Adaptation options at the fishing enterprise scale and governance modes in response to climate change effects in a changing political environment. Case of New Aquitaine (France) southern fleets

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1. Introduction

The European Union (EU) has developed a consistent regulatory framework to ensure sustainability of the exploitation of natural resources in the Northeast Atlantic [Common Fisheries Policy EU 1380/2013; Johannesburg World Summit on Sustainable Development in 2002; 1995 UN Fish Stocks Agreement and European plan for maximum sustainable yield COM (2006) 360 final]. These documents have set the conditions that are not likely to lead to a collapse of the stocks (precautionary approach) and/or those that allow the maximum sustainable yield to be reached (MSY approach). This has resulted in regulating access to resources and the setting of conservation measures aimed at reducing fishing effort, applying technical rules, and limiting catches.

However, this regulatory framework is now applied to marine ecosystems impacted by climate change (one of several phenomena leading to global change). Climate change induces modifications in biological and physico-chemical parameters within water bodies. These will in turn have a greater or lesser impact on a species depending on its habitat requirements, life cycle characteristics of their life cycle and its trophic position (Rijnsdorp et al., 2009). Changes in latitudinal distribution or depth and/or changes in abundance have already been identified, impacting human activities that depend on these resources (Branders, 2010; Perry et al., 2005). It is therefore necessary to develop legislation, particularly in terms of borders and access rights, while also considering political changes. These can be variable and the cause of socio-economic uncertainties and tensions over maritime activities in shared spaces.

In this context, marine resources exploited by vessels of the southern Bay of Biscay are no exception. These resources are made up of populations present within vast distribution areas, far beyond the limits of the region of New Aquitaine (where the vessels are registered) and living in various habitats. A recent review of thirteen species of importance for New Aquitaine fishermen indicated that modifications impacting related stocks and seen through the climate change prism, are mainly related to temperature, marine productivity, river flow regimes and, more incidentally, current and swell regimes (Le Treut, 2018). Among these modifications, changes in biogeographical limits with northward movements are the best documented such as for European hake (*Merluccius merluccius*) and anglerfish (*Lophius piscatorius, Lophius budegassa*).

This paper focuses on the impact of these changes for fishing fleets that are highly dependent on these resources and on the possible options for adaptations without forgetting to take into account the need for a new political framework in relation to Brexit.

2. Materials and methods

In New Aquitaine, hake and anglerfish constitute almost 50% of the income of all the 495 fishing vessels for the period 2013-2015 (Le Treut, 2018). For the 143 vessels registered in the Bayonne maritime district, this dependence even rises to slightly more than 60% (excluding seaweed exploitation) in 2006, corresponding to 73 million euros (Gallet et al., 2019). Depending on the technical characteristics of the vessels and the fishing gears used, there are strong disparities in importance of these resources with some vessels displaying a dominant small-scale coastal fishing activity and others operating in more deeply offshore fishing grounds, particularly in the Celtic Sea and the west of Ireland. For the vessels registered in Bayonne and based on the typology described in Gallet et al. (2019), the most dependent fleets are trawlers over 25m for anglerfish, gillnetters over 20m and longliners over 15m for hake (~ 40 vessels).

For these fleets, SACROIS is considered as the most complete available fishery database regarding production and fishing effort. Developed by Ifremer in connection with the French DG Maritime Affairs, fisheries and aquaculture, it is provided by an algorithm which cross-checks information from fishing forms, fishing fleet registers, logbooks, sales notes, VMS data and the scientific census of fishing activity calendars (Mateo et al., 2016). The SACROIS data were used, with a spatiotemporal aggregation of the landings by ICES statistical rectangles and years over 2005-2019 for the vessels belonging to the three fleets described above. Per fleet and for the 50 rectangles contributing the most to the catches, we first analyzed the evolution of the annual total catch per rectangle over the period. To do this, a normalized principal components analysis on the aggregated data was performed, followed by a hierarchical clustering on principal components (5 components, euclidian distance, Ward criterion). This resulted in a clustering of the rectangles in 3 or 4 groups, each one contains rectangles with similar dynamics and identified significant years of catches. Then, for the first paragon of each cluster, catch evolutions were displayed per fleet. This information was used to fuel the discussion in terms of adaptation not only at the fishery company scale but also regarding governance in a context of redefined maritime borders following Brexit.

3. Results and discussion

For anglerfish, the analysis of fishing statistics of trawlers above 25m exhibits spatial patterns (Figure 1). Rectangles belonging to cluster 1 are characterized by catches under the average for each year of the studied period except 2006. They are located in the middle of Great Sole Bank, to the west of Porkupine Bank and to the north, close to the coast in the west of Ireland and in the south Biscay. Regarding the southwest French coast, these results corroborate what is observed by fishermen (Henneveux, pers. comm) and are in line with Solmundsson et al's (2007 and 2010) observations: a recent decline in numbers near the coast and a "sinking" of the populations further offshore and at a greater depth. Regarding the decreasing trend observed in the southeast of Ireland, it could be linked to measures on other species such as cod or other Gadidae species related technical mesures in some specific area. Cluster 2 characterized rectangles with catches above averages for years 2011, 2012, 2015, 2017 and 2019. They are located mainly to the south and to the north of Great Sole Bank. Cluster 3 and cluster 4 includes rectangles with catches at very high levels for years 2007 to 2019 for the first and for years 2005-2012 and 2016-2019 for the second. For these clusters, the rectangles are located between the west of Ireland (7b) and Porcupine Bank (7c) and to the north of Great Sole Bank (7j). For this species and for the studied rectangles, the highest catches are located in the north of area 7. For 2019, the percentage of the French quota for zone 7 is 61% of the total French quota, while that for areas 6 (EU) and 5b (international waters), areas adjacent to area 7 to the north, is 16%. The ICES areas with catches intersecting with the new exclusive economic zones of the UK are 7j, 7h and 7g.

For hake, gillnetter and longliner statistical analysis do not exhibit a very clear spatial pattern except that the continental slopes are mostly characterized by the lower catch levels for the different years. The two fleets present a cluster 1 characterized by catches lower each year compared to the average. For gillnetters, cluster 2 depicts rectangles with catches above average between 2005 and 2011; cluster 3 represents areas where above average catches have been observed since 2014 and cluster 4 displays two rectangles with very high catches from 2005 to 2017. For longliners, cluster 2 illustrates rectangles with higher catches for years 2005, 2007-2012 and 2019; cluster 3 depicts a rectangle with very high catches from 2012 to 2018 (Figure 1). More than half of the rectangles studied have each year lower than average catches. The rectangles with catches well above averages are located in Great Sole Bank (7j) (north and centre) and on the continental shelf of South Brittany (8a) and South Biscay (8b) fishing grounds. For 2019, the percentage of the French quota in areas 6 and 7; EU and international waters of 5b; international waters of 12 and 14 on one side and in areas 8a, 8b, 8d and 8e on the other side are similar (46%). The ICES areas with catches intersecting with the new exclusive economic zones of the UK are 6a and to a less extend 7j for gillnetters and 6a, 4a and to a less extend 7j and 7h for longliners.

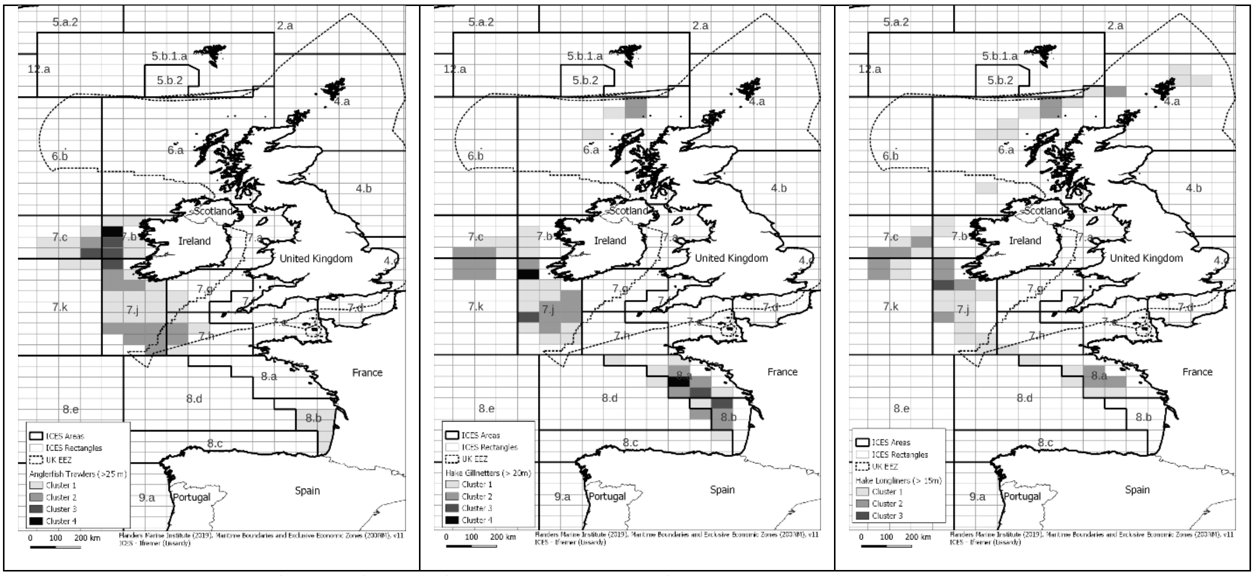

Figure 1. Spatial distribution of clusters for anglerfish/trawlers over 25m (left), hake/gillnetters over 20m (center), hake/longliners over 15m (right).

Catch evolution for the paragons shows an increasing trend from about 2012 onwards, followed by a marked decrease for the clusters characterized by high levels. For anglerfish this is concomitant with the arrival of several vessels from the group in the middle of the period. This is not the case for hake; most of the vessels in the two selected fleets have been active since the beginning of the period.

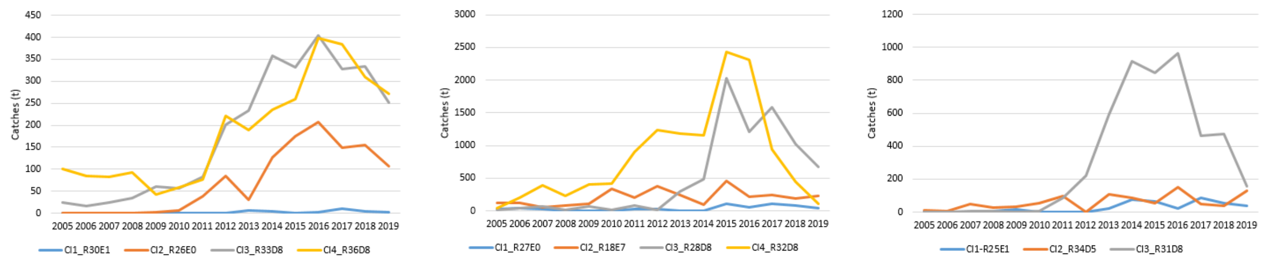

Figure 2. Evolution of the catches of the first parangon of each cluster [for anglerfish/trawlers over 25m (left), hake/gillnetters over 20m (center), hake/longliners over 15m (right)].

What do these changes in catch distributions imply for vessels of the southern Bay of Biscay? Given the economic interdependency which exists between European (and EU-UK) fishers (shared stocks, waters and markets), governance solutions encouraging a 'collectivisation' (rather than an 'individualization') of the climate problem require some thought. Yet, there has been limited effective consideration of how to ensure both 'just' and 'sustainable' fisheries management (JSFM) taking account of climate change. Indeed, how to institutionalise JSFM depends on adaptation scenarios.

In scenario 1, fleets continue fishing the same fish. When fished within EU waters, ecosystem governance approaches apply (Gormley et al, 2015), potentially granting French fishers a voice over access in domestic management committees and in EU marine region Advisory Councils (ACs) (e.g., providing collective advice on stock & fleet climate management) (post Brexit, UK fishers are only observers on ACs). When vessels choose to continue fishing in British waters (e.g., for anglerfish, hake) following Brexit, specific challenges arise on stability of access. Temporary access has been authorised under the rules of the UK-EU Trade and Cooperation Agreement (TCA) (2020) based on quotas and historic track records for non-quota species (2012-2016): 90% of French licences have been authorised (Stewart et al, 2022) (including 53 vessels registered in Bayonne). A new Specialised Committee on Fisheries (SCF) has been created (Article 508 TCA) to ensure sustainable co-management of stocks: this is, however, a formal, 'old fashioned' intergovernmental style committee (30 EU & 45 UK officials) likely to generate UK-EU 'stand-offs' (and trade-offs) over access and stock management. From the EU side, fishers have established a new 'inter-AC Brexit forum' and have asked to feed their views into SFC discussions. Consequently, although new rules and organisations exist which now govern this scenario (and in which fishers from southern Bay of Biscay might participate), nonetheless fishing the same fish will likely position vessels in a potentially turbulent political situation, with a risk of delays in rule application, conflicts (UK-France; UK-EU) and hence continued uncertainty over access (especially after the transition period). In addition, there are also regulatory considerations for landings which differ between EU and UK (traceability, customs ...).

In scenario 2, fleets decide to fish new stocks. Yet, here too, several JSFM challenges emerge. The current CFP norm of relative stability determining quotas and access (as well as national regulations) can create rigidity and barriers to access for newcomers. An alternative zonal attachment mechanism might seem appealing (this is the proposal of the UK, cf. Stewart et al, 2022), but does not solve all problems for JSFM of mobile stocks. Fleets cannot 'just change' to catch the fish now in their waters: fleet adaptation requires technical flexibility or acquisition of appropriate vessels/gear, as well as new skills for skippers (Mahévas,et al, 2011). Additionally, current co-habitation agreements regulating different professions fishing a common stock (using different gear) might need revision. In either case, new financial mechanisms are required accompanying adaptation. Finally, although thinking about production adaptation to climate change is sometimes separated from thinking about the market, the two are interconnected. Although fish migrate, food culture tends to be territorially attached. New political work will therefore be required to create new markets (either locally or globally), and this could be collectivised (e.g., via POs or local fishers guilds and associations).

4. Conclusions

For this preliminary analysis, we have chosen to work on catches of three fleets to understand future changes in enterprise strategy and governance. We identified potential future spatial issues (UK EEZ, distribution of quotas by area) which are different for anglerfish and for hake. Choices for data processing were made (selection of 50 rectangles per fleet, grouping of data at the fleet scale, etc.). It seems interesting to us, for example, to continue this work by looking at things at the vessel level and incorporating other species.

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