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Feeding Habits of *Serranus cabrilla* (Serranidae) in Edremit Bay (North Aegean Sea)

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Abstract: This study was carried out on 595 combers collected by trawl hauls in Edremit Bay in order to examine their feeding habits. Four hundred and ninety four combers were vomited, 90 were full and 11 were empty. The food was primarily consisted of fish and crustaceans. In addition, feeding habits of mature and non-mature were also compared. It was shown that the mature combers primarily fed on crustaceans while non mature combers fed on fish.

Key words: Serranidae, *Serranus cabrilla*, Edremit bay, feeding habits, sexual maturity

Introduction

Comber, *Serranus cabrilla* (L.) is one of the main species that has an important role in trawl fisheries of Aegean Sea of Turkey (Aksiray, 1987). It lives as demersal on the shelf and upper slope to about 500 m, on rocks, *Posidonia* beds and muddy bottoms. This Atlanto-Mediterranean species spreads through in Turkish seas (Bauchot, 1987). There are three species of *Serranus*; *S. cabrilla*, *S. scriba*, and *S. hepatus* in Turkish seas (Aksiray, 1987). Of 1000 tons combers, 398 have been caught in Aegean sea (Anonymous, 1999).

The study of feeding habits of fishes contributes to the knowledge of intra and interspecific relationship and thus to understand the structure and dynamics of marine communities. When commercially exploited species are involved, in the role of predators and/or as main prey species, the study of feeding habits of fishes are a basic step to multi species assessment approaches, therefore, being important to definition of fishery management options (Torres *et al.*, 2000).

Published literature on the biology and ecology of this species from Mediterranean sea and the adjacent seas is limited. The age and growth of comber (*Serranus cabrilla* L.) were studied from the Thracian sea and Thermaikos gulf (northern Greece) (Politou and Papaconstantinou, 1995), while age, growth, feeding habits and mortality are dealt with Cretan shelf (Labropoulou *et al.*, 1998) (Tserpes and Tsimenides, 2001). Labropoulou and Plaitis (1995) studied selectivity predation on small crustaceans by six demersal fish species in Cretan sea while fish and crustaceans were observed as the preferred and secondary preys in the northern coasts of Crete and Greece, respectively (Labropoulou and Eleftherio, 1995). Feeding habits of *Serranus cabrilla* L. were investigated with different indices calculated from digestive contents of samples caught commercially in the Canary islands (Tuset *et al.*, 1996). Labropoulou *et al.* (1998) studied age, growth and feeding habits of black comber on Cretan shelf.

The studies on biological aspects of comber in Turkish seas are scarce and contradictory, except for a preliminary study which was evaluated in Edremit bay (Torcu *et al.*, 1998).

The present work is a contribution to the knowledge on the feeding habits of comber with respect to the mature and non mature sexual conditions in Edremit Bay during the period of 13 months.

Materials and Methods

Five hundred and ninety five individuals of *Serranus cabrilla* L. were collected by trawls at depths ranging from 45 to 60 m near the localities of Altınoluk and Bozburun in Edremit Bay between September 1997 and 1998 (Fig. 1). This Bay occupies an area of

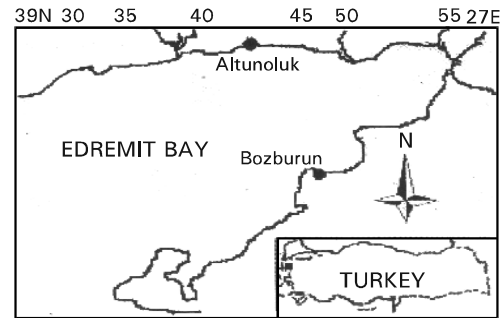


Fig. 1: Map of sampling sites in Edremit Bay

34.5 km from east to west, 25.5 km. from north to South (north Aegean sea) between 39° 17' and 39° 34' N, 26° 57' and 26° 34' E.

All samples were taken in a demersal trawl by a cod-end liner of 22 mm stretched mesh size. The duration of each trawl was 45 min and the trawling speed fluctuated from 2.5 to 3 knots.

The individuals were measured to the nearest millimetre (fork length) and weighed to the nearest 0.1 g. and their sexes were determined. Thereafter, the stomachs were removed and preserved in 4% formaldehyde or 70% alcohol solution for later analysis. Where possible, prey items were identified to species or the nearest possible taxonomic level, counted under a binocular microscope (Labropoulou *et al.*, 1998).

The gonads were assigned a state of maturity according to the scale of four steps proposed by Hyslop (1980) and Tuset *et al.* (1996). For the analysis, fish that have got developed gonads recovery were considered to be non mature, whilst those that have functional gonads were considered as mature. Number and length of fish analyzed are given in Table 1.

The results were expressed by the following numerical frequency indices (Tuset *et al.*, 1996): vacuity index, $V = E_v \times 100 / N$; average number of prey per stomach, $N_m = p / N$; numerical percentage of a prey, $C_n = p_x \times 100 / N_p$; frequency occurrence of a prey, $F_p = T_p \times 100 / N$; with N the number of fish examined, E_v the number of fish with empty stomach, N_p the total number of prey detected, p the number of a particular prey and T_p 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 given by Hureau (1986). To determine the relationship between diet and state of sexual development, a statistical test of (χ^2) independence was performed.

Results

The difference of sample sizes of mature and non mature caused the difference of Nt of combers (Table 1).

Of the 595 stomach analyzed, only 15% contained food items, giving a total vacuity index of V= 83 (Table 2, Fig. 2).

For combers of 86-223 mm, fish, crustaceans, cephalopod and echinoderms, were 53.75, 38.99, 5.78 and 1.48%, respectively (Fig. 3.).

There were at least 13 different prey species belonging to three major groups (fish, crustaceans and cephalopods). Decapods and Echinoderm asteroids could'nt be consistently identified to species level. The preferred preys were exclusively fish (Fp = 6.23%, Cn = 77.88%, Nm = 0.3) and crustaceans (Fp = 4.52%, Cn = 63.65%, Nm = 0.3). While Cephalopoda and Echinodermata occurred as occasional preys (Table 3).

The analyses were carried out using criteria in both groups of sexual maturation, Crustacea and Osteichthyes. The preferred preys followed by Cephalopoda and Echinodermata in the non mature specimens, Clupeiformes (Osteichthyes) were the first preferred prey (Fp = 3.87%), while Decapoda (Caridea and Brachyura) was the secondary followed by Asteroidea, *Octopus* and *Sepia officinalis* (Table 4). The significant relationship of diet and state of sexual development was found between mature and non mature ($\chi^2 = 13.473, p < 0.05$).

As mentioned before, due to lack of detailed studies on this species, the growth patterns and composition of the food of *Serranus cabrilla* L. in terms of gonadal development could be compared with only those carried out in the Canary Islands by Tuset et al. (1996) (Tables 5, 6 and 7).

The difference of size between combers of Edremit Bay and Canary islands may be attributed to local conditions (e.g. temperature, food availability etc.) (Table 5).

Discussion

The composition of food suggests that *Serranus cabrilla* L. is a carnivorous species that relies primarily on fish and epibenthic invertebrates, decapods.

Fish were the first preferred prey for all individuals (Table 3). Non mature preferred the fish and mature preferred crustaceans (Table 4). The prey preferred for *S. cabrilla* L. in Canary islands was Crustacea (Fp = 79.7%, Cn = 89.1%, Nm = 4.73) while Osteichthyes (Fp= 6.23%, Cn= 77.88%, Nm= 0.3) was the preferred prey in Edremit bay (Table 6). For non mature, fish were the preferred prey in Edremit Bay while crustaceans were the preferred prey in Canary islands. Crustaceans were the preferred prey for mature in both localities (Table 7).

This species shows synchronous hermaphroditism (Moyle and Cech, 1996). According to Fischer et al. (1987), this species matures when it is four years old and 18 cm in length. Size range of comber in Edremit bay is smaller than those in Canary islands (Table 5) (Tuset et al., 1996). It may be attributed to differences in local conditions. The feeding habits observed for *S. cabrilla* L. in the Edremit Bay defined the species as a stenophagus carnivore which mainly preys upon fishes, secondly crustaceans with the general intake of epibenthic prey, complementing its diet with fish. As comber consumed a considerable amount of small crustaceans in Cretan sea (Lapropoulou and Plaitis, 1995), our results of feeding habits of comber in Edremit bay confirmed the previous authors.

Table 2: Characteristics of stomach sampling

Specimens	N	Size range (mm)	N° Full	N° Vomit.	% Food	N° Empty	% Empty
Total	595	86-223	90	494	15	11	2

N° Full: Number of full stomachs, N° Vomit.: Number of vomited stomachs, % Food : Fullness percentage, % Empty: Emptiness percentage

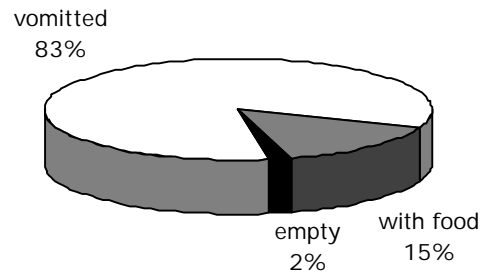


Fig. 2: Pie chart showing the analysis of the digestive tracts of *Serranus cabrilla* L. in Edremit Bay

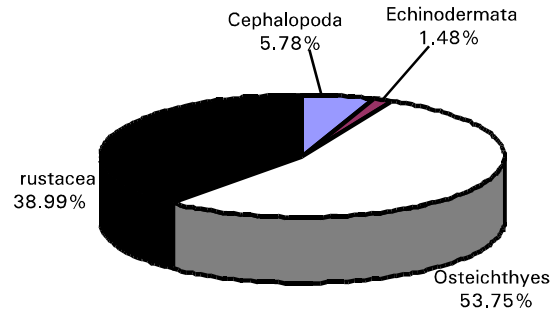


Fig. 3: Pie chart showing the food composition of the *S. cabrilla* L. in Edremit Bay

The feeding habits of mature and non mature specimens were all based on the ingestion of crustaceans, complemented with fish species. This confirms the Canarian diet by Tuset et al. (1996). It was pointed out that this species was a voracious predator of fish, crustaceans and cephalopods in the Mediterranean sea (Bauchot, 1987). Consequently, the Canarian and Edremit diets reveal a high degree of preference of 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* L.

The high value of the vacuity index in *S. cabrilla* L. seems to indicate, that the catching of prey occurred in a more or less

Table 1: Number and size of *S. cabrilla* L. examined

Specimens	N	Nt	Size range	Mean size	SD
Total	595	59	86-223	150.82	2.22
Non mature	476	49	86-222	147.91	2.14
Mature	119	10	117-223	163.23	2.13

N= number of specimens studied; Nt= number of fish food; size range and mean size in mm of fork length; SD= standard deviation

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Table 3: Composition of the food of *S. cabrilla* L. in Edremit Bay

Prey category	Fp	Cn	Nm
Cephalopoda	0.67	7.26	0.01
Octopus	0.50	5.36	0.01
<i>Sepia officinalis</i>	0.17	1.71	0.002
Crustacea	4.52	63.65	0.3
Unidentified Crustacea	0.17	3.51	0.003
Decapoda	0.50	51.27	0.3
Unidentified Caridea	0.50	5.36	0.01
Unidentified Brachyura	3.35	3.51	0.03
<i>Echinodermata asteroidea</i>	0.17	1.71	0.02
Osteichthyes	6.23	77.88	0.3
Perciformes	0.50	5.36	0.01
<i>Mullus barbatus</i>	0.17	1.71	0.002
<i>Gobius</i>	0.17	1.71	0.002
<i>Cepola rubescens</i>	0.17	1.71	0.002
Clupeiformes	1.18	13.45	0.2
<i>Sardina pilchardus</i>	1.01	11.75	0.01
<i>Engraulis encrasicolus</i>	0.17	1.71	0.01
Unidentified fish	2.86	40.48	0.03

Fp= frequency occurrence of a prey (%); Cn= numerical percentage of a prey (%); Nm= average number of prey per stomach

Table 4: Composition of the food of *Serranus cabrilla* L. in Edremit Bay according to the gonadal development

Gonadal Development	Non mature		Mature	
	Fp	Cn	Fp	Cn
Food items				
Cephalopoda	0.50	8.33	0.17	5.25
Octopus	0.33	5.14	0.17	5.25
<i>Sepia officinalis</i>	0.17	2.62	-	-
Crustacea	2.02	4.44	2.51	30.0
Unidentified Crustacea	0.17	2.62	0.17	5.25
Decapoda	1.34	25.81	2.02	15.0
Caridea	0.33	5.41	0.17	5.25
Brachyura	0.17	2.62	0.17	5.25
<i>Echinodermata asteroidea</i>	0.17	2.62	-	-
<i>Osteichthyes</i>	3.87	14.37	0.66	25.0
Perciformes	0.33	5.41	0.17	5.25
<i>Mullus barbatus</i>	0.17	2.62	-	-
<i>Gobius</i>	0.17	2.62	-	-
<i>Cepola rubescens</i>	-	-	0.17	5.25
Clupeiformes	1.18	21.86	-	-
<i>Sardina pilchardus</i>	1.01	18.17	-	-
<i>Engraulis encrasicolus</i>	0.17	2.62	-	-
Unidentified fish	2.34	31.36	0.50	17.65

Fp= frequency of occurrence of a prey (%); Cn= numerical percentage of a prey (%)

Table 5: The comparisons of the number and size of *S. cabrilla* L. examined in the Edremit Bay and the Canary islands (Tuset et al., 1996)

Specimens	Edremit Bay					Canary islands				
	N	Nt	SR	MR	SD	N	Nt	SR	MR	SD
Total	595	59	86-223	150.82	2.22	398	64	141-269	206.8	25.5
Non mature	476	49	86-222	147.91	2.14	283	34	141-269	204.7	26.7
Mature	119	10	117-223	163.23	2.13	115	30	153-253	210.2	22.1

N = number of specimens studied; Nt = number of fish food; size range and mean size in mm of fork length; SD= standard deviation, SR= Size Range, MR= Mean Range

Table 6: The comparison of compositions of the food of *Serranus cabrilla* L. in the Edremit Bay and Canary islands (Tuset et al., 1996)

Food items	Edremit Bay			Canary islands		
	Fp	Cn	Nm	Fp	Cn	Nm
Cephalopoda	0.67	7.26	0.01	4.7	0.9	0.05
Octopus	0.50	5.36	0.01	-	-	-
<i>Sepia officinalis</i>	0.17	1.71	0.002	-	-	-
Crustacea	4.52	63.65	0.3	79.7	89.1	4.73
Unidentified Crustacea	0.17	3.51	0.003	-	-	-
Decapoda	0.50	51.27	0.3	78.1	82.6	4.40
Unidentified Caridea	0.50	5.36	0.01	23.4	10.6	0.56
Unidentified Brachyura	3.35	3.51	0.03	28.1	5.6	0.30
<i>Echinodermata asteroidea</i>	0.17	1.71	0.02	1.6	0.3	0.02
Osteichthyes	6.23	77.88	0.3	34.3	7.9	0.42
Perciformes	0.50	5.36	0.01	1.6	0.3	0.02
<i>Mullus barbatus</i>	0.17	1.71	0.002	-	-	-
<i>Gobius</i>	0.17	1.71	0.002	-	-	-
<i>Cepola rubescens</i>	0.17	1.71	0.002	-	-	-
Clupeiformes	1.18	13.45	0.2	-	-	-
<i>Sardina pilchardus</i>	1.01	11.75	0.01	-	-	-
<i>Engraulis encrasicolus</i>	0.17	1.71	0.01	-	-	-
Unidentified fish	2.86	40.48	0.03	28.1	6.5	0.34

Fp= frequency of occurrence of a prey (%); Cn= numerical percentage of a prey (%); Nm= average number of prey per digestive tract

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Table 7: The comparison of *S. cabrilla* L. in the Edremit bay and the Canary islands (Tuset et al., 1996) in terms of the gonadal development

Food items	Edremit Bay				Canary islands			
	Juvenile		Mature		Juvenile		Mature	
	Fp	Cn	Fp	Cn	Fp	Cn	Fp	Cn
Cephalopoda	0.50	8.33	0.17	5.25	2.9	0.9	6.7	0.9
Octopus	0.33	5.41	0.17	5.25	-	-	-	-
<i>Sepia officinalis</i>	0.17	2.62	-	-	-	-	-	-
Crustacea	2.02	44.44	2.51	300.0	79.4	81.9	80.0	92.9
Unidentified Crustacea	0.17	2.62	0.17	5.25	-	-	-	-
Decapoda	1.34	25.81	2.02	150.0	79.4	69.8	76.7	89.3
Unidentified Caridea	0.33	5.41	0.17	5.25	17.6	18.1	43.3	10.7
Unidentified Brachyura	0.17	2.62	0.17	5.25	50.0	15.5	23.3	4.0
<i>Echinodermata asteroidea</i>	0.17	2.62	-	-	2.9	0.9	-	-
Osteichthyes	3.87	143.75	0.66	25.0	32.4	12.9	36.7	5.4
Perciformes	0.33	5.41	0.17	5.25	-	-	-	-
<i>Mullus barbatus</i>	0.17	2.62	-	-	-	-	-	-
<i>Gobius</i> sp.	0.17	2.62	-	-	-	-	-	-
<i>Cepola rubescens</i>	-	-	0.17	5.25	-	-	-	-
Clupeiformes	1.18	21.86	-	-	-	-	-	-
<i>Sardina pilchardus</i>	1.01	18.17	-	-	-	-	-	-
<i>Engraulis encrasicolus</i>	0.17	2.62	-	-	-	-	-	-
Unidentified fish	2.34	31.36	0.50	17.65	-	-	-	-

Fp= frequency of occurrence of a prey (%); Cn= numerical percentage of a prey (%)

haphazard manner, with a low frequency. On the other hand, this high vacuity index might also be an indication of the time of day that the fish were caught and the time lapse experienced before being preserved. *S. cabrilla* seems to play an important trophic role as macrophagic carnivorous species in Edremit Bay. Further studies could allow these hypotheses to be examined in case of *S. cabrilla*.

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