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5. Notes on the Esophagus- and Stomach-Contents of *Nautilus pompilius* in Fiji

by

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During the field study on the habitat of *Nautilus* in Fiji in 1983 the writers were engaged in the analysis of esophagus and stomach contents of *Nautilus*. Understanding the feeding habit of *Nautilus* seems to be important to consider the ecology of them in relation to the results of studies from the other points of view, such as the statistical analysis of the relation between *Nautilus* and its associated fauna (SHINOMIYA *et al.*, 1985), visual (KAKINUMA and TSUKAHARA, 1985) and photographic (HATTORI *et al.*, 1985) observation of the feeding behavior of *Nautilus* in captivity and in nature.

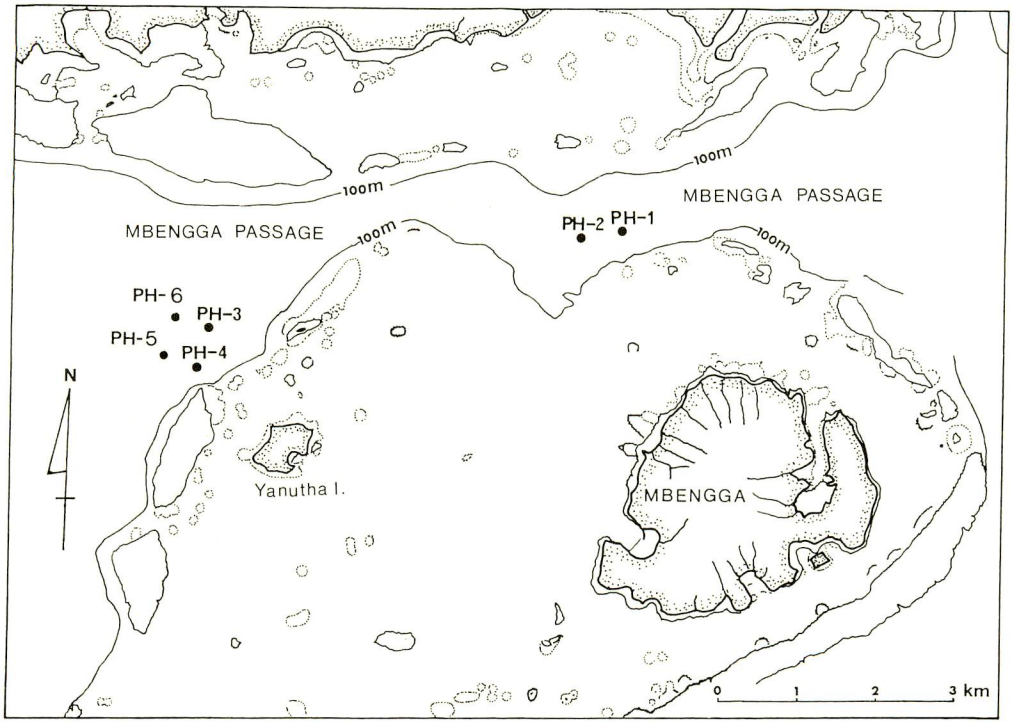

Fig. 1. Map showing the sampling locations of *Nautilus pompilius* and submarine topography of the Mbengga Passage, Viti Levu, Fiji.

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Materials and Methods

Among the *Nautilus* specimens collected early in September at the stations (PH-1~6) in the Mbengga Passage, south of Viti Levu, Fiji (Fig. 1), 34 specimens were dissected shortly after capture to take out the digestive organ (esophagus and stomach), which were preserved in formalin (20 %), and the contents of them were inspected. For trapping *Nautilus,* frozen whole bodies of sardine were used as bait. The depths of trapping stations were around 340 m.

Results

The weight of the esophagus contents ranges from 61.59 g in maximum to null and the average of the 34 specimens were 24.71 g. The weight of the stomach contents ranges from 6.60 g in maximum to 1.03 g in minimum and was 2.3 g in average. The esophagus contents are heavier than total weight of stomach and kept indigested and therefore easy to inspect, while the stomach contens are usually well digested and rather hard to inspect.

In the esophagus and stomach, meat chips of the bait fish were found most abundantly. Other than the bait fish, meat chips of shrimps (Pl. 24, figs. 5-7), small pieces of crab carapace (Pl. 24, fig. 8), unknown species of small fish(Pl. 24, figs. 1 and 2), nematodes (Pl. 24, fig. 3) and fragment of *Nautilus* tentacle (Pl. 24, fig. 4) were found (Table 1). Crustaceans were found from 15 specimens of *Nautilus* among 34. Meat chips of small fish were found from 12 specimens among 34. Nematodes were found from 2 specimens and the tentacle of *Nautilus* were from 2 specimens.

Consideration

On the feeding behavior or the feeding habit of *Nautilus,* many things are still remained unsolved. It has been well-known, however, that they are undoubtedly carnivore having a preference for shrimps, fishes, and even chickens and frogs (HAYASAKA *et al.*, 1982). Through the observation on the feeding behavior in captivity (KAKINUMA *et al.,* 1983, KAKINUMA and TSUKAHARA, 1985), the most favorite food for *Nautilus* has been known to be shrimps and fishes. This seems to well coincide with the results of the writers' analysis mentioned above.

Accórding to the statistical study on the coexistence of *Nautilus* and shrimps carried out in the present project (SHINOMIYA *et al.*, 1985), a shrimp species *Heterocarpus sibogae* has the closest relation with *Nautilus* among its associated fauna. Moreover, by the underwater camera works carried out by HATTORI *et al.* (1985) as a part of the present project, an individual of *Nautilus* clinging to several shrimps gathering around the bait was clearly photographed. From the foregoing data, it may be reasonably concluded that nautili are feeding on the benthic animals including shrimps.

It has been known that the deep sea carnivores used to eat much so that they may go without foods for some while, because of the scarcity of biomass near the deep sea bottom. One of the *Nautilus* specimens examined had the esophagus contents weighing 61.59 g and the stomach contents weighing 3.63 g. The total of these weights (65.22 g) attains to 12.7 % of the body weight of this animal. The average body weight of 34 specimens is 464 g and the esophagus and stomach contents are 24.71 g and 2.32 g, respectively, in average weight (about 5.4 % of the average body weight). Most of the foods eaten by the animal seem to be kept in esophagus and digested by

Table 1. Weight and composition of the stomach-and esophagus-contents of *Nautilus pompilius*.

	Specimen number	Date	Station number	Body weight (g)	Shell diameter	Sex	Stomach weight (g)	Stomach contents weight (g)	Esophagus weight (g)	Esophagus contents weight (g)	Composition of stomach and esophagus contents: Crustacea	Small fish	Nematoda	Tentacles of Nautilus	Bait fish
1	PH1-1	Sept.21	PH-1	477	141.1	♂	3.61	2.13	1.95	40.68	+	+	-	-	+++
2	PH1-2	Sept.21	PH-1	425	136.6	♂	4.61	4.31	2.07	7.45	-	+	-	-	++
3	PH3-3	Sept.21	PH-3	540	145.8	♂	4.43	6.60	2.25	29.94	+	+	-	-	+++
4	PH3-1	Sept.21	PH-3	365	131.4	♂	3.19	1.12	1.59	0	-	-	-	-	+
5	PH3-2	Sept.21	PH-3	435	136.6	♂	3.76	3.45	2.41	36.19	-	-	-	-	+++
6	PH3-4	Sept.21	PH-3	475	142.6	♂	3.44	1.99	1.93	31.72	+	+	-	-	+++
7	PH3-8	Sept.21	PH-3	475	142.2	♂	3.40	2.72	2.15	3.98	-	-	-	-	+
8	PH3-9	Sept.21	PH-3	470	140.5	♂	3.91	2.30	2.01	20.01	-	+	-	-	++
9	PH3-10	Sept.21	PH-3	405	137.6	♂	2.69	2.76	1.90	2.26	-	-	-	-	+
10	PH3-13	Sept.21	PH-3	510	147.4	♂	3.07	2.48	2.35	0	-	-	-	-	+
11	PH4-1	Sept.21	PH-4	515	141.0	♂	3.63	3.18	2.63	61.59	-	-	-	-	+++
12	PH4-2	Sept.21	PH-4	380	130.9	♂	3.20	1.19	1.85	17.89	+	-	-	-	++
13	PH4-3	Sept.21	PH-4	480	142.9	♂	3.74	1.03	2.01	4.83	-	+	-	-	+
14	PH4-4	Sept.21	PH-4	365	127.5	♂	2.98	3.21	1.73	17.66	+	-	-	-	++
15	PH4-5	Sept.21	PH-4	470	139.3	♂	3.17	2.18	2.83	29.90	+	-	-	+	+++
16	PH4-6	Sept.21	PH-4	577	140.2	♂	3.61	4.41	2.30	22.31	+	-	+	-	++
17	PH4-7	Sept.21	PH-4	517	144.5	♂	3.06	3.98	2.41	51.31	-	-	-	-	+++
18	PH4-8	Sept.21	PH-4	470	138.3	♂	3.40	2.09	2.06	37.20	-	-	-	+	+++
19	PH4-9	Sept.21	PH-4	437	138.9	♀	2.64	2.03	2.26	31.08	-	-	-	-	+++
20	PH4-10	Sept.21	PH-4	467	135.4	♂	3.10	2.13	2.11	55.68	+	+	-	-	+++
21	PH4-13	Sept.21	PH-4	505	143.4	♂	3.94	6.60	2.50	31.47	+	-	+	-	+++
22	PH4-14	Sept.21	PH-4	455	140.4	♂	3.25	1.32	1.89	23.35	-	+	-	-	++
23	PH4-15	Sept.21	PH-4	275	113.5	♂	1.88	1.74	1.02	32.55	-	-	-	-	+++
24	PH4-16	Sept.21	PH-4	338	126.8	♀	2.17	1.54	1.48	1.20	+	-	-	-	+
25	PH5-4	Sept.22	PH-5	536	145.4	♂	3.00	1.49	3.63	39.14	+	-	-	-	+++
26	PH5-9	Sept.22	PH-5	546	143.8	♂	3.16	0.82	3.28	44.89	+	+	-	-	+++
27	PH6-2	Sept.22	PH-6	469	144.8	♂	2.86	0.89	2.63	0.98	-	-	-	-	+
28	PH6-3	Sept.22	PH-6	466	138.2	♂	3.42	1.38	2.28	33.89	-	-	-	-	+++
29	PH6-5	Sept.22	PH-6	422	137.6	♀	2.79	2.00	2.51	32.77	+	-	-	-	+++
30	PH6-6	Sept.22	PH-6	553	147.9	♂	3.89	2.03	2.69	10.76	+	+	-	-	++
31	PH6-11	Sept.22	PH-6	478	141.8	♂	4.16	0.89	2.33	31.91	+	+	-	-	+++
32	PH6-15	Sept.22	PH-6	517	150.7	♂	3.44	4.97	2.56	3.75	-	+	-	-	+
33	PH6-19	Sept.22	PH-6	504	142.9	♂	3.07	1.66	2.41	27.36	-	-	-	-	++
34	PH6-7	Sept.22	PH-6	476	141.5	♀	3.12	1.21	2.57	41.63	-	-	-	-	+++

stomach little by little. This results in the smaller amount of the stomach contents (2.32 g in average) than the esophagus ones (24.71 g). In the contents of digestive organs, two pieces of *Nautilus* tentacle were found. This suggests that the animal ate its own tentacle catching food when pushing the food into mouth by tenltacls.

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Explanation of Plate 24

Fig. 1. Muscles of unknown small fish.
Fig. 2. Muscles of unknown small fish.
Fig. 3. A nematoda.
Fig. 4. Fragments of tentacles of *Nautilus*.
Fig. 5. Fragments of appendages and mouth-part of shrimp.
Fig. 6. Fragments of shell and muscles of shrimp.
Fig. 7. Fragments of shell and muscles of shrimp.
Fig. 8. Fragments of craw of a crab.

(Scale : in mm)


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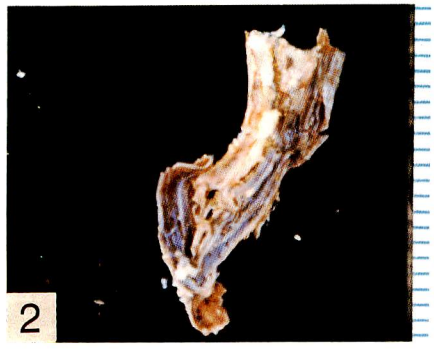
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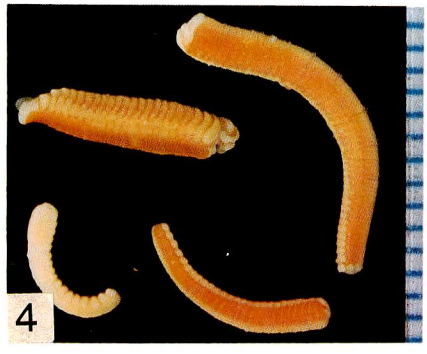
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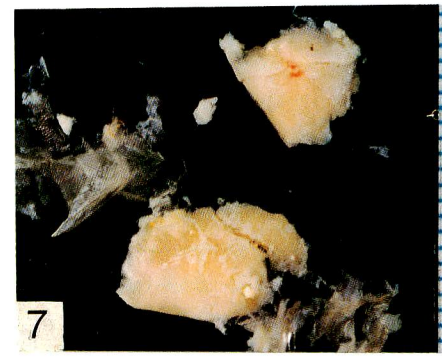
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