Bull. Inst. Zool., Academia Sinica 8: 71-77 (1969)

STOMACH CONTENTS ANALYSIS OF SOME INTERTIDAL FISHES OF TAIWAN

KUN-HSIUNG CHANG AND SIN-CHE LEE*

Received for publication

ABSTRACT

Analyses were made on the stomach contents of 2203 specimens representing 75 species of fishes obtained from the tide pools of Patoutzu and Maopitou from March to December, 1969. Classification of the types of food habits of the fishes by using the percentage of the occurrence of food organism in the stomach of young fishes or the juvenils was found to be difficult.

INTRODUCTION

An ecological study on some intertidal fishes collected at Patoutzu and Maopitou from March to December, 1969, had been reported in a previous paper**. In order to know the trophic relation and food niches of intertidal community, the stomach contents of these fishes were also examined. A survey of the stomach contents of fishes is important in investigating the feeding habits as well as the ecological and physiological relation among different species of fish.

MATERIALS AND METHODS

Stomach analysis was carried out soon after the identification of the fishes and measurements of their body lengths were made. Before examining, the stomachs were carefully dissected, and the stomach content of each specimen was picked out thoroughly and put into a Petri dish and washed. Then, the food organisms of each specimen were identified (Utinomi, 1961; Yamaji, 1959 and 1966).

Further, the stomach contents were made in details from the species to obtain the percentages of the occurrences of food organisms of 19 species from Patouzu and 18 species from Maopitou which had more than 10 individuals were calculated according to the following formula:-

$$\frac{\text{Number of fish feeding on a particular food organisms}}{\text{Number of surveyed fish}} \times 100$$

In making this calculation, it must be understood that the quantity of the fed organism is not taken into consideration; it considers only whether the said organism was fed on by the fish or not. (Yasuda, a, 1960).

The obtained percentages were represented by the following marks: "+" for less than 10%, "++" for percentages ranged from 10-50%, and "+++" for greater than 50%.

RESULTS

The qualitative data of the stomach

* Institute of Zoology, Academia Sinica, Taipei, Taiwan, Republic of China.

** A preliminary report of ecological study on some intertidal fishes of Taiwan.

contents of 75 species of the fishes are listed in the following:

Species name	No. of indiv.	Body length (mm.)	Stomach contents
Echidna polyzona	1	436	Crabs
E. nebulosa	8	91–356	Crabs, megalopa
Gymnothorax fimbriatus	2	141–154	Fishes
Atherion elymus	308	17–58	Tanaidacea, amphipoda, ostracoda, isopoda, copepoda, insect larvae, foraminifera, diatoms
Lepadichthys frenatus	8	43–71	Cephalopoda, mysidacea
Histrio histrio	10	11–20	Fishes, isopoda, diatoms
Rhineacanthus aculeatus	2	26–53	Copepoda
Arothron hispidus	25	13–70	Crabs, copepoda, sheil larvae, sea weeds
A. meleagris	9	11–17	Tanaidacea, copepoda, sea weeds
Canthigaster valentini	2	23–31	Amphipoda, sea weeds
Diodon holacanthus	5	97–183	Crabs, shells, sea weeds
Scorpaenodes guamensis	31	29–93	Fishes, shrimps, crabs, amphipoda, ostracoda
Synanceia verrucosa	3	71–84	Fishes, shrimps, sea weeds
Mugil tade	39	16–45	Mysidacea, amphipoda, ostracoda, copepoda, shell larvae, fish eggs, sea weeds, diatoms
M. kelaartii	1	60	Diatoms
Liza macrolepis	232	18–114	Fishes, amphipoda, ostracoda, isopoda, copepoda, insect larvae, sea weeds, diatoms
L. parva	8	17-34	Megalopa, amphipoda, copepoda, sea weeds, diatoms
Crenimugil crenilabis	60	26–72	Copepoda, diatoms
Platax orbicularis	2	26–34	Amphipoda
Chaetodon vagabundus	8	20–45	Polychaeta, copepoda, sea weeds
C. lunula	1	40	Polychaeta
C. auriga	2	26–30	Diatoms
C. collare	2	42–72	Mysidacea, copepoda
Pomacanthus semicirculatus	14	13–62	Sea weeds, diatoms
Microcanthus strigatus	100	17–46	Fishes, polychaeta, mysidacea, amphipoda, ostracoda, isopoda, copepoda, shell larvae, fish eggs, sea weeds, diatoms
Abudefduf saxatilis	229	12–57	Shrimps, polychaeta, stomatopoda, mysidacea, tanaidacea, megalopa, amphipoda, ostracoda, isopoda, copepoda, insect larvae, shrimp larvae, fish eggs, sea weeds, diatoms
A. sordidus	52	14–59	Polychaeta, amphipoda, ostracoda, isopoda, copepoda, insect larvae, fish eggs
A. septemfasciatus	36	18–84	Polychaeta, mysidacea, amphipoda, copepoda, shrimp larvae, sea weeds, diatoms
A. sexfasciatus	8	18–57	Fishes, mysidacea, tanaidacea, ostracoda, copepoda, sea weeds
A. biocellatus	34	15–65	Polychaeta, mysidacea, copepoda, sea weeds, diatoms

Pomacentrus coelestis	9	19–29	Copepoda, fish eggs, sea weeds, diatoms
Pempheris sp.	113	16–50	Mysidacea, megalopa, amphipoda, copepoda, shrimp larvae, fish eggs
Upeneus sulphureus	10	27–46	Megalopa, amphipoda, isopoda, copepoda
Apogon doederleini	43	15–80	Fishes, shrimps, crabs, megalopa, amphipoda, copepoda, insect larvae.
A. lineatus	3	27–43	Shrimp larvae
Girella melanichthys	92	22–52	Fishes, amphipoda, ostracoda, isopoda, copepoda, shell larvae, sea weeds, diatoms
G. mezena	3	50–73	Sea weeds, diatoms
Grammistes sexlineatus	2	29–71	Shrimps
Epinephelus caeruleopunctatus	40	20–160	Fishes, shrimps, crabs, mysidacea, megalopa. amphipoda, copepoda, shrimp larvae.
E. merra	2	31–112	Fishes, shrimps, crabs
E. fario	2	162–215	Crabs
Plesiops melas	6	34–67	Shrimps, megalopa, amphipoda, shrimp larvae
Dampieria spiloptera	6	34–54	Shrimps, crabs, amphipoda, copepoda
Lutjanus russelli	29	16–118	Fishes, shrimps, crabs, shells, mysidacea, tanaidacea, amphipoda, copepoda, sea weeds
L. vitta	2	22	Fishes, copepoda
Scolopsis cancellatus	4	19–64	Mysidacea, ostracoda
Terapon jarbua	1	31	Shrimps
Tripterygion etheostoma	15	30–44	Crabs, shells, tanaidacea, amphipoda, isopoda, copepoda, insect larvae, shell larvae
Omobranchus trossulus	4	25–47	Diatoms
O. sp.	21	27–58	Copepoda, sea weeds, diatoms
Istiblennius edentulus	18	50–108	Copepoda, diatoms
I. andamensis	2	57–83	Sea weeds, diatoms
Halmablennius lineatus	18	36–94	Copepoda, sea weeds, diatoms
H. striatomaculatus	5	48–68	Diatoms
Eleotris fusca	4	21–27	Shells
Asterropteryx semipunctatus	151	18–57	Shrimps, crabs, shells, mysidacea, tanaidacea, amphipoda, copepoda, shrimp larvae, shell larvae, foraminifera, sea weeds, diatoms
Eviota abax	7	19–62	Shells, amphipoda, copepoda, diatoms
Bathygobius fuscus	146	19–77	Fishes, shrimps, crabs, shells, polychaeta, mysidacea, megalopa, amphipoda, isopoda, copepoda, insect larvae, sea weeds, diatoms
Acentrogobius campbelli	25	39–74	Polychaeta, shells, tanaidacea, amphipoda, isopoda, copepoda, shell larvae, fish eggs, sea weeds, diatoms
A. ornatus	7	21–56	Tanaidacea, amphipoda, ostracoda, copepoda, insect larvae, sea weeds, diatoms
Zonogobius semidoliatus	9	18–32	Mysidacea, amphipoda, copepoda

Pipidonia arenarius	9	30–37	Shrimps, amphipoda, copepoda
Gnatholepis knighti	3	37–50	Copepoda, diatoms
Stethojulis strigiventer	40	18–63	Polychaeta, tanaidacea, amphipoda, ostracoda, isopoda, copepoda, shell larvae, diatoms
S. axillaris	18	31–72	Polychaeta, amphipoda, copepoda, shell larvae, diatoms
S. phekadopleura	37	18–95	Polychaeta, tanaidacea, amphipoda, ostracoda, copepoda, insect larvae, diatoms
S. kalosoma	21	35–72	Shells, amphipoda, copepoda, diatoms
Halichoeres marginatus	2	61–63	Amphipoda, copepoda, diatoms
H. margaritaceus	4	30–36	Megalopa, copepoda
H. trimaculatus	2	68–95	Crabs
H. melanochir	6	26–70	Shells, stomatopoda, amphipoda, copepoda, fish eggs, sea weeds
Thalassoma hardwicke	1	94	Shrimps
Leptoscarus vaigiensis	5	57–112	Sea weeds, diatoms
Acanthurus triostegus	7	21–44	Sea weeds, diatoms
Prionurus microlepidotus	7	29–45	Sea weeds

Notably, as shown in Table 1 and Table 2, the percentages of the occurrence of food organism in 37 species of the fishes indicated that almost all of the fishes fed on planktons. Among them copepoda, amphipoda, isopoda, ostracoda, diatoms and sea weeds were fed most abundantly. A few species of fishes also fed on other fishes, shrimps, crabs and polychaeta.

TABLE 1

The occurrence of food organisms in the stomach of the intertidal fishes of Paotoutzu

Species name	No. of fishes	Range of body (mm.) length	Fishes	Cephalopoda	Shrimps	Crabs	Polychaeta	Shells	Stomatopoda	Mysidacea	Tanaidacea	Megalopa	Amphipoda	Ostracoda	Isopoda	Copepoda	Insect larvae	Shrimp larvae	Shell larvae	Foraminifera	Fish eggs	Sea weeds	Diatoms
Atherion elymus	171	28–58												+		++				+			++
Arothron hispidus	23	13–16				+										+			+			++	
Crenimugil crenilabis	30	26–42																					++
Pomacanthus semicirculatus	13	13–41																				+++	+
Microcanthus scrigatus	100	17–46	+				+			+			++	+	+	+++			+		+	++	+
Abudefduf saxatilis	159	12–57								+	+	+	+	+		+++	+	+			+	+++	++
A. sordidus	36	14–55											+	+	+	+++					+	+++	+
A. septemfasciatus	10	19-46											+			+++						+++	
Apogon doederleini	16	21–44			++	++						++				++							
Girella melanichthys	92	22–52	+							+			+	+	+	+++			+			+++	++
Epinephelus caeruleopunctatus	40	20–60	++		++	+				+		+	+			+							
Lutjanus russelli	27	16–76	++		+	+		+		+	+		+			++						+	
Tripterygion etheostoma	15	30–44						++			++		++		++	+++	++		+				
Omobranchus formosana	21	27–58														++						++	++
Asterropteryx semipunctatus	103	18–57			+	+	+	+		+			+			+++			+			++	++
Bathygobius fuscus	69	26–77	+		+	++	+			+		+	+			++						++	+
Acentrogobius campbelli	25	39–74					+	++			+		++		+	+++			++		+	++	++
Stethojulis strigiventer	30	18-63											+	+		+++			+				
S. kalosoma	21	35–72						+					+			+++							+

Note: + less than 10% ++ between 10–50% +++ more than 50%

TABLE 2

The occurrence of food organisms in the stomach of the intertidal fishes of Maopitou

Species name / Range of body length (mm.) / No. of fishes / Food organisms	No. of fishes	Range of body length (mm.)	Fishes	Cephalopoda	Shrimps	Crabs	Polychaeta	Shells	Stomatopoda	Mysidacea	Tanaidacea	Megalopa	Amphipoda	Ostracoda	Isopoda	Copepoda	Insect larvae	Shrimp larvae	Shell larvae	Foraminifera	Fish eggs	Sea weeds	Diatoms
Atherion elymus	137	17–40									++		+	+	+	++	++			+			++
Scorpaenodes guamensis	31	29–93	+		++	++							+		+								
Mugil tade	39	16–45								+			+	+		++		+	+		++	+	++
Liza macrolepis	229	18–114	+										++	+	+	++	+					++	+++
Crenimugil crenilabis	30	28–72														+							+++
Abudefduf saxatilis	70	15–53			+		++		+	+			+	+	+			+				++	++
A. sordidus	16	16–59					+						++	+	+	++	+					+++	+++
A. septemfasciatus	26	18–84					+			+					+	++		+				+++	++
A. biocellatus	34	15–65					+			+						++						+++	+++
Pempheris nyctereutes	104	16–50								+	+	+		+	+	+++		+					+
Apogon doederleini	27	15–80	+		+	+						+	+			++	+						
Istiblennius edentulus	17	50–108														+							+++
Halmablennius lineatus	18	36–94														+						++	+++
Asterropteryx semipunctatus	48	18–40									+					++		+		+		+	+++
Bathygobius fuscus	77	19–62	+		+	+	+						+		+	+	+					++	+
Stethojulis strigiventer	10	21–43					+				++				++	+++							+
S. axillaris	18	31–72					+						++			+++				+			++
S. phekadopleura	36	18–95					+				++		++	+		+++	++						++

Note: + less than 10% ++ between 10–50% +++ more than 50%

DISCUSSION

From the results of the qualitative analysis of the stomach contents of 75 species of fishes listed above, we can see easily what kinds of food organisms are taken by the fishes. And, from Tables 1 and 2, we know not only the relative abundance of different food organisms but also the species of food organiams preferred by the fishes. Deducing from the results, the food niches of intertidal community of Patoutzu and Maopitou were found to be extremely similar to each other.

On the other hand, we also find the fact that it is difficult to classify the types of food habits of the fishes by using the percentage of the occurrence of food organisms in the stomach of young fishes or juvenils.

It might be true that the plankton-feeders, which usually feed on certain kinds of microplanktons, can not feed on much of macroplanktons or larger animals such as shrimps, crabs, polychaeta and other fishes. But the omnivorous and piscivorous (or carnivorous) fishes may feed on both planktons (micro and macro) and larger animals, and the younger omnivorous or piscivorous fishes feed on smaller food organisms.

REFERENCES

1. UTINOMI, H. 1961 *Coloured illustrations of sea shore animals of Japan*. Hoikusha, Japan.
2. YAMAJI, I. 1959 *The plankton of Japanese coastal waters*. Hoikusha, Japan.
3. _____ 1966 *Illustrations of the marine plankton of Japan*. Hoikusha, Japan.
4. YASUDA, F. 1960a The types of food habits of fishes assured by stomach contents examination. *Bull. Jap. Soc. Sci. Fish.* 26(7): 653-662.
5. YASUDA, F. 1960b The relationship of the gill structure and food habits of some coastal fishes in Japan. *Rec. Oceanogr. Works Jap.* 5(2): 139-152.