ON THE FOOD AND FEEDING HABITS OF SOME PHILIPPINE SHRIMPS IN MANILA BAY AND SAN MIGUEL BAY

by

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ABSTRACT

The paper describes the food of four of the commercially most important Penaeid shrimp in the Philippines, *Penaeus semisulcatus*, *P. merguiensis* *P. canaliculatus* and *Metapenaeus monoceros* from samples derived from Manila and San Miguel Bays. It notes slight regional and seasonal variation in the kind and quantity of food consumed and suggests that the diet composition is related to the availability of food items within the selective feeding.

INTRODUCTION

One of the most important fisheries of Philippines, with a good potential of expansion is the shrimp fishery which had a production of 11,285 metric tons in 1966 thereby contributing about 3.6% of the commercial fisheries landings.

For the past ten years shrimp production has been the first ten in the commercial landings, but with a much higher value, since shrimps command the highest price of any fishery product. Shrimps are caught mainly in the trawl fisheries.

As part of the marine biological program of the Philippines (Tiews, 1959) an investigation of the food and feeding habits of shrimps in Manila Bay was included to learn more about this important phase of biology, especially in view of shrimp farming which is an important aspect of fish farming in the Philippines. As a second research area the San Miguel Bay, known as an excellent fishing ground for shrimps, was chosen and this investigation was extended there in connection with other research activities.

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Earlier available works on Philippine shrimps are mostly taxonomic Estampador (1937), Blanco and Arriola (1937) and Villaluz and Arriola (1938) and on the culture of *Penaeus monodon*, Villadolid & Villaluz (1951) and Delmendo and Rabanal (1955). Domantay (1955) reviews the shrimp fisheries of the Philippines.

Existing studies on food and feeding habits of prawn and shrimps are scarce. Menon (1951) reported on the stomach contents of *Metapenaeus dobsoni* Miers in India.

Pillay (1954) listed detritus (20%), and sand grains (53%) as the most common contents of stomachs of *Leander styliferus* from West Bengal, India. Crustaceans, copepods, decapods, mysis and crustacean remains made up 53.5% of the contents, and fish remains 15.7%.

MATERIALS AND METHODS

Manila Bay Collections. Shrimp specimens were collected on board a commercial trawler fortnightly from October 1956 to October 1958. Some specimens were selected at random from the samples for this study, and other aspects of shrimp biology were also undertaken at the same time. The samples were taken quite evenly throughout the year from 13 field operations.

San Miguel Collection. Samples for gut analyses were taken from four collections made in July and September 1957 and February and May 1958.

Four of the most common commercial shrimp species were included in this study, these are:

Penaeus semisulcatus de Hann
P. merguiensis de Man
P. canaliculatus Olivier and
Metapenaeus monoceros Fabricius.

A total of 301 specimens were examined, 182 from Manila Bay and 119 from San Miguel Bay. The numbers of specimens per species were as follows: *M. monoceros* - 114; *P. semisulcatus* - 88; *P. merguiensis* - 78; *P. canaliculatus* - 21; of the total, 143 were males and 158 females. These were taken from 37 samples, of which 22 were from Manila Bay.

The specimens were preserved in 10% formalin solution soon after capture. In the laboratory the species and sexes were determined, the gut was removed and preserved in 4% formalin in separate containers. Examinations were done under a low power stereoscopic microscope.

The food items were recorded as to their occurrences, and listed as the frequency of occurrences, which is computed by dividing the number of the stomachs containing a particular food item by the total number of stomachs examined disregarding amount, and multiplied by 100.

In most instances, five specimens of each sex were examined per sample, especially of *M. monoceros*, the most abundant of the four species in both areas.

STOMACH AND INTESTINE CONTENTS

1. Food of *Penaeus semisulcatus* de Maan

a) Manila Bay

The specimens examined were mature and of commercial sizes.

It seems evident that both males and females feed greatly on benthonic foraminiferans throughout the year, inasmuch as these were present in all stomachs examined. In January 1958, for example, 75% of the males and 37% of the females food consisted of benthonic foraminiferans, 43% of the food of the females were phytoplankters, compared with only 6% of that of the males. Other zooplankters appeared occasionally to be eaten in great numbers as in December, otherwise they formed only a small percentage of the diet. The phytoplankters were invariably present and in greater quantity during August.

This species feeds mostly on foraminiferans, zooplankton and benthos, but benthonic foraminiferans are the dominant food, probably preferred because of its abundance. The feeding intensities vary with the sexes, the males consuming much more than the females.

The foraminiferan *Rotalia* was the most favoured food accounting for 22% of all food consumed by the species. Veliger larvae, ostracod and pelecypod larvae among the zooplankters were common in the stomach. Of the phytoplankton, *Conscinodiscus* is the most abundant (23.5%). Larger gastropods and pelecypods were very common in the stomachs as well as remains of fish and decapod legs, hooks of annelids and fish scales.

b) San Miguel Bay

Specimens of *P. semisulcatus* (July 1957 and February and May 1958) from San Miguel Bay showed also that benthonic foraminiferans formed the bulk of the food of this shrimp (40 to 54% in males and 23 to 50% in the females). There is not much difference in the feeding habits of the two sexes except in one sample where the females had about twice the amount of phytoplankton in the gut as the males.

The most important benthonic foraminiferans were *Valvulineria*, *Rotalia* and *Quinqueloculina*, and *Navicula* and *Coscinodiscus* among the phytoplankters. Most of the animal plankters were the swimming larvae of mollusks, echinoderms and fish eggs. A considerable amount of tunicates were taken also (29%). Benthos was represented by gastropods, shrimps, annelids, young *Pecten*, pelecypods, brachyurans and amphipods. Organic detritus and animal fragments were found in all guts examined.

2. *Penaeus merguiensis* de Man

a) Manila Bay

The specimens examined were about 140 mm in females and 120-135 mm in the males.

P. merguiensis is primarily a phytoplankton feeder (40-69% in the males and 69-71% in the females) however, benthonic foraminiferans were found in all guts examined and rank as the second most important food item. Zooplankters were also eaten in large numbers when they were plentiful, as in September.

There was not much difference in feeding habits between the sexes and sizes.

Rotalia and *Quinqueloculina* are the most dominant of the benthonic foraminiferans of the 33 recognizable genera represented. Among the zooplankters are the ostracods, copepods, fish eggs. Mollusk larvae were common. Of the phytoplankters, *Coscinodiscus* was the most abundant. Some annelids, pelecypods and gastropods were the benthonic animals represented.

b) San Miguel Bay

The food of both males and females consisted mostly of phytoplankters as was the case in Manila Bay. Benthonic foraminiferans were, however, the next in importance as food of this shrimp.

The most common benthonic foraminiferans were *Rotalia, Valvulineria* and *Quinqueloculina*; of the zooplankters, veliger larvae, ostracods, tunicate larvae and pelecypods are prominent; of *Pleurosigma, Navicula* and *Coscinodiscus* among the phytoplankton group, the most important was *Pleurosigma* with 18% frequency of occurrence.

Among the benthic organisms eaten were very young *Pecten, Tetraclita,* amphipods, gastropods, macrurans, pelecypods and annelids.

3. Food of *Penaeus canaliculatus* Olivier

a) Manila Bay

This species is found in deeper waters (40 m) with sandy-muddy substratum, near the mouth of Manila Bay where trawl fishery is rarely carried out. Hence only two samples (May and December 1957) were available for study.

In May, the frequency of occurrence of benthonic foraminiferans was 51% for males and 58% for the females. The phytoplankters were, however, also an important item of the diet of this shrimp together with the benthic organisms.

Planktonic foraminiferans and zooplankters were present in most of the food masses, and although benthonic foraminiferans form the dominating food item, the relative abundance of the other food groups were of significant importance. Sand and organic detritus are also present in the gut contents in all cases.

The most important foraminiferans were *Cibicides*, *Bolicina*, *Rotalia* and *Epomides*; ostracods and pelecypod larvae among the zooplankton, and *Coscinodiscus* the most important phytoplankter. The genera *Pleurosigma*, *Propleutella* and *Navicula* were also important. The benthic fauna were restricted to pelecypods, gastropods, annelids, amphipods and shrimps.

b) San Miguel Bay

P. canaliculatus is found more commonly near the mouth of the bay, where the bottom is sandy-muddy and this fact is known by the fishermen in this area.

Only one sample was taken from this Bay (September 1957). As in Manila Bay, benthonic foraminiferans are the most preferred food organisms. Phytoplankton, benthos and zooplankton were also invariably consumed. Planktonic foraminiferans were the least important food of this shrimp. Shell fragments and animal remains were also found.

Among the more than 40 genera of foraminiferans recognized in the gut of this species, the most abundant are *Omiqueloculina*, *Rotalia*, *Epomides* and *Cibicides*. Among the zooplankters were pelecypod and gastropod post-larvae, and fish eggs; *Coscinodiscus* is the most dominant phytoplankton besides *Amphora*, *Navicula* and *Pleurosigma*. The benthic forms were represented mostly by gastropods, annelids, *Dentalium*, macrurans, pelecypods and amphipods.

4. Food of *Metapenaeus monoceros* Fabricius

a) Manila Bay

The most dominant food of this shrimp was again benthonic foraminiferans, comprising as much as 50% in the males and 65% in the females (December 1957). Phytoplankton, zooplankton and benthic organisms were also fed upon during certain months. In May and June 1958 phytoplankton and benthonic foraminiferans accounted for 47% and 38% in the males and 58% and 30% in the females respectively. This shows the importance of both food items to this species. There were months (October and December) when phytoplankton reached a very low level of occurrence. All guts examined had organic detritus and other animal remains in them.

Of the benthonic foraminiferans, *Rotalia*, *Nonion*, *Vulvulina* and *Quinqueloculina* were the most common, with copepods, ostracods, fish eggs and pelecypod larvae representing the zooplankton.

Coscinodiscus with a percentage occurrence of 25% is the most common phytoplankter followed by *Pleurosigma* and others.

Pelecypods, shrimps, annelids, gastropods and amphipods were the common benthic animals noted.

b) San Miguel Bay

The food of *S. monoceros* in San Miguel Bay does not differ fundamentally with that in Manila Bay. Benthonic foraminiferans are also the most preferred food by both sexes. However, more phytoplankton was found especially in the smaller shrimps when diatoms were plentiful in the bay.

Among the benthonic foraminiferans, *Quinqueloculina, Bolivina* and *Bulmina* were most dominant, of the 38 genera represented. The phytoplankters were chiefly *Pleurosigma, Navicula* and *Coscinodiscus*. The zooplankton and benthic organisms were similar to those found in this species in Manila Bay. It appears that very young *Pecten* is preferred more than any other mollusk by this shrimp.

CONCLUSIONS AND SUMMARY

1. From the foregoing we observed that the main food of *M. monoceros, P. semisulcatus* and *P. canaliculatus* was benthonic foraminiferans while that of *P. merguiensis* was phytoplankton, although also in this species benthonic foraminiferans rank high in the diet.

2. The most dominant foraminiferans were *Rotalia, Bolivina, Quinqueloculina, Nonion* and *Cibicides*. The number of genera of foraminiferans represented in the gut of these commercial species of shrimps in Manila Bay did not vary very much between the species. From 71 specimens of *M. monoceros*, 37 genera of foraminiferans were identified, while from 23 specimens of *Penaeus merguiensis* 34 genera were identified. The results for *P. semisulcatus* and *P. canaliculatus* in Manila Bay were similar. It is then safe to say that shrimps do not, as a rule, prefer any particular foraminiferan.

3. In both Manila Bay and San Miguel Bay, the shrimps caught offshore and outside the bays contained an abundance of foraminiferans, while those caught inside the bays had fewer. This is probably related to the greater abundance of foraminiferans in the outer areas (Tiews, Ordonez, Ronquillo, MS.)

4. Common among the phytoplankton eaten by the shrimps were *Coscinodiscus, Pleurosigma, Navicula, Amphora, Cyclotella* and *Thallasiosira*.

5. Of the zooplankton group, copepods, chaetognaths, fish eggs, ostracods, pelecypod postlarvae, gastropod postlarvae, veliger larvae and tunicates were found in all the species studied. Annelids, brachyuran, macrurans and amphipods were also found.

6. The quantity of food found in the guts of *M. monoceros* was greater than that found in *P. semisulcatus*, *P. merguiensis* and *P. canaliculatus*.

7. In both Manila Bay and San Miguel Bay, a slight regional and seasonal variation in the composition of the food of the four species as well as a fluctuation in the intensity of feeding was noted. Samples from both sexes show a similar trend. Differences in the availability of food items more than a selective feeding seems to determine the diet composition.

8. The data do not permit conclusions to be drawn if the abundance of shrimps on certain fishing grounds depends on the availability of food organisms, as one may expect. The existing results of benthos research (Tiews *et al.* MS. 1968) however, do not support such a conclusion, since foraminiferans were found in less abundance in San Miguel Bay than in Manila Bay although shrimp catches per unit of effort are larger in San Miguel Bay than in Manila Bay. Further research is needed as the study on the distribution of benthic foraminiferans can be judged only as preliminary.

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