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MONITORING THE ARTISANAL FISHING EFFORT IN MARINE PROTECTED AREAS ON THE FRENCH MEDITERRANEAN COAST

Laurence LE DIRÉACH¹, Gwenaël CADIOU & Charles-François BOUDOURESQUE

RÉSUMÉ

De nos jours, les mesures de gestion du patrimoine naturel des aires marines protégées méditerranéennes doivent être définies en tenant compte à la fois des objectifs de protection et du maintien de la pêche artisanale traditionnelle. Les gestionnaires ont besoin *(i)* d'une connaissance précise des pratiques de la pêche, *(ii)* d'un suivi dans le temps d'indicateurs pertinents de l'activité de pêche (ressource et effort de pêche) et *(iii)* d'une concertation avec les pêcheurs professionnels. Différentes méthodes (agenda de pêche, cartes journalières de distribution des engins de pêche, embarquement à bord des bateaux de pêche, enquêtes dans les ports de débarquement) ont été utilisées dans deux aires marines protégées, le Parc national de Port-Cros (côte continentale de France) et la Réserve naturelle de Scandola (Corse), et peuvent être utilisées dans d'autres sites selon la nature de la coopération entre les pêcheurs et les gestionnaires des aires protégées. Les enquêtes ont permis de caractériser l'activité de pêche artisanale : description de la flottille de pêche, engins utilisés, rythmes et sites de pêche, espèces cibles. Elles fournissent en outre les données permettant de calculer le rendement par sortie, par filet, par pièce de filet, par type de maille et par espèce. L'information sur la répartition spatio-temporelle de l'effort de pêche est restituée sous forme de cartes (Système d'Information Géographique, SIG).

SUMMARY

Measures taken for the management of the natural patrimony of Mediterranean Marine Protected Areas are nowadays designed in such a way as to take into account both the aims of protection and the maintenance of small scale traditional fisheries. The managers thus need *(i)* detailed knowledge of fishing practices, *(ii)* monitoring over time of indicators relevant to the local fishery (resource and fishing effort) and *(iii)* collaboration with fishermen. A panel of methods (fishing log book, day-to-day charts of distribution of fishing gear, embarkation of scientists, landing port enquiries) have been implemented in the national park of Port-Cros (French Riviera) and in the natural reserve of Scandola (Corsica) and might be adapted for other sites according to the degree of cooperation existing between fishermen and park officers. In both cases, surveys have provided a basis for characterizing the activities of the artisanal fisheries: description of the fishing fleet, the equipment used, the fishing patterns and sites, the species targeted and for calculation of the yield per outing, per net, per piece of net, per type of mesh and per species or category of fish. Information on the space-time patterns of distribution of the fishing effort has been delivered in the form of charts (GIS – Geographical Information System) for different periods of the year.

INTRODUCTION

Until the late 1960s, the key concept behind protected areas was that they were areas not materially altered by human exploitation and occupation, and that

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steps should be taken by the competent authority to prevent or eliminate exploitation or occupation. So, protected areas were seen as “islands” of nature and tranquillity surrounded by incompatible resource uses (McNeely, 1994; Raffin, 2001). Since the 1970s, the notion of protected areas has first moved on to a more general concept of nature conservation, then to a more dynamic one of nature management. It is recognized that conserving nature requires a flexible approach in which local people should not be excluded *a priori*. This is part of the approach (sustainable development) which was formalized and popularized at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in June 1992.

Nowadays, the targets of the Marine Protected Areas (MPAs) are sixfold: (i) to set up conservatories for threatened species and habitats; (ii) to provide sites for public education on the environment; (iii) to provide reference areas for scientific research; (iv) to provide spectacular landscapes for tourism; (v) to establish no-take areas where fish density and sex-ratio make spawning possible, and which subsequently export eggs, larvae and adults to surrounding unprotected areas; (vi) to manage the different uses of the sea (e.g. artisanal fishing, amateur fishing, pleasure boating, scuba diving, snorkeling, bathing) in a rational way, so that they do not conflict with each other or with conservation aims (Agardy, 1997; Sumaila *et al.*, 2000; Francour *et al.*, 2001; Malakoff, 2001; Roberts *et al.*, 2001; Boudouresque, 2002). In order to implement the latter target, MPAs managers need detailed knowledge of the users and of resource uses, and at least relevant indicators for these practices that may be monitored over time. This is especially the case of artisanal fishing, an activity that is profoundly rooted in Mediterranean customs and traditions.

The corpus of methods that have been developed by scientists who study professional offshore fisheries are not well suited for the case of Mediterranean artisanal fishermen. Previous attempts to address specifically the issue of artisanal fisheries in the Mediterranean were developed by Farrugio & Le Corre (1984), Riutort (1989), Aboussouan & Rico (1990), Le Corre & Roscchi (1990), Culioli (1994), Francour *et al.* (1999), Miniconi (2000), Rigo (2000), Criquet (2001) and Cadiou *et al.* (2001). Here, we describe the setting up of a monitoring system for artisanal fishing (fishing practices, fishing effort and catches), based upon *in situ* observations and collaboration with fishermen, in the context of two MPAs, the Port-Cros National Park (French Riviera) and the Scandola Natural Reserve (Corsica).

The Port-Cros National Park, founded in 1963, is the oldest Mediterranean MPA. Its surface area of 1 288 ha is almost totally open to artisanal fishing, with however some constraints (e.g. mesh size of nets, prohibition of trawling). In addition, spear fishing is prohibited everywhere and amateur fishing prohibited in a large part of the park area. The Scandola Natural Reserve was founded in 1975. Its surface area is 1 000 ha, of which 72 ha constitute a no-take area with the remainder only open to artisanal fishermen, with constraints similar to those at Port-Cros.

MONITORING PROTOCOL

Fishing log book. Among the different agreements established between the park authorities and fishermen, the granting of permission to fish within the park waters is conditional on the filling in of a fishing log book. The form of the log book has been proposed by scientists and adapted on the basis of the park managers' and the fishermen's suggestions. The fishermen themselves record one page of the log

book for each outing (one day) in the waters of the park. They have to specify the fished sector, the characteristics of the gear used, the total number of net-pieces (an indicator that is more informative on the fishing effort than the number of nets) and finally their catches per selected target species (Table I).

Size classes (small, medium, large) were defined as one third of the maximum total length-minimum total length range, according to Harmelin-Vivien *et al.* (1985). The log books are collected at the end of the fishing season.

Charts of distribution of fishing gear. The form is subdivided into two parts. The first includes general information: date, time of beginning and end of sampling, meteorology and sea state. The second part is a table which will be completed during the sampling outing (Table II).

The variables determining the fishing effort are collected for each gear which has been observed: the time of observation, the name of the sector of use, the name of the boat (recorded from the gear buoys), the type of gear (if possible), the spatial coordinates (Global Positioning System, GPS) and the orientation of the gear (if relevant), the depth and the type of bottom (if known). Fishing gear is localized by one (bow net) or two (gill net, trammel) coordinates. The form is filled in by either park officers or scientists. When the GPS is not available (e.g. during inspection tours by park officers), data are recorded on a map background (1/25 000) rather than on a table. Surveys are performed early in the morning (before the fishermen haul in their nets) and at dawn (after they have set the nets) and last about one hour.

Data for distribution of fishing gear are input into a geographical information system (GIS, Arcview® software). Subsequently, thematic charts may be constructed by season, by year, by boat, by type of gear, etc. and may be superimposed on bottom charts or other uses or frequentation charts (Fig. 1).

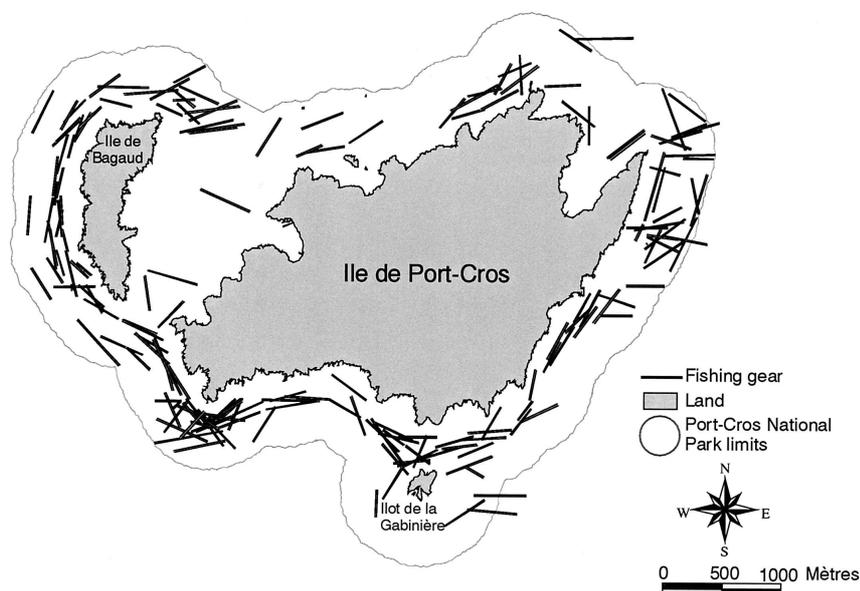


Figure 1. — GIS map of Port-Cros national Park, with superimposition of fishing nets for 52 survey days in 2000.

TABLE I

Example of a page of the log book completed by a Port-Cros (French Riviera) fisherman

Date	Day: 24	Month: 05	Year: 2001	
Fished sector		Gear used	Mesh size	Number of net-pieces
Bagaud		Trammel	large (5-7) ^a	18
Nord	X		small (8-11)	-
Sud	X	Gill net	large (5-7)	-
			small (8-11)	-
Species or category ^b	Small (kg)	Medium (kg)	Large (kg)	Total weight (kg)
<i>Diplodus sargus</i>		2.4		2.4
<i>Diplodus vulgaris</i>				
<i>Diplodus puntazzo</i>				
<i>Sparus aurata</i>				
<i>Pagrus pagrus</i>				
<i>Dentex dentex</i>				
<i>Spondyliosoma cantharus</i>				
<i>Sarpa salpa</i>				
<i>Dicentrarchus labrax</i>				
<i>Zeus faber</i>				
<i>Epinephelus marginatus</i>				
<i>Sciaena umbra</i>		0.8		0.8
<i>Scorpaena scrofa</i>		2.2	1.3	3.5
<i>Mullus</i> spp.				
<i>Conger conger</i> and <i>Muraena helena</i>		7	10	17
<i>Phycis phycis</i>		9	6	15
<i>Seriola dumerili</i> and pelamid				
“Bouillabaisse” ^c		X		2
“Soupe de poisson” ^d				
<i>Palinurus elephas</i>				
<i>Scyllarides latus</i> and <i>Scyllarus arctus</i>				
<i>Maja squinado</i>				
Other species	1 lobster			1
Remarks	2 bow nets used			

^a Number of knots per 25 cm net. ^b In the actual form, the usual French local names are given.

^c Various fishes used for a traditional local dish. ^d Various small fishes used for the preparation of a fish soup.

TABLE II

Example of the form used for localization of fishing gear at Scandola (Corsica). Names of boats are coded, in order to preserve anonymity of the data, as requested by fishermen

Form number:		24		Other observations:		
Date:		April 29, 2001		Two dolphins near B 8		
Time of the survey		from 6:50 AM to 7:50 AM				
State of sea		calm				
Sky		clouds < 1/9				
Wind		slight, NW				
Time	Name of the boat	Type of gear	Characteristics of the buoys	GPS coordinates	Depth	Type of bottom
7:05 AM	B 2	trammel	spherical, red	42.24.914 8.36.286	20 m	posidonia
			spherical, red	42.24.774 8.36.433	15 m	posidonia
7:20 AM	B 4	trammel	plastic container, white	42.25.049 8.35.525	56 m	coralligenous
			plastic container, white	42.24.971 8.35.497	54 m	coralligenous
7:40 AM	B 8	gill net	conical, yellow	42.21.197 8.33.364	20 m	posidonia
			conical, yellow + blue	42.21.253 8.33.388	30 m	posidonia & sand

Embarkation data. The cooperative spirit of fishermen in Corsica has made it possible to go aboard fishing boats for several outings of one day in the same period when the gear census took place. Accurate data concerning the fishing patterns, the type of gear (length, height, mesh size, number of pieces per net) and corresponding catches and rejects have been collected. This work has made it possible to calculate for each sampling period of the year, the yield per outing, per net, per piece of net (50 or 100 m long), per type of mesh and per species or fish category.

Landing data. Additional information is provided by surveys carried out in the landing ports. But such information is often difficult to collect, first because fishermen are busy with the marketing of their catch, secondly because the sorting and packaging of the catch by commercial categories make difficult the assessment of the total catch and thirdly, because the geographical origin of the catches is unknown: fishes from inside and outside the protected area are mixed together.

Data on boats allowed to fish in the MPAs (onboard equipment, length, power, harbour of origin of the fishing fleet) were collected on the basis of inquiries aboard fishing boats, in the landing ports as well, and from the Maritime Authority.

DISCUSSION: METHODS AND FUTURE PROSPECTS

The evaluation of the fishing effort by a census of fishing gear in a coastal area is a method which minimizes disturbance caused to the fishermen. In addition, though minor bias may occur (possible omitted gear), it is not dependent upon the fishermen's own assertions. However, gear characteristics (e.g. mesh size, number of pieces per net, piece length) remain unknown.

Marine Protected Areas offer the opportunity of establishing a constructive partnership between scientists and fishermen. In this way, the establishment of a local fishing charter in the Port-Cros National Park has made it possible to access both catch data and another basis for estimation of the fishing effort (*via* log books). It is worth noting that mean preliminary estimates of the fishing effort based upon log books are congruent with those based upon gear censuses by scientists and park officers.

The contact which was established by scientists with fishermen in the field during census operations of fishing gear and by informal discussions in the fishing ports, has progressively led to the opportunity for embarkation aboard the fishing boats.

TABLE III

Summary of the methods used for the monitoring of artisanal fishing in Marine Protected Areas. P: implemented in Port-Cros national park. S: implemented in Scandola natural reserve.

Method		Type of data	Expected results
Fishing log-book	P	Catches per species or fish category. Size and weight classes. Number and characteristics of the gear.	Yield per outing, per net, per piece of net and per species (or category) of fish. Total year catches.
Charts of distribution of fishing gear	P,S	Number of gear. Localization of gear. Name of the boats involved in fishing activity.	Spatiotemporal monitoring (GIS) of the distribution of gear.
Embarkation data	S	Catches per species. Accurate data on size and weight. Accurate data on characteristics of the gear. Number of nets. Rejected fishes (species, biomass).	Yield per outing, per net, per piece of net, per type of mesh and per species of fish.
Landing data	P	Catches per species or fish category. Size and weight.	Yield per outing (but may proceed from outside the MPA).

None of the above mentioned methods provides by itself an accurate answer to the questions asked by managers of the marine protected areas: what types of gear are used, and where? What is the fishing effort? (e.g. the average number of nets, the average cumulative length of net and the average number of boats fishing simultaneously). What are the catches? Or at least, can a proxy of these parameters be monitored over years to indicate patterns of change with time? In fact, it is the combined use of these complementary methods and their reciprocal checking of the data which forms an efficient management tool offering a basis for providing answers to these questions (Table III).

Moreover, seasonal and inter-annual variations of the resource and of the fishing effort mean that this work must necessarily be monitored on a medium term basis.

In addition, a large amount of qualitative information about e.g. spawning periods, fish behaviour, variability of fish abundance and predators have been reported by fishermen during the survey. Conversely, some information could be provided by the scientists to fishermen, which helps to improve the dialogue (sometimes more or less conflictual) between professional fishermen and the park officers. Moreover, this monitoring survey was a good occasion for fishermen to express their concerns and thoughts about the MPA and manifest their wish to be more involved in the MPA management. So the contacts thus established between managers, fishermen and scientists provide a basis for a less conflictual system of relationships and for closer co-operation.

CONCLUSION

In recent years, Marine Protected Areas have been widely promoted as both conservation and fishery management tools. However, only the long term monitoring of a complementary set of descriptors of the fishing effort and catches, together with the parallel *in situ* monitoring of habitats and flora and fauna populations (the latter not developed here), provide the MPAs managers with the data essential to decision-making, in order to adjust objectives for nature conservation and the maintenance of artisanal fishing, within the framework of a sustainable development strategy.

The panel of methods which has been tested here, some involving little disturbance for fishermen, others requiring the involvement to a greater or lesser extent of fishermen and park officers, makes it possible to cross check different sources of data and so to test the value of information. It is well suited to the context and the objectives of an MPA. In addition, it contributes to the improvement of the spirit of dialogue and understanding between the MPA users, here the fishermen, and the MPA officers.

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