Update of striped red mullet abundance indices from professional fishing data (2016-2018)

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Context

The ROMELIGO project (2015-2018) aimed to contribute to the improvement of the knowledge on three stocks (mur-west, whg-89a and pol-89a – see Table 1) on the basis of the available data (landings data, sampling data for the French fleet, data from scientific campaigns...) or specific data collected during the project.

Table 1: Stocks considered by the ROMELIGO project for red mullet, whiting and pollack.

Species	Stock name	Stock code
Striped red mullet	Striped red mullet areas VI, VIII et sub-areas VIIa-c, e-k et IXa (West area)	mur-west
Whiting	Whiting area VIII et sub-area IXa	whg-89a
Pollack	Pollack area zone VIII et sub-area IXa	pol-89a

The project was organized in the same way in three parts and applied for each of the three stocks:
- Part 1 - Analyses of catches and activity of the French professional fishery (composition and evolution of catches, seasonality, spatial distribution, gear used and discards);
- Part 2 - Analyses of the size composition of the catches on professional and scientific vessels, analyses of the discards, proposition of abundance indicators using professional fishing data and analyses of CPUE from available scientific surveys;
- Part 3 - Collection of basic biological data relying on various samplings and calculation of biological parameters (length / weight relationships, growth curves, length at first maturity (L50) or maturity ogive...).

The contract report is available online (Léauté et al., 2018[1]). A paper on the methodology used to select the reference fleets for the calculation of red mullet LPUE was also published (Caill-Milly et al., 2019).

In relation to this work and regarding **striped red mullet**, two WDs were already sent and presented to the WGWIDE respectively in 2017 and 2018:
- One dedicated to part 1 integrating as a preamble a bibliographic review on the biology of the species (Caill-Milly et al., 2017);
- One dedicated to parts 2 and 3 (Caill-Milly et al., 2018).

This WD provides the update of striped red mullet abundance indices from professional fishing data (2016-2018).

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[1] https://archimer.ifremer.fr/doc/00440/55126/

A reminder of the previous results (Caill-Milly et al., 2018)

For this species and for the Bay of Biscay, Table 2 describes the characteristics of the fleets selected to build abundance indices from professional fishing data. The selection was based on gears, technical characteristics of the vessels (defined by clusters), characteristics of the gears (mesh class) and time. No space specification within the Bay of Biscay were defined for this species. For red mullet, the retained gears and clusters are:

- "Bottom otter trawls" (OTB) and cluster 1. Cluster 1 corresponds to small vessels (7.9 to 15.8 m) with small tonnage (2.0 to 43.9 grt) and an engine power comprised between 44 and 256 kW. The full year was considered;
- "Set gillnets (anchored)" (GNS) and cluster 2. This second cluster corresponds to medium vessels (8.2 to 14.8) with medium tonnage (2.0 to 30.2 grt) and an engine power comprised between 70 and 331 kW. Depending of the mesh class, quarters 2 and/or 3 were selected because the activity is marked by a strong seasonality.

Table 2: Characteristics of the selected fleets regarding whiting.

Retained gear	Cluster	Gear mesh class	Period	Specific spatial delimitation
Bottom otter trawls (1 vessel) "OTB"	Cluster 1	70 to 79 mm	Annual	No (whole Bay of Biscay)
Set gillnets (anchored) "GNS"	Cluster 2	50 to 59 mm	Quarter 2	No (whole Bay of Biscay)
		50 to 59 mm	Quarter 3	
		60 to 69 mm	Quarter 2	
		Sup to 90 mm	Quarter 2	

Gear "OTB"

For the selected mesh class (70 - 79 mm), the evolutions of the LPUE mean level and of its use over time were considered for the entire year and the whole Bay of Biscay.

The number of uses shows a decrease during the study period, however this decrease is not significant. Like uses, LPUE decreases over the period of study but significantly in this case (Figure 1).
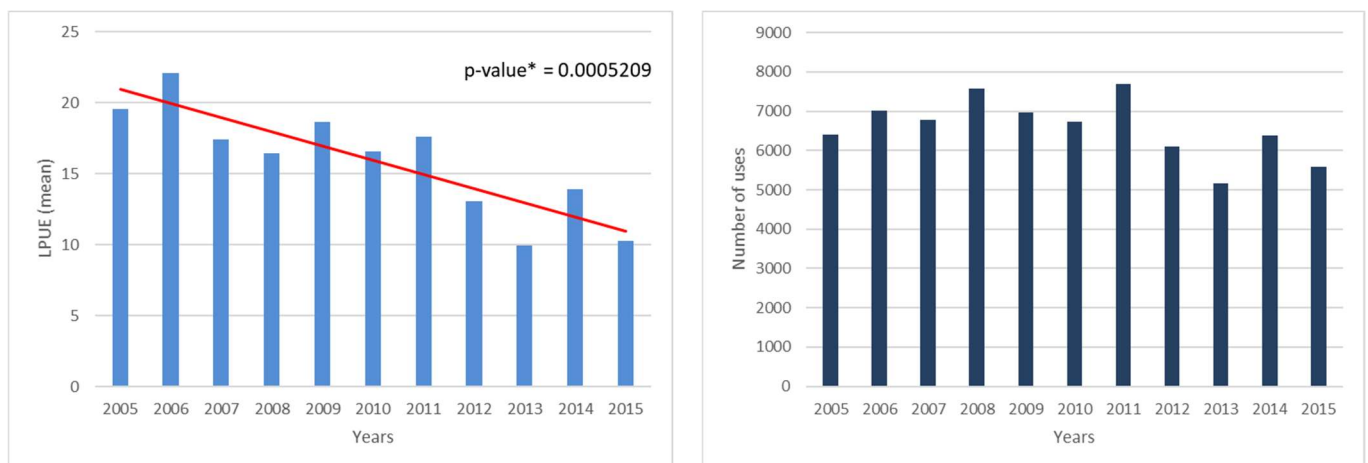

Figure 1: Levels of LPUE and number of uses - Bottom otter trawls - Cluster 1 - Mesh class 70 - 79 mm - Annual – Bay of Biscay

Gear "GNS"

For each of the combinations mesh / quarter of cluster 2 - GNS, the evolutions of their use over time and of their LPUEs for the entire Bay of Biscay were considered.

Gear meshes 50 - 59 mm and 60 - 69 mm have their use levels of gear that decrease significantly for the second quarter (Figures 2 and 4). For the gear mesh 60 - 69 mm, this decrease is in conjunction with a significant decrease of the LPUEs over the period. For the other couples of gear mesh classes / quarter, the number of uses and the LPUEs seem to decrease but it is not significant (Figures 3 and 5).
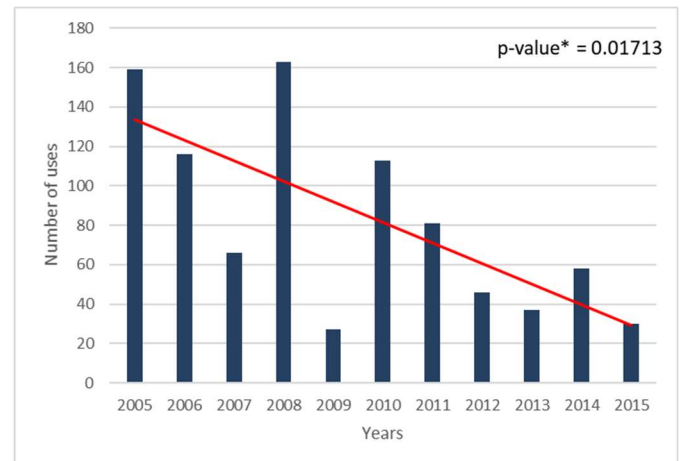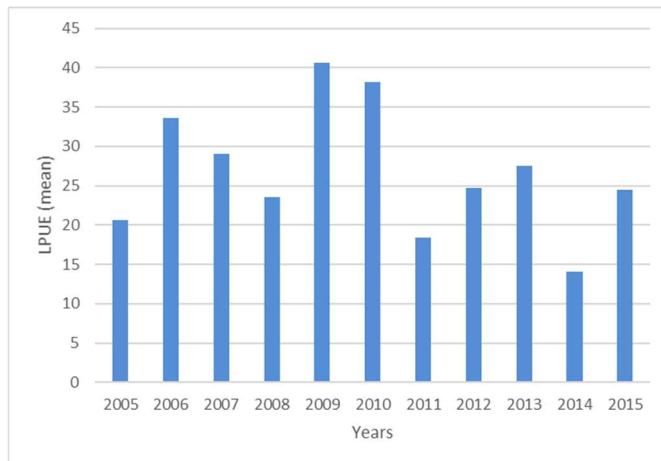
Figure 2: Levels of LPUE and number of uses - Set gillnets - Cluster 2 - Mesh class 50 - 59 mm - Quarter 2 – Bay of Biscay
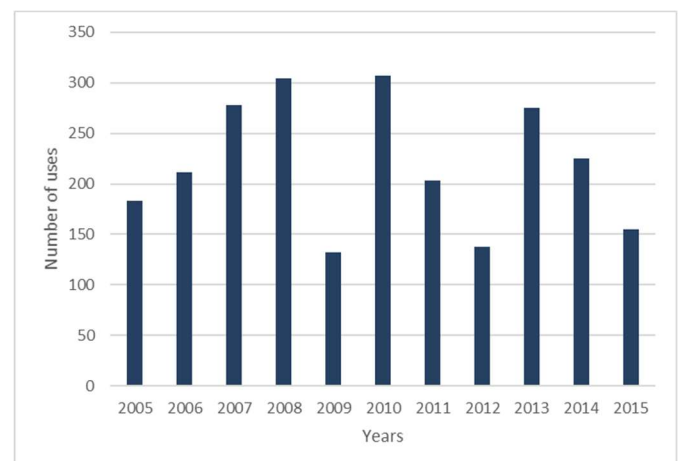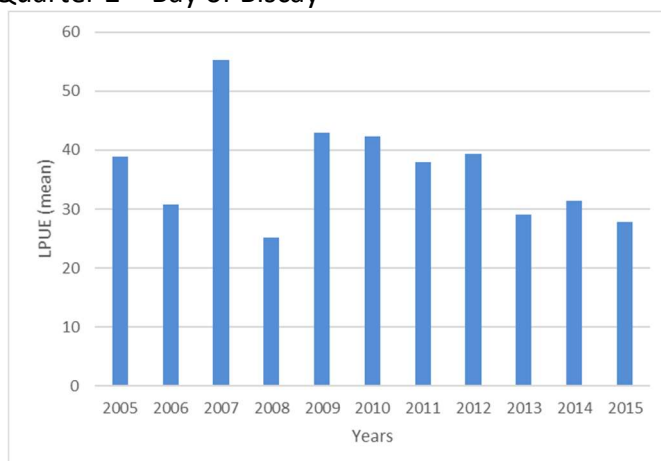

Figure 3: Levels of LPUE and number of uses - Set gillnets - Cluster 2 - Mesh class 50 - 59 mm - Quarter 3 – Bay of Biscay
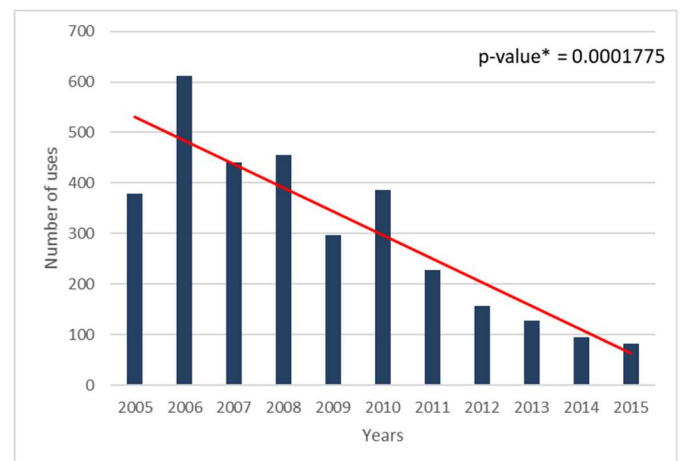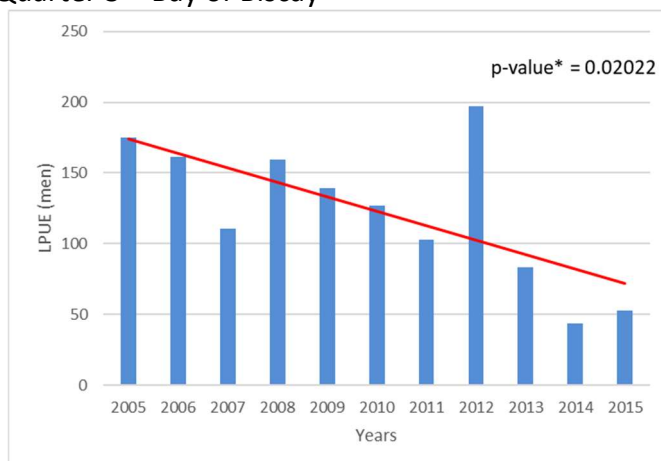

Figure 4: Levels of LPUE and number of uses - Set gillnets - Cluster 2 - Mesh class 60 - 69 mm - Quarter 2 – Bay of Biscay
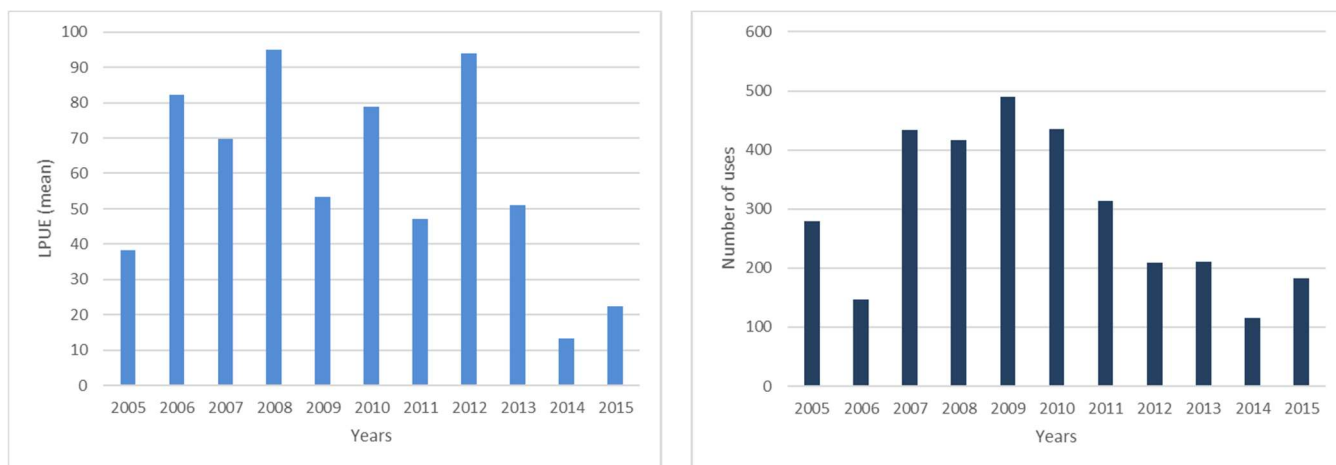
Figure 5: Levels of LPUE and number of uses - Set gillnets - Cluster 2 - Mesh class higher than 90 mm - Quarter 2 – Bay of Biscay

Method used to update the abundance indices from professional fishing data

The proposed method allows an update of the LPUEs of the selected fleets after 2015. It requires the assignment of new vessels in one of the clusters defined in the project beforehand. This is to be done at the level of the selected gear for the species (*i.e.* OTB and GNS for striped red mullet).

Clusters are the result of a hierarchical classification of vessels based on their technical characteristics (length, tonnage and engine power). The vessels were grouped according to their degree of similarity for these three variables using Hierarchical Aggregation Clustering (HAC) with Ward aggregation criterion and Euclidean distance.

When grouping with a clustering method such as the above one, it is difficult to identify clearly the bounds allowing to affect one vessel in a specified cluster (because of possible overlaps of some of the characteristics from one cluster to another). A method of assigning vessels was therefore developed for the selected gear.

To do this, conditional decision trees were built for each selected gear (OTB and GNS for striped red mullet). In each case, the targeted variable was the variable "cluster". Based on the existing classification, each decision tree provides the rules fixing the values that must take the different technical variables for a vessel to belong to a given cluster for a given gear. The leaves (of the tree) not selected are either because they do not concern the targeted cluster or because the risk of classification error is considered too high.

Once this step has been completed, updating of the data (number of uses of the selected gears and average levels of LPUE) was carried out. It concerned the years 2016, 2017 and 2018. This update was sent to the professional structures involved in the former "CPUE Working Group" of the Romeligo project. The objective was to identify regulatory or other elements that could potentially disturb the LPUE index constructed for 2016, 2017 and 2018.

Results

Decision criteria for the assignment of new vessels appearing in 2016, 2017 or 2018
Regarding striped red mullet and for OTB, the retained tree (Fig. 6) is the one which setting minimizes the prediction error for cluster 1 and for all the data (cluster 1 prediction error: 0.4%; total prediction error: 1.1%).
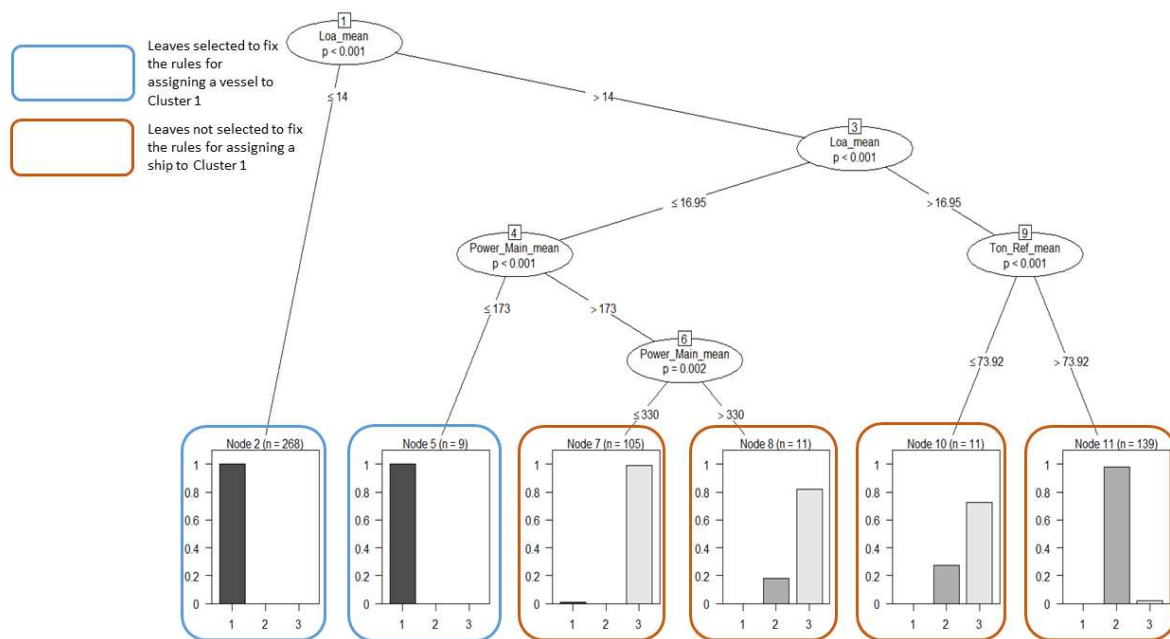
Figure 6: Conditional regression tree on cluster 1 variable (for striped red mullet / OTB) with technical characteristics [Loa: Length (m); Ton_Ref: tonnage (grt); Power_Main: engine power (kW)].

Consequently, a vessel falls into the cluster 1 if:
• Its length is less or equal to 14 m;
• Or if its length is greater than 14 m and less than 16.95 m with an engine power less or equal to 173 kW.

Regarding striped red mullet and for GNS, the retained tree (Fig. 7) is the one which setting minimizes the prediction error for cluster 2 and for all the data (cluster 2 prediction error: 0.8%; total prediction error: 1.3%).
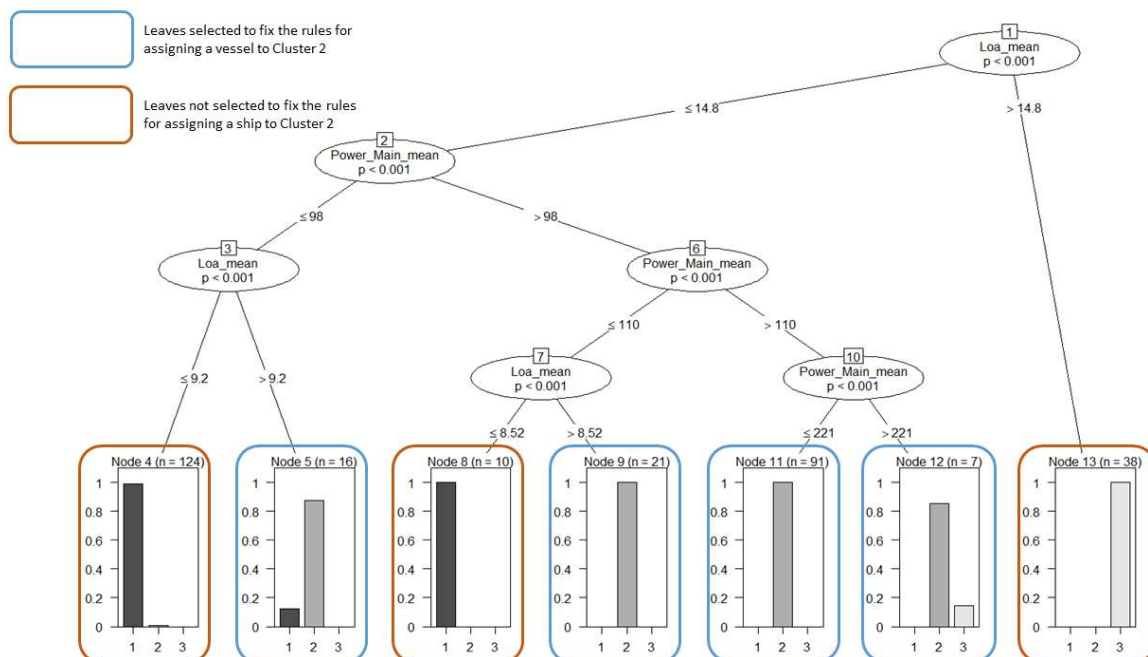

Figure 7: Conditional regression tree on cluster 2 variable (for striped red mullet / GNS) with technical characteristics [Loa: Length (m); Ton_Ref: tonnage (grt); Power_Main: engine power(kW)].

Consequently, a vessel falls into the cluster 2 if its length is less than 14.8 m and:
• If its engine power is less or equal to 98 kW and its length greater than 9.2 m;
• Or if its engine power is greater than 98 kW and lower than 100 kW with a length greater than 8.52 m;
• Or if its engine power is greater than 110 kW.

Update of data and evolution of the indices

For OTB
The evolution of the number of uses and of the mean level of LPUE are shown for the entire year and the whole Bay of Biscay (Figure 8).

Figure 8: Numbers of uses and levels of LPUE - Bottom otter trawls - Cluster 1 - Mesh class 70 - 79 mm – Annual – Bay of Biscay

The number of uses shows little variation during the period. In recent years, the LPUEs calculated for the Bay of Biscay show low levels which remain low compared to the whole series. The end of the series seems to be marked by an upward recovery which will remain to be confirmed in the following years.

For GNS
The evolution of the number of uses and of the mean level of LPUE for each couples of gear mesh classes / quarter are shown for the selected quarters and for the whole Bay of Biscay (Figures 9 to 12).
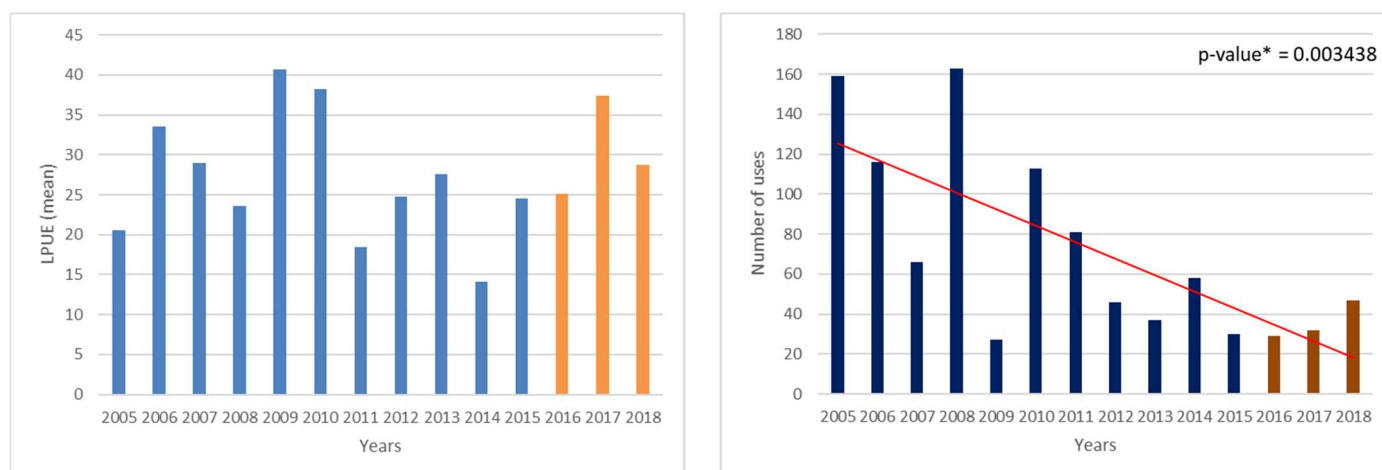

Figure 9: Numbers of uses and levels of LPUE - Set gillnets - Cluster 2 - Mesh class 50 - 59 mm – Quarter 2 – Bay of Biscay
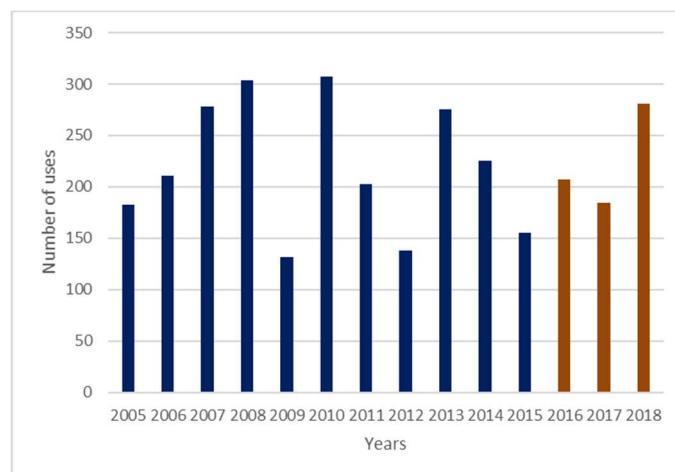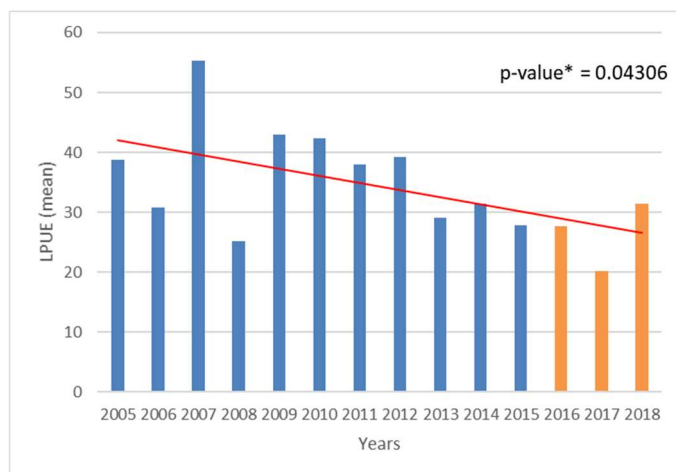
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Figure 10: Numbers of uses and levels of LPUE - Set gillnets - Cluster 2 - Mesh class 50 - 59 mm – Quarter 3 – Bay of Biscay
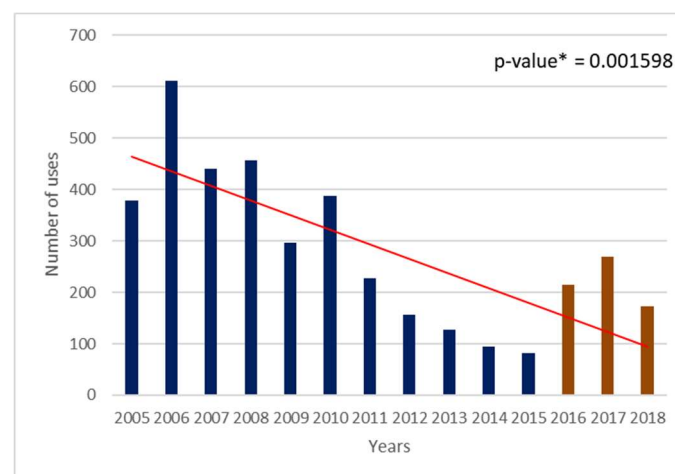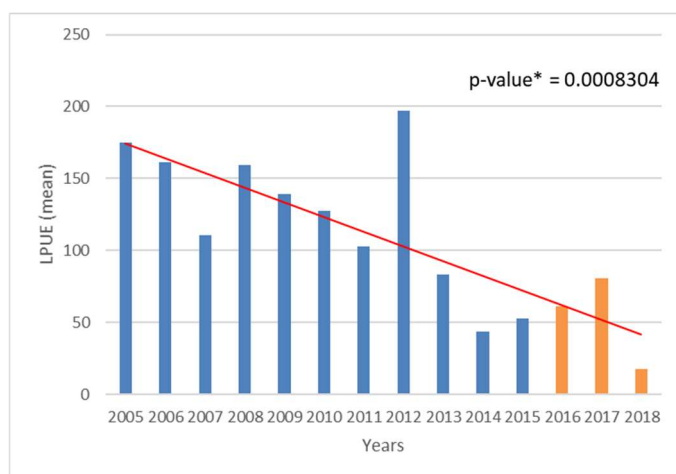

Figure 11: Numbers of uses and levels of LPUE - Set gillnets - Cluster 2 - Mesh class 60 - 69 mm – Quarter 2 – Bay of Biscay
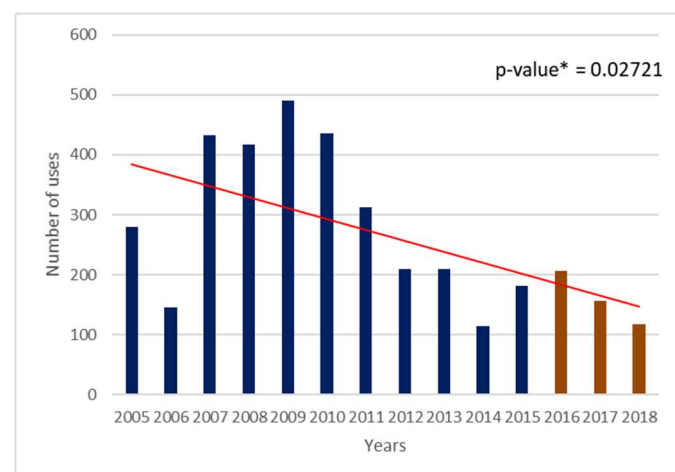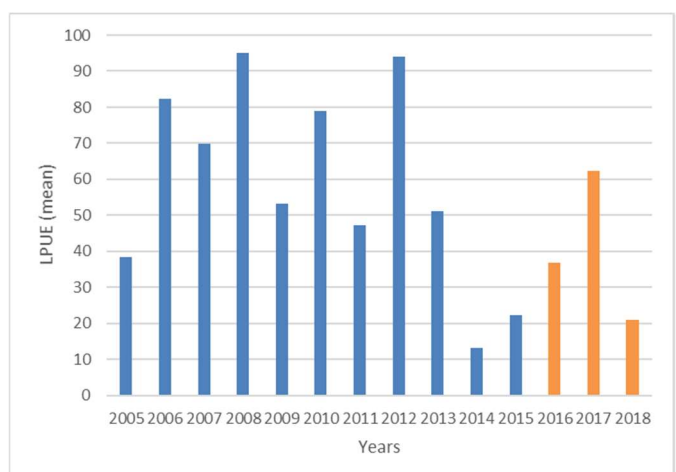

Figure 12: Numbers of uses and levels of LPUE - Set gillnets - Cluster 2 - Mesh class higher than 90 mm – Quarter 2 – Bay of Biscay

Over the whole period, a downward trend is observed in three out of four cases for the number of fishing sequences and in two out of four cases for the average LPUE.

In recent years, only LPUEs for the 50-59 mm class in the second quarter have shown high levels compared to the rest of the series, but for a low number of sequences. The LPUE level for the 60-69 mm mesh class in the second quarter was particularly low in 2018.

Information from the consultation of professional structures

For OTB

The consultation identified one regulatory element that could potentially have disturbed the LPUE indices built for 2016, 2017 and 2018: the decree concerning trawlers over 12 m which have a European Fishing Authorization (EFA) to fish common sole in the Bay of Biscay[2].

The list of these vessels was not recovered. We only looked at the evolution of the number of fishing sequences by vessels over 12 m and their associated LPUE. This number of sequences is marked by a sharp drop in 2016 and remained at a low level in 2017 and 2018. It was accompanied by a drop in the average LPUE for these vessels (longer than 12 m), a drop already recorded before.

⇨ Considering all the available data and assuming that all things are equal, it is estimated that the levels of LPUE between 2016 and 2018 could have been impacted by the measurement management, but without changing the trend of the indicator.

For GNS

The consultation did not identify regulatory element that could potentially have disturbed the LPUE / GNS indices built for 2016, 2017 and 2018.

Conclusion

Currently five fleets are selected for the Bay of Biscay:
- OTB - Cluster 1 - Mesh size 70 - 79 mm - Annual - Bay of Biscay;
- GNS - Cluster 2 - Class mesh 50 - 59 mm - Quarter 2 - Bay of Biscay;
- GNS - Cluster 2 - Class mesh 50 - 59 mm - Quarter 3 - Bay of Biscay;
- GNS - Cluster 2 - Class mesh 60 - 69 mm - Quarter 2 - Bay of Biscay;
- GNS - Cluster 2 - Class mesh greater than 90 mm - Quarter 2 - Bay of Biscay.

For the GNS indicators, the number of uses decreases in three out of four cases, that concerning the mesh class 50 - 59 mm in the 2nd quarter reaching a very low level (around 40 sequences in 2018). It is proposed to no longer use this last indicator because we consider that it is no longer representative. For the others, more in-depth work should be able to be carried out in the project ACOST (submitted to the FFP call). At the same time, the interest of considering the Danish seine gear could be posed because the length of the series is now sufficient.

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[2] Since January 1st, 2016, this decree imposes a mandatory minimum mesh size of 80 mm for the vessels concerned (having this authorization), out of derogation period from June 1st to September 30th each year. This latter period makes it possible to practice specific metiers (for example bottom trawls targeting wedge sole). This decree was modified at the end of 2018, with the possibility of shifting the derogation period of 4 consecutive months.

References

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Caill-Milly N., Lissardy M., Bru N., Dutertre M.-A., Saguet C., 2018. Reference fleets identification by LPUE data filtering applied to the striped red mullet (*Mullus surmulletus*) in the Bay of Biscay. Working Document for the Working Group on Widely Distributed Stocks (WGWIDE). 28 August - 3 September 2018, The Faroe Islands. https://w3.ifremer.fr/archimer/doc/00466/57750/

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Léauté J.-P., Caill-Milly N., Lissardy M., Bru N., Dutertre M.-A., Saguet C., 2018. ROMELIGO. Amélioration des connaissances halieutiques du ROuget-barbet, du MErlan et du LIeu jaune du GOlfe de Gascogne. RBE/HGS/LRHLR et ODE/UL/LERAR/18-001. https://archimer.ifremer.fr/doc/00440/55126/

Sacrois versions used for the update: V.3.3.7 for the 2016 to 2017 data and V.3.3.8 for the 2018 data (extraction November 2019)