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TITLE: Economic, sociocultural and ecological dimensions of fishing capacity: a mix-methods approach to Northwestern Mediterranean fisheries

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Abstract

The aim of this paper is to evaluate fishing capacity by identifying socioeconomic drivers while considering the current resources state in Northwestern Mediterranean fisheries. The case-study is focused on demersal fisheries from the province of Girona (NE Spain) whereas purse seiners were only juxtaposed as comparison. While in fishing capacity studies there has been a major effort in the analysis of vessel as means of production in estimating efficiency, social and cultural aspects are not usually integrated in the analysis. To address this knowledge gap in this study a more holistic capacity evaluation approach is used through qualitative-quantitative mix-method as the most suitable insight to capture the economic, sociocultural and ecological dimensions that can inform more accurately on fishing capacity. Data gathered from face-to-face semi-structured interviews were analysed through data envelopment analysis (DEA) model and triangulated with qualitative data extracted from interviews and participant observation. The results showed that higher inefficiency of small-scale fishing is due to, mainly, unpredictability of resources which is notably affecting small-scale fishing, whereas OTB is progressively being more subjected to fishing specialization, enhancing its efficiency. Small-scale fisheries need to work a lot of days, diversifying at maximum the target species to remain within the production frontier. Or, otherwise, they had to specialize in fishing specific highly demanded and priced species. An important finding is that social/familial networks as well as knowledge are paramount in fisheries-based economies and play a role in the characterisation of fishing capacity that has to be taken into consideration. The findings were discussed in light of the objective of the fishing effort reduction of European Multi Annual Plan (CFP) into force since January 2020.

Keywords

Fishing capacity, mix-methods approach, socioeconomic drivers, sociocultural aspects, Multi Annual Plan, demersal fishing

Highlights

- Mix-methods approach is applied for a more holistic fishing capacity evaluation approach
- Economic, sociocultural and ecological dimensions can inform more accurately about fishing capacity
- Fishing specialization in species under co-management plan show greater efficiency
- Knowledge as well as social aspects should to be integrated in co-management plans
- Multifunctional systems should be considerated in fisheries management plans

1. Introduction

Mediterranean fisheries show the highest rates of unsustainable exploitation in European waters and globally (FAO 2018, Cardinale et al., 2017; Colloca et al., 2017). The situation has been deteriorating since at least the early 1990s (Vasilakopoulos et al., 2014) and fisheries managers have not taken effective action to remedy the situation (Cardinale et al., 2017). Among the measures taken, reduction of the *capacity base* (i.e. the physical measure of fishing capacity in terms of vessels characteristics, such as engine power or tonnage) has been an important policy in recent decades (Penas Lado, 2016). In the Spanish Mediterranean, for instance, the number of licensed fishing units has decreased from 3337 to 2468 in the ten-year period 2008-2017 (27%), with the assistance of capacity reduction programmes (IFOP, EFF) (Sánchez-Lizaso et al., 2020).

However, the actual harvest capacity of a fishing fleet is given by its *capacity output* (Pascoe et al., 2003; Madau et al., 2009), which is a measure of the maximum potential harvest of a fleet when all means of production are optimally used. Under the current conditions of very low stock biomass (Vasilakopoulos et al., 2014) the means of production cannot be fully utilized, resulting in societal and economic inefficiencies. Conversely, individual fishing units attempting to maximize efficiency when resource levels are low will contribute to compound the problem of overexploitation.

The latest reform of the European Common Fisheries Policy (CFP, EU Reg. 1386/2013) imposed the adoption of Multi-Annual Management Plans (MAPs) for European fisheries at regional or sub-regional scale. For instance, a MAP for Western Mediterranean demersal resources was recently adopted by Spain, France and Italy (Herry and Souidi, 2019; COM/2018/0115 final – 2018/050 (COD)) that includes, among other provisions, the reduction of *fishing effort* by 40% in the period 2019-2024, with the implicit assumption that this reduction will result in a linear reduction of fishing mortality on the target stocks of the fishery (e.g. hake, red mullet, Norway lobster, deep-water rose shrimp blue-and-red shrimp). It is unclear at this stage how this effort reduction will be implemented, but it is likely that fishing activity (i.e. time) will be restricted by closed seasons, but the capacity base will not be reduced. Under this scenario, the problem of excess capacity is unlikely to be solved (cf analysis of past EU scrapping plans in Penas Lado, 2016, p. 112-113). A second aspect not usually taken into account in this type of fisheries management plans is the strong heterogeneity in the means of production of the different vessels that comprise a fleet. Capacity reduction programmes that do not take into account adequately this heterogeneity can end up being ineffective, or simply economically inefficient, and it is important that individual measures of productivity, efficiency and utilization are determined (Pascoe et al., 2003). Nevertheless, it is not only the vessels as means of production but also social and cultural aspects that wrap up fishers' decisions reflected in vessels operations that have also to take into account in capacity evaluation as a whole. In this vein the aim of this paper is to evaluate fishing capacity by identifying the socioeconomic drivers involving fishing economies, considering the current resources state.

We approach the analysis of capacity in Northwestern Mediterranean fisheries with a case study in the province of Girona (NE Spain), which over the lasts decades has experienced the greatest decrease in landings, by using a qualitative-quantitative mix-methods approach as the most suitable methodology to capture these different dimensions that can inform more accurately on fishing capacity.

2. Material and Methods

Mix-methods approach is more sensitive to capture different dimensions of fisheries in the assesment of productivity. In the middle of a continuum it incorporates elements of both qualitative and quantitative approaches that provide a more complete understanding of a research problem (Creswell, 2014; Small 2004, 2011; Johnson and Onwuegbuzie, 2004). Quantitative-Qualitative approaches have been more often used in agricultural studies (Wiskerke, 1997; van der Ploeg, 2003) whereas to study fishers and fisheries it has been more timidly used (Blount and Jepson, 2015) and rather introduced through social network analysis (Díaz-Reviriego 2016, Marin and Berkes 2010, Maya-Jariego et al. 2018; Maya-Jariego, Holgado, Florido 2016). According to our research objectives and assuming that the balance between quantitative and qualitative is difficult to achieve, we have chosen data triangulation as the most suitable methodological option. Data triangulation it is a comparative strategy that involves comparing data types from different sources to integrate different worldviews and standpoints with similar approaches to measure the variables (Colburn and Clay, 2012). It is also used as a means of convergent validation (Campbell and Fiske, 1959). In our study data triangulation implies analysis of quantitative data and qualitative data extracted from interviews along with fieldwork observations.

The mix-methods analysis is suitable given the qualitative nature of a part of the data set gathered from a random small sample (n=30) and when the contextual framework related to the categorical data is taken into consideration. Through Data Envelopment Analysis (DEA) the efficiency of vessels have been explored in terms of the optimal combination of inputs to achieve a given level of output. Therefore, DEA, a non-parametric statistical approach used in economic studies (Pascoe and Coglan, 2002; Pascoe et al., 2003; Lindebo, 2005; Coelli et al., 2002; Pascoe et al., 2003; Pinello et al., 2018) enabled to classify the fishing vessels as decision-making units (DMU) into different efficiency levels. This information has been crossed with information provided from qualitative data and observations. Whereas quantitative data analysis provided the description and identification of vessel types according productivity rate, qualitative data analysis provided the understanding of productivity differences usually non reflected in aggregated data.

There has been gathered 28 face-to-face semi-structured interviews consistint of a total of 49 open and closed questions as data source. The questionnaire comprised three types of information, including background personal data of the interviewed person: (1) Socio-demographic data, such as age, year of starting the professional career, or port of activity; (2) Technical and social characteristics of the production unit (LOA, engine power, etc.), crew size, remuneration scheme, among other; (3) Technical questions related to the fishing gear and economic variables (fuel consumption, fixed and variable costs, etc.); (4) Target species and fishing tactics, weekly marketed catch (volume and value), bycatch and unwanted species, changes in fisheries, mobility between ports, intentions and values of fishers in decision-making; (5) Social reproduction: main source of income, generational continuity within the family, social networks support, skills and training, among others. Furthermore, some informal interviews (without questionnaire but following the purpose of gathering specific information to clarify data) were also conducted. The questions were carried out during 2019 and corresponded to the situation in 2018. Finally, some punctual oral histories have been collected as some fishers referred to what they experienced in the past trying to reconstruct

their memory to explain the history of their enterprises in order to make judgments about present-day challenges they have to cope in the frame of fisheries transformations.

Interviews ranged from 1 to 3 hours in length, were audio-recorded for preservation with permission of the interviewed. Interviewees were vessel owners, who in most cases were also ship masters, as is usually reported for Mediterranean fisheries ("owner-operator" model, Maynou et al., 2011), owning in two SSF cases 2 vessels. Qualitative data have been coded and crossed each other for the analysis, and also to reduce possible bias. Alonside the interviews, several days, during six months, of participant and non-participant observation were undertaken which enable to contrast information gahered from oral interviews with real practices of fishers' activity (Gustavsson et al., 2017).

2.1 Study area and context

The study area comprises the two demersal fleet segments in the maritime district of Girona (northern sector of GSA06), -the small-scale fisheries and the trawl fisheries-, as a representative case study of the diversity of NW Mediterranean demersal fisheries. Information as also gathered from three purse seiners (pelagic fishery) which was not analysed in the same depth, but only juxtaposed as comparison. The fleet segments are distributed along the 9 different fishing ports (Fig 1) from this maritime district, where the small-scale fishing vessels represent 58% of the units and the OTB are 32% of the units (the remaining 10% is comprised of purse seiners). In the last decade this fleet landscape has been impacted by the scarce sea resources and the low economic performance threatening its viability. The 9 harbours had a fleet of 535 licensed commercial fishing vessels in 1990 that became 240 units in 2015. The fleets size has decreased by more than 50% in the 25-year period, as elsewhere in the Mediterranean Sea (Maynou, 2014; Pinello et al., 2018; Sabatella et al., 2017).

Demersal resources are exploited mainly by the otter bottom trawl fleet, targeting hake, red mullet and a variety of crustacean (Norway lobster, blue-and-red shrimp) and cephalopods (octopus, cuttlefish, squid). Small scale polyvalent vessels using a variety of static gear interact technically with bottom trawlers for certain demersal species (Lleonart and Maynou, 2003). The fisheries are managed by means of technical measures and input controls, as elsewhere in the Spanish Mediterranean. Specifically, fishing effort is controlled by restricting access to the fishery (license scheme to limit the capacity base), as well as restrictions to the time when fishing capacity can be applied to 5 days a week, 12 h a day and 1-month fishing ban, usually in February for bottom trawlers, resulting in a maximum of ca. 240 days annual working days. Technical measures specifying the minimum conservation reference sizes (EU Reg. 1963/2006 Annex III) and the characteristics of fishing gear (BOE 2012[1]) complement effort limitations.

2.2 The sample

The study has been focused in 7 most representative fishing ports from the 9 describing the maritime district of Girona province. The target number of fishing units to be investigated was 27, with allocation among the 2 segments (Table 1) considering different types distinguishing small OTB (VL1218) from large OTB (VL1824), polyvalent SSF (using different combinations of fisheries: GTR, GTN, FPO, LLS), or SSF focused only in LLS (longline) or SV (boat seine, which can

1 Official Journal of the Spanish State (BOE, 29-12-2012) Order AAA/2808/2012 of 21 December

be alternatively combined with trammel net). Therefore, it has been selected 11 OTB (6 small OTB and 5 large OTB); and 19 SSF according to different types (16 polyvalent SSF, 2 SV, and 1 LLS). Finally, data from 3 PS vessels was also obtained. Note that within the SSF there are two pair of vessels that represent two enterprises and within the PS one owner owns two vessels.

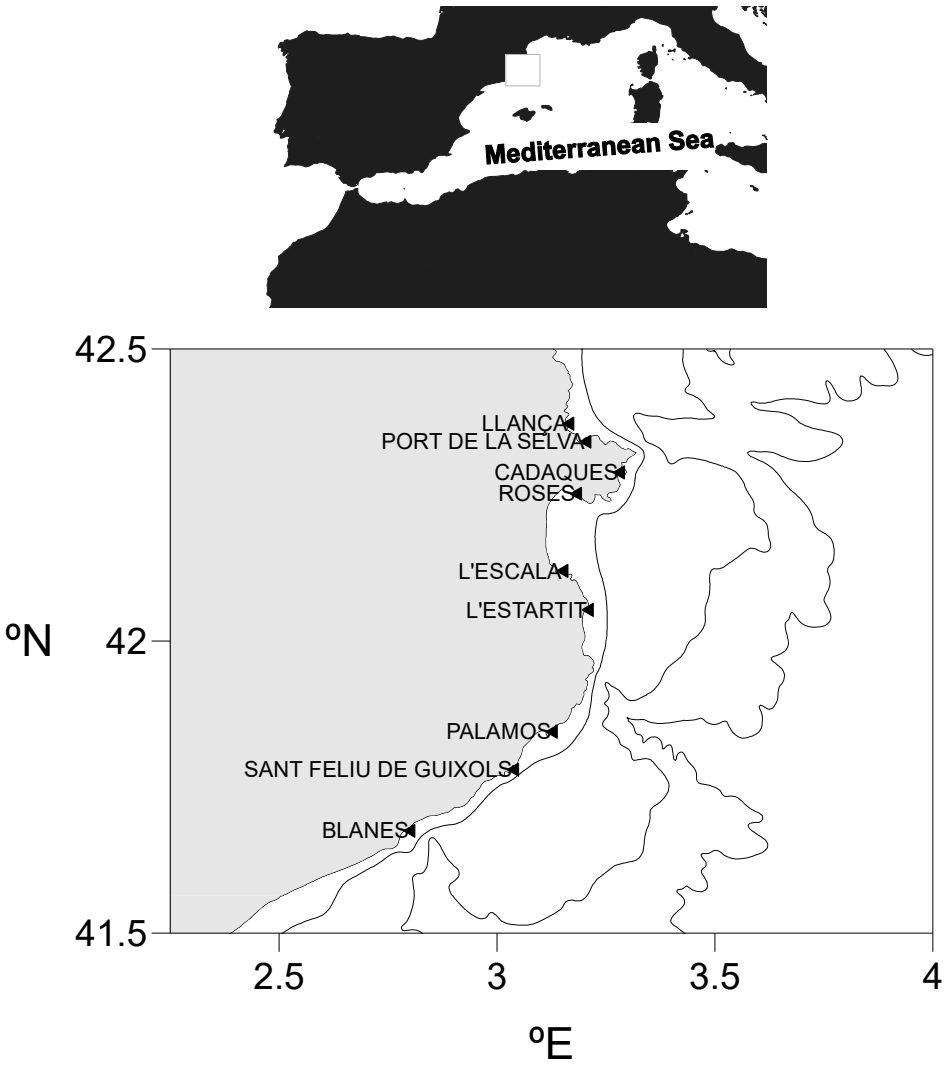

Fig. 1. Map of the study area in the context of the Mediterranean Sea (top). The bottom map shows the 9 commercial fishing harbours in the study area. Depth contours shown are 50, 200 and 1000 m depth.

Table 1. Characteristics of the fishing fleet from Port de la Selva, Cadaqués, Roses, L'Escala, L'Estartit, Palamós, Blanes.

Fleet segment	Fleet Size (2015)[2]	mean LOA	mean HP	Fleet Size (2017-2018)[3]	Target Number	Realized number of interviews (N)	mean LOA	mean HP
Bottom trawl (OTB)	66	20.92	333.69	54	11	11	19.27	433.15
Small Scale Fisheries (SSF)	119	7.97	45.3	93	19	17*	7.73	56.37
Purse Seine (PS)	26	18.22	242.34	23	3	2**	21.58	330
Total fleet in study area	185	13.86	174.69	149	30	28	12.84	206.84

*Note that there are 17 interviewed for 19 vessels since two owner-operators own two vessels. **One owner owns two PS.

2.3 Data analysis

2.3.1 Data Envelopment Analysis

The efficiency of fishing units, as Decision Making Units (DMU), was assessed by means of a standard application of Data Envelopment Analysis (DEA) (Coelli et al., 2002; Pascoe et al., 2003). This analysis basically constructs a piece-wise optimal production frontier from the data by means of linear-programming techniques. The performance of each DMU is assessed against this frontier to yield an estimate of Technical Efficiency (TE). For each DMU, TE is a measure of the relationship between input and output, and full efficiency in a DMU corresponds to producing the maximum output given its inputs. An additional efficiency indicator, Scale Efficiency (SE), was estimated for each DMU by dividing the aggregate efficiency by its TE. Furthermore, the capacity utilization (Madau et al., 2009) has been also calculated to assess the level of utilization of productive capacity by inputs (capital, crew, annual fuel consumption, working weeks, and annual costs). The levels of capacity utilization resulting from these analyses can be understood as short-term only (i.e. reflecting the situation at the end of the 2010s), because they are subject to the existing technology and resource levels.

2 According to official data of the Autonomous Catalan Government: http://agricultura.gencat.cat/ca/ambits/pesca/dar_flota_pesquera/dar_estadistiques/dar_detall_flota_pesquera_per_ports/

3 According data of official records provided by fishers' associations

TE was estimated under two assumptions: constant return to scale (CRS) and variable return to scale (VRS). In fisheries, VRS is clearly more appropriate (Coelli et al., 2002), but CRS is also given for comparison purposes, to assess those units below the production frontier (IRS: increasing returns to scale) and above it (DRS: decreasing returns to scale).

Under the CRS assumption, the Technical Efficiency (TE) of each fishing unit (DMU, *j* index, 1 to N) with a set of x_i inputs (*i* from 1 to K) and one output *y* (M=1) is obtained solving the following linear programming problem:

(1)

where *Y* is a *MxN* output matrix; θ is a scalar measure of the efficiency score of each DMU and λ is a Nx1 vector of wights. Values < 1.0 indicate technical inefficiency and the relative level of inefficiency is measured by 1-θ.

Under the VRS, the linear programming model is increased with the constraint $NI'\lambda = 1$:

(2)

The analyses were carried out with the DEAP 2.1 program produced by Coelli (1996), available at https://economics.uq.edu.au/cepa/software.

3. Results under the mix-methods lens

The summary values of the variables used in the DEA are shown in Table 2. The table shows that the four fleet segments present important differences in crew size, capital and costs. Crew size varied ten-fold, from the low 1.42 persons in average for SSF to the high 13.67 persons in PS. Vessel capital (as assessed by declared sale price) varied also importantly from 101,397 € for an average SSF unit to 1,100,000 for a PS vessel. Note how the large trawlers (OTB2) have a capital more similar to PS than to small trawlers (OTB1). In the case of costs, both fuel costs and annual costs are higher for OTB2 than for the PS segment. Regarding the level of activity, both trawler segments and purse seiners work for ca. 47 weeks per year, close to the maximum legally possible (48 weeks), while small scale units work considerably less (36.5 weeks per year). Landings value is higher for PS than for the bottom trawlers and more than tenfold the value declared by small scale units.

Table 2. Input variables and output (production in value) for the DEA analysis. OTB1: small trawlers (VL1218), OTB2: large trawlers (VL1824), PS: purse seiners, SSF: small-scale units. sd: *standard deviation*.

	OTB1	**OTB2**	**PS**	**SSF**

Input variables (mean values)	crew (#)	2.67	5	13.67	1.42
	sd	0.82	1.00	0.58	0.61
	Capital (€)	250101.26	864760.46	1100000	101397
	sd	101078.16	415372.10	100000	92818
	fuel costs (€)	48705	157500	97333	3258
	sd	23382.07	28007.2	9238	3182
	annual costs (€)	42386.80	89523.26	76355	8248
	sd	30621.21	33064.08	23825	6.139
	Weeks active	46.82	47.00	46.67	36.48
	sd	0.93	1.60	1.15	10.49
Output variables	Landings value (€)	179970.10	423781.32	525290	29916
	sd	91403.87	87907.02	160502	24942

Table 3. Results of the input-orientated DEA analysis. OTB1: small trawlers (VL1218), OTB2: large trawlers (VL1824), PS: purse seiners, SSF: small-scale units. TE: Technical Efficiency; SE: Scale Efficiency. sd: standard deviation; cv: coefficient of variation. IRS: Increase return scale; CRS: Constant return scale, DRS: Decrease return scale

		mean	**sd**	**cv**	**min**	**max**
OTB1	TE	0.833	0.154	0.185	0.67	1
	SE	0.880	0.164	0.186	0.566	1
	Scale of operation	IRS: 33.3% (2 of 6 DMUs)	CRS: 50% (3 of 6 DMUs)			N=6
OTB2	TE	0.935	0.111	0.119	0.740	1
	SE	0.969	0.045	0.047	0.891	1
	Scale of operation	IRS: 40% (2 of 5 DMUs)	CRS: 40% (2 of 5 DMUs)	DRS: 20% (1 of 5 DMUs)		N=5
PS	TE	0.825	0.155	0.188	0.706	1
	SE	0.964	0.037	0.038	0.926	1
	Scale of operation	IRS: 66.67% (2 of 3 DMUs)	CRS: 33.33% (1 of 3 DMUs)			N=3
SSF	TE	0.961	0.095	0.099	0.705	1
	SE	0.557	0.324	0.581	0.103	1
	Scale of operation	IRS: 79% (15 of 19)	CRS: 21% (4 of 19)			N=19

Our quantitative results show that, under the model of variable returns to scale, a large proportion of vessels were operating at IRS, and only 9 of 33 fishing units operated at the optimal scale (SE = 1.0). The fleet segment with more units at SE=1.0 were the bottom trawl fleet in vessel length class 12-18m (OTB 1) and the purse seiners, where we found that two thirds of the vessels were operating at optimal scale under the model of variable returns. As for the large OTB (OTB 2) 40% (2 of 5) would operate at CRS and IRS, while one DMU would

operate at DRS. In the case of SSF, IRS units represent a small percentage, 21% (4 of 19). As for purse seiners only one from the three vessels worked at CRS (33%).

It is interesting to note that SSF units had the lowest average scale efficiencies (SE) (0.557), and had also the largest coefficient of variation (Table 3). That is to say that SSF vessels are more heterogeneous than the other three segments. Interestingly, the small OTB units had a mean SE of 0.880, larger than SSF but still lower and with higher coefficient of variation than the large OTB units (0.969) and PS (0.964) (Table 3). Note how the average SE of large OTB and purse seiners are very near one with low variation.

As for the Technical Efficiency the results show the highest rate in SSF (TE=0.96), and relatively lower in the small and PS fleet segments, OTB1 (0.83) and PS (0.82), albeit more similar to the large fleet segment OTB2 (0.93).

Examining the same data from the perspective of capacity utilization (CU) (Table 4), the results indicate that SSF do not use completely all productive capacity, only 48.61% of the maximum, despite using the inputs (capital, crew, annual fuel consumption, working weeks, annual costs) at near their maximum rate (>85%). The largest value for CU was observed for OTB2. The utilization of the input variables shows large values (>89%) in all cases for OTB1 and OTB2. Purse seiners had optimal utilization of production costs (fuel and annual costs: 100%), but very low utilization of time (68.2%)

Table 4. Results of the input-orientated DEA analysis, averages of technical efficiency (TE), capacity utilization (CU) and input variables utilization (U) per fleet segment

	SSF	OTB1	OTB2	PS
theta1	2.3412	1.4956	1.1104	1.2843
TE	0.7860	0.7515	0.9208	0.8023
CU	0.4861	0.6148	0.8540	0.6622
U.x1 (crew)	0.8537	0.9297	0.8702	0.8280
U.x2 (capital)	0.9796	0.9634	0.9728	0.8613
U.x3 (fuel costs)	0.8500	0.8941	0.9234	1.0000
U.x4 (annual costs)	0.9872	0.9860	0.9671	1.0000
U.x5 (time)	0.9315	0.9427	0.8128	0.6820

In the following sections, by crossing the quantitative data with the qualitative data, we are going to describe in more detail the results considering the attributes that differentiate the SSF and the OTB productive efficiency in two different sections.

3.1 The small-scale fishing

The detailed review of the data provided by case study reveals that SSF showcase different use of capacity rate of work that enables to distinguish up to 4 kind of profiles that point out nuances among the small-scale fishers. In this way, those fishers that work between 47 and 49 weeks, a similar rate than OTB but above the average working weeks in SSF (36 weeks) represent the ***profile 1*** (3 units). These vessels correspond to those owners who declared fishing as their unique economic activity and stopping only approximately one month per year. Those slightly over the average working weeks (38 to 45 weeks) would correspond to the ***profile 2*** (9 units); that represent two different type of fishers. First, those whose families have another economic activity employing all family workforce during the summer tourist season (between June-July and September). Secondly, those whose main and unique work is fishing, despite working only 9 or 10 months in the sea, to work afterwards in preparing fishing gears in land (may be for other fishing units not of their property). Whereas the ***profile 3*** (2 units) correspond to two fishers (owner-operator) owning in partnership two vessels, on the average working weeks (36 weeks) that combine their activity between the two vessels. At the same time, these fishers diversify their fishing activity with other fishing-related activity but tourism oriented such us gastronomic workshops. The fishers working below the average weeks (14 to 24 weeks, less than half of the year), correspond to the ***profile 4*** (5 units) that usually combine their activity of fishing with another activity at 50% (not always it is a fishing-related activity) or they divide the time of fishing with different fisheries alternating between them by switching from one fishing gear to another, what can be done according to the enterprise characteristics in some cases involving family members. Typically, two partners or relatives but also one fisher alone that intensifies the production by dividing the time of work in two different vessels, especially feasible in the case of Sand eel (*Gymnammodytes cicerelus*).

Considering these different profiles only 4 over 19 show a Technical Efficiency (TE) and Scale Efficiency (SE) at Constant Return Scale (TE=1 and SE=1), two of them corresponding to the profile 1, one to the profile 2 and one more to the profile 4 but anyone of them to the profile 3. This is, a total of 21% operated at the production frontier in front of a 79% that operated at increasing return to scale (IRS).

Fishers operating at constant return to scale (TE=1 and SE=1) within the profile 1, deployed a great diversity of fishing tactics (up to 13, whereas it usually is 4) changing constantly according to target species, defined by season and the availability of the resource presumably more unpredictable over the lasts years. Although accounting for the reduction of fish consumer demand on more and more few species, fishers tended to focus on what has been called “fish of quality”. Otherwise, the fisher within the profile 2 and profile 4 developed fishing tactics specialized mainly on one specific high demanded species. *Octopus vulgaris* and *Gymnammodytes cicerelus,* respectively, which represents the important weight of revenues altogether other secondary species. The sand eel, as reported above, only being possible to fish it during 6 months every 15 days, therefore reducing the working weeks at a half, combined with *Aphia minuta* and *Crystallogobius linearis* the second half of the year.

All these fishers come from small-scale fishers’ families which conveyed them the fishing grounds knowledge together with the ecological knowledge on the resources and ecosystems of the area. A knowledge that is different according each fishing family tradition that usually correspond with the developing of different fishing tactics. Furthermore, no one of them have experienced and important changing of fisheries which would imply the acquisition of new knowledge and/or the exploration of new fishing grounds.

Nevertheless, only 3 from the total SSF analysed vessels (19) account below the Technical Efficiency frontier (TE) with a relatively lower rate than the average (0.75). Two of them are vessels from the profile 3, whereas one corresponds a vessel that have changed of fisheries (from LLS to trammel net) in the profile 2. Therefore, we can assert that SSF are efficient in technique.

As for the vessels that are far away from the Scale efficiency frontier (<0.9), there are 5 vessels showing very low rate below the average. Note how SE is as low as 0.103 in two DMU, and low also (SE=0.2 to 0.3) in the three other DMUs. These are vessels with low rate utilization of capacity work working less than half of the year (<40 weeks), two in the profile 4 that diversify at 50% the fishing activity with another economic activity, two vessels of the profile 3 combining between each other the fishing activity, and within the profile 2 one LLD vessel, whose owner complained of the scarcity of their main target, *Merluccius merluccius*, and some Sparidae.

Looking at CU analysis, we assess that 42% of the fleet do not use properly the production means. The unbalanced it is firstly pointed out on capital investment which do not correspond to the revenues in 37% of the cases and to a lesser extent the fuel expenses (26% of cases) and annual costs (21% of cases).

Mostly of SSF vessels are part of a consolidated communitarian and familial social network of support that produce some help in cushion the annual costs. While social networks involvement does not produce significant productivity differences in value of production, it can be asserted that 46.6% of small-scale fisheries enterprises interviewed receive direct social network support. Usually, elder family members (more men than women) contribute in mending nets and making up new fishing gear nets. This is especially clear in the case of vessels that deploy a great diversity of fishing tactics and spend above the average weeks at sea. The unpredictability boost the fisher to be provided of different fishing gears to switch from one fishing tactic to another in order to diversify the fishing tactics continuously and to span all possibilities for catching alternatively different species constantly. In these cases, family support implies a saving in hours invested in land, that enable to diversify the fishing tactics without need to miscarry the fishing activity to prepare new nets for the next fisheries.

Likewise, those who do not have direct family members helping in their tasks of keeping up means of production integrate the time of repairing nets by themselves as a part of their working time in land that in the case of changing of fishing tactic implies one or two months of preparing the fishing gears. This is the case of some of the fishers that stop working in the sea between 8-10 weeks (profile 2 and 3). Those without direct family support may receive support from retired people who can be paid or unpaid, and alternatively from skilled migrants to do this job receiving lower remuneration than usual, instead of 10-15 € per hour they receive 8 €. The cost of new material is too expensive and costly to recover (a minimum of 4000 €, in case of trammel nets for a completed set), whereas old material can last long time. Therefore, a big investment it is performed once and this has to be adjusted with the minimum expenses in keeping and repairing nets, two premises that have to be integrated into the fishing strategies.

The sense of informality of this kind support it is a common argument suggested when recycling fishing gears inherited from retired fishers, using that conserved since long time ago, as part of a circuit of mutual help whether remunerated or not. The value of the means of production it is very important specially accounting for the scarcity of resources that have

increased the unpredictability of fisheries and, therefore, obliged fishers to readjust to those available fisheries investing in new fishing gears or different ones, consequently implying new costs. Therefore, to become a “good fisher” it is not only to know fishing accounted by results in productivity efficiency but also to know how to avoid losses and mitigate the risk. Overall, social networks support helps to mitigate risks contributing in savings in money and time.

Women involved in repairing nets and in fisheries tasks are, in general, very few. Currently, in the cases where women it is involved in fisheries they usually are informally in charge of the accountability and administration tasks, which is a "support job" added to their regulated work at labour market. Although 88% of fishers declare that fishing is their only source of income not having alternative income in other economic activity, fishing sustainability is dependent on familial salaries derived from the work of the couple in 66.6% of the cases. Overall, all small-scale fisher profiles rely on other family patrimony revenues to maintain their livelihood. Nevertheless, fishing it is declared to be the main economic activity since it represents an average of 73% from the total income per household unit (composed by an average of 3 members, this is small household units) contributing to the domestic expenses. Nevertheless, the imprecision of this percentage is very high and would entail an in-depth small-scale fisheries household economic analysis.

The SSF are small units of production with an average crew of 1.4, which means that usually the crew it is composed by one only person. The reasons expressed by fishers are multiple but notably the saving in workers in a kind of fisheries that produces few margins of profit. Nevertheless, according DEA analysis, one of the 4 vessels that operated at CRS (TE=1 and SE=1), specialized in sand eel, employed 2 sailors, in addition of the owner-operator. The Sand eel is the kind of fisheries which is more likely to employ sailors. Overall, according capacity utilization analysis the size of the unit of operations accounting for the crew do not influence the scale efficiency. CU analysis only points out discordance between input target and input as regards the number of crew at the vessels in profile 3 composed of two owner-operators that should be reduced.

To summarize, data show us that whereas average fuel costs of SSF (8248 €/yr) and capital investment it is very low (101396 €/yr); small-scale fisheries need to work a lot of days, diversifying at maximum the target species to remain within the production frontier (average of annual scale value it is 30000 €). Or, otherwise, they had to focus mainly on fishing specific highly demanded species and priced. Although social/familial support network can help mitigate the costs, the fisheries skills and knowledge enabling to adjust the fishing tactics suitably it is paramount to enhance productivity. Alternatively, some fishers from the SSF segment combine fishing with a second source of income from jobs directly related to fishing or unrelated.

3.2 The industrial fleet, OTB1 and OTB2

Bottom trawlers have higher costs than SSF, fuel cost oscillated around 128 271 €/year with annual fixed costs about 76 355 €. Although in terms of activity bottom trawlers were active between 46 and 47 weeks per year, similar than purse-seiners, (i.e. practically all the available time, discounting 1-month seasonal closure) without differences between small and large OTB segments (OTB1 and OTB2 respectively). As for the technical efficiency, this is practical the same for both trawl vessels (0.833 in the case of OTB1 and 0.935 the case of OTB2), which is slightly lower than SSF fleet segment. Nevertheless, scale efficiency is notably higher in both

OTB segments than SSF, the large bottom trawl having the higher value (SE=0.969). Overall, scale efficiency was more homogeneous in the two large fleet segments, OTB2 and PS.

Whereas SSF operating at CRS represent a low percentage of vessels (21%), in OTB fleet segment they represent a higher percentage. A total of 4 OTB from 11 units operated at the optimal scale (36%), two small trawl vessels (12-18 m) and other two large trawl vessels (>18 m). Likewise, as it happened with the small-scale fisheries, there is some trend towards the specialization which in the case of OTB is focus on crustaceans (*Aristeus antennatus*, *Nephrops norvegicus* and *Parapenaeus longirostris*), although alternatively combining with multi-species as traditionally (Bas et al. 2003). This combination requires the ability to suitable perform a calculation of fishing decision considering factors that play a role in daily fishing activity such us weather conditions, the availability of resources, costs of fuel, the market demand, and the price of the product.

Furthermore, to combine between specialization in crustaceans and fishing multispecies requires good knowledge of the fishing grounds and fishing techniques acquired throughout the years and transmitted through generations. A knowledge firmly rooted on a "culture of fishing" altogether with the economic possibilities to invest in necessary fishing gears to reach deeper bottoms, more sophisticated devices and suitable power to go further away searching for the crustaceans fishing grounds at more than 100 m up to 1000 m. Whereas some have the knowledge to combine shrimp and multispecies with successful (profile 1), some only know fishing crustaceans (profile 2) and others (profile 3) only can catch multispecies of fish because do not have the adequate tools to reach the deep-sea water prawn fishing grounds. Since the vessel characteristics to go fishing shrimp are more easily fulfilled by large OTB, small OTB (12-18 m) have mostly specialised in alternative crustaceans (*Nephrops norvegicus* and *Parapenaeus longirostris*) whose habitat is shallower.

The 4 trawl vessels operating at constant return to scale correspond to the profile 1, whereas the other 7 move in-between the profile 1 and the other 2 profiles, pointing out toward a progressive specialization according the data extracted from the interviews, although finally depending on this calculation ability in fishing decisions embedded in the culture of fishing.

Unlike small-scale fisheries OTB presents a higher capacity utilization rate (Table 4). The small OTB (OTB1) showing the lower rate with a 61.4% whereas larger OTB (OTB2) shows only 15% of unused capacity using slightly more than 85% of their productive capacity. Both, small and large OTB, similarly to SSF presents a very high rate of the inputs used (OTB1 >89% and OTB2 >81%). Some nuances have been detected in fuel annual expenses which should be reduced for half of the OTB1 and OTB2 vessels, and also annual costs specially affecting larger OTB (OTB2).

Otherwise, contrary to what could be supposed, family support is higher in OTB than in SSF. A percentage of 63.6% of fisher-owners declared to receive support from family whereas 72.7% even shared the income with the family whether in the form of small contribution or part of the business. As family support it is considered not only the tasks of means of production maintenance, that in the case of OTB requires specific specialization and more manpower (the pieces are big and harder to repair than in the case of SSF), but economic and financial property (cash, credit, savings and investments). And also human capital (as generational replacement) and knowledge (which could be called as fisheries cultural capital). All the vessels are run by fishers' descendants that inherited the unit of production or invested in another whose property is shared in 54.5% of the cases with other relatives from the extended family.

Vessels are usually inherited by the kin that continues with the enterprise (mostly as owner-operator) and, in some cases, with the participation of some kin not devoted to this activity. In the northern of the province the enterprises are rather fisheries corporations belonging to different descendants (and/or partners) that not necessarily are owner-operators. Overall, the tendency is to avoid disaggregate the familial fishing patrimony by sharing the investments and costs among the family, therefore, keeping up the familial character of the fishery enterprise. The family engagement with fisheries enterprises is also important as producing emotional bond, in some cases expressed through symbolic payments of low amounts, for example, for helping in mending nets often carried out by elder family members. Otherwise, considering the high costs of repairing nets in trawl fisheries the trend is to self-repair the nets and the devices unless it is a major reparation implying the whole renovation of fishing gears and purchasing of engines. The family support it is important here as well as having the skills in repairing gears, what enable important savings in costs and what explains the lower annual costs of smaller OTB that presents a difference of 25105.2€ in savings in relation to non-efficient small OTB.

Although, the complexity of the vessel trawl devices and fishing gears limit their self-reparation and usually is in charge of the one or two unique enterprises in the province specialised in this kind of job. Likewise, as it happened in the SSF the practice of recycling old nets from former vessels is active among the trawl vessels, especially among the smaller ones, which helps them to mitigate costs that in the case of trawl vessel can be considerable.

The scarcity of family work involvement in land is relatively compensated by the work in the sea with 45% of vessels employing relatives whether sons, brothers, of nephews. Conversely of the SSF, OTB segment present higher scale efficiency whose size of unites of production present an average crew of 2.6 workers in OTB1 and 5 workers in OTB2. On the contrary, purse seiners were the most labour intensive (average crew 13.67), and present the bigger discordance between the maximum that could employ by vessel and the actually number of crew, employing 3 workers more.

4. Discussion

Fisheries management in the study area, as elsewhere in the Mediterranean (Lleonart and Maynou, 2003; Colloca et al., 2017), has failed to curb the unsustainable exploitation of fisheries (Cardinale et al. 2017). In addition to the poor performance of fisheries management in terms of ecological conservation, the economic performance of Mediterranean fisheries is low. Several authors have reported on the low economic efficiency of Mediterranean fisheries, based on bio-economic or purely economic analyses (Colloca et al., 2013; Maynou, 2014; Sabatella et al., 2017). Although, the uncertainties and risk in fishing have major implications for social organization and cultural aspects that have to take into account in the assessment of fisheries sustainability for future management planning.

Only 27.7% of the vessels operated at the frontier of production in our study, therefore we can assert that overall the efficiency it is very low. Importantly to highlight that small-scale fisheries it is the less efficient fleet segment at similar percentage as documented by Pinello et al. (2016) in Greece. They do not use their maximum productive capacity comparing with OTB, notably with OTB2 that have a high rate of capacity utilization near the frontier (=1). OTB2

presents the higher efficiency presenting the most homogeneous technical and scale efficiency rates together with the capacity utilization and inputs used. Although, all fleet segments, except PS characterized by high labour intensification with larger crews, show a high rate of inputs utilization.

Considering this panorama, by crossing quantitative data and qualitative data we can extract that this higher inefficiency of SSF is due to, mainly, unpredictability of resources which is notably affecting SSF whereas OTB it is progressively being more subjected to fishing specialization in some cases on co-managed species (e.g. *Aristeus antennatus*).

Accordingly, the efficient vessels we found deployed strategies focused primary in one specific species alternatively combining with multispecies, what we have called as *specialization*. Within the specialization species we find those under a co-management plan such us Sand eel *(Gymnammodytes cicerelus)* in the case of SSF and shrimp (*Aristeus antennatus*) in the case of OTB. But also not co-managed species such as Norway lobster (*Nephrops norvegicus)* and, in the case of SSF, octopus (*Octopus vulgaris*). For the case of SSF, we also find another strategy, implying constantly diversifying the target species although increasingly focusing on "fish of quality" (Bas et al., 2003) instead of quantity, which requires working above the average working weeks (>40 working weeks). We have called this strategy as *great diversification* (up to 13 fishing tactics). Both options (specialization and great diversification) are understood as resilience strategies in front of the resources scarcity and unpredictable availability.

The species under a co-management are very high valued at market although, except for the red shrimp, they have decreased in production. Since 2000 to 2015 the red shrimp (*Aristeus antennatus*) has practically doubled its production, from 158 to 369 t with some slightly decrease in 2018 to 231.4 t. It is important to highlight that this deep-water species is by far the most valuable fisheries resource in the area, with ex-vessel prices around 38 € on average. The *Gymnammodytes cicerelus* it is valued with average ex-vessel price of 13 €/kg similar to the *Sepia officinalis* which recently have been incorporated as part of a co-management plan. Conversely, *Octopus vulgaris* present the lower average price (8 €/kg) of species that are object of specialization. Whereas similar specializations in high valued species such as *Palinurus elephas* that are combined with multispecies do not produce great differences of efficiency between vessels despite presenting the highest average price (40 €/kg). Its catch which is very focus on two summer months has notably decreased between 2000 and 2018 to more than at half in landings, descending from 11.7 to 4.5 t. Other catches of small-scale fisheries are also relevant due to the high prices fetched albeit the landings have also decreased, except red mullets (*Mullus* spp.) and anglerfish (*Lophius* spp.). Otherwise, there is not always the same availability of these high valued target species, for example in the case of Sand eel whose year-to-year oscillation is inherently to its biological characteristics and biomass distribution, or even the case of *Octopus vulgaris*. Therefore, while market prices have been for long time reported as one of the main principles that guided the decision on the fishing tactics to optimize the profit (Maynou et al. 2011), the accelarated stock decline motivated by overfishing added to new patterns of consumption have obliged fishers to produce more sophisticated calculations in order to cope with the increasingly unpredictability on species availability as well as a reduction of species valued at the market.

Similarly to our case the OTB specialization in deep-water shrimp, as Pinello et al. (2018) found for the case of Strait of Sicily and the Sardinian Channel, it is a strategy that show the highest average levels of efficiency, in our case developed by the larger OTBs. Although, according our findings, despite it has been detected specializations among most efficient vessel, these have

to be nuanced inasmuch it is not like a sort of “technical fixings” but a flexible option whose development depend on a set of variables. Therefore, the conception of “specialization” is somewhat confusing being difficult to concrete inasmuch it actually responds to a variable strategy, with possibility to alternate with multispecies, that pivots grounding notably on that calculation where technical proceedings (working hours, workforce involving, etc.) interact with oscillation of material aspects of production (fuel cost) adjusting to market demand (which can vary even within the week) but environmentally and weather conditions dependant.

Although, because the scarcity of resources has increased the unpredictability of resources availability, it is not the characteristic of vessel (length and technical characteristics) as pointed out by Fousekis and Kloranis (2003) and Pinello et al. (2016) in the case of Greece, but rather the knowledge which is key in fishing decisions to improve fisheries economic performance. Unlike the findings of Pinello et al. (2016) the TE it is not correlated in the case of SSF with age and experience neither in the case of OTB fishers with technology, but with fishers that usually come from fishermen families whose knowledge have been transmitted and which is different according family fishing traditions, or they acquired it within the tight-closed circle of fishers from fishing community (Gomez, 2007; 2016). This is clear in the case of specialization of deep-sea water shrimp, which requires to have a specific knowledge.

Nevertheless, the analysis indicate that knowledge can be neutralized with the scarcity of resources and the changing of fisheries implying the searching for new fishing grounds and fisheries tactics, as it happens in SSF. The split of working weeks and workforce between two vessels also indicate inefficiency in the case of SSF, as well as diversifying at a half with other economic activity. Similarly, Pinello et al. (2016) found that when the fishing activity is the main source of income, the scale efficiency level is higher because owners are trying to fully exploit returns to scale and thus, to operate very close to constant returns to scale. On the contrary, as point out by Madau (2009) capacity tends to be only partially used, at the same time than as our study reveals, capital investment is doubled. Scale efficiency is positively correlated with days at sea. The reduction of working weeks could be only efficient in co-managed fisheries, as it happens in our study for the case of Sand eel, a biweekly fishery. Therefore, we add that it is not only a question of using their resources efficiently without necessary increasing the days of work as suggested by Madau et al. (2009), but also to stablish co-management plans for target species to recovery the stocks.

Despite as we have point out mechanisms that underlie fishing decisions inevitable unveils environmental adaptations, not less important it is the possibility to acquire the suitable means of production, which is paramount in fishing shrimp, and afterwards to cushion the maintenance costs. Aspects all of them that partly depend on the enterprise fisheries assets, the trajectory of fisheries family enterprise, but also on familial/social network support in land-based activities that can participate in the enterprise deploying different kind of works and financial support. In the case of SSF it does not produce important efficiency differences as it produces in the case of OTB which implies costlier production costs. The informality of these kind of networks which is translate it into a great imprecision of paid and unpaid labour activities and the kind of social actors’ involvement whether familial or fishers community members, is what show us that the social fabric of fisheries economic base occupy a role in the fishing economics. Even beyond the economic rationality, this informal social networks of work are kept as a "lifestyle" and a “way of doing” that produces community and social bonds through keeping different generations from fishing community involved in fisheries whether

fuelling the feeling and identity attached to fishing activity or the fisheries family enterprise sense.

Both fishing strategies we have found (1) the specialization of fleets and (2) diversification towards “quality of fish” depends on the historicity of fisheries in each fishing harbour, strengthen with the establishment of management plans and the possibilities of its local marketing and promotion using cultural heritage discourses or activating environmental projects to give added value to the product.

Crustaceans started to be a specialization in the 1970s, notably in the southern province (Alegret et al., 2018). Whereas in the northern it was the result of punctual entrepreneurship initiatives developed by those more fearless that had the capital to invest for the suitable means of production. Despite the history, the interviewed coincide to point out progressive crustaceans’ specialization with the oil crises between 2007 and 2009 with an important increasing in 2016, either in the northern than the southern, as an option of fishing technically implying less speed to sweep the deeper fishing grounds, only investing in navigating in larger distances. The fishing nets are smaller and the catch is more plentiful and market valued. Furthermore, crustaceans are perceived as a “cleaner product” which do not require too much manpower nor important physical effort to classify the product (producing fewer discards) when the catch is on board despite needing an average of 4 or 6 hours in performing the hauls which are longer, therefore, extending the working time. The co-management also answer to diferent historical processes that despite currently being institutionalized under the Catalan Maritime Strategy and the recent Governance Decree from the Autonomous Catalan Government (June 2018) have been developed along the time initially from fishers’ associations and specific fishing sectors. Species co-managed are, currently, being linked to initiatives of branding (e.g. MSC certification) to certify the origin and sustainable production of the product. These products (e.g. red shrimp) get visibility through touristic activities organized by fishers’ associations that give heritage value to the product distinguished by their quality and sustainability enclosing identitarian processes that identifies the product with the fishing port and their fishers.

As for the great diversification tending towards “fish of quality” in our case study can be understood as “non-productivism” strategy defined by Properi et al. (2019) as a non-definitive trend towards less productivity and more quality tied to diversified and multifunctional form of fisheries similar to the agricultural multifunctionality. Multifunctional Systems refer to public (the commons, non-commoditisable outputs, externalities) and private goods that are guaranted from an enviromental conservation approach through more sustainable forms of production, new ways of marketing and value chains. That is, in addition of food it is ensured private goods such us recreational activities, simultaneosly that public goods and non-commoditised outputs (biodiversity, health and environmental services), and social goods (employment, preservation of cultural heritage of fishing) (Renting et al., 2009). This is, by producing interrelations between fisheries functions (including primary production) and potential synergies with other activities producing services (Prosperi et al. 2019) in a manner to optimaze the trade-offs between conservation and the social and economic benefits that fisheries can provide. Although fishers interviewed are engaged in productivist activities the emphasis on quantity is reduced, whereas the greater focus is on the quality of the fish. At the same time some initiatives are being developed in the vein of multifunctional systems (www.projectesepia.com) together with short supply circuits for selling the products to hostelry establishments under a brand that certifies the quality of the product

environmentally-friendly (https://pescabrava.cat/) that will improve the price for the fisher. Nevertheless, it is still soon to evaluate the economic, environmental, social and cultural results of these projects that are just starting in the province of Girona, the specialization in "fish of quality" represented by specific species carefully size-driven selected may produce pressures on the most vulnerable species. At the same time that restraining the access of food of quality to high income consumers of restaurant. Similarly, deep-sea co-managed shrimps are also becoming a "premium product".

Accounting for this context, rather than fishery strategies we prefer to talk about "fishing styles" in the vein of Boonstra (2014), that capture motivations that guide the fisher decisions according to socio-historical and ecological context of each place, considering also policies regulations and management plan constraints and integrating the knowledge and values of fishers in a relational approach with the environment. It refers to different kind of rationalities regionally distinguished that can explain why fishers make different choices in similar circumstances of unpredictability, and the way each fisher develop strategies to cope with new and/or unexpected problems.

Despite, these strategies the presence of numerous fishing units operating at lower than optimal technological [or scale] efficiency in our study, as well as in other works (Pinello et al., 2018; Pinello et al., 2016; Madau, 2009) suggests that excess capacity is a structural problem of Mediterranean fisheries. The presence of excess or overcapacity may be quite costly to society in terms of foregone profits, inefficient production and loss of alternative opportunities. Reducing either excess or overcapacity, however, also may be quite costly, both in financial and social terms. The loss of employment in the short run through capacity reduction often counters many fisheries management plans, the objectives of which may be to maintain employment or viable fishing communities (Charles 1989).

Our study shows that overcapacity does not produce better profitability and that reducing the days of fishing as happens in the case of Sand eel or stablishing long temporary closures (60 days of ban) as it is the case of local co-management of shrimp in southern province, can produce better results. Moreover, working less days it is not contradictory to adjusting scales of unit of production by increasing the workforce accounting that among the most efficient vessels we have found the vessels employing more workers than the average.

In this direction, the new multi-annual plan for demersal fisheries in the western Mediterranean (Regulation (EU) 2019/1022 of the European Parliament and of the Council of June 20, 2019, OJEU L172/1) introduces the concept of maximum allowable fishing effort that will consist in reducing the days of fishing per year, although it is not forecasted how the fishing days it is going to be distribute throughout the year and across the fleet. The plan it is expected to produce socioeconomic impacts on the employment undermining generational replacement, one of the fisheries problems (Sánchez-Lizaso et al., 2020). Otherwise, in our study local co-management plans and certification schemas in the specific case of shrimp have already implied the reduction of fleet capacity based on the number of vessels by 20% by 2017, what has been overcome with a global reduction of 27%. Briefly, several fishers have been pushed towards the unemployment or absorbed in other fisheries, e.g. small-scale fisheries, or reemployed in land in not fisheries-related jobs. The regulation of other specific fisheries has also produced the conversion from the polyvalence system towards the specialization or the changing of fisheries for those not fulfilling the requirements. But if it does not come from the regulations, it comes from the lack of resources what has pushed fishers to change of fisheries and/or tactics. At the same time that regulation emphasising in

specialization (e.g. the license of Sand eel does not enable polyvalence at the same boat) constraint the flexibility of fishers in fishing decisions. Therefore, similarly as it has been observed in Tuscany (Prospery et al., 2019) it reduces the scope for fisher to practice many of the attributes associated with being a good fisher, such as the use of knowledge to determine what to fish. Otherwise, although recovering the stocks by restraining the quantity of catches through fixing a quota has increased the value of the catch, as it is the case of Sand eel, fishers point out a change in their relationship with nature. A feeling of industrialization producing alienation from the product whose only incentive is the good price of the catch. Specialization under co-management plan reduces unpredictability that try to control the impact on environment and ensuring the livelihood but also diminish the need to test the fishers' skills and ability in their daily activity.

Despite the obvious decreasing of fishing fleet over the last 15 years asserted for all the Mediterranean (Gomez, 2006; Sánchez-Lizaso et al. 2020), we have to take into account that recently the number of SSF vessels it is subjected to a great fluctuation. First, because there have been some displacements of SSF vessels between nearest ports but even towards other ports from the western Mediterranean looking for better possibilities for the marketing of the catch. Another reason could be the incorporation, although few, along the last 10 years of middle age people being currently between 30 and 45 years old (which represent a 64.7% from the total interviewed). Some of them without direct family tradition entered to the fishing activity looking for a "life worth living", with different motivations and values and sharing a renovated insight on fishing based on social, economic and ecological sustainability discourses and starting new seafood marketing projects. But they are also fishers belonging to families of fishers that were rattled by the severe economic crisis that gripped the Spanish economy in 2011, affecting their jobs in land, and who decided to took up the family fisheries-related enterprise. Moreover, there are also punctual incorporations that come from more industrialized fisheries from vessels that were scrapped as a result of the implementation of regulation policies (e.g shrimp management plan). Although, the direction will take this weak workforce renovation it is uncertain likewise the future of the emergence of those new projects of marketing and recreational activities presumably growing accompanied by an heritagisation process of the fishing activity in which the touristic activities it is expected to increase (Doyon and Carbonell, 2019). The situation for the OTB seems more dramatic. According our data only 3 from 11 OTB vessels forecast the enterprise continuation with the sons and/or nephews, and only in two cases a young fishing captain learner despite not belonging to the owner family it is expected will continue with the enterprise. Furthermore, interesting to note that unlike purse-seiners which staff is composed in 30% of migrants, we have not almost found migrants working in trawl vessels.

5. CONCLUSIONS

Our paper shows that fishers are not individuals acting under pure economical rational behaviour but social actors whose activity is embedded in social relations and the environment in a dynamic complex relationship of values, norms, policies, technology, economic motivations which are deployed both at sea and in land. To what we have to add, as happening in other fisheries communities of the world, the changes affecting the socio-economics and bio-physical factors interdependencies, which are not regardless to new market demands and

conditions neither new governance plans at the rate of environmental changes (Thiault et al., 2019).

Whereas overcapacity of vessels does not produce major profits, policies should consider the social and cultural capitalisation in future measures for integral sustainable fisheries management. Besides the recommendations of Sánchez-Lizaso et al. (2020) of reducing fishing time but together with implementing permanent and seasonal closures to fisheries, selectivity improvements and local co-management plans we add that also stablishing quotas for co-managed specific species (e.g. shrimp and sand eel) will should take into account to improve the resources availability. Furthermore, vessel adaptation to new challenges would increase if the local ecological traditional knowledge is integrated into co-management plans. Finally, policies should support fishing communities with the land-based activities, and marketing strategies but also initiatives of environmental conservation through more sustainable ways of producing (e.g. using technology of low impact) altogether with recreational activities to promote responsible consumption and environmental awareness towards widening the food variety. Finally, ensuring generational replacement which it is very weak and ill-defined, despite punctual new incorporations including those looking for a life more according their life expectations who could be called as "neo-seafarers". Therefore, policies to open the hiring to people in fisheries and/or activities fisheries-related in the frame of multifunctional system to support the generational replacement and employment creation are urgent. At the same time that giving more visibility to the different contributions by roles of working in fisheries economies incorporating the gender and ethnic perspective would help to identify aspects we also need to pay attention to improve fisheries economic performance.

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