

## Feeding Habits of *Graus nigra* (Labridae) in Coastal Waters of Iquique in Northern Chile

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Due to the local fishermen's increasing efforts to exploit a diversity of fish species, it is becoming more important to know the role of all species in the sublittoral fish community and possible consequences of a man-made disruption of the system by elimination of one of the component species. In the north of Chile the number of spear gun fishermen has increased in the last years and large sized species such as *Graus nigra* Philippi are being caught for commercial purposes in spite of the low population density of the fish.

There is little information on the feeding habits of *G. nigra*, one of the largest dwellers of the upper sublittoral zone in northern Chile. Studying 10 specimens of the species from Cartagena and Horcón in Central Chile, Moreno (1972) gave a brief list of prey species and concluded that it has benthophagic habits. The geographical distribution of this species has not been established clearly. While Fowler (1945) pointed that it is distributed between Coquimbo (Lat. 30°S) and Valparaíso (Lat. 33°S), Moreno (1972) gave a wider distribution from Iquique (Lat 20°12' S) to Concepción (Lat 36°50'S). In the North and Central Chile the fish inhabits boulderfields with substrata having many holes and crevices. During the daytime the fish is commonly observed in shallow waters inside holes, in the darkness and often close to the back wall, rarely freely swimming outside. Usually one or two individuals are observed cohabiting a hole with other species. Biological aspects of the fish such as reproduction, growth, population densities, ecological relationships, etc., have so far

been completely unknown.

Biologists usually have no chance to obtain a large sample of this species. The author took advantage of an underwater hunter competition held in northern Chile to study the trophic niche of *G. nigra*.

### Material and methods

The analysis of the food content in the gut of *Graus nigra* was based on an examination of 37 adult specimens, 29 males and 8 females ranging from 40.0 cm to 80.0 cm in total length and from 1300 g to 8400 g in body weight (Table 1). All were collected at an underwater hunter competition in Las Pizarras (Lat. 20°28'S) near Iquique, Chile, on April of 1978. All fish were caught with spear guns in depths from 1 m to 10 m, and between 1100 hr and 1300 hr. Total lengths of the specimens were determined to the nearest 0.5 cm and sex by macroscopical observation of the gonads. The complete digestive tubes were taken out, and preserved in 10% formalin for the examination of their contents. Most food items could be identified to the species level with the aid of appropriate keys and references.

For the gut contents both the numerical method as in Windell (1968), and the frequency of occurrence method as in Fuentes (1981) were used. A correlation analysis to assess the association between the diet of two body size groups and between sexes (with  $P < 0.01$  and  $t$  distribution for 15 degrees of freedom) was done.

### Results

Most of the specimens had the food in advanced degrees of digestion. One male which had nothing in the gut was ignored in the further analysis. In 11 digestive tracts sand was observed but not included in the analysis of the gut contents, and remains of an unidentified asteroid found in one gut was also ignored. The identification of prey was possible because they had resistant parts to digestion, for example shells and opercles; sometimes even a complete animal was found.

The results of analysis of the gut contents both by numerical and frequency of occurrence methods are shown in Table 2, where all prey items found are detailed. The Echinodermata *Stichaster striatus*, *Athyonidium chilensis*, and

Table 1. Sample composition of *Graus nigra* collected in Las Pizarras, Iquique, Chile.

Size range (TL cm)	Male	Female
40.0~60.0	11 (+1)*	2
60.5~80.0	17	6

\* No food was found in the gut.

*Tetrapygyus niger* were the most important types of prey found in both numerical and occurrence methods. Other prey-species such as *Concholepas concholepas*, *Cancer setosus*, *Acanthocyclus*

*gayi*, and *Urechis chilensis* appeared also in more than one gut. To assess the relative importance of each taxonomical group in the natural diet of *G. niger*, prey were grouped into

Table 2. Foods of *Graus niger* in Las Pizarras, Iquique, Chile, assessed by both numerical and frequency of occurrence methods ( $n=36$ ).

Prey species	Number	%Number	Occurrence	%Occurrence
Mollusca				
Gastropoda				
<i>Fissurella crassa</i>	1	1.28	1	1.63
<i>Tegula atra</i>	1	1.28	1	1.63
<i>Concholepas concholepas</i>	3	3.84	3	4.91
Polyplacophora				
<i>Chiton cumingsii</i>	1	1.28	1	1.63
Cephalopoda				
<i>Octopus</i> sp.	1	1.28	1	1.63
Crustacea				
Cirripedia				
<i>Chthamalus cirratus</i>	1	1.28	1	1.63
Decapoda				
<i>Allopetrolisthes violaceus</i>	1	1.28	1	1.63
<i>Pachycheles grossimanus</i>	1	1.28	1	1.63
<i>Acanthocyclus gayi</i>	3	3.84	3	4.91
<i>Cancer setosus</i>	6	7.69	6	9.83
Echinodermata				
Asteroidea				
<i>Heliaster helianthus</i>	2	2.56	2	3.27
<i>Stichaster striatus</i>	23	29.48	17	27.86
<i>Meyenaster gelatinosus</i>	3	3.84	3	4.91
<i>Patiria chilensis</i>	1	1.28	1	1.63
Echinoidea				
<i>Tetrapygyus niger</i>	7	8.97	5	8.19
Holothuroidea				
<i>Athyonidium chilensis</i>	21	26.92	12	19.97
Echiuroidea				
Xenopneusta				
<i>Urechis chilensis</i>	2	2.56	2	3.27
Total number of prey	78			
Total occurrence of prey			61	

Table 3. Percentage of the principal taxonomical groups of prey present in the natural diet of *Graus niger* in northern Chile compared with the data by Moreno (1972) obtained in Central Chile.

Prey group	Northern Chile		Central Chile*	
	%Number	%Occurrence	%Number	%Occurrence
Mollusca	8.96	11.43	14.50	10.71
Crustacea	15.37	19.63	55.40	57.14
Echinodermata	73.05	65.83	26.30	28.57
Echiuroidea	2.56	3.27	—	—
Osteichthyes	—	—	2.90	3.57

\* Recalculated on the total sum of the individual number and occurrence of prey.

nine taxonomical groups (Fig. 1), and individual percentages of prey belonging to a respective group were summed. Important groups both in number and occurrence were Asteroidea, Holothuroidea, and Decapoda.

The diets of the fish in two groups of body size, from 40.0 cm to 60.0 cm ( $n=13$ ) and from 60.5 cm to 80.0 cm in total length ( $n=23$ ), and between sexes (28 males and 8 females), showed a highly significant correlation ( $P<0.01$ ) in an analysis made on the results obtained in the numerical and occurrence methods.

### Discussion

*Graus nigra* (mulato or vieja negra in Spanish common name) has been described by Moreno (1972) as a benthophagic carnivorous fish occupying the third and fourth levels in the trophic chain of the sublittoral community in Horcón (Lat.  $32^{\circ}42'S$ ) and Cartagena (Lat.  $33^{\circ}31'S$ ) in Central Chile. According to the results observed in this study the author can assert that the same description can be made of the fish in the north of Chile. The basic foods in Las Pizarras, in the Nikolski's (1963) sense, could be composed of Echinodermata (Asteroidea and Holothuroidea), Crustacea (Decapoda), and Mollusca (Gastropoda). Secondary foods could be Echiuroidea. Table 2 shows that a total of 17 prey-species were found in the fish from Las Pizarras, while Moreno (1972) found only 13 prey-species from the gut in Central Chile. Both in northern and Central Chile prey-species belong to 4 phyla. Also, although *G. nigra* eats principally Echinodermata, Crustacea, and Mollusca both in northern and Central Chile, the order of preferences in number and occurrence for these groups of prey look different by regions (see Table 3). In northern Chile the most abundant group of prey was Echinodermata represented principally by 3 species, *S. striatus*, *A. chilensis*, and *T. niger*, while in Central Chile (Moreno, 1972) crustacean Decapoda was more abundant, and Echinodermata was represented only by *T. niger* and *S. striatus*. Such differences in the feeding habits could be explained by latitudinal changes in the abundance of prey, by populational differences, or by changes in the preferences for a type of prey.

In spite of a rather small sample size, the diet of fish in two groups of body size showed a highly

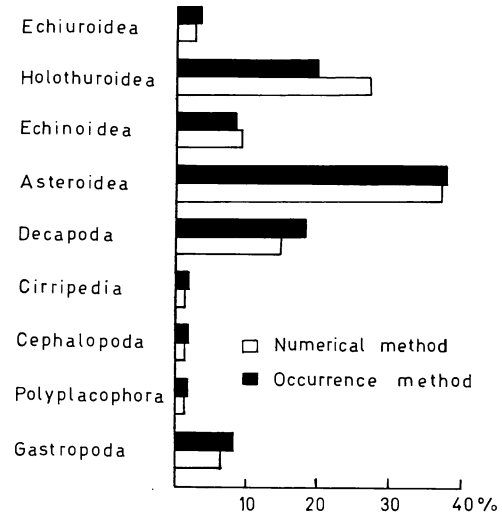


Fig. 1. Taxonomical groups of preys present in the natural diet of *Graus nigra* in Las Pizarras, Iquique, Chile.

significant correlation ( $P<0.01$ ) in both numerical and frequency of occurrence method analyses, indicating a similarity in the diet in these two groups of fish. From the size of the specimens it is considered that they were all adults. An extension of this assertion to juveniles will not be safe; they may have different feeding habits. The author observed juveniles of the fish inhabiting tide pools and swimming actively during daytime. A highly significant correlation ( $P<0.01$ ) in the diet was also observed for males and females.

Hobson (1974) pointed out that when fishes are speared the digestion is sharply curtailed by the death of the fish. Assuming that his assertion is true also for *G. nigra*, the feeding activity takes place principally at night or early morning, because during the collection time (between 1100 hr and 1300 hr), most of the specimens had the gut contents in some grade of digestion or already completely digested. Furthermore, with exception of two specimens the gut content was observed much closer to the anus than to the pharynx, indicating that probably no ingestion of prey took place close to the capture. Hobson (1974, 1975), Ebeling and Bray (1976), and several other authors have established that the wrasses are active during the day resting in reef crevices and under the sand at night. *G. nigra* was never observed feeding or

freely swimming during the sampling time. The field observations and the analysis of the gut content (Table 2) indicated that the feeding behavior of this species is rather different from the general pattern described for most labrid fishes, suggesting its nocturnal or early morning feeding activity.

From the knowledge of the food and the habits of other labrid fish, Randall (1978) speculated on the method used by *C. undulatus* to capture its prey; he believes that the fish will overturn rocks to expose invertebrates beneath, and dig up the sand by ejecting a stream of water to obtain prey. Such behaviors were not observed during the present study period, but will not be rejected because sand was found in 11 guts, and the principal prey (*S. striatus*, *A. chilensis*, *C. setosus*, and *C. concholepas*) in Las Pizarras are habitually observed under stones, inside crevices, or buried in the sand during the daytime. We need, however, further field observations to clarify if *G. nigra* has a feeding behavior similar to *C. undulatus* or other wrasses. On the other hand it is interesting to compare the feeding activity of *G. nigra* with that of *S. maculatus*, also a large sized wrasse dweller in the sublittoral zone in northern Chile, which has been described as a diurnal predator (Fuentes, 1981). Undoubtedly, these two sympatric predators will have some mechanism of coexistence which has yet to be explained.

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チリ北部・イキケの沿岸水域における *Graus nigra* (ペラ科) の食性

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チリ北部の沿岸帯において、*Graus nigra* の食物組成を研究した。本種の食性は大小2群間および雌雄間で大きな差違は観察されなかった。水深1mより10mまでの範囲で採集した標本の消化管には、移動性および固着性の底生生物、棘皮動物、十脚甲殻類が一般的に含まれていた。これらの知見に基づいて本種の摂餌様式を討論した。天然行動型の観察結果も付け加えた。