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DISTRIBUTION OF ZOOPLANKTON IN THE EAST SEA

"Results of the Vietnam - Philippines joint Oceanographic and Marine Scientific Research Cruise, 2000"

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ABSTRACT A qualitative and quantitative study of zooplankton was conducted in the waters of East Sea (South China Sea) (along the cruise track from Nha Trang city to Manila) from May 27 – June 2, 2000.

The estimates of zooplankton biomass ranged from 3.55 mg/m^3 to 10.30 mg/m^3, with a mean of 7.07 mg/m^3. Maximum and minimum densities of zooplankton recorded were 17,950 Inds/m^3 in station 13 and 5,950 Inds/m^3 in station 5 respectively.

The results of this study show that zooplankton is more abundant in the coastal region than in the offshore region.

PHAN BO ÑONG VAT NOI Ô VUNG BIEN ÑONG

"Ket qua chuyen khao sat thuoc Chöông trình hôp tac nghien cöu bien giöa Viet Nam va Philippines, 2000"

Nguyen Cho, Nguyen An Khang
Vien Hai Döông Hoc (Nha Trang)

TOM TAT Nghien cöu ñong vat phu du ñöôc thöc hien ô vung Bien Ñong (doc theo mat cat tö Nha Trang ñen Manila) trong chöông trình hôp tac nghien cöu bien giöa Viet Nam va Philippines ñöôc thöc hien tö ngay 27/5 ñen 2/6/2000.

Sinh vat löông dao ñong tö 3,55 ñen 10,30 mg/m^3. Gia trò trung bình ñat 7,07 mg/m^3. Mat ño dao ñong tö 5.950 ñen 17.950 ca the/m^3.

Ket qua phan tích cho thay vung ven bô co sinh vat löông ñong vat phu du cao hôn so vôi vung xa bô.

I. INTRODUCTION

The seawaters of Central Vietnam have been studied for a long time by the Institute of Oceanography in Nha Trang.

M. Rose was the first one who published a list of 42 phytoplankton species and 56 zooplankton species in the coastal waters of Vietnam in 1926 and a list of 119 copepods species in Nha Trang bay during 1955 – 1956.

In 1929, C. N. Dawydoff studied on the seasonal and daylight variation of species composition of zooplankton in Nha Trang bay.

R. Serene studied the temporal variation of plankton related to environmental factors.

In 1956, the other authors such as: M. Hamon published a list of 11 Chaetognaths species and E. Leloup published a list of 21 Siphonophora species in Nha Trang bay, in 1958 M. Yamashita published the variation of plankton biomass in Nha Trang bay waters.

The NAGA investigation program conducted by United States of America during the period of 1959- 1961 was considered to be the most standard study in the waters of East and South Vietnam from 4^o N to 16^oN, expanded to 114^o E. Many studies on plankton were published in the NAGA reports. In 1963, E. Brinton published the biomass of plankton in the waters of East and South Vietnam, in the East Sea, with mean biomass of 150 cc/m^3. Bui Thi Lang published some species of Copepods, which were dominant in the waters of South Vietnam, M. Rotman published a list of Pteropoda, A. Alvarino published a list of Siphonophora and Chaetognatha species. Publications on Euphausiids in 1975 by E. Brinton were considered to be the most complete studies on species taxonomy of zooplankton in the waters of Vietnam before 1975.

During the period of 1971-1974 the CSK Programme (Cooperation Study of the Kuroshio and Adjacent Region) was implemented to investigate zooplankton in the coastal waters of Phu Yen - Khanh Hoa.

After the liberation of South Vietnam (1975), many comprehensive investigations in the waters of South Vietnam were carried out. In which the programme named "Comprehensive investigation in Thuan Hai - Minh Hai waters (1978-1980) was considered to be the most standard with 11 surveys of "Bien Dong" Ship and 4 surveys of "03 Marine Research" Ship.

Specimens of zooplankton in large area were collected by the Nauka Ship in the Programme named "Study on the marine fish resource in the waters of South Vietnam". Also from 1982 up to now, many research vessels of USSR such as "Prof. Bogorov" (1981-1985), "Academican Nesmeyanov" (1982), "Sokanski" (1992-1994) were used to collect plankton specimens in the waters of South Vietnam.

From 1991 to 1994 the waters of Central Vietnam limited from the depth of 110m toward the seashore had been fundamentally investigated. The upwelling area in Southern Central Vietnam was specially cared for.

Three surveys were conducted at Spratly islands (a coral archipelago), 216 zooplankton species were classified. In which seven species were firstly found in Vietnam.

II. MATERIALS AND METHODS

Plankton sampling had been done at 16 oceanographic stations in the study area (Fig. 1) from May 27 to June 2, 2000. The sampling locations are shown in figure 1.

Samples were collected at each station, using a plankton net (mesh size 64 μm, mouth diameter: 50 cm, length 150 cm) and vertical tows from 100m to surface. Four additional samples were obtained for the qualitative assessment of zooplankton from vertical tows from 200m to the surface. The replicated samples of 500ml were obtained from each station for determination of abundance and biomass. All samples collected were

concentrated and fixed with 5% formaldehyde solution.

In the laboratory, to determin abundance and density of zooplankton, samples were subdivided into two size groups: > 500μm and < 500μm. The organisms that were retained by the sieve were counted fully while those that passed through the sieve were subsampled. To subsample, a 20μm size sieve was used. The organisms that were retained in the 20μm mesh sieve were added with 100ml of filtered seawater and stirred well to form a uniform distribution of the organisms. One ml of subsample was taken using a stempel pippette and placed into a sedgewick - Rafter cell.

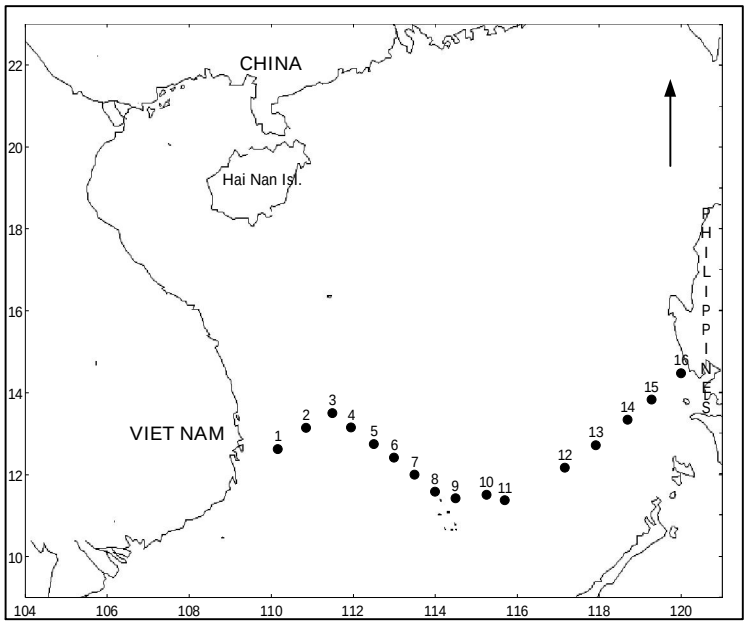

Fig. 1: Location of the sampling stations

The organisms were uniformly spread in the counting slide for microscopic observation. The count of organisms was done in triplicates and performed under alight microscope. The zooplankton density (inds/m^3) was estimated by McManus (1993).

Determination of zooplankton biomass was conducted after a month of storing the samples at room temperature to allow maximal leaching of preservative. The samples were filtered on a pre-dried and pre-weighed filter paper, dry weight of zooplankton was obtained after oven- drying the concentrated samples at 60^{o}C for 48 hours.

Zooplankton species was identified using main keys of Alvarino, A. (1963) Brinton (1975), Chen Q.C. & Zhang S.Z. (1965) , Chen Q.C., Zhang S. Z. & Zhu C. S. (1974), Owere .H. B. & M. Foyo (1967) and Nguyen Van Khoi (1985).

Most of the individuals had been identified to species level but this was not possible for some groups such as: the larval stages of invertebrates, especially the Protozoa.

III. RESULTS

1. Zooplankton biomass

The biomass estimated by using dry weight method showed that the

biomass ranged from 3.55 to 10.30 mg/m^3, with an average of 7.07 mg/m^3 (Fig. 2). The highest biomass of 10.30 mg/m^3 and the lowest biomass of 3.55 mg/m^3 were found at stations 10 and 14, respectively.

The spatial distribution of biomass estimates of zooplankton in the whole investigated area is shown in fig. 3. A zooplankton - rich patch which shares highest biomass estimates of 10.30 mg/m^3 was observed at station 10 off north Spratly islands. Coastal waters of Nha Trang (Central Vietnam) (stations 1, 2 and 3) and Manila (Western Philippines) (stations 15 and 16) also have relatively high biomass estimates ranging from 7 - 8 mg/m^3. Offshore waters of northeastern Spratly islands also have relatively high biomass estimates (station 13).

On the whole, offshore waters between Nha Trang (Central Vietnam) and Spratly islands (stations 4, 5 and 6) as well as between Spratly islands and Manila (western Philippines) (stations 12 and 14) have lower biomass estimates ranging 3 – 6 mg/m^3 than those of the coastal waters as noted above (except at station 13).

2. Composition abundance and distribution of major zooplankton community

Figure 4 shows a fairly comparable picture of the distribution and abundance of zooplankton community in the East Sea along the cruise track from Nha Trang City to Manila City is assessed. The number of each group of zooplankton per station was expressed in individual/m^3. The relatively high zooplankton counts in the survey area were due entirely to copepods, including copepodite and nauplii, could be grouped into three orders “viz Calanoida, Cyclopoida and Harpacticoida” among them, copepod nauplii was the most dominant. Copepods was the most dominant of zooplankton with counts ranging from 4,760 to 12,275 inds/m^3 in all stations and constituted 76.47 % of total zooplankton.

This group was most abundant in terms of numbers and species. One hundred and twenty eight species were identified, distributed among 24 families.

As with zooplankton density, counts of copepods were comparatively uniform in the survey area. Two maximum abundance peaks of 12,275 inds/m^3 and 11,475 inds/m^3 occurred at stations 13 and 16, respectively.

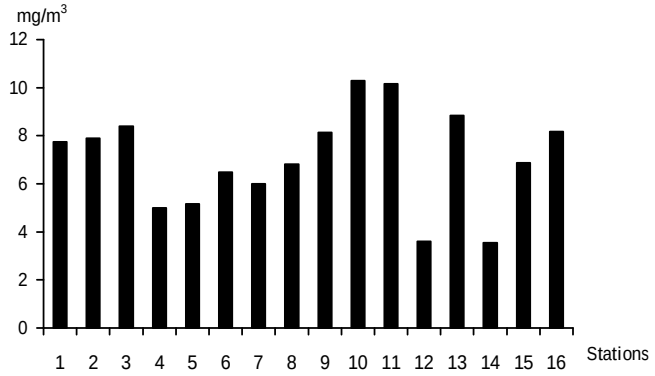

Fig. 2: Biomass of zooplankton

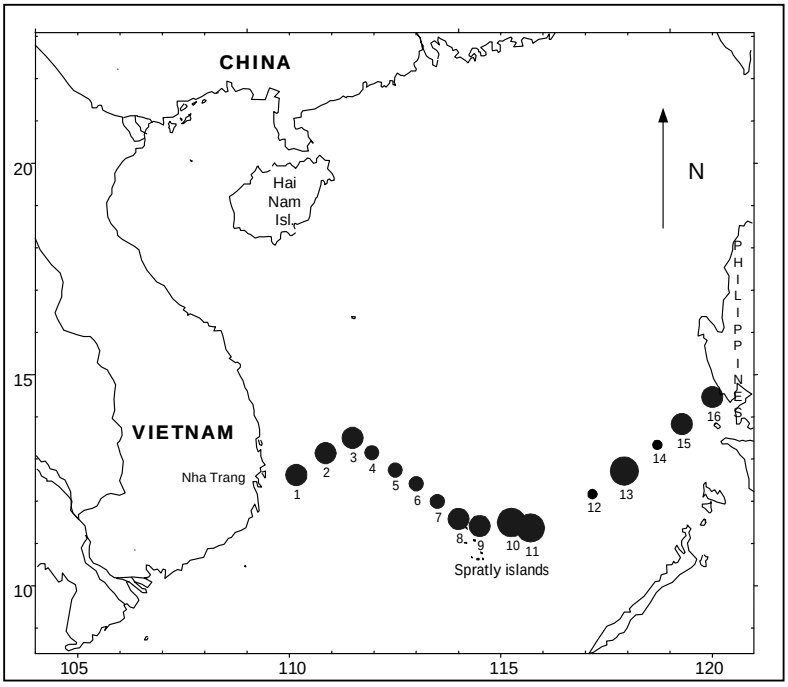

Fig. 3: Distribution of zooplankton biomass, May 27-June 2, mg dry weight/m^3

Legend: • < 5 ● 5 - 6 ● 7 - 8 ● > 8

Protozoa: This group which consisted of Radiolaria, Foraminifera and Holotricha made up less than 17 % of the total numbers of zooplankton. They were the next dominant groups, with counts ranging from 99 to 5,682 inds/m^3 in all stations. Protozoa also contributed to the maximum peaks of abundance at offshore waters off northwestern and northeastern Spratly islands (stations 6 and 13) having 5,682 and 3,807 inds/m^3, respectively.

Tunicata: This group was represented by two classes: Larvacea and Thaliacea, which constituted less than 6 % of the total zooplankton, with counts ranging from 120 to 1,073 inds/m^3 in all stations. Counts of Tunicata were comparatively low in the eastern part than that of the western part off the Spratly islands. Two major peaks of abundance for such organisms occurred in the following: one at station 3 in the coastal waters off Nha Trang City (Central Vietnam), another one at station 12 in the northeastern Spratly islands, with counts of 845 inds/m^3 and 1,073 inds/m^3, respectively. The Tunicata was represented by the genus: Oikopleura, Fritillaria, Dolioletta, Salpa, Thalia…

Chaetognatha: Chaetognatha constituted less than 1 % of the total zooplankton and ranked fourth in abundance. Ten species of Chaetognatha have been identified. Sagitta enflata was the most dominant. This resulted from the relatively low counts which ranged from 7 to 157 inds/m^3 recorded for all stations. The organism was dominant in the area that was particularly observed at stations 4 and 15 having 151 and 157 inds/m^3, respectively.

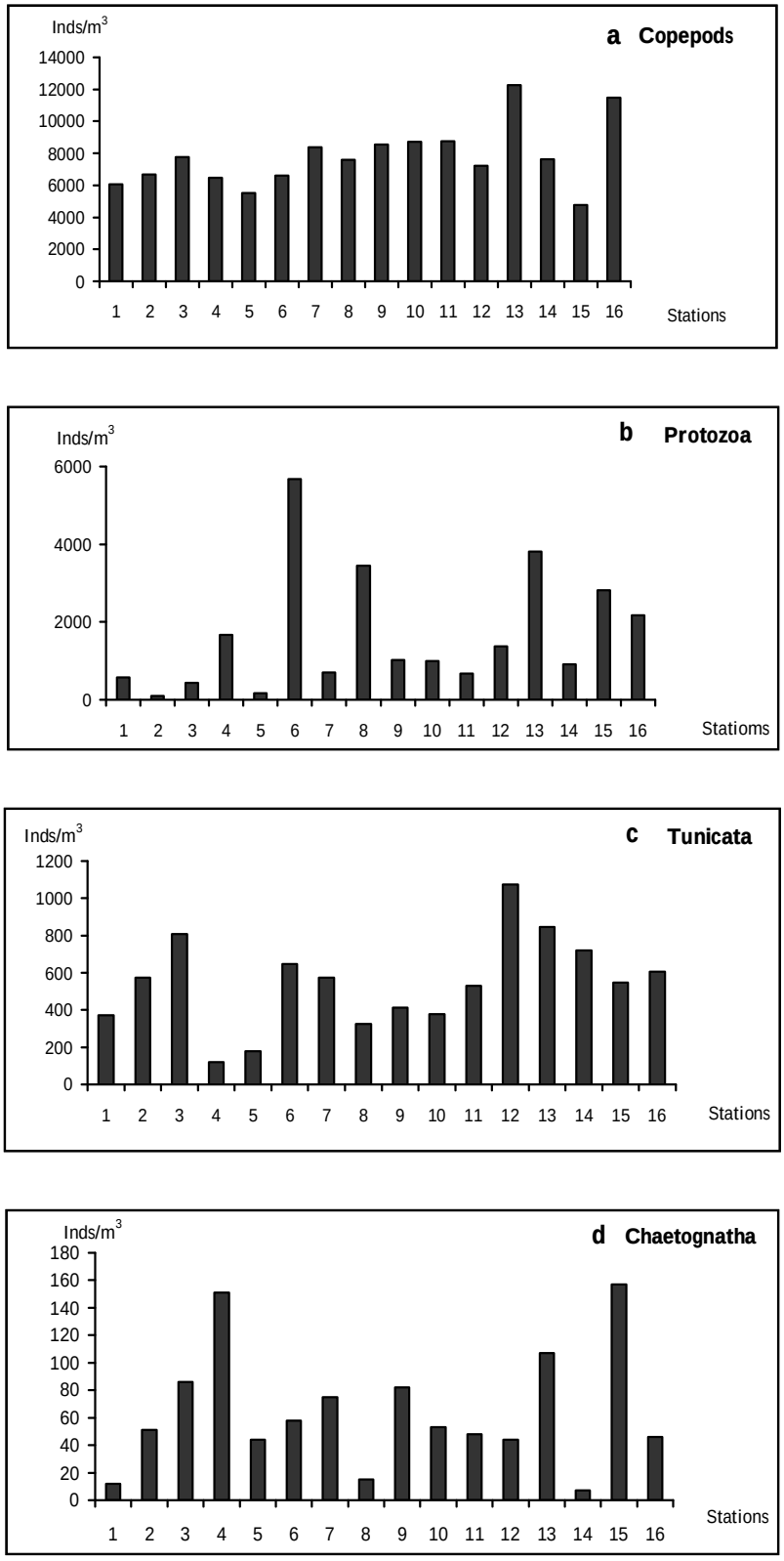

Fig. 4: Population density of the dominant zooplankton groups per station in the East Sea, May 27 - June 2 - 2000

IV. DISCUSSION

The ranges of total zooplankton counts (5,950-17,095 individuals/m^3) in present study of East Sea (along the cruise track from Nha Trang City to Manila) are lower than those values previously reported for waters of the ASEAN region and some tropical waters. In comparison with the total number of zooplankton per m^3 obtained in Singapore Strait, for example, it is evident that the minimum average of approximately 14,000 inds/m^3 and maximum average of approximately 60,000 inds/m^3 [Tham et al. (1970)] were considerably higher than that of the present study. Results obtained by Tseng 1969 in Taiwan Strait (594 - 1,449 inds/m^3) as well as Nguyen Thuong Dao and Le Thi Ngoc Anh (1972) in Nha Trang bay (75 – 562 inds/m^3) were lower than even that of the former. The methods used by Tham et al. (1970), Tseng (1969) and Nguyen Thuong Dao & Le Thi Ngoc Anh (1972) were by horizontal surface tows with different types of nets. Whereas, vertical hauls of plankton net with mesh size of 64 μm, mouth diameter of 50 cm and length 150 cm was used in the present study. These facts show that the method of sampling is very important in revealing the consistency of distribution and abundance of zooplankton among areas.

Figure 3 generally depicted a pattern of distribution of higher zooplankton biomass at the coastal waters of Manila (Western Philippines) (stations 15 and 16), Nha Trang (Central Vietnam) (stations 1, 2 and 3) and northern Spratly islands (stations 9, 10 and 11) compared to those obtained at offshore waters (except station 13) with a path of relatively high biomass estimates ranging from 7.5 – 8.5 mg dry weight/m^3. Waters off northern Spratly Islands was featured by a highest zooplankton biomass of 10.30 mg/m^3 dry weight/m^3 (station 10). Likewise, in terms of numerical abundance, these particular areas demonstrated relatively high zoo-plankton community, which ranged from 7,084 inds/m^3 to 10,382 inds/m^3. However it could be noted that the highest total zooplankton of 17,040 inds/m^3 occurred at station 13 in offshore waters between Spratly islands and Philippines.

Analyzed results show that, the water areas of northeastern Spratly islands established relatively higher biomass estimates than that of the water areas in northwestern Spratly islands. This phenomenon was probably influenced by the monsoon circulation pattern of the ocean regime in the northeast side of the Pacific ocean [Takenoute et al. (1970)] that converged with the northward longitudinal current of the East Sea during April. Likewise induced waters circulation from the southern part of East Sea which caused water mass displacement during May and have probably contributed to zooplankton rich in the northeast waters of Spratly islands.

General observation made on the occurrence and abundance of the different zooplankton organisms which comprised 305 taxa show that copepods formed the major component and occurred throughout study area. The pattern of quantitative distribution of zooplankton in the entire area was dominated by copepods (76.47% of the total zooplankton). Maximum peaks of abundance in coastal waters (stations 1, 2, 3 ,9 , 10 , 11, 15 and 16) have

been attributed to copepods, mainly comprised of copepods nauplii, Cyclopoida, Calanoida and Harpacticoida. Copepods also distributed to the maximum peaks of abundance at offshore waters (stations 7 and 13). Copepods are distributed throughout the World Ocean and are one of the most important components of the plankton community. They play a crucial role in the marine food chain, since they link with primary production to higher tropic level and are important component in the diet of many fishes, seabirds and even whales. The copepods that include herbivores, carnivores and omnivores play a significant role in the transformation of organic matter in marine pelagic ecosystem [Anraku and Omori (1963)].

The plankton analyzed by Alvarino (1981) also shows that Copepod was the dominant group in almost 80 % of collections made in the waters of California, Interestingly this also conforms well with the present study wherein copepods constituted 87.38 % of the total zooplankton in the entire sampling area.

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