UNIVERSITY OF GUAM

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PRELIMINARY REPORT

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PLANKTON SURVEY IN PALAU

DECEMBER 1971 to JANUARY 1972

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AGANA, GUAM 96910 USA

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Prepared by

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Most sessile coral reef animals produce pelagic larvae that appear among many kinds of holoplankton in plankton samples. Larval plankters are of direct interest because they reveal some aspects about the reproductive behavior of the organisms. Although there are often problems in identification, the occurence of particular larvae from the sessile animal community reflects seasonality and intensity of breeding and distribution patterns of both adults and larvae.

Several attempts have been made to find pelagic larval stages of *Acanthaster planci*, the coral predator starfish, along the coral reefs in Australia (Pearson & Endean, 1969) and in Guam. However, none have been recorded from the plankton samples taken thus far. This paper reports on a plankton survey and search for the larvae of coral reef asteroids in Palau. Once again, the plankton tows failed to record *Acanthaster* or any other species of starfish larvae, even though tow efforts covered most of the reefs of the island.

The second resurvey of *Acanthaster planci* on the reefs of the Palau Islands was conducted by representatives from the University of Guam Marine Laboratory from December 28, 1971 to January 17, 1972 (Marsh & Bryan, 1972). The plankton sampling was conducted by the monitoring team at the same time as the monitoring, and sixty samples each from one station were collected out of a total of two hundred fourteen stations.

Palau had no great aggregations of *Acanthaster* at this time. However, the coral reefs of Palau do support a wide variety of asteroids and some of these species are usually fairly abundant. For example, *Linckia laevigata* and *Linckia multifora* are abundant in the shallow waters of Palau (Hayashi, 1938). Also, larger conspicuous asteroids such as *Culcita novaeguineae* and *Protoreaster nodosus* are very common in Palau (Marsh & Bryan, 1972; Yamaguchi, 1969). It was thought that such a plankton survey would provide useful information for the present *Acanthaster* problem in particular and other asteroids in general. To date, there have been no attempts to sample plankton at this intensity on the coral reef to find *Acanthaster* or other asteroid larvae.

METHODS

The plankton net used for the sampling was a Norpac-type net of simple conical shape, about forty-five cm in mouth diameter and with approximately 0.3 mm mesh of filtering Müller gauze (or bolting silk). The net was towed close to the surface for five minutes at each station from a boat running at a speed of two to three knots.

The plankton samples were fixed by formalin immediately after collection. The preserved samples were studied at the Marine Laboratory under a binocular dissecting microscope.

The relative abundance of each group of larval plankton was recorded as follows: 1 to 5 per sample, present; 5 to 50 per sample, common; and more than 50 per sample, abundant.

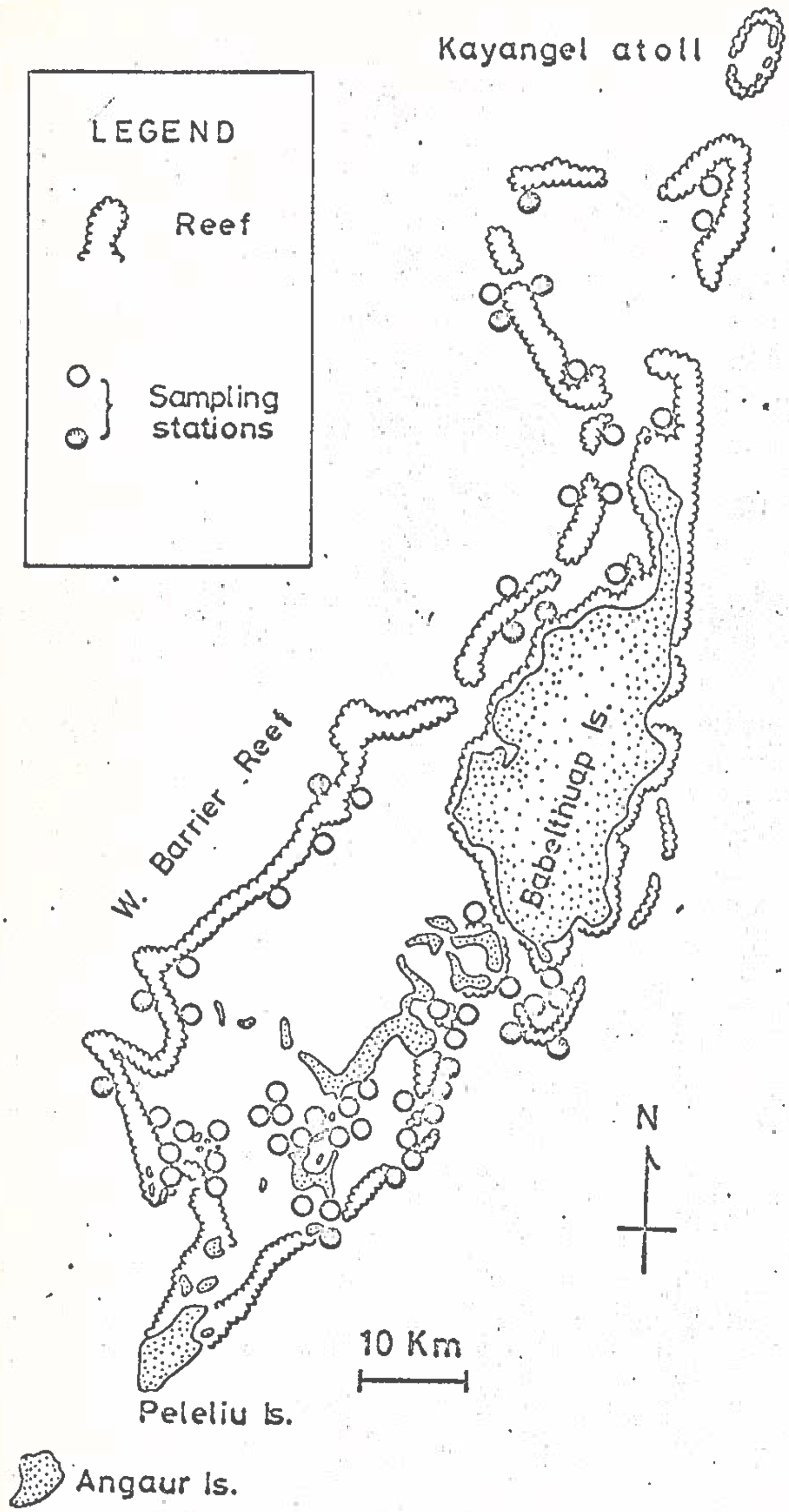

Figure 1. Status of zooplankton biomass at Palau during December, 1971 and January, 1972. Solid circles indicate the stations with zooplankton settling volume of more than 4 ml per sample.

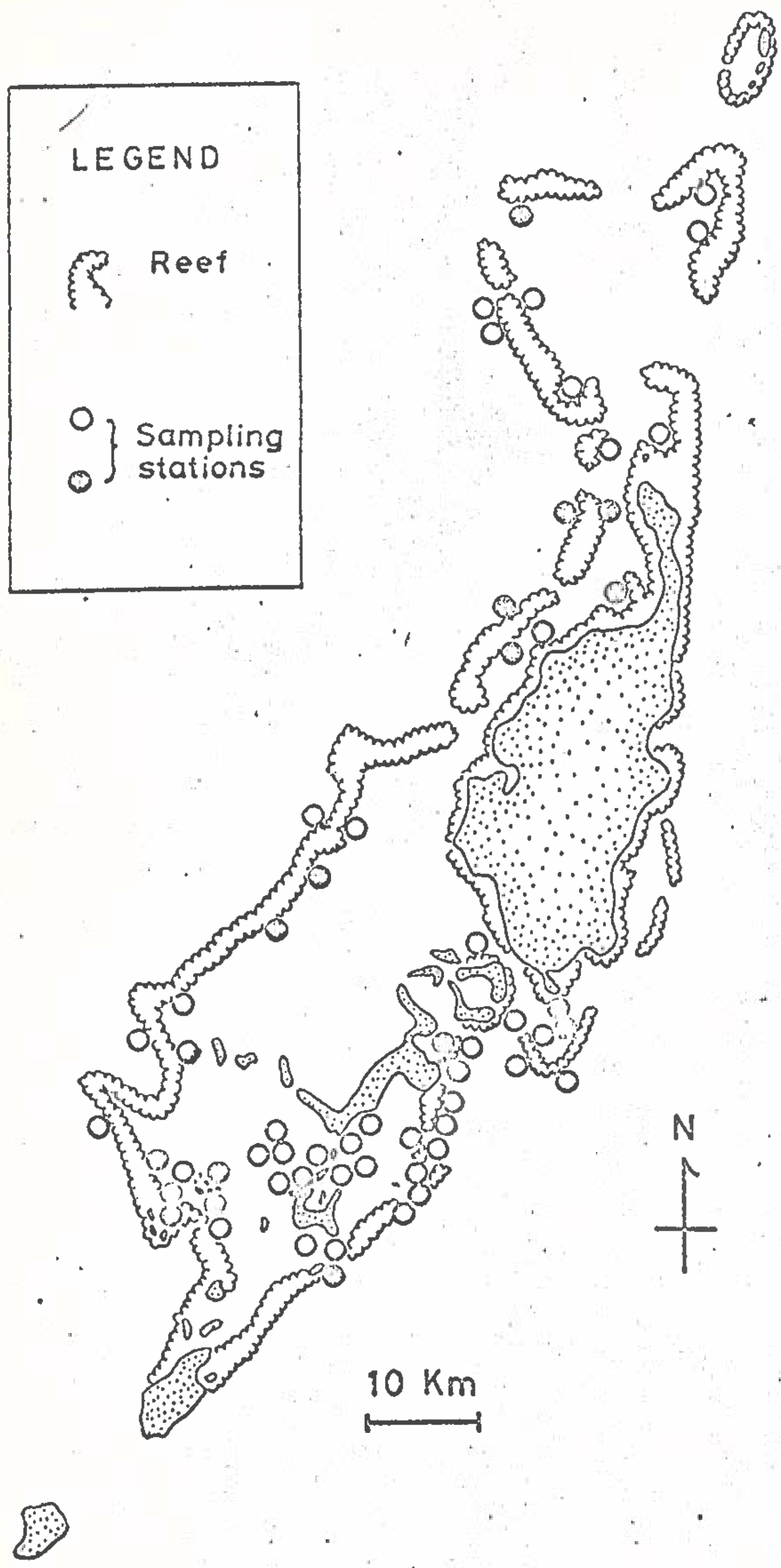

Figure 2. Status of detritus concentration at Palau during December, 1971 and January, 1972. Solid circles indicate 18 stations with relatively high concentration of detritus.

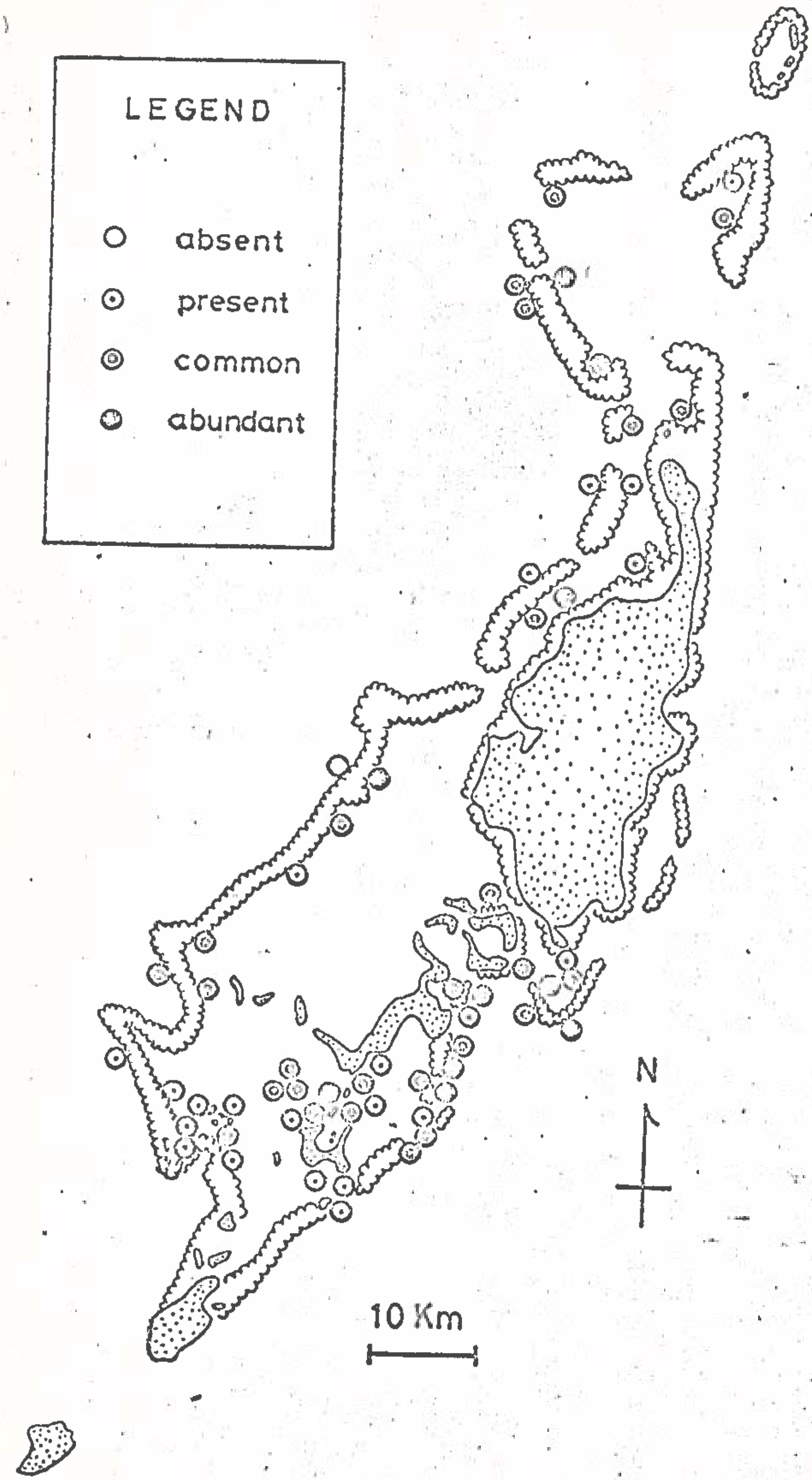

Figure 3. Distribution of decapod larvae.

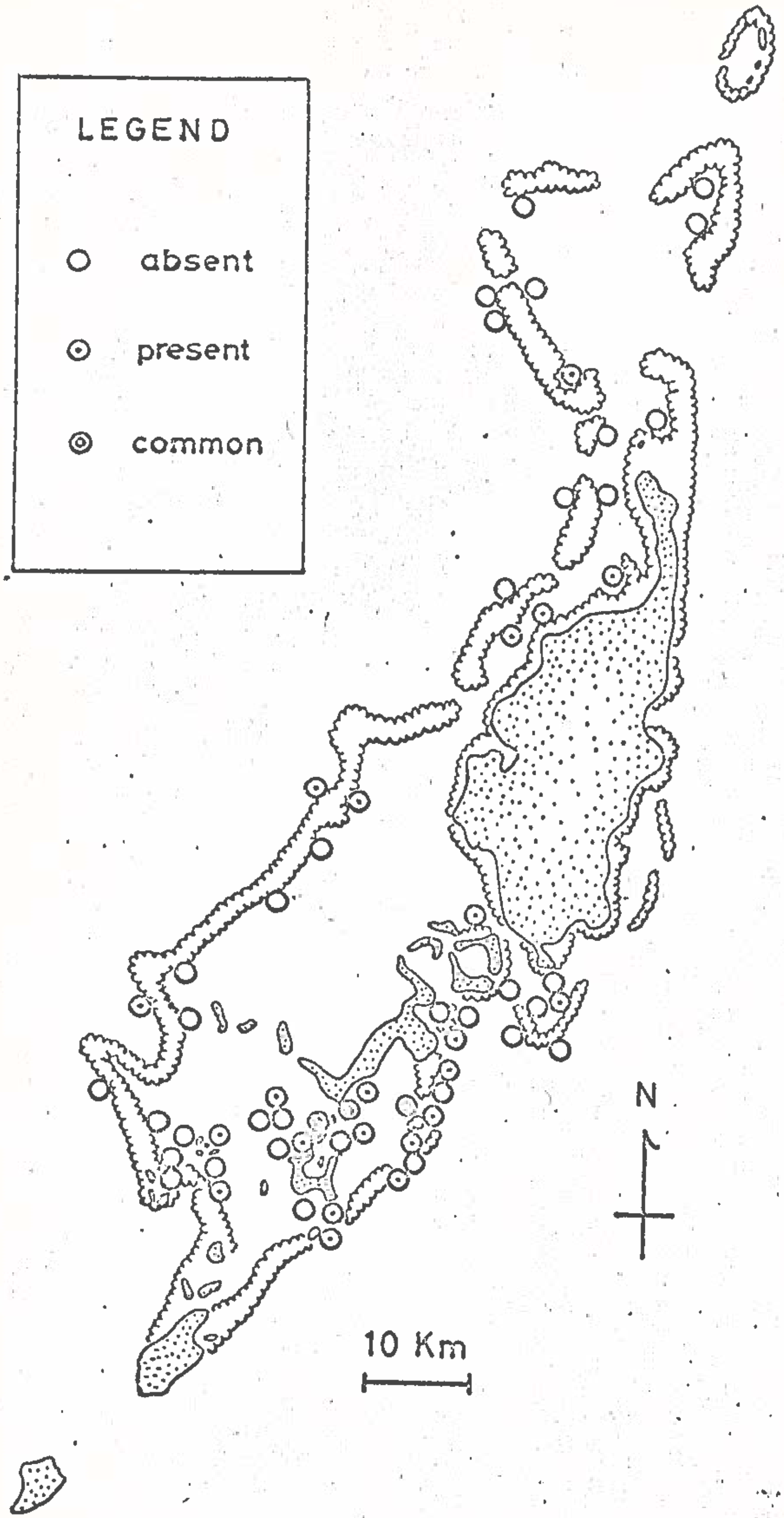

Figure 4. Distribution of cirriped larvae.

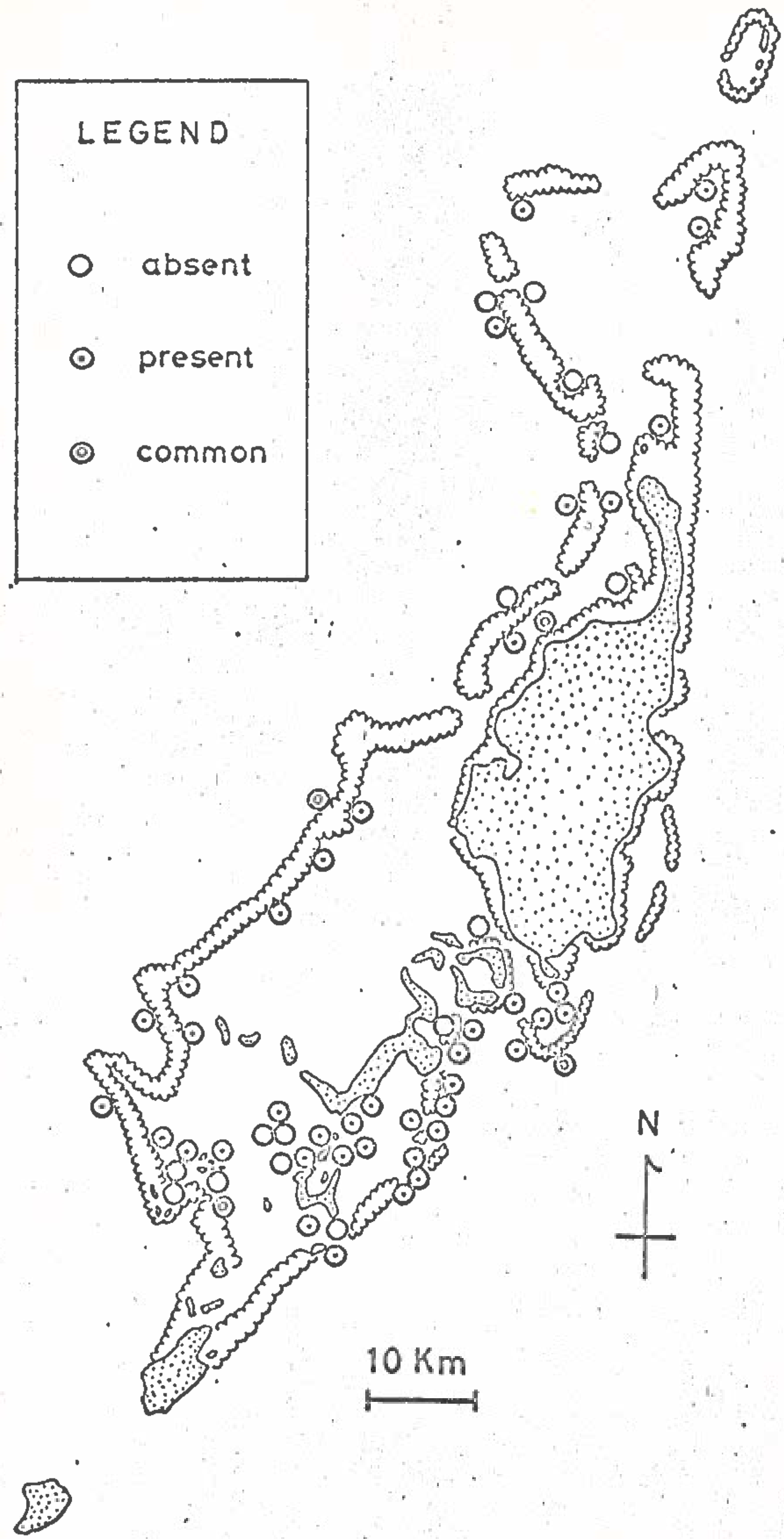

Figure 5. Distribution of gastropod larvae.

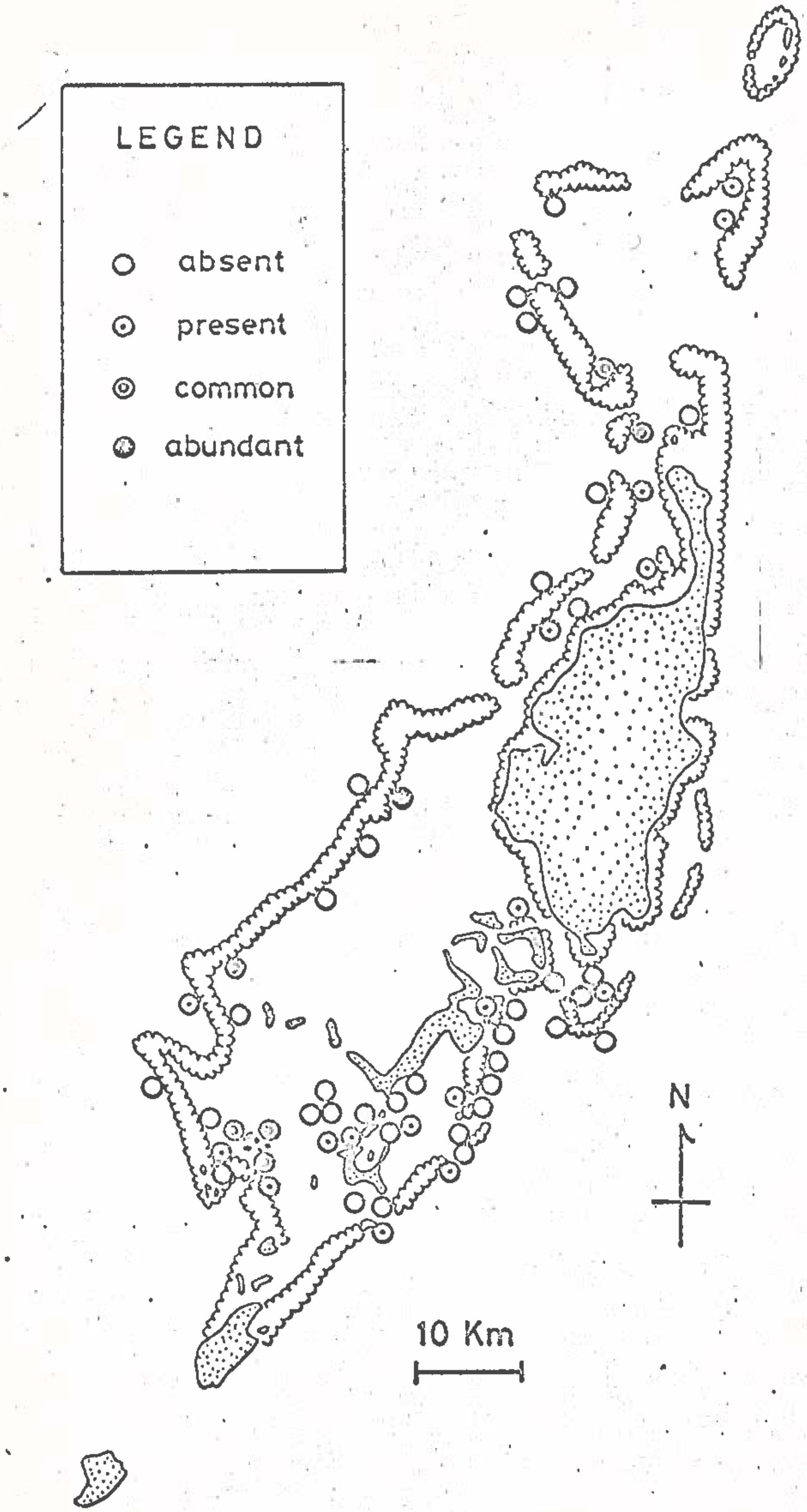

Figure 6. Distribution of ascidian larvae.

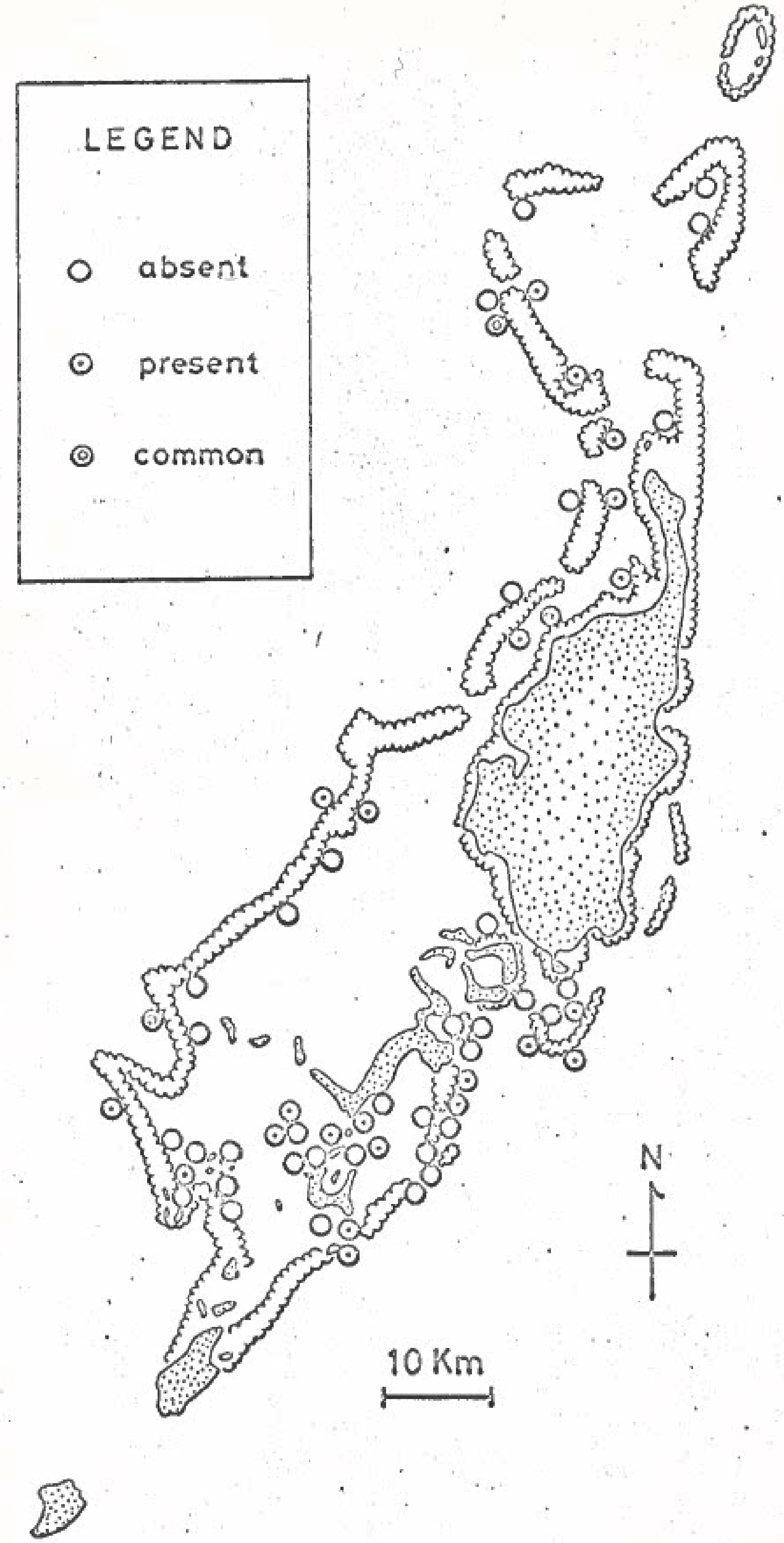

Figure 7. Distribution of polychaet larvae.

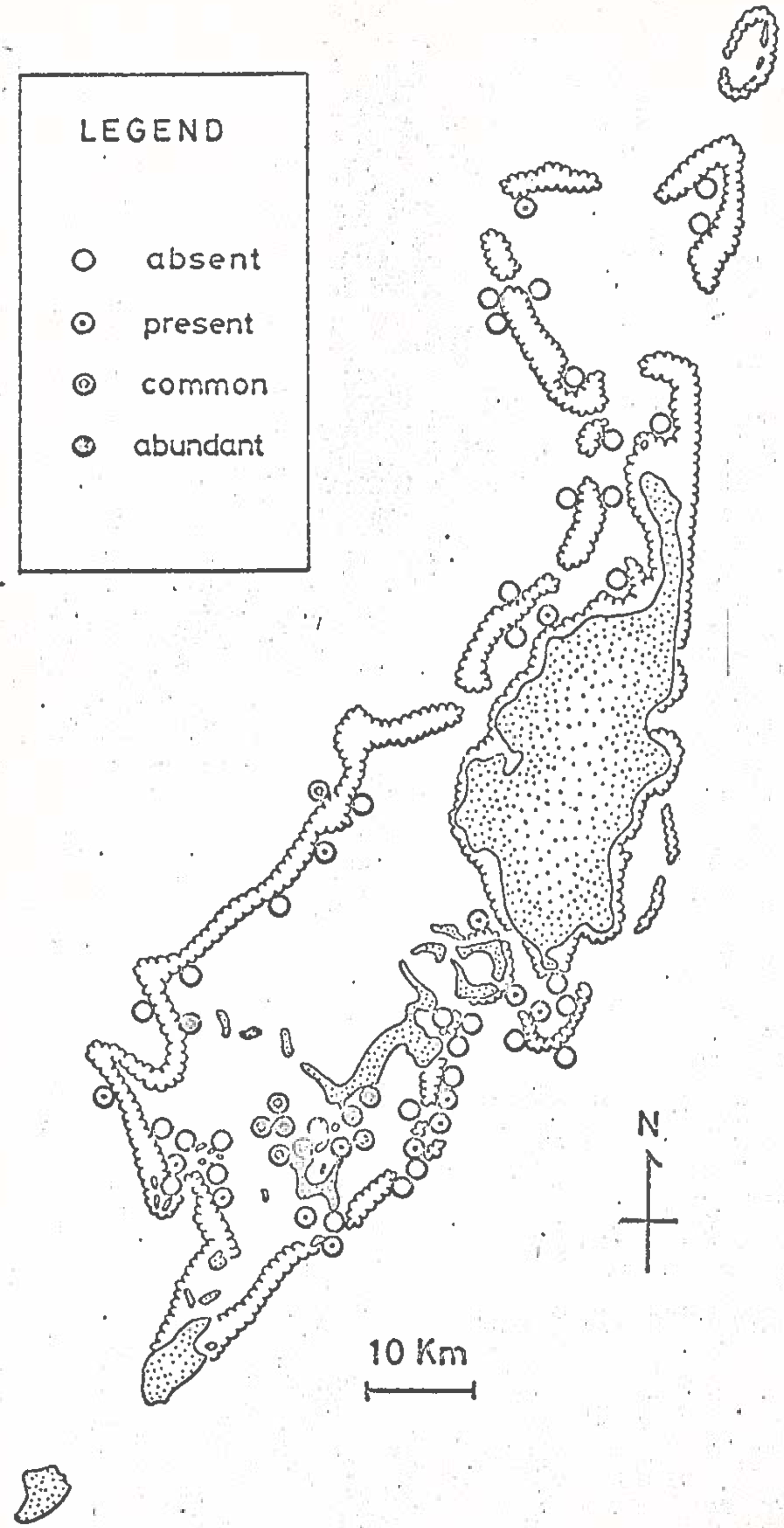

Figure 8. Distribution of ophiuroid larvae.

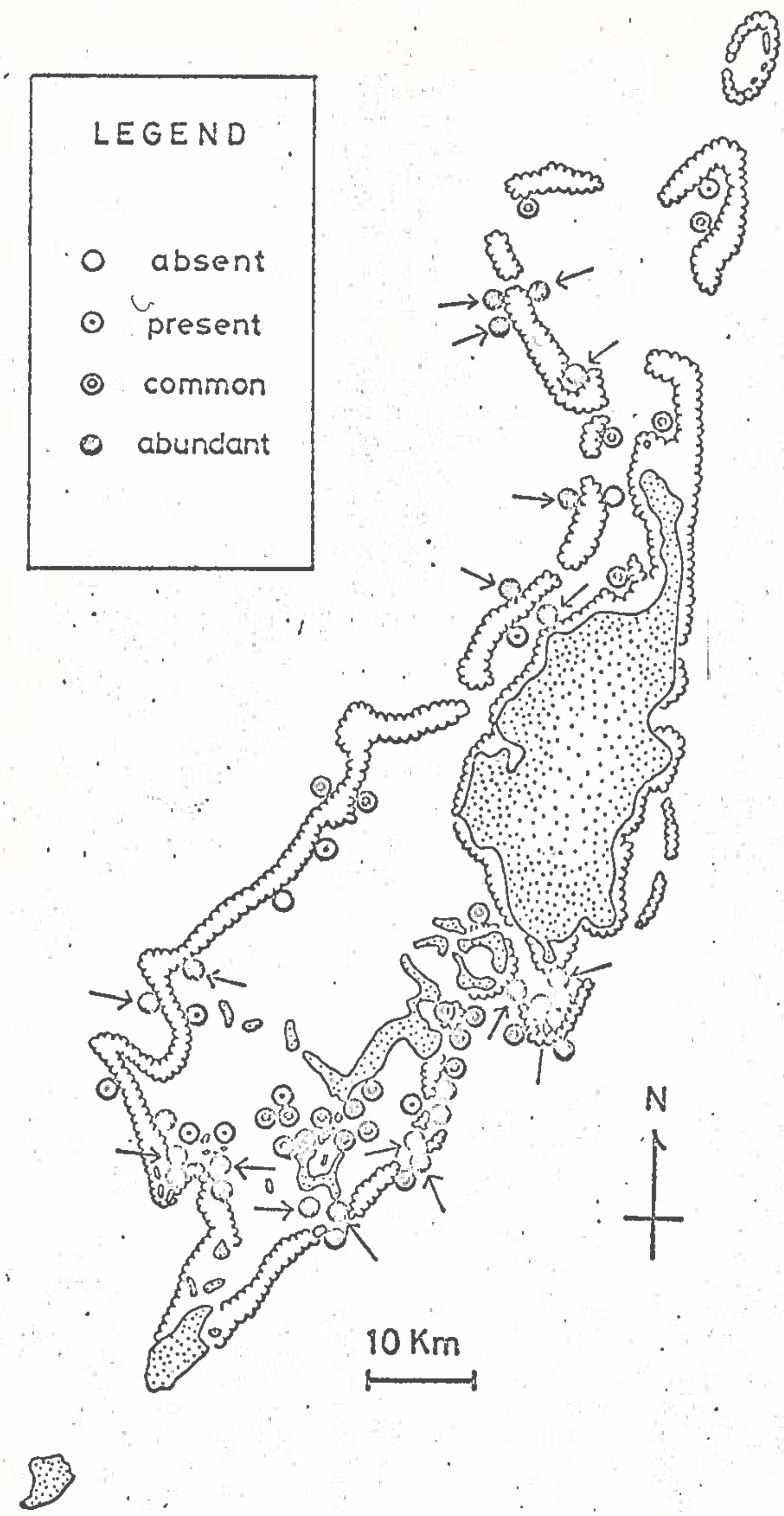

Figure 9. Distribution of fish eggs. Arrows indicate the stations with relatively high concentrations of anchovy eggs.

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RESULTS

(1) Zooplankton Biomass:

Solid circles in Figure 1. indicate eighteen stations which had the highest (more than 4 ml of settling volume per sample) biomass among sixty stations sampled. The stations around the southeastern reefs and northwestern reefs showed the highest concentrations of zooplankton. There was an interesting contrast between outside and inside the western barrier reef. All three stations outside the western barrier reef showed much higher plankton biomass than the inside ones.

(2) Detritus:

The most conspicuous feature of the plankton samples from Palau was the high concentration of detritus derived from benthic algae, seagrasses, and moults of benthic crustaceans, etc. Figure 2. indicates eighteen stations with relatively rich detritus in the samples. Again there appeared a contrast between outside and inside the western barrier reef (inside rich in this case).

(3) Larvae of benthic invertebrates:

The most abundant larval plankters are representatives of crustaceans particularly the Decapoda (Macrura, Anomura, and Brachyura). Fifty-nine stations out of sixty had specimens of larval forms of decapods (zoea larvae and ten samples were above fifty specimens per sample (Figure 3). Nauplii and cyprids of Cirripedia (both acorn and goose-neck barnacles) appeared in only twenty-five stations and their abundance was much less than that of decapod larvae (Figure 4).

Although there were only four stations which had larvae of Pelecypoda (bivalve molluscs), the majority (45) of stations had larvae of Gastropoda. However, the specimens of gastropod larvae were not abundant in the stations where they occurred (Figure 5).

Larvae of both solitary and compound ascidians appeared fairly large numbers. Most of them were larvae of compound ascidians. Twenty-five stations had the larval forms of this group of animals (Figure 6).

Polychaeta larvae appeared in twenty-six stations, but their abundance was low (Figure 7).

A single coral planula appeared in one station. The planula of another group of coelenterates was found at a different station, but it was not identifiable.

Larval forms of echinoderms were the main interest of this survey. However, except for plutei of ophiuroids, this group was represented by low concentrations of specimens. There were no asteroid larvae. Only one

The vertical distribution of asteroid larvae in nature is not well known, but they have very strong geonegative taxis in locomotion and they may normally be distributed close to the surface (Yamaguchi, in press).

Another reason for the scarcity of echinoderm larvae in plankton samples may be the low relative abundance of adult populations of these animals even though they are large and conspicuous enough to attract peoples' attention. More intensive tow efforts may be required in order to get larvae of any particular starfish.

The timing of spawning, if the starfish were triggered to shed gametes by any stimulus such as tidal currents and temperature changes in nature, would be very useful information for the sampling of larvae in the field. In any case, the concentration of such larvae in Palau is at a fairly low level and they would seem to be very occasional components of zooplankton community. This is true not only in Acanthaster but in most of the more abundant asteroids, echinoids and holothuroids.

Larvae of suspension feeders such as bivalve molluscs and acorn barnacles are much lower in relative abundance as compared to those of temperate waters. Although many of those larvae were too small to be retained, this may reflect the paucity of their parent populations. On the other hand, larvae of compound ascidians were rather abundant. There usually is a large population of this group of animals under coral boulders and the dead stems of reef-coral thickets.

The paucity of coral planulae in the plankton samples has been recorded by previous workers who tried to find them (Stephenson, 1931, and Motoda, 1939). The present survey agrees well with those results.

The abundance of fish eggs and larvae is the most striking characteristic in the plankton samples from Palau. Many of the eggs of pelagic fishes would develop into swimming larvae within one day or so (Mito, 1966). Therefore, the occurrence of the fish eggs means very recent spawning. There appeared large numbers of species of fish eggs, but most of these could not be identified to even the family level. Only the eggs of the anchovy (engraulids) were very easily discriminated from others and represented the dominant fish eggs in the samples. Those were presumably of Stolephorus heterolobus which is one of the most important bait-fish for skipjack fishing in Palau (Uchida, 1970).

Although the fish eggs occurred everywhere on the coral reefs of Palau, the stations of greatest abundance were limited mostly to outer reefs and seemed to be related somewhat to channel areas. Fish eggs were less abundant inside lagoon reefs.

specimen of auricularia (holothuroid larva) was found and two stations had one and two echinoplutei each (echinoid larvae). On the other hand, twenty-six stations had ophioplutei and one of them had more than fifty specimens per sample (Figure 8).

Besides the above larval forms, trochophora larvae (probably of sipunculoids), cyphonautes larvae (of bryozoans) and Muller's larvae (of polyclads) appeared occasionally. Still some other specimens looked like larval forms of some benthic animals, but could not be attributed to any specific groups.

There were no notable patterns in the larval distribution of these groups mentioned above except for ophiuroid plutei that tended to concentrate around the patch reefs between Urukthapel and Eil Malk (Figure 8).

Larvae of scyphomedusa (ephyra) were found in fourteen stations. Their distribution was not related to any particular locality, and they seemed to occur everywhere but were not very abundant. It is impossible to tell the species of the ephyra (or ephyrae). Several species of conspicuous scyphomedusae such as Mastigias and Cassiopea are known from Palau.

(4) Fish eggs and larvae:

Nearly half (twenty-six) the stations showed abundant (more than fifty eggs per sample) fish eggs and only two stations lacked them. The stations with abundant fish eggs seemed to occur mostly in channel areas of the reef complex. Many species of fish eggs occurred, but they were counted together because of identification problems. However, eggs of anchovies were easily discriminated from the others because of their characteristic football shape. Figure 9. indicates the relative abundance of fish eggs and their distribution. The arrows indicate the eighteen stations that showed relatively higher concentrations of anchovy eggs.

Fish larvae were also represented by a wide variety of species. They appeared in forty-four stations, but the number of specimens was much less than that of eggs.

DISCUSSION

The paucity of echinoderm larvae, especially of asteroids, echinoids and holothuroids, may reflect many causes. First, the larvae of this group are smaller than most other zooplankters and the net could retain only larger larvae. Those of the earlier and smaller stages might go through a net of about 0.3 mm mesh. The larger or older larvae may be more widely dispersed than younger ones and they may be less concentrated.

Because the survey covered three weeks there is a possibility to hit the time when such animals would spawn. Many of asteroids in Guam seem to spawn at any season of the year and those of Palau may behave in a similar manner.