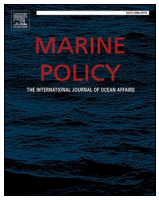
Marine Policy 179 (2025) 106764

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol



Full length article

Allocating individual fishing possibilities through producer organisations: The case of the Bay of Biscay common sole fishery in France

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ARTICLE INFO

Keywords:
Fisheries management
Quotas
Producer organisations
Transaction costs

ABSTRACT

Management of the economically important Bay of Biscay common sole fishery has long relied on the setting of annual Total Allowable Catches (TACs). Allocation of these fishing possibilities at the French level is largely administered by six Producer Organisations (POs) for the fraction of the national quota they are responsible for, depending on the catch history of vessels belonging to their members. We surveyed representatives of these POs with the aim to understand the principles and processes that have evolved for determining allocation of sole quota among their members. Survey results show that the move away from derby fishing and towards the setting of individual catch allocations, initiated in the years 2000, has continued, along with the development of strategies at different levels to reconcile members' demand for catch allocations with quota constraints. While one might have expected these individual allocations to reflect the track records of fishing vessels, we find that POs have developed alternative allocation rules to satisfy the needs of their members. POs thus play a key role in the definition of fishing possibilities in this and most of the TAC-managed fisheries in which French fleets operate. In so doing, POs bear the brunt of the transaction costs associated with quota allocation.

1. Introduction

In Western Europe, economically important and shared fish stocks are often managed by limiting catches through Total Allowable Catches (TACs) (Le Floc'h et al., 2015; [28]). In North East Atlantic Waters, these TACs are determined mainly based on scientific advice, according to Maximum Sustainable Yield objectives. The TACs thus defined are distributed among the Member States according to the principle of relative stability (Lagière, Macher, and Guyader 2012; [29,23,24]; Hoefnagel, De Vos, and Buisman, 2015). While the establishment of these conservation measures has allowed at least partial restoration of fish stocks,[1] they do not solve the access regulation problem posed by the common-pool nature of fisheries resources. Indeed, in the absence of individual access rights, a race to fish will usually occur until the TAC is reached, leading to the development of excess capacity and economic inefficiencies, eventually placing pressure on the conservation targets themselves [10,32,36,5]. This phenomenon can be regulated by establishing individual limits on fishing possibilities, such as individual catch limits, identifying who can fish and how much, in TAC-managed fisheries. Regulating the TAC by individual quotas encourages operators to optimize their efforts and limits the trend towards overcapacity [10,2,34].

While the race to fish can be avoided by the individualization of fishing possibilities, efficiency is likely to be strongly conditioned on the transferability of these harvesting rights. Whether in the short or the long term, transferability can help promote the optimizing by economic agents of their production and investment choices [9,14]. Transferability can be administered, or based on voluntary and autonomous exchanges such as in individual transferable quota (ITQ) systems. ITQs also raise questions of equity, which may strongly affect the perceived legitimacy of allocation rules [6,30,31,37]. In ITQ systems, the costs of searching and trading catch possibilities are borne by individual operators. As stressed by Stavins [33], some level of transaction cost is common, and significant transaction costs have previously been observed in markets for a number of tradable permits. Innes et al. [19] showed that transaction costs could constitute an important determinant of quota trading patterns in a mixed fishery context. Innes et al. [18] discussed this in the context of an Australian ITQ-managed fishery, observing that such transaction costs led to the emergence of quota brokering operators, playing a key role in the development of trading,

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[1] https://www.eea.europa.eu/en/analysis/indicators/status-of-marine-fish-and

https://doi.org/10.1016/j.marpol.2025.106764
Received 13 December 2024; Received in revised form 14 March 2025; Accepted 10 May 2025
Available online 21 May 2025

particularly in-season quota leasing. Transaction costs were also seen to help explain the observed difficulties by smaller individual operators to balance their quota accounts at the end of the fishing season, with unfished catch possibilities remaining despite positive net quota trading prices [18]. Such asymmetries between smaller and larger operators with respect to the impacts of transaction costs on their activities, also observed in other contexts (Abdullah et al., 1998; [21]), may negatively affect the economic efficiency of catch allocations.

An alternative model for the allocation of catch shares is the management of pooled fishing quota by harvester cooperatives which can facilitate coordination, enabling efficiency gains [12,3]. In France, fisheries management relies on in-principle non-transferable fishing rights [23]. For quota-managed fish stocks, responsibility for the allocation of catch possibilities to individual vessel owners has been largely delegated to Producer Organizations (POs) spread across the country, except for a small number of vessels that are not members of a PO. POs pool their members' quotas and allocate shares of the national quotas to fishers or groups of fishers belonging to their organization, as annual fishing possibilities. Thus, POs play a central role as intermediaries between the national regulator and producers, in the management of fishing possibilities ([4]; Lagière, Macher, and Guyader, 2012; [7]). A review of the system ([29]; Lagière, Macher, and Guyader, 2012; [4,7]) showed a diversity of ways in which fishing possibilities were being allocated by POs in the years 2000–2010, with a trend towards greater individualization of allocations. In particular, Bellanger et al. [4] studied allocations resulting from the system for the Bay of Biscay sole fishery, and showed that it had enabled POs to maintain a diversity of fishing activities across the fishery, that might not have resulted from tradeable fishing rights. Movements of members between POs, merging of POs and decommissioning schemes have taken place in the last decade, and led to evolutions of the sub-quota shares and of PO memberships. The strategic role of POs in quota management and these recent changes in the system remain however poorly documented and analyzed. There is a need to better describe and understand the recent evolution of this important component of the French fisheries management system, with the aim to better understand how it deals with the costs of catch possibility transfers at various scales in the fishery.

We carried out a survey of the six POs involved in managing allocation of fishing possibilities for common sole in the Bay of Biscay, a decade after the last available description of the system in 2012 (Lagière, Macher, and Guyader, 2012). The fishery, which involved 389 vessels catching more than one ton of sole in 2020, and 1068 crew members [17], has been subject to a TAC since 1984. This fishery provides an example of a mixed fishery, involving multiple gears, with netters catching the largest share and trawlers the remainder [17]. Despite the various crises that have affected the fishery (high fuel prices, Covid-19 crisis, reduction in TACs, Brexit), sole remains an economic important species for the Bay of Biscay fishing sector. It is the third most valuable species in mainland France, with a turnover of 39 million euros in 2020 [17]. For all the POs, the relative economic importance of sole in total fish sales of their members has remained stable over the last ten years. The fishery was chosen as a case study due to its significant economic importance, and the pressures it faces, including a stock in poor condition and regular proposals for quota reductions in recent years. Additionally, it is historically one of the first French fisheries to have implemented individual quotas in 2006.

The article is structured as follows. After a brief description of the fishery management system, Section 3 presents the survey approach. Section 4 presents the survey results detailing the individual allocation system, as well as the PO strategies developed at inter-annual, annual, and infra-annual scales to reconcile members demands for catch allocations with available fishing possibilities. We also compare the resulting catch allocations with those that would have resulted from the straight application of historical vessel catch track records, that are used as the basis for splitting the French national quota. Section 5 discusses these results and concludes.

2. Management of the Bay of Biscay sole fishery

Access to the sole fishery is based on fishing authorizations, which determine who can fish, and on catch allocations, which determine the fishing possibilities accessible to individual fishing operators. If a vessel owner wishes to catch more than two tonnes of Bay of Biscay sole per year, or more than one hundred kilograms per trip, he must hold a National Fishing Authorization (*Autorisation Nationale de Pêche*, *ANP*). This authorization is issued annually by the *Direction de la Mer et du Littoral* (DML). In 2022, 337 authorizations were issued. The number of ANP delivered is not limited, hence it is fishing possibilities that are the concrete barrier to enter the fishery.

The French government, through its administration DG AMPA,[2] delegates responsibility for allocating French fishing quotas to the POs since 1997.[3] Each year, these organizations are allocated a sub-quota, which they can then distribute among their members. The POs monitor consumption and ensure that their sub-quota is not overused. In the case of Bay of Biscay common sole, the POs of interest include Les Pêcheurs de Bretagne (LPDB), OP Vendée, OP des Pêcheurs Artisans de Noirmoutier (OPPAN), OP La Cotinière, OP From Sud-Ouest and OP Pêcheurs d'Aquitaine (Fig. 1).

As POs are responsible for their sub-quotas, they impose catch limitations on their members, both holders of ANPs and other members.[4] Membership of a PO entitles a vessel to fishing possibilities for Bay of Biscay sole in accordance with the criteria established by the PO. Membership of fishing companies in a PO is voluntary. For vessels that are not members of a PO, a regional quota is allocated into individual shares directly by the central administration (DGAMPA), based on the track record of vessels that are not members of a PO for that region.

The six POs identified in Fig. 2 received 94,7 % of the French common sole quota in the Bay of Biscay in 2022. The Other French POs, non-PO members and the French national quota reserve (see infra) represented 5,3 % of this common sole quota. Relative to the other species harvested by the members of the POs, sole was in most cases the first or second species in terms of value for the POs. PO3, PO4 and PO6 received a similar share (around 13 %) of the Bay of Biscay common sole quota while for PO2, PO4, PO5 and PO6 common sole represented a similar share of their total sub-quotas received, across all species. The 6 POs however all present different combined characteristics in terms of the relative importance of sole in the activity of their members, and of their contribution to overall catch, leading to potentially different levels of constraints and needs with respect to catch possibilities within each of the POs. (Fig. 2).

3. Methods

3.1. Literature review

We reviewed the existing literature on the Bay of Biscay sole fishery, including documents on the biological status of the stock such as the ICES annual reports [16], expert reports about the fishery (e.g. [25]), and studies on the economics of the fishery [4,7,22,23,24]. Regulatory and institutional documentation of the TAC and quota distribution system was also reviewed, at the European[6] and French[7] levels. This enabled us to establish an updated description of the process for

2 Direction Générale de Affaires Maritimes, de la Pêche et de l'Aquaculture

3 Loi n°97–1051 du 18/11/97 https://www.legifrance.gouv.fr/loda/id/JORFTEXT000000751904/

4 Any vessel may catch less than two tons of sole per year or 100 kg per trip, without an ANP. A vessel could receive a fine if these limits are overpassed.

6 https://oceans-and-fisheries.ec.europa.eu/fisheries/rules/fishing-quotas_en

7 https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000045531080; https://www.legifrance.gouv.fr/codes/section_lc/LEGITEXT000006071367/LEGISCTA000022196218/#LEGISCTA000022199825.

Fig. 1. Location of the head offices of the French POs in the Bay of Biscay (Source: Own realization).

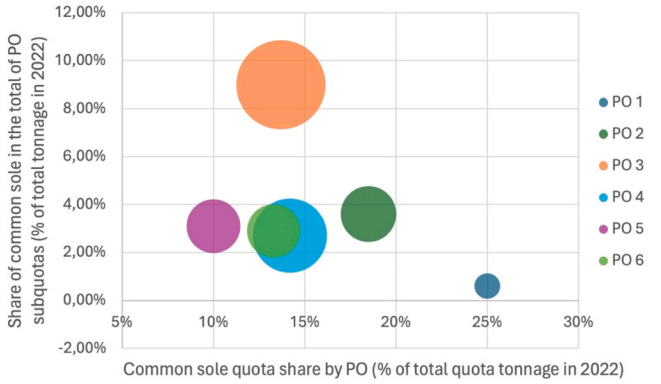


Fig. 2. – Importance of common sole in the overall quota management activity of the Bay of Biscay POs in 2021–22 (own production based on survey results and National allocation of fishing sub-quotas[51]) The size of each circle represents the share of the common sole in the turnover of the PO's vessels, ranging from 3 % to 36 % (% of total turnover in 2021, Own production based on survey results). Reading example: common sole represented 36 % of the gross turnover of PO3's vessels in 2021, and 13,7 % of the French common sole quota and 9 % of the PO's total sub-quota allocations in tonnage, across all species, in 2022..

distributing catch possibilities from the European to the French and to the PO levels, as well as a reconstruction of the distribution of the sole quota, of which no publicly available synthesis exists.

3.2. Survey

Next, a series of semi-structured interviews was conducted with key experts of the quota management system involved in the Bay of Biscay common sole fishery (Table 1).

Interviewees included stakeholders involved in the management of POs, as well as other industry representatives, researchers, and state representatives. In total, 18 interviews of approximatively an hour were conducted, of which 5 face-to-face and 13 by video-conference. The total number of interviewees was 21. The interview guide (see annex 1) was structured around the following main themes: the importance of sole in the PO activity, the management of sole sub-quota, the strategies developed by POs to manage their members' fishing possibilities at inter-annual, annual and infra-annual scale.

We compiled the various actions undertaken by the POs identified in individual surveys, and classified them according to categories relating to three distinct levels of decision-making: inter-annual, annual and in-season, considering the nature of the decision, the identified decision options and the objectives and possible consequences associated with these decisions.

In addition, we collected information from selected POs regarding the allocation of sole fishing possibilities to their members for the period 2009–2022.[8] This data allowed assessing the extent to which the resulting allocations deviate from those one would expect based on the 2001–2003 track record.

The information collected through the interviews, along with the information extracted from the literature review, was used to develop schematics representing:

the processes by which catch possibilities are allocated at the different levels of the allocation system (international, national, local), along with a description of the key determinants of these processes;

the types of decisions that POs undertake to address the questions arising in the course of allocating catch possibilities among their members.

Post-survey workshops were organized online, with PO managers, to obtain feedback on these schematics. This resulted in further adaptation of the schematics, to best reflect the operating mode of the allocation system at the time of the study. This iterative approach helped identify common practices among POs, as well as any differences, leading to a shared representation of the allocation processes.

Table 1
Interviews conducted with Bay of Biscay common sole fishery experts.

Date	Interviewed people	Number of interviews	Number of interviewees
From 03/2022–07/2022	POs Managers	12	11
03/2022	Ifremer common sole experts	1	2
05/2022	Maritime business broker	1	1
05/2022	French fisheries administration (DGAMPA) – Office of resources management	1	3
06/2022	Quota manager at fisheries National committee	1	1
06/2022	Quota managers at regional fisheries committee	2	3
Total		18	21

[8] Only 3 of the 6 POs agreed to share such data with us.

3.3. Transaction costs

The resulting representations of PO activities relating to sub-quota allocation were then analysed from the perspective of how these activities help reduce the transaction costs associated with the allocation and reallocation of fishing possibilities in the fishery. Transaction costs are *"All the costs which do not exist in a Robinson Crusoe economy. […] They arise only where there are institutions, or in a "society" in the plain sense of the term."* [8]. By being a central actor in the management of the fishery, POs support a number of these transaction costs. At each of the temporal scales identified in the survey, the type of transaction costs that POs face and possible strategies to reduce them can be identified. Dahlman [11] categories transactions costs in three group: search and information costs, bargaining and decision costs and policing and enforcement costs. We examine the allocation procedures developed by POs with respect to these categories of transaction costs, and we discuss the extent to which these procedures may enable PO members to bear lower costs than they would face as an individual company needing to search for reallocation opportunities in an Individual Transferable Quota (ITQ) management system [1,18,35].

4. Results

We present the results of this research in three sections, building on the schematics we obtained via our iterative approach with stakeholders. First, we detail the Bay of Biscay common sole TAC allocation process, from the European to the national and to the vessel levels. Second, we describe the catch limitation rules and criteria applied by the different POs. Finally, we examine the management strategies implemented by the Bay of Biscay POs at different time scales, from inter-annual and annual to infra-annual adaptation, as well as the outcomes of these allocation decision processes.

4.1. From the European level to individual producers

In 2022, the Bay of Biscay sole TAC was divided between France, Spain, Netherlands and Belgium according to the "relative stability principle", which is the CFP fixed allocation rule to distribute the TAC between the Member States, based on historic catches (1973–1978), the regions dependence of fishing and losses due to the ZEE implementation [15]. Most of the TAC was allocated to France (91.6 %) (Fig. 3). Quota swapping also occurred between the Netherlands and Belgium, allowing the latter country to increase its allocation to under 10 % of the French catch possibilities, the Dutch vessels holding track record of sole catch in the Bay of Biscay no longer targeting this stock (Fig. 3).

In France, since 2014, the sub-quota allocated to a PO is calculated annually based on the track records held by the vessels of members of that PO, in accordance with the Rural and Maritime Fishing Code ([13]. These track records refer to the fraction of total landings of a fish stock that were caught by vessels over the years 2001, 2002 and 2003. These track records serve as a basis for determining potential catch possibilities associated with the vessel in any given year. This implies that the sale of vessels is a de facto means to unofficially trade fishing possibilities [20,23,4].

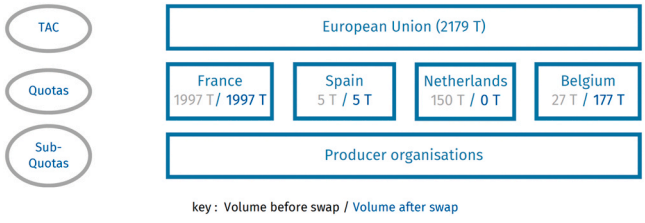


Fig. 3. – Allocation of Bay of Biscay common sole fishing possibilities in 2022, from the European Union to the PO level (Own production according to European council regulation[9]1)..

Every year, DG AMPA lists the PO's members as of 1st of January and sums the 2001–2003 catch history of the members' vessels. Each PO receives a share of the national quota for a stock (called sub-quota) equal to the fraction of the PO's track records in the total French track records for that stock. Under this mechanism, in 2022 in the Bay of Biscay sole fishery, the quota was mainly allocated between the six Bay of Biscay POs (Fig. 4).

In 2022, the volume allocated to non-PO vessels represented 32 tons nationally, or 1.6 % of the French sole quota for the Bay of Biscay (Fig. 4). Furthermore, in 2022, only five fishing authorizations were issued to non-members, i.e. 1.5 % of the authorizations issued. A small fraction of the national quota was also allocated to POs outside the Bay of Biscay, due to the existence of track record of landings for the reference period, attached to vessels belonging to members of these POs. A national reserve was also held directly by the administration. This National Reserve corresponds to track records not allocated to vessels, which result from the successive transfers of track records following vessel decommissioning and ownership transfers (see below). According to Article R921–48 of the French Rural and Maritime Fishing Code [27], these catch possibilities may be allocated directly to individual producers based on environmental, social and economic criteria, or to POs to allocate to their members.

4.2. Transferring track records

Not all the vessels fishing for Bay of Biscay common sole during the reference years of 2001–2003 have remained active, and new vessels have since joined the fishery. While catch possibilities cannot be privately transferred through market transactions in France,[10] there are various mechanisms which lead to variations in of the track records attached to vessels [23]. These transfer mechanisms are essential, as they determine the share of the quota for which a PO will be responsible. The allocation of track records following a change in vessel status depends on two different scenarios (Fig. 5).

In cases where the vessel stops fishing or is decommissioned (eq. 1), 30 % of the track record attached to the vessel revert to national reserve and the other 70 % goes to the PO's reserve, which the PO can use to

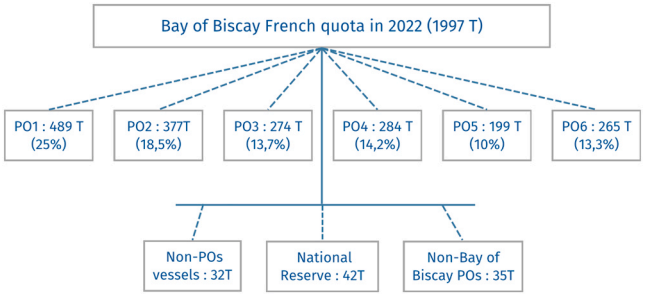
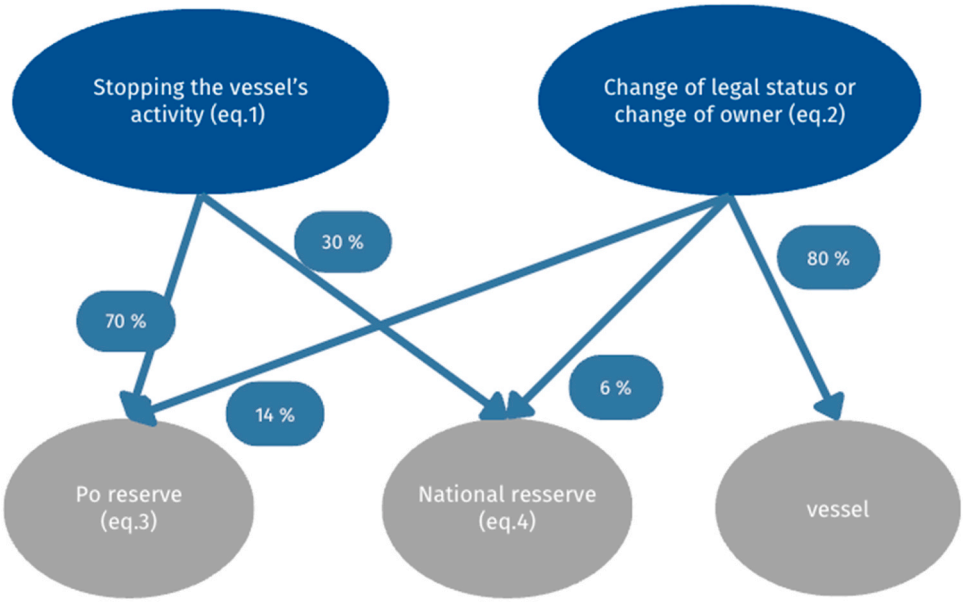


Fig. 4. Allocation of Bay of French Biscay common sole sub-quota by PO in 2022.(own production based on survey results and national orders for the allocation of fishing sub-quotas).

[5] Arrêté du 5 avril 2022 portant répartition de certains quotas de pêche accordés à la France pour l'année 2022. https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000045531080

[10] Article L921-4 du code rural et de la pêche maritime https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000031284262



$$\text{Eq. 1} \quad TRstop^{n} = \sum_{v=1}^{S} (stoppingvessel_{v} \cdot Trackrecords_{v})$$

$$\text{Eq. 2} \quad TRchange^{n} = \sum_{v=1}^{C} (changingvessel_{v} \cdot Trackrecords_{v})$$

$$\text{Eq. 3} \quad POreserve^{n+1} = POreserve^{n} + TRstop^{n} \cdot 0,7 + TRchange^{n} \cdot 0,14$$

$$\text{Eq. 4} \quad NATIONALreserve^{n+1} = POreserve^{n} + TRstop^{n} \cdot 0,3 + TRchange^{n} \cdot 0,06$$

Fig. 5. Diagram of the track record transfer system in France (own production according to the French Rural and Maritime Fishing Code). *TRstop* represents the track records associated with the C vessels that stop their activity in year n, and is equal to the sum of the track records associated with these vessels. *TRchange* represents the track records associated with the C vessels that change of legal status or of owner in year n, and is equal to the sum of the track records associated with these vessels. *POreserve* in year n + 1 represents the sum of *POreserve* in year n, 70 % of *TRstop* in year n and 14 % of *TRchange* in year n. *NATIONALreserve* in year n + 1 represents the sum of *POreserve* in year n, 30 % of *TRstop* in year n and 6 % of *TRchange* in year n.

allocate fishing possibilities to its members along the year, according to its own allocation rules. In cases where the vessel changes legal status or changes owner (eq.2), 20 % are deducted from the vessel's track record, 70 % of which go into the PO's reserve and 30 % of which go into the national reserve. The remaining 80 % remain attached to the vessel and its new owner can use it as a basis to claim access to fishing possibilities within his PO or with the central administration if not a member of a PO.

The PO's reserves (eq 3) build up through vessel transfers and vessel retirements (Fig. 5). These reserves are then distributed annually to the vessels in the form of fishing allocations, in the same way as allocations based on the track records attached to individual vessels. However, they cannot be permanently assigned as additional track records to a vessel, and remain dissociated from any reference to the historical activity of vessels belonging to the PO members. These reserves, at both national and PO levels, are expected to increase over time, as vessels are exchanged or leave the fleet (eq. 3 and 4).

Even though the track records attached to individual vessels provide a basis for allocating catch possibilities between POs, they in no way constitute a fishing right, since the POs can then decide to deviate from this to define individual or collective allocations of fishing possibilities. This is even more the case with quota reserves, which are by construction detached from any catch history of a particular vessel. For this reason, and because of the non-transferability of quotas directly between vessels owners, PO managers we interviewed referred to "annual individual catch limitations" when describing individual catch allocations, these determining a maximum that a member's vessel can fish, rather than a quota allocation.

4.3. Catch limitation rules and criteria

Subject to the approval of their administration board, POs are free to define the way in which they manage the fishing possibilities allocated to them and do so independently. Fig. 6 presents a synthesis of the allocation methods that were used by the Bay of Biscay POs in 2022 for allocating sole catch possibilities, based on the responses to our survey.

There are two types of catch limitations instituted by POs at the beginning of the year for the current fishing season: individual and collective. Individual catch limitations are established by vessel, at the beginning of the fishing season, for the duration of the season; while collective limitations are opened to fishing by all PO members, with no individual limitations, until the PO's allocation is completely caught. In the case of sole, individual limitations accounted for the largest fraction of catch possibilities handled by the POs (Fig. 6), although some reallocations of these catch possibilities could also occur during the year (see below). According to the interviewees, this method of allocation allows producers to take responsibility for the way in which they use their fishing possibilities, but also to have visibility over the activity they can carry out during the year. Individual limitations also enable POs to impose individual penalties on vessel owners who exceed their allocated catch possibilities'.

Four of the six Bay of Biscay POs used collective limitations (Fig. 6).

[9] Council Regulation (EU) 2022/109 of 27 January 2022 fixing for 2022 the fishing opportunities for certain fish stocks and groups of fish stocks applicable in Union waters and for Union fishing vessels in certain non-Union waters

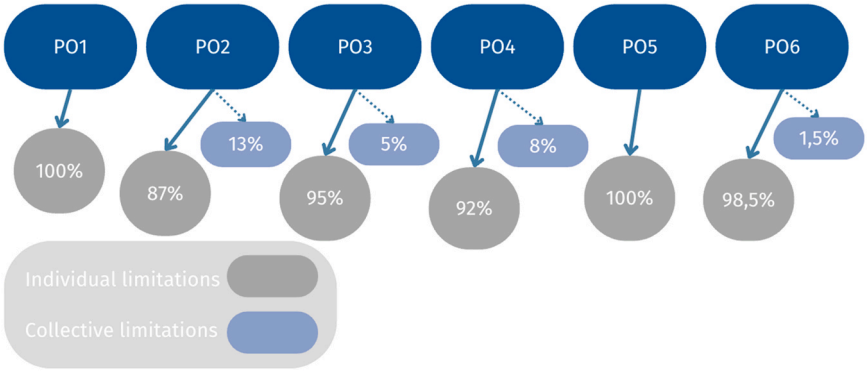


Fig. 6. Allocation of Bay of Biscay common sole fishing possibilities by PO in 2022 (own production according to the survey results).

These were dedicated to managing sole landings by vessels with little or no economic dependence on sole, but catching it as a by-catch species. Trawlers, which catch a variety of species including sole, were often subjected to such collective allocations. This type of limitation pools fishing possibilities, but also the risk of exceeding the sub-quota, so the responsibility is shared between the fishers (Bellanger et al., 2017). Collective limitations applied to vessels that do not target common sole also reduces the management and transaction costs that would be associated with the search and trade of the fishing possibilities that would be associated with small allocations associated with by-catch in transferable quota systems [1,18,26,35].

4.4. Limitation criteria

The POs differ from one another in the criteria they choose for establishing individual limitations. As summarized in Table 2, each PO uses a combination of different criteria to allocate possibilities to different parts of their fleet.

For three of the POs (PO3, PO4 and PO5), individual limitations on fishing possibilities for Bay of Biscay sole are based on the 2001–2003 track records attached to the vessels. Each vessel receives a share of the sub-quota equivalent to the share of its track record in the total track record used to calculate the PO's sub-quota, as would also occur in a transferable quota system.

However, three POs (PO1, PO2 and PO6) have chosen not to strictly follow the track records of vessels in order to set individual limitations, but rather to rely on criteria such as the economic dependence of vessels on the stock, vessel size, and/or the more recent production history of the vessel. Based on these criteria, PO1 and PO2 have set up sub-groups of vessels, within which the individual limitations are the same for all vessels and may be distinct from their share of the PO's track record of catch possibilities. These variations in the modes of allocation and in vessel groups result from PO member characteristics (in terms of vessel sizes, fishing strategies and fishing areas in particular), which vary across POs.

Over the past ten years, these six POs have also made efforts to clarify annual limitation rules and to ensure greater transparency regarding these rules. This initiative followed various mergers, and requests from members.

In 2022, at the scale of the fishery, based on the responses from the interviewees, 37.9 % of the quota was allocated among vessels according to the 2001–2003 track record, and 56.8 % according to alternative allocation rules decided by POs (Table 3). This is without considering collective allocations, which were also not allocated according to catch history. Thus, POs play an important role in the final distribution of fishing possibilities, highlighting the delegation of responsibility from the French government to the POs regarding this important dimension of fisheries policy. The costs associated with this management activity are also at least partially supported by POs. This includes the monitoring of individual vessel uptake of catch possibilities, as well as the work associated with elaborating and adapting limitation rules and criteria, with the aim to adjust allocations to their members' needs. This highlights the capacity of POs to support the first Dahlman [11] category of transaction costs associated with search and information sharing, which would be supported directly by fishers in an individual transferable quota system [1,26,35].

Table 2
Methods and criteria for allocating Bay of Biscay sole fishing possibilities in 2022 according to PO (own production according to the survey results).

POs	Method of limiting the sole sub-quota	Groups	Limitation criteria
PO1	Individual limits (100 %)	Specialist netters	Track records 2001–2003, vessel size, stock dependency
		Diversified netters	Individual limitation homogeneous within the group
		Trawlers (divided in 4 sub-groups)	Individual limitation homogeneous within each subgroup
		Norway lobsters fishers (divided into 5 sub-groups)	Individual limitation homogeneous within the group
		Accessory catches	Individual limitation homogeneous within the group
PO2	Individual limits (87 %)	Offshore netters	Individual limitation homogeneous within the group
	Collective limits (13 %)	Coastal netters	Individual limitation homogeneous within the group (except for some small vessels)
		Trawlers	Collective limitation
PO3	Individual limits (92 %)	Vessels production > 2 T	Track records 2001–2003
	Collective limits (8 %)	Other vessels	Collective limitation
PO4	Individual limits (95 %)	Vessels production > 1 T	Track records 2001–2003
	Collective limits (5 %)	Other vessels	Collective limitation
PO5	Individual limits (100 %)	All members	Track records 2001–2003
PO6	Individual limits (98,5 %)	Vessels production > 1 T	Individual limits defined in 2012 when the CAPSUD and ARCACOOP PO merged
	Collective limits (1,5 %)	Vessels production < 1 T	Collective limitation (4 T)

Table 3
Share of PO sole sub-quotas according to limitation criteria in 2022 (Own production according to the survey results).

Groups	Track records 2001–2003 as main limitation criteria			Other main limitation criteria		
PO	**PO3**	**PO4**	**PO5**	**PO1**	**PO2**	**PO6**
Share of sole quota by PO	13,7 %	14,2 %	10 %	25 %	18,5 %	13,3 %
Share of sole quota by group	37,9 %			56,8 %		

4.5. Objectives, strategies and adaptation of POs to sub-quota management constraints

The interviews confirmed that, in determining the fishing possibilities of their individual members, all the POs aim to facilitate the uptake of quotas, as well as optimizing the deployment of fishing effort, improving information sharing among their members and reducing monitoring costs [2]. A core objective for POs is to guarantee the adequation between their member's demand for fishing possibilities and the sub-quota constraints, and to bring visibility to their members regarding their individual fishing possibilities for the coming fishing season. They thus work to define short and longer-term strategies to smooth out variabilities and absorb any crises faced by the fishery. This implies securing, allocating and promoting the uptake of catch possibilities, inter-annually, annually and within the fishing season.

4.6. Strategies developed at inter-annual scale to manage PO members' fishing possibilities

Medium-term investment and disinvestment decisions by fishing companies will lead to changes in the number of vessels in a PO, and therefore to changes in its track record. This will affect a PO's room to move in its management of fishing possibilities, both for Bay of Biscay sole and for other fish stocks targeted by its members. The main reported aim for POs at this level is to ensure a degree of stability over time in the fishing possibilities available to their members.

Fig. 7 describes the decisions that POs must make at this inter-annual level, and their implications (the same structure is followed in Figs. 8 and 9 which represent the common decisions of all POs). At the top of the figure are the areas in which decisions can be made or changes need to be managed by a PO, followed in the green boxes by the possible options that a PO may face in these areas. The main consequences associated with these options are listed in the red boxes.

First, POs can choose to merge. There are now six POs in the Bay of Biscay but there were nine in 2012 [4]. Three mergers have taken place.[11] These mergers have enabled the POs to increase the base of their membership, and to broaden the portfolio and the scope of fishing possibilities, which they manage on behalf of their members. These mergers have also led to changes in the ways in which the POs determine individual allocations of fishing possibilities. For example, PO6 revised the basis for its individual allocations to better benefit fishers from each of the POs involved in the merger, using the best-performing year as the reference for these limitations (see above). PO1 began creating harmonized sub-groups following the merger, the greater number of vessels making it possible to create these groups, with the purpose to facilitate the management, by pooling the catch possibilities, meeting the best the members' needs and getting clearer rules for the members.

Secondly, every year existing POs can admit new members. As the calculation of the sub-quota depends on the track record of the PO's vessels, the entry of new members determines the sub-quota received the following year. All the POs study the fishing plan of new members and ensure that the contribution of the vessel's track record for sole corresponds to the proposed landings of sole in this fishing plan. This is unless the member holds track records for other fish stocks that are of interest to other members of the PO, or that the PO could use in inter-PO trades, thus providing access to other fishing possibilities. According to survey respondents, the binding level of sole quota in the years preceding the survey has meant that POs have generally not been able to allocate sole fishing possibilities to new members who had no prior catch history. POs hold both the power and the responsibility of acting as entry barriers to the fishery, as they control access to catch possibilities allocation and regulate the entry of new members based on their catch history and contribution to the organization.

POs can also see members leave,[12] which entails a loss of fishing possibilities that can reduce the capacity for the PO to adjust the catch possibilities of its remaining members. The consequences of these departures are more important as the PO is small, and the vessels departing are among the largest operators in their membership.

Thirdly, POs can develop the services they offer to their members and adjust their membership fees, to increase the value to the members of these services, and influence decisions by the members to join or leave. Membership of a PO is based on an *ad valorem* contribution of approximately 1 % of the turnover of vessels (similar in all POs). In exchange, POs offer services to the vessel owners, which in practice seem to be relatively the same in all the POs we interviewed. The POs provide support in the commercialization of products to helps members achieve better valorization and help their members access public support measures.

At the interannual scale, as collectives that regularly interact between themselves and with DGAMPA, and that manage their membership, we thus find that POs act to reduce transactions costs of the first two Dahlman [11] types. They are both well aware of the track records of their members and of potential availability of fishing possibilities in other POs, while they also collect information that helps them understand the needs of their members during the year (search and information costs). POs also support the decision-making costs associated with maintaining entry barriers in the fishery (bargaining and decision-making costs).

4.7. Strategies developed to guarantee fishing possibilities for PO members at the annual level

Decisions taken on an annual basis are more cyclical, adapting from one year to the next to changes in the fleet, in the allocation of fishing possibilities, and in the economic and environmental conditions of the fishery. Here, POs work to ensure that available fishing possibilities are optimally used and to smooth out the inter-annual variability of the Bay of Biscay sole sub-quota, and absorb the various conjunctural crises that its members may face. Fig. 8 describes the decisions that the POs may take in this respect, and their implications.

Exchanges of sub-quotas between POs are a way for them to improve their allocation of Bay of Biscay sole sub-quotas and thus better cover the needs of their members. Indeed, part of the French Bay of Biscay sole quota is allocated to French POs that are based outside the region (CME,[13] COBRENORD, FROM Nord and OPN[14]) and whose members own vessels that have a history of catching Bay of Biscay sole, but do not currently target this stock.

The choices concerning the methods and criteria for allocating

[11] OPOB (Organization des Pêcheries de l'Ouest Bretagne) merged with PMA (Pêcheurs de Manche Atlantique) to create Les Pêcheurs de Bretagne, OP Ile d'Yeu was integrated to OP Vendée and Arca-Coop merged with CAP-SUD to create OP Pêcheurs d'Aquitaine.

[12] Fishers are not often leaving a PO, in general they switch to another one. The main reason to switch from a PO to another is geographical.

[13] CME: Coopérative Maritime Etaploise

[14] OPN: Organization des Pêcheurs Normands

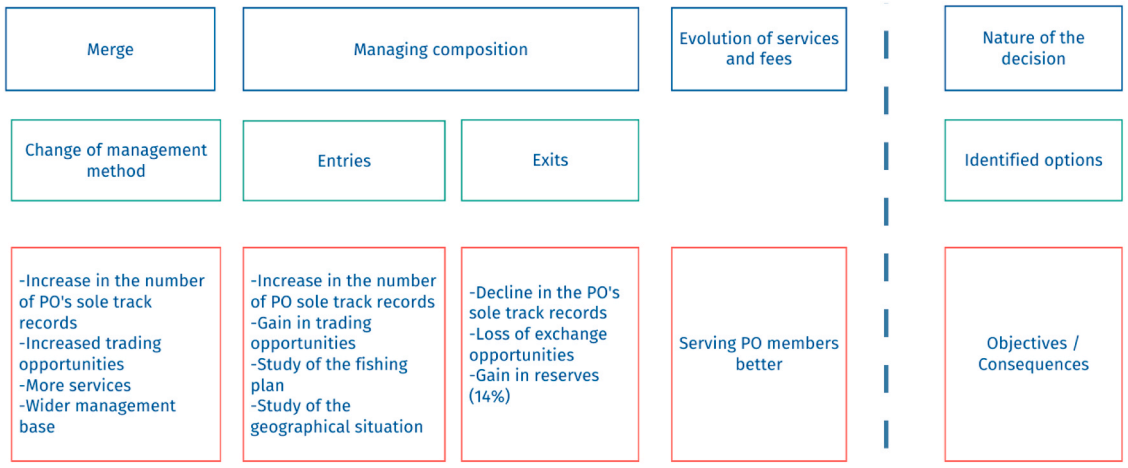


Fig. 7. Interannual decision scheme (Own production according to the survey results. Blue boxes represent the nature of the decision, the green ones the identifies options and the red ones the objectives and consequences).

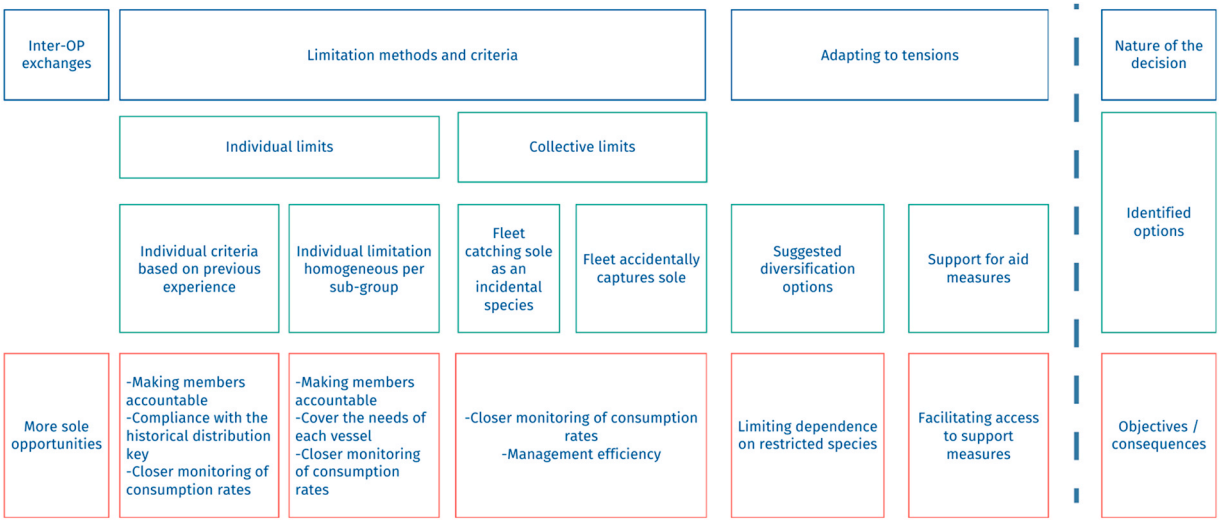


Fig. 8. Annual decision scheme (Own production according to the survey results. Blue boxes represent the nature of the decision; green boxes identify options and red boxes consequences).

fishing possibilities discussed above are another important area which the POs work, on especially in cases when the TAC is reduced as in 2022 (see Fig. 8). Rather than applying simple proportional variations to their individual members, POs have the ability to adapt individual allocations according to the activity profiles of vessels, in order to help maintain their activity despite such overall reduction in catch possibilities. In practice, interviewees highlighted that in such circumstances, individual allocations ended up being concentrated on the vessels most dependent on sole for their overall fishing activity. Moreover, the methods and criteria employed by the POs enable more precise monitoring of catches, allowing them to better align with the needs of their members.

Beyond the re-allocation of sole catch possibilities, POs can also encourage their members to transfer the fishing activity of their vessels to alternative species, for the fishing season (Fig. 8). For stocks for which the PO holds sub-quota, the PO can allocate catch possibilities to vessels affected by the fall in the sole TAC. In practice, however, the interviewees stressed that this option is often only feasible for certain vessels, and a limited number of fish species, as vessels are not necessarily able to easily change fishing métiers.

We thus find that POs play a key role at the annual level, in organizing the discussions within their membership regarding internal fishing limitation methods and criteria and adapting to changes in the overall situation of the fishery. In doing so, they support transaction costs of the first two Dahlman [11] types. As shown in the previous section, this leads to more than half of the French sole quota being allocated in a way that does not strictly follow vessels' 2001–2003 catch records (Table 3). POs enable their members to access catch possibilities beyond their historical catches, and facilitate exchanges with other POs to improve the adjustment of fishing possibilities with sub-quota constraints. By doing so, they take on a role that would otherwise fall to individual fishing companies, reducing the high transaction costs associated with seeking and trading fishing opportunities (Abdullah et al., 1998; [21]).

In addition to these catch monitoring and management activities, POs also provide annual services to their members, informing them of new regulations, as well as of the terms and conditions of financial support that may be available to the fishery, and assist their members with respect to the implementation of administrative procedures.

4.8. *Adaptive management strategies within the fishing season*

Decisions taken on an infra-annual scale relate to short-term adaptation choices. POs here work to enable their members to be active throughout the year and to ensure full uptake of the fishing possibilities

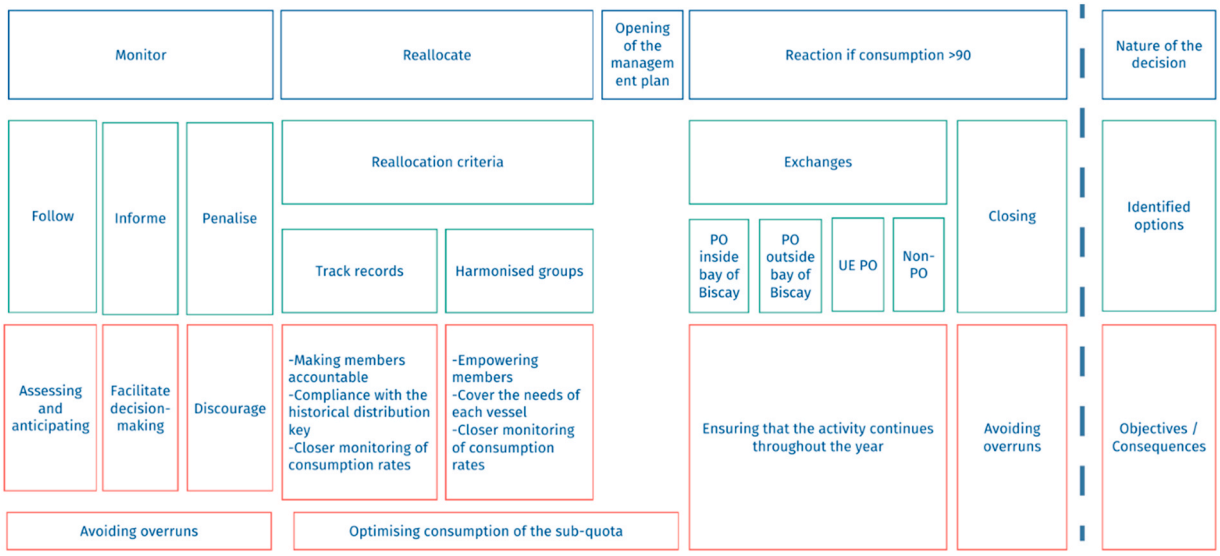


Fig. 9. Infra-annual decision scheme (Own production according to the survey results. Blue boxes represent the nature of the decision, the green ones the identifies options and the red ones the objectives and consequences).

allocated to the PO. These infra-annual choices also meet the PO's need not to exceed its sole sub-quota. Fig. 9 below describes the decisions that enable such adaptation, and their potential implications.

To ensure that it does not exceed their sub-quota for Bay of Biscay sole, POs must closely monitor the consumption of catch possibilities by their members. POs thus bear some of the monitoring costs, both for their members and for the government, effectively supporting the implementation of the overall management system. POs may be penalized by DG AMPA, if their sub-quota is exceeded, through a reduction equivalent to the overrun in the following year. The interviewees confirmed that the adoption of individual limitations by POs was in fact largely linked to the pressure that may arise on specific stocks and the risks of exceeding the sub-quota [4]. For stocks such as sole where such individual limitations dominate, POs alert their members at various thresholds of consumption of their allocation. In the event of individual overruns, the POs can penalize the vessels at fault, although according to the interviewees, overruns are nowadays very rare, alerts allowing fishers to prevent these from happening.

POs may also reallocate fishing possibilities one or several times in the course of the fishing season, depending on the overall level of sub-quota uptake, to maximize the total consumption of the sub-quota allocated to them, as well as to allow each member to fish throughout the season (Table 4).

Three ways of reallocating fishing possibilities during the year were cited in the interviews (Table 4). The reallocation can be individual, but homogenous between all the vessels in the PO or within sub-groups of vessels within the PO. It can also be carried out on a case-by-case basis according to needs, by asking each member what it intends to catch in relation to unused allocations. The reallocation is then carried out independently of initial allocations. Lastly, the modification of the initial allocation can also take the form of what interviewees called "an opening of the management plan", i.e. the management plan established at the beginning of the year is revoked and all the vessels in the PO benefit from a collective limitation, which remains open until the PO sub-quota is entirely caught.[15]

Given the highly seasonal pattern of sole fishing in the Bay of Biscay, with a large fraction of the landings occurring in winter and early spring, during the first three months, and at the end of the calendar year, most of these reallocations take place in summer. At this point in the fishing season, some vessels may have used up their entire allocation and potentially need additional allocations to continue fishing at the end of the year, while others already anticipate that they will not be able to use up the rest of their allocation in the last few months of the year. The above reallocation mechanisms allow redistributing fishing possibilities accordingly.

We thus find that, during the year, POs play a key role in reducing the third type of transaction costs, relating to monitoring and enforcement [11], alerting their members before they overrun their fishing allocations, and implementing sanctions when needed. Their day-by-day activity also involves helping their members access information, as new regulations, or support schemes become available. In this system, these monitoring and enforcement costs are largely supported by the PO. This monitoring and the observed in-season reallocation mechanisms also seem to help ensure that all available fishing possibilities are taken up by PO members, avoiding the problems of unused catch allocation observed in other contexts [18].

Table 4
Reallocation of fishing possibilities during the year according to PO (Own production according to the survey results).

PO	Reallocation methods		
	Individual reallocation on a case-by-case basis	Homogeneous individual reallocation according to sub-groups	Collective consumption
PO1		X	
PO2		X	
PO3	X		
PO4	X		
PO5	X		X
PO6	X		X

5. Discussion and conclusions

We characterized the role of Producer Organisations in the allocation

[15] In practice, the landing data for PO vessels is regularly monitored by the administration. Given the delay in recording landing data, it is expected that when the recorded consumption rate of a PO's sub-quota reaches 90 %, the PO is getting close to reaching its total fishing possibilities. DG AMPA thus sends the PO a notice of early closure of the fishery. While closure has not yet been ordered, the PO must justify solutions enabling it to allocate additional fishing possibilities to its members, e.g. through exchanges with other POs. If it cannot, the early closure is implemented.

of Bay of Biscay sole fishing possibilities. While two main ways of allocating fishing possibilities based on collective or individual limitations – had been identified in previous studies, we find that over the last 10 years, POs have generalized individual limitations and introduced increasingly detailed and individualized monitoring systems to track quota uptake and support the management of sub-quota allocation among their members. Rules have also been clarified, in response to a call by PO members for increased transparency accompanying the merging of POs. Individual limitations can be based on multiple criteria. These include the historical track records held by individual vessels, but also flat allocations to sub-groups of vessels considered of similar types, or criteria such as the size or dependence of the vessels to sole landings. We find that, for more than half of the French sole quota, the individual limitations do not necessarily follow the 2001–2003 track records of vessels, which confirms the major role played by POs in the distribution of fishing possibilities between fishing companies and their vessels. Indeed, we find that POs can allow their members to access fishing possibilities beyond what they would be able to recover based on their catch history. Regular exchanges with other POs are also used to allow for finer adaptations to the needs of their members. In doing this, POs take on a role which would otherwise be left to the individual fishing companies, which would need to seek available fishing possibilities and needs, and establish some kind of trading system based on individual allocations. The transaction costs for an individual business associated with such a search for fishing possibilities has been shown to be potentially high (Abdullah et al., 1998; [21]). In the French management system, POs as a co-management institution thus bear a large part of the transaction costs associated with allocation and reallocation of fishing possibilities, including information, bargaining, monitoring and enforcement costs, all of which constitute key components of the transaction costs associated with fisheries management (Abdullah et al., 1998; [21]). Their capacity to take on this role is supported by the overview they have of the fishing activities of their members, whom they closely monitor the landings of. POs also support marketing of the production of their members and provide administrative support, thus having an in-depth understanding of the economic circumstances of their members, and of the potential gains from reallocating catch possibilities among their vessels.

In their responses to our survey, PO managers also highlighted their significant social and territorial role, which involves sustaining the diversity of fleets and fishing operations within the fishery, as well as ensuring the viability of various operators through pooling and redistribution of catch possibilities mechanisms. At the national level, the delegation of certain responsibilities to POs—such as allocating sub-quotas, collecting data on the uptake of allocations, and monitoring fishers' compliance—helps limit central administrative and enforcement costs. POs thus play a key role in the implementation of the public policy related to quota management.

The management system has recently evolved, the new regulation[16] governing the French National reserve of quota aiming to identify access condition for fishing vessels wishing to access the fishing possibilities held within this reserve. New entries into the fishery are now possible based on various criteria, such as the vessel owner's age and the vessel's decarbonization efforts. These new requirements aim to facilitate the entry of newcomers while promoting sustainable practices to reduce the industry's carbon footprint. Through these criteria, POs and the government could in principle regulate access to the sole fishery taking into account these and other policy objectives.

The assessment of different sub-quota allocation systems implemented by POs offers valuable insights into their economic and social implications. By analysing these mechanisms, we can better understand the factors that constrain the matching of demands for fishing possibilities with available sub-quota, at multiple scales, from the infra-annual to the inter-annual level, and the impacts of collective decision-making processes regarding allocation on the final distribution of catch, its overall efficiency, and implications for stakeholder access. Further research could explore how different allocation methods influence the long-term sustainability of the fishery and adaptability of the fishing fleets, providing a basis for refining existing policies.

[16] https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000050767463

CRediT authorship contribution statement

Dudouet Benjamin: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Macher Claire:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Thébaud Olivier:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

None.

Acknowledgment

This work was supported by the ISblue project "Interdisciplinary graduate school for the blue planet" co-financed by a government grant managed by the Agence Nationale de la Recherche under the "Investissements d'avenir" program integrated into France 2030, bearing the reference ANR-17-EURE-0015.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.marpol.2025.106764.

Data availability

The authors do not have permission to share data.

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