FEEDING HABITS OF *SERRANUS CABRILLA* (SERRANIDAE) IN THE CANARY ISLANDS

by

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ABSTRACT. - Feeding habits of comber or cabrilla seabass, *Serranus cabrilla*, were investigated with different indices calculated from digestive contents of commercial samples caught in the Canary Islands. The preferred prey was exclusively the Crustacea, while the secondary prey was the Osteichthyes. The Crustacea Decapoda (Brachyura, larvae, Caridea, and Anomura) were by far the most important prey. The diet did not differ with the coloration of individuals, but with their sexual maturity. Mature fish ingested more Caridea and less Brachyura than the non-mature fish.

RÉSUMÉ. - Le régime alimentaire du serran chèvre, *Serranus cabrilla*, a été étudié au moyen de différents indices calculés à partir des contenus digestifs d'échantillons commerciaux pêchés aux îles Canaries. Les Crustacés sont les proies préférentielles, tandis que les poissons sont les proies secondaires. Les Crustacés Décapodes (Brachyoures, larves, Caridés et Anomoures) sont les proies les plus importantes. Il n'existe pas de différence de régime alimentaire liée à la coloration des individus. En revanche, le régime diffère selon leur maturité sexuelle. Les individus matures ingèrent plus de Caridés et moins de Brachyoures que les individus immatures.

Key-words. - Serranidae, *Serranus cabrilla*, Canary Islands, Feeding habits.

In the Canary Islands, *Serranus cabrilla* (Linnaeus, 1758) is a common species found mainly on rocky bottoms, although juveniles can also be found on sandy substrates between 5 and 500 m, but more generally below 50 m (Lozano *et al.*, 1990; Brito, 1991). Lozano *et al.* (1990) found, in experimental surveys in the south off the island of Gran Canaria, that *S. cabrilla* and its congeneric species *S. atricauda* were the most abundant ichthyological species caught in fish traps at depths between 110 and 200 m. In the Canary archipelago, *S. cabrilla* is the object of artisanal fisheries on the shelves and slopes of all the islands (González, 1991; Peréz-Barroso *et al.*, 1993). In spite of its relative abundance and importance to local fishing, there exists no study on the biology or ecology of this species in the Canary Islands.

Some studies have been carried out on various aspects of the biology of *S. cabrilla* in the Mediterranean. One of the aspects studied was the coloration pattern, red versus yellow, which was the object of different interpretations: chromatic modification resulting from age, sex or habitat (Cuvier and Valenciennes, 1828; Moreau, 1881), or a differentiation between two "sub-species" or "varieties" (Dieuzeide *et al.*, 1954; Dufossé, 1956). Oliver (1970), in a study of gill parasites in *S. cabrilla*, observed significant differences such as the presence of *Protolamellodiscus serranelli* (Monogenea, Diplec-

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tanidae) in the "red variety", as opposed to the "yellow variety", which could be related to the possible existence of two sub-species. Oliver (1980) also found significant differences between each "variety" by electrophoresis of crystalline proteins, concluding that these results could serve to separate two populations. Nevertheless, he argued that only a genetic study could be decisive in the interpretation of this double coloration as the initial stage of speciation, where each chromatic "variety" would settle in a different habitat: the red on the rocky bottoms and the yellow on the sandy ones.

In the present paper an initial approach to knowledge of the feeding habits of *S. cabrilla* in Canarian waters was carried out. The analysis of data in relation to each coloration type was performed in order to discover whether significant trophic differences exist. An analysis of the data with respect to the "mature" or "immature" sexual condition was also carried out.

MATERIAL AND METHODS

398 individuals of *Serranus cabrilla* were analysed between September 1992 and February 1995. These specimens came from commercial catches of the local fisheries with fish traps, gillnets, longlines and handlines at depths between 15 and 278 m near the islands of Gran Canaria and Fuerteventura. The individuals were measured, weighed and differentiated chromatically as red or yellow. Then, the digestive tracts were removed and preserved in 70% alcohol for later analysis. The gonads were assigned a state of maturity according to the scale of five steps proposed by Holden and Raitt (1975). For the analysis of data, fish in a virgin, recovering spent or spent stage were considered to be "non-mature", whilst those in a maturing or ripe stage were treated as "mature". Number and length of fish analysed are given in table I.

The results were expressed by the following numerical frequency indices (Hyslop, 1980; González and Hernández, 1991): vacuity index, $V = Ev*100/N$; average number of prey per digestive tract, $Nm = p/N$; numerical percentage of a prey, $Cn = p*100/Np$; frequency of occurrence of a prey, $Fp = Tp*100/N$; with N the number of fish examined, Ev the number of fish with empty digestive tract, 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 coloration, and between diet and state of sexual development, a statistical test of independence (χ^2) was performed, using Cramer's V as a means of association between both variables and comparing the Fp and Cn of the preferred and secondary prey with the statistical programme SPSS/PC+.

Table I. - Number and size of *Serranus cabrilla* examined. N = number of specimens studied; Nt = number of fish with food; size range and mean size in mm of total length; SD = standard deviation.

	N	Nt	Size range	Mean size	SD
Total	398	64	141-269	206.8	25.5
Yellow variety	117	13	153-263	212.9	21.2
Red variety	281	51	141-269	205.3	24.9
Non-mature	283	34	141-269	204.7	26.7
Mature	115	30	153-253	210.2	22.1

RESULTS

Of the 398 digestive tracts analysed only 64 contained food items, giving a total vacuity index of V = 83.9. Thirty-one types of prey were detected (Table II), the average number of prey per digestive tract being 5.7±9.4. The preferred prey was exclusively the the Crustacea (Fp = 79.7%, Cn = 89.1%, Nm = 4.73), while the secondary prey was the Osteichthyes (Fp = 34.3%, Cn = 7.9%, Nm = 0.42). Polychaeta, Mollusca, Echinodermata and brown algae occurred as occasional prey (Table II).

The Crustacea Decapoda were by far the most important prey (Fp = 78.1%, Cn = 82.6%, Nm = 4.40), the Brachyura (Fp = 37.5%), the decapod larvae (Fp = 37.5%), the Caridea (Fp = 29.7%), and the Anomura (Fp = 25.0%) alone reaching the category of secondary prey. The most common species in the gut contents were *Munida curvimana* (Fp = 15.7%), *Galathea intermedia* (Fp = 4.7%) (both Anomura Galatheidae), and *Parthenope* cf. *massena* (Fp = 4.7%) (Brachyura, Parthenopidae) (Table II).

Table II. - Composition of the food of *Serranus cabrilla* in the Canary Islands. Fp = frequency of occurrence of a prey (%); Cn = numerical percentage of a prey (%); Nm = average number of prey per digestive tract.

Food items	Fp	Cn	Nm
Brown algae	1.6	-	-
Sargassum vulgare	1.6	-	-
Polychaeta	7.8	1.5	0.08
Mollusca Bivalvia	1.6	0.3	0.02
Cephalopoda Sepiidae	4.7	0.9	0.05
Crustacea	79.7	89.1	4.73
Cladocera	1.6	0.3	0.02
Isopoda	1.6	0.6	0.03
Copepoda	1.6	0.3	0.02
Amphipoda Gammaroidea	9.4	2.4	0.13
Amphipoda Capreloidea	7.8	2.9	0.16
Decapoda	78.1	82.6	4.40
Caridea	29.7	13.2	0.70
Alpheidae	1.6	0.3	0.02
Ligur ensiferus	3.1	0.6	0.03
Processidae	3.1	0.6	0.03
Plesionika edwardsi	1.6	0.3	0.02
Plesionika sp.	1.6	0.6	0.03
Philocheras cf. *sculptus*	1.6	0.3	0.02
Unidentified Caridea	23.4	10.6	0.56
Penaeidea	1.6	0.3	0.02
Anomura	25.0	7.7	0.41
Diogenidae	3.1	0.9	0.05
Paguridae	1.6	0.3	0.02
Munida curvimana	15.7	5.3	0.28
Galathea intermedia	4.7	0.9	0.05
Unidentified Anomura	1.6	0.3	0.02
Brachyura	37.5	7.9	0.42
Ethusina cf. *talismani*	1.6	0.3	0.02
Ebalia cf. *tuberosa*	1.6	0.3	0.02
Atelecyclus rotundatus	1.6	0.3	0.02
Liocarcinus depurator	1.6	0.3	0.02
Parthenope cf. *massena*	4.7	1.2	0.06
Unidentified Brachyura	28.1	5.6	0.30
Unidentified larvae	37.5	53.5	2.84
Echinodermata Ophiuroidea	1.6	0.3	0.02
Ophiactis virens	1.6	0.3	0.02
Osteichthyes	34.3	7.9	0.42
Syngnathiformes	1.6	0.3	0.02
Perciformes	1.6	0.3	0.02
Lepidorhombus sp.	1.6	0.3	0.02
Unidentified Pleuronectiformes	3.1	0.6	0.03
Unidentified fish	28.1	6.5	0.34

When the data were analysed with respect to the coloration (Table III), no particular preferred prey was associated with the "yellow variety" or the "red variety". No statistically significant difference of feeding was found between the two coloration types (Table IV). Decapod crustaceans (Fp = 100-70.5%, Cn = 89.0-80.6%, respectively) dominate in both "varieties" and *M. curvimana* was the most common and abundant prey (Fp = 38.5-9.8%, Cn = 12.2-3.1%, respectively).

Table III. - Composition of the food of *Serranus cabrilla* in the Canary Islands according to the coloration. Fp = frequency of occurrence of a prey (%); Cn = numerical percentage of a prey (%).

Colouration	Yellow		Red	
Food items	**Fp**	**Cn**	**Fp**	**Cn**
Brown algae	7.7	-	-	-
Polychaeta	-	-	9.8	1.9
Mollusca Bivalvia	-	-	2.0	0.4
Cephalopoda Sepiidae	-	-	5.9	1.2
Crustacea	100.0	90.2	74.5	88.8
Cladocera	-	-	2.0	0.4
Isopoda	-	-	2.0	0.8
Copepoda	-	-	2.0	0.4
Amphipoda Gammaroidea	7.7	1.2	9.8	2.7
Amphipoda Capreloidea	-	-	9.8	3.9
Decapoda	100.0	89.0	70.5	80.6
Caridea	38.5	22.0	27.5	10.5
Penaeidea	-	-	2.0	0.4
Anomura	46.2	14.6	19.6	5.4
Munida curvimana	38.5	12.2	9.8	3.1
Galathea intermedia	7.7	1.2	2.0	0.8
Brachyura	46.2	7.3	35.3	8.1
Parthenope* cf. *massena	-	-	5.9	1.6
Unidentified larvae	46.2	45.1	35.3	56.2
Echinodermata Ophiuroidea	-	-	2.0	0.4
Osteichthyes	38.5	9.8	33.3	7.4

Table IV. - Result of the statistical analysis comparing the food of *Serranus cabrilla* according to the coloration type (red versus yellow) and the state of maturation (mature versus non-mature) of the individuals.

		χ^2	d.f.	p	Cramer's V
Colouration analysis	**Fp**	4.639	4	ns	0.1125
	Cn	9.254	4	ns	0.0551
Gonadal analysis	**Fp**	38.02	6	0.001	0.3239
	Cn	34.52	6	0.001	0.4269

Table V. - Composition of the food of *Serranus cabrilla* in the Canary Islands according to the gonadal development. Fp = frequency of occurrence of a prey (%); Cn = numerical percentage of a prey (%).

Gonadal development	Non mature		Mature	
Food items	**Fp**	**Cn**	**Fp**	**Cn**
Brown algae	2.9	-	-	-
Polychaeta	8.8	2.6	6.7	0.9
Mollusca Bivalvia	2.9	0.9	-	-
Cephalopoda Sepiidae	2.9	0.9	6.7	0.9
Crustacea	79.4	81.9	80.0	92.9
Cladocera	2.9	0.9	-	-
Isopoda	2.9	1.8	-	-
Copepoda	-	-	3.3	0.5
Amphipoda Gammaroidea	11.8	4.3	6.7	1.3
Amphipoda Capreloidea	5.9	5.1	10.0	1.8
Decapoda	79.4	69.8	76.7	89.3
Caridea	17.6	18.1	43.3	10.7
Penaeidea	-	-	3.3	0.5
Anomura	26.5	9.5	23.3	6.7
Munida curvimana	17.6	5.1	16.7	5.4
Galathea intermedia	5.9	1.7	3.3	0.5
Brachyura	50.0	15.5	23.3	4.0
Parthenope* cf. *massena	8.8	3.5	-	-
Unidentified larvae	38.2	26.7	36.7	67.4
Echinodermata Ophiuroidea	2.9	0.9	-	-
Osteichthyes	32.4	12.9	36.7	5.4

The analysis of data according to the sexual maturation (Table V), revealed that, in both groups, Crustacea Decapoda were the preferred prey while Osteichthyes and Amphipoda were the secondary prey. The statistical analyses revealed a significant difference of food between mature and non-mature specimens (Table IV). In the "non-mature" specimens, the Brachyura were the only preferred prey (Fp = 50.0%) while Anomura and Caridea were secondary prey. All these three groups of prey found in the "mature" individuals were secondary prey. In both cases the most common and abundant species was *M. curvimana* (Fp = 17.6-16.7%, Cn = 5.1-5.4%, respectively).

DISCUSSION

The high value of the vacuity index in *S. cabrilla* would seem to indicate, according to Geistdoerfer (1978), that the catching of prey occurred in a more or less haphazard manner, with a low frequency. On the other hand, this high vacuity index might also be indicative of the time of day the fish were caught, and the time lapse experienced before being preserved. Since this type of information is not available, the value of the vacuity

index might be, in this case, more of a reflection on the methods of capture used than on the feeding patterns of the species. The feeding habits observed for *S. cabrilla* in the Canary Islands define the species as a stenophagous carnivore, which mainly preys upon crustaceans (Fp = 79.7%, Cn = 89.1%, Nm = 4.73) with a general intake of epibenthic prey, complementing its diet with fish.

No statistically significant difference was found between the diets of the "yellow" and the "red" specimens. Typical prey of sandy bottoms (Polychaeta, Mollusca Bivalvia, Cephalopoda Sepiidea, *Philocheras* cf. *sculptus* or *Ethusina* cf. *talismani)* were observed exclusively in the digestive contents of the "red" specimens, which were associated with rocky bottoms by Oliver *et al.* (1980). So, these fishes were able to feed on surrounding soft bottoms.

The feeding habits of the "mature" and the "non-mature" specimens were all based on the ingestion of crustaceans, complemented by fish species. However, if we consider the groups of crustacean which are the most important prey in their diet, the "mature" specimens ingest a significantly lower amount of Brachyura than the "non-mature" fish which, on the contrary, ingest fewer Caridea than the "mature" fish. Moreover, the Amphipoda Gammaroidea and the Amphipoda Capreloidea are secondary prey in the diet of "non-mature" and "mature" specimens, respectively. This could indicate slight dietary changes during sexual maturation and at breeding time.

Benmouna *et al.* (1986) showed that in Corsican waters, *S. cabrilla* presented a clear predominance of crustaceans in its diet, with *Galathea spp.* and *Mysis spp.* as fundamental components. Near Marseille, this species mainly feeds on Caridea by day and on Mysidacea by night, also complementing its diet with fish (Bell and Harmelin-Vivien, 1983). Bauchot (1987) pointed out that, in the Mediterranean, this species is a voracious predator that feeds on fish, cephalopods and crustaceans. Consequently, the Canarian and Mediterranean diets reveal a high degree of concordance in what is referred to as preferred prey. The stenophagia, together with the high degree of coincidence of basic prey in different geographical areas, would seem to indicate a selective character in the diet of *S. cabrilla.* Nevertheless, the fact that crustaceans are the most common and abundant prey in the feeding habits of *S. cabrilla* may be due to their wide distribution and abundance, but may also be due to the fact that the carapaces are resistant to the digestive enzymes of the predator. In general, the ingested crustaceans were brachyurans, not excessively small, possibly providing a considerable proportion of energy compared to Anomura and to Caridea.

S. cabrilla, based on its relative abundance in the area of the Canary Islands and on its feeding habits, is placed at a high level within the benthic trophic network. Arcuelo *et al.* (1993) studied the dietary composition of *Serranus scriba* in the Gulf of Palermo (Sicily), noting that it showed dietary habits very similar to those of its congeneric species *S. cabrilla.* For this reason, it would be interesting to undertake a comparative study between the diets of *S. cabrilla, S. scriba* and *S. atricauda.*

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