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Fish assemblages of Berlengas Natural Reserve (marine protected area) and Peniche coast (Portugal). How different they are?

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Introduction

The Berlengas Natural Reserve (BNR) is an archipelago formed by 3 groups of islands (Berlenga, Estelas and Farilhões). It was created in 1981 and has a total area of 9560 hectares, 9456 of which marine (Maranhão *et al.*, 2006). It is located 5 miles off Peniche (Fig. 1), a city where a great part of the local population works on activities related to the fishing industry. Therefore, it is absolutely imperative to protect local fish communities and the BNR could have an important role here. However, very few scientific studies have been developed to assess the species that inhabit these waters and the ones concerning fishes are scarce and exclusively related to the coastal area of Berlengas (Henriques, 1993; Rodrigues, 1993; Almeida, 1996; Rodrigues *et al.* 2008a; Rodrigues *et al.*, 2008b).



Figure 1 – Berlengas geographically

Methods and material

Six sampling spots were selected in this study. Three from Peniche coast and three from Berlengas (Fig. 2). Two different methods of non-destructive underwater visual census were used to assess the fish communities in Peniche and Berlengas: transect (Fig. 3) and point counts (Fig. 4). On each spot, eight census were performed. Each census lasted about five minutes and during that time all fishes observed were registered and separated according to species and size classes (Table I).



Figure 2 – Sampling spots of Berlengas and Peniche

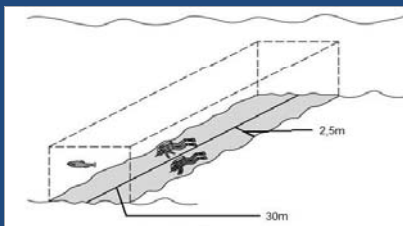


Figure 3 – Underwater visual census – transect method (Adapted from Jennings *et al.*, 2001)

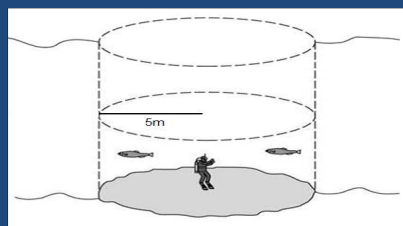


Figure 4 – Underwater visual census – point counts method (Adapted from Jennings *et al.*, 2001)

Results

A total of 7406 fish of 29 species and 15 families have been observed during this campaign (Table I). *Gobiusculus flavescens* (Fig. 8) was the most abundant followed by *Gymnammodytes semisquamatus* (Fig. 9). The most frequent species was *Diplodus vulgaris* (Fig. 10) (97,9%), which was also the third most abundant.

Table I – Checklist of fishes from Berlengas and Peniche

Family	Species	N°	OF (%)
Rajidae	<i>Raja</i> sp.	1	2
Ballistidae	<i>Ballistes capriscus</i>	10	2
Sparidae	<i>Boops boops</i>	21	4,2
	<i>Diplodus sargus</i>	5	8,3
	<i>Diplodus vulgaris</i>	714	97,9
	<i>Oblada melanura</i>	8	2
	<i>Pagrus auriga</i>	2	2
	<i>Sparus aurata</i>	2	4,2
	<i>Spondylosoma cantharus</i>	12	14,6
Carangidae	<i>Trachurus trachurus</i>	4	2
Mugilidae	<i>Chelon labrosus</i>	4	4,2
Gadidae	<i>Pollachius pollachius</i>	5	8,3
	<i>Trisopterus luscus</i>	9	18,8
Serranidae	<i>Serranus cabrilla</i>	9	10,4
Labridae	<i>Centrolabrus exoletus</i>	63	47,9
	<i>Coris julis</i>	62	20,8
	<i>Centrolabrus rupestris</i>	65	64,6
	<i>Labrus bergyllia</i>	82	45,8
	<i>Labrus mixtus</i>	1	2
	<i>Symphodus</i> sp.	84	60,4
Triglidae	<i>Trigloporus lastoviza</i>	1	2
Gobiidae	<i>Gobius paganellus</i>	1	2
	<i>Gobiusculus flavescens</i>	4260	64,6
	<i>Pomatoschistus pictus</i>	1	2
Callionymidae	<i>Callionymus lyra</i>	2	4,2
Blenniidae	<i>Parablennius pilicornis</i>	42	37,5
Tripterygiidae	<i>Tripterygion delaisi</i>	2	4,2
Syngnathidae	<i>Syngnathus acus</i>	1	2
	<i>Gymnammodytes semisquamatus</i>	1933	14,6

N°, Number of Individuals; OF, Occurrence Frequency. 7406

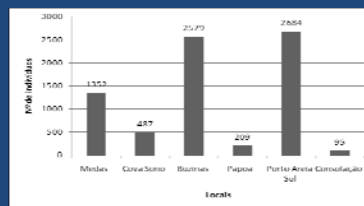


Figure 5 – Total of fish on each spot

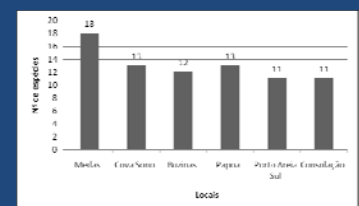


Figure 6 – Total of species on each spot

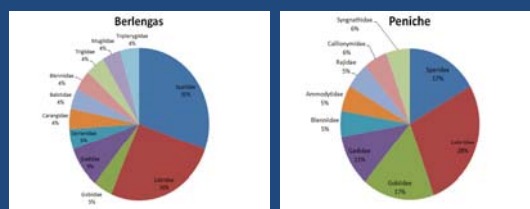


Figure 7 – Relative abundance of families in Berlengas and Peniche



Figure 8 – *Gobiusculus flavescens*

Table II – Density and Shannon-Wiener index (H') from sampled spots

	Medas	Cova do Sono	Buzinas	Papoa	Porto Areia Sul	Consolação
DENSITY	0,405	0,192	0,240	0,080	0,117	0,075
(H')	1,77	2,03	0,53	1,88	1,17	2,18

The high abundance of *Gymnammodytes semisquamatus* in Porto Areia Sul and of *Gobiusculus flavescens* in Buzinas (Figure 5) explains why these are the two spots where the abundance of fish is highest. Highest specific richness value was registered in Medas (Berlengas), and lowest in Porto Areia Sul and Consolação (both in Peniche) (Figure 6). Sparidae family was the most represented in Berlengas (7 spp.) and Labridae was the most represented in Peniche (5 spp.) (Fig. 7). Highest density was registered in Medas and highest diversity was registered in Consolação (Table II).



Figure 9 – *Gymnammodytes semisquamatus*

Figure 10 – *Diplodus vulgaris*

Discussion

Prior studies reported higher density of fishes (Almeida, 1996) and higher specific richness (Almeida, 1996; Rodrigues, 2008a and Rodrigues, 2008b). The most likely reason was the methodology adopted in the present study; the one, according to Willis (2001), underestimates cryptobenthic fishes. The absence or low abundance of several species in Peniche when compared to Berlengas could be explained by two main reasons: the affinity of some species with oceanic environment (e.g. *Oblada melanura*, *Boops boops*), and therefore, their higher occurrence in Berlengas; the high anthropogenic disturbance felt in Peniche when compared to Berlengas (boat traffic, pollution and intensive fishing) (Queiroga, *et al.* 2009).

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