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Marine protected areas in the Atlantic arc

Fisher participation in data collection and advice provision within an MPA: the Luiz Saldanha Marine Park (Portugal) case study.

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Field Study Report

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Fisher participation in data collection and advice provision within an MPA: the Luiz Saldanha Marine Park (Portugal) case study

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Contents

Abstract

The project MAIA (Marine Protected Areas in the Atlantic arc) provided an opportunity to address the problems of fishery data quality within an MPA (Marine Park Luiz Saldanha – PMLS) through a partnership between fishers and scientists. The long-term goals of this partnership were to reinforce the trust among stakeholders, improve accuracy in catch data and, eventually, enhance fisheries management within the MPA by the elaboration of proposals with scientific and fisher backing. For that a model for fishery data collection through anonymous self-register by fishers was tested for 16 months, aiming to describe fishing reality in PMLS and to derive appropriate indicators (biological and socioeconomic) for fishery monitoring and MPA management effectiveness evaluation. This report presents a summary of the MAIA study that was proposed to PMLS fishers, together with its execution and main findings in relation to participatory monitoring. Results are discussed in relation to the specific objectives set by the project, but also within the wider context of tensions and dilemmas resulting from working in the peculiar frontier between empowerment and regulation in small-scale fisheries that interact with MPAs.

I. Background and rationale for the study

The Natural Park of Arrábida (Parque Natural de Arrábida – PNA) was created in 1976 to protect one of the most important green areas within the metropolitan region of Lisboa-Setúbal in SW Portugal (Figure 1A) from increasing anthropogenic pressure and degradation. Although the original decree also considered that the coastal zone of Arrábida deserved special consideration, the Marine Park Luiz Saldanha (Parque Marinho Luiz Saldanha - PMLS) was only designated in 1998 as the seaward expansion of PNA. PNA currently covers an area of 176.5 km^2, of which 52.75 km^2 are marine (PMLS), encompassing sites with geological, botanical and zoological interest that form the basis for spatial zonation with variable degrees of protection and restrictions (from areas were practically all human activities are prohibited to areas were most activities are allowed under specific conditions). In 2003 PNA was formally included in the Natura 2000 network (both terrestrial and marine) by the designation of a Special Protection Area (SPA) in Cape Espichel following the Birds Directive, and of a Site of Community Interest (SCI) in Arrábida/Espichel following the Habitats Directive. Finally, in 2005 was published the specific plan that regulates all human activities within the PNA (including PMLS) and also defines the zonation of PMLS into one total protection – reserve - area (about 5% of total), 4 partial protection areas (about 39% of total) and remaining complementary areas (Figure 1B).

The legislative acts of 1998 and 2005 brought specific additional regulation to fishing within PMLS, beyond that generically applied to commercial fishing in the continental shelf of mainland Portugal (e.g. Cabral et al 2008). In 1998 was prohibited the use bivalve dredgers and the hand-pick of bivalves with the use of autonomous scaphander across PMLS. In 2005 prohibition was extended to other trawling gears, to all hand-picking (commercial and recreational) and to recreational spear-fishing. In addition, the maximum size of fishing vessels operating in PMLS was set to 7 m of total length, which effectively prohibited the entry of purse seiners operating from the harbours of Sesimbra and Setubal. Finally, for vessels < 7 m operating with static gears and registered to the harbour of Sesimbra, a specific license was created to allow fishing within the PMLS (renewed annually given sufficient registered activity in previous year or sufficient justification for lack of it) and additional restrictions were set in the use of static gears across zones (progressively implemented until 2009) and the transfer of licenses and vessels (PMLS license can only be maintained if vessel is passed from father to children, being lost in all other scenarios of transfer or transaction).

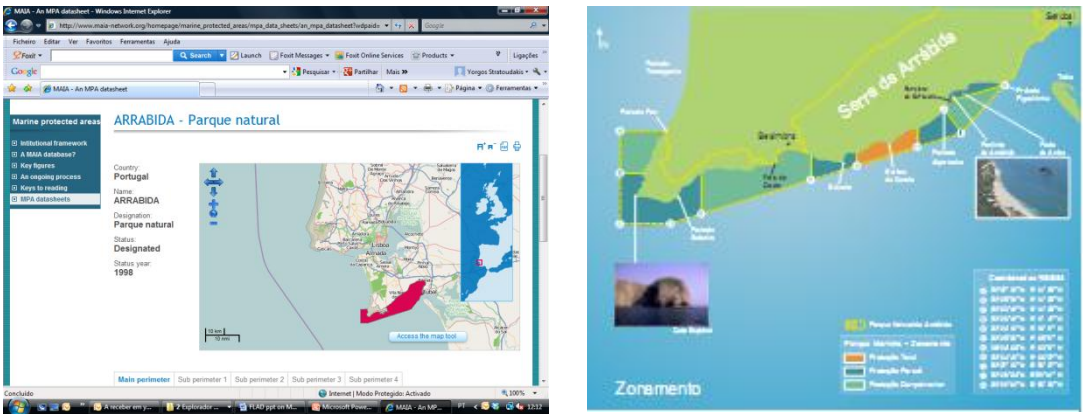

Figure 1: Left: Location of Marine Park Luis Saldanha (PMLS) as depicted in the MAIA database; Right: Zonation of Arrabida Marine Park reproduced from ICNF portable card for users (orange indicates reserve area of total protection, dark blue indicates areas of partial protection and lighter blue indicates complementary areas of the MPA).

In 2006 (first year of PMLS plan implementation), 113 commercial fishing vessels registered to the fishing harbour of Sesimbra, demonstrating fishing activity within 2005 and being smaller than 7 m total length were granted a license to fish within the MPA. Of the PMLS licensed vessels, 77 were smaller than 5 m total length. This separation by length category is informative, as it distinguishes fleet components with different characteristics (Figure 2). Smaller vessels (locally known as *aiolas*) are older, predominantly wooden, open-decked, have low power engines (usually < 10 HP) and are operated by a single fisher (vessel owner) that usually has 2-3 fishing licenses only related to hooks and lines. Comparatively larger vessels (locally known as *botes*) are more recent, usually made of fiber and some of them semi-enclosed, have more powerful engines (> 40 HP) and are often operated by 2 fishers that have 4-5 fishing licenses that also include set nets and/or pots. Fishers with smaller vessels are generally older, often non-associated; fishers with larger vessels are slightly younger (but generally >40 y) and practically all are members of the local fisher Association (AAPCS – Associação de Armadores de Pesca Artesanal Centro e Sul).

All vessels that were granted a PMLS license in 2006 had a valid fishing license as emitted by the national fisheries authority (currently DGRM – Direcção Geral de Recursos Naturais, Segurança e Serviços Marítimos). By 2011, the number of authorized fishing vessels in the PMLS was reduced to 68. The reduction was more accentuated in the 3-5 m vessels category (*aiolas* were reduced from 68% to 62% of the authorized total within 5 years) and during the first year of implementation (when 53% of the total reduction until 2011 took place). According to the PMLS managing authority (currently ICNF – Instituto da Conservação da Natureza e das Florestas), the great majority of license eliminations has been due to vessels that did not conduct any fishing activity or performed very little activity and did not seek to provide any justification for not attaining the required 100 registered landings in the previous year

(rule for renewal of PMLS license). However, apart from the elimination of vessels from the PMLS, the rule of 100 days has also created an incentive for over-reporting or mis-reporting of landings. As a result, this rule has further contributed to the unreliability of landings data from small scale fishing vessels (where log-books are not compulsory, registered landings do not identify fishing gear or area, or black landing of valuable species is frequent), rendering them unsuitable for monitoring or for providing specific fisheries management advice within the PMLS.

Figure 2: Example of *aiola* (left) and *bote* (right) operating within the PMLS (photos by Miguel Carneiro).

The INTERREG project MAIA (Marine Protected Areas in the Atlantic arc), with partners from Portuguese public institutes responsible for nature conservation (ICNF) and fisheries research and advice (currently IPMA – Instituto Português do Mar e da Atmosfera) respectively, provided an opportunity to address the above problem of fishery data quality in PMLS through a partnership with the local Fishery Association - AAPCS. The long-term goals of this partnership are to reinforce the trust among stakeholders, improve accuracy in catch data and enhance fisheries management within PMLS by the elaboration of proposals with scientific and fisher backing. The short-term specific objectives of the study under MAIA were to:

- propose and test a model for fishery data collection that is effective, simple, cheap, and can have temporal continuity;
- describe fishing reality in PMLS, based on local knowledge;
- derive appropriate indicators (biological and socioeconomic) for PMLS fishery monitoring and MPA management effectiveness evaluation.

The rest of this report presents a summary of the MAIA study that was proposed to PMLS fishers, together with its execution and main findings in relation to participatory monitoring. Results are discussed in the context of the specific objectives set by the project, but also within the wider framework of seeking equilibria between empowerment and regulation in the context of small-scale fisheries (Jacobsen et al 2012).

II. Selected methodology

The methodology selected to monitor the PMLS fishery was voluntary self-register by fishers, adapting a process previously applied experimentally for monitoring small-scale fisheries across Portugal (project *Small-scale fisheries monitoring* led by *Quarto.Seis* for DGRM during 2008-2010). The method is based on an assumption of willing participation and truthfulness, both attributes that can only be stimulated at the onset of the study and verified at its end. To stimulate willingness of participation, the proposal was first discussed with the leadership of AAPCS (summer/autumn 2010) to guarantee its consent and collaboration. Subsequently, a feasibility study was undertaken for 2 months in late 2010 with 3 volunteering fishers of the Association to demonstrate that the selected register of daily fisher practices (Figure 3) was easy and rapid to respond. Finally, an official presentation of the MAIA study proposal took place in December 2010 (Figure 4) aiming to explain to PMLS fishers the objective of the study, demonstrate the feasibility of their active participation and the potential benefits resulting from it. To stimulate truthfulness, it was agreed, with the tacit approval of the PMLS and national fisheries authorities (ICNF and DGRM respectively), that the voluntary self-reporting scheme would be anonymous, to guarantee the impossibility of individual penalization resulting from reports of lack of compliance. After the meeting and following fishers´ suggestion, it was agreed that the secretariat of the Association would act as the focal point for the collection and anonymization of registers prior to delivering to the participating scientists.

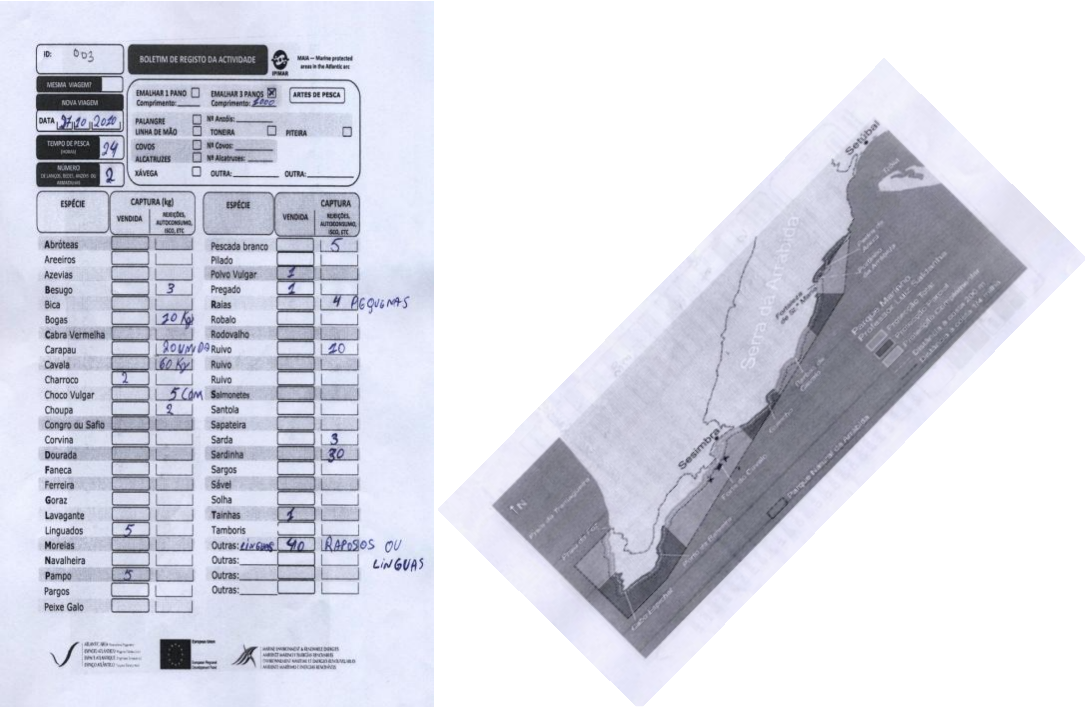

Figure 3: Example of self-register sheet filled-in by a fisher for a single day activity with trammel nets in the complementary area off Sesimbra.

During the meeting, apart from the methodology and the reasons for developing it, were also clarified the expectations that should and should not be held by participating fishers. It was explicitly assumed that:

- ✓ confidentiality of registers is guaranteed;
- ✓ data will never be used in ways that reveal individuals or for control purposes;
- ✓ data will be used integrally and, possibly, be published in scientific journals;
- ✓ results will regularly be presented to fishers and other organizations;
- ✓ management proposals by IPMA will only be publicly presented after debate with fishers and based on study conclusions.

It was also explicitly assumed during the meeting that the fishers should not expect that:

- ✓ the study can guarantee a timeline for the revision of the PMLS spatial plan;
- ✓ the results will unequivocally support the requests and aspirations of the PMLS fishers.

Within the study period and in association with MAIA, some additional activities and events provided opportunities for interaction and interim reporting, namely:

- o experimental licensing for red mullet (*Mullus surmuletus*): temporary authorization (January to April) to use gill nets of 60 mm to target red mullets within the PMLS, on the condition of providing an anonymous daily report of activity and not using any other gear in the MPA;
- o fisher basket initiative: initiative by an NGO (Liga para Proteção da Natureza – LPN) and the Municipality of Sesimbra to set-up a community supported fishery program;
- o catch sampling on land: ad-hoc sampling of catch during arrival of vessels on land ;
- o public presentations of MAIA studies, nationally and internationally: discussion during the preparation and presentation of progress reprorts with members of the direction of AAPCS.

Figure 4: Presentation of MAIA study proposal to PMLS fishers, both those belonging to the local Association and those non-associated (meeting on December 2010 at Municipality of Sesimbra, with the presence of representatives from the PMLS authority, the national fisheries authority and the local Municipality).

III. Main findings

Participation: The study lasted 16 months (from January 2011 to April 2012), resulting in 1027 valid registers of fishing events anonymously reported by 22 fishers (Table 1). Most registers were provided for pot (30% of total), trammel net (29%) and gill net (24%) fishing events. Considerably less information was made available for jigs and lines. Considering that PMLS fishery is composed by approximately 40 *aiolas* mainly dedicated to hook and line fishing and 25 *botes* dedicated to other static gears or combinations, approximately a quarter (22.5%) of the first group and half (52%) of the second participated at some stage in the study. However, the median number of registers by participating fisher was only 31 events (ranging from 3 to 160), with many fishers only participating for a short period (2 fishers stopped participating after the first month and another 3 after the first trimester). Most other fishers collaborated only providing sporadic registers, with just 4 fishers having provided more than 100 registered events along the 16 months of the study.

Table 1: Summary of self-registers by gear during the 16 months of the study in PMLS. Total period corresponds to 14 months of the study and total number of fisher is distinct from the sum of fishers that participated in each gear since some fishers registered use of more than one gears (up to 3).

Gear	Period (days)	Fishers (number)	Events (number)
Gill net	482	10	244
Trammel net	471	7	295
Hand line	1	1	1
Octopus jig (piteira)	101	3	38
Long-line	372	6	60
Squid jig (toneira)	356	7	85
Pots	482	6	304
Total	482	22	1027

Figure 5 shows the monthly evolution of participation in the study (left) in comparison to the fishing activity of PMLS vessels as registered in the DOCAPESCA of Sesimbra along 2011. In the early months of the study self-register corresponded to more than 15% of the official landing trips by PMLS vessels and coverage reached a peak in April 2011 (>20%). This was a month that included the compulsory register of vessels using an experimental license for red mullet and coincided with a period of additional effort to convince fishers to participate (through extra meetings and regular probing by the secretariat of the association). However, after the cessation of the experimental license in May 2011, coverage was progressively reduced along the year and remained at similar levels in the first months of 2012 (when fishing for red mullet in the PMLS was resumed). Given these poor levels of adherence, it was decided to conclude the trial in April 2012.

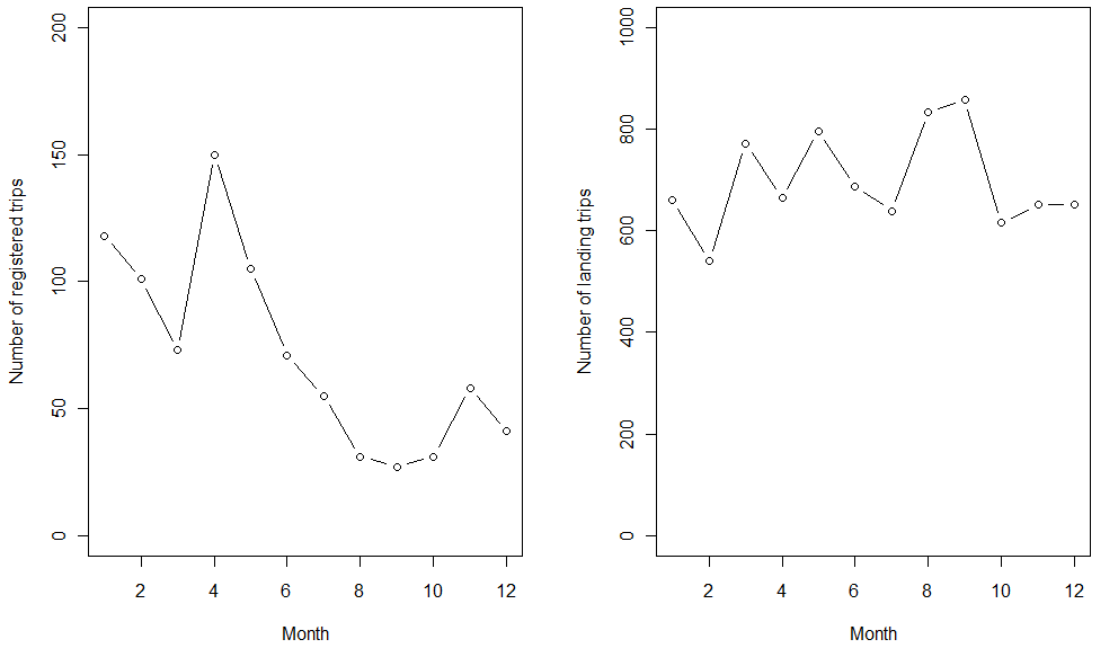

Figure 5: Number of self-registered trips (left) and number of trips with declared landings (right) by PMLS-licensed vessels monthly along 2011.

Register completeness and consistency: Of the 1161 registers provided during the study period, 20 were not used because they missed basic identifiers (date and/or gear used) and 114 were excluded because they provided the catch from two distinct gears in the same register (most of them pots and trammel nets). Among the remaining registers considered valid for the analysis (i.e. with sufficient information on fishing gear, date and catch composition), Table 2 summarizes the degree of completeness in terms of spatial information (signaled PMLS zone at back page of register), gear dimension characteristics (length of net or number of hooks or pots) and duration of the fishing operation (soaking time) per set. Overall, completeness was highest for fishing duration and lowest for gear dimension (the latter also affected by the unaccounted fraction of fishers that provided less precise measures of gear size for gill nets), but in all cases the majority of registers contained the requested information. Long-line was the gear with higher global levels of incompleteness, while nets were less prone to provide spatial information.

Table 2: Summary of registered events by gear (number and percentage of total) that provided spatial, gear dimension and fishing duration information.

Gear	Spatial register	Gear dimension	Fishing duration
Gill net	172 (70%)	132 (54%)	238 (98%)
Trammel net	194 (66%)	288 (98%)	279 (95%)
Octopus jig (piteira)	38 (100%)	NA	38 (100%)
Long-line	52 (87%)	27 (45%)	25 (42%)
Squid jig (toneira)	69 (81%)	NA	77 (91%)
Pots	279 (92%)	304 (100%)	278 (91%)
Total	804 (78%)	651 (72%)	935 (91%)

Figure 6 shows the results of a classification tree that partitions the provision of spatial information in the register (binary variable: yes or no) into progressively more homogeneous groups as a function of gear, phase within the study period and catch level. The selected tree indicates that the percentage of registers with spatial information was considerably higher for catch levels > 15.5 kg, with all gears other than gill nets having 91% of spatial registers. For catch levels < 15.5 kg register reduced to 62%, being lower for trammel nets and pots (39%), particularly during the first half of the study (just 19% of spatial reference in the 129 trammel net or pot events registered within the first 212 days of the study period). On the contrary, for all other gears under low catch levels, spatial register became worse with the advance of the study (passing from 98% in the 139 events until day 271 of the study to 43% in the 65 events after). Finally, it is worth noting that the only indication of omission of spatial information with increasing catch levels was found in gill nets, where spatial register was considerably poorer in the 55 events with >55.5 kg catch (42%) than in the 126 events with intermediate catch range (83%).

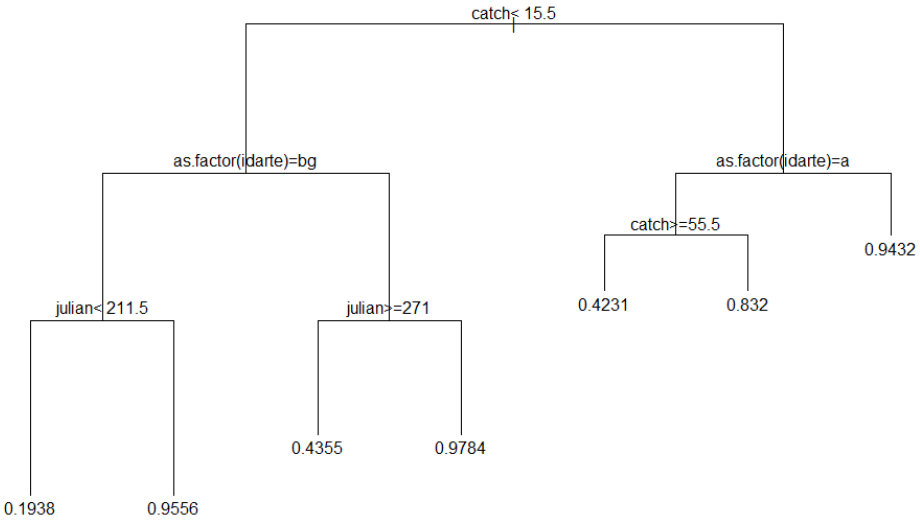

Figure 6: Classification tree summarizing proportion of registers with spatial information (n=1027) during recursive partitioning of events, as a function of gear, catch level (kg) and phase of study period (idarte, catch and Julian respectively in the legends). Split points in the tree demonstrate the variable and cut-off point that creates the smallest prediction error at each partition level (e.g. the first split point is for variable catch and with a cut-off point at 15.5 kg). Nodes resulting from split points are either intermediate - leading to new split points and further nodes, or terminal - leading to estimates of mean value for the response variable (estimated mean proportion of presence of spatial registers in this case).

Apart from the above exercise of indirect validation, there is some additional evidence that appoints to satisfactory register quality, resulting from the existence of information that fishers know it would be impossible for scientists to obtain from other sources and from demonstration of consistent patterns in the data after combination among distinct providers. The former is deduced by spatial registers in areas where fishing activity is not allowed within the MPA or gear dimension registers above those stipulated by fisheries law (both cases limited, but existing), catch registers of species that were not present in the list of species transactions in 2011 at the harbour of Sesimbra (small quantities of valuable crustaceans) and catch registers superior or very disproportionate of sample size in comparison to official annual fleet landings (most evident in valuable flatfish, like soles – *Solea* sp. - and wedge sole *Dicologlossa cuneata*). The latter derives from Figure 7 that demonstrates a significant linear relationship between total catch and total effort in each event when considering together all data provided by 6 fishers for 304 events of pot fishing (note that legal effort limit for vessels <9m is 500 pots). Nevertheless, the graph also allows to detect outlying performance, with one fisher demonstrating considerably higher variation in

CPUE than all others, as a result from registering a constant daily effort for very variable levels of octopus (*Octopus vulgaris*) catch.

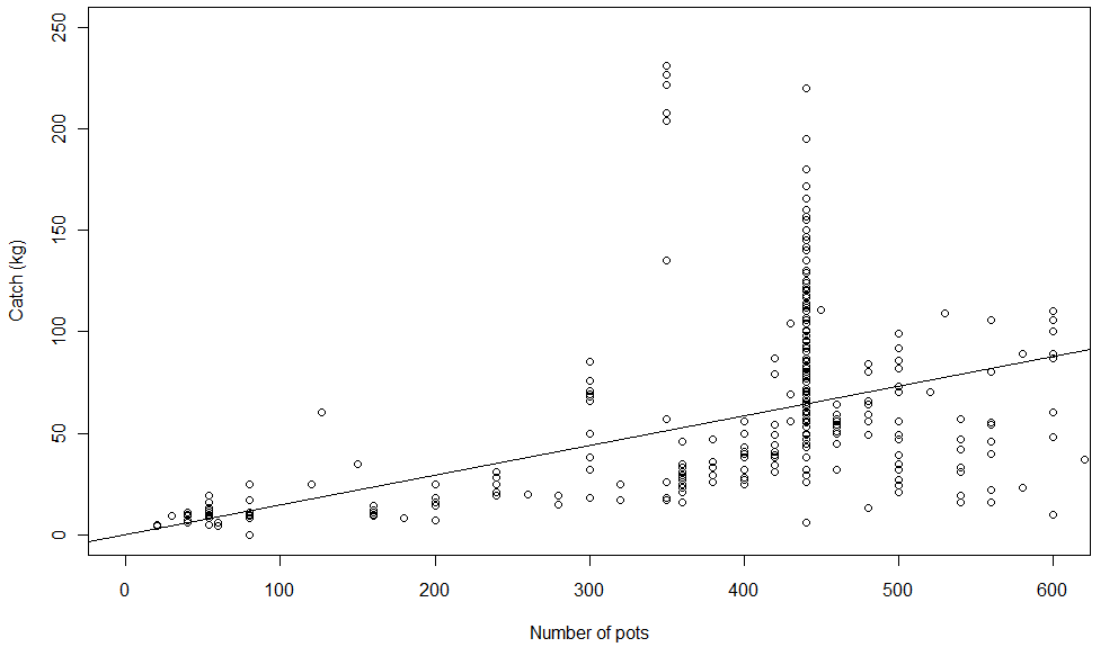

Figure 7: Relationship between registered catch and daily effort (number of pots per fisher) for the pot fishery for octopus in the PMLS. Solid line corresponds to linear model with no intercept and slope of 15.9 kg per 100 pots.

PMLS fishery characterisation: Based on the information obtained from the registers, the following general statements can be made in relation to the characteristics of the PMLS fishery:

- Areas: Licensed fishers use the area outside the PMLS more than anticipated; 33% of the trips with spatial information took place, at least partially, outside the MPA and 17% did not perform any fishing within the MPA (percentages rise to 44% and 33% respectively when total catch is considered instead of number of trips);
- Gears: As expected, PMLS fishers use more than one fishing gear - some of them even simultaneously - but some combinations are much more likely than others: fishers that used lines and jigs tended to be distinct from those that used other gears (only 2% of registers where of other gears for the 9 fishers that registered long-line or jig events), giving further support to the separation of two fleet components (*aiolas* and *botes*); fishers that mainly used pots also used to some extend trammel nets and/or gillnets, while fishers that mainly used nets were less likely to also use pots;

- Catch: For multi-species gears (relevant only for nets and long-lines, given that pots and jigs are very selective for cephalopods), the lists of most caught (in weight) and most frequently caught species (Tables 3 and 4 respectively) confirm that main species composition profiles are distinct for the three; further, it also shows (together with Table 5) that there are potentially significant differences in catch revenues among gears (despite similar mean levels of total catch per trip), since revenues seem higher and more predictable (i.e. more stable, with less inter-trip variation) for pots and trammel nets in comparison to long-lines and gill-nets;
- Discards: The comparison of Tables 3 and 4 also denotes the relatively infrequent catch of large quantities of semi-pelagic fish, especially chub mackerel (*Scomber colias*), by both gill-nets and trammel nets; according to the registers (but also in situ observations during sampling of catches on land), at least 50% of chub mackerel and horse mackerel (*Trachurus trachurus*) and more than 75% of bogue (*Boops boops*), blue jack mackerel (*Trachurus picturatus*) and sardine (*Sardina pilchardus*) are discarded when caught – unintentionally – by nets in and around PMLS. This is a topic that clearly deserves additional attention because it is both wasteful in natural resources and labour (hauls dominated by these species lead to many hours of disentangling and mending the nets with little or no revenue associated).

Table 3: List of the five most important species (in weight) in the catch of nets and long-lines as obtained from register data. Values in parenthesis indicate mean catch weight in a daily trip by each gear and corresponding mean % contribution of each species.

Rank	**Gill net** (40.1 kg)	**Trammel net** (46.3 kg)	**Long line** (39.0 kg)*
1	*Scomber colias* (8.5 kg, 21%)	*Scomber colias* (12.5 kg, 27%)	*Raja* sp. (7.6 kg, 19%)
2	*Boops boops* (6.7 kg, 17%)	*Solea* sp. (7.2 kg, 15%)	*Dicentrarchus labrax* (5.7 kg, 15%)
3	*Trachurus trachurus* (6.5 kg, 16%)	*Sepia oficinalis* (5.0 kg, 11%)	*Sparus aurata* (4.2 kg, 11%)
4	*Merlucius merlucius* (5.1 kg, 13%)	*Dicologlossa cuneata* (4.7 kg, 10%)	*Conger conger* (3.6 kg, 9%)
5	*Pagelus acarne* (2.6 kg, 6%)	*Trachurus trachurus* (2.6 kg, 6%)	*Diplodus* sp. (3.5 kg, 9%)

* Possible distortions due to small sample size: practically all rays and most seabream caught in few trips by a single vessel outsider the PMLS.

Table 4: List of the five most frequently caught species in nets and long-lines as obtained from register data. Values in parenthesis indicate number of trips by each gear (header) and corresponding number of trips where each species was caught and % frequency for each gear.

Rank	**Gill net** (244)	**Trammel net** (295)	**Long line** (60)
1	*Merlucius merlucius* (155, 64%)	*Solea* sp. (249, 85%)	*Diplodus* sp. (21, 35%)
2	*Trachurus trachurus* (152, 62%)	*Sepia oficinalis* (211, 72%)	*Dicentrarchus labrax* (14, 23%)
3	*Mullus surmuletus* (144, 59%)	*Raja* sp. (146, 49%)	*Sparus aurata* (14, 23%)
4	*Boops boops* (132, 54%)	*Dicologlossa cuneata* (112, 38%)	*Muraena helena* (14, 23%)
5	*Pagelus acarne* (127, 52%)	*Octopus vulgaris* (71, 24%)	*Octopus vulgaris* (13, 22%)

Table 5: Mean catch (and % coefficient of variation) and mean price (from 2011 harbour auction in Sesimbra) for the most frequently caught species for each gear in PMLS.

Gear	**Most frequently caught**	**Mean catch, kg (CV%)**	**Mean price, €/kg**
Gill-net	*Merlucius merlucius*	5.1 (264%)	3.11
Trammel net	*Solea* sp.	7.2 (169%)	12.71
Long-line	*Diplodus* sp.	3.5 (229%)	11.10
Pot	*Octopus vulgaris*	60.4 (73%)	5.97

MPA monitoring indicators: Although the information obtained in the registers allows a more reliable characterization of PMLS fishing activity in comparison to previously available public information, the incomplete and variable over time participation precludes the estimation of catch and effort totals for the fishery. As such, it also precludes the creation of fishing pressure indicators or of socio-economic indicators of total costs and revenues based on PMLS annual fleet data by gear. However, it allows the use of species catch per unit of effort data to obtain indicators of relative abundance and compare them temporally or spatially (Figure 8a). Nevertheless, Figure 8 also shows that small sample sizes (in terms of distinct fishers providing information) and unknown degree of randomness in fisher sample selection recommend particular care in the interpretation of these data. For example, based on the aggregate data, it seems tempting to indicate that there is a significant difference in CPUE within and outside the MPA and that there is a seasonal trend along the year (with higher relative abundance in winter months). Nevertheless, when decomposing the data by fishers,

these differences either become imperceptible (the seasonal pattern) or are mainly based on differences between fishers (the spatial pattern).

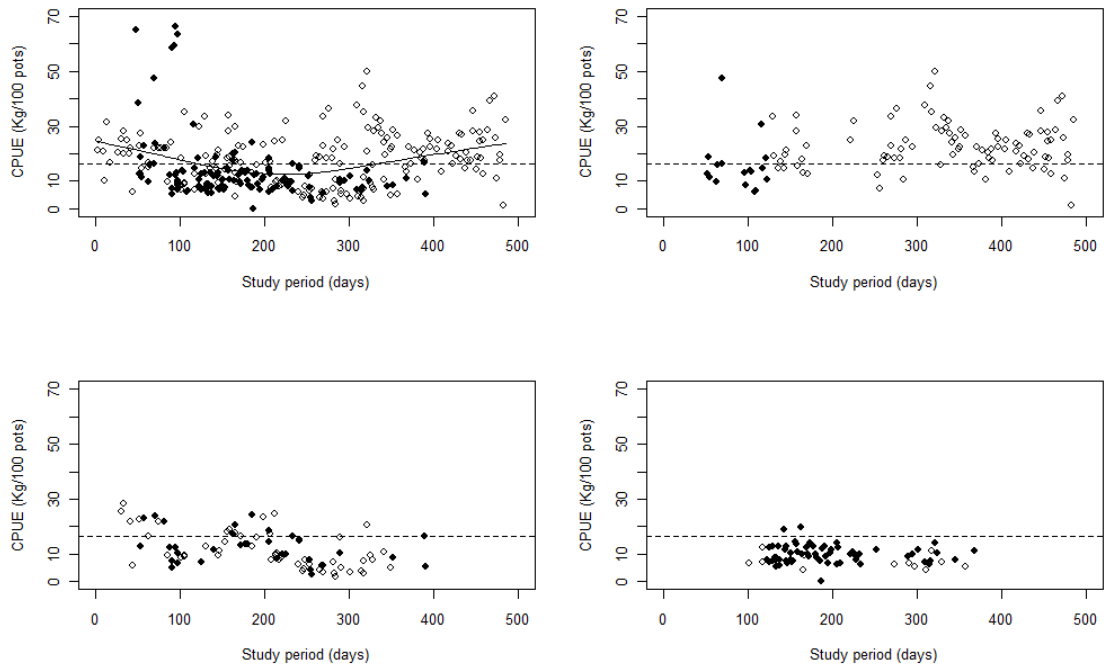

Figure 8: Temporal evolution and spatial comparison of catch per unit effort (kg caught per 100 pots) in the daily register for pots, overall (top left) and separately for the three fishers that provided most information during the study for this gear. Empty circles depict events within PMLS and full circles events that had at least some part outside. Full line in top left panel indicates smoother of temporal trend and dashed line in all panels indicates mean CPUE across registers.

IV. Balance and first conclusions

Comparing the outputs of the project with the study objectives, the following comments can be made:

- *Method utility*: the method was simple and cheap, and did allow to collect basic fisheries information in relatively large quantities and at a discrimination level that was not previously available for the PMLS; anonymity towards the researchers (with the help of the Association secretariat) proved a necessary additional condition that possibly enhanced fisher trust and register quality (with some doubts remaining on the experimental fishery for red mullet, where the proportion of missing spatial data was higher when catches were highest); despite the involvement of the Association and the good inter-personal relations between scientists and fishers, expectation of full participation was, in retrospect, unrelastic – targeting distinct sampling rates for the two strata would have probably been a more viable and adequate design; finally, temporal continuity proved problematic - on balance, we consider that unless some mild statutory obligation (that can be operational for the collectivity even under individual anonymity) can be associated to the conditional attribution of some tangible incentive or priviledge, reliable self-register of fishing activity is difficult to become a long-term routine in small-scale fisheries, even in situations where such information would clearly facilitate the revisition of contentious management points.

- *Understanding PMLS reality*: the exercice was successful in allowing scientists to obtain a clearer notion of the fishing reality within the MPA, although it is difficult to separate the relative contribution of this trial from the remaining activities and interactions that took place in the same period; at this stage, it is likely that the evaluation of fishers is not as positive, given that the objectives considered legitimate for them at the onset of the study depend more on the outcomes rather than the outputs of the trial; overall, we consider that a more global evaluation will be possible after the main findings (e.g on distinct characteristics and needs of *aiola* and *botes* fleet components, degree of MPA area use by *botes*, different level and stability of revenue among gears, discards of pelagic and semi-pelagic species, etc.) have been adequately processed and discussed with interested parties aiming to address pending management problems in the PMLS.

- *Deriving MPA indicators (biological and socioeconomic)*: the incapacity to convince all PMLS fishers to provide self-registers precluded the direct estimation of total activity within the MPA (e.g. fishing effort, yield and revenue overall and/or by gear); although stratification by fleet component would have been a more viable design, exploration of systematic differences in performance between volunteers and non-volunteers and auxiliary information (in the case of *botes*) to relate the authorized fishing gear licences to those effectively used by PMLS vessels would still have been required to obtain unbiased estimates of totals; overall, the degree of coverage of the *botes* fleet component may permit the estimation of indicators of relative abundance for focal species by main gear (e.g. octopus CPUE in pots, sole and cuttlefish CPUE in trammel nets, red mullet CPUE in gill nets), but with considerable levels of both within and between fisher variation; as an alternative, a research line based on interviews and questionnaires was proposed by the Association for long-term monitoring and was tested in the second part of the MAIA project.

Finally, Jacobsen et al (2012) identify five dilemmas that tend to arise within any fisher-scientist relationship as a result of the inbuilt tension between empowerment and regulatory control within the very context of cooperation. All of these dilemmas (or aspects of them) were somehow recognized at the design phase of the study and strategies to address them were defined, although the execution of the study in all cases demonstrated some additional nuances of the problem. We conclude by providing a brief report in relation to each dilemma in the case of the participatory monitoring and its outputs presented in this study:

1) *Should links between management and research be emphasized or de-emphasized?*

The study was designed explicitly aiming to strengthen links with management at the outcome level, both locally (through ICNF for PMLS management) and nationally (through DGRM for small scale fisheries management). This intention was emphasized from the start, coupled with an effort to guarantee safe and transparent uses of data for advice (and NOT for control) and to define legitimate fisher expectations (and NOT to sign a blank check on all fisher aspirations). Despite this effort and some tangible success during the study (efficient operationalization of a long-lasting fisher aspiration for a seasonal red mullet fishery within the PMLS), the general feeling is that the study has fallen short to fisher expectations as revealed by progressively lower motivation and collaboration.

2) *How close should the relationship between scientists, fishers and managers be?*

Relationship between scientists and fishers and between scientists and managers was planned to be as close as possible, aiming to bridge the gap and personal distrust that had been created between fishers and PMLS managers along the process of MPA designation. It is too early to evaluate whether this strategy has led to any improvement and would require an external evaluation, but some events during the study demonstrated that some prejudices persisted. This option clearly put a lot of pressure on the participating scientists that managed to maintain a functional relation with both sides along the period and to promote some tense but civilized meetings among entities, although voices occasionally surfaced suggesting scientists being too close to managers or too close to fishers.

3) *How widely should the data gathered in participatory research be shared among researchers?*

Data usage was designed to be complete towards management advice and to serve towards publication by the participating scientists, but no provision was made for potential sharing of the raw data with other scientists. Non-selective use of data was a prerequisite that, if challenged by fishers, would have led to cancelation of the trial. Unconditional data use for publication was a wish of the participating scientists that, if challenged by fishers, could have led to an alternative negotiation of data use for public dissemination among researchers. Neither of these requests were challenged at the onset or during the study, although the full understanding of the range of their implications remains to be evaluated by both sides.

4) *How to handle differences in work demands?*

This is an issue that was inadequately planned and frequently created operational dilemmas, both in relation to data collection and use. In terms of data collection, although the feasibility study demonstrated clearly that the register was easy and fast to fill-in, several fishers among those willing to collaborate did not manage to adapt to the regularity and discipline of its requirements. Similarly, participating scientists did not manage to be present close to the fishing operations with the regularity that fishers considered necessary or sufficient to obtain a clear understanding of the practice. Finally, there was a clear difference in the perception of elapsed time and the reasonable duration of acts anticipated to have a visible repercussion in management (leading to the frustration of both parts).

5) How to communicate across professional cultures?

The study aimed to be universal in reach and effective in communication with PMLS fishers. Although all participating scientists had large previous experience of interactions with fishers and fisher Associations, universality of participation was clearly an operational target set too high, despite the close collaboration of the Association (mainly because most *aiola* fishers do not belong to the Association and were difficult to reach). Communication proved more effective in smaller groups, either with the representatives of the Association or in one to one meetings with fishers, and less effective in larger meetings (more than 5-6 people and more than two institutions) that mainly served to transmit messages (both within and across groups or institutions) rather than communicate.

V. Relevant Literature

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MAIA

Marine protected areas
in the Atlantic arc

Towards an Atlantic network of Marine Protected Areas

The purpose of the European Marine Protected Areas in the Atlantic arc (MAIA) project is to create a **network of MPA managers and stakeholders**, who will take initiatives on an international level in terms of designation, governance and management. This will be to enhance the **development of a consistent, efficient and accepted MPAs network** in the Atlantic arc.

MAIA is structured in four main technical lines of work:

- Establishing a status report on the existing MPAs
- Setting up common monitoring strategies
- Implementing management plans
- Involving stakeholders

MAIA gathers 9 partners from 4 countries: United Kingdom, France, Spain and Portugal, **involved in MPAs designation and management.**

As lead partner, the French Marine Protected Areas Agency, coordinates the project implementation.

The 2010 – 2012 Action Plan

Organisation of technical workshops on common MPA management issues in the Atlantic arc.

Site visits in each partner country to enhance the sharing of information, knowledge and know-how.

Overview reports to compare MPAs' situation in the Atlantic arc.

Field studies to be carried out by MAIA partners, promoting the exchanges within the network.

Creation of a dedicated website, including a private collaborative space, a document database and a GIS database used to establish a baseline on the status of MPAs in the Atlantic arc.

Production and dissemination of document resources.

www.maia-network.org

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