A study of feeding in some inshore reef fish of the Natal Coast, South Africa

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A detailed quantitative investigation of the feeding habits of seven important Natal inshore reef fish (*Epinephelus andersoni* Boulenger, 1903, *Coracinus multifasciatus* (Pellegrin, 1914), *Pomadasys olivaceum* Day, 1875, *Diplodus sargus* Linnaeus, 1758, *Sarpa salpa* (Linnaeus, 1766), *Acanthurus triostegus* Linnaeus, 1758 and *Neoscorpis lithophilus* (Gilchrist & Thompson, 1908)) is described. Qualitative information on the feeding of 23 other species is also given, and when all species are considered the ratio of carnivores, omnivores and herbivores is 4:1:1.
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'n Noukeurige kwantitatiewe ondersoek van die eetgewoontes van sewe belangrike Natalse vlakwater rifvisse (*Epinephelus andersoni* Boulenger, 1903, *Coracinus multifasciatus* (Pellegrin, 1914), *Pomadasys olivaceum* Day, 1875, *Diplodus sargus* Linnaeus, 1758, *Sarpa salpa* (Linnaeus, 1766), *Acanthurus triostegus* Linnaeus, 1758 en *Neoscorpis lithophilus* (Gilchrist & Thompson, 1908)) word beskryf. Kwalitatiewe informasie oor die voeding van 'n verdere 23 spesies word ook verskaf en resultate van al die spesies dui op 'n verhouding van roofvisse, omnivore en herbivore van 4:1:1.
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The only quantitative feeding studies on South African marine teleosts that have been published are those of Blaber (1974) on *Rhabdosargus holubi*, Christensen (1978) on some juvenile sparids (although the latter did not measure the quantities of food items in stomachs directly) and Whitfield and Blaber (1978) on piscivorous fishes.

The objective of the present study is to provide quantitative information on the feeding habits of teleosts inhabiting inshore reefs in Natal, many of which are important angling species possibly requiring management. The study also contributes to a project currently being undertaken on the ecological energetics of an inshore reef, known as the ORI Reef, which is located in the surf zone in front of the Oceanographic Research Institute Buildings, Durban.

Inshore reefs are defined here as being those within the limits of influence of the surf zone or shore break. The physical features of the Natal nearshore zone and the benthic intertidal biota have been described by Jackson (1976). Within this zone the teleost fauna is rich and diverse and 65 species have been recorded on the ORI Reef alone, of which 14 occur regularly. Seven of the most important species (in terms of fishermen's catches along the entire coast and biomass on the ORI Reef) were selected for quantitative investigation of feeding habits. These were: *Sarpa salpa* (strepie), *Neoscorpis lithophilus* (stonebream), *Diplodus sargus* (blacktail), *Pomadasys olivaceum* (piggy), *Coracinus multifasciatus* (banded galjoen), *Acanthurus triostegus* (convict surgeon), and *Epinephelus andersoni* (catface rockcod). Qualitative results of feeding in 23 other species occurring on the ORI Reef are also presented.

Materials and Methods

Stomachs were collected between January 1976 and March 1977 from anglers' catches and also by shooting fish with a speargun. Sampling was carried out between Cape Vidal (28°08′S, 32°33′E) in the north and Port Edward (31°03′S, 30°14′E) in the south but was most intensive near Durban. Samples from the ORI Reef were combined with those from the rest of the coast after comparison revealed that there were no marked differences in feeding habits. All *E. andersoni* and *A. triostegus* were collected on the ORI Reef. Field observations were made during 109 diver hours using SCUBA.

Stomachs were removed by severing the oesophagus as near to the buccal cavity as possible and the intestine just posterior to the pyloric caecae before being preserved in 10% formalin. The locality, date, fork length, mass, sex, degree of gonad activity and bait used were recorded for each fish examined.

Food items were analysed in terms of frequency of occurrence (Hynes 1950, Pillay 1952), wet and dry mass (Hynes 1950, Blaber 1974), volume using water displacement (Karamchandani & Desai 1962) and a modified version of Hynes' (1950) points method, in as much as extremely small amounts of food were in this instance recorded only as a trace.

After measuring the volume of the entire stomach contents the food items were separated into taxonomic groups as tabled with the aid of a dissecting microscope. The volume was then estimated using the points system as described by Hynes (1950). The different food items were accumulated separately and at the end of the study their volume, wet mass and dry mass (dried to a constant mass at 60 °C) was determined. Seaweeds were grouped as Rhodophyta, Chlorophyta and Phaeophyta.

Variation in the types and quantities of food items ingested were analysed on the basis of the austral seasons. However, the results were of doubtful value and were too voluminous to be presented on a seasonal basis and the data were consequently pooled. Obvious seasonal differences in diet are referred to in the text.

Calcium carbonate was removed from organisms such as Crustacea using 10% nitric acid. Most ingested Ascidiacea had sand and shell fragments incorporated in the tests, the mass of which was determined by combustion in a muffle oven for two hours at 650 °C. At this temperature there was probably some loss of inorganic material, particularly carbonate.

Because it was necessary to relate the results of this study with the overall energetics project being carried out on the ORI Reef, a Gallenkamp adiabatic bomb calorimeter was used to determine energy values of food items. The mean of two readings, which did not differ by more than 5%, was taken for each sample.

Results

Stomach content analysis of *N. lithophilus*

N. lithophilus is a subtropical species known from the Transkei, Natal and Zululand on the East Coast, but extends as far south as Cape Agulhas and as far north as Fort Dauphin in Madagascar (M.M. Smith 1978, pers. comm.).

Two hundred stomachs containing food from fish ranging in length from 64 mm to 430 mm (mean = 238 mm) were analysed. The mean stomach content volume was 13,8 ml (range: 0,1 ml to 68,2 ml. S.D. = 9,66 ml). In most instances fish had full stomachs and there was good correlation between stomach content volume and fish length during the seasons of highest feeding intensity (i.e. summer and winter). It was found that stomach content volume was equal to $2{,}32 \times 10^{-7}$ $(\text{length})^{3,2}$ ($r^2 = 0{,}89$ $n = 190$). This species is a typical herbivore having a long gut (Weatherley 1972) and produces faeces in which the seaweeds are well digested.

Food items recorded in the stomach contents of *N. lithophilus* are tabulated in Appendix 1. This herbivore feeds almost exclusively on Rhodophyta of which 39 species were identified and 16 others were unidentified. *Hypnea spicifera* (39% T.D.M. = Total Dry Mass) was the dominant rhodophyte in the diet, while *H. rosea* (16,7% T.D.M.) and *Polyzonia elegens* (13,9% T.D.M.) were also important food items (Table 1). Although the unidentified rhodophyte species were prominent (19,6% award) (App. 1) as a whole, no single species was of any consequence in the diet.

With regard to the major food items consumed (App. 1), *H. spicifera, H. rosea, P. elegens* and *Ulva* sp. were prominent during all seasons. *Galaxaura* sp. was only important during summer and autumn; *T. tenebrosa* during autumn; *C. compressa* during spring and summer and *Hypnea* sp. and *Pterosiphonia cloiophylla* during spring. There were otherwise only minor variations among the less abundant species.

Over the size range of juvenile and adult fish examined (64 mm to 430 mm) no change in diet was apparent with increase in size.

There is a tendency for juvenile *N. lithophilus* to form larger shoals than adults, which are usually seen singly or in small groups. Feeding occurs close inshore, often in turbulent water.

Stomach content analysis of *A. triostegus*

This acanthurid is found in the warm waters of the Indo-Pacific and is abundant on the South African east coast, occurring as far south as Port Alfred (Smith 1965).

Eleven stomachs containing food were examined. Fish ranged in length from 127 mm to 188 mm (mean = 153 mm), and the mean stomach content volume was 0,79 ml (range: 0,3 ml to 1,6 ml S.D. = 0,46 ml). Stomachs were usually over half full of algae. This is another herbivore with a typically long gut and the seaweeds it ingests are egested in a well degraded state. These analyses were not undertaken on a seasonal basis.

Appendix 2 gives a breakdown of the food items ingested by *A. triostegus*. Rhodophyta (78,4% T.D.M.) consisting largely of six turf-like species, were more important in the diet than Chlorophyta (20,5% T.D.M.), but most of the rhodophyte algae were unidentified (52,4% award) (App. 2). Of the identified algae, the chlorophyte *Ulva* sp. (20,1% T.D.M.) was most prominent (Table 1), and no unidentified rhodophytes were of more importance in the diet.

A. triostegus usually occurs close inshore near the littoral fringe where small groups or loose shoals may be seen grazing on the algal 'turf'.

Stomach content analysis of *S. salpa*

S. salpa is found from the Black Sea and the Adriatic, through the Mediterranean down the west coast of Africa and to as far north as Delagoa Bay on the east coast (Christensen 1976).

One hundred and eighty seven stomachs containing food collected from fish ranging in length from 131 mm to 224 mm (mean = 183 mm), were analysed. The mean stomach content volume was 1,74 ml (range: 0,1 ml to 7,0 ml S.D. = 1,14 ml). Stomachs were usually more than half full of algae. This species is a typical herbivore for reasons similar to those given earlier for *N. lithophilus* and *A. triostegus*.

Table 1 Dominant food items in the diets of seven species of inshore reef fish

Species	Dominant food items	% Frequency occurrence	% Award	T.D.M. (g)	% T.D.M.	Energy value (ash free jg^{-1})	Feeding category
N. lithophilus	*Hypnea spicifera*	94,5	27,8	76,1[a]	39,0		Herbivore
	Hypnea rosea	79,0	11,9	32,6[a]	16,7	19 902 (Rhodophyta)	Benthic feeder;
	Polyzonia elegens	90,0	9,9	27,1[a]	13,9		refer to Appendix 1
A. triostegus	*Ulva* sp.	100,0	21,4	0,15[a]	20,1	19 594 (Chlorophyta)	Herbivore Benthic feeder; refer to Appendix 2
S. salpa	*Hypnea spicifera*	78,1	21,3	5,8[a]	20,4	19 902 (Rhodophyta)	Herbivore
	Hypnea rosea	59,9	8,4	2,3[a]	8,1		Benthic feeder; refer to
	Hydrozoa	61,0	7,6	2,1[a]	7,4	22 131 (1) & (2)	Appendix 3
D. sargus	Rhodophyta	70,8	23,9	3,3	31,5	19 902	
	Chlorophyta	63,2	21,2	1,7	15,6	19 594	
	Porifera	15,8	6,6	1,6	15,5	17 919	Omnivore
	Pelecypoda	24,6	8,1	0,93	8,7	23 953	Benthic feeder
	Ascidiacea	42,7	16,0	0,74	7,0	18 665 (1)	
P. olivaceum	Natantia	24,1	18,6	0,26	21,1	27 717	Carnivore
(Juvenile)	Crustacean remains	29,6	11,7	0,23	18,3		Midwater and benthic
	Polychaeta	22,2	19,7	0,09	7,3	22 855 (1)	feeder
C. multifasciatus	Bryozoa	50,4	20,2	0,92	8,4	20 093 (2)	Carnivore
	Small Crustacea	77,6	11,4	0,72	6,3	19 128	Benthic feeder
	Ascidiacea	40,6	11,4	0,49	4,6	See above	
E. andersoni	Pisces	68,8	55,0	6,7	50,8	28 063	Carnivore
	Brachyura	56,3	19,5	2,1	15,6	18 836 (2)	Benthic feeder

(1) = Atkinson & Wacasey (1976)
(2) = Cummins (1967)
([a]) = Calculated by proportion from percentage award values
T.D.M. = Total dry mass

Appendix 3 shows the food items recorded in the stomach contents of *S. salpa*. This sparid feeds mainly on Rhodophyta; 40 species being recorded in the diet, of which 19 were unidentified. The two dominant algae were *H. spicifera* (20,4% T.D.M.) and *H. rosea* (8,1% T.D.M.) (Table 1). The only noteworthy seasonal change in feeding habits was an increase in the quantity and occurrence of Hydrozoa (7,4% T.D.M.) (Table 1) in stomach contents during autumn.

From underwater observations it is apparent that *S. salpa* is a shoal fish largely confined to the surf zone. It is continually on the move, stopping intermittently to crop algae.

Stomach content analysis of *D. sargus*

D. sargus is found throughout the range of *S. salpa*, occurring additionally up the east coast of Africa to the Persian Gulf (Christensen 1976).

One hundred and seventy one stomachs containing food were analysed from fish ranging in length from 101 mm to 307 mm (mean = 199 mm). The mean stomach content volume of these fish was 0,60 ml (range: 0,01 ml to 4,4 ml. S.D. = 0,68 ml).

D. sargus ingests a wide variety of food items (App. 4). The most prominent items were Rhodophyta (31,5% T.D.M.), Chlorophyta (15,6% T.D.M.), Porifera (15,5% T.D.M.), Pelecypoda (8,7% T.D.M.) and Ascidiacea (7,0% T.D.M.) (Table 1), showing that this species is omnivorous. Unidentified animal remains (15,5% T.D.M.) (App. 4) frequently occurred in stomach contents but appeared to consist of a number of different animals which were in advanced stages of digestion. Sand and shells also made up a high proportion of stomach contents (10,7% by volume) (App. 4).

Rhodophyta were the main constituent of stomachs during summer and autumn, while Pelecypoda and Porifera were the two dominant food items during spring and winter respectively. Amongst the animals eaten by *D. sargus*, Ascidiacea were only less important than Porifera in terms of dry mass, but were more frequently consumed and of prominence during all seasons.

Loose shoals of adult and juvenile *D. sargus* occur over rocky substrates where they feed on benthic organisms, whereas fry were always observed to swim and feed in midwater, confirming the findings of Christensen (1978).

It was found that red and green seaweed passing through the gut of *D. sargus* appeared to be undigested. Therefore the possibility that *D. sargus* digested the epiphytic diatoms on seaweeds, which has also been found to occur in two other sparids namely, *Rhabdosargus holubi* (Blaber 1974) and juvenile *S. salpa* (Christensen 1978), was investigated.

Christensen (1978) chose samples from the oesophagus and rectum when he investigated *S. salpa*, however food was rarely found in the oesophagus of *D. sargus*. Therefore *Ulva* sp. from the stomach and rectum of *D. sargus* were viewed under a scanning electron microscope and a light microscope using epifluorescence. The scanning electron microscope samples showed that the density of diatoms on the stomach samples was high (Fig. 1) but that their density on the samples from the rectum was very low (Fig. 2) and large areas of the *Ulva* sp. viewed were devoid of diatoms. Using epifluorescence it was established that not only were there fewer diatoms on the rectal samples than those from the stomach, but in contrast to the stomach samples they appeared to be devoid of cell contents. Stomach and rectal samples were also compared with field samples of *Ulva* sp. to check whether

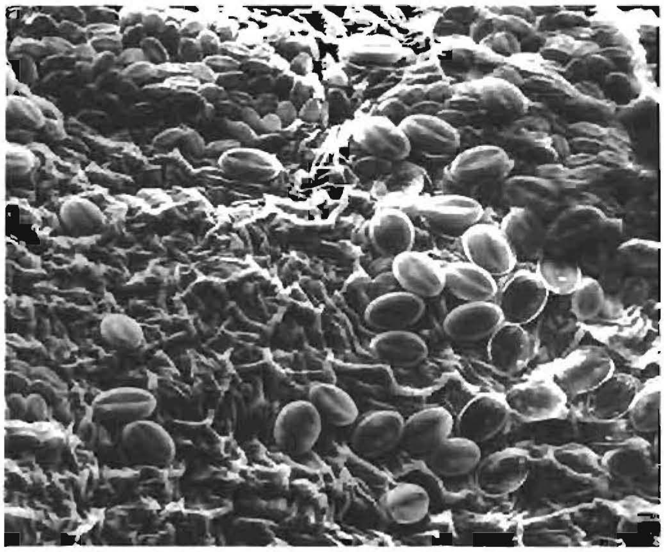

Fig. 1 Normal density of diatoms covering the surface of *Ulva* sp. from the stomach of *D. sargus* (scanning electron micrograph × 360).

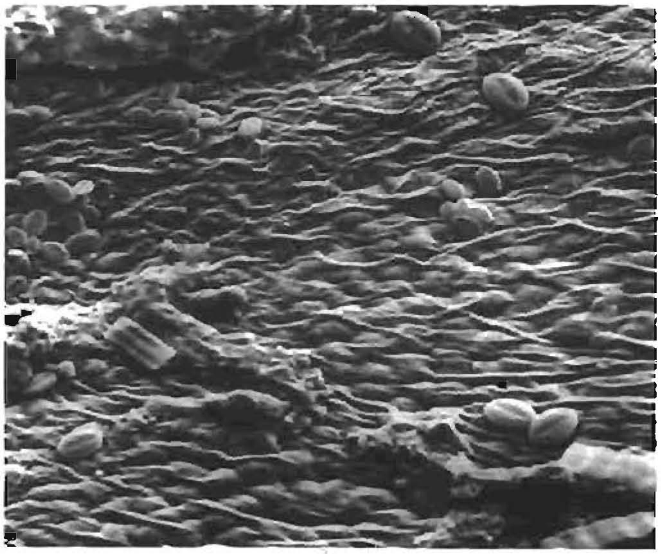

Fig. 2 High density of diatoms covering the surface of *Ulva* sp. from the rectum of *D. sargus* (scanning electron micrograph × 360).

any digestion of the seaweed substrate had occurred, but no differences were apparent. In addition, two rhodophyte algae, *H. rosea* and *Jania* sp., commonly ingested by *D. sargus* were collected from the field and examined using epifluorescence. Both were found to have diatoms adhering to their surfaces, suggesting that all seaweeds ingested by *D. sargus* act merely as a substrate for diatoms.

Stomach content analysis of *P. olivaceum*

P. olivaceum, one of the smallest members of the Pomadasydae, is common in warm seas of the Indian Ocean. It is confined mainly to the east coast of South Africa, reaching False Bay in the south (M.M. Smith 1978, pers. comm.). *P. olivaceum* occurring in the littoral zone are mostly immature, while those fish caught in 50 m to 90 m are almost exclusively mature. The present study was concentrated on juveniles but limited results on feeding in adults are also presented.

Juveniles

Fifty four stomachs containing food from specimens ranging in length from 71 mm to 137 mm (mean = 102 mm) were analysed. The volume of stomach contents ranged from 0,01 ml to 0,8 ml (mean = 0,19 ml. S.D. = 0,18 ml). Of the stomachs examined in the field 74,4% were empty. The constituents of the diet of juvenile *P. olivaceum* are tabulated in Appendix 5. Overall, unidentified animals remains (32,8% T.D.M.) were of most importance in the diet but crustaceans appear to form the bulk of the food ingested by this fish, with Natantia (*i.e.* Penaeoidea and Caridea) (21,1% T.D.M.) predominating (Table 1). The only other major food items were unidentified crustacean remains (18,3% T.D.M.) and Polychaeta (7,3% T.D.M.) (Table 1). Cephalopoda (*Octopus* sp. (juv.)) were of consequence in the diet when assessed gravimetrically (8,7% T.D.M.), but only occurred in three stomachs (*i.e.* 5,6%) (App. 5). No marked seasonal variations in food preferences were observed.

P. olivaceum occurs in shoals sometimes consisting of several thousand specimens. Seldom seen close to the bottom, this species is normally found swimming in midwater over sand close to reefs. It was only observed to feed on organisms in the water column, although certain of its food items were benthic (e.g. Polychaeta, Amphipoda and Copepoda).

Adults

Eleven stomachs of adult *P. olivaceum* were analysed using the frequency of occurrence and points methods, since the intention was merely to ascertain if there was a change in diet with increase in size. The length range of specimens was 134 mm to 194 mm (mean = 169 mm). Appendix 6 gives a breakdown of the food items eaten by adult *P. olivaceum*. Stomatopoda were the dominant food (61,1% award). Unidentified animal remains (12,5% award) were also important and in general crustaceans formed the basis of the diet in offshore fish (75,7% award) (App. 6).

Stomach content analysis of *C. multifasciatus*

This warm water coracinid occurs from the eastern Cape to Madagascar, being common on the Transkei, Natal and southern Mozambique coasts (M.M. Smith 1978, pers. comm.).

A total of 143 stomachs containing food were analysed. Specimens ranged in length from 133 mm to 302 mm (mean = 224 mm) and stomach content volumes ranged from 0,08 ml to 3,4 ml (mean = 0,87 ml. S.D. = 0,57 ml).

Appendix 7 shows that *C. multifasciatus* is a carnivore ingesting a wide range of organisms. Unidentified animal remains amounted to 71,2% (T.D.M.) of the diet (App. 7). There is no doubt that a small proportion of these remains consisted of Bryozoa zooids which had broken off from the uniserial branches of colonies. The time spent separating out these minute zooids meant that invariably some were left to be included with unidentified animal remains. Of those identifiable food items Bryozoa (8,4% T.D.M.), small Crustacea (mainly gammarid and caprellid Amphipoda) (6,3% T.D.M.) and Ascidiacea (4,6% T.D.M.) were of most importance in the diet (Table 1). Sand and shells also made up a high proportion of stomach contents (58,4% by volume) (App. 7). Bryozoa dominated during all seasons except spring when small Crustacea were of more consequence in the diet.

C. multifasciatus occurs singly or in small shoals and on the basis of observation and stomach contents it appears to take its food almost exclusively off rocky substrates.

Stomach content analysis of *E. andersoni*

This serranid is confined to southern Africa from Knysna to Delagoa Bay (Smith 1965).

Of the 21 stomachs examined 16 contained food remains. Fish ranged in size from 147 mm to 249 mm (mean = 196 mm) and the mean stomach content volume was 3,83 ml (range: 0,1 ml to 23,0 ml. S.D. = 5,62 ml). Stomachs were not analysed on a seasonal basis.

Food items ingested by *E. andersoni* are presented in Appendix 8. Fish (50,8% T.D.M.) (Table 1) constituted the bulk of food ingested and blennies (*Blennius cristatus* and *B. cornutus* (I. Joubert 1980 pers. comm.) were positively identified in 50% of stomachs examined. Brachyura (15,6% T.D.M.) were also an important food item (Table 1).

This cryptically coloured species is most often observed on the bottom usually in a rock crevice or hole where it lies in wait for unsuspecting prey.

Feeding in the other species

Qualitative feeding data on 23 other species occurring on the ORI Reef are summarized in Appendix 9. Only the most important food items have been included in each instance.

Energy content of food items

The total and ash free energy values of most of the food items consumed are presented in Appendix 10. Some of the values obtained in the present study reflect food items accumulated from stomach contents but only if items appeared to be relatively little digested. Energy values of the latter food items are therefore liable to some error. However, most of the values are those of animals collected from the environment. Where samples were too small to obtain meaningful results, values given by other authors have been used.

Discussion

When considering the species of fish involved in this study, it is apparent that those consuming plant material must not be considered to be exclusively herbivorous since all ingested differing proportions of animal food. Furthermore, the proportions of animals and seaweeds ingested may also vary seasonally or with age.

A. triostegus is probably the most truly herbivorous species on inshore reefs in Natal. This species does not take bait and in the Durban Aquarium it will starve to death if fed an exclusively animal diet. It would appear therefore that the small amounts of animal food which are found in stomach contents are ingested incidentally. *A. triostegus* is probably responsible for utilizing the greatest quantities of Chlorophyta in the inshore zone, as this fish is abundant and ingests more green seaweed than either *S. salpa* or *N. lithophilus*.

Unlike *A. triostegus*, *N. lithophilus* tends occasionally to feed opportunistically on animal food, notably copepods, although the small quantities of animal food sometimes found in stomach contents suggest that most is ingested incidentally. Furthermore this species readily takes bait and does well in the Durban Aquarium on a purely animal diet.

Although *S. salpa* is a typical herbivore it may be placed at the other end of the herbivore scale. There is a definite omnivorous tendency in this species during autumn when animal food becomes important in the diet. This may reflect an increased abundance of Hydrozoa during autumn and therefore opportunistic feeding behaviour, or alternatively it may be associated with the onset of the breeding season and the accumulation of fats for development of the gonads, which occurs at this time. It is possible that in a number of inshore reef fish, feeding habits may change seasonally because of fluctuations in the abundance of certain food items. For example this might mean that a normally preferred food item may become unimportant during a particular season, merely because it has become scarce over that period.

Christensen (1978) studied the feeding habits of juvenile and sub-adult *S. salpa*, which ranged in length from 9 mm to 150 mm. He found that there was a change in diet with increase in size and that this was associated with changes in dentition and relative gut length. He concluded that small juveniles were carnivorous, feeding mainly on harpacticoid copepods, large juveniles were omnivorous feeding primarily on diatoms and Rhodophyta (only 9,9% of the diet consisted of animal food) and sub-adults, like the adult fish dealt with in this study, were herbivorous, feeding on red and green seaweed.

It is interesting to note that *S. salpa*, *N. lithophilus* and *A. triostegus* all have a black peritoneal lining to the abdominal cavity which was not a characteristic of any of the carnivores examined in this study. This may be a means of preventing light penetration which could result in photosynthetic activity and gaseous production in the gut. It is likely that during the day feeding is more or less continuous in these three herbivores, since stomachs were seldom less than half full of algae. All three species are abundant in the littoral zone and are therefore likely to have considerable impact on the Rhodophyta and Chlorophyta communities of inshore reefs.

The rhodophytes *H. rosea*, *P. elegens*, *Galaxaura* sp., *Tayloriella tenebroza*, *Champia compressa* and particularly *H. spicifera* are important foods to both *N. lithophilus* and *S. salpa* and there is, therefore, a possibility of competition between these two herbivores. However, underwater observations have shown that there is spatial separation (Newell 1979) between these two fish species where *S. salpa* tends to feed in deeper water than *N. lithophilus*. Furthermore *H. spicifera* (the most important alga in the diets of both species) is abundant on the Natal coast (Jackson 1976), so that they are not competing for a limited food resource.

Another species which consumes substantial amounts of seaweeds but which would usually be regarded as an omnivore because of the high proportion of animal food in the diet, is *D. sargus*. The seaweeds eaten by this species pass out undamaged and it appears that they act merely as a substrate for epiphytic diatoms which are digested. However, further research would be necessary to evaluate the exact importance of epiphytes to *D. sargus*. These epiphytes, although not quantified in this study, probably constitute only a small proportion in relation to the animal food intake and *D. sargus* may in fact be largely carnivorous, which is confirmed by its comparatively short gut (Weatherley 1972). Nevertheless *D. sargus* plays an important role in cropping seaweed and passing it into the detrital pool of inshore reefs. There was no indication that any of the herbivores or other omnivores examined during this study were ingesting algae for their epiphytes only. In all instances digestion of seaweeds occurred. A point of interest here is that *S. salpa* as a juvenile does ingest algae for its epiphytes (Christensen 1978), but digestion of the algae occurs in adult fish.

Christensen's (1978) study on juvenile *D. sargus*, which ranged in length from 5 mm to 165 mm, demonstrated that the smallest size classes feed largely on zooplankton such as harpacticoid copepods, amphipods, cirripede nauplii, chironomid larvae and algae. He found that larger individuals ingested mainly amphipods and Chlorophyta. From his study and the present results it is apparent that with an increase in size *D. sargus* changes from midwater to benthic feeding and from being a carnivore to an omnivore. This change in diet with increase in size, also a characteristic of *S. salpa*, emphasizes the importance of different food resources to some marine fishes during different phases of their life cycles. Furthermore, these changes in diet usually necessitate movement to a new habitat in order to exploit a particular food resource.

Apart from *D. sargus* a number of other omnivores, namely *Blennius cristatus, B. fascigula, B. cornutus* and *Abudefduf sordidus* feed on Chlorophyta and Rhodophyta. In *A. sordidus* the algae eaten are digested. This aspect in *B. cristatus, B. cornutus* and *B. fascigula* is, however, still under investigation.

When considering the species of fish dealt with in this study it is apparent that carnivores (66,7%) outnumber both omnivores (16,7%) and herbivores (16,7%). Bakus (1969) has stated that there is general agreement that tropical coral reef fish species consist of roughly 69% carnivores, 22% herbivores and 9% omnivores, whereas fishes outside the tropics have fewer herbivores which confirms the findings of the present study. The importance of crustaceans in the food chain is demonstrated by the fact that they are recorded in the diet of all the omnivores and 94% of the carnivores. This shows the importance of detritus, which periodically accumulates on inshore reefs in Natal (Berry 1978), in the food chain because many crustaceans are detritivores, obviously making use of this energy input.

It is likely that *P. olivaceum* inhabits the edges of reefs in order to prey on the prawn *Macropetasma africana* which was observed to be abundant in association with detritus. Food items were similar in both adult and juvenile *P. olivaceum* differing only in the categories of crustaceans which were of most importance. Being a small carnivore, a rapid digestion rate could be expected (Weisz 1954), nevertheless the high incidence of empty stomachs recorded in this species is surprising and suggests that feeding may be intensified at night. This could not be verified as all samples in this study were collected during the day.

In the diet of *C. multifasciatus*, small Crustacea (mainly gammarid and caprellid amphipods) were secondary to Bryozoa in quantitative terms, but were the most frequently occurring item in stomachs and therefore their importance in the diet may be underestimated. The large quantities of sand and shells consumed by *C. multifasciatus*, and to a lesser extent by *D. sargus*, is of interest. It is not clear whether these are swallowed incidentally along with food and accumulate in stomachs or whether they are used in the mechanical breakdown of food items.

E. andersoni is one of the most important predators on the ORI Reef because it feeds on Blenniidae, the most abundant benthic teleosts on the reef (I. Joubert 1979, pers. comm.). This predator/prey relationship is important when it is considered that only juveniles of *E. andersoni* occur on inshore reefs and this must be an important pathway of energy export to deeper reefs inhabited by adult *E. andersoni*. Other important predators which prey extensively on inshore reef fish and which are responsible for transporting energy away from the inshore environment are the elf *Pomatomus saltatrix* (van der Elst 1976); the dusky shark *Carcharhinus obscurus* (van der Elst 1979); the garrick *Lichia amia* and the kob *Argyrosomus hololepidotus*.

Berry (1978) has shown that there are extremely high and fluctuating densities (between approximately 2 000/m^2 and 170 000/m^2) of the brown mussel (*Perna perna*) on the ORI Reef, which are utilized opportunistically by *Coracinus capensis, D. sargus* and *Rhabdosargus sarba* mainly after new spatfalls when the mussels are small. Although Pelecypoda feature in the diet of *C. capensis* and *D. sargus* collected elsewhere along the coast, they are not nearly as important as in those fish collected on the ORI Reef. *D. sargus* from the ORI Reef had fed mainly on mussels (52,4% by dry mass) whereas fish collected elsewhere had not (10% by dry mass). This discrepancy is thought to be due to the greater availability of mussels on the ORI Reef. The above species as well as *Trachinotus africanus*, the most important teleost mussel predator, probably play a minor part in controlling the mussel population of the reef, as Berry (1978) has pointed out that physical factors are of greater importance than predation in affecting the mortality rate of the ORI Reef mussels.

This study has highlighted the importance of the following food items to the inshore reef fish examined: Rhodophyta, Chlorophyta, Polychaeta, Mysidacea, Natantia, Brachyura and Pelecypoda (mainly *P. perna*). These amount to 26% of the total number of items consumed.

It has been postulated by Berry (1978) that inshore reefs in Natal act as traps for plant debris derived from littoral marine macrophytes and terrestrial plant material which, after mechanical and microbial breakdown, is available as food in the form of detritus for filter feeders. This results in increased productivity of zoobenthos and availability of food items on inshore reefs which is probably the most important single factor attracting teleosts to the inshore zone.

It is significant that the inshore teleosts recorded on the ORI Reef were predominantly sub-adults and juveniles and of 55 species in which the state of maturity could be evaluated 46 (84%) were represented as juveniles. This also demonstrates the importance of inshore reefs as nursery areas.

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Appendix 1 *Neoscorpis lithophilus*: Analysis of Stomach Contents

Food items	Number stomachs	% Frequency occurrence	Points awarded	% award	Volume (ml)	Volume %	Wet Mass (g)	Wet Mass %	Total dry mass (g)	Total dry mass %
Rhodophyta										
Hypnea spicifera	189	94,5	1 012,0	27,8						
Unidentified species	185	92,5	713,0	19,6						
Hypnea rosea	158	79,0	431,0	11,9						
Polyzonia elegens	180	90,0	360,0	9,9						
Galaxaura sp.	106	53,0	130,0	3,6						
Champia compressa	124	62,0	98,0	2,7						
Tayloriella tenebrosa	132	66,0	91,0	2,5						
Hypnea sp.	42	21,0	85,0	2,3						
Erythroclonium sp.	71	35,5	53,0	1,5						
Pterosiphonia cloiophylla	71	35,5	41,0	1,1						
Vidalia serrata	55	27,5	42,0	1,1						
Gymnogongrus sp.	41	20,5	36,0	1,0						
Gelidium amanzii	29	14,5	32,0	0,9	2 305,8	97,1	2 509,3	96,9	188,1	96,4
Gelidium versicolor	32	16,0	24,0	0,7						
Plocamium sp.	18	9,0	6,0	0,2						
Plocamium rigidum	21	10,5	5,0	0,1						
Jania sp.	13	6,5	1,0	0,04						
Amphiroa ephedraea	25	12,5	1,0	0,04						
Prionitis nodifera	1	0,5	1,0	0,01						
Spyridia cupressina	2	1,0	T	–						
Cheilosporum cultratum	6	3,0	T	–						
Arthrocardia sp.	2	1,0	T	–						
Corallina sp.	6	3,0	T	–						
Duthiophycus setchellii	2	1,0	T	–						
Chlorophyta										
Ulva sp.	153	76,5	177,0	4,9						
Unidentified species	114	57,0	147,0	4,0						
Cladophora sp.	25	12,5	5,0	0,1						
Codium duthiae	12	6,0	4,0	0,1	57,5	2,4	66,5	2,5	5,2	2,7
Pseudocodium de-vriessei	8	4,0	3,0	0,1						
Caulerpa filiformis	3	1,5	2,0	0,1						
Chaetomorpha sp.	4	2,0	T	–						
Halimeda cuneata	1	0,5	T	–						
Phaeophyta										
Unidentified species	1	0,5	8,0	0,2	0,5	0,02	0,5	0,02	0,03	0,02
Sargassum sp.	1	0,5	1,0	0,03						
Animal										
Copepoda	16	8,0	27,0	0,8						
Brachyura	29	14,5	25,0	0,7						
Hydrozoa	95	47,5	15,0	0,4						
Amphipoda	66	33,0	14,0	0,4						
Ascidiacea	38	19,0	14,0	0,4						
Polychaeta	21	10,5	11,0	0,3						
Pelecypoda	24	12,0	3,0	0,1						
Isopoda	12	6,0	4,0	0,1						
Crustacean remains	11	5,5	4,0	0,1						
Mysidacea	4	2,0	4,0	0,1						
Insecta	8	4,0	1,0	0,04	12,0	0,5	12,5	0,5	1,8	0,9
Natantia	3	1,5	1,0	0,04						
Bryozoa	5	2,5	1,0	0,03						
Sipunculida	4	2,0	1,0	0,03						
Unidentified remains	3	1,5	1,0	0,03						
Palinuridae	1	0,5	1,0	0,03						
Anomura	1	0,5	1,0	0,03						
Porifera	1	0,5	1,0	0,03						
Pycnogonida	9	4,5	T	–						
Cirripedia	2	1,0	T	–						
Gastropoda	2	1,0	T	–						
Pisces eggs	1	0,5	T	–						
Totals	200		3 638,0		2 375,8		2 588,8		195,1	

Appendix 2 *Acanthurus triostegus*: Analysis of stomach contents

Food items	Number stomachs	% Frequency occurrence	Points awarded	% award	Volume (ml)	Volume %	Wet mass (g)	Wet mass %	Total dry mass (g)	Total dry mass %
Rhodophyta										
Unidentified species	8	72,7	44,0	52,4						
Hypnea sp.	4	36,4	3,0	3,6						
Champia compressa	5	45,5	2,0	2,4						
Hypnea rosea	2	18,2	1,0	1,2						
Jania sp.	2	18,2	1,0	1,2	4,9	76,6	4,4	79,3	0,57	78,1
Amphiroa ephedraea	2	18,2	1,0	1,2						
Pterosiphonia cloiophylla	1	9,1	T	–						
Corallinaceae	1	9,1	T	–						
Tayloriella tenebrosa	1	9,1	T	–						
Chlorophyta										
Ulva sp.	11	100,0	18,0	21,4						
Cladophora sp.	10	90,9	6,0	7,1						
Unidentified remains	7	63,6	1,0	1,2	1,4	21,9	1,1	19,8	0,15	20,6
Pseudocodium sp.	1	9,1	T	–						
Animal										
Hydrozoa	6	54,6	5,0	6,0						
Amphipoda	4	36,4	2,0	2,4						
Polychaeta	2	18,2	T	–	0,1	1,6	0,05	0,9	0,01	1,4
Gastropoda	1	9,1	T	–						
Totals	11		84,0		6,4		5,55		0,73	

Appendix 3 *Sarpa salpa*: Analysis of stomach contents

Food items	Number stomachs	% Frequency occurrence	Points awarded	% award	Volume (ml)	Volume %	Wet mass (g)	Wet mass %	Total dry mass (g)	Total dry mass %
Rhodophyta										
Unidentified species	160	85,6	612,0	23,5						
Hypnea spicifera	146	78,1	583,0	21,3						
Hypnea rosea	112	59,9	229,0	8,4						
Galaxaura sp.	76	40,6	201,0	7,3						
Tayloriella tenebrosa	88	47,1	136,0	5,0						
Champia compressa	86	46,0	82,0	3,0						
Polyzonia elegens	103	55,1	69,0	2,5						
Hypnea sp.	37	19,8	45,0	1,6						
Gelidium versicolor	28	15,0	33,0	1,2						
Amphiroa ephedraea	35	18,7	29,0	1,1						
Vidalia serrata	31	17,1	31,0	1,1						
Jania sp.	33	17,7	21,0	0,8	208,4	88,1	244,4	89,9	25,2	88,7
Erythroclonium sp.	31	16,6	16,0	0,6						
Gelidium amanzii	8	4,3	9,0	0,3						
Plocamium sp.	6	3,2	9,0	0,3						
Cheilosporum cultratum	22	11,8	5,0	0,2						
Corallinaceae	20	10,7	6,0	0,2						
Gymnogongrus sp.	7	3,7	6,0	0,2						
Plocamium rigidum	30	16,0	4,0	0,1						
Corallina sp.	8	4,3	3,0	0,1						
Duthiophycus setchellii	2	1,1	1,0	0,04						
Arthrocardia sp.	3	1,6	T	–						
Chlorophyta										
Ulva sp.	44	23,5	44,0	1,6						
Chaetomorpha sp.	10	5,4	26,0	1,0						
Cladophora sp.	39	20,9	23,0	0,9						
Caulerpa filiformis	8	4,3	25,0	0,9	11,6	4,9	11,5	4,2	1,3	4,6
Unidentified species	93	49,7	125,0	0,9						
Halimeda cuneata	11	5,9	22,0	0,8						
Codium duthiae	7	3,7	6,0	0,2						
Pseudocodium de-vriessei	5	2,7	4,0	0,1						

Appendix 3 (continued)

Food items	Number stomachs	% Frequency occurrence	Points awarded	% award	Volume (ml)	Volume %	Wet mass (g)	Wet mass %	Total dry mass (g)	Total dry mass %
Phaeophyta										
Dictyopteris macrocarpa	7	3,7	10,0	0,4	0,9	0,4	0,7	0,3	0,1	0,4
Sargassum sp.	1	0,5	1,0	0,04						
Animal										
Hydrozoa	114	61,0	207,0	7,6						
Ascidiacea	29	15,5	23,0	0,8						
Amphipoda	85	45,5	19,0	0,7						
Copepoda	27	14,4	10,0	0,4						
Polychaeta	26	13,9	9,0	0,3						
Bryozoa	3	1,6	4,0	0,2						
Pelecypoda	27	14,4	4,0	0,1						
Tanaidacea	3	1,6	2,0	0,07						
Pisces eggs	2	1,1	1,0	0,04	15,7	6,6	15,4	5,7	1,8	6,3
Cirripedia	10	5,4	1,0	0,04						
Mysidacea	3	1,6	1,0	0,04						
Isopoda	4	2,1	1,0	0,04						
Pycnogonida	3	1,6	1,0	0,04						
Euphauseacea	1	0,5	1,0	0,04						
Porifera	1	0,5	1,0	0,04						
Sipunculida	1	0,5	T	–						
Natantia	1	0,5	T	–						
Totals	187		2 739,0		236,6		272,0		28,4	

Appendix 4 *Diplodus sargus*: Analysis of stomach contents

Food items	Number stomachs	% Frequency occurrence	Points awarded	% award	Volume (ml)	Volume %	Wet mass (g)	Wet mass %	Total dry mass (g)	Total dry mass %
Rhodophyta	121	70,8	404,0	23,9	14,10	22,4	16,60	26,2	3,34	31,5
Chlorophyta	108	63,2	358,0	21,2	17,15	27,2	16,51	26,1	1,67	15,7
Porifera	27	15,8	111,0	6,6	4,27	6,8	4,58	7,2	1,63	15,4
Unidentified animal remains	94	55,0	126,0	7,5	5,15	8,2	5,69	9,0	1,61	15,2
Pelecypoda	42	24,6	136,0	8,1	5,99	9,6	4,76	7,5	0,93	8,8
Ascidiacea	73	42,7	269,0	16,0	10,96	17,4	9,92	15,7	0,74	7,0
Polychaeta	35	20,5	56,0	3,4	1,46	2,3	1,45	2,3	0,21	2,0
Bryozoa	29	17,0	77,0	4,6	1,31	2,1	1,21	1,9	0,13	1,2
Cirripedia	46	26,9	53,0	3,2	0,73	1,1	0,61	1,0	0,07	0,7
Hydrozoa	36	21,0	32,0	1,9	0,57	0,9	0,55	0,9	0,07	0,7
Gastropoda	11	6,4	11,0	0,6	0,56	0,9	0,52	0,8	0,08	0,8
Small Crustacea	63	36,8	36,0	2,2	0,48	7,7	0,42	0,7	0,06	0,6
Actinaria	2	1,2	2,0	0,1	0,19	0,3	0,20	0,3	0,02	0,2
Pisces	1	0,6	4,0	0,2	0,10	0,1	0,14	0,2	0,02	0,2
Octocorallia	1	0,6	T	–	0,01	0,01	0,02	0,03	0,008	0,08
Anomura	1	0,6	T	–	0,01	0,01	0,03	0,05	0,007	0,07
Brachyura	3	1,8	3,0	0,2	0,06	0,1	0,04	0,06	0,005	0,05
Natantia	2	1,2	T	–	0,05	0,8	0,01	0,02	0,003	0,03
Sipunculida	1	0,6	T	–	0,03	0,04	0,02	0,03	0,002	0,02
Insecta	1	0,6	T	–	0,01	0,01	0,005	0,008	0,0001	0,001
Polyplacophora	1	0,6	T	–	0,01	0,01	0,005	0,008	0,0001	0,001
Pycnogonida	1	0,6	T	–	0,01	–	0,0001	–	0,0001	–
Ophiuroidea	1	0,6	T	–	0,01	–	0,0001	–	0,0001	–
Sand & Shells	74	43,3	90,0	–	6,75	–	10,96	–	8,94	–
Totals	171		1 678,0		63,2		63,29		10,61	

Appendix 5 Juvenile *Pomadasys olivaceum*: Analysis of stomach contents

Food items	Number stomachs	% Frequency occurrence	Points awarded	% award	Volume (ml)	Volume %	Wet mass (g)	Wet mass %	Total dry mass (g)	Total dry mass %
Unidentified animal remains	32	59,3	118,0	26,5	1,80	26,5	1,89	27,1	0,41	32,8
Natantia	13	24,1	83,0	18,6	1,40	20,6	1,44	20,6	0,26	20,8
Crustacean remains	16	29,6	52,0	11,7	0,73	10,7	0,83	11,9	0,23	18,4
Cephalopoda	3	5,6	11,0	2,5	0,80	11,8	0,84	12,0	0,11	8,8
Polychaeta	12	22,2	88,0	19,7	0,93	13,7	0,82	11,8	0,09	7,2
Mysidacea	7	13,0	25,0	5,6	0,52	7,7	0,54	7,7	0,07	5,6
Ophiuroidea	2	3,7	11,0	2,5	0,20	2,9	0,22	3,2	0,03	2,4
Pisces	4	7,4	11,0	2,5	0,12	1,8	0,10	1,4	0,02	1,6
Brachyura	5	9,3	25,0	5,6	0,14	2,1	0,14	2,0	0,02	1,6
Stomatopoda	1	1,9	8,0	1,8	0,10	1,5	0,11	1,6	0,01	0,8
Small Crustacea	10	18,5	14,0	3,1	0,05	0,70	0,04	0,6	0,002	0,2
Anomura	1	1,9	T	–	0,01	0,2	0,006	0,09	0,0004	0,03
Chlorophyta	1	1,9	T	–	0,01	–	0,0001	–	0,0001	–
Hydrozoa	1	1,9	T	–	0,01	–	0,0001	–	0,0001	–
Totals	54		446,0		6,8		6,98		1,25	

Appendix 6 Adult *P. olivaceum*: Analysis of stomach contents

Food items	Number stomachs	% Frequency occurrence	Points awarded	% award
Stomatopoda	7	63,6	88,0	61,1
Unidentified animal remains	7	63,6	18,0	12,5
Pisces	1	9,1	16,0	11,1
Natantia	3	27,3	12,0	8,3
Brachyura	1	9,1	8,0	5,6
Amphipoda	2	18,2	1,0	0,7
Polychaeta	1	9,1	1,0	0,7
Totals	11		144,0	

Appendix 7 *Coracinus multifasciatus*: Analysis of stomach contents

Food items	Number stomachs	% Frequency occurrence	Points awarded	% award	Volume (ml)	Volume %	Wet mass (g)	Wet mass %	Total dry mass (g)	Total dry mass %
Unidentified animal remains	130	90,9	492,0	36,0	24,45	53,8	27,11	58,8	7,93	71,3
Bryozoa	72	50,4	275,0	20,2	5,30	11,7	5,15	11,2	0,92	8,3
Small Crustacea	111	77,6	156,0	11,4	3,43	7,5	3,39	7,4	0,72	6,5
Ascidiacea	58	40,6	155,0	11,4	5,72	12,5	5,22	11,3	0,49	4,4
Polychaeta	53	37,1	86,0	6,3	1,62	3,5	1,68	3,6	0,33	3,0
Hydrozoa	69	48,2	48,0	3,5	1,22	2,7	1,05	2,3	0,25	2,3
Brachyura	36	25,2	34,0	2,5	0,74	1,6	0,55	1,2	0,17	1,5
Porifera	18	12,6	22,0	1,6	0,73	1,6	0,75	1,6	0,14	1,3
Cirripedia	48	33,6	36,0	2,6	0,36	0,8	0,23	0,5	0,09	0,8
Gastropoda	35	24,5	18,0	1,3	0,25	0,5	0,18	0,4	0,03	0,3
Pelecypoda	15	10,5	41,0	3,0	2,04	4,5	0,73	1,6	0,04	0,4
Natantia	1	0,7	1,0	0,07	0,10	0,2	0,6	0,1	0,01	0,09
Ophiuroidea	4	2,8	T	–	0,01	0,02	0,004	0,009	0,0004	0,004
Pycnogonida	4	2,8	T	–	0,01	0,02	0,005	0,01	0,0003	0,003
Sipunculida	2	1,4	T	–	0,02	0,05	0,003	0,007	0,0002	0,002
Anomura	1	0,7	T	–	0,01	0,02	0,003	0,007	0,0001	0,0009
Sand & Shells	126	88,1	316,0	–	26,85	–	45,99	–	35,46	–
Totals	143		1 364,0		46,01		46,12		11,12	

Appendix 8 *Epinephelus andersoni*: Analysis of stomach contents

Food items	Number stomachs	% Frequency occurrence	Points awarded	% award	Volume (ml)	Volume %	Wet mass (g)	Wet mass %	Total dry mass (g)	Total dry mass %
Pisces	11	68,8	183,0	55,0	22,7	41,0	27,34	49,0	6,67	50,8
Palinuridae	1	6,3	30,0	9,0	21,0	37,9	16,46	29,5	4,03	30,7
Brachyura	9	56,3	65,0	19,5	8,5	15,3	8,87	15,9	2,05	15,6
Natantia	7	43,8	54,0	16,2	3,01	5,4	2,97	5,3	0,36	2,7
Unidentified animal remains	4	25,0	12,0	3,6	0,2	0,4	0,16	0,3	0,03	0,2
Totals	16		333,0		55,41		55,80		13,14	

Appendix 9 Qualitative data on feeding in 23 species of lesser importance on the ORI Reef

Species	Number	Length (mm)	Feeding category	Food items	Remarks
Abudefduf sordidus	4	108 – 134 (mean = 118)	Omnivore	Chlorophyta; Rhodophyta; Brachyura; Hydrozoa; Natantia	Benthic feeder
Abudefduf saxatilis	1	115	Herbivore	Rhodophyta; Chlorophyta	Benthic feeder
Acanthurus lineolatus	1	126	Herbivore	Rhodophyta; Chlorophyta	Benthic feeder
Blennius cristatus	1 210	17 – 102	Omnivore	Rhodophyta; Crustacea; Hydrozoa; Chlorophyta	Benthic feeder
Blennius cornutus	1 158	16 – 87	Omnivore	Crustacea; Hydrozoa; Rhodophyta; Chlorophyta	Benthic feeder
Blennius fascigula	69	35 – 101	Omnivore	Hydrozoa; Crustacea; Rhodophyta; Chlorophyta	Benthic feeder
Coracinus capensis	16	325 – 431 (mean = 371)	Carnivore	Ascidiacea; Gastropoda; Cirripedia; Pelecypoda; Rhodophyta	Rhodophyta incidental; Benthic feeder
Caranx williamsi	59	352 – 804 (mean = 555)	Carnivore	Pisces; Cephalopoda; Brachyura	Midwater and Benthic feeder
Chelonodon patoca	3	122 – 156 (mean = 140)	Carnivore	Pisces	Midwater feeder
Dinoperca petersii	2	132;227	Carnivore	Natantia; Mysidacea; Brachyura	Benthic feeder
Drepane punctata	5	248 – 305	Carnivore	Crustacea; Polychaeta	Benthic feeder
Epinephelus guaza	5	438 – 545 (mean = 488)	Carnivore	Brachyura; Pisces; Palinuridae	Benthic feeder
Elops machnata	2	593;600	Carnivore	Crustacea; Pisces	Midwater feeder
Gaterin chubbi	1	133	Carnivore	Natantia; Amphipoda	Benthic feeder
Monodactylus argenteus	5	165 – 202 (mean = 187)	Carnivore	Mysidacea; Isopoda; Amphipoda	Midwater and Benthic feeder
Pomatomus saltatrix	270	200 – 480 (mean = 367)	Carnivore	Pisces; Cephalopoda; Natantia	After van der Elst (1976) Midwater feeder
Pseudupeneus fraterculus	3	129 – 235 (mean = 198)	Carnivore	Brachyura; Panuliridae; Pisces; Ophiuroidea	Benthic feeder
Pomadasys commersoni	45	[a]332 – 857	Carnivore	Pelecypoda; Crustacea; Gastropoda; Pisces; Echinoidea; Ascidiacea; Hydrozoa	Benthic feeder
Rhabdosargus sarba	97	[a]306 – 621	Carnivore	Pelecypoda; Natantia; Brachyura; Cirripedia; Echinoidea; Gastropoda; Chlorophyta	Chlorophyta thought to be incidental since colonial Bryozoa covered all plants. Benthic feeder
Rhabdosargus holubi	17	[a]185 – 354	Carnivore	Pelecypoda; Gastropoda; Cirripedia; other Crustacea; Bryozoa; Chlorophyta	Chlorophyta thought to be incidental since colonial Bryozoa covered all plants. Benthic feeder
Rhonciscus anas	1	298	Carnivore	Crustacea	Benthic feeder
Scomberoides tala	4	239 – 277 (mean = 251)	Carnivore	Mysidacea; Natantia	Midwater feeder
Trachinotus africanus	24	[a]185 – 750	Carnivore	Pelecypoda; Crustacea; Pisces; Echinodermata	Almost exclusively Pelecypoda (*Perna perna*) Benthic feeder

[a] Total length

Appendix 10 Energy values of food items. Lumped animal remains = animals ingested by *S. salpa* and *N. lithophilus*

Food items	jg^{-1} (dry mass)	jg^{-1} (ash-free dry mass)
Rhodophyta	16 929	19 902
Chlorophyta	16 912	19 594
Porifera	3 254 (2)	17 919
Hydrozoa	–	22 131 (1) & (2)
Actinaria	14 199	–
Polychaeta	18 815	22 855 (1)
Cirripedia	5 283	22 554 (1)
Small Crustacea	10 998	19 128
Stomatopoda	21 279 (2)	–
Natantia	20 362 (2)	27 717
Brachyura	12 624	18 836 (2)
Insecta	–	23 100 (2)
Pycnogonida	–	21 493 (1)
Bryozoa	11 658 (2)	20 093 (2)
Pelecypoda	20 277	23 953
Gastropoda	15 582 (2)	22 833 (1)
Cephalopoda	21 221	22 569
Echinoidea	–	23 648 (1)
Ophiuroidea	–	22 932 (1)
Ascidiacea	–	18 665 (1)
Pisces	21 283	25 811
Lumped animal remains	17 134	22 373

(1) = Atkinson & Wacasey (1976)
(2) = Cummins (1967)