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Food of the grouper *Caprodon longimanus* from Alejandro Selkirk Island, Chile (Perciformes: Serranidae)

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Abstract: Diet and food preference of *Caprodon longimanus* were studied at Alejandro Selkirk Island, Chile. The fishes (N=55) were collected in November and December 1996 using long line and the sizes ranged from 176-286 mm in SL. This grouper is a pelagic opportunistic zooplanktivorous predator. *Thalia* sp. (Tunicata: Salpida) was the most frequent and abundant prey accounting for 93.3% occurrence based on 1655 individuals. A total of 17 genera of crustaceans as well as pteropods, chaetognaths and polychaete worms were found in the stomach contents. A total of 14.3% of all stomachs were empty.

Key words: *Caprodon longimanus*, Serranidae, stomach content analysis, Alejandro Selkirk Island, Eastern South Pacific, Chile.

Groupers are carnivorous fishes that live near the bottom in littoral and sublittoral zones of tropical and subtropical seas. Most species occur on coral reefs, but some live in estuaries and are near or at the top trophic levels of the food chains. This group includes over 400 species within five subfamilies and most of them are of considerable economic value (Shpigel and Fishelson 1989, Heemstra and Randall 1993).

These fishes play an important role in coastal marine ecosystems where they are active predators of a number of organisms. Most groupers feed mainly on a variety of fishes, large crustaceans and cephalopods (Randall and Brock 1960, Randall 1967, Harmelin-Vivien and Bouchon 1976, Nagelkerken 1979, Diamant and Shpigel 1985, Parrish 1987, Shpigel and Fishelson 1989, Bullock and Smith 1991). Some species may even occasionally prey on juvenile turtles (Witzell 1981).

A few species, however, stand apart from this pattern eating small prey and showing specific adaptations for this feeding mode. They have long and numerous gillrakers that allow them to filter planktonic organisms (Parrish 1987, Bullock and Smith 1991, Heemstra and Randall 1993).

The genus *Caprodon* is a serranid that belongs to the subfamily Anthiinae and is composed by three species (Kharin and Dudarev 1983). Although there is abundant information in the literature regarding feeding habits of serranid species, groupers, sandbasses, etc., there is almost no information for any species of *Caprodon.*

The species *C. longimanus* (Günther, 1859) has an usual and interesting distribution,

ranging from the Indopacific (Kharin and Dudarev 1983) to the southeastern Pacific islands (Sepúlveda and Pequeño 1985, Rojas and Pequeño 1997 in prep.), at depths from 3 to 200 m. The purpose of the present study is to provide the first information on the diet of *C. longimanus* at Alejandro Selkirk Island, Juan Fernández Archipelago, Chile.

MATERIALS AND METHODS

Fifty-five specimens of *C. longimanus* were collected on November 21 and December 4, 1996 at Alejandro Selkirk (33°46'S, 80°46'W), the westernmost island of the Juan Fernández Archipelago. The fishes were caught by artisanal fishermen using long-lines. Their weights (± 0.5 g) and standard lengths (SL, ± 0.5 cm), were recorded and the stomachs were removed and preserved in 10% formaldehyde. The specimens were deposited in the Division of Marine Fishes, Institute of Zoology of University Austral of Chile (IZUA-PM 2016-2020).

In the laboratory, the stomachs were opened and the contents analyzed. The prey items were identified to the lowest taxonomic level following Palma (1985) and Palma and Kaiser (1993). Due to the nature of the food, the digestion rate, ineffective preservation, an important fraction of the samples contained material unidentifiable that was classified as "unidentified prey".The number of empty stomachs was also recorded.

The numeric frequency and the frequency of occurrence were calculated according to Hyslop (1980) and Starck and Schroeder (1970) respectively. The most important prey items were determined according to index of dietary importance (DI) (Hureau 1969). The biomass of prey items could not be determined due to the high degree of digestion and the soft and delicate nature of the dominant prey items. Diversity, evenness, and dominance of prey were calculated using the computer package ACOM (Navarro 1984).

RESULTS

Caprodon longimanus has a long oblique mouth, with the upper jaw extending past the lower jaw when closed. The jaw has two rows of villiforms teeth, with two small canines at the end of each row. The premaxilla has two rows of small conical teeth. Band broadest anterior end of jaws near symphysial diastem. A rhombus-shaped patch of about two rows are found on the vomer and on a band of two rows on the palatines. The tongue is slender, without teeth. The stomach cavity is narrow, short, and not heavily muscled.

The numbers of individuals and frequency of occurrence in each food category found in the stomachs are shown in Table 1. Based on the presence of mature gonads, all individuals were considered to be adults. A total of 14.3% of all the stomachs were empty and they correspond to individuals captured deeper than 150 m in the water column. The food items consumed by *C. longimanus* included salps, radiolarians, siphonophores, polychaets, pteropods, chaetognaths, tunicates and crustaceans. Five orders (Amphipoda, Calanoida, Decapoda, Euphausiacea, and Ostracoda) with 17 genera of crustaceans were represented (Table 1).

Thalia democratica (Van Soest 1973) (Tunicata: Thaliacea), was the main prey item (by number of individuals recorded 1655 and frequency of occurrence 93.3%). Calanoids copepods (mainly *Pleuromamma* sp. with 43.3% frequence of occurrence) were the second most important food item. Radiolaria, Copepoda Cyclopoida and Amphipoda Hyperiidea as a group were the third prey item. Pisces (eggs and larvae), pteropods, chaetognaths, euphausids, decapods, doliolids and appendicularians were found only occasionally in the stomach content. Fishes might be more important in the diet of *C. longimanus* than our data suggest. Their identification proved difficult because of the advanced state of digestion. The diversity, dominance and evenness indices of the items prey was 0.89, 0.82, and 0.18 respectively.

TABLE 1

Composition of diet of C. longimanus

Prey category	A (N)	A (%)	B N	B (%)	DI	Prey category	A (N)	A (%)	B N	B (%)	DI
PROTOZOA											
Radiolaria	20	1.0	2	6.77	II	unidentified Cyclopodia	9	0.5	5	16.7	III
CNIDARIA						**Amphipoda**-Hyperiidea	68	3.5			II
Siphonophorae	10	0.5	5	16.7	III	*Scina* sp.	2	0.1	1	3.3	III
Muggiaea atlantica	5	0.3	2	6.7	III	*Vibilia* sp.	14	0.7	9	30.0	III
Abylopsis tetragona	3	0.2	1	3.3	III	*Paraphronima* sp.	2	0.1	2	6.7	III
Chelophyes appendiculata	2	0.1	2	6.7	III	*Lestrigonus* sp.	1	0.05	1	3.3	III
ANNELIDA						*Hyperietta* sp.	3	0.1	3	10.0	III
Polychaeta	12	0.6	4	13.3	III	*Streetsia* sp.	2	0.1	1	3.3	III
Larvae	6	0.3	2	6.7	II	*Platyscelus* sp.	3	0.1	2	6.7	III
Adults	6	0.3	2	6.7	III	unidentified Hyperiidea	41	2.1	14	46.7	II
MOLLUSCA						**Euphausiacea**	10	0.5	8	26.7	III
Pteropoda	6	0.3	4	13.3	III	*Nematoscelis megalops*	1	0.05	1	3.3	III
CHAETOGNATHA						Larvae of *Euphausia* sp.	9	0.4	7	23.3	III
Sagitta sp.	11	0.5	2	6.7	III	**Decapoda**	5	0.2	3	10.0	III
ARTHROPODA						Larvae	5	0.2	3	10.0	III
Ostracoda	6	0.3	5	16.7	III	**TUNICATA**					
Copepoda-Calanoida	85	4.3			II	**Salpida**	1655	84.7	28	93.7	I
Calanus chilensis	4	0.2	2	6.7	III	*Thalia* sp.	1655	84.7	28	93.7	I
Nannocalanus sp.	1	0.05	1	3.3	III	**Doliolida**	5	0.2	3	10.0	III
Ctenocalanus sp.	1	0.05	1	3.3	III	**Appendicularia**	6	0.3	2	6.7	III
Rhincalanus sp.	15	0.8	8	26.7	III	*Oikopleura* sp.	6	0.3	2	6.7	III
Pleuromamma sp.	22	1.1	13	43.3	II	**VERTEBRATA**					
Euchaeta sp.	3	0.1	2	6.7	III	**Pisces**	10	0.5	8	26.7	III
Centropages sp.	1	0.05	1	3.3	III	Eggs	9	0.4	7	23.3	III
unidentified Calanoida	38	1.9	14	46.7	II	Larvae	1	0.05	1	3.3	III
Copepoda-Cyclopoida	23	1.2	II			**Unidentified prey**	30	1.5	30	85.7	II
Sapphirina sp.	14	0.7	9	30.0	III	**Total**	1953				
unidentified Cyclopoida	9	0.5	5	16.7	III						

(A) number of specimens, (B) percentage of ocurrence, (DI) dietary importance.
Percentages given are based upon total number of prey items.

A high number of stomachs had unidentifiable remains (85.7%) that contained scales, crustaceans appendages, destroyed eggs and components digested beyond recognition.

DISCUSSION

The serranid fishes show a correlation between gillraker configuration and feeding habits. Those taxa with fewer and shorter gillrakers are generally carnivores, whereas the opposite holds for planktivores (Parrish 1987, Bullock and Smith 1991, Heemstra and Randall 1993) (Table 2). The condition of more developed and abundant gillrakers is present in *C. longimanus*, which suggests planktivorous feeding habits. In fact, this species has more gillrakers than any other serranid in the southeastern Pacific off Chile (Rojas and Pequeño 1997b in prep.).

Based on the type of prey found, *C. longimanus* can be characterized as a opportunistic pelagic polyphagic-zooplanktivorous predator. Salps, copepods, and amphipods are the main components of the diet of this

TABLE 2

Number of gillrakers (N) and prey preferences of some other serranids fishes from tropical and subtropical oceans

Taxa	Gillrakers (N)	Prey	Location	Reference
Acanthistius brasilianus	20-27	Sh-F	Argentina	Goldstein and Cousseau 1987
Anthias nicholsi	39-44	C-P	Florida	Bullock and Smith 1991
Anthias squamipinnis	31-36	C	Red Sea	Shapiro and Genin 1993
Anthias tenuis	34-39	C	Gulf of México	Bullock and Smith 1991
Caprodon longimanus	**31-39**	**A-C-S-L**	**Chile**	**Present study**
Dicentrarchus labrax	32-35	C	France	Roblin and Brusle 1984
Epinephelus cruentatus	18-21	Ca	Jamaica	Nagelkerken 1979
E. adcensionis	24-28	Sh-F	Puerto Rico	Randall 1967
E. guttatus	24-27	Sh-F	Bahamas	Thompson and Munro 1978
E. itajara	22-24	Sh-F	Florida	Bullock and Smith 1991
Hemanthias peruanus	31-34	C	Perú	Heemstra 1995
Hemanthias leptus	35-40	C-O	Florida	Bullock and Smith 1991
Holanthias martinicensis	34-41	C-O, P	Bermuda	Bullock and Smith 1991
Hypoplectrus unicolor	17-20	Sh-F	Florida	Bullock and Smith 1991
Paralabrax humeralis	27-30	F	Chile	Borquez et al. 1988
Plectropomus leopardus	21-26	F	Australia	Kingsford 1992
Serranus annularis	15-18	Sh-E	Bermuda	Robins and Starck 1961

A=Amphipods, Sh=Shrimps, S=Stomatopods, F=Fishes, C=Copepods, O=Ostracods, P=Pteropods, L=Salps

grouper, similar results have been reported for other serranids (i.e. Robin and Brusle 1984, Bullock and Smith 1991, Shapiro and Genin 1993, Heemstra 1995).

The absence of food items in some specimens can be attributed to the regurgitation (by contraction of esophagic muscles) and/or by eversion of the stomachs caused by changes in pressure during capture. Specimens collected at depths between 150 and 190 m presented everted guts with food remnants scattered in the oropharyngeal cavity. This was not observed in specimens captured at depths less than 150 m.

Although no plankton samples were collected to study food preference, the high numbers of *T. democratica* in the stomach contents can be attributed more to an eventual seasonal abundance of this resource than to prey selection. During summer months, *T. democratica* is found in high concentrations, associated with phytoplankton abundance, in the Juan Fernández Archipelago (Palma 1985, Palma & Kaiser 1993). This means that the diet during other times of the year is expected to be different, but containing mainly planktonic prey. The feeding strategy of *C. longimanus* would involve specialized predation and energetic benefits, i.e. reduction of search time by utilizing the most abundant resource, increasing feeding efficiency.

The low diversity and evenness of prey items were related to the dominance of large quantities of blastozoids of salps in the stomach contents. These results could reveal a certain degree of specialization in feeding habits. According to Berg (1979), high diversity index values characterize euryphagous fishes, while low values (as in the case of *C. longimanus*) are indicative of stenophagous fishes. Furthermore the buccal morphology, gillraker configuration, and the diet are all consistent with a zooplanktivorous mode of feeding, a rather unusual finding among serranids, which are characterized as being typically carnivorous.

The results provide a basis for further studies and comparisons of the role of this species along its distributional range that

encompasses biotopes as distant and different as those of Australia, Japan, Korea, Hawaii and of course the Eastern Pacific Islands.

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RESUMEN

La dieta y preferencia alimentaria de *Caprodon longimanus* fue estudiada a partir de 55 especímenes capturados en la Isla Alejando Selkirk, Chile entre Noviembre y Diciembre de 1996. Los ejemplares fueron capturados utilizando línea de profundidad. El intervalo de tallas fue 176-286 mm LE. Este serránido es un depredador pelágico zooplactófago oportunista. El componente alimentario más abundante y frecuente fue *Thalia* sp. (Tunicata:Salpida), con un total de 1655 individuos y 93.3% de frecuencia de ocurrencia. Se identificaron crustáceos (17 géneros), pterópodos, quetognatos y poliquetos. El 14.3% de los estómagos estaba vacío.

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