

Food and Feeding Habits of *Nemipterus peronii* (Valenciennes) from the South China Sea

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Keywords : Food composition, monthly variation, length-class variation, sex variation, *Nemipterus peronii*, Malaysia

ABSTRAK

Satu penyelidikan telah dijalankan untuk mengetahui makanan dan tabiat makan *Nemipterus peronii* dari Laut China Selatan. Makanannya terdiri daripada ikan, *Leiognathus elongatus*, *L. splendens*, *Upeneus sulphureus*, *U. vittatus*, *Nemipterus sp.*, *Trichiurus sp.*, *Selaroides leptolepis* dan *Saurida sp.*, udang, ketam, sotong serta bahan-bahan organik dan bukan organik yang telah reput. Ikan, udang dan ketam merupakan makanan utama sepanjang tahun. Peratusan perut kosong yang terendah (0%) didapati pada bulan Ogos dan yang tertinggi (45%) pada bulan Disember. Udang tidak dijumpai di dalam perut-perut ikan yang julat panjangnya antara 9.6 - 11.5 sm sementara sotong tidak dijumpai di dalam perut-perut ikan yang julat panjangnya kurang daripada 13.6 sm. Kepentingan relatif jenis makanan bagi *N. peronii* juga dibentangkan.

ABSTRACT

A study was conducted to investigate the food and feeding habits of *Nemipterus peronii* from the South China Sea. Diets consisted of fish, *Leiognathus elongatus*, *L. splendens*, *Upeneus sulphureus*, *U. vittatus*, *Nemipterus sp.*, *Trichiurus sp.*, *Selaroides leptolepis* and *Saurida sp.*, shrimps, crabs, squids and miscellaneous decomposed organic and inorganic substances. Fish, shrimps and crabs constituted the main diets. The lowest percentage (0%) of empty stomachs was observed in August and highest in December (45%). Shrimps were absent in the stomachs of length class 9.6 to 11.5 cm while squids were absent in the stomachs of length class smaller than 13.5 cm. Relative importance of food items is presented.

INTRODUCTION

The study of diet based on stomach analysis is a routine practice in fish ecology (Hyslop 1980). Amongst others, it assists in describing the ecological role of species in a biotic community and is useful in discussing predator-prey relationships, aquaculture, nutrition and management.

Information on the food and feeding habits of the most widely distributed species, *Nemipterus japonicus* was given by Kuthalingam (1969) and Krishnamoorthi (1971), and on *N. tolu* by Said *et al.* (1983).

The purpose of this paper is to document the quantitative and qualitative estimations of food and feeding habits of *N. peronii* in relation to month, length-classes and sex from Malaysia.

MATERIALS AND METHODS

Collection of Specimens

Specimens were collected by trawl from the inner-shelf region (Subarea I) and the mid-shelf region (Subarea II) off the north-eastern coast of Malaysia (Fig. 1). Samples were collected every month from July 1982 to June 1983. During each sampling, a minimum of 20 specimens were taken and kept frozen. In the laboratory, after recording the weight and length of each specimen, the belly was slit open, the stomach removed, and the feeding intensity (stomach fullness) assessed. The stomach was then preserved in 10% buffered formalin.

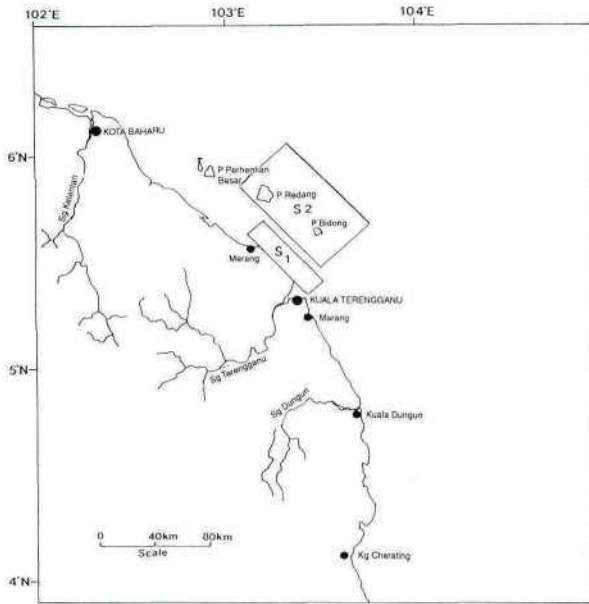


Fig.1: Map showing the study area
 1 = Subarea 1, S2 = Subarea 2

Analysis of Food Items

The formalin preserved stomachs were taken out, blotted dry with paper towel and cut open to remove the food items. The various food items were separated, weighed and identified.

The index of stomach fullness was estimated according to Frost (1946); the index of relative importance (RI_i) according to Windell (1971); the

percentage by weight according to Gibbons and Gee (1972); the frequency of occurrence (AI_i) according to Kennedy and Fitzmaurice (1972); the percentage by number according to Crisp *et al.* (1978), and the modifications of RI_i as suggested by George and Headley (1979), and Hyslop (1980).

RESULTS AND DISCUSSION

The results of the study on the food and feeding habits of *N. peronii* show that the food consists of five categories of items, namely, shrimps, fish, crabs, squids and miscellaneous. Among the species of fish identified in the stomachs were *Leiognathus elongatus*, *L. splendens*, *Upeneus sulphureus*, *U. vittatus*, *Nemipterus sp.*, *Trichiurus sp.*, *Selaroides leptolepis* and *Saurida sp.*. Shrimps as a food item constituted the highest in the average AI_i (38.8%), closely followed by fish (20.8%), crabs (19.2%), miscellaneous items (18.3%) and squids (4.6%). However, fish was highest in terms of weight composition (34.5%) (Tables 1 and 2). Table 2 gives the RI_i of the various food items in the diet of *N. peronii*. Shrimps appeared to have the highest value (35.7) followed by fish (26.3), crabs (18.9), miscellaneous items (15.1) and squids (4.0).

Sainsbury and Whitelaw (1984) have also reported that shrimps and fish were the main diets of *N. peronii* of the Northwest Shelf of Australia. The present observation on the qualitative

TABLE 1
 Monthly frequency of occurrence (AI_i), monthly composition by weight % (W) and by number % (N) of various food items in the stomach of *Nemipterus peronii*

Month	Fish			Shrimp			Crab			Squid			Misc		
	AI_i	W	N	AI_i	W	N	AI_i	W	N	AI_i	W	N	AI_i	W	N
July	35	58	36	45	21	33	35	19	25	10	2	6	0	0	0
August	35	55	39	30	13	35	20	5	17	10	27	9	0	0	0
September	50	91	76	40	7	22	0	0	0	5	2	2	0	0	0
October	25	32	5	40	28	32	50	33	48	0	0	0	20	7	16
November	25	38	11	60	50	71	15	9	8	0	0	0	20	3	11
December	20	9	4	20	28	32	20	58	50	0	0	0	15	6	14
January	5	1	3	20	36	63	5	9	3	0	0	0	45	54	30
February	10	23	11	15	2	17	25	19	39	0	0	0	30	51	33
March	10	30	13	60	47	47	25	14	25	0	0	0	25	9	16
April	15	19	13	40	42	50	20	13	19	10	20	7	15	5	11
May	5	25	5	45	66	73	5	2	5	10	3	9	10	5	9
June	15	33	5	50	11	29	10	7	9	10	10	7	40	43	50
Total	250	414	289	465	351	475	230	188	265	55	64	28	220	183	143
Mean	20.8	34.5	24.1	38.8	29.3	39.6	19.2	15.7	22.1	4.63	5.3	2.3	18.3	15.3	11.9

TABLE 2

Index of relative importance (RI_a) of the common food items in the diets of *Nemipterus peronii* during the study period

Item	Freq. Occ.	Weight	No.	RI_a
Fish	20.8	34.5	24.1	26.3
Shrimp	38.8	29.3	39.6	35.7
Crab	19.2	15.7	22.1	18.9
Squid	4.6	5.3	2.3	4.0
Miscellaneous	18.3	15.3	11.9	15.1

importance of the food of *N. peronii* is in agreement with the reports on other nemipterids. Kuthalingam (1969) reported that fish and shrimps were the two dominant items in the stomach of *N. japonicus* while, Krishnamoorthi (1971) noted *Squilla* was consumed throughout the year by the same species. Eggleston (1972) found that the diet of *N. japonicus*, *N. virgatus* and *N. bathybus* consisted mainly of crustaceans, fish and cephalopods.

Food by Month

The percentage of fish by weight was relatively higher from June to November whereas the percentage of shrimp was high from October to January and from March to May. The percentage of crab varied from 0 to 58% throughout the year. Squids were not recorded from October to March whilst miscellaneous food items were not recorded from the stomachs of *N. peronii* from July through to September (Table 1).

The percentage of fish occurrence by number was high from July to September while the percentage of shrimp was relatively high throughout the year. The percentage of crabs varied from month to month while that of squids was relatively low. Shrimps ranked first in occurrence followed by fish, crabs, miscellaneous items and squids.

The percentage of empty stomachs varied considerably during the study period (Fig. 2). The lowest percentage was in August (0%) when all the fish had full stomachs. The highest percentage of empty stomachs was in December (45%). The mean percentage of empty stomachs for the study period was 21.3%. Analysis of feeding intensity showed that 44.2% of all fish had full stomachs; 8.8% were 3/4-full and 21.7% were empty (Fig. 3).

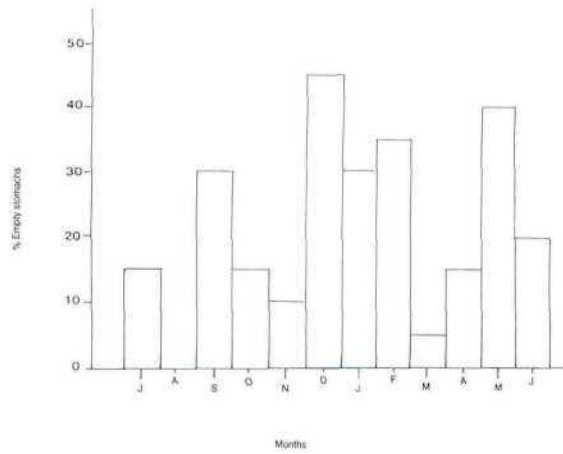


Fig. 2: Monthly variation of the percentage of empty stomachs in *Nemipterus peronii*

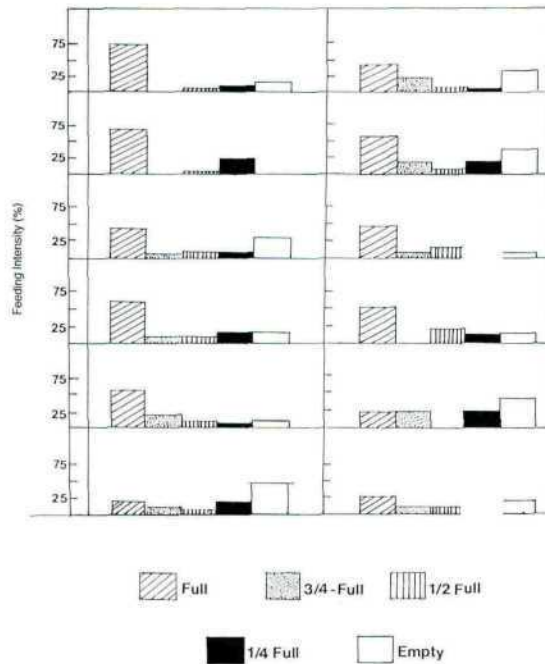


Fig.3: Stomach fullness of *Nemipterus peronii* during the study period

Food by Length Classes

There seemed to be an increase in the percentage of fish consumed as length increased with an exception of the length class of 9.6 to 11.5 cm (Table 3). The high AI_a in the mentioned length class was due to its relatively small sample size ($n = 5$) (Figs. 4 and 5). Shrimps were not found in

TABLE 3

The frequency of occurrence (AI_i) of various food items in stomachs of different length classes of *Nemipterus peronii*

Length Class (cm)	Food Item (%)					Empty Stomach
	Fish	Shrimp	Crab	Squid	Misc.	
9.6 - 11.5	40	0	40	0	20	20.0
11.6 - 13.5	13	41	28	0	28	21.9
13.6 - 15.5	11	41	23	2	17	26.6
15.6 - 17.5	13	44	25	2	29	12.7
17.6 - 19.5	19	22	7	4	22	37.0
19.6 - 21.5	41	13	13	5	14	22.7
>21.6	50	67	33	17	17	0

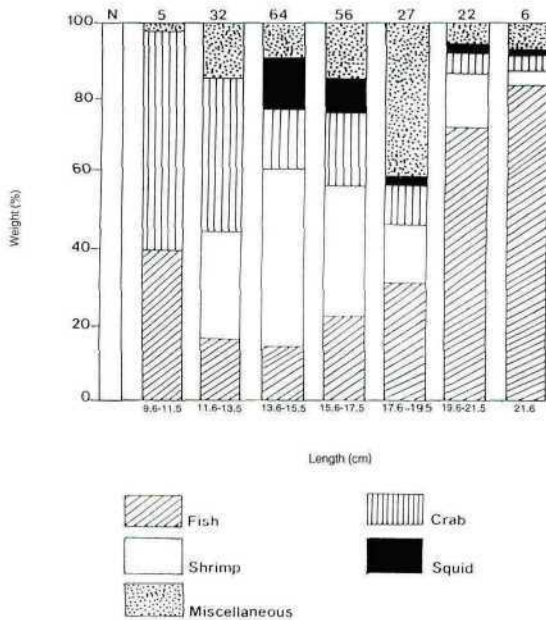


Fig. 4: The weight composition (%) of various food items in different length classes of *Nemipterus peronii*

the stomachs of fish in length class 9.6 to 11.5 cm, presumably due to the above reason. However, shrimps were predominant in the stomachs of other length classes implying that shrimps were abundant in the environment and were available throughout the year. Squids were not recorded in fish smaller than 13.5 cm but a steady increase in percentage was observed with increasing size of fish. The incidence of miscellaneous items in

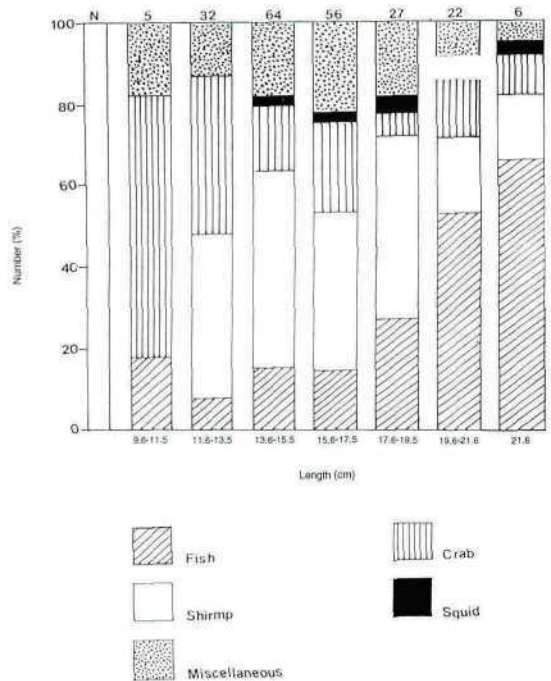


Fig. 5: The percentage by number of various food items in different lengths of *Nemipterus peronii*

the stomachs was high for all length classes with values ranging from 17 to 29% (Table 3).

The food composition of fish by weight increased with the increasing fish length with the exception of the length class 9.6 to 11.5 cm (Fig. 4). The percentage of fish consumed ranged from the lowest 14.7% to the highest 84.1% for length classes of 13.6 - 15.5 and >21.6 cm, respectively. The weight compositions of both crabs and shrimps decreased with increasing fish size. The percentage composition of crabs was high at length class of 9.6 - 11.5 (58.9%) but decreased progressively until it reached only 3.7% at length class larger than 21.6 cm. The composition of squids among the food items was relatively low for all the length classes. Values ranged from 1.2% to 12.8%. The composition for miscellaneous food items was low for all sizes except in length class of 17.6 to 19.5 (41.1%).

Stomachs of *N. peronii* in the upper length classes have a much higher percentage composition by number of fish than the stomachs in the lower length classes (Fig. 5). The range in composition of fish items by number varied from 8.5 to 66.7%. The composition by number of shrimps

in the stomachs showed relatively high values (22.0 to 40.6%) for length classes of between 11.6 - 13.5 cm and 17.6 - 19.5 cm. In terms of number, squid accounted for a low percentage for all length classes; and variation between the length classes was also small. A lower percentage composition by number was common in larger size fish.

The number of prey items in the stomach varied for all length classes. The average number per stomach was small, ranging from 1.1 to 2.2 for fish in length classes between 9.7 and 21.5 cm. However, length classes larger than 21.6 cm were recorded to have an exceptionally high average of 8 items per stomach.

The percentage of empty stomachs for all length classes ranged from 0 to 37%. The stomachs of fish larger than 21.6 cm were never found empty. However, the occurrence of 'full-stomach (4/4)' was always found to be the highest in all seven length classes (Table 4).

The results of the analysis on the food taken by different length classes suggest that fish were favoured by higher length classes while shrimps were preferred by the lower length classes (Table 3).

Food by Sex

The composition of fish in the diet was only recorded from male and female samples because the diet of juvenile samples (indiscriminates) did not include any fish (Table 6). The occurrence of fish in the diet of male and female samples was found to be about equal in percentage. Squids were recorded most in the juveniles (Table 6).

TABLE 4

The stomach fullness and the percentage of empty Stomachs in different length classes of *Nemipterus peronii*

length class (cm)	feeding intensity (%)				
	3/4	1/2	1/4	empty	
	full	full	full	full	stomach
9.6 - 11.5	60.0	20.0	0	0	20.0
11.6 - 13.5	49.6	15.6	6.2	9.4	21.9
13.6 - 15.5	48.4	6.2	10.9	7.8	26.6
15.6 - 17.5	39.3	12.5	14.3	21.4	12.5
17.6 - 19.5	33.3	7.4	7.4	14.8	37.0
19.6 - 21.5	45.5	0	9.2	22.7	22.7
>21.6	66.7	0	16.7	16.7	0

TABLE 5

Index of relative importance (RI_i) of the common food item in the diet of *Nemipterus peronii* by length classes

length class	item	percentage (%)			
		freq.	occ.	weight	no. RI _i
9.7 -11.5	fish	40.0	39.8	18.2	32.7
	shrimp	0	0	0	0
	crab	40	58.9	63.6	54.2
	squid	0	0	0	0
	miscellaneous	20.0	1.3	18.2	13.2
11.6 -13.5	fish	12.5	16.7	8.5	14.7
	shrimp	40.6	28.4	40.8	42.9
	crab	29.1	41.3	38.0	42.2
	squid	1.6	0	0	0
	miscellaneous	28.1	13.7	12.7	21.3
13.6 -15.5	fish	10.9	14.7	16.2	16.8
	shrimp	40.6	45.5	47.8	53.7
	crab	23.4	16.2	16.5	22.5
	squid	1.6	13.8	2.0	7.0
	miscellaneous	17.2	9.8	17.5	17.9
15.6 -17.5	fish	12.5	22.5	14.7	20.6
	shrimp	33.9	32.8	38.7	43.6
	crab	25.0	20.4	22.7	28.2
	squid	1.8	14.1	2.6	7.7
	miscellaneous	28.6	14.1	21.3	26.5
17.6 -19.5	fish	18.5	30.7	27.5	28.0
	shrimp	22.0	14.5	44.8	29.7
	crab	7.4	10.4	6.9	9.0
	squid	3.7	3.3	3.8	4.0
	miscellaneous	22.0	41.1	17.2	29.3
19.6 -21.5	fish	40.9	71.6	53.1	56.5
	shrimp	12.0	15.0	18.8	15.6
	crab	12.0	16.1	15.6	14.9
	squid	4.6	3.3	3.1	3.8
	miscellaneous	13.6	4.0	9.4	9.2
>21.6	fish	50.0	84.1	66.7	52.3
	shrimp	66.7	3.7	17.7	23.0
	crab	33.3	3.7	9.8	12.2
	squid	16.7	1.2	1.9	5.2
	miscellaneous	16.7	7.6	3.9	7.4

TABLE 6

Percentage frequency of occurrence (AI_a), weight composition % (W), and composition by number (N) of various food items in the stomachs of males, females and indeterminates *Nemipterus peronii*

item	percentage (%)								
	male			female			indeterminate		
	AI_a	W	N	AI_a	W	N	AI_a	W	N
fish	18.7	57.1	30.5	16.2	26.1	22.5	0	0	0
shrimp	32.7	12.7	32.0	36.2	36.2	41.3	58.2	31.1	31.9
crab	22.4	12.8	21.8	23.8	18.0	21.8	49.1	45.4	59.2
squid	2.8	9.7	3.0	1.9	1.9	2.0	9.1	3.4	3.0
miscellaneous	20.6	7.8	12.8	23.8	17.8	12.9	5.5	20.2	5.9

TABLE 7

Index of relative importance (RI_a) of the food items in the diets of *Nemipterus peronii* by sex

item	male				female				juvenile			
	freq. occ.	wt.	no.	RI_a	freq. occ.	wt.	no.	RI_a	freq. occ.	wt.	no.	RI_a
fish	18.7	57.1	30.5	35.0	16.2	26.1	22.5	21.8	0	0	0	0
shrimp	32.7	12.7	32.0	26.1	36.2	36.2	41.3	26.8	58.2	31.9	31.9	37.6
crab	22.4	12.8	21.8	19.2	23.8	18.0	21.8	19.2	49.1	45.4	59.2	47.7
squid	2.8	9.7	3.0	5.2	1.9	1.9	2.0	2.0	9.1	3.4	3.0	4.8
miscellaneous	20.6	7.8	12.8	13.9	23.8	17.8	12.9	18.3	5.5	20.2	5.9	9.8

The occurrence of miscellaneous items in males and females was about four times higher than that in the juveniles. The percentage AI_a showed that all the food items occurred equally in males and females. However, shrimps and crab predominated in the food of juveniles.

The juveniles were found to consume about three times more crabs than the female and male fish. The AI_a of squids in the diet of juvenile samples was highest followed by male and female samples. However, males consumed comparatively larger squids judging by the weight composition which was highest in males by contrast with the indeterminate and female samples. The weight composition of miscellaneous was highest in juveniles, followed by females and males (Table 6). The number of crabs in the stomach was found to be about three times higher in juveniles than in male and female fish.

The various categories of feeding intensity (stomach fullness) for male, female and indeterminate specimens are presented in Fig. 6. The juveniles were observed to have full stomachs during the study period.

The RI_a values for all the food items in the males and females indicated only a slight variation particularly in the shrimps and fish; the former accounted for 26.1 in males and 36.8 in females, while the later accounted for 35.8 and 21.8 in males and females respectively (Table 7).

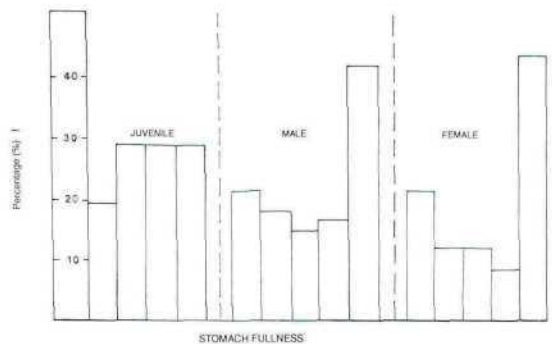


Fig. 6: Stomach fullness of juvenile, male and female *Nemipterus peronii*

The nature of the diet of *N. peronii* suggests that it is a voracious carnivore, feeding on motile organisms. The position of the mouth and nature of the gill rakers support this view.

ACKNOWLEDGEMENTS

We would like to thank Universiti Pertanian Malaysia for the research funding and facilities for carrying out the study. Thanks are also due to Ms. Fauziah Ahmad for typing the manuscript.

REFERENCES

CRISP, D.T., R.H.K. MANN and J.C. MECORMACK. 1978. The effects of impoundment and regulation upon the stomach contents of fish at Cow Green, Upper Teesdale. *J. Fish Biol.* **12**: 287-301.

EGGLESTON, 1972. Patterns of biology in the Nemipteridae. *J. Mar. Biol. Ass. India.* **14**(1): 357-364.

FROST, W.E. 1946. On the food relationships of the fish in Windermere. *Biol. Jaarb.* **13**: 216-231.

GEORGE, E.L. and W.F. HEADLEY. 1979. Food and habitat partitioning between rock bass (*Ambloplites rupestris*) and smallmouth bass (*Micropterus dolomieu*) young of the year. *Trans. Am. Fish. Soc.* **108**: 253-261.

GIBBONS, J.R.H. and J.H. GEE. 1972. Ecological segregation between longnose and blacknose dace (*Rhinichthys*) in the Mink River, Manitoba, *J. Fish. Res. Bd. Can.* **29**: 1245-1252.

HYSLOP, E.J. 1980. Stomach contents analysis - a review of methods and their application. *J. Fish Biol.* **17**: 411-429.

KENNEDY, M. and P. FITZMAURICE. 1972. Some aspects of the biology of gudgeon, *Gobio gobio* (L.) in Irish waters. *J. Fish Biol.* **4**: 425-440.

KRISHNAMOORTHY, B. 1971. Biology of threadfin bream, *Nemipterus japonicus* (Bloch). *Indian J. Fish.* **18**(1 & 2) : 1-21.

KUTHALINGAM, M.D.K. 1969. Notes on some aspects of the fishery and biology of *Nemipterus japonicus* (Bloch) with special reference to feeding behavior. *Indian J. Fish.* **12**(2): 500-505.

SAID, M.Z.M., M.A. AMBAK and A.K.M. MOHSIN. 1983. Some aspect of the fishery and biology of *Nemipterus tolu* (Cuv. & Val.) off the Terengganu Coast, South China Sea. *Pertanika* **6**(2): 108-111.

SAINSBURY, K.J. and A.W. WHITELAW. 1984. Biology of Peron's threadfin bream, *Nemipterus peronii* (Valenciennes) from the North West Shelf of Australia. *Aust. J. Mar. Fresh. Res.* **35**: 167-85.

Windell, J.T. 1971. Food analysis and rate of digestion. In *Methods for assessment of fish production in freshwaters*, ed. W.E. Ricker, IBP Handbook 3. Oxford, England: Blackwell.

(Received 22 January 1993)