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Catch composition, catch rates and size selectivity of three long-line methods in the Algarve (southern Portugal)

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ABSTRACT

Three long-line methods have been studied in the Algarve: 1) small-hook long-line for inshore (less than 30 m) 'white' sea breams (Sparidae); 2) small-hook long-line for deeper water (40-60 m) 'red' sea breams; and 3) deep water (500-700 m) semi-pelagic long-line for hake *Merluccius merluccius* (Linnaeus, 1758). Selectivity studies were carried out with three hook sizes in the first two cases: Mustad round-bent Quality 2369 hooks, numbers 15, 13, and 11, baited with a standard-sized razor-shell *Ensis siliqua* (Linnaeus, 1758). Four hook sizes (numbers 10, 9, 7, and 5) of Stell round-bent, eyed hooks were used in the semi-pelagic long-line selectivity study, baited with a half of a standard-sized sardine. Some factors affecting catch composition and catch rates of the small hook long-lines were also evaluated: bait, gangion length, setting time, fishing ground, and depth.

Species diversity was relatively high, with 40, 36 and 27 species, respectively, in the three studies. However, the catches were dominated by a limited number of species. Catch rates (number of fish per 100 hooks) were variable (< 5 %; > 20 %), with a general decrease in catch rate with increasing hook size in all the studies. In general, the catch size distributions for the different hook sizes for each species were highly overlapping, with little or no evidence of differences in size selectivity. Hooks caught a wide size-range for each species, with few or no illegal-sized fish, in most cases. Some implications of these results for the management of multi-species, multi-gear fisheries are discussed.

Key words: Long-line, hooks, methods, artisanal, fishery, Algarve, Portugal.

RESUMEN

Composición, tasa de captura y estudio de la selectividad mediante tres métodos de vida larga en Algarve (sur de Portugal)

Tres artes de palangre han sido estudiados en Algarve: 1) palangre de anzuelo pequeño para espáridos de aguas costeras (menos de 30 m); 2) palangre de anzuelo pequeño para espáridos rojos de aguas mas profundas (40-60 m); y 3) palangre semipelágico de profundidad para merluza Merluccius merluccius *(Linnaeus, 1758). En los dos primeros casos, los estudios de selectividad han utilizado anzuelos de tres tamaños:* round bent *marca Mustad modelo 2369 (números 15, 13 y 11), utilizando como cebo pedazos de navajas* Ensis siliqua *(Linnaeus, 1758) de la misma talla. En el estudio de selectividad con el palangre semipelágico se han utilizado cuatro tamaños de anzuelo (números 10, 9, 7 y 5)* round hook *de la marca Stell, con media sardina como cebo. Se evaluán, también, otros factores que afectan a la composición y a la tasa de captura de los palangres equipados con anzuelo pequeño: cebo, longitud de la puntera, hora de largada del aparejo, área de pesca y profundidad.*

La diversidad de especies en los tres estudios ha sido relativamente elevada: 40, 36 y 27 especies, respectivamente. Sin embargo, las capturas han sido dominadas por un número reducido de especies. Las tasas de

captura (número de peces por 100 anzuelos) han variado (< 5 %; > 20 %), observándose en los tres estudios un descenso general de las tasas de captura con el aumento del tamaño del anzuelo. De forma general, se ha observado una fuerte sobreposición de las distribuciones de las capturas con los diferentes tamaños de anzuelo para cada especie, con poca o ninguna evidencia de diferencias en la selectividad por talla. Los tamaños de anzuelo probados han capturado un rango de tallas amplio para cada especie, con escasa o ninguna captura de peces de talla ilegal en la mayoría de los casos. Se discuten algunas implicaciones de estos resultados en la gestión de pesquerías incluyendo varias especies y varios artes de pesca.

Palabras clave: *Palangre, anzuelos, artes, artesanal, pesquerías, Algarve, Portugal.*

INTRODUCTION

Long-lines are widely used in Portuguese fisheries. In the Algarve (southern Portugal), 1 300 long-line licences were issued in 1993, and 1 232 in 1996; they accounted for 31 % and 27 % of all commercial fishing licences, respectively, in those years (Portuguese Department of Fisheries, pers. comm.). Long-lines are used to catch a wide variety of species, including many species of sea breams (Sparidae), hake *Merluccius merluccius* (Linnaeus, 1758), conger eel *Conger conger* (Linnaeus, 1758), and wreckfish *Polyprion americanus* (Oken, 1817).

Long-line methods can be classified based on the following criteria and characteristics: 1) type (bottom, semi-pelagic, pelagic); 2) mainline (material, diameter); 3) gangion (material, diameter, spacing); 4) hook type and size; 5) bait; 6) target species; and 7) fishing strategy (fishing grounds, depth, bottom type, season, time of set, duration of set).

In the Algarve, a number of different long-line methods have been identified. The four main methods are: 1) small-hook long-line for inshore, 'white' sea breams; 2) small-hook long-line for deeper water, 'red' sea breams; 3) semi-pelagic *pedra e bola* long-line for hake; and 4) bottom long-line for large demersals.

The first method's inshore targets are know as white sea breams; namely, *Diplodus sargus* (Linnaeus, 1758), *D. vulgaris* (E. Geoffrey Saint-Hilaire, 1817), *Lithognathus mormyrus* (Linnaeus, 1758), and *Spondyliosoma cantharus* (Linnaeus, 1758). The long-line consists of a monofilament mainline, 1.1 or 1.2 mm in diameter, with 0.5 to 0.6 diameter monofilament gangions spaced 1.5-3 m apart. The most commonly used hooks are Mustad round-bent spade-end hooks, sizes 13 and 12. The length of the gangion is usually 0.5-1 m. A variety of baits are used, including mud shrimp *Upogaebia* spp., razor-shell *Ensis siliqua* (Linnaeus, 1758) and sipunculids. The long-line is coiled in tubs containing 300 to 400 hooks. The number of hooks fished is variable, with 3 000 to 4 000 hooks per set being a maximum (pers. obs.). The pre-baited long-line is set in relatively shallow water, generally between depths of 10-30 m, on rocky or patchy bottoms. The long-line may be set around sunrise or sunset, or during the day. The duration of the set can vary from less than 1 h to 3-4 h.

The second long-line method differs from the first only in terms of the target species and the fishing strategy, with the long-line, hooks and baits used being essentially identical. In this fishery, the target species are *Pagellus acarne* (Risso, 1826) and *Pagellus erythrinus* (Linnaeus, 1758). Fishing takes place at greater depths (40-70 m), and the long-line is usually set one to two hours before sunrise.

Whereas the latter small-hook long-lines involve small boats, 5-6 m in length, with crews of two or three, vessels in the semi-pelagic long-line hake fishery are much larger, and have crews of at least five to six fishermen. Fishing takes place at much greater depths (500-700 m) and the long-line is lifted off the bottom by glass buoys attached at regular intervals along the mainline. The most commonly used hook sizes are 8, 7, and 6, and the main target species is *M. merluccius*. The number of hooks per set is usually between 6 000 and 8 000, giving a total long-line length of 10-15 km.

The last method uses essentially the same type of long-line as the semi-pelagic long-line, except that no buoys are used to lift the hooks off the bottom. A wider depth- range is fished with this gear, with considerable diversity in terms of target species.

The first three of these methods have been studied as part of an ongoing series of projects on the small-scale multi-species fisheries of the Algarve funded by the European Commission (Erzini *et al.*, 1995, 1996a, 1996b, 1997a, 1997b). The objective of the present paper is to review the results of the

selectivity studies carried out to date in Algarve (southern Portugal) waters, with particular emphasis on catch compositions, catch rates, size distributions, factors affecting catch rates, and discards/bycatches. Some implications of the main findings of these studies for the management of small scale, multi-species, multi-gear fisheries are discussed.

MATERIALS AND METHODS

Three long-line selectivity studies have been carried out since 1994 (table I). For each method, local fishermen were consulted prior to the design of the experimental fishing gear used in the selectivity studies. This preliminary survey enabled us to fully characterise the different methods.

Small-hook white sea bream method

In the first study, concerning the small-hook white sea bream method, Mustad round-bent spade-end Quality 2316 DT hooks were used (sizes 15, 13 and 11). The characteristics of the experimental long-line, the hooks, and a summary of the experiments carried out are given in figures 1a and 2a and table I. The long-line consisted of monofilament mainline having a diameter of 1.1 mm, with 75 cm gangions of 0.5 mm monofilament, and a distance of 1.75 m between gangions.

Forty-five long-line sets were made for the selectivity part of the project, baited with standard-sized razor-shells. The first two sets consisted of 600 hooks, with 200 hooks of each size. The remaining sets consisted of 900 hooks, with series of 100 hooks of each size. The long-lines were set in the morning and retrieved after a period of 2-4 h.

A further 18 sets were made to evaluate some factors that may affect catch rates and catch composition. In these efficiency trials, hook size, bait (mud shrimp, razor-shell, squid), and gangion length (40 cm, 75 cm) were the variables, for a total of 18 different combinations.

Fishing took place within a restricted area at depths of 10-20 m (figure 3). All fish were transported to the laboratory for measurement, weighing, and biological studies. For detailed descriptions of the methodologies used in the present study, see Erzini *et al.* (1995, 1996a, 1997a).

Small-hook red sea bream method

The same Mustad hook sizes and experimental long-lines were used in this study. However, the number of hooks was increased to 1 200, for a total of four tubs with 300 hooks (Erzini *et al.*, 1997b). Each tub consisted of three sections with 100 hooks of each size. In this study, two different boats/fishermen were used. The first 18 selectivity sets were carried out by the first boat in fishing grounds A and B (figure 3) using razor-shell bait. The remaining selectivity and efficiency sets were carried out by another boat in fishing grounds C and D (table I, figure 3). In the efficiency trials, the only variables were hook size and bait (mud shrimp, razor-shell), giving six different possible combinations.

In this study, fishing took place at greater depths and the fishing strategy also differed. Most of the long-line sets were made one to two hours before dawn, and the long-lines were generally retrieved within an hour of being set. As in the white sea bream study, the fishermen were always accompanied by at least one member of the project team, who recorded location, depth, time of set, duration of set, gear loss, and ensured that the catch was separated according to each hook/bait/gangion combination. Whereas all the fish caught in the first se-

Table I. Summary of long-line selectivity studies carried out in the Algarve

Métier	Type of set	Dates	No. sets	Hook No.	Gangion	Bait	Total No. Hooks
Small hook, white sea bream	Selectivity	03-94/03-95	45	15, 13, 11	75 cm	Razor-shell	39 900
	Efficiency	06-95/07-95	18	15, 13, 11	40 cm, 75 cm	Mud shrimp Razor-shell Squid	16 200
Small hook, red sea bream	Selectivity	08-95/06-96	20	15, 13, 11	75 cm	Razor-shell	24 000
	Efficiency	06-96/08-96	8	15, 13, 11	75 cm	Mud shrimp Razor-shell	9 600
Semi-pelagic hake	Selectivity	04-97/08-97	10	10, 9, 7, 5	100-120 cm	Sardine	64 224

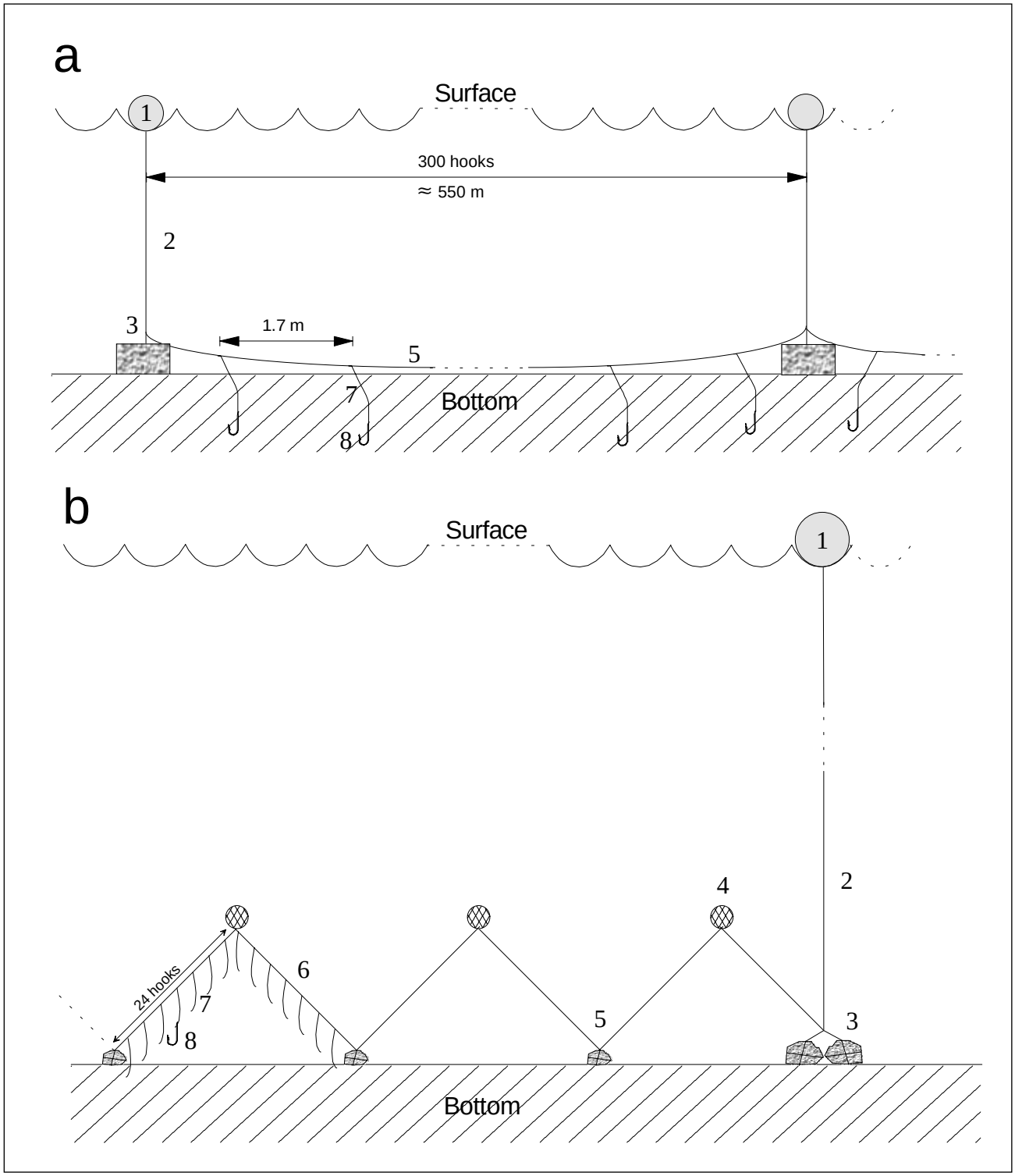

Figure 1. Schematic representations of: (a): one unit –3 glass buoys, 138 hooks– of semi-pelagic long-line; (b): a section of long-line used in the white and the red sea bream studies. (1): buoy; (2): rope; (3): weight –*poita*–; (4): glass buoy –*bola*–; (5) weight –*pedra*–; (6): mainline; (7): gangion; (8): hook. The mainline and the gangions used had diameters of 1.60 mm and 0.90 mm for the *M. merluccius* project and 1.10 mm and 0.50 mm for the sea bream projects

ries of fishing trials (selectivity A) were transported to the laboratory for sampling, this took place at the landing site for the other selectivity (B) and efficiency sets (table I).

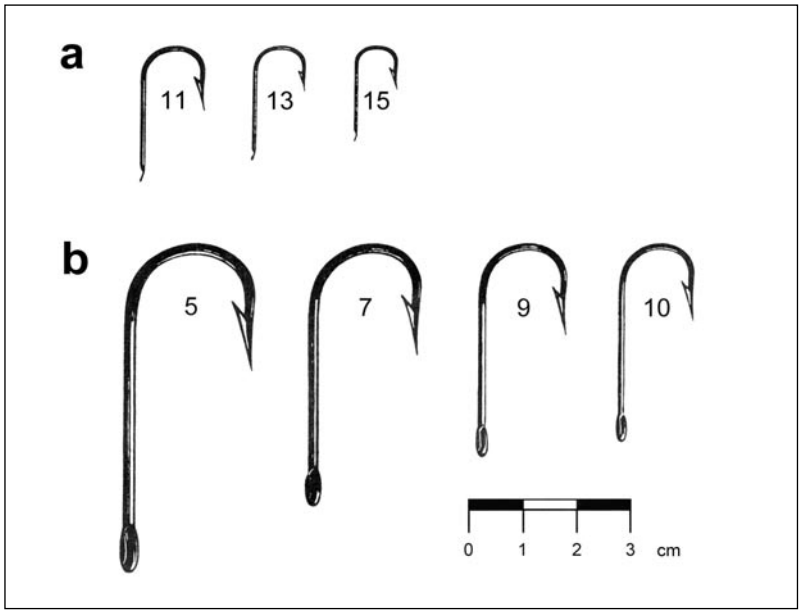

Figure 2. Shapes and dimensions of: (a): Siapal brand hooks used in the semi-pelagic long-line hake study; (b): Mustad brand –Quality 2316 DT– hooks used in the selectivity and efficiency studies for the white and the red sea bream methods

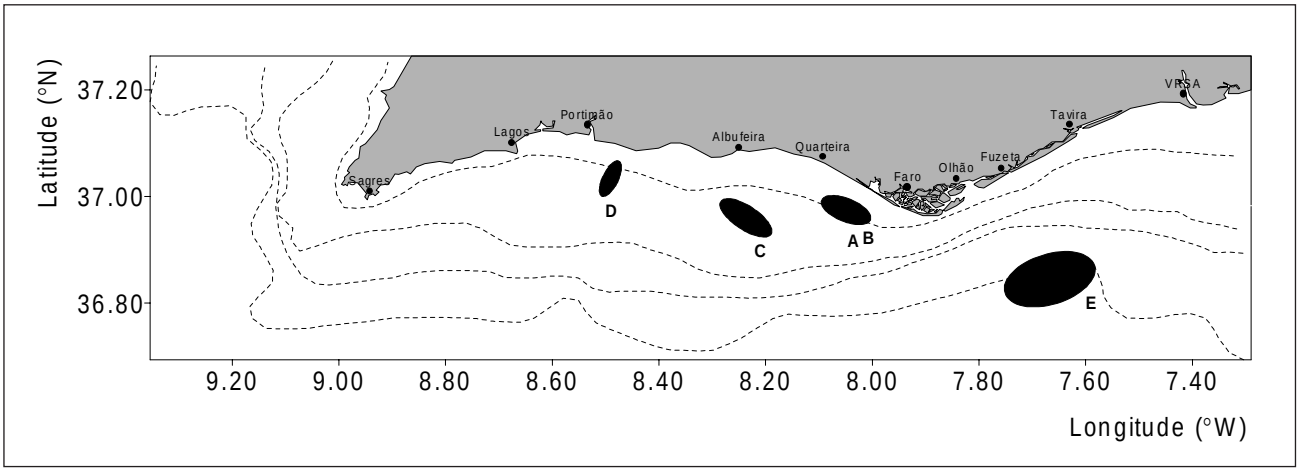

Figure 3. Map showing the location of the fishing grounds for the different selectivity and efficiency studies. (A): small-hook white sea bream method; (B): small-hook red sea bream method –selectivity–; (C) and D): small-hook red sea bream method –selectivity and efficiency–; (E) semi-pelagic long-line hake method. Depth contours are in meters

Semi-pelagic long-line hake method

Four hook sizes of Stell hooks were used in this study (figure 1b). The experimental long-line consisted of 56 units, each unit comprising 144 same-sized hooks coiled in one tub (figure 2b). The mainline consisted of monofilament with a diameter of 1.60 mm, and the gangions were 0.90-mm monofilament, approximately 1 m in length. Hooks were baited with standard-sized half sardines. A total of 10 sets were made, using 38 to 48 units of long-line per set; the same order of hooks was used along the length of the long-line (i.e. 10, 5, 9, 7). Fishing generally took place at depths of 500-600 m (figure 3), with the long-line set starting around dawn. All catches were measured on board and the hook size was recorded.

RESULTS

Species diversity of the catches was relatively high, with 40, 36, and 27 species, respectively, in the white sea bream, red sea bream and semi-pelagic long-line hake studies (table II). However, catches were dominated by a few species only. In the first study, eight species (6 Sparidae, 1 Serranidae, and 1 Trachinidae) accounted for 76 % by number and

71 % by weight. Overall, sea breams (Sparidae), dominated the catches, with the valuable common or white sea bream *D. sargus* alone accounting for 26 % of the total catch by weight.

In the red sea bream study, five species of Sparidae dominated the catch, with 78 % by number and 85 % by weight (table II). The axillary sea bream, *P. acarne*, was the most important species, with a total catch of 169.7 kg (27.5 %).

M. merluccius was by far the most important species in the semi-pelagic long-line selectivity study, with 40.6 % of the total catch in numbers (table II). This and five other species accounted for 92.2 % of the combined total catch for all four hook sizes.

In terms of by-catch and discards, the highest amounts were in the latter study, where, of the main species other than the hake, only *Benthodesmus elongatus* (Clarke, 1879) was retained. Some other species which were rarely caught (< 5 % of the catch) but had commercial value included *Brama brama* (Bonnaterre, 1788), *Polyprion americanus*, *Lepidopus caudatus* (Euphrasen, 1788), *Conger conger*, *Raja* spp., *Prionace glauca* (Linnaeus, 1758), and *Mustelus mustelus* (Linnaeus, 1758). In the two sea bream selectivity and efficiency studies, fewer species were of no commercial value and would normally have been discarded: *Calyonimus lyra* (Linnaeus, 1758), *Coris julis* (Linnaeus, 1758), *Labrus* spp., *Scorpaena notata* (Rafinesque, 1810),

Table II. Catches of the most important species (> 5 % of the total catch in number and/or weight) in three long-line selectivity studies. (a): white sea bream métier; (b): red sea bream métier; (c): semi-pelagic long-line hake métier (weights not available)

a)

Family	Species	Number	%	Weight (kg)	%
Sparidae	*Boops boops*	245	10.7	27.4	6.2
Sparidae	*Diplodus annularis*	180	7.9	17.1	3.9
Sparidae	*Diplodus sargus*	226	9.9	111.8	25.5
Sparidae	*Diplodus vulgaris*	108	4.7	22.6	5.1
Sparidae	*Lithognathus mormyrus*	83	3.6	27.5	6.3
Serranidae	*Serranus cabrilla*	122	5.3	9.8	2.2
Sparidae	*Spondyliosoma cantharus*	282	12.3	41.4	9.4
Trachinidae	*Trachinus draco*	485	21.2	54.5	12.4
	Total No. of species: 40				
	Total (all 40 species)	2 287		439.0	

b)

Family	Species	Number	%	Weight (kg)	%
Sparidae	*Boops boops*	412	12.4	27.7	4.5
Sparidae	*Diplodus vulgaris*	516	15.5	102.0	16.5
Sparidae	*Pagellus acarne*	750	22.5	169.7	27.5
Serranidae	*Pagellus erythrinus*	188	5.6	94.6	15.3
Sparidae	*Spondyliosoma cantharus*	732	22.0	132.2	21.4
	Total No. of species: 36				
	Total (all 36 species)	3 328		616.4	

c)

Family	Species	Number	%
Trichiuridae	*Benthodesmus elongatus*	311	8.3
Squalidae	*Etmopterus pusillus*	210	5.6
Scyliorhinidae	*Galeus melastomus*	858	22.8
Gadidae	*Merlangius merlangus*	368	9.8
Merluccidae	*Merluccius merluccius*	1 524	40.6
Scyliorhinidae	*Scyliorhinus canicula*	192	5.1
	Total No. of species: 27		
	Total (all 27 species)	3 757	

Anthias anthias (Linnaeus, 1758), and *Serranus hepatus* (Linnaeus, 1758).

Catch size-frequency distributions of the most important species for different hook sizes are given in figures 4, 5, and 6. In most cases, the distributions are highly overlapping, with all hook sizes catching a similarly wide size-range for each species. For species having a minimum legal size, few or no illegal-sized individuals were caught, even with the smallest hooks in each study. The only exception was the black sea bream *S. cantharus*, which has a minimum legal size of 23 cm. Catch rates (number of fish per 100 hooks) varied considerably between and within the three studies (table III). However, in general, catch rates decreased with increasing hook size. The highest catch rates

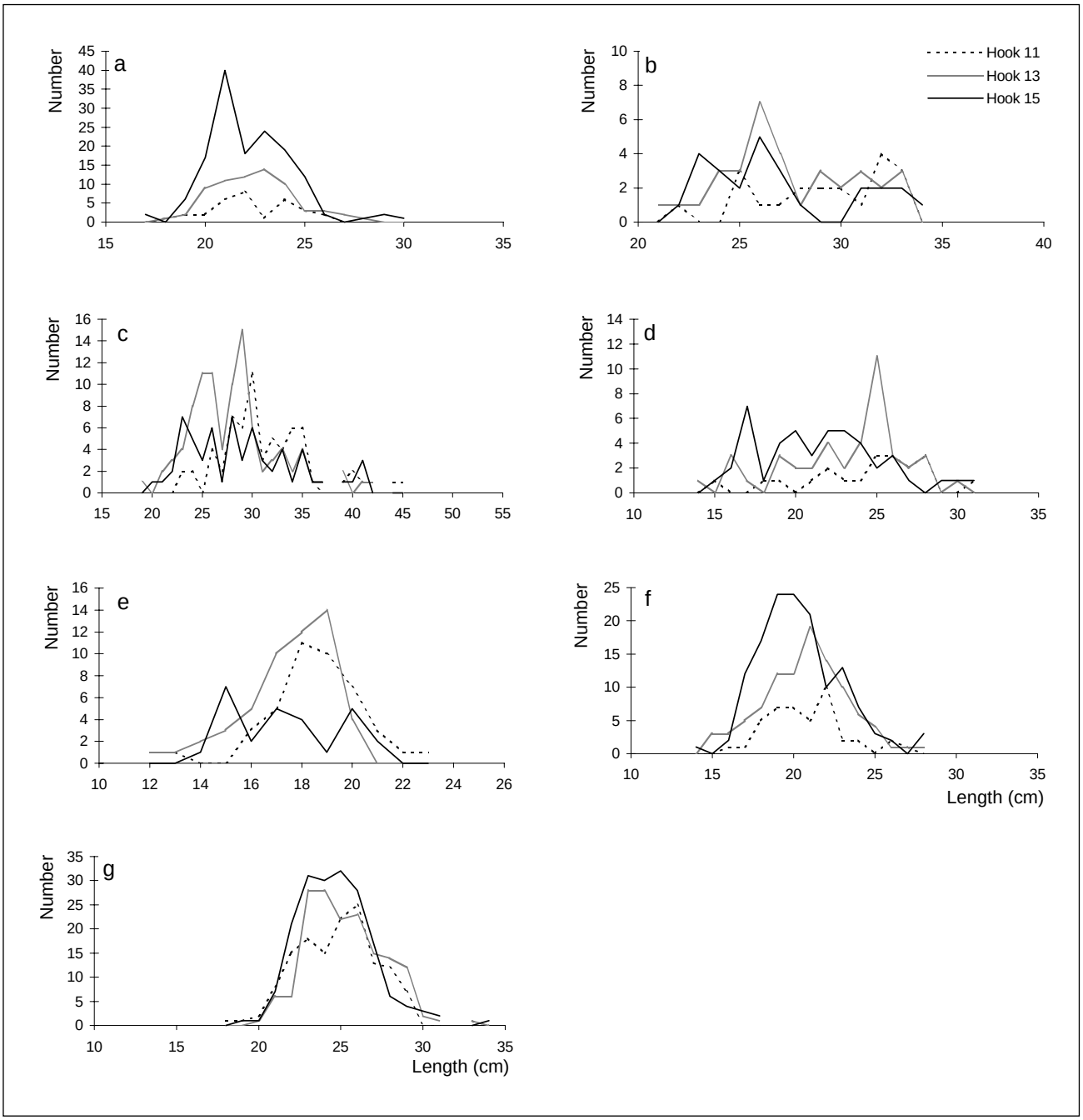

Figure 4. Catch size-frequency distributions of three hook sizes for seven of the most important species in the white sea bream study: (a): *Boops boops*; (b): *Lithognathus mormyrus*; (c): *Diplodus sargus*; (d): *Diplodus vulgaris*; (e): *Serranus cabrilla*; (f): *Spondyliosoma cantharus*; (g): *Trachinus draco*

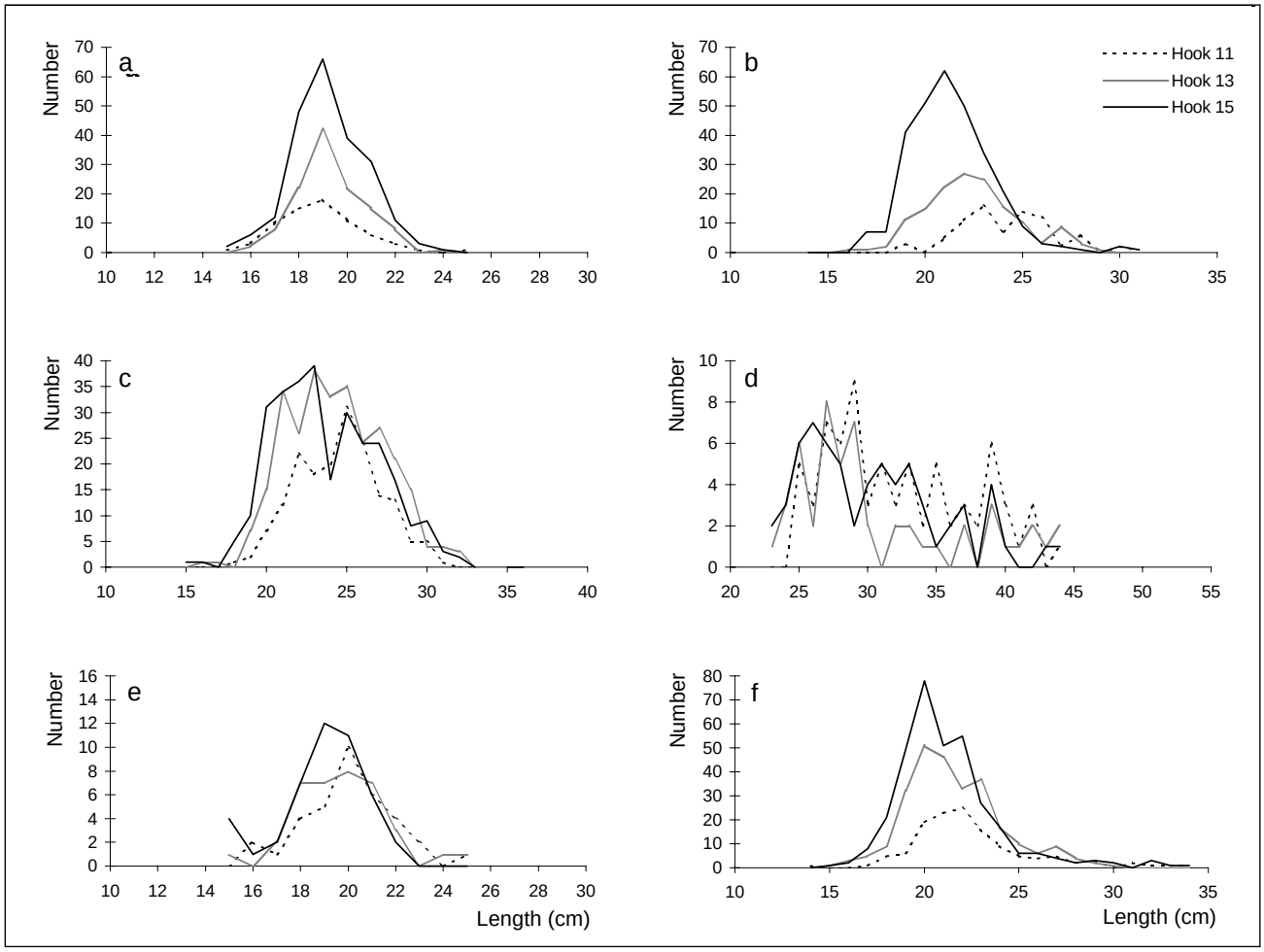

Figure 5. Catch size-frequency distributions of three hook sizes for six of the most important species in the red sea bream selectivity study: (a): *Boops boops*; (b): *Diplodus vulgaris*; (c): *Pagellus acarne*; (d): *Pagellus erythrinus*; (e): *Serranus cabrilla*; (f): *Spondyliosoma cantharus*

were obtained in the red sea bream study, where catch rates with the smallest hook (no. 15) were greater than 30 % in a significant number of long-line sets (Erzini *et al.*, 1997b).

In terms of catch size-distributions and catch rates of different hook sizes per species, four distinct patterns can be identified in these studies:

1) Highly overlapping catch size-frequency distributions (i.e. no evidence of differences in size selectivity), and decreasing catch rates with increasing hook size (e.g. *M. merluccius*, *Trachinus draco* (Linnaeus, 1758), *Boops boops* (Linnaeus, 1758).

2) Highly overlapping catch size-frequency distributions, with catch rate increasing to a maximum for intermediate-sized hooks (e.g. *P. acarne*).

3) Small displacement of the catch size-frequency distributions with increasing hook size (i.e. differences in size selectivity), along with a decrease in catch rate with increasing hook size (e.g. *D. vulgaris*, *S. cantharus*).

4) Displacement of the catch size-frequency distributions with increasing hook size, but no decrease in catch rate with increasing hook size (e.g. *P. erythrinus*).

DISCUSSION

Despite the major socio-economic importance of small-scale fisheries in this region, many aspects have not been studied comprehensively. In particular there is a lack of information on size selectivity of hook and line gear, catch composition, catch rates and factors which affect these, and gear overlap and competition. Little is known concerning the amount of long-line gear in use, since there is

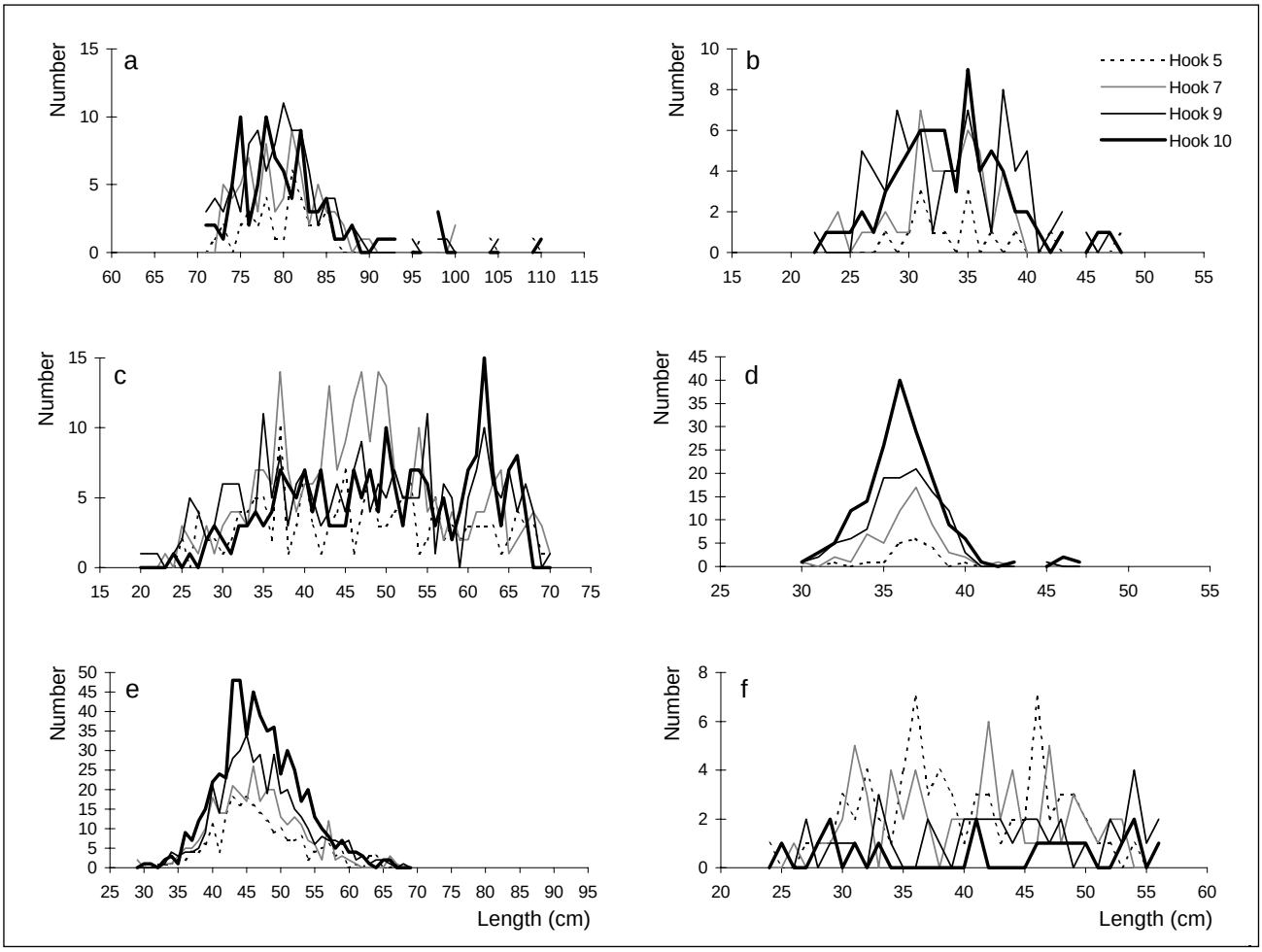

Figure 6. Catch size-frequency distributions of four hook sizes for six of the most important species in the semi-pelagic hake selectivity study: (a): *Benthodesmus elongatus*; (b): *Etmopterus pusillus* (Lowe, 1839); (c): *Galeus melastomus* Linnaeus, 1758; (d): *Merlangius merlangus* (Linnaeus, 1758); (e): *Merluccius merluccius*; (f): *Scyliorhinus canicula* (Linnaeus, 1758)

no legislation limiting hook and line gear. Our personal observations of small-scale fishermen suggest that 1 000-3 000 hooks per set is typical in small-hook long-line methods, while 6 000-8 000 hooks per set is more common in the semi-pelagic long-line hake method. Considering the potential fishing effort in terms of total numbers of hooks of boats using long-lines in Algarve waters, and the fact that catch rates may be as high as 20 % to 30 % (i.e. 20-30 fish for every 100 hooks), long-line gear may be a significant source of fishing mortality, especially for the larger individuals of many commercially important species.

Catch rates, species composition and size selectivity in hook-and-line fisheries are influenced by a number of variables (Bjordal and Løkkeborg, 1996). These include: hook size and design (Forster, 1973; Anon., 1983; Skeide, Bjordal and Løkkeborg, 1986; Bjordal and Løkkeborg, 1996), fishing strategy (Bjordal and Løkkeborg, 1996), bait and bait size (Moreno, Pol and González, 1992; Bjordal and Løkkeborg, 1996), and the use of accessories, e.g. swivels and floats (Bjordal and Løkkeborg, 1996). Given the large number of potentially important variables, any experimental study must be limited in terms of design. In our studies we have focused on hook size because of the implications for management, and on a few other factors which we consider to be potentially the most important in terms of affecting catch composition and catch rate (bait and fishing strategy).

In our studies of three long-line methods, an apparent lack of evidence for differences in size selectivity due to hook size was a common result for many of the species. In the two sea bream studies, several factors may contribute to explaining the ap-

Table III. Mean catch rates (No. of fish/100 hooks) ± 1 S.D. by hook size in the different selectivity and efficiency studies. (a): white sea bream métier; (b): red sea bream métier; (c): semi-pelagic long-line hake métier. A and B refer to selectivity trials with two different boats, in different areas

a)

			Catch rate ± 1 S.D.		
Type of set	Gangion	Bait	Hook No. 15	Hook No. 13	Hook No. 11
Selectivity	75 cm	Razor-shell	5.0 ± 2.39	4.4 ± 2.09	2.8 ± 1.49
Efficiency	40 cm	Mud shrimp	6.1 ± 4.98	2.0 ± 2.63	1.4 ± 2.16
Efficiency	75 cm	Mud shrimp	5.6 ± 3.44	3.4 ± 2.60	2.4 ± 2.94
Efficiency	40 cm	Razor-shell	5.3 ± 3.64	3.4 ± 2.70	4.5 ± 4.53
Efficiency	75 cm	Razor-shell	7.6 ± 6.25	4.8 ± 6.19	2.1 ± 2.59
Efficiency	40 cm	Squid	5.3 ± 10.09	3.4 ± 3.48	1.9 ± 1.86
Efficiency	75 cm	Squid	5.5 ± 6.91	4.6 ± 4.83	1.8 ± 1.77

b)

			Catch rate ± 1 S.D.		
Type of set	Gangion	Bait	Hook No. 15	Hook No. 13	Hook No. 11
Selectivity (A)	75 cm	Razor-shell	9.4 ± 2.88	6.8 ± 2.68	4.7 ± 1.52
Selectivity (B)	75 cm	Razor-shell	27.5 ± 6.55	19.3 ± 3.42	11.3 ± 0.89
Efficiency	75 cm	Mud shrimp	12.3 ± 5.24	10.3 ± 4.37	5.3 ± 3.03
Efficiency	75 cm	Razor-shell	15.7 ± 6.99	15.7 ± 9.76	7.4 ± 5.34

c)

			Catch rate ± 1 S.D.			
Type of set	Gangion	Bait	Hook No. 10	Hook No. 9	Hook No. 7	Hook No. 5
Selectivity	100 -120 cm	Sardine	7.1 ± 3.36	6.2 ± 2.67	5.6 ± 3.1	4.1 ± 2.15

parent lack of selectivity. Firstly, most of the species caught in these long-lines are small, with maximum reported sizes of less than 45-60 cm, in most cases. Secondly, smaller individuals may not be well represented at the depths that were fished in this study. Thus, the populations that were fished may have been fairly limited in terms of size structure, consisting mainly of large individuals. This may have been particularly true for *D. sargus* and *P. erythrinus*. With such limited size distributions, it is not surprising that the catch size-frequency distributions of the different-sized hooks were often highly overlapping (Erzini *et al.,* 1996a, 1996b, 1997a). In the case of the hake, fishing took place at depths of 500-600 m, while small individuals are found on the continental platform and the upper continental slope and would not have been accessible to the gear used in our study. Furthermore, *M. merluccius* is a highly predatory species with a very large mouth, meaning that even the smaller individuals caught in this study could take the largest hook (no. 5), thereby ensuring that no differences were found between the hook sizes used.

The general decrease in catch rate with increasing hook size indicates that there is a limited effective hook-size range in these fisheries. It is interesting to note that our highest catch rates were obtained with hook sizes that are not used by the Algarve fishermen: number 15 in the sea bream methods, and no.10 in the semi-pelagic long-line hake method. In particular, the number 10 hook had significantly higher catch rates for *M. merluccius* than the larger hook sizes that are normally used in this method. Fishermen may be reluctant to use small hooks for a number of reasons. These include: higher catches of less desirable species, e.g. *B. boops,* which are time-consuming to remove and may twist and tangle the gangions; small hooks are generally more difficult to bait and to handle; they are more easily damaged; and because they are weaker and straighten under pressure, they may not hold exceptionally large fish.

Despite the small size of the number 15 hook in the sea bream studies and the number 10 hook in the *M. merluccius* study, the capture of illegal-sized fish was minimal, with only the black sea bream (*S. cantharus*) being the exception. As discussed in Erzini *et al.* (1995, 1996a and 1997b), the minimum legal size for this species may be inappropriate, given current population size structures and size at maturity.

Long-lines have a number of characteristics that are highly favourable in terms of the rational use and management of living resources. These include the minimal capture of undersized fish, essentially no harmful effects in terms of the environment, low energy costs, low discard rates, and the capture of a high quality product. This study is part of ongoing research on the small-scale fisheries of southern Portugal, which will hopefully contribute to the improved management and utilisation of demersal species, which are increasingly scarcer.

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