Fisheries Management and Ecology, 2007, **14**, 343–352

An assessment of catches and harvest of recreational shore angling in the north of Portugal

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Abstract Recreational shore angling in the Atlantic Ocean between Moledo and Aveiro (Portugal) was examined using roving creel surveys (March/September 2001). Cooperation was high (90% of 2310 anglers approached). At least 39 species of fish were caught at a rate of approximately 0.5 fish angler h^{-1}. An estimated 7319 kg of *Dicentrarchus labrax* (L.), with 45.6% below the minimum legal size, and 2040 kg of sea breams (genus *Diplodus*), correspond to 5.75% and 1.19% of the commercial landings in the same geographical area, respectively. The results shed light on a number of issues relevant to integrated coastal management, including temporal and spatial distribution of fishing effort, species caught, sizes of fish, catch rates, and factors influencing catches and angler satisfaction. Whilst the results suggest that the catches of sea breams and sea bass by day-time recreational shore angling in northern Portugal are small compared with commercial fishing, other recreational activities, such as boat fishing and spear-fishing, must be assessed.

KEYWORDS: recreational fishing, rod and line, shore angling, sport.

Introduction

Recreational or sport fishing is a popular activity, involving an estimated 6% of the population of the European Union (Toivonen, Tuunainen, Navrud, Roth, Bengtson & Gudbergsson 1999), with angling participation rates from less than 1% in southern European countries to more than 40% in Finland (Hickley & Tompkins 1998; Cooke & Cowx 2004). Little or no information is available on the number of sea anglers in Portugal. However, the number of freshwater sport/recreational fishing licences has increased steadily since 1980, reaching more than 270 000 in 1998; and recreational fishing of all kinds is expanding rapidly (Sousa 2000; Marta, Bochechas & Collares-Pereira 2002). Non-professional fishing is classified into two categories: recreational and sport fishing. The latter is distinguished from the former by taking place within the framework of organised competitions and/or with the objective of obtaining records.

Until recently, no specific policies or management plans applied to Portuguese saltwater recreational fisheries, which were regulated by Decreto-Lei n° 246/2000 of 29 September 2000 and Decreto-Lei n° 112/2005 of 8 July 2005. No licenses were required and the most relevant articles were those stipulating that fishermen could use up to three hand lines or rods with a maximum of three hooks on each and that they could not sell their catch. The same minimal legal sizes (MLS) are applicable to commercial and recreational sectors (IGP 2003).

On 1 January 2007 a new law regulating recreational fishing came into effect, with licences required for the first time and stipulating a daily bag limit of 10 kg per angler for shore-based angling (Portaria n° 868/2006 of 29 August 2006). The new legislation resulted, in part, from demands, especially from the commercial fishing sector, for the introduction of licensing of saltwater recreational fishing activity, the regulation of catches (i.e. daily bag limits) and for more effective monitoring. The legislation includes the following justification: '… create the best conditions for recreational fishing, protect this activity, ensure the sustainability of marine resources and prevent professional (commercial) fishing activity disguised as recreational fishing'.

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 doi: 10.1111/j.1365-2400.2007.00560.x

The recognition of recreational fisheries as a major stakeholder in the allocation of scarce fisheries resources has long been acknowledged (Glover 1980). Recreational fishing is a highly valued (Toivonen, Roth, Navrud, Gudbergsson, Appelblad, Bengtsson & Tuunainen 2004) and economically important activity, generating jobs and significant revenue (Roth, Toivonen, Navrud, Bengtsson, Gudbergsson, Tuunainen, Appelblad & Weissglas 2001). Conflict between commercial and recreational fishermen is endemic to all developed countries, with anglers often justifying their demands for preferential access based on the presumption that recreational fishing activity brings greater social and economic benefits to the community than commercial fishing (Kearney 2002; Cooke & Cowx 2006).

Unlike commercial fisheries, where data on catch and effort are regularly collected for assessment and management purposes, data on recreational fisheries that allow estimation of recreational catches, the detection of trends and the evaluation of impacts are rare (Gartside, Harrison & Ryan 1999), especially for European marine recreational fisheries (Arlinghaus, Mehner & Cowx 2002). Exceptions are time series of results from rod and reel and spear fishing competitions (Gartside *et al.* 1999; Coll, Linde, García-Rubies, Riera & Grau 2004).

Recreational fisheries data are usually collected over relatively short periods of time using a variety of methods. These include creel surveys, where catches of recreational fishermen are quantified in the field (Rasmussen, Staggs, Beard & Newman 1998), roving surveys where interviews are carried out in a systematic way in the field (Schill & Kline 1995; Rasmussen *et al.* 1998), log book surveys, where recreational fishermen keep records of their fishing activity in log books (Anderson & Thorpe 1991; Connelly & Brown 1995; Cooke, Dunlop, MacClennan & Power 2000; Kitada & Tesuka 2002), telephone surveys (Weithman 1991; Wilde, Riechers & Ditton 1998) and mail surveys (Riechers, Matlock & Ditton 1991; Wilde & Riechers 1992; Wilde & Ditton 1994; Toivonen *et al.* 1999). The most reliable catch data are obtained by face to face interviews in the field (Pollock, Jones & Brown 1994; National Research Council 2006).

The objective of this study, the first on saltwater recreational fishing in Portugal, was to carry out creel surveys in the north of Portugal to characterise and quantify recreational catches and fishing effort. The information will contribute to the ongoing debate on the relative importance of recreational fishing activity and will provide useful data for the development of new policies, management plans and recreational fishing legislation.

Materials and methods

Random creel surveys of anglers fishing with rod and line were conducted from beaches, rocks and jetties in the northern region of Portugal, from Aveiro to Moledo from March to September 2001. Three local angling associations were consulted to obtain preliminary information on fishing locations and angling activity. Eleven sites were selected from a total of 58 identified by the angling associations and from maps and aerial photographs (Geovirtual 2000) along the shoreline of approximately 120 km. Sampling was stratified by weekdays, weekends, public holidays and period during the day (Rasmussen *et al.* 1998). The 11 locations were surveyed on a weekly basis, with two sampling periods per day: morning (9:30–13:30) and afternoon (14:30–18:30). The day of the week (Monday to Friday) and the period during the day for sampling were randomly selected each week for the 11 sampling locations. Weekends were treated differently, with each location being visited once per month on a Saturday and once per month on a Sunday. The daily period on Saturdays was randomly selected, with the opposite daily period used for Sundays. Surveys were carried out at two to four randomly selected locations during each public holiday. Thus, for example, during June (30 days) with two public holidays (Sunday, June 10 and Thursday, June 14), three morning and three afternoon surveys were conducted at each of the 11 locations for a total of 66 surveys.

To assess fishing effort, an initial count of all anglers was made (Pollock *et al.* 1994). Given that the sampling locations were in most cases jetties or beaches, with few access points, and that the interviewer remained at the location during the whole 4 h period, the probability of missing anglers was low. All anglers leaving or arriving during the survey were recorded. A socio-economic questionnaire (29 items) was used to obtain information on distance travelled, fishing trip expenses (transport, gear, bait, food), fishing conditions, fishing equipment, type of fishing activity (e.g. surf casting, float, spinning), bait used, target species, gear loss and catch (Oliveira 2003). Fishers were also asked to characterise their fishing day on a scale ranging from very poor to excellent (Oliveira 2003). Questionnaires were tested in the field in February 2001 to remove unnecessary questions and to gain acquaintance with fishers, thereby ensuring a satisfactory response rate. A minimum of 30% of the anglers was randomly selected and interviewed at each sampling location.

Catch rates were calculated as a mean of ratios (Pollock *et al.* 1994):

$$\bar{R}_i = \frac{\sum_{j=1}^{n} (C_{i,j}/h_j)}{n}$$

where i refers to the species, $c_{i,j}$ is the total catch of angler j, h_j is the number of hours fished by angler j and n is the total number of anglers interviewed. Standard errors of total catch rates and for the most important species were calculated per strata.

Fish were identified and weighed (g), but were not measured to minimise conflict and to maximise cooperation with fishers who tend to associate length measurements with regulations and enforcement. The total lengths (TL, mm) of sea bass, *Dicentrarchus labrax* (L.), were determined using the mass–length relationship in Gonçalves, Bentes, Lino, Ribeiro, Canário & Erzini (1997): Mass = 0.00000758 $TL^{3.039}$.

Estimates of the total daytime recreational catches of sea bass and sea breams (*Diplodus* spp.), the second most important target species in the study area, were obtained from the estimated total numbers of recreational anglers for the whole study area, the fishing effort and the catch per unit effort (CPUE).

The total recreational catch was compared with the official commercial landings data (Direcção Geral das Pescas 2001) for both *Dicentrarchus labrax* and *Dicentrarchus punctatus* (Bloch) (spotted sea bass) and for all species of *Diplodus* spp. pooled, as landings for the latter species are grouped together in the landings statistics.

Logistic regression was used to test the influence of one or more independent variables on a binary dependent variable (0.1). Logistic regression uses linear functions of independent variables to explain a categorised response variable (Zelterman 1999). This technique was applied to test the influence of variables such as bottom type on catch success and to evaluate angler satisfaction in relation to catches (Walker 1997).

Following Kitada & Tesuka (2002), correspondence analysis, which can be described as a weighted principal component analysis of a contingency table in which each line and column represents a point in Euclidean space, was used to evaluate the interaction(s) between categorised variables in a data table. Here, this was used to explore the relationships between catches, time of the year (month) and fishing location. All statistical analysis was carried out with SAS (SAS Institute Inc. 1989).

Results

A total of 3652 anglers was encountered. Of these, 2310 were approached and 2081 completed questionnaires for a 90% response rate (229 refusals). Complete catch data were obtained for 1961 individual fishing trips. More anglers were interviewed during weekdays (1138) than during weekends or national holidays (943). The sampling site with the greatest recreational fishing activity was Aveiro (site 11) (411 questionnaires), followed by Foz do Douro (site 7) and Póvoa de Varzim/V. do Conde (site 5), with 398 and 330 questionnaires respectively (Table 1). The number of refusals increased towards the south and in general, anglers from more urban areas, such as Madalena/Valadares (site 8), Cabo do Mundo (site 6) and Póvoa do Varzim/Vila do Conde, were less cooperative.

The highest number of recreational fishermen was recorded in August (1066), followed by July (749) and September (595). The same pattern was observed for the completed questionnaires (Table 2). As only con-

Table 1. Sampling locations (S1–S11), fishing grounds (R = rocky; S = sandy; J = jetty), number of fishermen, completed questionnaires and number of refusals

Sampling site	Type of fishing ground	Number of fishermen	Completed questionnaires	Refusals
S1 – Moledo	R, S	74	63	3
S2 – Carreço	R, S	38	30	0
S3 – Cabedelo of Viana do Castelo	J, S	214	137	8
S4 – Amorosa	R, S	70	47	2
S5 – Póvoa de Varzim/V. do Conde	R, S, J	663	330	15
S6 – Cabo do Mundo	R, S	185	108	16
S7 – Foz do Douro	J, S	823	398	11
S8 – Madalena/Valadares	R, S	122	88	23
S9 – Espinho	J, S	306	238	12
S10 – Furadouro	J, S	348	231	11
S11 – Barra de Aveiro	J, S	809	441	8
Total		3652	2081	109

Table 2. Number of observed fishermen, refusals and completed questionnaires for each sampling month

Month	Observed fishermen	Refusals	Completed questionnaires
March	93	18	69
April	298	65	235
May	452	74	309
June	399	21	262
July	749	28	394
August	1066	13	470
September	595	10	342
TOTAL	3652	229	2081

firmed data were used for the catch analysis, 117 questionnaires were excluded from the analysis.

A total of 3738 fish and invertebrates weighing 674.5 kg were caught in 1964 individual fishing trips (Table 3). Although *Atherina presbyter* Cuvier (Atherinidae) was the most abundant species in the creel surveys (707 individuals), only 11.54 kg was caught. The European bass, *Dicentrarchus labrax* (Moronidae), ranked third in abundance and second in weight with 554 individuals and 190.4 kg.

The total catches in numbers and in mass of the most important families are given in Figure 1, with families contributing less than 2% to the overall catch grouped in the category 'others'. Mullets (Mugilidae) were the important family in terms of mass with 274.8 kg, followed by sea basses (Moronidae) and sea breams (Sparidae). The European bass was considered the target species in 52.8% of the fishing episodes, while 8% of the interviewed anglers indicated that they were targeting sea breams, and 6.1% targeted both sea bass and sea breams. Only 12.3% of anglers targeted other species, and 31% of anglers declared that no particular species or group was being targeted.

The mean mass of sea bass was of 343.6 g. According to the mass–length relationship this corresponds to a total length of 33 cm, which is 3 cm below the established MLS of 36 cm (IGP 2003). Based on the mass–length relationship, a bass of 36 cm TL should weigh 445 g. This suggests that 203 of all sea bass caught, 45.6% of the total, weighed less than 445 g, and were therefore probably below the MLS.

The total annual recreational catch for the genus *Dicentrarchus* (sea bass and spotted sea bass) in the study area was estimated to be 7318.7 kg, corresponding to 5.8% of the official total annual commercial catch of 127.3 t (Direcção Geral das Pescas 2001) for the same area. The same analysis for sea breams resulted in an estimated total annual recreational catch of 2040.0 kg, corresponding to 1.2% of the total annual commercial catch of 172.1 t for the same geographical area (Direcção Geral das Pescas 2001).

A total of 7302 fishing hours was used for the CPUE calculations. Approximately one fish was caught during 2 h of fishing per angler (0.46 fish per angler h^{-1}), corresponding to 0.078 kg per angler h^{-1}. A high investment in hours of fishing is needed to obtain a reasonable catch, even for the most important target families Moronidae and Sparidae (Fig. 1).

CPUE in weight was highest in May but greatest in September in terms of number caught, and lowest for March (Fig. 2). The same pattern in both CPUE in number and in weight was found at the 11 sampling sites (Fig. 3) with greatest CPUE values, in general, for Foz do Douro, Póvoa de Varzim/V. do Conde, Moledo and Barra de Aveiro (the last is only valid for the CPUE defined by number). The lowest CPUE in number was for Carreço and in weight for Madalena/Valadares. Correspondence analysis for catches in relation to fishing zone and month identified two groups (Fig. 4). Successful fishing trips (i.e. with catch) were most closely associated with Barra de Aveiro (site 11), followed by Foz do Douro (site 7) and Póvoa de Varzim/V. do Conde (site 5) and the months of April, May, June and July. Fishing trips where the angler caught no fish were associated more with the months of August, July and September and sampling sites 2, 8, 9 and 10 (Fig. 4).

Logistic regression revealed that the type of fishing ground (rocky or sandy) is an important factor influencing whether or not sea basses are caught ($P < 0.001$), with greater angler success associated with rocky areas. By contrast, bottom type is apparently not an important factor for sea breams catches ($P = 0.285$).

Anglers considered that 35% of the fishing episodes were not satisfactory, 18% were considered average, while 19%, 12% and 4% were judged to be good, very good and excellent respectively (Fig. 5). Logistic regression results indicated that while catches were important for angler satisfaction ($P < 0.001$), the actual number of fish caught was not ($P = 0.133$). For anglers targeting bass, the same analysis indicated that whether or not bass are caught was not important for classifying the fishing day as satisfactory or not ($P = 0.465$).

Discussion

In this study of shore-based recreational sport fishing in northern Portugal, roving creel surveys were used to quantify harvest composition, catch rates and angling effort (Pollock *et al.* 1994). The response rate

Table 3. Taxonomic classification, common names, total number and weight (kg) of angler catches (fish common names based on Froese & Pauly 2005)

Family	Species	Common name	Catch weight (kg)	Catch number (*n*)
Osteichthyes				
Ammodytidae	*Gymnammodytes semisquamatus*	Smooth sandeel	1.53	14
Anguillidae	*Anguilla anguilla*	Anguilla	10.72	64
Atherinidae	*Atherina presbyter*	Atherina	11.54	707
Balistidae	*Balistes carolinensis*	Grey triggerfish	7.55	15
Belonidae	*Belone belone*	Garpike	1.11	8
Bleniidae/Gobiidae	Not specified	Blenny/Goby	10.24	296
Carangidae	*Trachurus trachurus*	Atlantic horse mackerel	0.68	55
Clupeidae	*Alosa fallax*	Twaite shad	0.49	3
	Sardina pilchardus	European pilchard	0.04	4
Congridae	*Conger conger*	European conger	19.07	12
Cottidae	*Taurulus bubalis*	Longspined bullhead	0.21	4
Gadidae	*Gaidropsarus* sp.	Rockling	4.62	35
	Micromesistius poutassou	Blue whiting	0.12	2
	Raniceps raninus	Tadpole fish	0.88	13
	Trisopterus luscus	Pouting	10.84	318
Labridae	*Coris julis*	Mediterranean rainbow wrasse	0.08	1
	Not specified	Wrasse	20.66	133
Moronidae	*Dicentrarchus labrax*	European seabass	190.36	554
	Dicentrarchus punctatus	Spotted seabass	3.89	8
	Mycteroperca rubra	Mottled grouper	0.25	6
Mugilidae	Not specified	Mullet	274.81	583
Mullidae	*Mullus surmuletus*	Striped red mullet	0.11	1
Pleuronectidae	*Platichthys flesus*	Flounder	6.12	29
Scombridae	*Scomber japonicus*	Chub mackerel	1.66	24
	Scomber scombrus	Atlantic mackerel	8.58	214
Scophthalmidae	*Scophthalmus rhombus*	Brill	2.20	7
Soleidae	*Solea vulgaris*	Common sole	4.04	8
Sparidae	*Boops boops*	Bogue	4.32	18
	Diplodus annularis	Annular seabream	0.50	5
	Diplodus sargus	White seabream	34.50	165
	Diplodus sp.	Seabream	8.31	40
	Diplodus vulgaris	Common two-banded seabream	11.07	88
	Pagellus acarne	Axillary seabream	0.36	24
	Sarpa salpa	Salema	0.55	2
	Sparus aurata	Gilthead seabream	6.47	51
	Spondyliosoma cantharus	Black seabream	3.28	44
Trichinidae	*Trachinus* sp.	Weever	3.15	117
Triglidae	Not specified	Gurnard	5.81	32
Not specified	Not specified	Not specified	0.25	5
Asteroidea				
Asteridae	*Marthasterias glacialis*	Spiny starfish	0.05	1
Cephalopoda				
Loliginidae	*Loligo vulgaris*	Common squid	2.40	15
Crustacea				
Portunidae	*Necora puber*	Velvet swimmer crab	0.04	1
Not specified	Not specified	Not specified	0.74	12

was high, reflecting the willingness of anglers to cooperate, and a desire to understand the reasons for changes in fish availability and catch rate at different sites and over time. Indeed, many fishermen asked about these issues when they were approached by the interviewers.

The sampling strategy implemented in this study allowed all shore-based angling options to be covered, as seen from the wide variety of species and sizes recorded. The highest number of anglers was recorded for the beaches near the major cities within the study area: Aveiro, Porto, Póvoa de Varzim and Vila do

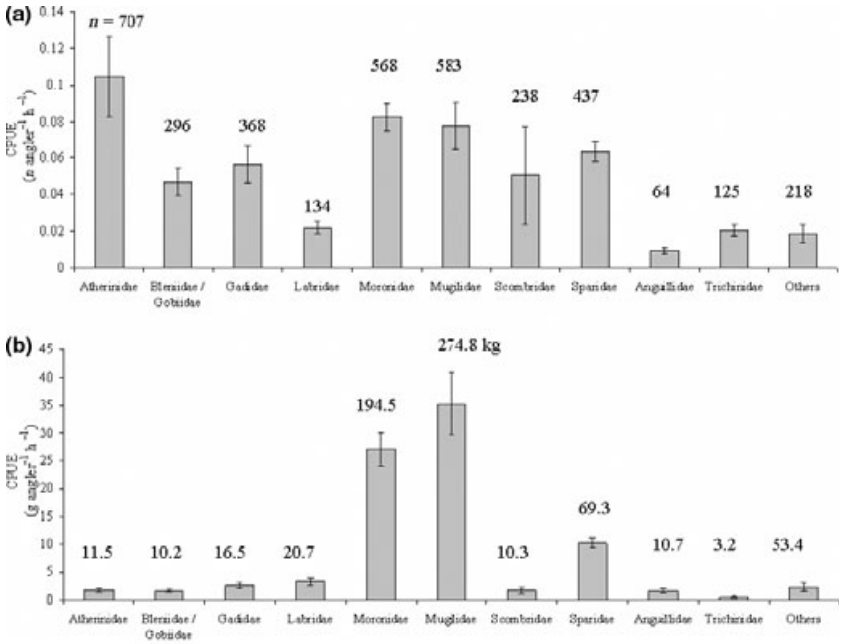

Figure 1. CPUE (mean + SE) by family in (a) number and (b) mass (g) per angler hour of fishing. The total catches in number and kg are also given.

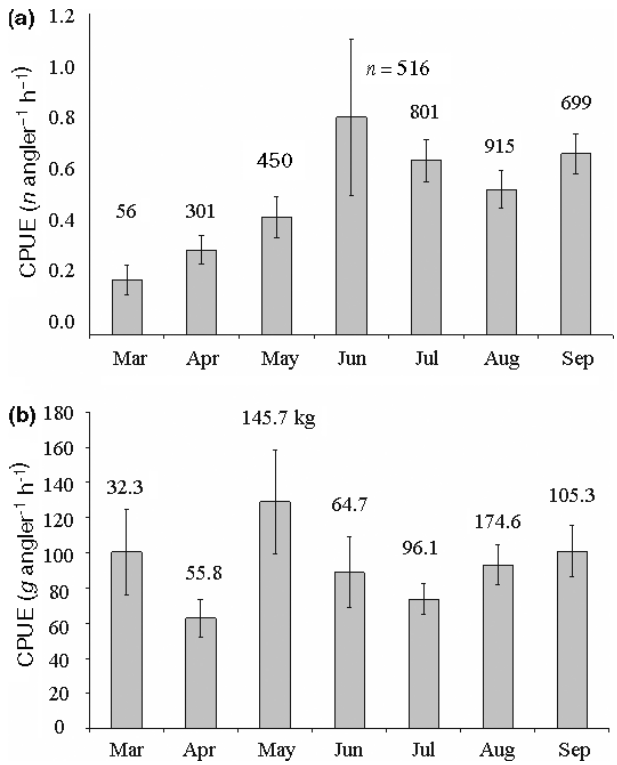

Figure 2. CPUE (mean + SE) by month in (a) number and (b) mass (g) per angler hour of fishing. The total catches in number (*n*) and kg are also given.

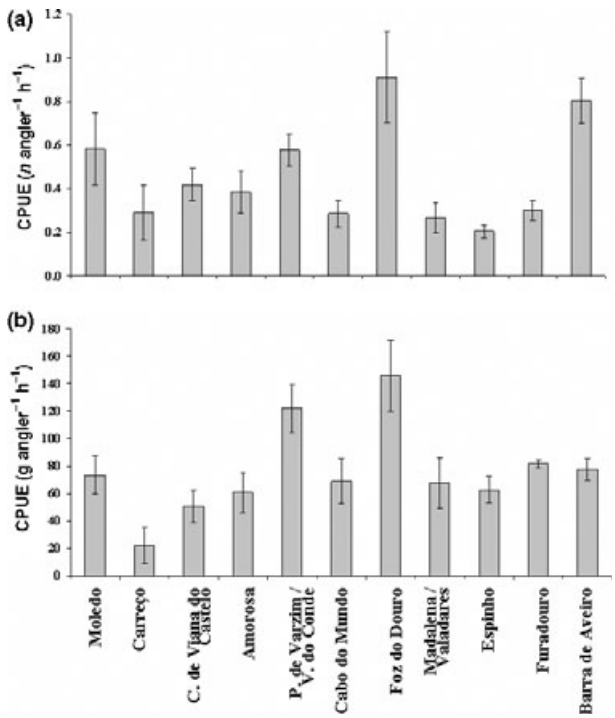

Figure 3. CPUE (mean + SE) by sampling site in (a) number and (b) mass (g) per angler hour of fishing.

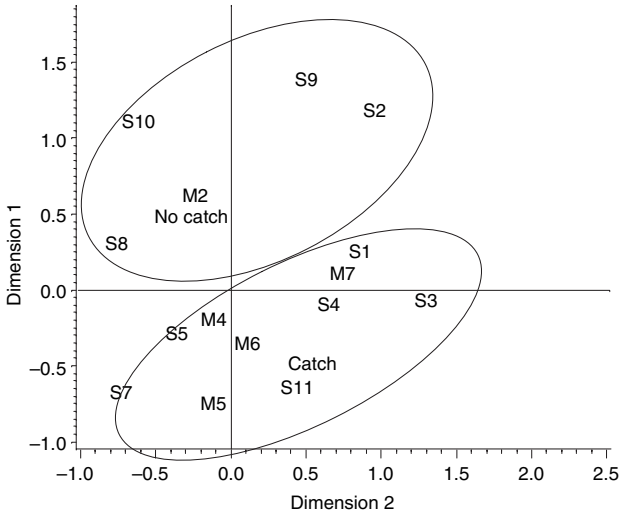

Figure 4. Correspondence analysis for catches (catch/no. catch) in relation to fishing sites (following sites designation of Table 1) and months (March corresponding to M1 to September corresponding to M7).

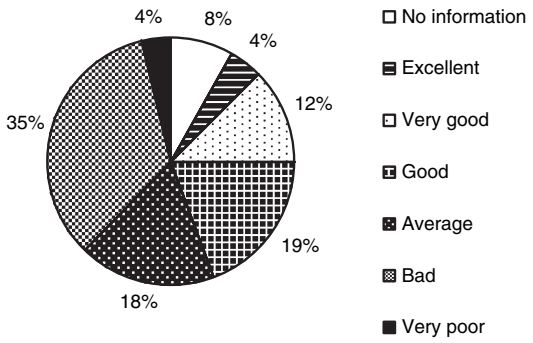

Figure 5. Angler satisfaction with fishing trip.

Conde. All these areas have jetties, so it may also reflect an important option when choosing fishing grounds. Jetties located in predominantly soft bottom areas have similar effects as artificial reefs in that they attract and aggregate fish (Burchmore, Pollard, Bell, Middleton, Pease & Mathews 1985; Wilson 1997), resulting in higher angler catch rates (Sousa 2000).

The afternoon period was preferred by anglers, probably because it allows fishing after working hours, which emphasises the recreational aspects of this activity. Unexpectedly, more angling took place during working days than weekends. In Portugal, July, August and September are the official school holidays and this was probably the main reason for observing a higher number of anglers in those months.

As in many other parts of southern Europe, bass and sea breams are the main target species of shore anglers. Anglers landing sea bass and sea breams may contribute to the capture of significant numbers of under-sized fish. The mean size of sea bass was 33 cm TL, with 45.6% of the individual fish caught being below the MLS of 36 cm. Many anglers complained about lack of information regarding this aspect and of the lack of interest shown by the authorities to inform anglers.

The analysis of angler behaviour is fundamental for fisheries management, definition of regulations and law enforcement (Pollock *et al.* 1994; Ditton & Hunt 2001). Of particular interest are angler motivation and satisfaction. According to Falk, Graefe & Ditton (1989), anglers often consider a fishing trip satisfactory even when no fish are caught; contact with nature, social interaction and breaks from day-to-day routines cited as key factors for this evaluation. Portuguese anglers tended to consider catch an important attribute for satisfaction. However, number or size of fish was not considered important and this may contribute to the large proportion of undersized fish caught and retained, unlike in other sport fisheries where size and number of fish caught was the main criteria determining angler satisfaction (Petering, Isbell & Miller 1995).

The number of fishing episodes with catches was higher than those with no catches. Catches of sea bass and sea breams were relatively higher from jetties, especially those located in Foz do Douro and Póvoa de Varzim/V. do Conde, which may indicate some feeding opportunism of individuals in populated areas with urban discharges enriching the waters. Erzini, Bentes, Coelho, Correia, Lino, Monteiro, Ribeiro & Gonçalves (2002) also found sea breams and sea basses were caught in greatest numbers in beach seines in the most polluted area of the Ria Formosa lagoon in the south of Portugal. The Ria de Aveiro, a large lagoon and important nursery, was also an important fishing location for sea breams and sea bass. Lowest catch rates were associated with the more exposed, sandy beaches that may be limited in terms of fish feeding opportunities.

It is important to note that this evaluation of recreational shore fishing did not take into consideration night-time or winter catches. For species such as bass, catch rates may be higher during the night, at sunrise and sunset and in winter. Conversely, commercial landings may be underestimated as catches of high value species such as *D. labrax* are often not declared. Instead of being sold at auction, where the records contribute to the official landings statistics, these fish are sold directly to restaurants and middlemen.

Considering fish family as an analysis unit, CPUE was low (0.01–0.07 fish caught per angler h^{-1}), but

increased to 0.42 fish caught per angler h^{-1} when all species were included. This is comparable with Clarke & Buxton (1998) and Pradervand, Beckley, Mann & Radebe (2003) in Port Elizabeth and Kwazulu-Natal (South Africa) where the mean total catch rates were 0.28 and 0.11 fish per angler h^{-1} respectively. It is worth noting that no angler of the total 2081 interviewed had a daily catch that was anywhere near the daily bag limit of 10 kg, with the best catches consisting of only a few kg of fish.

In some cases recreational catches can exceed commercial ones in quantity and the value of recreational fisheries often exceeds those of commercial fisheries (Gartside *et al.* 1999; Arlinghaus & Mehner 2003). This was not true for the recreational fishery studied here where comparison with the commercial landings data from Direcção Geral das Pescas (2001) indicated that the total day-time recreational catch in the sampled area in 2001 represents only approximately 1.43% of the total official commercial landings for the same area. Comparison with data from other studies on the catches and CPUE of static gear (longline, gill net and trammel nets) used in Portuguese small-scale inshore fisheries also indicate that the catches of recreational shore fishing activity are a fraction of the commercial catches (Erzini, Gonçalves, Bentes, Lino & Cruz 1996; Erzini, Gonçalves, Bentes, Lino & Ribeiro 1998; Erzini, Gonçalves, Bentes, Lino, Ribeiro & Stergiou 2003; Stergiou, Moutopoulos, Soriguer, Puente, Lino, Zabala, Monteiro, Errazkin & Erzini 2006).

Recreational fishing can have many of the same negative effects as commercial fishing, including reduced size of the stock, decreasing mean size, genetic changes, ecosystem level changes and habitat degradation (Cooke & Cowx 2006; Lewin, Arlinghaus & Mehner 2006) . Although commercial fisheries account for by far the greater part of the biomass harvested from the sea, the global impact of recreational fishing may be much more significant than previously thought, especially concerning species of upper trophic levels (Coleman, Figueira, Ueland & Crowder 2004; Cooke & Cowx 2004, 2006; Arlinghaus & Cooke 2005). Coleman *et al.* (2004) report that marine recreational fisheries in the USA accounted for up to 23% of the total national non-industrial landings in 2002, with greater recreational than commercial catches in many cases.

However, Arlinghaus & Cooke (2005) and Nussman (2005) argued that many other factors must be considered when evaluating the causes for declines in fish stocks, such as juvenile by-catch and discard mortality in commercial trawl fisheries, and call for greater research efforts to improve management and conservation. Comprehensive information is needed for recreational fisheries management to ensure the sustainable use of common fishery resources (FAO 1995; Cooke & Cowx 2004, 2006). In addition to obtaining information on direct and indirect ecological and economic impacts, social impacts should also be carefully evaluated and adaptive management plans implemented using information gathered from sport fishers (Arlinghaus *et al.* 2002; Pitcher & Hollingworth 2002; Ferrer Montaño, Dibble, Jackson & Rundle 2005).

Ongoing studies in the north and south of Portugal will continue to assess shore angling catches and effort, as well as other recreational fishing activities, namely bottom fishing from boats and underwater spear-fishing. Both the latter activities probably account for far greater catches than shore angling and are more likely to cause conflict with commercial small-scale fisheries (Coll *et al.* 2004; Morales-Nin, Moranta, García, Tugores, Grau, Riera & Cerda 2005). A national assessment of recreational saltwater fishing activities in Portugal will provide quantitative data that can be used propose modifications of the current sport fishing legislation, and for conservation and management measures within the framework of integrated coastal management that will contribute to sustainable, multiple user fisheries.

Acknowledgments

The authors wish to thank all the anglers who so kindly collaborated in this study. They are also extremely grateful to the team of interviewers who participated in the creel survey. Thanks also to Dr Maria do Céu Viegas, Dr Mónica Felício, Dr Andreia Henriques and Professor Paulo Santos for their valuable help during the project. The comments of two anonymous referees greatly contributed to improving the manuscript.

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