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Patterns of abundance of fish larvae, fish eggs, decapod shrimp larvae, and cubomedusae in two coastal areas in Iligan Bay, Northern Mindanao, Philippines

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Abstract

Two adjacent inshore areas in Iligan Bay were sampled every month for 13 months from October 1998 to October 1999 to determine spatio-temporal abundance patterns of fish larvae, fish eggs, decapod shrimp larvae, and cubomedusae. In all four categories, abundance varies between months but less so between sites. The monthly variations in peaks of abundance conform for the three (3)-month seasons (March-April-May = dry hot, June-July-August = wet-hot, September-October-November = wet-cold, December-January-February = dry cold) within a year and the dominant northeast and southwest monsoonal patterns. Variability in abundance of the four zooplanktonic groups correlate with salinity, water temperature and depth. The El Niño phenomenon incidentally appears to contribute to the variability. Therefore, the present study provides evidence to the growing knowledge that patterns do exist particularly in tropical planktonic communities that are important to tropical fisheries.

Keywords: *pattern in ecology, fish larvae, fish eggs, decapod shrimp larvae, cubomedusae, fisheries, Iligan Bay*

Introduction

Community ecologists have long been in dispute whether or not species and/or population components of a community do reveal any pattern at all (Krebs 1985; Pulman 1994). Whether practitioners of this relatively young sub-discipline of ecology have reached at a consensus or not, inarguably ecology like most fields of science has long been in quest

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for pattern in the natural world. Pattern in communities as defined by Odum (1972) is the structure that results from the distribution of organisms in, and their interaction with their environment. The quest for pattern in tropical community ecology may be considered at its pioneering stage for the obvious reason that attention has been focused in this area only very recently. Pattern analysis in tropical aquatic communities is no exception, as evident in very few studies have been done on possible spatio-temporal patterns among planktonic communities.

Available literature on plankton studies in the Philippine marine waters dates back in 1854 and this mainly focused on phytoplankton (Ordoñez and Furio 1989). The primary impetus of these plankton studies is to gain an assessment of the potential productivity of our fishing grounds by rational analysis of the distribution and abundance of indicator planktonic communities. With the exception of some pioneering works in Sibuguey Bay, Zamboanga and in the waters of Sulu archipelago, the majority of the published studies have been conducted in the waters of Luzon and the Visayas (Ordoñez and Furio 1989). Among the planktonic organisms that receive much attention are the ichthyplankton (fish larvae and eggs) and decapod shrimp larvae for their relevance in fisheries. Cubomedusae need to be studies for they potentially compete with fish larvae in terms of their copepodan prey.

This study sought to determine patterns of spatial and temporal variations in abundance of four zooplanktonic groups (fish larvae, fish eggs, decapod shrimp larvae and cubomedusae) in two coastal waters of Iligan Bay, Northern Mindanao, Philippines.

Materials and Methods

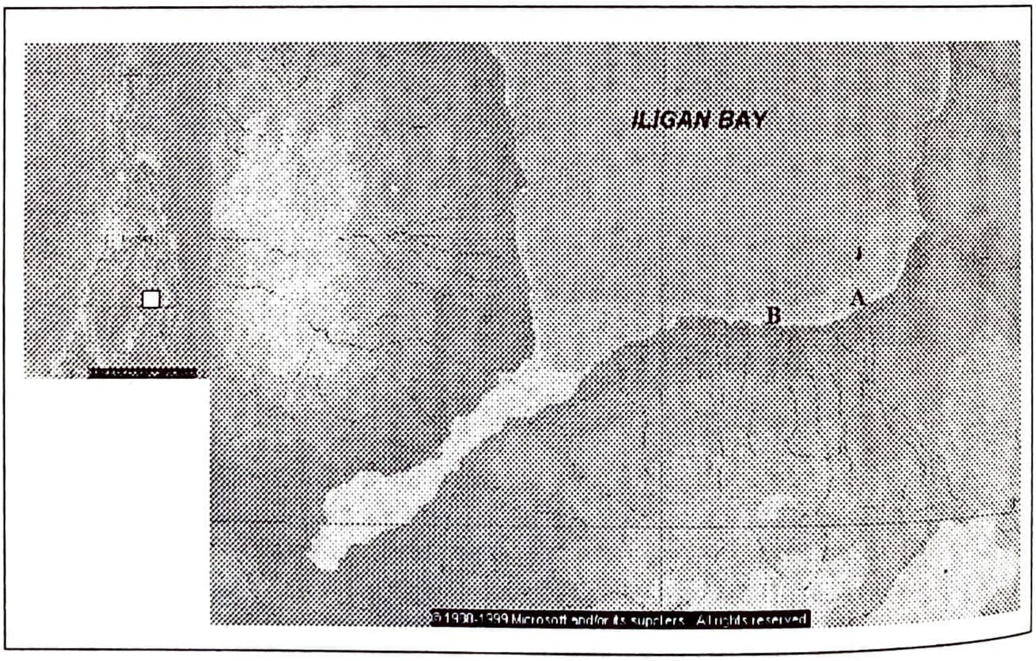

Figure 1. Map showing Iligan Bay and study sites A (Tambacan) and B (Larapan). Inset is the map of the Philippines showing the location of Iligan Bay marked with a square.

The collection of the four zooplankton groups for the present study is part of a larger project that deals with the potential prey of the micronekton *Acetes erythraeus* in Iligan Bay (see Metillo 2000). The bay lies approximately between 8°30'31" North Latitude, 123°43'51" East Latitude with an estimated area of about 2000 km² (see Figure 1). Two inshore areas in the bay were sampled with zooplankton and the micronekton. These sampling areas have been described by Metillo (2000).

Monthly sampling was conducted for a period of 13 months from October 1998 to October 1999 every last week of the month. Collection of sample was done at night between 2100H to 0100H. Dense sample are often collected at night in tropical areas (McManus 1992a,b). However, other studies show no significant difference between day and night samples in coastal waters (Magnusson et al. 1973; Shaw and Robinson 1998). Replicate samples were collected for every sampling area. Ancillary data on salinity, water pH, water temperature, total suspended solids, were also recorded during sampling. Methods in determining these parameters are described in Quiñones (1999).

A *General Oceanics* bongo plankton net with a mesh size of 267 mm and 0.39 - meter ring diameter was used in the horizontal collection of the zooplankters. Samples collected from the cod end of the net was transferred to a properly labeled container and was immediately fixed with buffered 10% formalin.

Examination and counting of zooplankton was done under a Zeiss Stemi 2000 stereomicroscope. Zooplankton of interest were carefully sorted out from the bulk sample. Data for the entire zooplankton sample will be reported elsewhere. All cubomedusae and fish larvae were individually counted and tallied, but the smaller categories (fish eggs and deca-

Table 1. Average values of physico-chemical data over the entire sampling period in the two sites. Data from the Tambacan study site are in parenthesis.

Month	Salinity (ppt)	Temperature (water, °C)	Depth (m)	Total Suspended Solids (g dry weight)	pH
Oct 1998	37 (39)	28 (29)	20 (25)	------ (------)	7.0 (7.0)
Nov 1998	35 (22)	28 (28)	30 (30)	0.017 (0.015)	7.0 (7.0)
Dec 1998	35 (19)	29 (29)	30 (30)	0.020 (0.022)	7.0 (7.0)
Jan 1999	34 (34)	29 (29)	30 (30)	0.021 (0.018)	7.0 (7.0)
Feb 1999	20 (25)	29 (26)	30 (30)	0.028 (0.021)	7.0 (7.0)
Mar 1999	11 (17)	28 (28)	32 (35)	0.184 (0.190)	7.5 (8.0)
Apr 1999	30 (15)	29 (28)	35 (39)	0.205 (0.204)	7.5 (8.0)
May 1999	29 (17)	29 (29)	30 (45)	0.193 (0.238)	8.0 (8.0)
Jun 1999	25 (18)	29 (28)	38 (35)	0.186 (0.249)	7.5 (8.0)
Jul 1999	25 (10)	28 (26)	35 (37)	0.210 (0.182)	8.0 (8.0)
Aug 1999	20 (20)	28 (28)	30 (35)	0.198 (0.226)	8.0 (8.0)
Sep 1999	23 (11)	28 (28)	30 (35)	0.190 (0.218)	8.0 (8.0)
Oct 1999	27 (11)	28 (29)	20 (25)	0.206 (0.197)	8.0 (8.0)

pod shrimp larvae) were subsampled. Subsamples were analyzed and counted using a Sedgewick counting chamber.

The relationship between the abundance of fish larvae, fish egg, cubomedusae and decapod shrimp larvae and the different physico-chemical parameters in the two sites was determined using the Pearson Rank Correlation Analysis.

Results

Physico-chemical ancillary data are presented in Table 1. Salinity was lowest in the months of March (11 ppt) and August (20 ppt) in the Larapan site. Also in the same site water temperature ranged from 27-29 °C, depth ranged from 20-35 m, and pH ranged from 7-8. Total suspended solids varied over the sampling period in this study site, which ranged from 0.017- 0.210 g. Higher values of TSS were recorded starting March and peaked in July. In the Tambacan study site, salinity showed a range of 11-39 ppt. The range of water temperature of 26 -29 °C from this site is quite comparable with that of the Larapan site. The sampling depth in the Tambacan site ranged from 25 to 45 m, but the 45 m record is due to a pronounced drift during sampling. Excluding the 45 m, sampling depth range in the two sampling sites is comparable. Total suspended solids data from the Tambacan site followed a similar trend as that of the Larapan site, but higher values were recorded in the former than in the latter site. The pH range in the Tambacan site is comparable to that in the Larapan site.

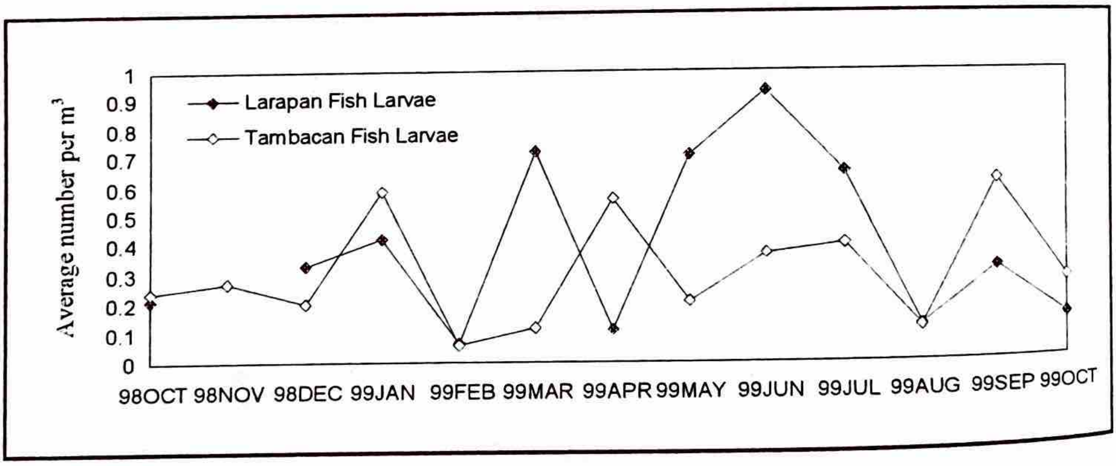

Figure 2. Monthly abundance of fish larvae from two (Larapan and Tambacan) coastal sites of Iligan Bay.

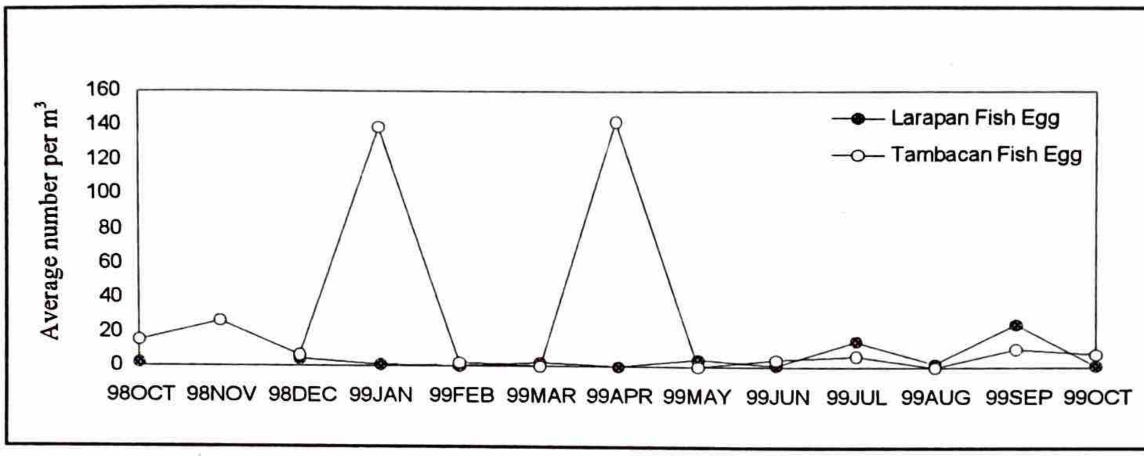

Figure 3. Monthly abundance of fish eggs from two (Larapan and Tambacan) coastal sites of Iligan Bay.

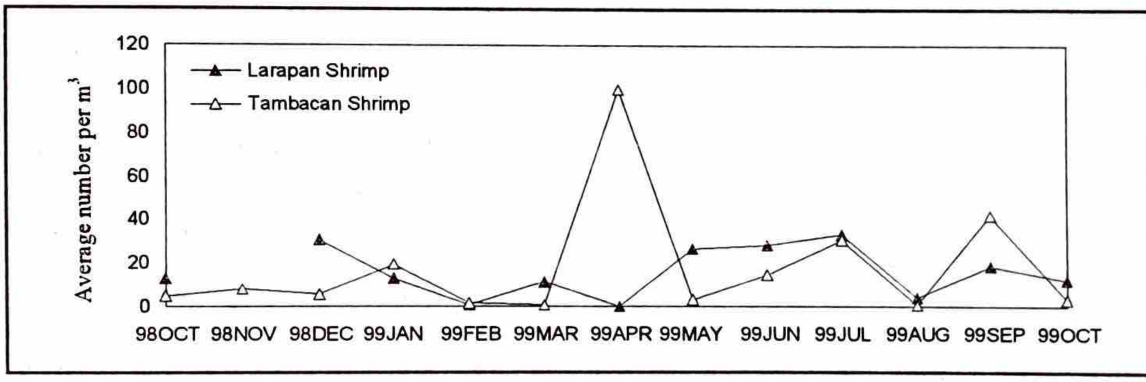

Figure 4. Monthly abundance of decapod shrimp larvae from two (Larapan and Tambacan) coastal sites of Iligan Bay.

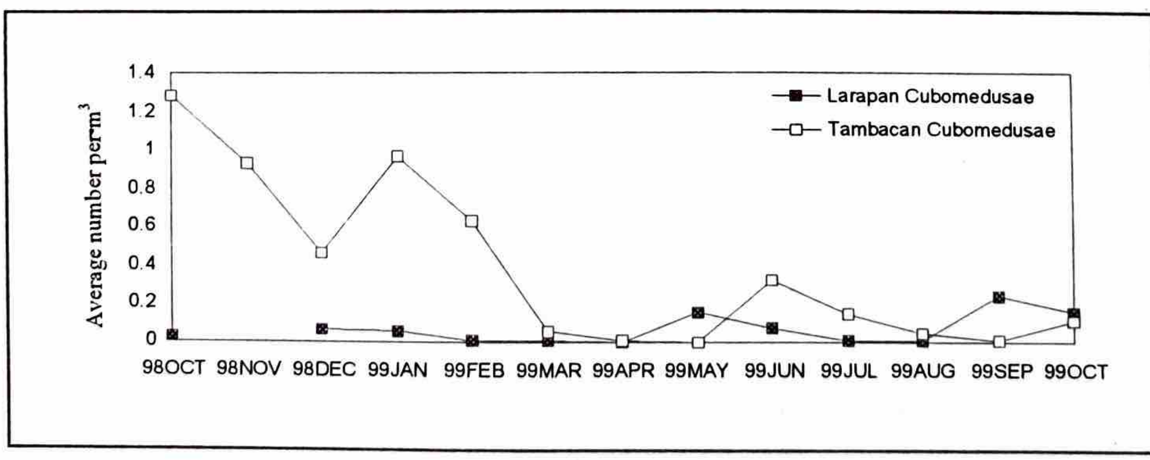

Figure 5. Monthly abundance of cubomedusae from two (Larapan and Tambacan) coastal sites of Iligan Bay.

Figures 2-5 show the temporal variation of the four zooplanktonic group collected from the Tambacan and Larapan sites. Samples were lost, thus explaining the absence of data for November. Despite the absence of exact correspondence in peaks, both sites appear to show four comparable major peaks in fish larvae abundance. These peaks happen to occur first in December-January-February, second in March-April-May, then June-July-August, and lastly September-October-November. However, the Tambacan site showed relatively higher abundance in fish larvae during March and June. Although the same pattern occurs for fish eggs abundance, the higher peaks of abundance in the Tambacan site occurred in and April, while that in Larapan occurred in July and September. Differences in major peaks in the two sites are observable in the decapod shrimp larvae data. The highest peak was observed in April and two minor peaks occurred in July and September for the Tambacan site. The Larapan site showed peaks in December and July. It is interesting to note the absence of peak in the Larapan site during April. The population of cubomedusae bloomed in the Tambacan site in October 1998 and January 1999 and another minor peak in June 1999. Peaks in cubomedusae abundance in the Larapan site occurred in May and September, but in general relatively more cubomedusae were found in the Tambacan site.

For both sampling sites, computation of Pearson correlation coefficients was only made between the abundance of the four zooplankton categories and three (salinity, temperature depth) physico-chemical parameters because of the missing data for the total suspended solids, and the very narrow range of pH values (see Tables 2 and 3). The pH values recorded from both sites are within the range of the normal neutral to slightly alkaline estuarine water. In the Larapan site, all four zooplankton groups appear to be negatively correlated with salinity with cubomedusae showing the weakest negative correlation. Fish eggs and decapod shrimp larvae show strong positive correlation with water temperature. All four taxa show weak correlation with depth. In the Tambacan site, again cubomedusae shows weak correlation with salinity, but the other three groups showed strong positive correlation with salinity. Only cubomedusae show very strong positive correlation with water temperature. Surprisingly, only cubomedusae shows again a very strong positive correlation with depth in the Tambacan site.

Table 2. Pearson rank correlation coefficients between the abundance of the four zooplankton categories and the three physico-chemical parameters in the Larapan site.

Taxon	Salinity	Water Temperature	Depth
Fish larvae	-0.1549	0.3256	0.4451
Fish Eggs	-0.0073	0.6290	0.3340
Shrimp larvae	-0.0885	0.5690	0.1374
Cubomedusae	-0.3365	0.2887	0.0751

Table 3. Pearson rank correlation coefficients between the abundance of the four zooplankton categories and the three physico-chemical parameters in the Tambacan site.

Taxon	Salinity	Water Temperature	Depth
Fish larvae	0.5874	0.0159	0.0159
Fish Eggs	0.5788	0.3156	0.3156
Shrimp larvae	0.6606	0.3359	0.3359
Cubomedusae	0.4022	0.8094	0.7418

Discussion

The pelagic environment is highly dynamic as evident in the fact that factors such as tidal currents, tidal height, ecology, climate, geology and hydrography act not singly but interactively on planktonic systems. This fact alone presupposes variability in distribution and abundance of pelagic organisms both in space and time. Spatial variations in tropical planktonic communities have been well reported (McManus et al. 1992a, b; Ordoñez and Furio 1989) and the results of the present study confirm these earlier findings. However, stated adjacent similarly positioned sampling site may not be a strong force resulting in variation (Estudillo et al. 1987). The two sampling sites seem highly comparable only in terms of the pattern of fish larvae abundance. In general, the Tambacan study site appear to give higher abundance for the other three zooplanktonic categories after adding up all samples over the 13-month period.

McManus et al. (1992) recognized seasonality in Bolinao neritic zooplankton tobe defined by significant changes in dominance between three(3)-month seasons (MAM = dry hot, JJA = wet-hot, SON = wet-cold, DJF = dry cold). This is a temporal pattern of tropical plankton dynamics that may be nested within the widely known strong influence of the northeast (JFM) and southwest (JAS) monsoons, and the transitional periods (AMJ and OND) (Soekarno 1989). The three (3)-month season appears to explain very much the peaks of fish larvae data for both sites over the entire sampling period. Peaks in fish eggs differ in both sites in that they occurred during dry months in the Tambacan site while wet months in the other sampling site. Different species of fish spawners fine tuned to the conditions in either sites cannot be ruled out in explaining the difference. According to Llorca (1976), warm water temperature correlates well with the spawning season of *bangus* (and perhaps of other fish species of similar biotopes) with peak months on April to June and October to November. Other species of fish larvae and eggs might be brought horizontally offshore through floodwaters during heavy rains from the spawning and nursery grounds in mangrove areas (Estudillo et al. 1987). The major peaks of shrimp larvae during the dry and wet months are comparable in both sites. This is also in close agreement with the patterns of seasonal abundance of *Penaeus merguensis* in northern tropical Australia (Vance et al. 1998).

Although not observed in the Larapan sampling site, the peaks of cubomedusae in the cold months in the other site is unusual for sea jellies normally bloom in the tropics during or sight after a dry hot season. This might be explained by the pronounced 1997 El Niño phenomenon which extended up to early 1998.

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