Diet of *Spondyliosoma cantharus* and *Diplodus puntazzo* (Sparidae) in the Eastern Central Adriatic

by

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ABSTRACT. - The stomach contents of *Spondyliosoma cantharus* and *Diplodus puntazzo* were analysed using three simple methods (numeric, gravimetric and frequency of occurrence) and a composite index (IRI - Index of relative importance). To compare the species, the Schoener index was used. The diet of *S. cantharus* consisted mainly of amphipods followed by polychaetes, ophiuroids and hydrozoans, while macrophyta, bivalves, spongids, polychaetes and ophiuroids dominated in the case of *D. puntazzo*. There were some size-related differences in *S. cantharus* and *D. puntazzo* feeding. Diet overlap was high and significant between species. Polychaetes were the dominant prey group in all seasons for *S. cantharus*, particularly from spring to autumn. Significant differences among seasons were found for polychaetes, amphipods, ophiuroids and decapods. Mean weight and mean number of prey significantly increased to spring-summer period. Macrophyta and bivalves were the dominant prey groups in all seasons for *D. puntazzo*, particularly from spring to summer. Significant differences among seasons were found for macrophyta, bivalves, ophiuroids and hydrozoans. Mean weight and mean number of prey significantly increased to spring-summer period.

RÉSUMÉ. - Régime alimentaire de *Spondyliosoma cantharus* et *Diplodus puntazzo* (Sparidae) en mer Adriatique centrale.

Les contenus stomacaux de *Spondyliosoma cantharus* et *Diplodus puntazzo* ont été analysés en utilisant trois méthodes simples (numérique, gravimétrique et fréquence d'apparition) et l'index de composition (IRI - index d'importance relative). L'index de Schoener a été utilisé pour comparer les espèces. La nourriture de *S. cantharus* est principalement composée d'amphipodes, de polychètes, d'ophiures et d'hydrozoaires, tandis que les macrophytes, les bivalves, les éponges, les polychètes et les ophiures dominent dans l'alimentation de *D. puntazzo*. Des différences de comportement alimentaire en relation avec la taille ont été observées entre *S. cantharus* et *D. puntazzo*, ainsi qu'un recouvrement significatif du type de nourriture. Pour *S. cantharus*, les polychètes ont été les proies dominantes durant toutes les saisons, particulièrement du printemps jusqu'à l'automne. La masse et le nombre moyen des proies ont augmenté significativement au printemps et en été. Pour *D. puntazzo* les macrophytes et les bivalves ont été les proies dominantes durant toutes les saisons, particulièrement du printemps à l'été. La masse et le nombre moyen des proies ont augmenté significativement au printemps et en été.

Key words. - Sparidae - *Spondyliosoma cantharus* - *Diplodus puntazzo* - MED - Adriatic Sea - Diet.

The black sea bream *Spondyliosoma cantharus* (Linnaeus, 1758) (=*Cantharus cantharus* Linnaeus, 1758) is a relatively common fish of inshore waters on rocky or sandy bottoms and *Posidonia oceanica* beds at depths down to 50 m (young) and 300 m (adults). Black sea bream form a significant component of the gill net and fish trap catch in Croatian coastal fishery (Jardas, 1996). The sharpsnout sea bream *Diplodus puntazzo* (Cetti, 1777) is a common fish throughout the Mediterranean and Adriatic Sea in littoral waters on rocky bottoms to 150 m (more abundant around 60 m). It form a significant component of the beach seine net catch in Croatian coastal fishery (Jardas, 1996). Information on the biology of these two species in Adriatic and Mediterranean waters is scarce and some few dietary studies exist from the Atlantic. Gonçalves and Erzini (1998) examined the feeding habits of the black sea bream from the southwest coast of Portugal. Sala and Ballesteros (1997) reported a partitioning of space and food resources by three fish of the genus *Diplodus* (among them *D. puntazzo*) in a Mediterranean rocky infralittoral ecosystem. There are some data about the biology and ecology on black sea bream from the eastern Adriatic. Dulčić and Kraljević (1996) presented data on growth of the black sea bream in the eastern central Adriatic, while data on fecundity were presented by Dulčić *et al*. (1998).

Despite their abundance, little is known about the trophic ecology of black sea bream and sharpsnout sea bream in the Adriatic Sea. The objective of this study was to examine diet and feeding habits of these two species off the eastern central Adriatic. Feeding strategies were also compared with other species of the Sparidae family.

MATERIAL AND METHODS

Spondyliosoma cantharus specimens were collected with beach seine nets (4 mm and 22 mm mesh-size stretched), gill nets (32 mm and 60 mm mesh-size stretched) and fish traps

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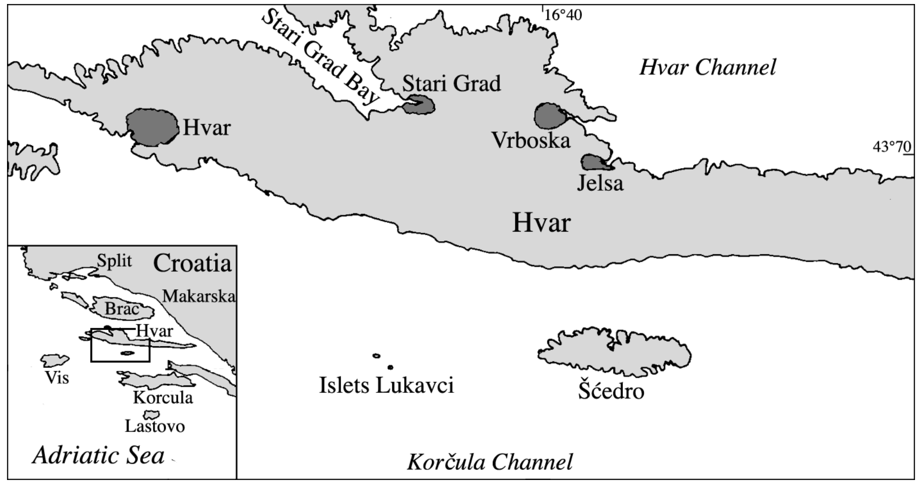

Figure 1. - Sampling area for the *Spondyliosoma cantharus* and *Diplodus puntazzo* in the eastern Adriatic (Croatian coast). *[Zone d'échantillonnage pour* Spondyliosoma cantharus *et* Diplodus puntazzo *en Adriatique orientale (côtes croates).]*

on rocky and, mainly, sandy bottoms. *Diplodus puntazzo* samples were collected with beach seine nets (4 mm and 22 mm mesh-size stretched) on rocky bottoms. Sampling took place between December 1998 and January 2000 in the eastern central Adriatic (islets Lukavci, island Šćedro near island Hvar, Korčula channel, eastern middle Adriatic) (Fig. 1). Specimens were measured promptly after collection, to the nearest 0.1 cm TL (total length) and 0.1 g weight. Guts were removed and both ends of the stomach were tied off. Fishes were immediately set out to avoid regurgitation of food ingested, and used for diet analysis. Stomachs with contents were preserved in 4% buffered formaldehyde. A total of 432 black sea bream and 412 sharpsnout sea bream stomach contents were analysed. The contents of the dietary material were sorted and identified to the taxonomic groups under a binocular microscope. Presence of inorganic matter and detritus in the stomachs was recorded, but excluded from the analysis. After identification, preys were weighed to the nearest 0.01 g. Hard parts such as beaks of cephalopods, telson or pereion fragments of crustaceans and fish otoliths were often significantly helpful in identifying prey items. To assess for possible changes in diet with respect to the ontogeny stages (first maturity), fish (both species) were divided into two size classes (sub-adults < 22.0 cm, adults > 22.0 cm for black sea bream; sub-adults < 24.0 cm, adults > 24.0 cm for sharpsnout sea bream; Jardas, 1996).

Following Hureau (1970), the methods used to quantitatively and qualitatively describe the diet were: a) numeric (%N = (n/N) x 100), where n is the number of prey items of a particular taxon and N is the total number of prey items found in all stomachs; b) gravimetric (%W = (w/W) x 100), where w is the total wet weight of a particular prey group or taxon and W is the total weight of all the prey in all stomachs and c) frequency of occurrence %F, which is the proportion of all stomachs examined which contain a particular taxon or prey group. A composite index: the Index of Relative Importance, IRI = (%N+%W) x %F (Pinkas *et al.*, 1971), using wet weight instead of volume, was used to evaluate prey preferences. In order to evaluate periods of feeding activity and inactivity, the coefficient of emptiness:

CV = (total number of empty stomachs/total number of stomach analysed) x 100) was calculated (Hureau, 1970).

The Spearman correlation coefficient was used to compare diets of both sparids (Zar, 1984). T tests were used to evaluate the significance of the results. The Schoener Index (Schoener, 1970) was used to evaluate diet overlap:

C = 1 - 0.5 x (S (Px*i*-Py*i*)) where Px*i* and Py*i* are the proportions of prey *i* in the diets of the species x and y.

Values range from 0 (no overlap, when two species use totally different resources) to 1 (when they use the same resources in the same proportions) with values greater than 0.6 generally considered significant (Zaret and Rand, 1971). Reviews of dietary overlap indices indicate that the Schoener's index appears to provide quite good estimates of the niche overlap on the basis of prey type (Wallace, 1981; Linton *et al.*, 1981). For standardisation purposes, %F and IRI were transformed into percentage values of their total.

Statistical differences (p < 0.05) in diet composition with respect to size and season, were assessed by a chi-square test applied on the frequency of given prey. The variation of the vacuity index was also tested by a chi-square test. The significance of variation of mean number of prey items and mean weight per stomach among size classes and seasons was tested by analysis of variance (ANOVA) while Tukey's test was employed to locate the source of any difference (Zar, 1984).

RESULTS

Feeding intensity, diet composition and classification of prey

The coefficient of vacuity for *S. cantharus* was 12.5% of the 432 stomachs analysed (54 were empty). This percentage

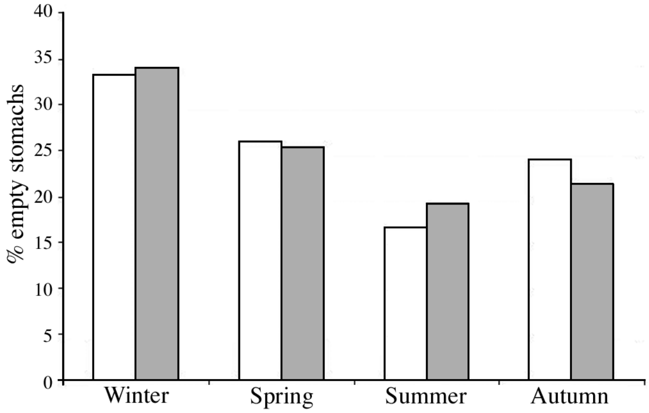

Figure 2. - Seasonal variations in percentage of empty stomachs for *Spondyliosoma cantharus* (white) and *Diplodus puntazzo* (black). *[Variations saisonnières du pourcentage d'estomacs vides pour* Spondyliosoma cantharus *(blanc) et* Diplodus puntazzo *(noir).]*

varied significantly over the year ($\chi^2 = 46.1$, $p < 0.05$), with a maximum of 33.3% during winter and a minimum of 16.6% during summer (Fig. 2). The mean number of prey items per stomach was 12.1, and the average weight of the stomach contents was 0.39 g. The coefficient (6.6% in juveniles and 5.9% in adult specimens) did not differ significantly among size classes ($\chi^2 = 0.5$, $p > 0.05$).

For *D. puntazzo*, 47 (11.4%) of the 412 stomachs were empty. This percentage varied significantly over the year ($\chi^2 = 31.3$, $p < 0.05$), with a maximum of 34.0% during winter and a minimum of 19.2% during summer (Fig. 2). The mean number and weight of prey per stomach was 10.6 and 0.35 g, respectively. The coefficient of emptiness (6.1% in juveniles and 5.3% in adult specimens) did not differ significantly among size classes ($\chi^2 = 0.5$, $p > 0.05$).

Concerning the basic diet composition, 260 individual prey items were identified in the stomachs of the black sea bream. The diet was diverse; with polychaetes, ophiuroids, amphipods, and hydrozoans being the most frequent and important in terms of weight, and polychaetes were numerically the dominant group, with a great variety of other marine organisms contributing to the diet (Tab. I). Of a total of 233 individual prey items found in the stomachs of the sharpsnout sea bream, macrophyta were the most frequent and numerically dominant group, while bivalvia in terms of weight (Tab. II).

Analysis based on the feeding index (IRI) showed that the principal prey groups for the black sea bream were amphipods, followed by polychaetes, ophiuroids and hydrozoans (Tab. I). According to the classification of Rosecchi and Nouaze (1987) amphipods, polychaetes and ophiuroids are classified in the principal prey category, while hydrozoans and echinoids as secondary prey.

Table I. - Percentage composition by frequency of occurrence (%F), by number (%N) and by weight (%W) and composite index (IRI) for the total sample, by size for *Spondyliosoma cantharus*. *[Composition en pourcentage par fréquence d'apparition (%F), nombre (%N) et poids (%W) et index composé (IRI) pour l'échantillon total, par taille pour* Spondyliosoma cantharus.*]*

Taxa	General				TL < 22.0 cm				TL > 22.0 cm			
	%F	%N	%W	IRI	%F	%N	%W	IRI	%F	%N	%W	IRI
Polychaeta	24.7	58.5	30.8	2205.8	25.0	37.2	22.1	1482.5	22.2	65.6	44.9	2453.1
Amphipoda	33.8	27.6	53.0	2724.2	37.5	22.6	71.1	3515.3	33.3	22.5	52.2	2487.5
Hydrozoa	24.7	19.0	4.0	566.1	17.5	20.1	4.0	421.7	26.7	18.1	3.7	583.6
Gastropoda	8.1	2.5	1.3	30.7	4.0	3.5	< 0.1	14.0	15.2	3.7	1.1	72.9
Decapoda	13.5	3.1	2.2	71.8	4.0	7.0	4.1	44.1	21.2	3.7	1.5	110.8
Ophiuroidea	39.2	14.5	19.7	1340.7	64.0	42.1	27.6	4458.0	36.4	6.7	18.2	907.6
Cephalopoda	2.7	0.6	17.3	48.4	4.0	1.8	1.7	13.9	3.0	0.6	41.7	128.2
Isopoda	5.2	0.4	0.1	2.6	-	-	-	-	8.9	0.6	< 0.1	5.5
Bivalvia	6.5	0.9	0.1	6.3	5.0	0.9	< 0.1	4.3	6.7	0.9	< 0.1	5.9
Mysidacea	5.4	1.2	0.9	11.7	8.0	3.5	0.7	33.7	6.1	1.2	0.2	8.6
Echinoidea	14.9	21.2	7.6	429.1	12.0	3.5	0.0	42.1	27.3	16.0	16.7	890.6
Anthozoa	2.7	1.5	< 0.1	4.2	4.0	3.5	< 0.1	14.0	3.0	1.8	< 0.1	5.6
Copepoda	4.0	0.3	< 0.1	1.3	7.5	1.7	< 0.1	12.8	2.2	0.1	< 0.1	0.3
Cnidaria	5.4	1.2	6.2	40.4	4.0	1.8	< 0.1	7.0	3.0	0.6	< 0.1	1.9
Ostracoda	4.1	0.9	< 0.1	3.8	4.0	1.8	< 0.1	7.0	3.0	0.6	< 0.1	1.9
Bryozoa	2.7	1.5	< 0.1	4.2	4.0	3.5	< 0.1	14.0	3.0	1.8	< 0.1	5.6
Holothuroidea	1.4	0.3	5.1	7.3	4.0	1.8	1.2	11.8	-	-	-	-
Osteichthyes	6.8	1.8	0.2	13.6	3.7	1.9	0.1	7.4	10.2	1.7	0.3	20.4
Not identified	2.6	0.3	5.0	13.8	2.5	0.2	3.3	8.8	2.6	0.4	6.9	19.0

Table II. - Percentage composition by frequency of occurrence (%F), by number (%N) and by weight (%W) and composite index (IRI) for the total sample, by size for *Diplodus puntazzo*. *[Composition en pourcentage par fréquence d'apparition (%F), nombre (%N) et poids (%W) et index composé (IRI) pour l'échantillon total, par taille pour* Diplodus puntazzo.*]*

Taxa	General				TL < 24.0 cm				TL > 24.0 cm			
	%F	%N	%W	IRI	%F	%N	%W	IRI	%F	%N	%W	IRI
Macrophyta	68.2	26.1	20.9	3205.4	72.3	12.9	13.7	1923.2	69.8	38.3	28.2	4641.7
Spongia	34.1	8.8	23.1	1807.8	24.7	8.2	13.5	536.0	43.9	9.3	23.2	1426.8
Hydrozoa	37.7	12.0	7.7	742.7	46.7	19.0	4.0	1074.1	29.3	5.2	11.2	480.5
Anthozoa	37.5	0.8	19.7	768.8	17.5	0.4	4.6	87.5	57.9	1.2	33.7	2020.7
Bivalvia	40.9	23.4	51.8	3075.7	10.4	2.1	13.2	159.1	71.5	42.4	86.5	9216.4
Polychaeta	38.6	21.3	8.2	1138.7	24.0	14.0	6.4	489.6	52.7	28.2	12.3	2139.6
Copepoda	11.4	0.5	0.3	9.1	2.6	0.4	0.1	1.3	8.7	0.6	0.2	7.0
Decapoda	13.6	4.2	2.1	85.7	18.2	7.4	3.7	143.8	8.9	0.7	0.5	10.7
Isopoda	36.4	0.6	0.3	32.8	23.1	0.4	0.2	13.9	13.3	0.8	0.3	14.6
Amphipoda	31.1	4.6	3.8	261.2	32.7	6.2	3.7	323.7	28.1	3.7	3.1	191.8
Bryozoa	25.1	1.7	0.2	47.7	23.0	3.1	0.1	73.6	27.1	0.7	0.3	27.1
Ophiuroidea	36.4	15.6	14.1	1081.1	54.0	24.1	21.6	2629.8	20.4	6.7	4.2	222.4
Ascidiacea	18.8	1.8	0.1	35.7	21.4	1.3	0.1	30.0	15.2	2.6	0.2	42.6
Not identified	3.6	1.9	6.0	28.3	2.9	0.9	6.1	20.3	5.1	2.9	7.1	51.0

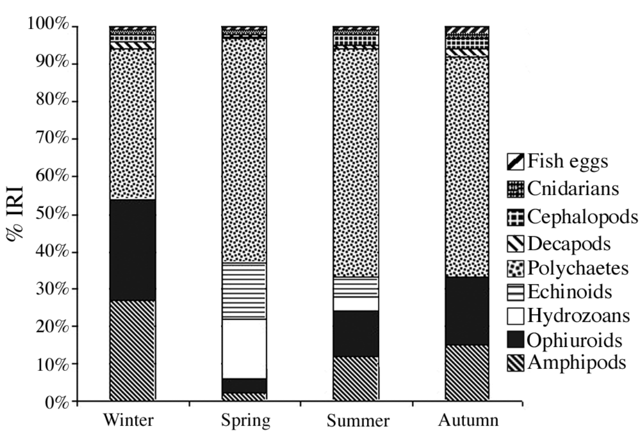

Figure 3. - Seasonal variations of *Spondyliosoma cantharus* diets based on the %IRI values of the major prey groups. *[Variations saisonnières de l'alimentation de* Spondyliosoma cantharus*, basées sur les valeurs %IRI du groupe principal de proies.]*

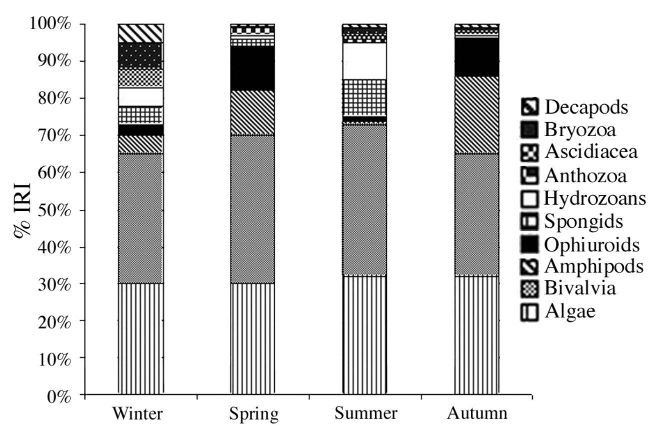

Figure 4. - Seasonal variations of *Diplodus puntazzo* diet based on the %IRI values of the major prey groups. *[Variations saisonnières de l'alimentation de* Diplodus puntazzo *basées sur les valeurs %IRI du groupe principal de proies.]*

For the sharpsnout sea bream, the IRI index indicated that the main prey groups were macrophyta, followed by bivalves, spongids, polychaetes and ophiuroids. According to the classification of Rosecchi and Nouaze (1987) macrophyta and bivalvia are classified as the principal prey category, while spongia, polychaetes and ophiuroids as secondary prey.

Food in relation to fish size

The black sea bream, analysed in the study ranged in size from 14.0 to 46.5 cm TL, with mean values of 18.7 ± 1.39 (SD) for individuals less than 22.0 cm TL and 31.5 ± 1.53 cm (SD) for those greater than 22.0 TL. The two size groups differed significantly in terms of diet ($p < 0.05$), with gastropods, echinoids and cephalopods relatively more important for the largest fish. The IRI of polychaetes, gastropods, decapods, echinoids and cephalopods increase with black sea bream size whereas the IRI of amphipods, ophiuroids, mysids, copepods and bryozoans decreased. A chi-square revealed non-signifcant differences only between ingestion of bivalvia ($\chi^2 = 4.1$, $p > 0.05$). The total amount of food ingested varied significantly among size classes ($F = 6.6$, $p < 0.05$). Tukey's test revealed that mean weight of stomach contents for adult specimens differed significantly from that for sub-adults ($p < 0.01$).

A similar size range of the sharpsnout sea bream was used in the study: 15.2 to 41.5 cm TL, with mean lengths of 21.7 ± 0.98 (SD) cm for fish less than 24 cm TL and 30.4 ± 1.8 (SD) cm for fish greater than 24 cm TL. Diets of these two groups were significantly correlated according to the Spearman test ($p < 0.01$). In the group of smaller individuals sponges, amphipods and ophiuroids were relatively more

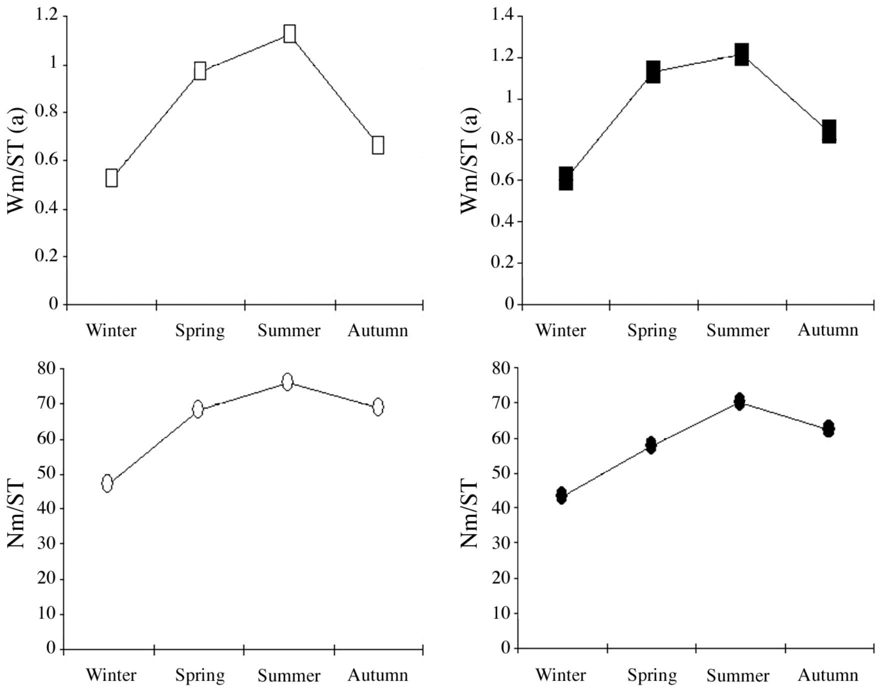

Figure 5. - Mean weight of prey items per stomach (Wm/ST) (squares) and mean number of prey items per stomach (Nm/ST) (circles) of *Spondyliosoma cantharus* (white) and *Diplodus puntazzo* (black) through the year. *[Poids moyen des proies par estomac (Wm/ST) (carrés) et nombre moyen de proies par estomac (Nm/ST) (cercles) de* Spondyliosoma cantharus *(blanc) et* Diplodus puntazzo *(noir) au cours l'année.]*

important, while macrophyta, bivalvia and anthozoa were more dominant in the diet of larger fish. The IRI of macrophyta, spongia, hydrozoa anthozoa, bivalvia, and polychaeta increase with sharpsnout sea bream size whereas the IRI of hydrozoa, decapods, amphipods and ophiuroids decreased. A chi-square revealed non-significant differences only between ingestion of isopods ($\chi^2 = 4.1$, $p > 0.05$), ascidiacea ($\chi^2 = 3.5$, $p > 0.05$) and copepoda ($\chi^2 = 3.8$, $p > 0.05$). Tukey's test revealed that mean weight of stomach contents for adult specimens differed significantly from that for subadults ($p < 0.05$).

Seasonal variation in the diet

Polychaetes were the dominant prey group in all seasons for black sea bream, particularly from spring to autumn (%IRI > 58). Amphipods and ophiuroids were present in the diet throughout the year with a peak in winter, while hydrozoans and echinoids were present during spring and summer with a peak in spring (Fig. 3). Decapods, cephalopods, cnidarians and fish eggs were present in the contents during all seasons, but in smaller quantities. Significant differences among seasons were found for hydrozoans ($\chi^2 = 17.7$, $p < 0.05$), amphipods ($\chi^2 = 41.3$, $p < 0.05$), ophiuroids ($\chi^2 = 15.8$, $p < 0.05$) and echinoids ($\chi^2 = 29.4$, $p < 0.05$). Mean weight and mean number of prey significantly increased to spring-summer period ($F = 19.8$, $p < 0.05$; $F = 5.2$, $p < 0.05$) (Fig. 5). In both cases, Tukey's test showed that spring and summer samples differed significantly from those of winter ($p < 0.01$).

Algae and bivalves were the dominant prey groups in all seasons for sharpsnout sea bream, particularly from spring to summer (%IRI > 64). Amphipods and ophiuroids were present in the diet throughout the year with a peak in spring, while spongids and hydrozoans with peak in summer (Fig. 4). Anthozoa were present during spring and summer with a peak in spring. Ascidiacea, bryozoa and decapods were present in the contents during all seasons, but in smaller quantities. Significant differences among seasons were found for amphipods ($\chi^2 = 22.7$, $p < 0.05$), spongids ($\chi^2 = 40.3$, $p < 0.05$), ophiuroids ($\chi^2 = 18.8$, $p < 0.05$) and hydrozoans ($\chi^2 = 39.4$, $p < 0.05$). Mean weight and mean number of prey significantly increased to spring-summer period ($F = 21.8$, $p < 0.05$; $F = 7.2$, $p < 0.05$) (Fig. 5). In both cases, Tukey's test showed that spring and summer samples differed significantly from those of winter ($p < 0.05$).

Comparison of diets between species

According to the Spearman rank correlation coefficient the diets of these two species are significantly different ($p < 0.05$), with differential consumption especially of bryozoa, bivalves and anthozoa, contributing to this result. Gastropoda, Cephalopoda, Mysidacea, Echinoidea, Cnidaria, Ostracoda, Holothuroidea and Osteichthyes were consumed only by the black sea bream, while algae, spongidae and ascidians by the sharpnout sea bream. In terms of diet overlap, Schoener coefficient values were below (%F = 0.37 and %IRI = 0.44), indicating some overlapping, and above the 0.60 limit (%N = 0.98 and %W = 0.76) indicating some high overlap between species. Based on the data of Gamulin-Brida and Pérès (1973) of the benthic and epibenthic communities, it can be concluded that the diets of both species generally reflect the principal available prey groups in the area of investigation, especially with regards to polychetes, crustaceans and ophiuroids.

DISCUSSION

The diet of the black sea bream from the eastern central Adriatic was characterised by small crustaceans (amphipods), polychaetes, ophiuroids and hydrozoans. Gonçalves and Erzini (1998) reported that the diet of *S. cantharus* from the south-west coast of Portugal was based on polychaetes, amphipods and hydrozoans. Quéro (1984) observed that its diet in the Gulf of Biscay was based on macrophyta (Enteromorpha), crustaceans (copepods and amphipods), and hydrozoans. This species was found also to feed on fishes, crustaceans (mysids and ostracods), as well as polychaetes and marine plants. In general, these findings are very similar with the present study, especially regarding polychaetes, small crustaceans (amphipods) and hydrozoans. In the Santo Andre lagoon in Portugal, black sea bream were found to feed primarily on insects (chironomids) (Bernardo, 1990), revealing the adaptability of this species in terms of feeding. The black sea bream preferentially preyed on crustaceans (small crustaceans and amphipods in August and turning to mysids in May) in the Ria Formosa (southern Portugal) (Pita *et al.*, 2002). As with other sparids, the black sea bream is an opportunistic feeder, including a wide range of organisms from rocky, mud and sand substrates in its diet (Gonçalves and Erzini, 1998). The presence of macrophyta in approximately 25% of the stomachs analysed confirms the classification of this species as omnivore (Bauchot and Hureau, 1986; Quéro, 1984; Jardas, 1996).

Analysis of the gut contents and of the feeding indices indicates that the diet of the sharpsnout sea bream consists mainly of macrophyta, followed by bivalve, polychaetes, sponges, and ophiuroids what is similar with findings of Sala and Ballesteros (1997) for the area of Mediterranean infralittoral rocky habitats. The same authors pointed that sharpsnout sea bream is markedly omnivorous, macrophyta representing the most important prey type, followed by sponges and cnidarians. According to them this species exploited a resource that is apparently not used by any other species of littoral fish in the western Mediterranean and exploitation of sponges may segregate this species ecologically from other sparid species and thereby may help to minimize whatever level of competition for food resources may occur between them. Some other authors also pointed that this species is omnivorous (Bauchot and Hureau, 1986; Jardas, 1996).

The diets of these two species are significantly different, since some food items were found only in one of the species, i.e. macrophyta, sponges and ascidians were consumed only by sharpsnout sea bream in this study, but the calculated diet overlap was high in terms of numeric and gravimetric index. According to Collwell and Futuyma (1971) high niche overlap can be interpreted as evidence both for and against competition. Both species are markedly benthophagous and necto-benthic species (Jardas, 1996). Some authors reported that black sea bream is consuming macrophyta (Bauchot and Hureau, 1986; Jardas, 1996). Both species appear to feed on variety of substrates on the most available prey groups, but there are some differences in depth distribution. Adult specimens of sharpsnout sea bream were caught from depths between 100 and 150 m, while those of black sea bream deeper, around 250 m. So and although the results showed a significant feeding overlap in terms of numeric and gravimetric index and some overlap in terms of frequency of occurrence and IRI, we suggest that they may not be sharing resources with each other, because the trophic activities of the two species are obviously segregated by differences in depth distribution, even though some small juveniles could be found together in shallow areas (Dulčić *et al.*, 1997).

These two species differ in terms of mouth shape and dentition, with the snout conical and in each jaw 8 incisors inclined forward in sharpsnout sea bream and more round and relatively larger mouth with 4-6 rows of conical and rather slender teeth in each jaw in black sea bream (Onofri, 1986, 1987) The same author reported that fish with larger mouths would be better at biting or pulling, while those with smaller mouths would be more sucessful in engulfing small particles or prey. Sala and Ballesteros (1997) pointed out that sharpsnout sea bream has a longer intestine than either species from genus *Diplodus*, and thus it appears to be adapted to feeding on “low-digestible” organisms, like algae and sponges.

Feeding intensity is negatively related to the percentage of empty stomachs (Bowman and Bowman, 1980). Even though the feeding intensity was high during the study period, the percentage of empty stomachs was significantly higher during winter for both species. In addition the values of mean weight (Wm/ST) and mean number (Nm/ST), which were highest in spring and summer, and were lowest in winter for both species. Different factors may cause a decrease in the feeding activity in fish (Nikolsky, 1976). Many demersal fish show a decrease in the feeding rate when the temperature drops (Tyler, 1971), particularly those with thermophilous characteristics and with spring and summer spawning. In the study area, the lowest water temperatures happen in winter (February) and in the beginning of spring (Zore-Armanda *et al.*, 1991). Because of the reduced abundance of prey and the lowered metabolism of the fish, predation on plankton and benthos was probably at a minimum during winter. This assumption broadly agrees with the model of thermophilous fish growth from seas of medium geographic latitudes (Cefali *et al.*, 1987), which shows lowest growth rate in winter and in the beginning of spring. This is in agreement for *Diplodus puntazzo* since it spawns in June and July in the sampling area (Jardas, 1996). Black sea bream spawns from February to May (Jardas, 1996) so it probably intensified its feeding in the second period of spawning. Favourable environmental conditions, during the warmer months, and abundant food supply support the larger expanded fish community without competitive interactions, but in case of two investigated species the diet overlap was high and significant. The effects of temperature may be confounded with the effects on other abiotic factors and/or a change in food availability (Worobec, 1984).

Similarly to black sea bream and sharpsnout sea bream, high degrees of stomach fullness were reported for other demersal fish in the same area, such as *Scorpaena porcus* by Jardas and Pallaoro (1991) and *Chromis chromis* by Dulčić (1996). This indicates an abundance of food in this region even though this region belongs, according to Buljan and Zore-Armanda (1976) to relatively oligotrophic part of the Adriatic Sea. The abundance of food in this region is connected with upwellings in the area of Palagruža, which is in vicinity of the studied area (Regner *et al.*, 1987). This phenomena is more pronounced during years with increased Mediterranean inflow at the time of strong advection of intermediary water and also during upwelling periods in spring and summer (Buljan, 1965).

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