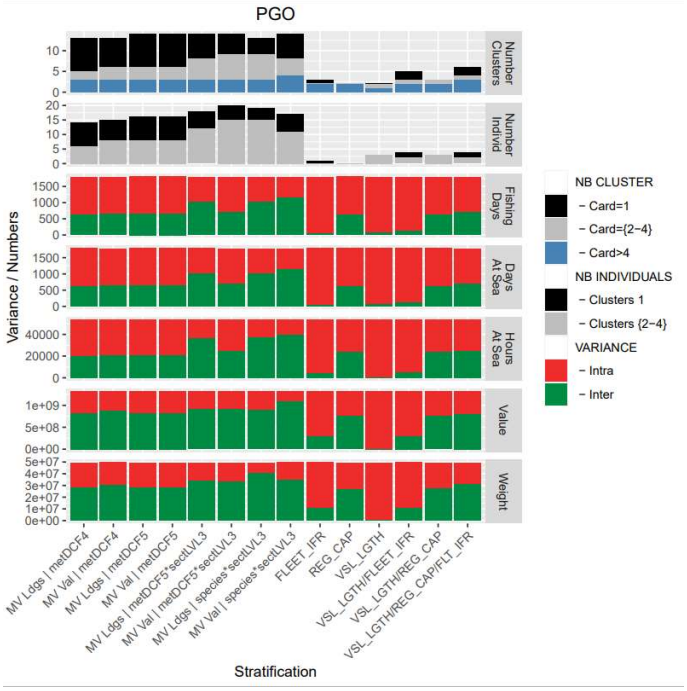


Annex III/ Comparison and stability of the different tested fleet segmentation from clustering approaches and pre-existing fleet segmentations by EU-MAP fleet segment

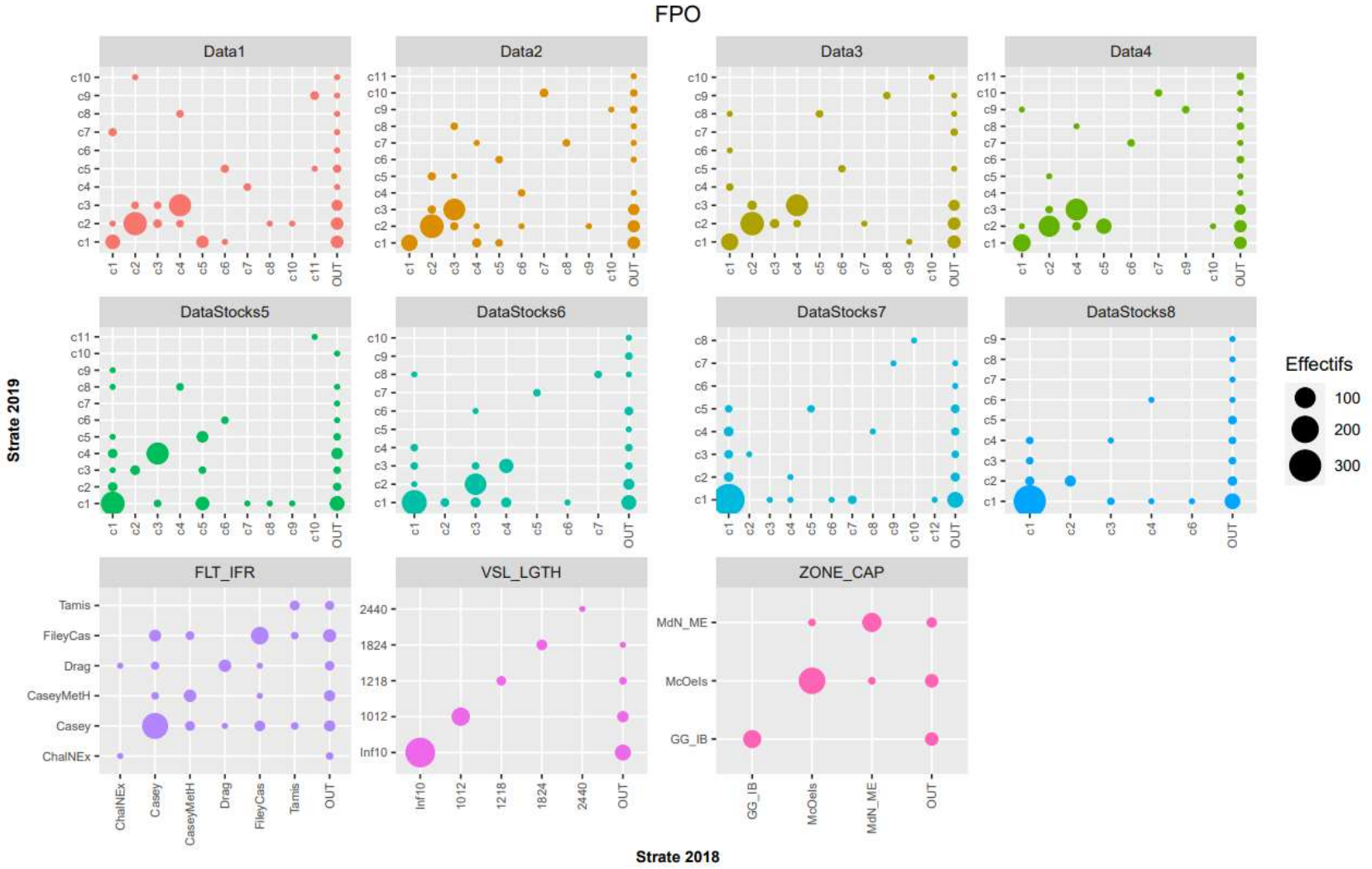


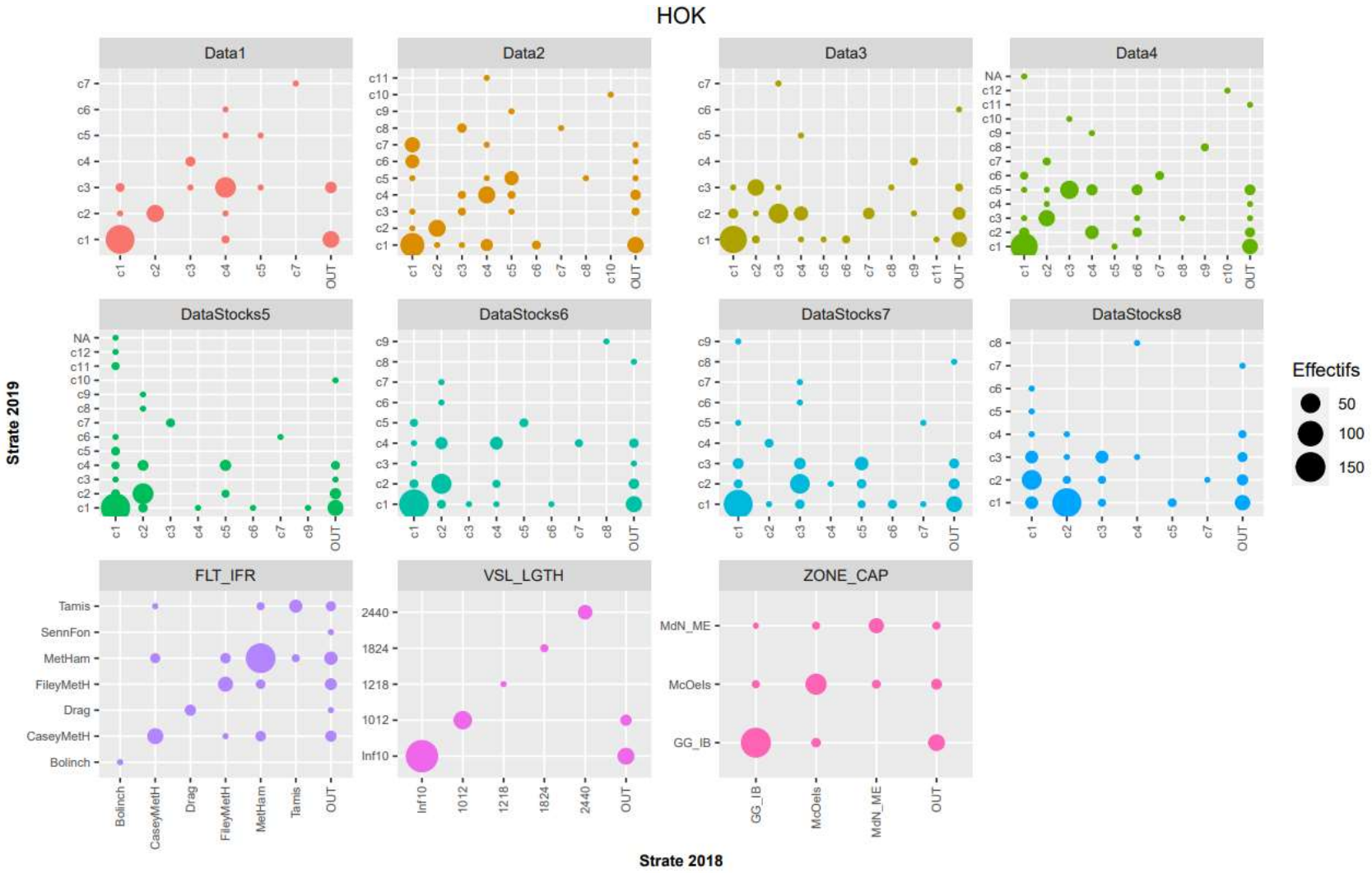


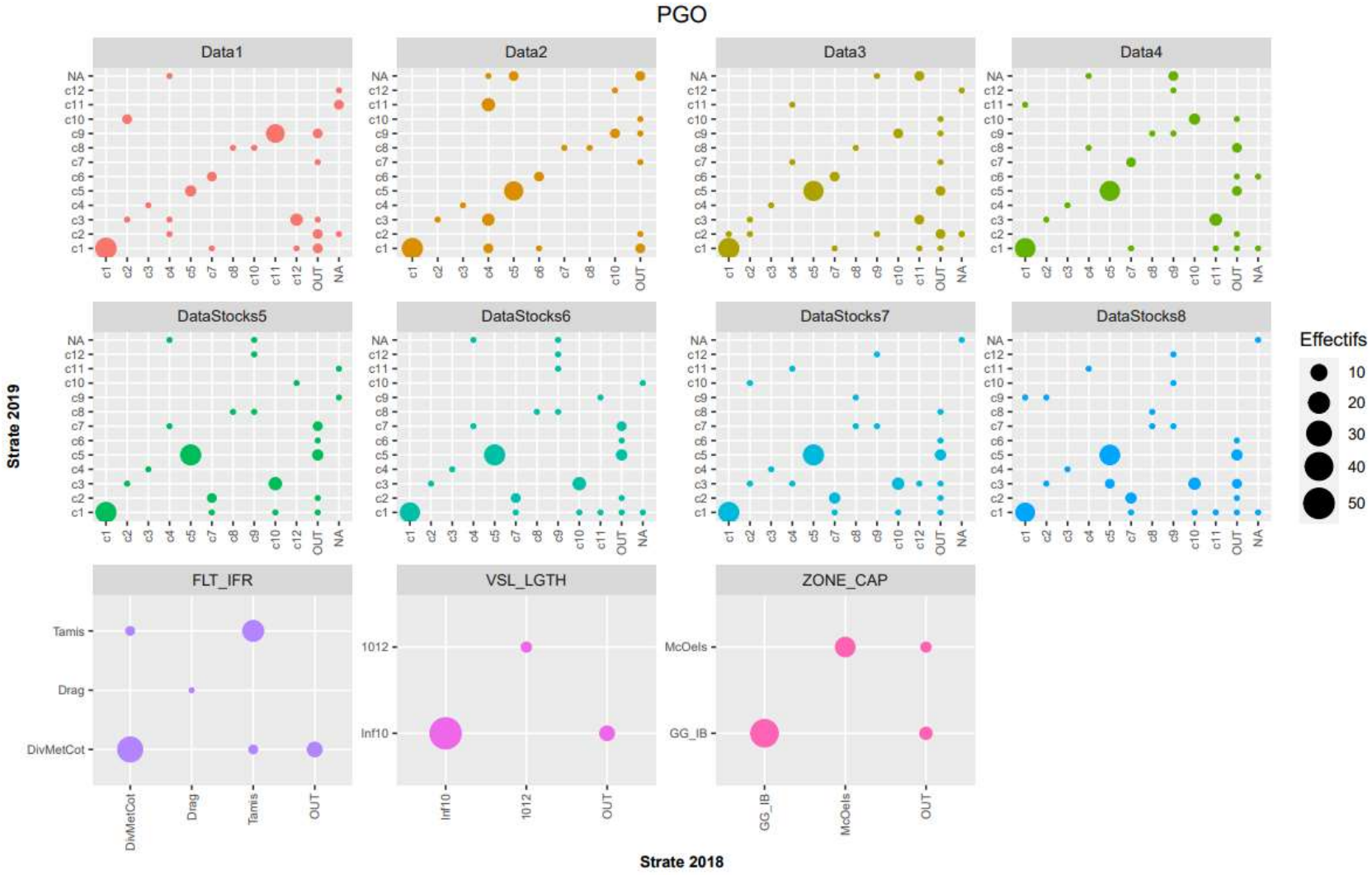

HOK
Number Clusters
Number Individ
Fishing Days
Days At Sea
Hours At Sea
Value
Weight
Variance / Numbers
NB CLUSTER
– Card=1
– Card={2–4}
– Card>4
NB INDIVIDUALS
– Clusters 1
– Clusters {2–4}
VARIANCE
– Intra
– Inter
MV Ldgs | metDCF4
MV Val | metDCF4
MV Ldgs | metDCF5
MV Val | metDCF5
MV Ldgs | metDCF5*sectLVL3
MV Val | metDCF5*sectLVL3
MV Ldgs | species*sectLVL3
MV Val | species*sectLVL3
FLEET_IFR
REG_CAP
VSL_LGTH
VSL_LGTH/FLEET_IFR
VSL_LGTH/REG_CAP
VSL_LGTH/REG_CAP/FLT_IFR
Stratification


PGO
Number Clusters
Number Individ
Fishing Days
Days At Sea
Hours At Sea
Value
Weight
Variance / Numbers
NB CLUSTER
– Card=1
– Card={2–4}
– Card>4
NB INDIVIDUALS
– Clusters 1
– Clusters {2–4}
VARIANCE
– Intra
– Inter
MV Ldgs | metDCF4
MV Val | metDCF4
MV Ldgs | metDCF5
MV Val | metDCF5
MV Ldgs | metDCF5*sectLVL3
MV Val | metDCF5*sectLVL3
MV Ldgs | species*sectLVL3
MV Val | species*sectLVL3
FLEET_IFR
REG_CAP
VSL_LGTH
VSL_LGTH/FLEET_IFR
VSL_LGTH/REG_CAP
VSL_LGTH/REG_CAP/FLT_IFR
Stratification


DTS
Data1
Data2
Data3
Data4
DataStocks5
DataStocks6
DataStocks7
DataStocks8
FLT_IFR
VSL_LGTH
ZONE_CAP
Effectifs
100
200
300
Strate 2019
Strate 2018
SennFon
ChalNEx
ChalExc
Sup40
2440
1824
1218
1012
Inf10
MdN_ME
McOeIs
GG_IB
OUT


FPO
Data1
Data2
Data3
Data4
DataStocks5
DataStocks6
DataStocks7
DataStocks8
FLT_IFR
VSL_LGTH
ZONE_CAP
Strate 2019
Strate 2018
Effectifs
100
200
300
Tamis
FileyCas
Drag
CaseyMetH
Casey
ChalNEx
2440
1824
1218
1012
Inf10
MdN_ME
McOels
GG_IB
OUT


HOK
Data1
Data2
Data3
Data4
DataStocks5
DataStocks6
DataStocks7
DataStocks8
FLT_IFR
VSL_LGTH
ZONE_CAP
Strate 2019
Strate 2018
Effectifs
50
100
150
Tamis
SennFon
MetHam
FileyMetH
Drag
CaseyMetH
Bolinch
MdN_ME
McOels
GG_IB
Inf10
1012
1218
1824
2440
OUT


PGO
Data1
Data2
Data3
Data4
DataStocks5
DataStocks6
DataStocks7
DataStocks8
Effectifs
10
20
30
40
50
Strate 2019
FLT_IFR
Tamis
Drag
DivMetCot
VSL_LGTH
1012
Inf10
ZONE_CAP
McOels
GG_IB
OUT
Strate 2018

Annex IV/ Vessel Fishing activity calendar census survey (VFACCS) questionnaire

FISHING FLEET ACTIVITY CENSUS 2007 Individual annual fishing calendar

Registration Code	Starting date	Ending date	Vessel name	District Name	Port Name	Loa	Tonnage	Power (kW)	Owner code and name	EU main gear code and subsidiary gear code	Year building

							Métier 1						Métier 2						Métier 3						Métier 4						Métier 5					
Month	District	Port	Owner	Crew	Das	FD	Métier	O	AREA 1	R	AREA 2	R	Métier	0	AREA 1	R	AREA 2	R	Métier	O	AREA 1	R	AREA 2	R	Métier	0	AREA 1	R	AREA 2	R	Métier	O	AREA 1	R	AREA 2	R
J																																				
F																																				
M																																				
A																																				
M																																				
J																																				
J																																				
A																																				
S																																				
O																																				
N																																				
D																																				

DAS = NB days at sea during the month / FD = NB fishing days / O = Origin of information (I = from Interview, L = from Logbook analysis) R = Fishing range of operation :Lagoon, Inshore, Mixed, ,Offshore

Reliability of information
❑ Direct
❑ Estimation
❑ Indirect

Activity Evolution	2006	2007
NB days at sea / year		
NB fishing days / year		
NB motor hours / year		

Panel
Would you agree to participate an another enquiry, belong to the Panel ?
Yes ☐ No ☐

Owner data : address phone

Métiers in logbooks or fishing forms All ☐ Some ☐ (A) *No* ☐

landings reliab : Y ☐ N ☐ NoAdjud ☐
Welc Quality : + ☐ = ☐ - ☐ NoAdjud

First selling of auction ☐ **All through auction market** ☐ **Partly through auction** ☐ (B) **Totally**

Whole landings ☐ (A + B)

Species completely sold through auction market : ..... / ..... / ..... / ..... / .....
Species completely sold out auction market : ..... / ..... / ..... / ..... / .....

Annex V/ From a single fishing set to the fishing fleet