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Coping with poachers in European stalked barnacle fisheries: Insights from a stakeholder workshop

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ABSTRACT

In January 2020, a stakeholder workshop was organized as a knowledge sharing strategy among European stalked barnacle fisheries. Management of this fishery differs greatly among regions and ranges from less organized and governed at large scales (>100 km, coasts of SW Portugal and Brittany in France) to highly participatory systems which are co-managed at small spatial scales (10′s km and less, Galicia and Asturias). Discussions revealed that poaching is ubiquitous, hard to eradicate, and adapts to all types of management. The stakeholders identified some key management initiatives in the fight against poaching: granting professional harvesters with exclusive access to the resource, increasing social capital among harvesters through tenure systems (e.g. Territorial Use Rights in Fisheries) that empower them as stewards of their resource and intensification of surveillance with the active participation of the harvesters. Furthermore, increased cooperation between fishers associations and regional fisheries authorities, improved legal frameworks, adoption of new technologies and the implementation of market-based solutions can also help coping with this systemic problem.

1. Introduction

The Common Fisheries Policy Reform in 2013 aimed to improve fisheries management in the European Union, including the promotion of coastal fishing activities (Reg EU 1379/2013 in CFP, 2013 [1]). One practical approach to achieve these goals is the identification of successful practices that could be adapted to different cultural or socio-economic contexts. The international PERCEBES project (http://www.

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unioviedo.es/percebes/) identified the potential of the stalked barnacle fishery in SW and W Europe as a model for the exchange of management practices among regions. Harvesters in these small-scale fisheries collect stalked barnacles, which grow on very exposed rocky shores. Cultural differences among the regions have led to large differences in the socio-economic relevance of these fisheries (Table 1). The Atlantic regions also differ in the spatial scale of management, the participation of harvesters in monitoring and surveillance, the level of responsibilities of harvesters and administration in the decision-making process (e.g. co-management) and the access regime (e.g. Territorial Use Rights for Fisheries - TURFs) [2]. However, harvesters, administrations, NGOs and scientists frequently remain unaware of many successful management practices applied outside of their regions. In January 2020, the PERCEBES project organized a workshop with the participation of a diverse group of stakeholders from Portugal, Spain and France to facilitate the exchange of knowledge and experience among regions. During the discussions, poaching surfaced as the main issue common to all regions, with systemic effects on all aspects of the fishery. Despite its relevance, poaching in the stalked barnacle fishery has only been investigated in Galicia [3–7], where this complex phenomenon causes significant economic losses [8]. In Asturias and in Portugal, poaching of *P. pollicipes* has only been indirectly addressed [9,10], whereas in France poaching is only mentioned in the news. The present work is a summary of the information extracted during the workshop, with particular emphasis on the problem of poaching and on potential solutions.

2. Methods

The workshop took place in Cudillero (Asturias) on January 24, 2020. Among the stakeholders there were harvesters (n = 8), fisheries managers (n = 7), fisheries surveillance personnel (n = 4), NGO advocates (n = 4) and scientists (n = 27). Participants came from Spain (n = 33), Portugal (n = 10) and France (n = 6), specifically from the following 5 regions: Morbihan (Brittany, France), Asturias and Galicia (Spain), Reserva Natural das Berlengas (RNB, Portugal) and Parque Natural do Sudoeste Alentejano e Costa Vicentina (PNSACV, Portugal) (Fig. 1). The stakeholders received a summary of the project's findings and were introduced to the different management practices of each of the five participating regions. We followed a roundtable discussion approach [12] to explore the opinions of a diverse group of stakeholders from different regions. All discussions were aided by 3-language simultaneous translation, recorded and transcribed for analysis. The quantitative method we employed renders bottom-up solutions that are more likely to be accepted and help garner higher compliance by the users.

Facilitators steered the discussions to ensure equal input opportunities for all participants. In a first session of roundtable discussions participants from each sector separately –either harvesters or fisheries managers or fisheries surveillance personnel and NGOs or scientists- shared experiences and perceptions regarding the exploitation and management of stalked barnacles in their respective regions. In a second session, participants from each region gathered to identify the most relevant topics for the sector and discuss the potential of importing successful management practices from other regions (Table 2). A concluding, general session allowed to summarize the most important topics for each region and sector. The final recommendations were not discussed among all stakeholders during the workshop, but were extracted during the analysis of the recordings from the roundtable discussions. Therefore, consensus among them was not tested, neither were they ranked by importance or efficiency. Images and further information on the workshop can be viewed at: https://www.youtube.com/watch?v=Y3CQqsu5O2w&feature=youtu.be.

3. Results and discussion

Poaching was a central theme during the meeting. It dominated the discussions in the harvesters roundtable, and was addressed in the scientists and managers/NGOs tables. Furthermore, it was voted as key discussion topic and further discussed in the regional roundtables (Table 2).

3.1. Management strategies within the participating regions

This summary is based on the detailed regional account in Aguión et al. [2] and on information acquired during the workshop. In general, management differs among countries, but only slightly between regions within the same country (for example, Galicia and Asturias in Spain vs RNB and PNSACV in Portugal) (Table 1). Common to all regions are the need for a professional license and the enforcement of daily harvest quotas, both for professional and recreational harvesters (Table 1). In addition, in all regions, except for Morbihan, there is a legal minimum size for the stalked barnacles (Table 1). However, there are important differences among regions in the level of implementation of the four governance elements (Spatial scale of management, level of co-management, fisher's participation and access regime; [2]).

Implementation is higher in Galicia and West Asturias, with an exclusive access regime, high levels of co-management and fisher's participation, small spatial scales of management (10–1000 s Km) and no recreational harvesting allowed. In these regions, the harvesters belong to *cofradías*, which are geographically-based fishers associations located in coastal villages. Additionally, in Galicia stalked barnacle harvesters form resource-specific associations within the *cofradías*.

Table 1
Socio-economic characteristics and management tools of the participating stalked barnacle fisheries. Figures are representative for recent years.

Region		Socio-economic characteristics					Management tools		
	Number of professional harvesters	Landing volume (t year^{-1})	Landing value (10^3 € year^{-1})	Price (€ kg^{-1})	Recreational fishery	Daily quota recreational (kg day^{-1})	Professional licenses	Daily quota professionals (kg day^{-1})	Minimum size* (mm)
Morbihan	30	50	325	5–8	Yes, without license	3	Yes, unlimited	120	No minimum size
Asturias-West	204	44	1408	32	No	–	Yes, limited	5–8	18.0 on 60% of the harvest
Galicia	1308	325	7640	23.5	No	–	Yes, limited	3–10	18.3 on 60% of the harvest
RNB	40	12	275	23	No	–[1]	Yes, limited	20	23.0 on 50% of the harvest
PNSACV	80	–	–	14	Yes, with license	2	Yes, limited	10–15	20.0 on 75% of the harvest

* Rostro-carinal length [11].
Source:Adapted from Aguión et al., 2021 [2].

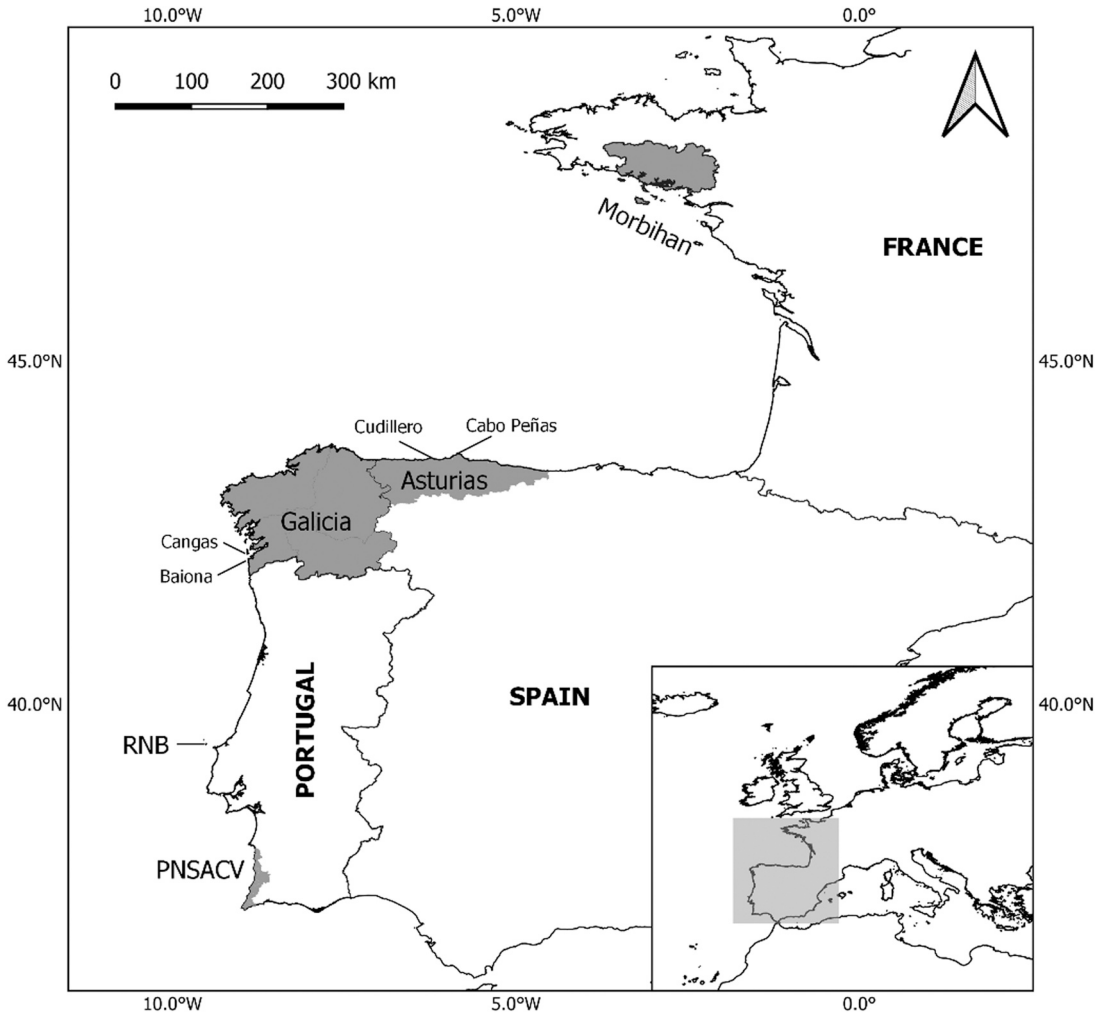

Fig. 1. Map of the regions represented in the workshop. This includes the Morbihan region in Brittany, Galicia and Asturias in Spain, the Reserva Natural das Berlengas (RNB, Portugal) and the Parque Natural do Sudoeste Alentejano e Costa Vicentina (PNSACV, Portugal). Locations (Cabo Peñas, Cudillero, Cangas and Baiona) indicate the *cofradías* represented by participating professional harvesters.

Table 2
Topics voted for discussion and topics discussed in the regional roundtables.

Region	Topics voted in the regional tables	Topics discussed
Morbihan (France)	Differences of the management between France and Spain	Yes
	Scientific knowledge and monitoring	Yes
	Poaching	Yes
	Market and price issues	Yes
	Marine Reserves	Yes
Asturias-West (Spain)	Collaboration between science and fishing sector	No
	Marine Reserves	No
	Poaching	No
	Reasons for stock decrease	No
	Raising education and awareness of harvesters	No
	Surveillance	No
		Improving co-management
Galicia (Spain)	Rotation and harvest bans	Yes
	Current state of the resource	Yes
	Marine Reserve	Yes
	Larval settlement	No
	External scientific counseling	No
	External figure in co-management	No
		Poaching
RNB/PNSACV (Portugal)	Co-management vs centralized management	Yes
	Poaching	Yes

TURFs are granted to the *cofradias*, giving exclusive access over an area and its resource to a limited number of harvesters [13]. The resource is co-managed between the *cofradía* or association and the regional fisheries authorities, who share decision-making power and responsibilities [9,14]. The harvesters propose a yearly management plan, providing detailed indications for the temporal and spatial allocation of harvesting effort (e.g. rotational harvesting schemes or temporal ban areas). The management plans must then be approved by the regional fisheries administration and made publicly available for consultation. Surveillance is done by TURF and regional coast guards, and in some cases by harvesters and National Park guards.

Lowest implementation levels characterize Morbihan and PNSACV, where management is done at regional scales, recreational harvesting is allowed and surveillance is conducted by reduced police patrols along vast swaths of coast. The quota for recreational harvesters is lower than for professionals, particularly in Morbihan. Recreational licenses though, are only needed in PNSACV, where they can be obtained daily, monthly, or yearly.

RNB takes on an intermediate or transitional position. Inspired by the TURF system applied in Spain, harvesters in RNB are involved in a pilot-project (CO-PESCA 2) since 2018 to transition towards co- management [15]. The project has already resulted in an increased level of participation of the harvesters in management and better monitoring of the resource. Recreational harvesting is forbidden and because RNB is an archipelago of islands, it functions similarly to a TURF.

3.2. Poaching in the stalked barnacle fisheries

During the workshop poaching was identified as a major problem in all regions, with the potential to jeopardize the sustainability of the resource. In the context of this fishery, poaching is the illegal harvest of stalked barnacles. It is a complex phenomenon that has been classified in detail by Ballesteros and Rodríguez-Rodríguez 2018 [3]. During the workshop certain types of poaching, likely those perceived as the most common and/or harmful, were mentioned by the participants. According to those accounts, poaching can be done by:

- ***Licensed professional harvesters,*** who are allowed to harvest stalked barnacles for sale but do not comply with the rules, by exceeding the daily permitted quota (referred to as *overquota*), harvesting at prohibited places or times inside or outside of their own region or selling on the black market. Hereafter we will refer to these as *insider poachers* and the rest as *external poachers*.
- ***Recreational harvesters,*** who are allowed to catch barnacles for self-consumption but do not comply with the rules through *overquota*, by selling their catch on the black market, by harvesting in forbidden areas or at forbidden dates, or without a license where a license is required (e.g. [16]).
- ***Unlicensed harvesters,*** who extract stalked barnacles without a permit in areas where licenses are required. Some of them form highly organized groups with carefully planned logistics and use rental cars, shared boats and SCUBA-diving equipment. The typically small fines are often factored into their budgets, leading to a significant accumulation of legal charges. Violent behavior and clashes with local harvesters are frequent, because these poachers operate on the best harvest sites, or in areas which have been banned in collaboration with the licensed harvesters to allow recovery of the stock. In Spain they sometimes bypass legal SCUBA-diving prohibitions and harvest at illegal sites or times (i.e. during high tides or at night) while relying on public disclosures of TURF regulations to locate the best harvest areas.
- ***Trans-national harvesters,*** who extract stalked barnacles illegally in both Brittany and Portugal to sell them in Spain where the market price is higher. They include unlicensed harvesters, professionals licensed to operate in other regions, and traders who buy stalked barnacles and use their legal invoices to hide a barnacle load larger than declared, usually involving a handful of local collaborators as harvesters.

Individual motives for the conscious breaking of fishery regulations may be manifold [4,5]. During the workshop, stakeholders only discussed market and profit-based motivations (value, differences in markets, commercialization, distribution and the role of restaurants in the black market) and control (traceability and surveillance), leaving out drivers like recreational pleasure, use and habit, self-consumption, drug addiction or necessity [4,5]. This is a natural bias, since their interest is on physically deterring the illegal harvest of stalked barnacles and not on addressing the underlying causes, which are in any case problems of a much broader nature.

Professional harvesters at the workshop considered external poachers as the core of the problem. They expressed their dissatisfaction with the existing surveillance, whose main focus is on controlling professional harvesters and not external poachers. They requested more severe punishments for poachers that cause serious harm to the resource, act repeatedly, or form highly organized criminal groups. In contrast, the fisheries surveillance group identified the constant and very common practice of small-scale overharvesting by professionals as more harmful for the resource than the occasional large losses due to external poachers. This may reflect the widespread acceptance of small-scale overharvesting by the professionals [4].

Last, underfunding causes inefficient surveillance in all regions, with limited personnel covering vast territories and having numerous responsibilities. In addition, coast guards in Spain depend on the Police and *Guardia Civil* (a military body) for the enforcement of sanctions [6], adding yet another layer of bureaucratic complexity. Fines on poaching are negligible according to the harvesters in the workshop and frequently members of highly organized poaching groups plead insolvency to avoid payment of the sanction. This is a legal gap commonly used by shellfish poachers in Galicia [6].

3.3. The adaptive nature of poaching

According to the discussions, poaching seems to evolve in response to the level of management. In PNSACV and Morbihan, where the recreational harvest of stalked barnacles is still allowed and strongly integrated in the local culture and co-management and TURFS have not yet been implemented, poaching by non-professionals represents the main problem. In Morbihan anyone can harvest stalked barnacles recreationally without a license and in Portugal recreational licenses are unlimited and easily obtained, making poaching harder to control. In the fight against poaching, stakeholders from Portugal have placed some hope on recent legal initiatives to facilitate co-management. Its success however, will require a slow transition, and will likely face the resistance of different stakeholders through intense trial/error processes before arriving to locally tailored solutions [17].

In the other end of management complexity, regions with co-management, TURFs, restricted access and significant social capital have to deal with technically sophisticated and organized poachers. For their success, these systems need to promote a strong sense of ownership and responsibility for the resource among harvesters, promoting their cooperative participation in the governance and enforcement [7]. For example, members of the *Cofradía* of Baiona (Galicia) first had to overcome intense internal conflict before reaching a solid social capital driven under strong leadership, which allowed for the introduction of useful internal agreements. Members now pay a monthly fee to hire additional surveillance that supplements the co-paid internal surveillance common to all Galician TURFs. Failure to comply with fees or regulations (i.e. overquota) is treated with a graduated sanctions scheme. This strategy has successfully addressed both internal and external poaching.

The TURF managed by the *Cofradía* of Cangas (Galicia) has the highest level of organization represented in the workshop and is an

excellent example of successful management of the resource. There, harvesters have adopted the so-called "all for all" (from Spanish "todos para todos") strategy, where they work as a team with specific roles for harvesting, selecting, sorting, transporting and selling, mimicking the women's associations in Galicia dedicated to clam harvesting [18]. They focus their daily harvesting activity in one particular area of the TURF, and both roles and areas are rotated in subsequent harvesting bouts. Total harvest is negotiated in advance with buyers to avoid superfluous exploitation, and the benefits are shared equally among the harvesters. In such a highly cohesive system, internal poaching is very difficult. Given that most of the TURF is located within the *Illas Atlánticas* National Park, the level of surveillance is higher than in other TURFs and the harvesters themselves conduct surveillance in groups of 10 with one guard from the *cofradía*. The success of this system partly stems from strong leadership in the harvesters association, which has also been identified as a key aspect of successful Asturian *cofradias* [19]. All these circumstances lead to virtually no poaching activity, as acknowledged by members of the Cangas harvesters association in the workshop. Although not all fishers associations have the necessary social capital to achieve this high degree of cohesion, it may inspire fisheries where co-management is already in place, such as in Galicia and Asturias.

Trans-national poaching predates on the marked contrast in the level of governance and social structure of the fishery and in the difference in demand and market prices between France, Portugal and Spain. Spanish poachers are experienced in the highly surveyed and spatially organized TURFs and garner precise knowledge of black market channels in Spain. This gives them an advantage in less organized, surveyed, and therefore undefended fisheries.

Last, it is worth noting that poaching thrives in a consolidated black market, capable of absorbing large quantities of national and international illegal shellfish, and uses sophisticated distribution networks supported by the legal shellfish market [6]. However, prosecution is strongly biased towards poachers and not the supporting market and commercialization structures [20].

4. Recommendations

4.1. Increasing social capital

All stakeholders at the workshop showed great interest in the graduated sanctions scheme from Baiona, the "all for all" strategy from Cangas and their practice of holding preliminary contacts with the buyers. However, to implement this in other regions would require strong leadership, adaptation to the local context and support from the administration. Incremental steps towards this ideal may be highly beneficial at all levels of governance. For example, in Brittany, a minimum level of association among harvesters may allow them to bypass intermediaries, i.e. through online markets or by investment in a distribution infrastructure. Direct sale at Spanish markets would lead to higher profits, allowing for more professionalization of the fishery and laying the grounds for further improvement. Co-management is gaining momentum in Portugal, with RNB at the forefront. Nevertheless in PNSACV the problem of competition with recreational harvesters remains. Conflict mitigation might be achieved with the implementation of professional TURFs interspersed with zones for recreational harvesting [16], leading to partial exclusion of recreational harvesters. Stricter access rules, the introduction of limited licenses and enhanced control of the recreational harvesting would be important in the fight against poaching in both Portugal and Morbihan.

The eradication of internal poaching requires voluntary compliance with the rules by the professional harvesters [7]. Cooperative co-management is a step towards this goal, but requires that government and users work together as equal partners in decision-making [21]. Although decisions are adopted under some degree of consensus between the fisheries administration and the harvesters, in the current *statu quo* the government can always impose its decision if they consider it necessary. To increase equity in decision making, co-management should first be incorporated into the legal framework [22,23]. An example is Portugal or the Spanish Autonomous Region of Catalonia, where co-management has been recently included into the core of their fisheries legislations (Portuguese Decreto-Lei no. 73/2020 [24], September 2020 and Catalonian Decreto 18/2018 [25], June 2018).

4.2. Improve enforcement-compliance

With the recent change in the Spanish law (Article 335 of the Penal Code of the Organic Law 1/2015 [26], of 30 March), illegal harvest of stalked barnacles has changed from an administrative to a criminal offense. The law now involves higher fines and the possibility of penal charges, of up to two years in prison. Whether this change, long-claimed by the fishing sector, actually achieves an effective deterrence of poaching in the future is not certain, as long as the underlying systemic factors that lead to the illegal harvest stay unresolved [20]. For example, stricter sanctions may not be as effective when addressing poaching driven by poverty, drug addiction or unemployment, and may in fact lead to a vicious poaching circle [5]. In this regard, anti-poaching measures should allow for a distinction among different types and motives for poaching [3,4].

4.3. Landings monitoring

In Spain, all barnacles sold must be labelled with the total weight, cost and harvesters name, which is possible because catches can only be landed in authorized points. Spanish *cofradías* are usually in charge of these landing points and run the first market sales, allowing for the initial traceability of the product. In Portugal, harvesters can legally sell the barnacles in auction points, but also "outside the auctions", thus turning the monitoring of the landings more difficult [10]. However, professional barnacle harvesters are striving to adopt an official label and to channel the first sale through the harvesters associations [16]. Although the Common Market Organisation (CMO, Reg EU No 1379/2013 [27]) adopted in the European Union incentivizes the use of certifications, this practice has not been implemented in all regions yet. A clear recommendation that came from the workshop is to have a comprehensive monitoring of all catches in the fishery and to centralize sales in auction points under the control of the fishers associations.

4.4. Increase in surveillance and traceability

Surveillance needs to be intensified and novel strategies need to be adopted to cope with the reality of each region. Active participation of professional harvesters in the surveillance is required. Furthermore, surveillance drones are currently being tested in Asturias, with promising results. Randomized flight schedules and infrared, night-vision may effectively deter poaching. Moreover, there are emerging methodologies to detect fraud in markets and restaurants. Genetic methods, such as microsatellites and additional DNA fingerprints [28], which are currently being developed for stalked barnacles, may help trace the origin of confiscated barnacles in the future. The analysis of trace elements in the calcareous shells of the barnacles can identify their geographic origin in a scale of 10′s of kilometers with confidence levels of up to 98% [29]. It is yet to be shown whether those techniques are cost or time beneficial for full-scale deployment.

4.5. Implementation of market-based solutions

EU No 1379/2013 [27] regulation prompts for the adoption of quality and sustainability labels. Compliance with certification standards, linked to awareness-raising campaigns among the consumers may increase transparency and facilitate fraud detection. In a post-COVID context where online seafood markets are gaining momentum [30], labels may play an important role. The adoption of co-management may

facilitate the development of sustainability labels, thus increasing the profitability of the fishery (as in the MSC-certified Octopus fishery in Western Asturias, [31]).

CRediT authorship contribution statement

Katja J. Geiger: Conceptualization, Data curation, Investigation, Visualization, Writing – original draft, Writing – review & editing. **Antonella Rivera:** Conceptualization, Investigation, Writing – original draft, Writing – review & editing. **Alba Aguión:** Data curation, Investigation, Writing – review & editing. **Julio Arrontes:** Investigation, Writing – review & editing. **Jorge Álvarez:** Investigation, Writing – review & editing. **Yaisel Juan Borrell:** Investigation, Writing – review & editing. **Teresa Cruz:** Funding acquisition, Investigation, Writing – review & editing. **Dominique Davoult:** Funding acquisition, Investigation. **Jesús Dubert:** Investigation, Writing – review & editing. **Marieke E. Feis:** Investigation, Writing – review & editing. **Joana N. Fernandes:** Investigation, Writing – review & editing. **Consolación Fernández:** Investigation, Writing – review & editing. **Lucía García-Flórez:** Investigation, Writing – review & editing. **David Jacinto:** Investigation, Writing – review & editing. **Didier Jollivet:** Investigation, Writing – review & editing. **Gonzalo Macho:** Investigation, Writing – review & editing. **Elena Mateo:** Investigation, Writing – review & editing. **David Mateus:** Investigation, Writing – review & editing. **Paloma Morán:** Investigation, Writing – review & editing. **Carlota Muñiz:** Investigation, Writing – review & editing. **Amandine Nicolle:** Investigation, Writing – review & editing. **Rita Nolasco** Investigation, Writing – review & editing. **Marina Parrondo:** Investigation, Writing – review & editing. **Henrique Queiroga:** Funding acquisition, Investigation, Writing – review & editing **José Rico:** Investigation, Writing – review & editing. **Teresa Silva:** Investigation, Writing – review & editing. **Alina Sousa:** Investigation, Writing – review & editing. **Eric Thiébaut:** Funding acquisition, Investigation, Writing – review & editing. **Elsa Vázquez:** Investigation, Writing – review & editing. **José Luis Acuña:** Conceptualization, Data curation, Funding acquisition, Investigation, Project administration, Supervision, Writing – original draft, Writing – review & editing.

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Declaration of Competing Interest

None. Submission declaration and verification: We declare that the work described has not been published previously and is not under consideration for publication elsewhere. Its publication is approved by all authors and explicitly by the responsible authorities where the work was carried out. If accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder.

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Glossary

- *Cofradías*: Spanish fishers associations
- Territorial Use Rights for Fisheries (TURFs) in the stalked barnacle fishery are area-based harvesting rights that give members of a *cofradía* exclusive privileges to extract in a specified area.

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