FEEDING HABITS OF *SERRANUS SCRIBA* (OSTEICHTHYES: SERRANIDAE) IN THE MARINE RESERVE OF LANZAROTE (CANARY ISLANDS)

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With 5 tables and 1 appendix

ABSTRACT. Feeding habits of painted comber, *Serranus scriba*, were investigated from stomach contents of fish caught in the Canary Islands. An analysis of the data with respect to the mature or immature sexual condition, season and size was carried out. Crustacea Decapoda (Brachyura, Anomura and Caridea) were the prefered prey, while Osteichthyes were the secondary prey. The most common families in the gut contents were Galatheidae, Majidae, Xanthidae and Alpheidae. No significant changes were found in the diet of mature or immature individuals. However, decapods show a tendency to a slight decrease in frequency and abundance, while the importance of fish in the diet increases with predator size. No important seasonal variations in type of food were found, however, with respect to the other decapods, carideans were more frequent and abundant from April to June, while brachyurans reached maximum values from October to December.

KEY WORDS: feeding habits, diets, sexual condition, food preferences, seasonal variations, Serranidae, *Serranus scriba*, Canary Islands.

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RESUMO. Os hábitos alimentares da garoupa *Serranus scriba* foram estudados a partir de conteúdos estomacais de peixes capturados nas Ilhas Canárias. Os dados colhidos foram analisados e relacionados com o estado de maturação (maduro e imaturo), o tamanho dos indivíduos e a época do ano em que se realizou a colheita. As presas favoritas foram os Crustáceos Decápodes (Brachyura, Anomura e Caridea) e, em segundo lugar, os peixes Osteichthyes. Galatheidae, Majidae, Xanthidae e Alpheidae foram as famílias mais encontradas nos tubos digestivos. Os indivíduos maduros e imaturos não apresentaram diferenças significativas na dieta. Os crustáceos decápodes mostraram uma ligeira tendência para diminuir em frequência e abundância, com o aumento do tamanho dos predadores. Fenómeno inverso deu-se com os peixes. Não foram encontradas variações sazonais importantes na dieta, embora os Caridea tornaram-se mais frequentes e abundantes entre Abril e Junho, enquanto que os Brachyura atingiram valores máximos entre Outubro e Dezembro.

PALAVRAS CHAVE: Hábitos alimentares, dietas, condição sexual, preferências alimentares, variações sazonais, Serranidae, *Serranus scriba*, Ilhas Canárias.

INTRODUCTION

The painted comber *Serranus scriba* (Linnaeus, 1758) (Osteichthyes, Serranidae) is known from the Eastern Atlantic, from the English Channel and Bay of Biscay to the Canary Islands and Western Sahara, around the Azores and Madeira and also the Mediterranean and Black Sea. It has been reported possibly southward to Senegal and even in South Africa to Natal (rare). It is a benthic species found on rocks, mud and algal or seagrass substrates, to depths up to 150 m but mainly shallower than 30 m (SMITH, 1981, 1990; TORTONESE, 1986; BAUCHOT, 1987).

This species was included in the FAO catalogues of species of interest to fisheries in the Eastern Central Atlantic (SMITH, 1981) and the Mediterranean and the Black Sea (BAUCHOT, 1987).

In the Canary Islands, it inhabits rocky or rocky sand bottoms with considerable growth of algae or seagrasses, from 3 to 80 m depth. The species is more frequent on the rocky sand substrates of the eastern islands (Lanzarote and Fuerteventura) (BRITO, 1991; GONZÁLEZ *et al.*, 1993; FRANQUET & BRITO, 1995). *Serranus scriba* is a secondary species in the catches of the artisanal small-scale fisheries for sparids with handlines and fish traps. This species was included in the list of threatened species in the Canary Islands, due to the small size of its insular populations and the negative effect of the fishery activity (BONNET & RODRÍGUEZ, 1992).

Although *S. scriba* is of interest to fisheries in Eastern Atlantic and Mediterranean regions (Egyptian Mediterranean waters; ABDEL-AZIZ, 1991) it has received relatively little biological study, referred exclusively to the Mediterranean Sea (BRUSLÉ & BRUSLÉ, 1975; ABDEL-AZIZ & RAMADAN, 1990; SIAU & BOUAIN, 1994). No previous work has been done on feeding habits of this species on the Atlantic coasts; only the study by ARCULEO *et al.* (1993) in the Tyrrhenian Sea provides information on this subject.

This study supplies information regarding the feeding habits of *Serranus scriba* as researched in the Canary Islands to date, and contributes to the knowledge of biodiversity of the marine reserve of "La Graciosa island and the rocks north to Lanzarote" (Canary Islands), which may become necessary for its future management.

MATERIALS AND METHODS

A total of 351 individuals of *Serranus scriba* were analysed between September 1995 and August 1996. Specimens came from commercial catches of the local fisheries with handlines at depths between 10 and 30 m near La Graciosa island (N of Lanzarote, Canary Islands). Catches were made during daylight. The individuals were measured and weighed. Then, digestive tracts were removed and preserved in 70% alcohol for later analysis. Gonads were assigned a state of maturity according to the scale of five steps proposed by GARCÍA-DÍAZ *et al.* (1997) for synchronous hermaphrodite species. For the analysis of data, fish in an immature, developing virgin or recovering spent and spent stage were considered to be "non-mature", whilst those in a maturing or ripe stage were treated as "mature".

Results were expressed by the following numerical and frequency measures (HYSLOP, 1980; TUSET *et al.*, 1996): vacuity index, V = Ev * 100 / N; numerical percentage of a prey, Cn = p * 100 / Np; frequency of occurrence of a prey, Fp = Tp * 100 / Nt; with N the number of fish examined, Ev the number of fish with empty digestive tract, Nt the number of digestive tracts with food, Np the total number of prey detected, p the number of a particular prey, and Tp the number of fish containing a given type of prey.

The different groups of prey in the diet were classified as preferred, secondary or occasional, according to criteria established by HUREAU (1970). To determine the relationship between diet and state of sexual development, between diet and size, and between diet and season (January-March, April-June, July-September, and October-December), a statistical test of independence (X^2) was performed, using Cramer's V as a mean of association between both variables and comparing the Fp and Cn of the preferred and secondary preys. To study the variation in food composition with fish size, five length-classes (< 189, 190-209, 210-229, 230-249 and > 250 mm) were used. One-way analysis of variance (ANOVA, $\alpha = 0.05$) and t-test ($\alpha = 0.05$) was used

to compare mean length among season and between maturity stages, respectively. In both cases, to use these tests were verified its assumptions (ZAR, 1996).

Statistical data on the size of fish in each analysis are given in Table 1.

RESULTS

Of the 351 digestive tracts analysed only 107 contained food items, giving a total vacuity index of V = 69.5%. Five taxa of brown algae (Phaeophyta), one of seagrasses (Magnoliophyta Cymodoceae), and thirty-six types of prey were detected (APPENDIX 1).

The most abundant prey were exclusively the Crustacea, while the secondary prey were Osteichthyes. Polychaeta and Mollusca occurred occasionally. Crustacea Decapoda were by far the most important, Brachyura, Caridea and Anomura alone reaching the category of secondary prey. The most common and abundant families and species in the gut contents were Galatheidae (*Galathea sp.*, *Galathea squamifera*), Majidae (*Acanthonyx lunulatus*), Xanthidae, and Alpheidae (APPENDIX 1).

TABLE 1 - Statistical data on the size (total length, mm) of *Serranus scriba* examined.

Group	N	Nt	Size range	Mean	SD
Total sample	351	107	150-289	218.30	25.49
Mature	181	49	163-280	221.24	22.73
Non-mature	170	58	150-289	215.17	27.85
150-189	46	15	150-189	177.02	9.85
190-209	81	22	190-209	199.42	5.37
210-229	98	21	210-229	219.30	5.34
230-249	91	33	230-248	237.93	5.50
250-289	35	16	250-289	262.40	11.73
January-March	98	31	150-260	214.37	23.45
April-June	109	40	159-280	216.86	26.18
July-September	64	7	175-281	219.08	21.61
October-December	80	29	157-289	224.45	28.85

N, number of fish examined; Nt, number of fish with food; SD, standar deviation.

TABLE 2 - Frequency of occurrence (Fp) and numerical percentage (Cn) for "non-mature" and "mature" specimens of *Serranus scriba*.

	Non-mature		**Mature**	
Food items	Fp	Cn	Fp	Cn
Phaeophyta	15.52	-	12.24	-
Magnoliophyta Cymodoceae	1.72	-	-	-
Polychaeta	1.72	0.63	-	-
Mollusca	3.45	1.25	8.16	2.76
Crustacea	96.55	76.88	87.76	73.10
Decapoda	89.66	65.01	73.47	54.48
Caridea	32.76	24.38	42.86	25.52
Anomura	24.14	15.00	22.45	11.72
Brachyura	51.72	25.63	40.82	17.24
Stomatopoda	1.72	0.63	-	-
Crustacea unidentified	20.69	11.25	32.65	15.86
Osteichthyes	34.48	21.25	42.86	24.14

TABLE 3 - Comparison of the preferred and secondary preys (Anomura, Caridea and Osteichthyes) of Serranus scriba according to state of maturation ("mature" versus "non mature"), size and season.

		χ^2	**d. f.**	**P**	**Cramer's V**
Gonadal analysis	Fp	3.485	3	ns	0.1092
	Cn	1.905	3	ns	0.1075
Size analysis	Fp	74.75	12	0.001	0.1848
	Cn	79.45	12	0.001	0.2517
Seasonal analysis	Fp	119.30	9	0.001	0.2651
	Cn	108.70	9	0.001	0.3294

Fp, frequency of occurrence; Cn, numerical percentage; df, degree freedom; p, significance level.

TABLE 4 - Frequency of occurrence (Fp) and numerical percentage (Cn) of prey for each size class (total length, mm) of *Serranus scriba*.

	150-189		190-209		210-229		230-249		250-289	
Food items	Fp	Cn	Fp	Cn	Fp	Cn	Fp	Cn	Fp	Cn
Phaeophyta	13.3	-	4.6	-	19.1	-	9.1	-	31.3	-
Magnoliophyta	-	-	-	-	4.8	-	-	-	-	-
Polychaeta	-	-	4.6	1.5	-	-	-	-	-	-
Mollusca	13.3	5.7	9.1	3.0	-	-	3.0	1.1	6.3	2.6
Crustacea	100	82.9	95.5	84.9	95.2	74.4	87.9	72.7	87.5	57.9
Decapoda	100	74.3	81.8	65.2	85.7	52.6	75.8	60.2	75.0	52.6
Caridea	46.7	28.6	63.6	45.5	42.9	15.4	24.4	22.7	12.5	10.5
Anomura	33.3	17.1	18.2	7.6	28.6	15.4	24.4	18.2	12.5	5.3
Brachyura	46.7	28.6	36.4	12.1	47.6	21.8	48.5	19.3	56.3	36.8
Stomatopoda	-	-	4.6	1.5	-	-	-	-	-	-
Crustacea unidentified	20.0	8.6	36.4	16.7	33.3	17.9	24.4	12.5	12.5	5.3
Osteichthyes	20.0	11.4	27.3	10.6	47.6	25.6	42.4	26.1	50.0	39.5

TABLE 5 - Frequency of occurrence (Fp) and numerical percentage (Cn) of prey for each season in *Serranus scriba*.

	January-March		April-June		July-September		October-December	
Food items	Fp	Cn	Fp	Cn	Fp	Cn	Fp	Cn
Phaeophyta	6.45	-	7.5	-	71.43	-	17.24	-
Magnoliophyta	-	-	-	-	-	-	3.45	-
Polychaeta	3.23	1.45	-	-	-	-	-	-
Mollusca	3.23	1.45	10.00	2.96	14.29	5.88	-	-
Crustacea	100	85.51	87.50	74.81	71.43	35.29	96.55	75.00
Decapoda	90.32	71.01	77.50	56.30	57.14	23.53	86.21	66.67
Caridea	32.26	23.19	57.50	32.59	-	-	24.14	21.43
Anomura	29.03	27.54	22.50	8.15	-	-	24.14	13.10
Brachyura	38.71	20.29	40.00	15.56	57.14	23.53	62.07	32.14
Stomatopoda	3.23	1.45	-	-	-	-	-	-
Crustacea unidentified	19.35	13.04	35.00	15.56	28.57	11.76	20.69	8.33
Osteichthyes	22.58	11.59	40.00	22.22	71.43	58.82	44.83	25.00

Mean length of both "mature" and "non-mature" were not significantly different (t = 1.22). The analysis of data according to sexual condition revealed, in both groups, that Crustacea were the preferred prey, while Osteichthyes were secondary. In the "non-mature" specimens, Brachyura were the preferred prey, while Caridea and Anomura were secondary. In the "mature" individuals, all these groups of Decapoda occurred as secondary prey (Table 2). However, no statistically significant difference in feeding was found between the both groups (Table 3).

The analysis of data with respect to the size range showed, in all groups, that Crustacea occurred as preferred prey with a tendency to a slight decrease in terms of presence and abundance. In general, Brachyura showed similar values of frequency in all groups, while Caridea and Anomura seem to decrease with increasing size in terms of presence. Osteichthyes were secondary prey in the four first groups (150-249 mm) reaching the category of preferred prey in the larger individuals (250-280 mm) (Table 4). Statistically significant differences in feeding were found between the size groups except for the samples varying from 210 to 249 mm (Table 3).

Mean length by season were not significantly different (P = 0.48). The seasonal analysis showed no variations in the main food composition; Crustacea Decapoda were preferred prey while Osteichthyes occurred as secondary prey throughout the year (Table 5). The sample from July to September was not representative (7 individuals, 6 of which belonging to the three larger groups of size). Within the Crustacea Decapoda, statistically significant differences were found between the food groups (Table 3). During the second quarter, Caridea were more frequent and abundant than the other decapods, reaching their maximum percentages of presence and abundance. During the fourth quarter, Brachyura were more frequent and abundant than the other decapods, reaching their maximum percentages of presence and abundance (Table 5).

DISCUSSION

The feeding habits observed for *S. scriba* in the marine reserve of Lanzarote (Canary Islands) define the species as a stenophagous carnivore, which mainly preys upon crustaceans complementing its diet with teleostean fish. Similar results were obtained for this species from the Central Mediterranean (ARCULEO *et al.*, 1993) and for *Serranus cabrilla* from the Canary Islands (TUSET *et al.*, 1996).

Serranus scriba from the Canaries shows a general intake of epibenthic prey with hard structures, including slow movers (brachyurans, anomurans) as well as relatively quick swimmers (teleostean fish). It also feds on benthic prey with soft structures and rapid movements (carideans). Most prey detected are common on littoral substrates with considerable growth of algae or seagrasses (GONZÁLEZ, 1995). This fact, together with the presence in diet of brown algae typical from rocky sand bottoms (CARRILLO & SASON, 1999), reflects the predator preferences in habitat, in which

this species occupies a high trophic position.

The *Xantho*-species (Brachyura, Xanthidae) occurred as relatively frequent and abundant components of the diet. In the Canary Islands, the shore degradation and overfishing have resulted in a decrease in the populations of these littoral crabs, which are commonly used as living bait in the local artisanal fisheries with poles and handlines (BONNET & RODRÍGUEZ, 1992; GONZÁLEZ, 1995).

The feeding habits of the "mature" and "non-mature" specimens were all based on the ingestion of crustaceans, complemented by fish species. This could indicate no main dietary changes during gonad maturation and at breeding time. TUSET *et al.* (1996), working on *Serranus cabrilla* from the Canary Islands, found that the "mature" individuals ingest a significantly lower amount of brachyurans than the "non-mature" fish which, on the contrary, ingest fewer carideans than the "mature" ones. Moreover, these authors also found other significant differences related to amphipods. These differences in food composition were attributed to different gonad development.

Although the decapod crustaceans complemented by bony fishes were the main components of diet in all size groups considered, the decapods show a tendency to a slight decrease in frequency and abundance, which is due to a diminution of carideans and anomurans in terms of presence. On the contrary, the importance of fish in the diet increases with size, even reaching the category of preferred prey in the larger individuals of predator, which can be explained on the basis of a higher energetic demand. Similar variations in the diet have been found as common in many benthic teleosts, for example mysids being substituted by decapods (SARTOR & De-RANIERI, 1996), or decapods by bony fishes (MURIE, 1994). MORATO GOMES (1995), working on the feeding habits of the congeneric species *S. atricauda* from the Azores, found no differences in food composition with predator size; nevertheless, this author related these results to the absence of juveniles in their samples.

No important seasonal variations in type of food were found. However, with respect to the other decapod crustaceans, carideans were more frequent and abundant from April to June, while brachyurans reached their relative maximum values from October to December. Since no basic dietary changes could be linked to the reproductive cycle, seasonal variations in the diet could be attributed to fluctuations in prey densities (COSTA *et al.*, 1992; GERKING, 1994) and could reflect the adaptative flexibility in the feeding habits of the predator (DILL, 1983; KING, 1993).

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APPENDIX 1

Composition of the food of *Serranus scriba* in the Canary Islands.

Items	**Fp**	**Cn**
Phaeophyta	14.02	-
Cystoseira abies-marina	3.74	-
Cystoseira mauritanica	4.67	-
Cystoseira tamariscifolia	2.80	-
Spatoglossum solierii	0.93	-
Zonaria tournefortii	1.87	-
Magnoliophyta (*Cymodocea nodosa*)	0.93	-
Polychaeta	0.93	0.33
Mollusca	5.61	1.97
Gastropoda	2.80	0.98
Cephalopoda	2.80	0.98
Loligo sp.	0.93	0.33
Cephalopoda unidentified	1.87	0.66
Crustacea	92.52	75.08
Isopoda	0.93	0.33
Amphipoda Gammaridea	1.87	0.98
Decapoda	82.24	60.00
Caridea	37.38	24.92
Alpheidae	14.02	6.89
Alpheus sp.	7.48	3.28
Alpheus dentipes	3.74	2.30
Alpheus macrocheles	2.80	1.31
Crangonidae	1.87	0.66
Philocheras fasciatus	0.93	0.33
Crangonidae unidentified	0.93	0.33
Hippolytidae (*Lysmata seticaudata*)	0.93	0.33
Palaemonidae	4.67	3.28
Palaemon xiphias	3.74	2.62
Palaemonidae unidentified	0.93	0.66
Caridea unidentified	26.17	13.77
Anomura	23.36	13.44
Galatheidae	23.36	13.44
Galathea sp.	13.08	5.57
Galathea squamifera	12.15	7.87
Brachyura	46.73	21.64
Dromiidae	0.93	0.33
Dromia sp.	0.93	0.33
Majidae	20.56	7.87
Acanthonyx lunulatus	13.08	4.92
Pisa sp.	2.80	0.98
Pisa nodipes	0.93	0.33
Pisa tetraodon	4.67	1.64

Items	**Fp**	**Cn**
Portunidae	3.74	2.95
Bathynectes longipes	0.93	0.33
Portunus hastatus	2.80	2.62
Xanthidae	18.69	7.87
Pilumnus sp.	0.93	0.33
Xantho sp.	8.41	2.95
Xantho incisus	5.61	2.62
Xantho poressa	4.67	1.97
Brachyura unidentified	7.48	2.62
Stomatopoda (Pseudosquillidae)	0.93	0.33
Crustacea unidentified	26.17	13.44
Osteichthyes	38.32	22.64
Synodontidae (*Synodus synodus*)	0.93	0.33
Syngnathidae (*Syngnathus sp.*)	1.87	0.66
Serranidae (*Serranus sp.*)	0.93	0.33
Labridae	3.74	2.95
Centrolabrus trutta	0.93	0.33
Labridae unidentified	5.61	2.62
Blenniidae	1.87	1.97
Parablennius pilicornis	2.80	1.31
Scartella cristata	0.93	0.33
Blenniidae unidentified	0.93	0.33
Tripterygiidae (*Tripterygion delaisi delaisi*)	1.87	0.66
Atherinidae (*Atherina presbyter*)	6.54	2.30
Scorpaenidae	2.80	0.98
Scorpaena maderensis	1.87	0.66
Scorpaenidae unidentified	0.93	0.33
Gobiesocidae	0.93	0.66
Lepadogaster sp.	0.93	0.66
Gobiidae	1.87	0.66
Gobius niger niger	1.87	0.66
Osteichthyes unidentified	20.56	11.15

Date received: 04-04-2000.