Preliminary Report
of
The Hakuhō Maru Cruise KH-81-5
(WESTPAC)

Sept. 7-Nov. 20, 1981

The Philippine and the South China Seas

Ocean Research Institute

University of Tokyo

1983

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by

The Scientific Members of the Expedition

Edited by

Ryuzo MARUMO

Preface

The KH-81-5 Cruise of the R. V. Hakuhō Maru of the University of Tokyo was conducted in the Philippine Sea and the South China Sea during a period of 75 days from September 7 to November 20, 1981 with port calls at Hong Kong, Singapore and Cebu in the Philippines.

This report contains biological, biochemical and hydrographical data obtained during this cruise and short summaries of research carried out by each scientist and the scientific teams aboard.

This cruise formed part of the WESTPAC Programme of activities aimed at studying the pelagic ecosystem and its dynamics in the western Pacific region. On this cruise, 37 scientists were on board, including one from each of Korea, China, Malaysia, Indonesia and Australia and two from the Philippines. The research was actively and successfully carried out with the close cooperation of all scientists aboard.

On behalf of the scientists aboard, I wish to express our sincere thanks to the officers in the Intergovernmental Oceanographic Commission, and UNESCO in Paris, and also officers in the Japanese Ministry of Education, Science and Culture and the Ministry of Foreign Affairs for their diplomatic arrangement of permission to carry out marine scientific research in coastal waters and for providing travel funds for scientists participating from WESTPAC countries. Thanks are also extended to Captain I. Tadama, officers and crew mumbers of the Hakuhō Maru for their cooperation and capable assistance throughout this cruise.

Ryuzo Marumo
Chief Scientist

Contents

Outline of the cruise

Under the overall title of "Studies of the Marine Pelagic Ecosystem and its Dynamics in the Western Pacific" the following research topics were investigated: (1) taxonomy, ecology and production of phyto- and zooplankton, (2) taxonomy and assessment of abundance of ichthyoplankton and micronekton, (3) ecology and activity of microorganisms, (4) biochemical activity and metabolism in the sea and (5) hydrographic observations in the Philippine Sea and the South China Sea.

The cruise consisted of four legs: Leg 1 from Tokyo to Hong Kong, Leg 2 from Hong Kong to Singapore, Leg 3 from Singapore to Cebu in the Philippines and Leg 4 from Cebu to Tokyo. The cruise itinerary is shown in Table 1. The location of observation lines and stations are given in Fig. 1. During the cruise, Hakuhō Maru stayed one, two or three days at 15 major stations and 5 days at Stn. 6 to study various aspects of the biological dynamics of the sea in the South China Sea. At these stations, field observations and shipboard experiments were carried out on the biomass and activity of phytoplankton, zooplankton, micronekton and bacteria in conjunction with various observations of physical and chemical properties of the ocean such as ocean currents, water temperature, salinity, dissolved oxygen, nutrient salts, chlorophyll pigments etc., in order to analyze diurnal fluctuation and vertical migration of these marine organisms.

The names and specialities of the 37 scientists who participated in the cruise are listed in Table 2.

Table 1. Cruise itinerary

	Arrival	Departure
Tokyo		Sept. 7, 1981
Hong Kong	Sept. 21	Sept. 25
Singapore	Oct. 11	Oct. 16
Cebu	Oct. 31	Nov. 5
Tokyo	Nov. 20	

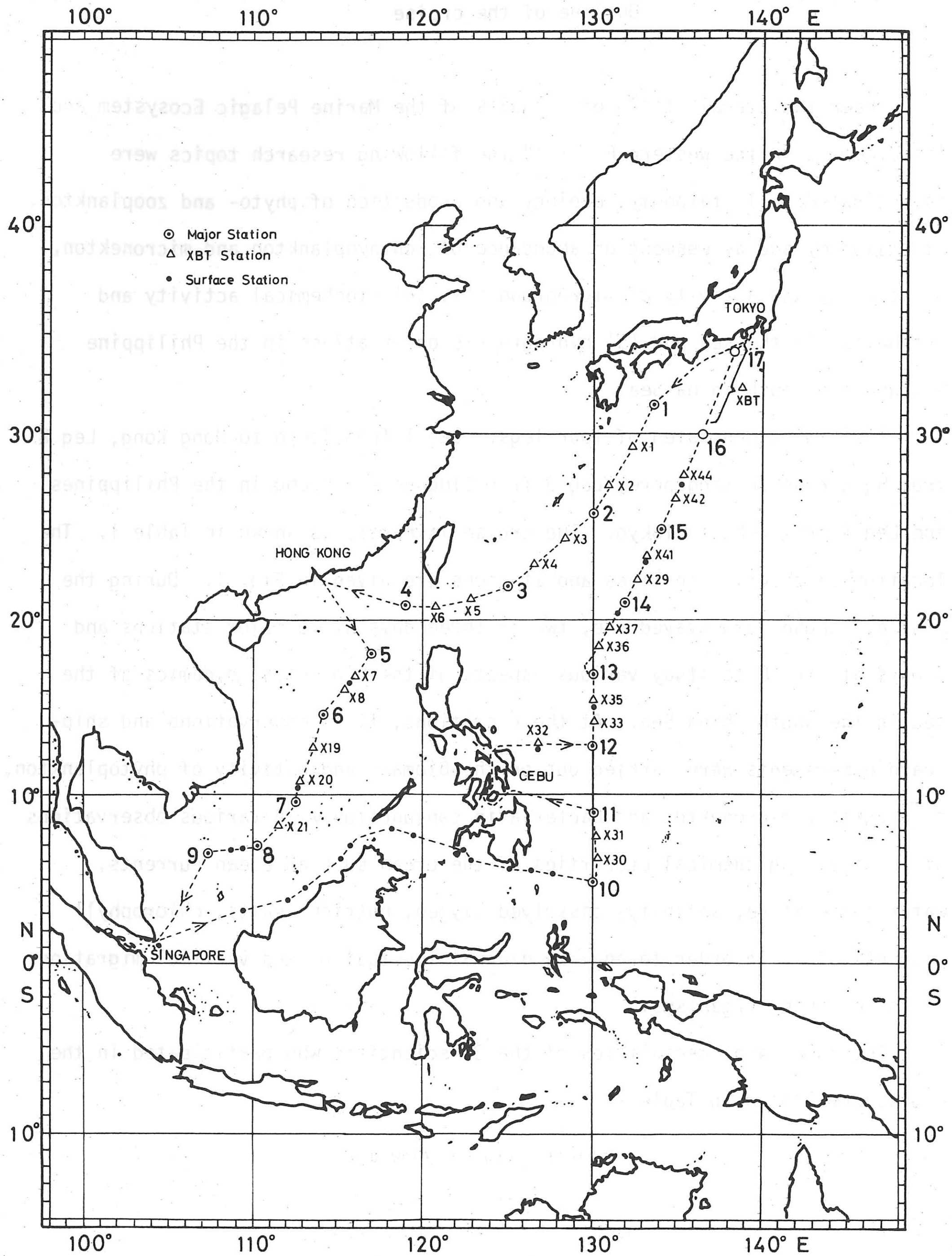

Fig. 1. Track chart and observation stations of the KH-81-5 cruise of the Hakuho-maru.

Table 2. Scientists aboard

Ryuzo MARUMO (Chief scientist)	Ocean Res. Inst., Univ. of Tokyo	Plankton
Nobuo TAGA	Ocean Res. Inst., Univ. of Tokyo	Bacteria
Tsuneo AOYAMA	Ocean Res. Inst., Univ. of Tokyo	Fish. ecology
Yoshihiko FUJITA	Ocean Res. Inst., Univ. of Tokyo	Algal physiology
Takahisa NEMOTO	Ocean Res. Inst., Univ. of Tokyo	Plankton
Usio SIMIDU	Ocean Res. Inst., Univ. of Tokyo	Bacteria
Toshisuke NAKAI	Ocean Res. Inst., Univ. of Tokyo	Physical oceanoraphy
Masachika MAEDA	Ocean Res. Inst., Univ. of Tokyo	Bacteria
Toshiro SAINO	Ocean Res. Inst., Univ. of Tokyo	Marine biochemistry
Takashi ISHIMARU	Ocean Res. Inst., Univ. of Tokyo	Marine physiology
Shuhei NISHIDA	Ocean Res. Inst., Univ. of Tokyo	Plankton
Ken FURUYA	Ocean Res. Inst., Univ. of Tokyo	Plankton
Hirotaka OTOBE	Ocean Res. Inst., Univ. of Tokyo	Physical oceanography
Tadashi INAGAKI	Ocean Res. Inst., Univ. of Tokyo	Fish. ecology
Yutaka MATSUO	Ocean Res. Inst., Univ. of Tokyo	Plankton
Yuichi HIROTA	Ocean Res. Inst., Univ. of Tokyo	Plankton
Katsuya MIKI	Ocean Res. Inst., Univ. of Tokyo	Marine ecology
Kazuhiro KOGURE	Ocean Res. Inst., Univ. of Tokyo	Bacteria
Won Jae LEE	Ocean Res. Inst., Univ. of Tokyo	Bacteria
Apichart TERMVIDCHAKORN	Ocean Res. Inst., Univ. of Tokyo	Ichthyoplankton
Nozomu IWASAKI	Ocean Res. Inst., Univ. of Tokyo	Plankton
Masayuki TAKAHASHI	Inst. of Biol. Sci., Univ. of Tsukuba	Marine ecology
Joji ISHIZAKA	Inst. of Envi. Sci., Univ. of Tsukuba	Marine ecology
Masaaki MURANO	Tokyo Univ. of Fisheries	Plankton
Takashi ANAKUBO	Tokyo Univ. of Fisheries	Plankton
Kensaku MURAOKA	Kanagawa Prefectural Museum	Plankton
Yuzaburo ISHIDA	Fac. of Agri., Univ. of Kyoto	Bacteria
Saburo HARA	Fac. of Sci., Univ. of Osaka	Bacteria
Shiro NISHIDA	Nara Kyoiku Univ.	Plankton
Kimiaki YASUDA	Fac. of Agr., Univ. of Miyazaki	Bacteria
Xiuren NING	Nat. Bureau of Oceanography, China	Plankton
Ving Ching CHONG	Dep. of Zool., Univ. of Malaya, Malaysia	Primary production
Dong Yup KIM	Col. Nat. Sci., Seoul Nat. Univ., Korea	Plankton
Jose A. ORDONEZ	Bureau of Fish. & Aquat. Recources, Philippines	Fish. ecology
A. B. SUTOMO	Nat. Inst. of Oceanology, Indonesia	Plankton
Andrew M. G. FORBES	CSIRO, Div. of Oceano. Australia	Physical oceanography
Ruben A. ESTUDILLO	Bureau of Fish. & Aquat. Resources, Philippines	Fish. ecology

1. Hydrographic characteristics

T. Nakai, H. Otobe and R. Marumo

Temperature, salinity, dissolved oxygen and nutrient data were obtained through routine hydrocast survey using a CTD with Niskin bottle samplers. XBT observations were also made in order to obtain temperature profiles. Using these data, hydrographic characteristics are described for each leg of the cruise.

(1) Section I (Figs. 2, 3, 4 and 5)

Section I cut across the Philippine Sea from Stn. 1 to Stn. 3 on Leg 1 and the South China Sea from Stn. 4 to Stn. 9 on Legs 1 and 2. In the Philippine Sea, the seasonal thermocline and the main thermocline existed at about 75 m and 500 m, respectively. The water between the first and second thermoclines can be called the North Pacific Subtropical Mode Water. On the other hand only one thermocline was observed at about 50 m in the South China Sea. In the waters around Stn. 3, the surface temperature was more than 29°C, which is higher than in other areas of the Philippine Sea. This high temperature water is supposed to be the major source of the Kuroshio.

In the Philippine Sea, water with a salinity maximum lay in layer at about a depth of 200 m while water with a minimum value can be seen at about 700 m. The detailed characteristics of these waters are given in Section II. In the South China Sea, a slight salinity maximum and minimum were observed at about 150 m and 500 m, respectively.

The dissolved oxygen content in the surface layer was uniform at about 4.5 ml/l in almost all sections. A thick layer rich in dissolved oxygen was observed in the North Pacific Subtropical Mode Water while a dissolved oxygen poor water occupied the midlayer of the South China Sea. Water with a dissolved oxygen minimum less than 2.0 ml/l can be observed below the core of the salinity minimum layer in the Philippine Sea.

According to the temperature-salinity diagram (Fig. 19), the water from Stn. 1 to Stn. 3 in the Philippine Sea can be classified as the Western North Pacific Central Water while the water from Stn. 4 to Stn. 9 shows characteristics of the South China Sea, one of the large marginal seas in the Western Pacific.

The sigma-t gradient on the west side of Stn. 3 indicates the probable major source of the Kuroshio. Monsoon winds control the surface currents in the South China Sea. During the summer monsoon, the prevailing wind characteristically has a southwesterly component. Therefore the surface water of the South China Sea flows generally northward and the core of the current lies along the south Vietnam coast. The ship's drift vectors obtained by NNSS suggest (Fig. 20) there were some weak counter currents on the course of Leg 2.

(2) Section II (Figs. 10, 11, 12 and 13)

Section II is compiled from the Philippine Sea data from Stn. 10 to Stn. 17 on Legs 3 and 4 and is presented in Figs. 10-13. The isotherms become gradually deeper northward from Stn. 11 to Stn. 16 where the surface mixed layer was thickest. Stn. 11 lay in the boundary water between the North Equatorial Current and the Equatorial Counter Current. The vertical gradient of temperature in this area was the largest in this section. XBT observations indicate the presence of a strong meander in the Kuroshio current between Stn. 16 and Stn. 17. The North Pacific Subtropical Mode Water, with a temperature of around 17°C or more, was observed in the thick layer between the seasonal thermocline and the main thermocline from 20°N to 30°N as in Section I.

The North Pacific Tropical Water lay at about 150 m in the subtropical region from Stn. 12 to Stn. 16. An outstanding salinity minimum value less than 34.5 ‰ was observed below the North Pacific Subtropical Mode Water and it can be traced from the coast of Japan to 10°N as the North Pacific or Subarctic Intermediate Water. It is believed that the low salinity water at the surface at Stn. 11 is caused by precipitation. In this area where an

Intertropical Convergence Zone is found, violent squalls frequently occur. Thus, it can be seen that the salinity structure east off Mindanao is very complicated.

The oxygen minimum water with less than 1.75 ml/l lay in the deeper layer of the North Pacific Intermediate Water at about 400 m at Stn. 11.

The watermass found at Stn. 13 to Stn. 17, the North Pacific Intermediate Water, can be discriminated from the Western North Pacific Central Water on the basis of the temperature-salinity diagram. It seems that the water from Stn. 10 to Stn. 12 belongs to a watermass transitional between the Western North Pacific Water and the Pacific Equatorial Water.

According to the sigma-t, temperature distribution and the NNSS data, the currents in Section II during this cruise may be classified as follows: the Equatorial Counter Current between Stns. 10 and 11; the North Equatorial Current between Stns. 15 and 16; and the Kuroshio meander between Stns. 16 and 17.

2. Radiation measurements and heat budget across the sea surface

H. Otobe and T. Nakai

Direct measurements of downward short- and long-wave radiation fluxes at the sea surface were made in order to estimate the heat budget across the sea surface in the South China Sea and the Philippine Sea. The data were collected continuously during this cruise.

A short-wave sensor (Neo-Pyranometer Model MS-41, Eiko Seiki Sangyo Co., Tokyo) and a long-wave sensor (Ishikawa radiometer Mosel RL-2, Ishikawa Sangyo Co., Tokyo) mounted on the gimbals were installed on the handrail of the anti-rolling tank at the top of the vessel.

Heat budget across the sea surface (Q) is given by

$$Q = Rn - (lE + H), \qquad (1)$$

where Rn is the net radiation flux, lE the latent heat flux, and H is the sensible heat flux. For this cruise, the net radiation flux (Rn) was computed from following equation

$$Rn = (1 - r)\,S\downarrow - \varepsilon(\sigma T^4 - L\downarrow), \qquad (2)$$

where $S\downarrow$ and $L\downarrow$ are the fluxes of downward short- and long-wave radiation measured directly, r the albedo derived by Pane (1972), T the sea surface temperature, ε and σ are the emissivity of the sea water and the Stefan-Boltzman constant, respectively. The latent heat flux (lE) and the sensible heat flux (H) are estimated by use of the aerodynamics bulk method (Kondo, 1975) and routine meteorological data.

As an example, Fig. 21 shows the diurnal variation of the heat budget and its components at Stn. 6 in the South China Sea.

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3. Taxonomy and ecology of zooplankton and micronekton

R. Marumo, T. Nemoto, Shuhei NISHIDA, Y. Matsuo, Y. Hirota, N. Iwasaki and K. Furuya

One of principal purposes of this cruise was to describe the zooplankton and micronekton fauna of the South China Sea, the Philippine Sea and the

Kuroshio waters in terms of taxonomy, biomass, geographical distribution and vertical distribution. The following studies and sampling were carried out. Detailed data regarding the collections have been recorded in the Plankton Record (KH-81-5) deposited in the Plankton Laboratory, Ocean Research Institute.

(1) Collection of zooplankton and micronekton

A NORPAC-twin net constructed of a 0.10 mm-mesh and a 0.33 mm-mesh net was towed vertically from a depth of 200 m to the surface mostly at night to collect larger phytoplankton and epipelagic zooplankton.

A Motoda horizontal net (MTD net) was towed day and night mostly in 10-20 different strata between 1000 m and the surface by two series of tows; a shallow series and a deep one. Three types of nets with mesh sizes of 0.10 mm, 0.33 mm and 0.68 mm were used to cover a wide range of animals from smaller zooplankton to fish larvae.

A Longhurst-Hardy plankton recorder (LHPR; both the conical net and the rolled gauze with 0.33 mm mesh) was used to study the small-scale vertical distribution of zooplankton.

To collect larger zooplankton and micronekton, two types of ORI net were used. An opening-closing ORI-100 net (1.0 mm mesh) was towed horizontally in different strata between 1000 m and the surface day and night to study the vertical distribution of larger zooplankton and micronekton, while an ORI-69 net (0.69 mm mesh) was towed obliquely in the layer between 1500 m and the surface to collect zooplankton and micronekton including euphausiid larvae. During Leg 1 an opening-closing Bongo net was used to study the vertical distribution of zooplankton, while on the following legs it was replaced with an ORI-100 net because of a malfunction of the former.

A 10-ft IKMT (5 mm mesh) was towed obliquely in the layer between a depth of 1500 m and the surface to collect micronekton.

(2) Zooplankton and micronekton fauna and their biomass

The measurement of biomass of each taxonomic group is being made for the samples collected with a NORPAC net, ORI-100 net, ORI-69 net, IKMT and Bongo net. Table 21 shows the wet weight of each taxonomic group collected with an ORI-69 net and IKMT. The value of total wet weight of zooplankton was high in the South China Sea, low in the Philippine Sea and intermediate in the Kuroshio. The vertical distribution of zooplankton biomass at Stn. 6 (Table 22) indicates a daytime maximum in the layer between 358 and 459 m and two nighttime maxima near the surface and in the layer between 402 and 525 m. This suggests the occurrence of marked vertical migration of certain taxa such as copepods, euphausiids, chaetognaths and decapod shrimps. Taxonomy and zoogeography of copepods, chaetognaths, euphausiids, decapods and mysids will also be studied with these materials.

(3) Vertical distribution and diurnal migration of zooplankton

Day-night vertical distribution of copepods, euphausiids and decapod shrimps was studied with the MTD net, ORI-100 net, Bongo net and LHPR collections. At Stn. 6 in the South China Sea, 12 series of MTD net collections were made within 24 hours to study the diurnal migration of zooplankton.

(4) Feeding habit and respiration of euphausiids and decapod shrimps

The food items and feeding rhythm of euphausiids and decapod shrimps have been analysed with the MTD net, ORI-69 net and ORI-100 net collections, accompanied by analyses of the phytoplankton composition of water samples. The size selectivity of living euphausiids fed natural plankton was measured with a Coulter Counter. The respiratory rates of decapod shrimps were measured by the Winkler method.

(5) Horizontal and microvertical sampling of neuston

Neuston was collected at the first 9 stations in this cruise using an ORI neuston or modified ORI neuston net.

The modified ORI neuston net was made by adding one net (0.1 mm in mesh size) with a rectangular mouth part (60 cm W, 20 cm H) to the ORI neuston net at a depth of 1 m. RGS flow meters were mounted in the mouth part of the 10-30-cm and 1-m layer net, and the volume of water filtered was estimated. This modified net was used at the first 6 stations (Stn. 1~6-3). The ORI neuston net was used for Stns. 6-5~9.

At Stns. 1, 2, 4, 5, 7, 8 and 9, the neuston net was towed once around noon. At Stn. 3, the neuston net was towed day and night, and at Stn. 6, the net was towed 10 times successively during 22 hours in order to study diurnal microvertical migration of neuston organisms. All the samples collected were fixed and preserved in 5 % borax-buffered formalin sea water.

(6) Vertical distribution of organic particulate matter

Organic particulate matter in the sea is important particularly as a probable food source for plankton and as a reservoir of organic matter in the sea.

At three stations (Stns. 10, 11 and 12) in the Philippine trench during the KH-81-5 cruise, sampling of the vertical distribution of organic particulate matter was carried out. Water samples collected with a 10 l Van Dorn water sampler were filtered with nucleo-pore and glass fiber filters. Samples were taken at depths down to 4000 m. The former filters will be washed with Ammonium formate and dried at 60°C for dry weight measurement, while the latter will be analysed to estimate carbon, nitrogen and hydrogen contents.

The results of these analyses will be compared with the patterns of vertical profiles of plankton, micronekton and chlorophyll a distribution.

4. Collection of zooplankton in bay waters

M. Murano and T. Anakubo

For the purpose of studies on the taxonomy, zoogeography and species composition of zooplankton in the neritic regions of Southeast Asia, plankton collections were made during the cruise at three anchorage harbors; Hong Kong, Singapore and Cebu in the Philippines. For sampling, a conical net, 25 cm in diameter, 80 cm in filtering length and 0.096 mm in mesh aperture, was raised vertically from 8- or 10-m depth to the surface twice a day, daytime and nighttime, at each harbor. Samples obtained were preserved in 10 % formaldehyde seawater. In all the samples, Copepoda is the most dominant group on the basis of biomass, followed by Chaetognatha.

5. Ecology and taxonomy of brachyuran larvae (Crustacea, Decapoda)

K. Muraoka

The purpose of this work is to investigate the horizontal and zoogeographical distribution, population density and classification of brachyuran larvae, zoea and megalopa stages in South Eastern Asian waters.

The brachyuran larvae were collected by ORI-69 net (160 cm in mouth diameter) from a total of 34 stations. The net was towed horizontally at the sea surface at two knots for 30 minutes at each station. The following preliminary results have been obtained. The brachyuran fauna generally consists of larvae of littoral and neritic species with several deep benthic species. The fauna of Leg III was particularly rich compared to that of other areas. In the former area, roughly half of the individual groups obtained were Portunid megalopae such as genera of *Portunus*, *Charybdis* and *Thalamita*, adult crabs of which are commonly found on sandy bottoms of both coast and bay beaches. The next most abundant groups were usually megalopae of Xanthids and Grapsids. Fauna of Leg IV, the open ocean off the coast of the Philippines, was extremely sparce. Sampling data for both Legs III and IV are shown in Table 20.

It is interesting that megalopae of benthic species such as *Arcania* sp., *Petaromera* sp. and Raninidae Gen. sp. were taken in the surface layer at night. Moreover, it is also worthy of note that megalopae of the common shore species Percnon planissimum, Percnon sp. and Ocypode spp., occur in the oceans; the former was collected in the Pacific Ocean, the latter in the South China Sea. It seems that all of these have vertical or horizontal migratory habits.

6. Nannoplankton distribution

Shiro NISHIDA

The present study is intended to clarify the nature of the tropical to subtropical nannoplankton flora in the western Pacific.

During the cruise, surface water nannoplankton were collected at 1 to 4 hours intervals with a bucket. The vertical distribution of nannoplankton was also analysed to a depth of 300 m at each station. Samples were filtered with a Millipore filter (0.8 μm pore size) and washed with deionized water to remove salt. Nannoplankton collected on the filter were dried at room temperature, brought back to the laboratory, coasted with gold by an ion spattering method and examined under a scanning electron microscope (SEM).

Nannoplankton were identified under the SEM, and at the same time, the number of nannoplankton specimens in a unit area was counted to obtain the nannoplankton population in a unit volume of sea water.

7. Taxonomy and ecology of phytoplankton

R. Marumo and K. Furuya

(1) The community structure and biomass of phytoplankton

Phytoplankton collected with Van Dorn samplers from the layers between 0 and 300 m at all hydrographic stations were treated as follows: 1) 10-20 l of the water sample were filtered through 20 μm mesh. A part of the water sample and the mesh-filtered one were fixed with 1 % glutaraldehyde. Specific composition and population density were examined using a sedimentation method (Utermöhl, 1931). Detailed morphology was examined with electron microscopy. 2) Another portion of the sample was treated with 1 % glutaraldehyde, filtered with a membrane filter, and examined by a modified method of Tsuji and Yanagita (Tsuji and Yanagita, 1981). With this method fragile forms were preserved well. Fluorescent and phase-contrast microscopy of the filtered samples was used to determine biomass. Cell number and volume were measured with an Image Analysing System (Luzex 500, Nihon Regulator Co., Tokyo). By detecting chlorophyll fluorescence, phytoplankton could be distinguished from non-photosynthetic plankton and detritus.

The non-preservable fraction of phytoplankton, the so called "naked flagellates" were identified and enumerated using a serial dilution culture method (Throndsen, 1969) at Stns. 1, 3, 6, 12, 13 and 14. Sea water samples collected with a Niskin bacteria sampler from two to four depths within the euphotic zone, were inoculated into modified Erd-Shreiber medium. The culture was incubated for several weeks under controlled in-situ temperature and light conditions, and examined microscopically every week.

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(2) Fine structure of the phytoplankton community in the subsurface chlorophyll maxima

The vertical microstructure of the phytoplankton community around the subsurface chlorophyll maxima and its relation to fine oceanographic structure were studied at Stns. 3, 5, 6, 10 and 12.

For continuous profiles of temperature, salinity and in-vivo chlorophyll fluorescence, downward and upward casts of a CTD fitted with Variosens (Impuls Physik, West Germany) were made (Fig. 22). During the upward cast water samples were collected with a Rosset sampler attached with 5 l Go-Flowbottles from nine depths determined by Variosens signal.

Salinity, nitrate, nitrite, phosphate, silicate, chlorophyll a, phaeopigment and dissolved oxygen were measured. For phytoplankton composition and biomass, a part of the water samples was fixed in 1 % glutaraldehyde and treated as described in section (1).

8. Physiology of phytoplankton

T. Ishimaru, Y. Fujita and K. Miki

Physiological studies of phytoplankton in waters of the Kuroshio and South China Sea were made during Legs 1 and 2. Studies focused on three objectives; photosynthetic characteristics of subsurface phytoplankton, succession of the surface population induced by nutrient-enrichment, and photosynthesis of Trichodesmium.

(1) Photosynthetic characteristics of subsurface phytoplankton

We found a well developed subsurface chlorophyll maximum around a depth of 100 m at every station. Photosynthetic capacity was measured on the basis of DCMU-induced fluorescence increase and characteristics of the pigment system were analysed using a newly developed fluorescence method. The method can compare fluorescence yields of chlorophyll a- and accessory pigment-excitations. The latter absorbs light mainly around 500 nm, so that the method provides information on chromatic adaptation of the pigment system to the light environment in deeper layers.

Water samples collected from different depths between the surface and 150 m were subjected to both measurements within 2 hours. Before measurement, samples were kept in the dark. Chlorophyll a contents were determined fluorometrically after extraction with acetone.

Stns. 2 and 3. A subsurface chlorophyll maximum appeared around 90 m depth; at Stn. 2 chlorophyll a concentration at the maximum was almost 3 times higher than at the surface while at Stn. 3 the concentration was 8 times higher. Photosynthetic capacity was highest at 10 m, but the capacity at the depth of the subsurface maximum still retained more than 80 % of this peak capacity. The ratio of fluorescence yields of carotenoid-vs chlorophyll-excitation was generally higher at the subsurface maximum. The ratio at the surface was occasionally found to be as high as in the subsurface. In such cases, *Trichodesmium* occurred in the water samples.

Stns. 4 to 7. A subsurface chlorophyll maximum appeared at 80 to 100 m. Chlorophyll a content at the maxima was 4 to 7 times higher than that at the surface. Photosynthetic capacity was generally unaltered in the samples above 100 m. Except for Stn. 7 the ratio of fluorescence yields was higher in the subsurface than that at the surface; at Stns. 4 and 6, the ratio in the subsurface was more than double that at the surface.

These results clearly indicate that (1) the subsurface chlorophyll maxima so far examined are formed by active phytoplankton and (2) the photosynthesis of such phytoplankton is adapted chromatically to the light environment in the deeper layers. (T.Ishimaru and Y. Fujita)

(2) Experimental culture of phytoplankton in surface waters

Experimental cultures of phytoplankton in surface waters of the Kuroshio (Stn.1) and South China Sea (Stn. 6) were made using a newly developed chemostat system. The study was aimed at determining the effect of nutrient enrichment on the surface population. Water samples collected with a Niskin sampler were aseptically transferred to a sterilized culture vessel (500 ml), and the culture was grown under fluorescent illumination. Two types of culture were analysed; in the first, $NaNO_3$ plus NH_4Cl (6 μg at-N/l) and Na_2PO_4(0.6 μg at-P/l) were first enriched in the inoculum and were continuously supplied to the culture (dilution rate, 0.19 per day), and in the second, the enriched medium was added to the inoculum at the dilution rate, so that the nutrient concentration was gradually increased. During the first 5-day period, a succession of dominant species, from naked flagellates to diatoms, occurred in every case, and the culture became stable within 2 weeks. Naked flagellates were still found even in the stable culture. Thus, the succession does not seem to be due to a defect of the culture method for growth of naked flagellates, rather the growth conditions set by us may be more favorable to diatoms which were a minor component of the natural population. (K. Miki).

(3) *Trichodesmium* photosynthesis

Measurements of photosynthesis were performed on *Trichodesmium* collected at Stn. 9 (*T. thiebautii* dominant) using a Clark-type O_2 electrode. The maximum activity was 200 to 300 μmoles O_2 per mg chl. per hr. These values are comparable to those obtained previously with samples from the East China Sea and the western Gulf of Mexico, but are far higher than those generally observed in blue-green algae. A high photosynthetic activity may be a characteristic of *Trichodesmium*. (Y. Fujita and T. Ishimaru)

9. Detection of local upwelling with a continuous monitoring system

J. Ishizaka and M. Takahashi

In order to detect local upwelling, temperature, salinity, *in vivo* chlorophyll fluorescence and nitrate (plus nitrite) near the surface collected through the bottom intake hole of the vessel were measured continuously along the cruise track with a monitoring system. Sample water was brought into the laboratory within one minute or less, which resulted in only a minute change in temperature of less than 0.1°C compared with bucket samples collected at the surface. *In vivo* chlorophyll fluorescence was determined with a Turner Design fluorometer using a flow cell system. Subsamples for calibration of chlorophyll and salinity were taken periodically. Salinity samples were determined with an Autosal inductive salinometer. Chlorophyll *a* was determined by fluorometry after extraction of the sample retained on a HA Millipore filter with 90 % acetone. Nitrate (plus nitrite) was determined by the Cu-Cd reduction method using an autoanalyzer.

Upwelling plumes near the surface were detected at almost all shallow straits during the present cruise, such as Basy, Balabac, Basilan, Surigao and San Bernardino, but not in Sarangani, a deep strait. In these upwelling areas surface temperature was a few degree centigrades lower compared with the immediately surrounding area, however salinity, chlorophyll *a* and nitrate were higher. In Basilan Strait, temperature was 1-2°C lower, the maximum concentration of chlorophyll *a* reached 0.7 μg./l and nitrate was more than 1 μg at./l. Centric diatoms, *Chaetoceros* spp. dominated in the upwelled waters.

10. Natural abundance of ^{15}N in particulate organic matter

T. Saino

The mechanism of vertical transport of particulate organic matter was studied using the natural abundance of ^{15}N in particulate organic nitrogen (PON) as a tracer. On legs 1 and 2 of the KH-81-5 Cruise, PON samples in the water column were collected at Stns. 1, 3, 5 and 6, while bottom sediment samples were collected at Stns. 1, 3 and 6 (Table 23).

The water samples were collected with Niskin bottles (23 liters). Twenty liters (< 200 m) or 40 liters (> 200 m) of the seawater samples were filtered through precombusted (400 °C overnight) Whatman GF/F filters (47 mm ϕ). The filters with collected PON were stored in a deep freezer. Water temperature, salinity, dissolved oxygen, phosphate, nitrate, nitrite, and silicate were measured (data are available on request). The sediment samples were collected with an OKEAN grab sampler, placed in plastic containers, and kept frozen.

The ^{15}N content of PON and sediment samples will be measured with a Hitachi RMU-6 Mass Spectrometer for precision isotope ratio measurement.

11. Size distribution and photosynthetic light responses of phytoplankton in the subsurface chlorophyll maximum zone of the South China Sea

M. Takahashi

The subsurface chlorophyll maximum phenomenon has long been of interest since Ichimura et al (1968) first pointed it out in a lake. Analogous chlorophyll accumulation near or below the euphotic depth has also been found widely in the ocean, and much information on this phenomenon has been accumulated from the world ocean. Compared with the detailed understanding of the mechanism for accumulation of chlorophyll in lakes, however, little is known of the mechanism in the ocean. This is mainly due to technical difficulties involved in following the developmental stage of a given chlorophyll maximum by a series of repeat observations in the ocean. In the South China Sea, the water column is stratified strongly even in the euphotic zone almost throughout the year because of the warm climate. In the present cruise, population structure and photosynthetic light responses of phytoplankton occurring at the chlorophyll maximum zone were investigated and compared with those at the surface at fixed stations in the South China Sea.

Reference

Ichimura, S., S. Nagasawa and T. Tanaka, 1968. On the oxygen and chlorophyll maxima found in the metalimnion of a mesotrophic lake. Botan. Mag., 81, 1-10.

12. Determination of microbial biomass

M. Maeda

The concentrations of particulate lipopolysaccharide (LPS) and adenosine triphosphate (ATP) were determined in twelve layers of the water column for assessing microbial biomass in the sea areas of the KH-81-5 cruise. For determination of ATP, 2 or 3 liters of sample were obtained from a Van Dorn sampler and the samples were filtered through a glassfibre filter (Reeve Angel, 984-H). The filters were put into 5 ml of boiling Tris/HCl buffer (0.02 M, pH = 7.75) and ATP was extracted for five minutes. The filter in Tris/HCl was kept at -20°C until ready for ATP analysis.

Water samples for LPS analysis were obtained with sterilized Niskin vinyl type samplers. Analyses were carried out immediately after collecting the samples following the method of Maeda and Taga (1979). In the profiles of LPS, maximum values were obtained around 10 to 30 m while below 75 m concentrations decreased rapidly with increasing depth. These profiles showed little parallel relationship with profiles of chlorophyll-*a*.

Reference

Maeda, M. and N. Taga, 1979. Chromogenic assay method of lipopolysaccharide

(LPS) for evaluating bacterial standing crop in seawater. J. Appl. Bacteriol., 47, 175-182.

13. Bacterial biomass and activity

K. Kogure

In order to clarify the bacterial contribution to the carbon cycle in the marine ecosystem, bacterial biomass and activities were measured in the South China Sea and North Western Pacific Ocean. The profiles were compared with those of phytoplankton and various organic and inorganic substances.

The total count of bacteria was obtained using the epifluorescent microscopic method (Hobbie et al., 1977). The direct viable count (DVC) method was used for enumerating the living bacterial population (Kogure et al., 1980). Bacterial heterotrophic activity was measured according to the method of Wright and Hobbie (1966). Seawater samples were incubated for 3 hours with [^{14}C]-amino acid mixture.

Generally, total counts of bacteria were most abundant in the surface layer, ranging from 1 to 1.5 x 10^6 cells/ml. At 150 m, the mean total bacterial number was 4 - 5 x 10^5 cells/ml. At several stations, the number constantly decreased with depth down to 150 m. At other stations, the numbers were almost constant in the upper layer (0 - 50 or 60 m), and then relatively rapid decrease was observed down to 150 m. The numbers at 1200 m were about 1 - 2 x 10^4 cells/ml. From 150 m to the deeper layers, the population gradually decreased with depth without a noticeable peak.

DVC, which indicates the number of living bacterial cells, was generally two orders of magnitude less than the total count. The DVC profile, however, didn't always show the same profile as total counts. DVC often showed clear peaks at the surface and/or in the subsurface layer between 50 and 100 m. Similar results were also obtained for the profile of heterotrophic activity. At several stations, DVC and heterotrophic activity were in good accordance. It is widely accepted that the bacterial activity in the thin surface layer of the ocean is quite high compared to the layer just below it. The subsurface peaks often emerged just below the subsurface chlorophyll maximum layer, where bacterial activity is also expected to be high, because of the organic supply from the overlying layer.

References

Hobbie, J. E., R. J. Daley and S. Jasper, 1977. Use of nuclepore filters for counting bacteria by fluorescence microscopy. Appl. Environ. Microbiol., 33, 1225-1228.

Kogure, K., U. Simidu and N. Taga, 1980. Distribution of viable marine bacteria in neritic seawater around Japan. Can. J. Microbiol., 26, 318-323.

Wright, R. T. and J. E. Hobbie, 1966. Use of glucose and acetate by bacteria and algae in aquatic ecosystems. Ecol., 47, 447-464.

14. Distribution of oligotrophic bacteria

Y. Ishida

The concentration of organic matter in the ocean is usually much lower, compared with conventional media. Oligotrophic bacteria which cannot grow in conventional media may contribute very significantly to the metabolism of organic matter in the ocean.

In order to clarify the ecological significance of oligotrophic bacteria in the marine ecosystem, their distribution in the western Pacific Ocean and South-east China Sea was examined. It was found that the oligotrophic bacteria dominated in the open ocean, whereas coastal seas were occupied by eutrophic bacteria. Most of the oligotrophs were able to utilize amino acids but not acetate and glucose, in contrast with the eutrophs which can utilize a wide range of organic compounds.

15. Binding of bacteria to chitin

S. Hara

A seawater sample was collected from a depth of 50 m with a Niskin sampler for bacteria at Stn. 15 on Nov. 15, 1981. The sample was diluted with the same volume of sterilized seawater containing 0.2 M N-acetyl-glucosamine (GlcNAc). At intervals, 10 ml of the diluted sample was filtered on a 0.2 μm pore size Nuclepore filter and then the filters were incubated at 20°C on agar plates composed of 1.5 % agar and 0.5 % colloidal chitin in aged seawater. As a control, a sample was treated concurrently in the same manner without GlcNAc. After 3 weeks, colonies on the plates were counted. Results are shown in Fig. 23.

Two obvious phenomena can be observed. The first is a gradual decrease in colony numbers during the course of filtration. It is important to consider such a decrease for the viable plate count. The second is a marked increase in colony numbers in the case of treatment with GlcNAc. This strongly suggests that binding of bacteria to chitin is accomplished by lectin-like substances which are easily released by GlcNAc.

16. Isolation and cultivation of ciliated protozoa from the open ocean

M. Maeda and N. Taga

Many species of ciliated protozoa are known to feed on bacteria *in situ* and *in vitro*. During this cruise, we collected samples of water, sediment and suspended materials for the purpose of isolating marine ciliates occurring in the open ocean. Using these samples, we cultivated ten species of ciliates during the cruise. Three strains of these ciliates were used for determining the optimum nutritional level for their growth at 20°C. Most ciliates grew feeding on bacteria alone, but some needed mixed cultures of microgreen algae and bacteria as food. Among the ciliates which fed on bacteria alone, some ciliates preferred feeding on a mixture of different bacteria to a single bacterial culture.

17. The consumption of a natural assemblage of bacterioplankton by copepods

W. J. Lee and N. Taga

Copepods, _Oncaea_ spp., _Oithona_ spp., _Pontella_ spp. and _Acartia_ spp. were collected with a Norpac net (XX-13). They were then put separately into glass containers with sterilized seawater and maintained for 4 to 8 hours before the feeding experiment. 250 ml of seawater filtered through Nuclepore filters (pore size: 1 and 5 μm) was poured into a sterilized Erlenmeyer flask (500 ml-volume) to which 50 individuals of each copepod species were added. The decreased number of bacterioplankton in the seawater containing copepods was counted directly by the epifluorescent method at periods of 1, 2, 3, 4 and 24 hours, and compared with that in control seawater without copepods.

The results of the feeding experiment indicate that the natural assemblage of bacterioplankton in the seawater was clearly fed on by the copepod species examined.

18. Analysis of dissolved and particulate organic matter in seawater

W. J. Lee and N. Taga

Seawater samples were collected by Van-Dorn sampler from various depths (0-400 m) at each station of this cruise. The samples were filtered through double-layer glass fiber filters (Reeve Angel, 984-H) immediately after sampling on board. The filters and filtrates were stored at -20°C until analysis of the amounts of particulate organic carbon (POC) and dissolved organic carbon (DOC). Twenty samples of particulate organic matter with a size range of particles between 0.3 and 5 μm were condensed on double-layer Reeve-Angel (984-H) glass fiber filters from seawater at 4 stations, and were also stored at -20°C until determination of the composition of fatty acids. These samples are in the process of being analysed at the Ocean Research Institute, University of Tokyo.

19. Hydro-acoustic measurement of biomass

T. Inagaki and T. Aoyama

Trial measurements of the biomass of nekton, micronekton and plankton at sea were carried out using hydro-acoustic methods. Three kinds of instruments were used for this survey.

A 50 KHz echo sounder system played the main role in measurement of biomass in the sea. This system is composed of a towed transducer, transmitter, receiver, analogue and digital data recorder and mini-computer. The receiver output was displayed on a wet paper recorder, digitised and stored in a digital data logger, and also processed by the mini-computer. The ship speed was adjusted to 6 kt in the survey. Fig. 24 shows an example of the vertical distribution of sound reflections at Stn. 6, derived from the 50 KHz echo sounder system.

A 28 KHz echo sounder with a hull mounted transducer was also used for the purpose of monitoring the movement of the deep sea scattering layer (DSL). The receiver output was displayed on a dry paper recorder and colour display.

Fig. 25 shows an example of diurnal vertical movement of the DSL which was observed at Stn. 15 on November 15, 1981.

An ORI net and IKMT were hauled horizontally at the depth of the DSL, and an MTD net at eleven layers shallower than 400 m for the purpose of examining the composition and density of biota.

A deep sea camera system was used to identify sound reflecters and to estimate their density.

20. Abundance and distribution of fish larvae

A. Termvidchakorn and T. Aoyama

The species, abundance and distribution of fish larvae were studied from samples taken with a surface towed ORI-69 net and an MTD net with a mesh size of # GG54. The samples were preserved in 10 % formalin and sorted and identified to the family level. The samples from the ORI-69 net contained 10790 specimens belonging to 72 families while the MTD samples contained 5709 specimens belonging to about 60 families.

On the basis of the abundance of larvae, the most abundant fish families during this cruise in order of abundance were Engraulidae (1870 specimens), Gobiidae (1590 specimens), Myctophidae (1298 specimens), Gonostomatidae (1080 specimens), Lutianidae (910 specimens), Carangidae (714 specimens), Bothidae (332 specimens) and Scombridae (309 specimens).

Gonostomatidae, Myctophidae, Scombridae and Bothidae were the dominant families at most stations. Engraulidae, Carangidae, Lutianidae and Gobiidae were abundant at stations around shallow sea and coastal waters.

The most abundant fish larvae from the MTD net samples were Myctophidae (2455 specimens), Gonostomatidae (1112 specimens), Engraulidae (439 specimens), Gobiidae (234 specimens), Bothidae (214 specimens), Labridae (150 specimens) and Scombridae (120 specimens).

Gonostomatidae, Myctophidae, Scombridae and Gobiidae were the dominant families at most stations. Myctophidae were the most abundant fish larvae at all depths from 10 to 150 m. Gonostomatidae were present from a depth of 20 to 150 m. Scombridae and Bothidae were distributed from the surface down to 75 m.

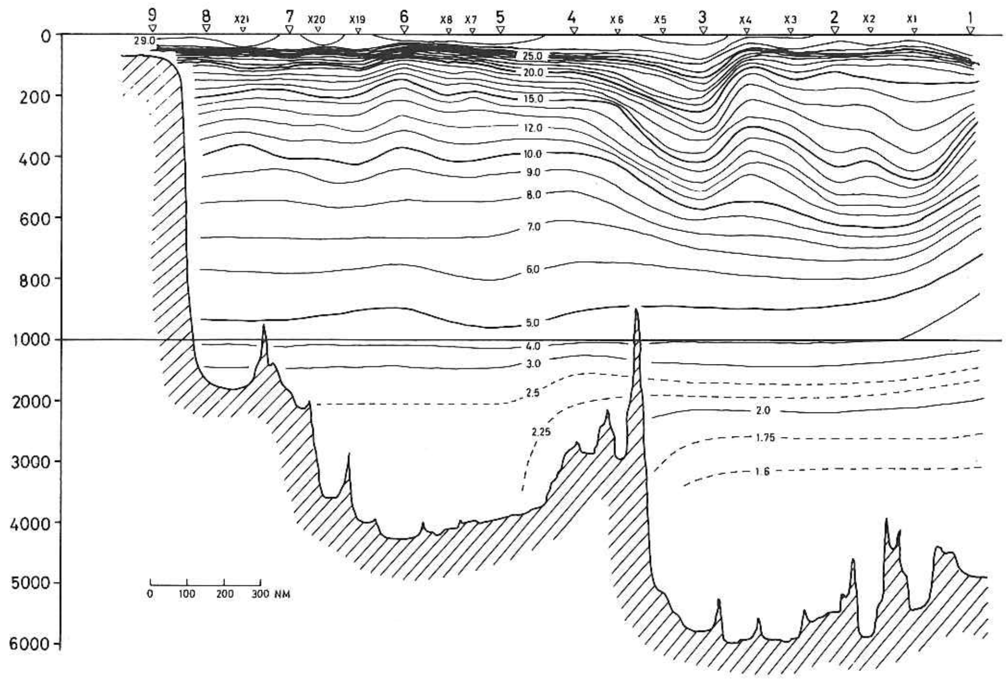

Fig. 2. Water temperature (°C) along Section I.

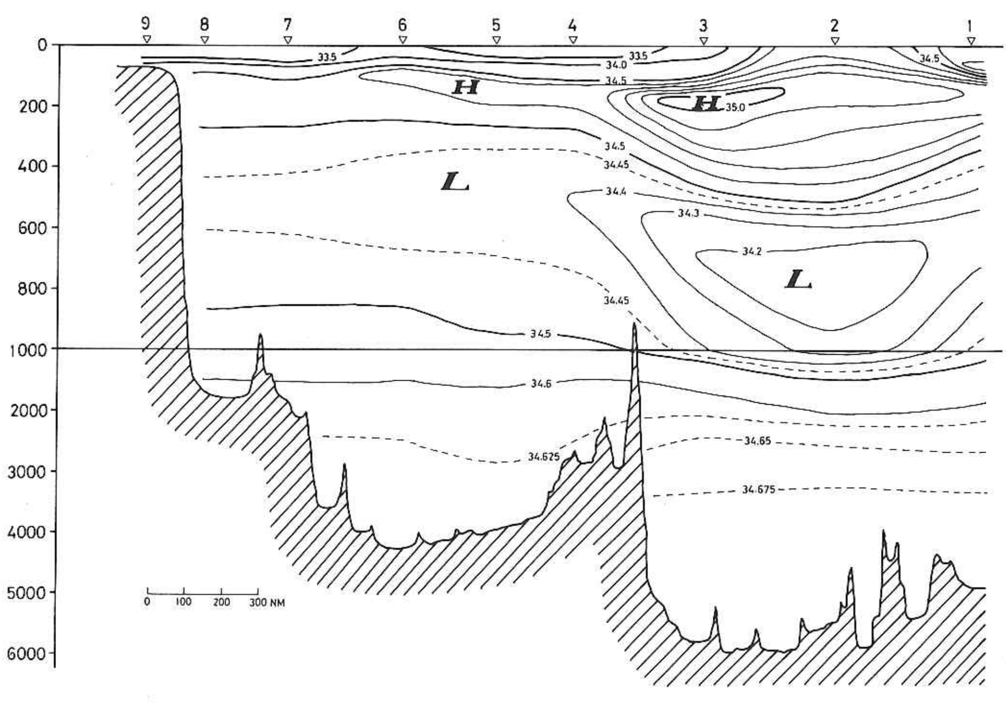

Fig. 3. Salinity (‰) along Section I.

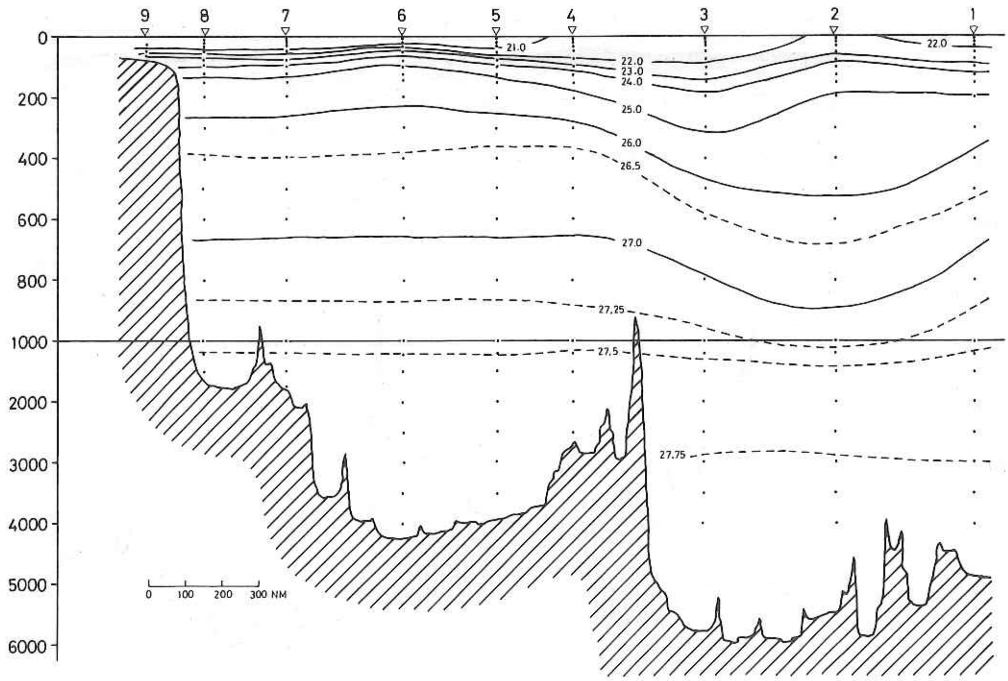

Fig. 4. Sigma-t along Section I.

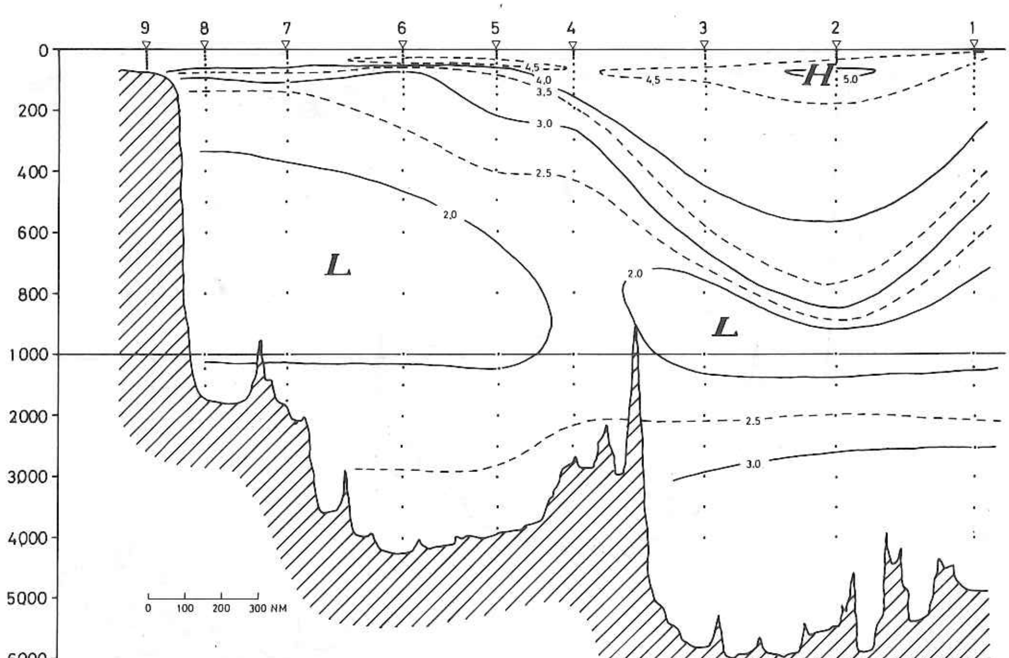

Fig. 5. Dissolved oxygen (ml/l) along Section I.

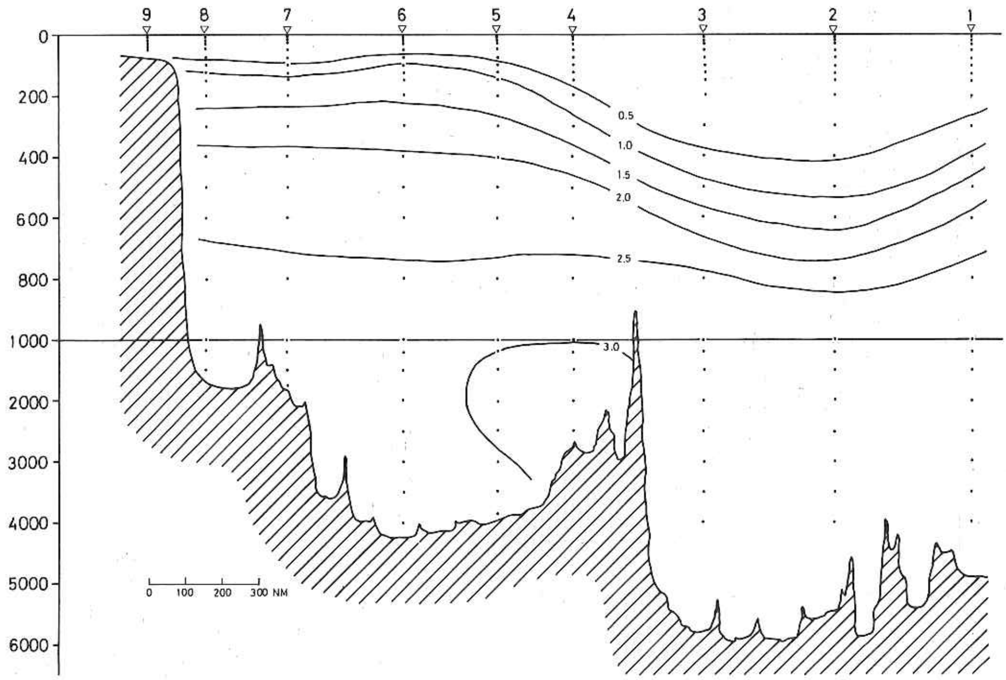

Fig. 6. Phosphate-P (μg-atms/l) along Section I.

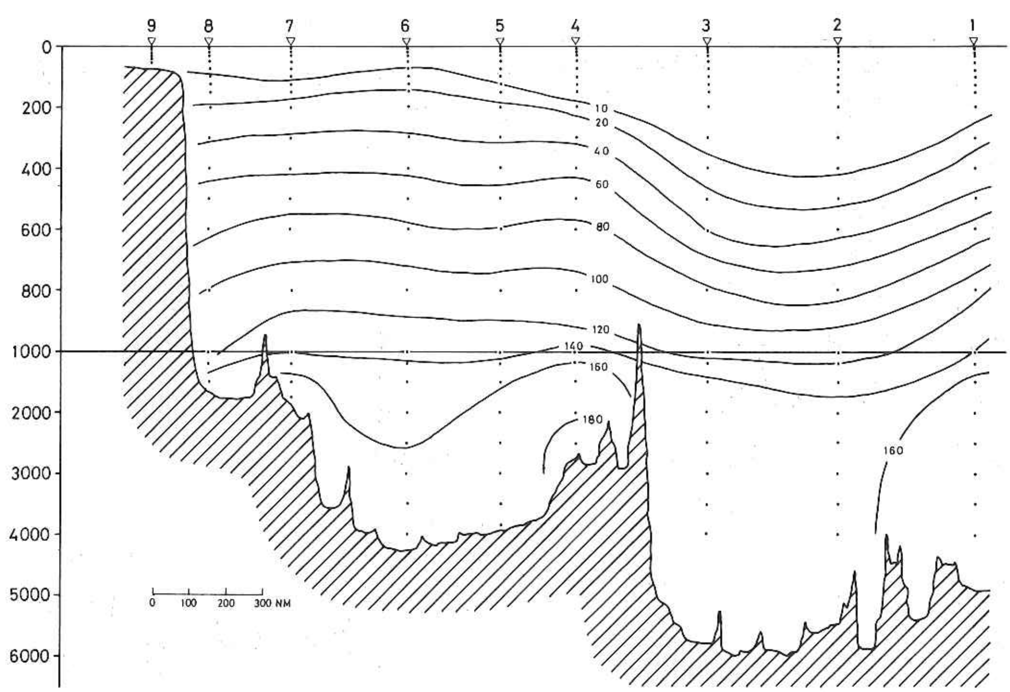

Fig. 7. Silicate-Si (μg-atoms/l) along Section I.

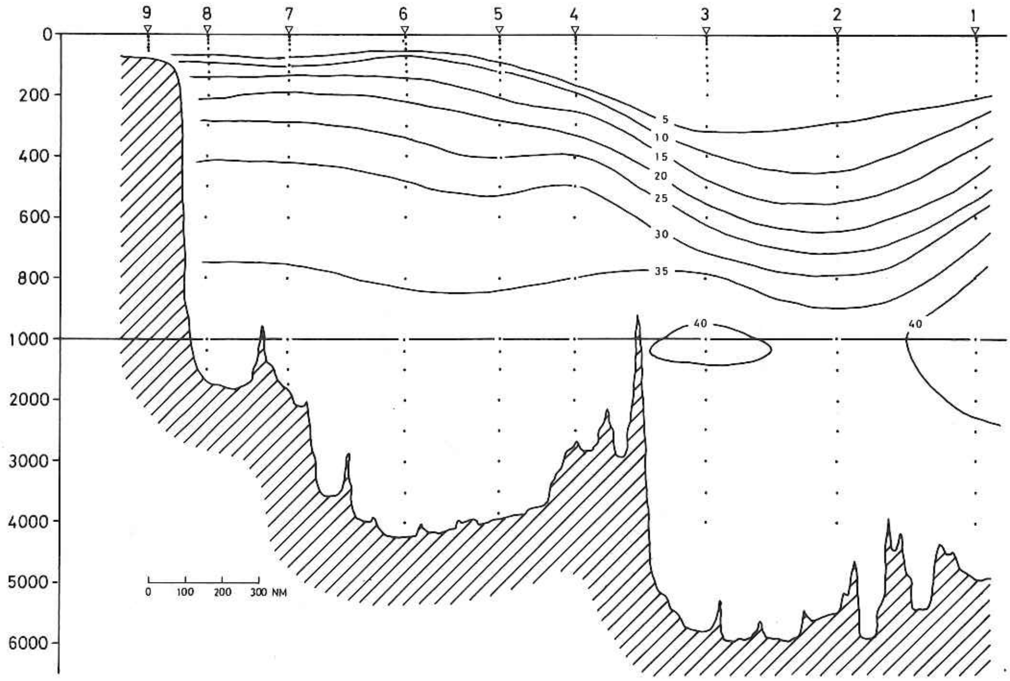

Fig. 8. Nitrate-N (μg-atms/l) along Section I.

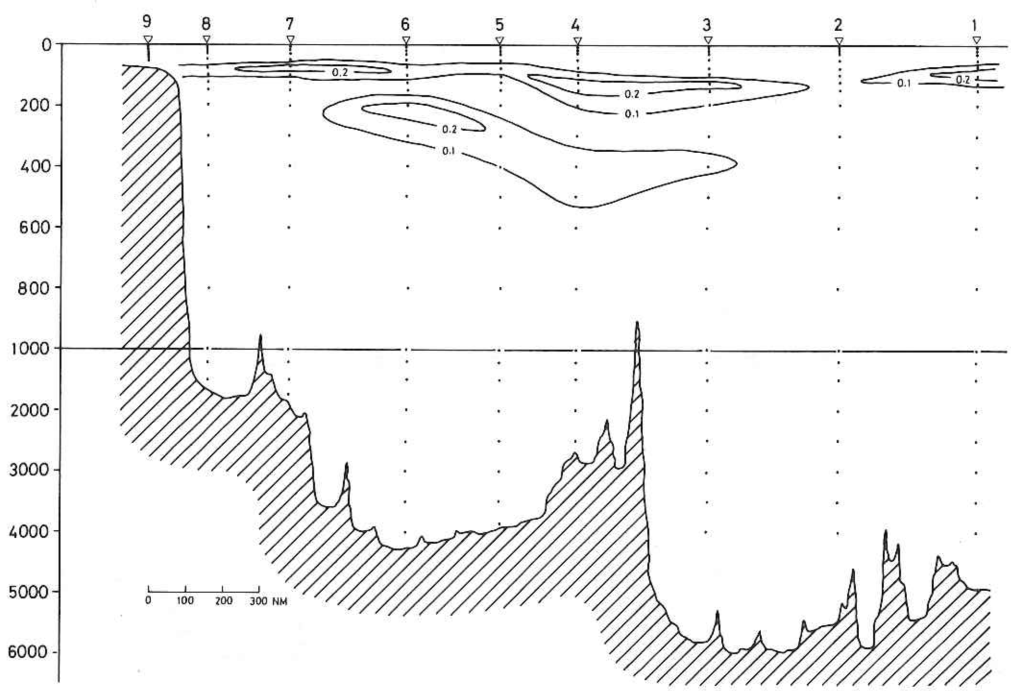

Fig. 9. Nitrite-N (μg-atoms/l) a-ong Section I.

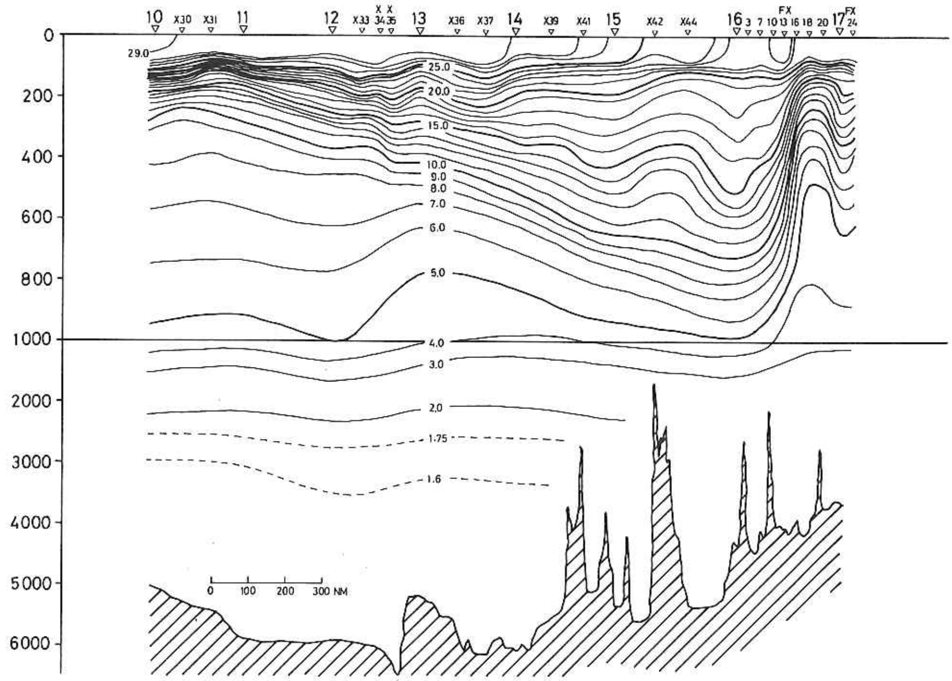

Fig. 10. Water temperature (°C) along Section II.

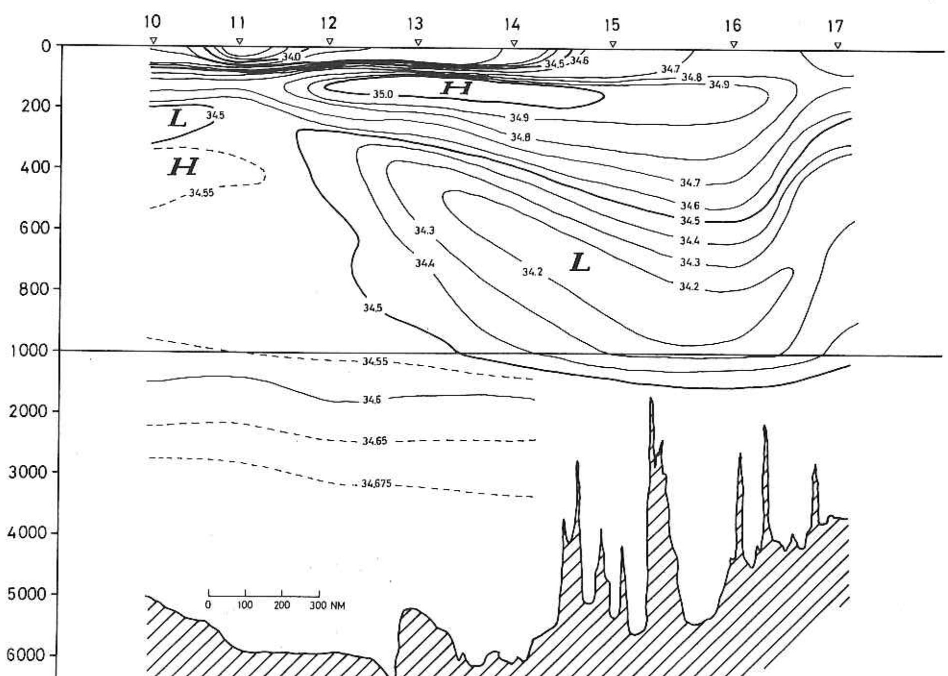

Fig. 11. Salinity (‰) along Section II.

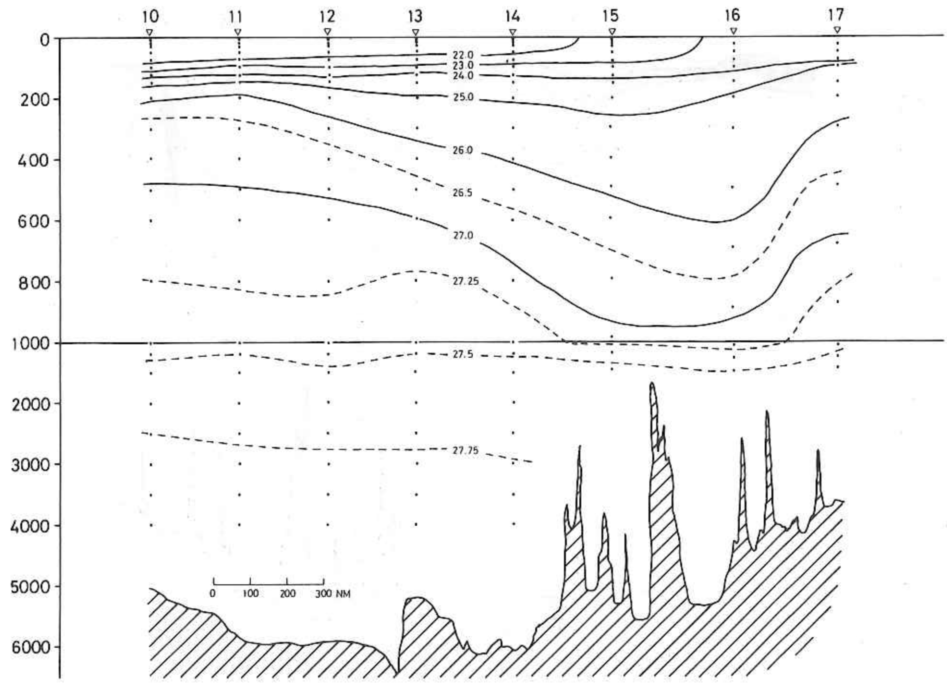

Fig. 12. Sigma-t along Section II.

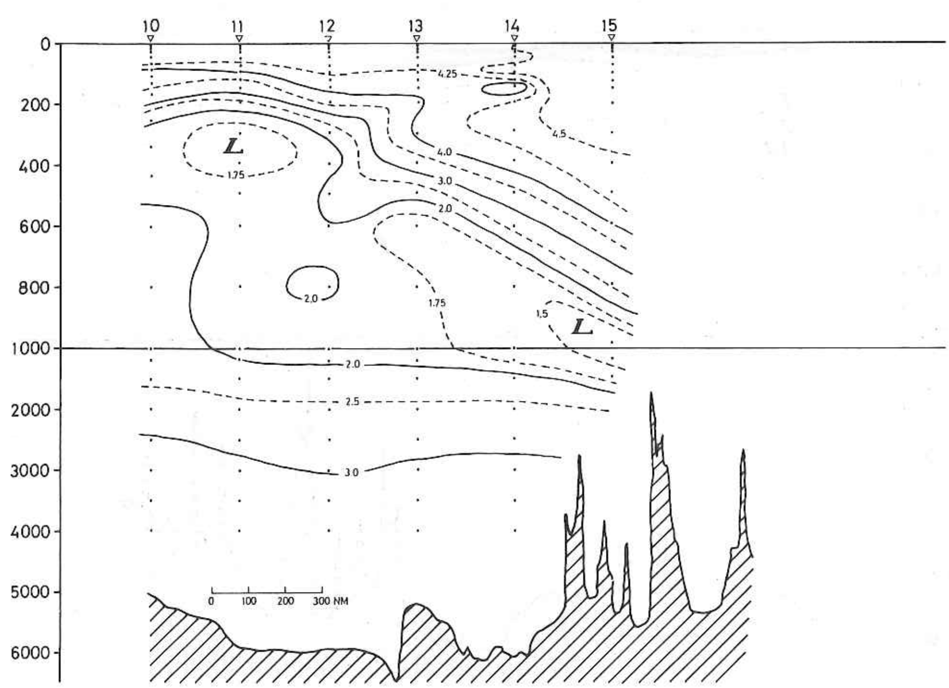

Fig. 13. Dissolved oxygen (ml/l) along Section II.

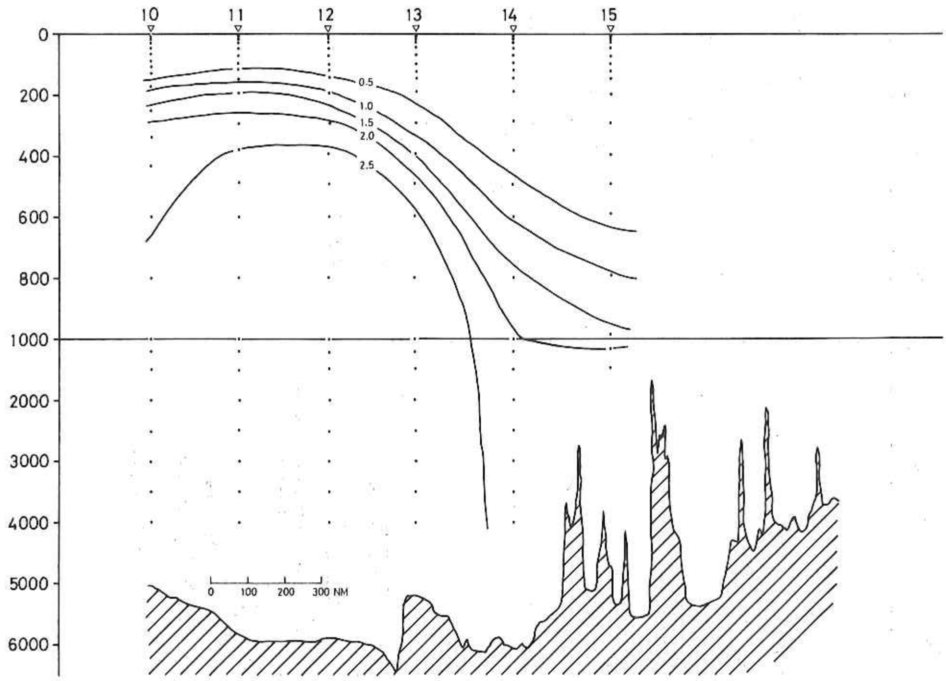

Fig. 14. Phosphate-P (μg-atoms/l) along Section II.

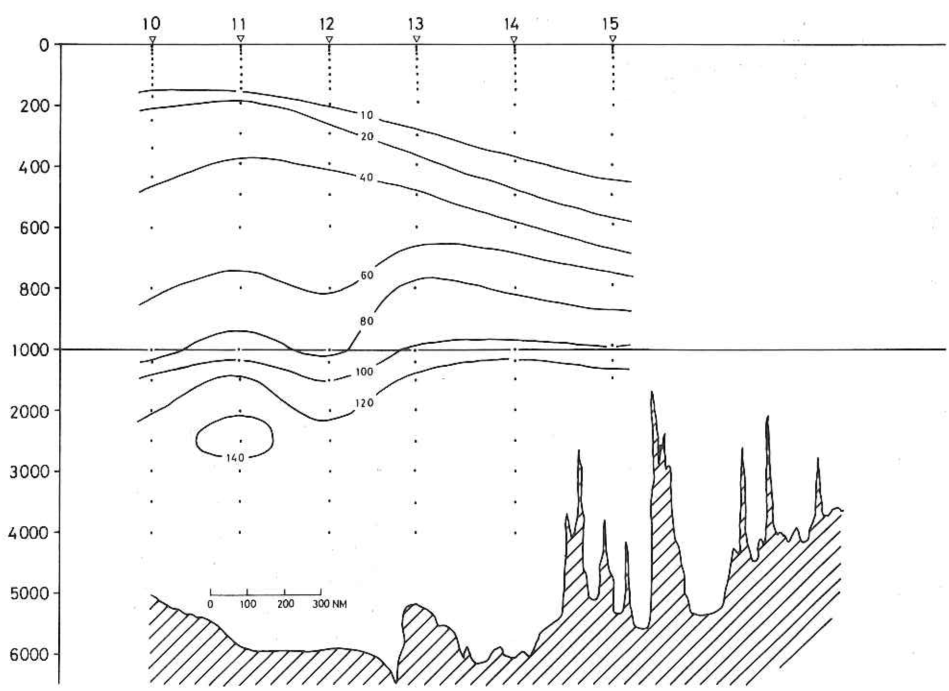

Fig. 15. Silicate-Si (μg-atoms/l) along Section II.

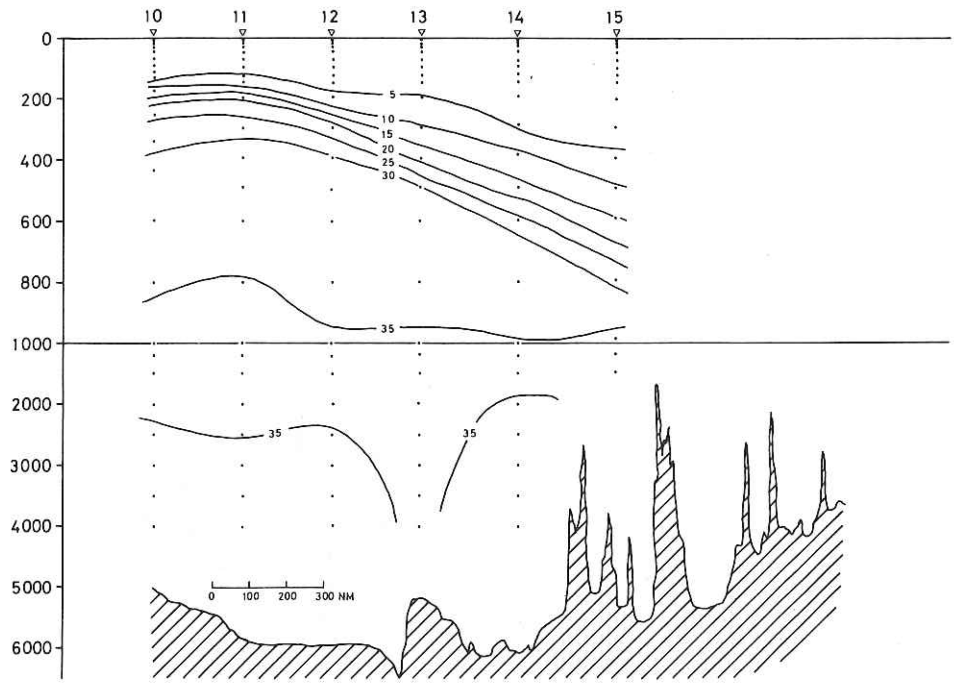

Fig. 16. Nitrate-N (μg-atoms/l) along Section II.

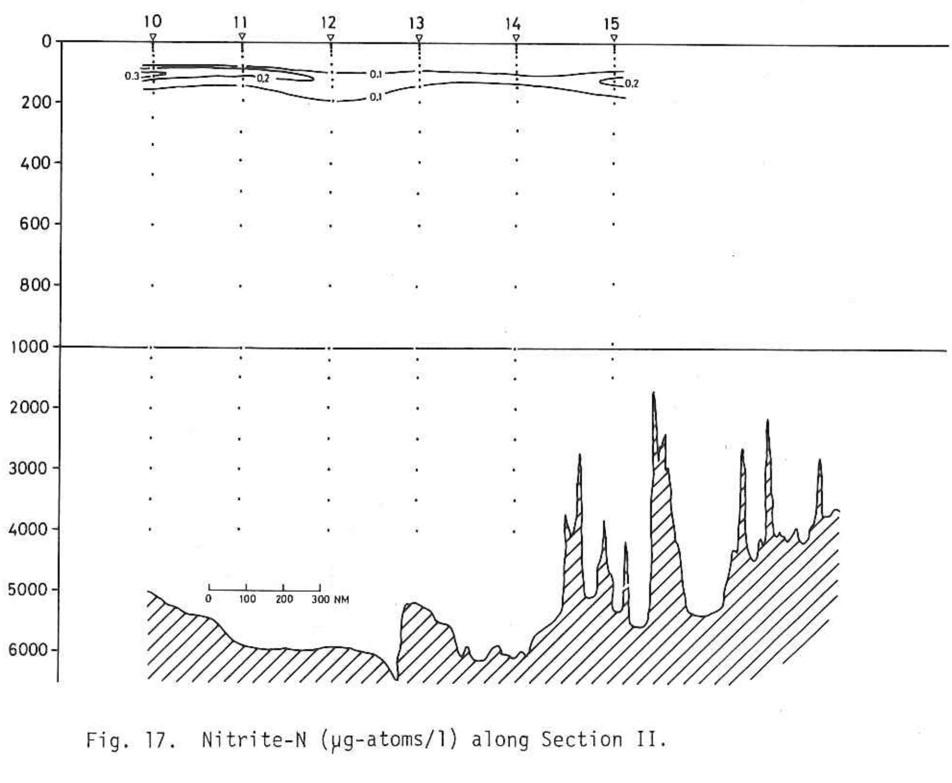

Fig. 17. Nitrite-N (μg-atoms/l) along Section II.

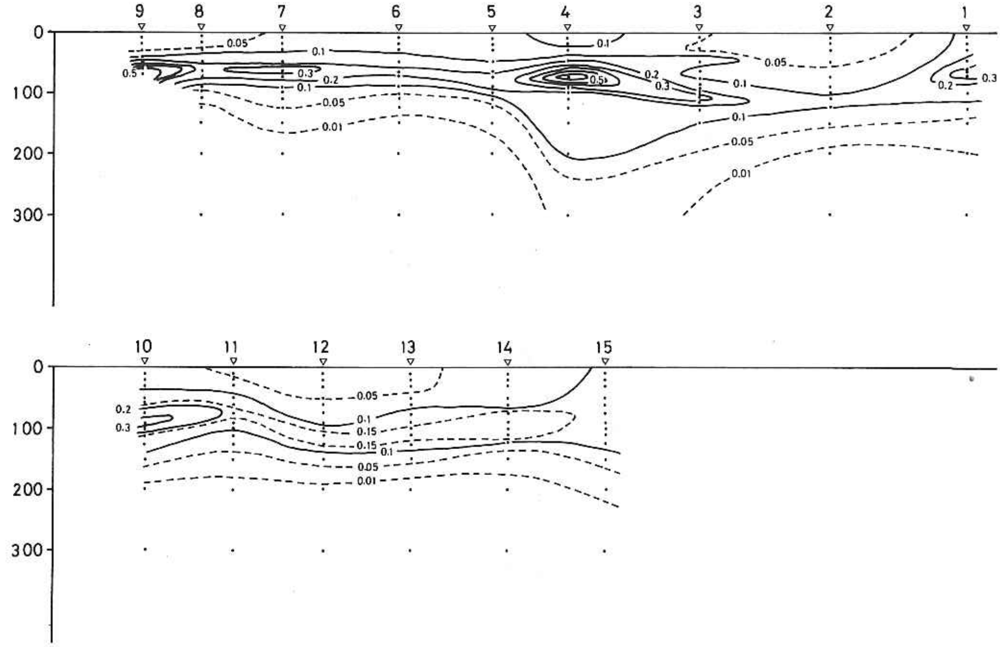

Fig. 18. Chlorophyll-a (μg/l).

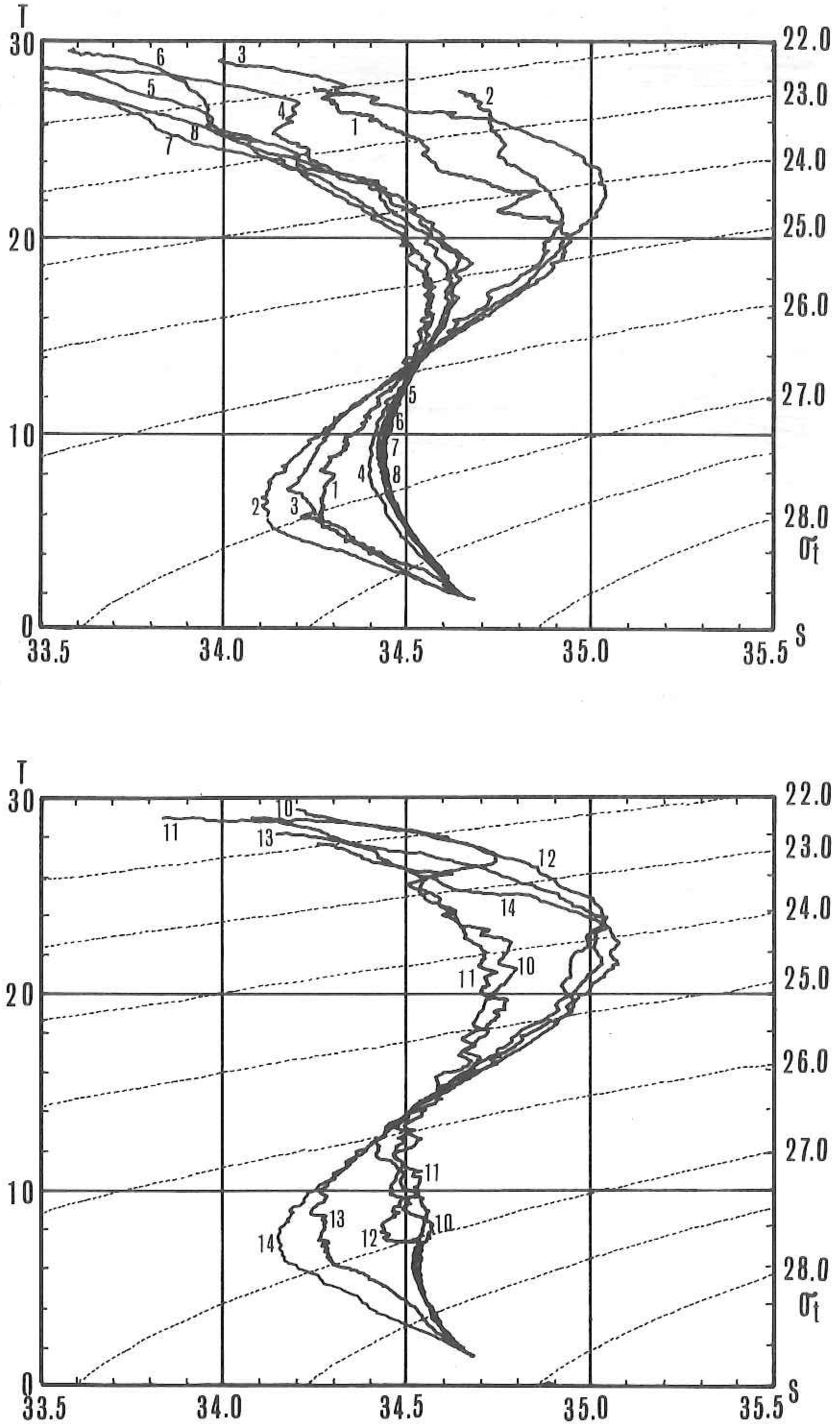

Fig. 19. T-S diagram.

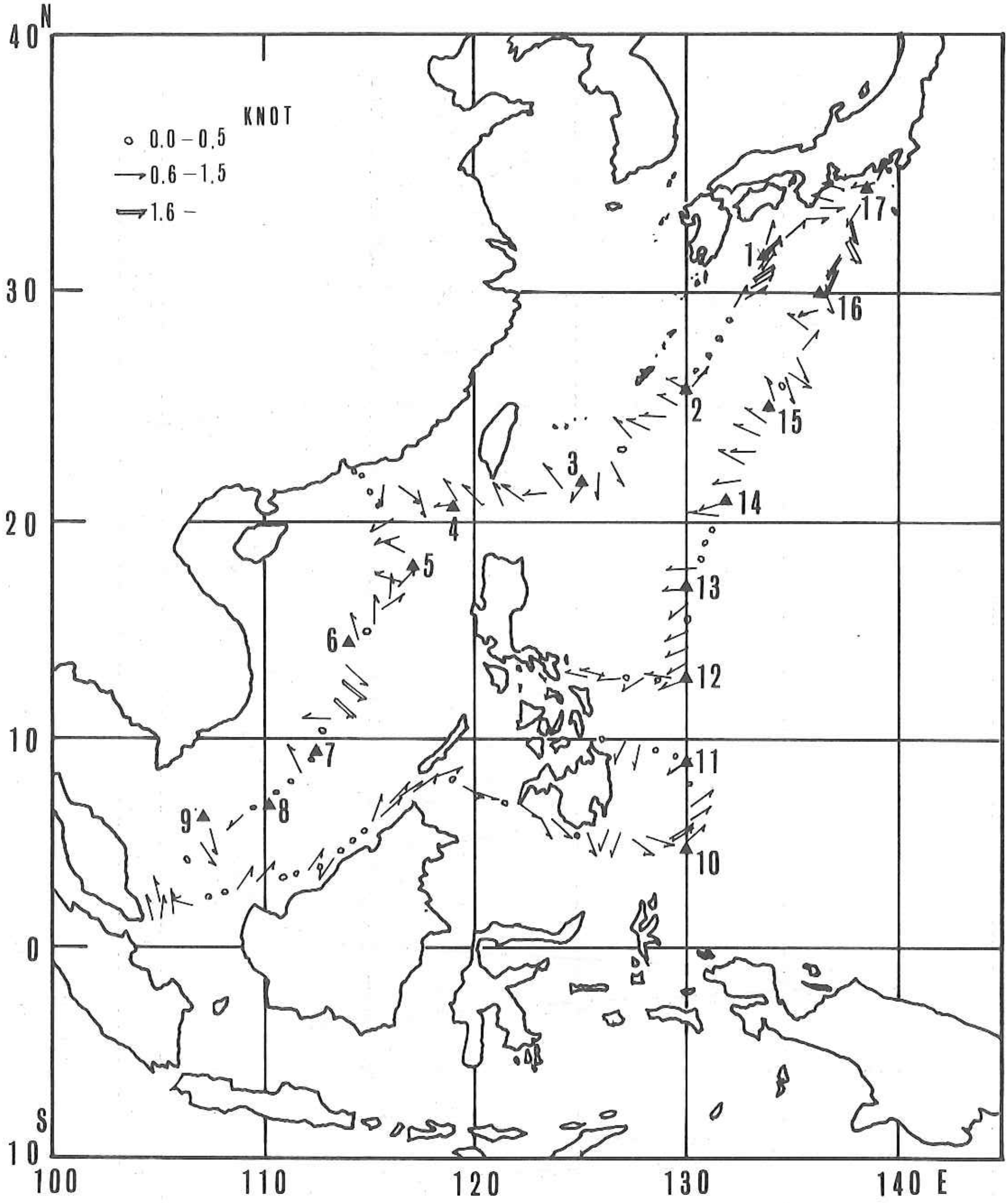

Fig. 20. Ship's drift vectors obtained by the NNSS.

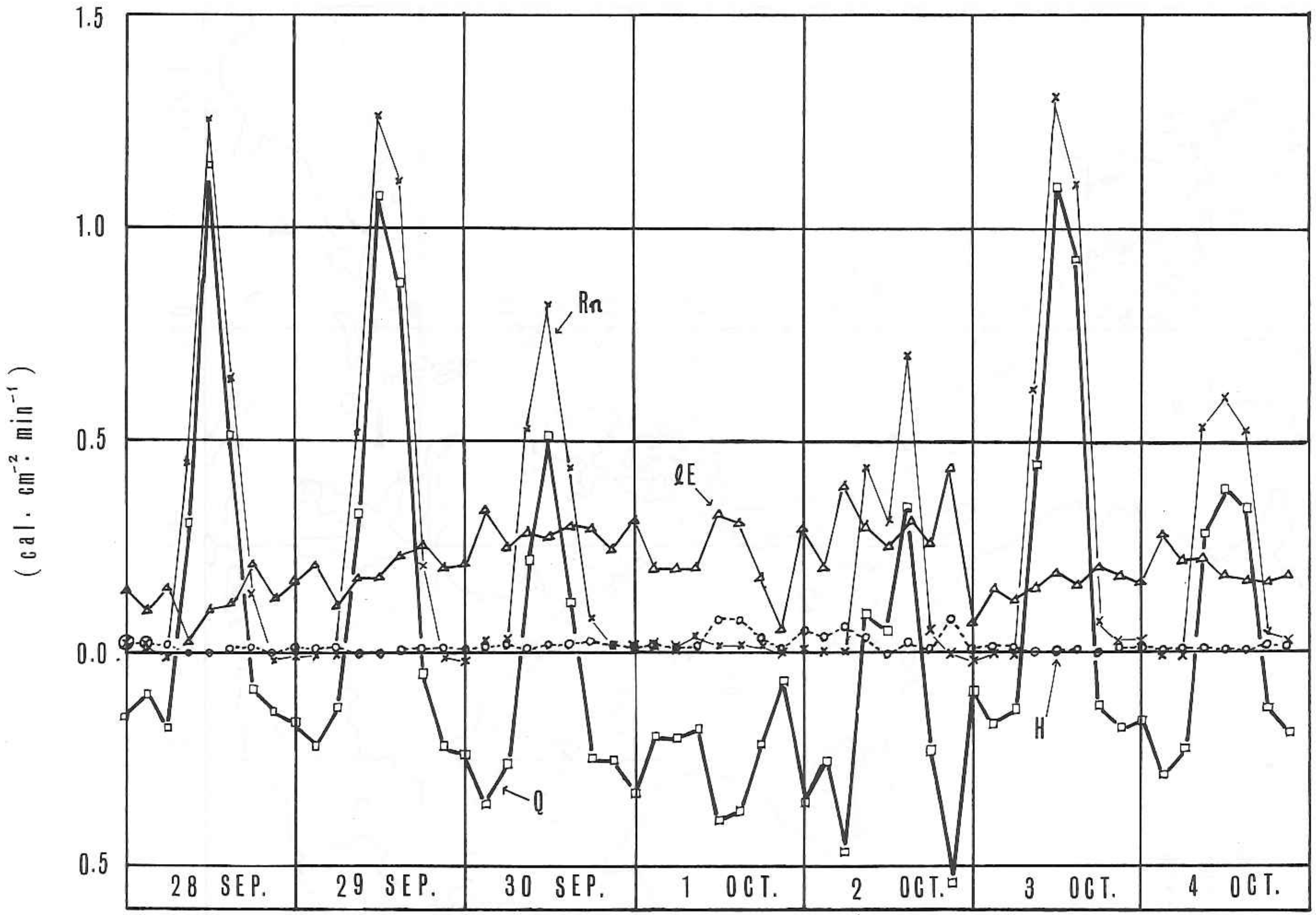

Fig. 21. Diurnal variations of the heat budget across the sea surface (Q), the net radiation flux (Rn), the latent heat flux (lH), and the sensible heat flux (H) at Stn. 6 in the South China Sea.

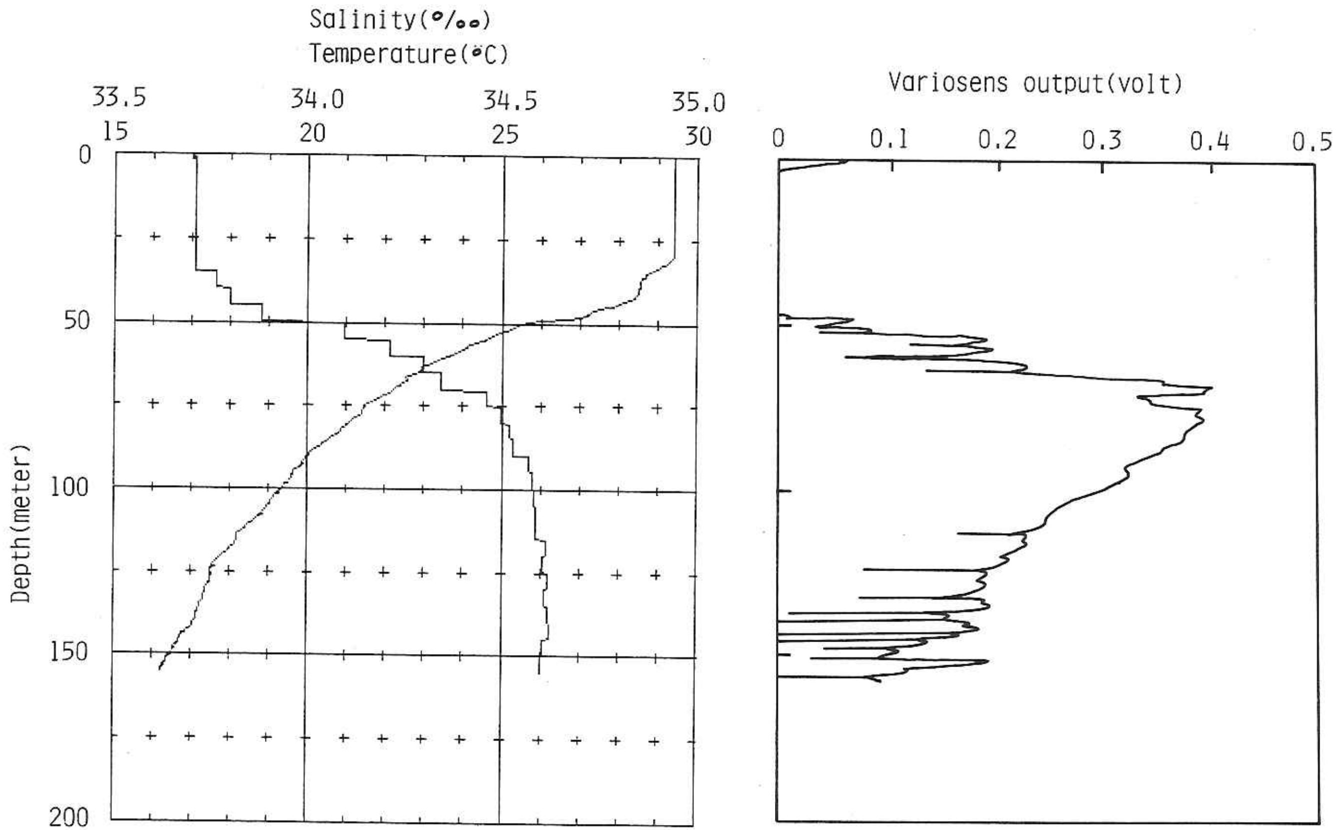

Fig. 22. Vertical profiles of temperature, salinity and in-vivo chlorophyll fluorescence (Variosens) taken by CTD-Variosens downward cast at Stn. 6.

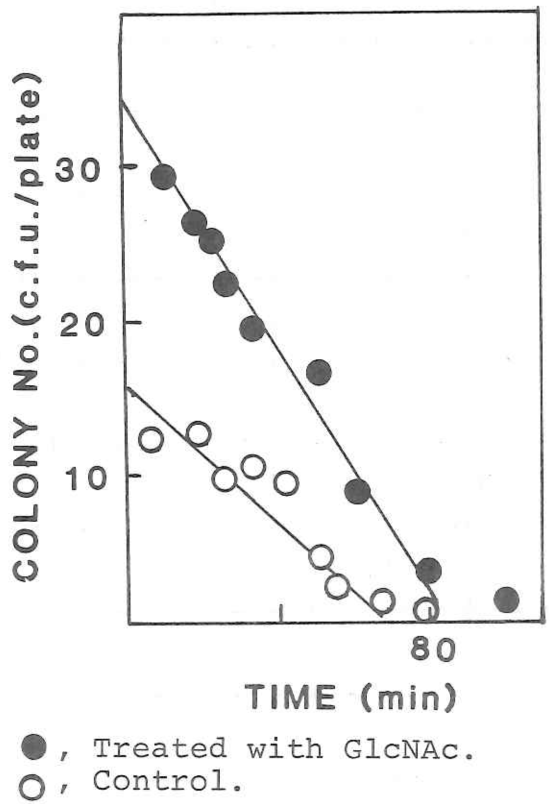

Fig. 23. Effect of GlcNAc on viable plate counts.

Treated with GlcNAc Control.

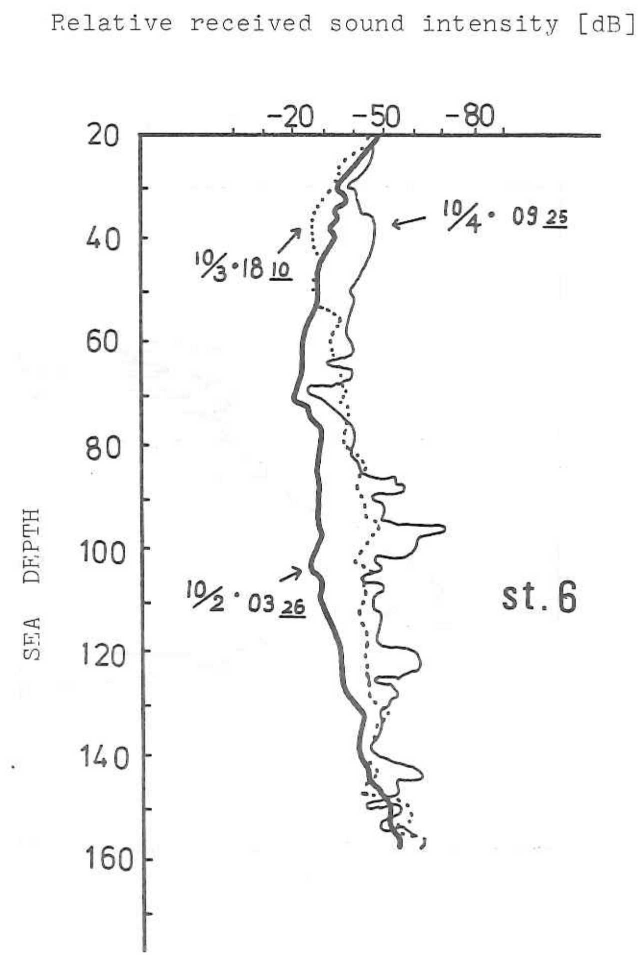

Fig. 24. The change of values of the relative received sound intensity at Stn. 6.

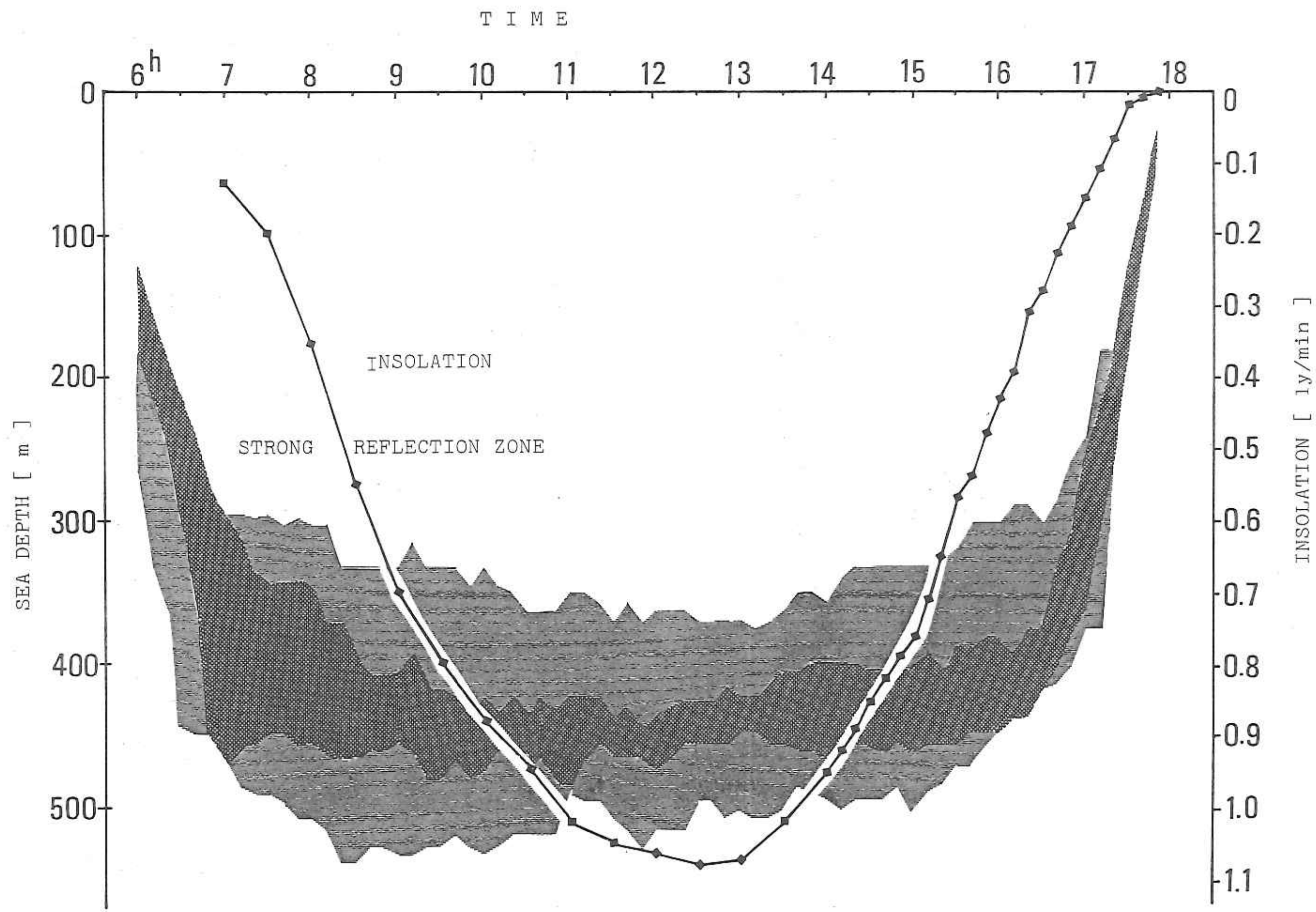

Fig. 25. The diurnal vertical movement of deep sea scattering layer (shaded zone) with relation to the change of insolation (line and dots). Value of insolation is presented by H. Otobe.

Explanation of Tables 3 to 19.

Abbreviations and symbols used:

D depth
T temperature
S salinity
σt sigma t $[=(\rho-1)x1000]$
DO dissolved oxygen
O_2-Sat percent oxygen saturation
AOU apparent oxygen utilization
ΔD dynamic depth anomaly
* Rosette multi sampler
Others Niskin sampler

Abbreviations and symbols used:

D depth
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Abbreviations and symbols used: D depth; T temperature; S salinity; σt sigma t $[=(\rho-1)x1000]$; DO dissolved oxygen; O_2-Sat percent oxygen saturation; AOU apparent oxygen utilization; ΔD dynamic depth anomaly * Rosette multi sampler; Others Niskin sampler

Table 3.

Station	Latitude	Longitude	Date	Ship time	Depth
1	31-30.1N 31-32.6N	133-30.1E 133-34.1E	Sept. 9, 1981	16:57 20:52	4890m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
18:00	27.1°C	W - 6.0m/s	3	1	fine

Observed D (m)	T (°C)	S (‰)	σ_t	DO (ml/l)	O_2-Sat (%)	AOU (ml/l)	PO_4-P	SiO_2-Si	NO_2-N	NO_3-N	CTD D (m)	T (°C)	S (‰)	σ_t	ΔD
							(μg atoms/l)								
0	27.6	34.239	21.97	4.43	97.6	0.11	0.00	0.5	0.05	0.0	0	27.68	34.245	21.95	0.000
10	27.66	250	96	4.51	99.4	0.23	0.03	0.1	0.05	0.0	10	27.68	247	95	0.059
19	27.58	241	98	4.48	98.6	0.06	0.05	0.1	0.05	0.1	20	27.63	243	97	0.118
29	27.56	246	99	4.51	99.2	0.04	0.04	0.3	0.06	0.0	30	27.61	246	98	0.176
49	27.51	272	22.03	4.46	98.1	0.09	0.10	0.1	0.07	0.0	50	27.43	273	22.05	0.293
73	27.29	333	15	4.46	97.7	0.10	0.08	0.1	0.18	0.4	75	26.57	309	36	0.436
97	24.86	509	23.03	4.41	92.8	0.34	0.13	1.5	0.40	1.5	100	24.17	557	23.28	0.564
122	20.99	817	24.38	4.37	86.1	0.70	0.30	2.6	0.11	3.6	125	21.17	805	24.32	0.668
146	20.41	901	60	4.59	86.9	0.67	0.23	1.7	0.08	3.2	150	20.33	896	62	0.756
195	18.59	854	25.03	4.40	83.0	0.90	0.31	3.2	0.09	4.8	200	18.66	860	25.02	0.915
292	15.19	639	67	3.98	70.1	1.70	0.81	15.6	0.09	11.5	300	15.13	611	66	1.192
390	12.44	462	26.11	3.66	60.9	2.35	1.23	26.6	0.09	17.5	400	12.46	470	26.11	1.408
487	10.70	414	39	3.26	52.1	2.99	1.60	40.2	0.08	22.9	500	10.30	382	44	1.593
600*	7.23	267	83	2.58	38.2	4.17	2.15	69.8	0.09	31.6	600	7.23	267	83	1.744
800*	4.44	350	27.25	1.86	25.7	5.36	2.61	119.7	0.09	40.6	800	4.44	350	27.24	1.963
1000*	3.37	451	43	1.62	21.9	5.78	2.86	142.2	0.10	42.7	1000	3.37	451	44	2.124
1200*	2.94	495	51	1.98	26.5	5.50	2.81	147.8	0.09	42.2	1200	2.94	495	51	2.263
1500*	2.45	544	59	2.22	29.3	5.36	2.88	161.9	0.10	42.6	1500	2.45	544	59	2.448
2000*	2.00	608	68	2.44	31.9	5.21	2.72	164.7	0.08	41.2	2000	2.00	608	68	2.720
2500*	1.77	642	72	3.01	39.1	4.69	2.75	166.3	0.10	40.4	2500	1.77	642	72	2.965
3000*	1.63	664	75	3.13	40.6	4.59	2.60	162.7	0.09	39.2	3000	1.63	664	75	3.197
3500*	1.56	677	77	3.27	42.3	4.46	2.59	163.9	0.08	39.0	3500	1.56	677	77	3.422
4000*	1.56	682	77	3.45	44.6	4.29	2.57	163.1	0.08	38.8	4000	1.56	682	77	3.650

Table 4.

Station	Latitude	Longitude	Date	Ship time	Depth
2	25-57.8N 25-58.8N	129-59.9E 129-59.7E	Sept. 12, 1981	13:12 17:13	5350m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
15:00	27.7°C	WSW - 5.0m/s	2	1	fine

Observed											CTD				
D (m)	T (°C)	S (‰)	σ_t	DO (ml/l)	O_2-Sat (%)	AOU (ml/l)	PO_4-P	SiO_2-Si (μg atoms/l)	NO_2-N	NO_3-N	D (m)	T (°C)	S (‰)	σ_t	ΔD
0	27.8	34.747	22.29	-	84.6	0.69	0.01	1.6	0.04	0.2	0	27.54	34.653	22.31	0.000
10	27.14	715	48	4.46	97.6	0.11	0.01	1.8	0.03	0.0^+	10	27.28	673	40	0.055
20	27.08	712	50	4.53	99.1	0.04	0.03	1.8	0.03	0.0^+	20	27.05	694	49	0.109
30	26.96	703	53	4.47	97.6	0.11	0.01	1.6	0.08	0.0^+	30	26.88	689	54	0.162
50	26.46	716	70	4.55	98.4	0.07	0.00	1.8	0.03	0.0^+	50	26.44	723	71	0.267
75	22.84	865	23.90	5.07	103.2	-0.16	0.01	1.8	0.03	0.0^+	75	22.74	869	23.93	0.382
100	20.98	920	24.46	4.95	97.5	0.13	0.02	2.0	0.04	0.0^+	100	20.94	928	24.47	0.476
125	20.20	921	67	4.73	95.3	0.23	0.10	2.4	0.08	0.8	125	20.09	939	71	0.561
150	19.72	922	79	4.69	90.3	0.50	0.16	2.7	0.04	1.4	150	19.50	926	86	0.642
200	18.67	889	25.04	4.44	83.9	0.86	0.26	3.9	0.03	3.2	200	18.58	895	25.06	0.795
300	16.86	760	38	4.40	80.1	1.09	0.42	6.5	0.02	5.4	300	17.04	790	36	1.078
400	15.64	682	60	4.40	78.3	1.22	0.43	8.3	0.03	6.8	400	15.89	699	56	1.341
500	13.10	478	99	4.13	69.6	1.80	0.93	17.4	0.02	12.3	500	13.76	523	89	1.581
600*	10.63	304	26.32	3.98	63.7	2.27	1.38	30.5	0.02	18.2	600	10.63	304	26.32	1.786
800*	6.03	120	88	3.38	48.5	3.58	2.38	71.4	0.02	30.9	800	6.03	120	88	2.095
1000*	4.28	264	27.19	1.43	19.7	5.82	2.93	110.7	0.03	37.7	1000	4.28	264	27.19	2.320
1200*	3.52	397	38	1.60	21.7	5.77	2.88	120.5	0.03	36.8	1200	3.52	397	38	2.496
1500*	2.80	502	53	-	-	-	-	-	-	-	1500	2.80	502	53	2.713
2000*	2.16	595	66	2.51	32.9	5.11	2.82	147.2	0.03	36.4	2000	2.16	595	66	3.011
2500*	1.81	646	72	2.95	31.7	6.35	2.78	150.5	0.03	36.0	2500	1.81	646	72	3.263
3000*	1.62	668	76	3.22	41.7	4.50	-	-	-	-	3000	1.62	668	76	3.494
3500*	1.57	678	77	-	-	-	-	-	-	-	3500	1.57	678	77	3.719
4000*	1.57	683	77	3.40	44.0	4.33	2.65	148.9	0.03	34.5	4000	1.57	683	77	3.946

Table 5.

Station	Latitude	Longitude	Date	Ship time	Depth
3	21-59.9N 21-59.2N	124-59.8E 124-59.0E	Sept. 14, 1981	06:56 10:53	5830m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
09:00	28.8°C	ENE - 6.5m/s	3	1	fine

Observed											CTD				
D (m)	T (°C)	S (‰)	σ_t	DO (ml/l)	O_2-Sat (%)	AOU (ml/l)	PO_4-P	SiO_2-Si (μg atoms/l)	NO_2-N	NO_3-N	D (m)	T (°C)	S (‰)	σ_t	ΔD
0	29.4	33.962	21.17	4.45	100.7	-0.03	0.00	1.3	0.07	0.0^+	0	29.13	33.984	21.28	0.000
10	29.28	950	20	4.33	97.7	0.10	0.01	1.4	0.07	0.0^+	10	29.14	990	28	0.065
20	28.98	979	33	4.36	98.5	0.07	0.01	1.4	0.07	0.0^+	20	29.14	992	28	0.130
30	28.98	997	34	4.38	99.0	0.04	0.01	1.6	0.07	0.0^+	30	29.04	983	31	0.196
50	28.90	998	37	4.33	97.7	0.10	0.02	1.6	0.07	0.0	50	28.90	34.001	37	0.325
75	27.35	34.532	22.28	4.63	101.6	-0.08	0.02	1.4	0.07	0.0	75	28.88	036	40	0.486
99	26.39	670	68	4.56	98.6	0.07	0.01	1.4	0.07	0.0	100	26.80	408	22.36	0.634
124	24.97	876	23.28	4.41	93.2	0.32	0.06	1.3	0.22	0.2	125	26.04	726	84	0.766
149	23.63	909	70	4.36	90.2	0.48	0.10	1.8	0.12	1.0	150	24.98	873	23.27	0.888
198	22.19	35.026	24.20	4.17	84.0	0.79	0.14	1.9	0.10	1.4	200	22.30	35.036	24.18	1.099
298	18.61	34.852	25.03	4.07	76.8	1.23	0.36	4.6	0.08	4.7	300	18.83	34.871	98	1.438
397	14.92	599	70	4.18	73.2	1.53	0.52	10.7	0.12	10.4	400	15.35	637	25.63	1.714
496	11.42	360	26.22	3.62	58.9	2.53	1.22	23.2	0.08	17.9	500	12.54	434	26.06	1.943
600*	9.03	243	54	3.46	53.3	3.03	1.64	38.2	0.07	24.1	600	9.03	243	54	2.127
800*	5.58	269	27.05	1.78	25.4	5.24	2.56	84.4	0.07	37.0	800	5.58	269	27.05	2.401
1000*	4.21	413	32	-	-	-	2.78	112.9	0.08	40.2	1000	4.21	413	32	2.599
1200*	3.42	490	46	1.74	23.6	5.65	2.79	127.6	0.07	40.2	1200	3.42	490	46	2.758
1500*	2.75	567	58	2.22	29.5	5.30	2.74	140.3	0.08	39.6	1500	2.75	567	58	2.955
2000*	2.10	620	68	2.48	32.4	5.16	2.77	147.4	0.07	39.2	2000	2.10	620	68	3.232
2500*	1.79	653	73	2.81	36.5	4.88	2.65	150.2	0.07	38.6	2500	1.79	653	73	3.477
3000*	1.63	669	76	3.17	41.0	4.55	2.49	148.2	0.08	37.4	3000	1.63	669	76	3.706
3500*	1.57	678	77	-	-	-	-	-	-	-	3500	1.57	678	77	3.932
4000*	1.57	683	77	3.42	44.2	4.31	2.51	148.6	0.07	37.1	4000	1.57	683	77	4.160

Table 6.

Station	Latitude	Longitude	Date	Ship time	Depth
4	21-00.3N 21-00.0N	119-01.2E 119-01.3E	Sept. 19, 1981	07:06 09:43	2680m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
08:00	27.8°C	NNE - 9.0m/s	3	1	cloudy

Observed D (m)	T (°C)	S (‰)	σ_t	DO (ml/l)	O_2-Sat (%)	AOU (ml/l)	PO_4-P	SiO_2-Si	NO_2-N	NO_3-N	CTD D (m)	T (°C)	S (‰)	σ_t	ΔD
							(μg atoms/l)								
0	28.8	33.391	20.95	4.42	98.8	0.06	0.00+	2.9	0.08	0.0	0	28.70	33.433	21.01	0.000
10	28.73	408	98	4.43	98.8	0.06	0.00	3.6	0.08	0.0	10	28.70	433	01	0.068
20	28.72	409	99	4.43	98.9	0.05	0.01	3.2	0.06	0.0	20	28.71	433	01	0.136
29	28.72	410	99	4.42	98.7	0.06	0.03	2.8	0.08	0.0	30	28.71	434	01	0.204
49	28.73	435	21.00	4.45	99.3	0.03	0.01	3.3	0.06	0.0	50	28.21	911	53	0.337
73	28.00	972	64	4.48	99.0	0.04	0.02	2.2	0.08	0.0	75	26.25	34.190	22.37	0.485
98	27.49	34.094	90	4.44	97.5	0.12	0.09	2.1	0.16	0.1	100	22.86	369	23.52	0.611
122	26.15	161	22.38	4.38	94.0	0.28	0.08	2.8	0.28	0.1	125	20.02	581	24.46	0.710
146	24.03	243	23.08	4.39	90.9	0.44	0.10	2.9	0.24	0.1	150	18.74	681	86	0.794
195	18.94	645	24.78	3.41	63.3	1.94	0.61	10.8	0.13	10.1	200	15.55	602	25.56	0.934
300*	12.39	485	26.13	-	-	-	-	-	-	-	300	12.39	485	26.13	1.153
400*	9.73	408	56	2.57	40.3	3.81	1.83	55.0	0.11	26.8	400	9.73	408	56	1.330
500*	8.29	399	78	2.34	35.5	4.25	2.28	72.2	0.18	30.3	500	8.29	399	78	1.476
600*	7.05	416	97	2.19	32.4	4.58	2.45	89.1	0.06	33.2	600	7.05	416	97	1.602
800*	5.72	458	27.18	-	-	-	-	-	-	-	800	5.72	458	27.18	1.820
1000*	4.30	515	39	2.25	31.1	4.98	2.98	144.2	0.08	37.9	1000	4.30	515	39	1.999
1200*	3.21	572	55	2.36	31.8	5.07	3.11	163.0	0.08	39.0	1200	3.21	572	55	2.140
1500*	2.60	606	63	-	-	-	3.27	171.6	0.08	39.1	1500	2.60	606	63	2.316
2000*	2.40	618	66	-	-	-	3.08	171.6	0.08	48.6	2000	2.40	618	66	2.592
2500*	2.35	625	67	2.64	34.9	4.94	3.40	183.2	0.09	40.2	2500	2.35	625	67	2.871

Table 7.

Station	Latitude	Longitude	Date	Ship time	Depth
5	18-05.0N 18-03.7N	116-59.9E 116-59.4E	Sept. 26, 1981	21:11 00:48	3950m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
22:00	28.7°C	SE - 5.5m/s	4	3	cloudy

Observed D (m)	T (°C)	S (‰)	σ_t	DO (ml/l)	O_2-Sat (%)	AOU (ml/l)	PO_4-P	SiO_2-Si	NO_2-N	NO_3-N	CTD D (m)	T (°C)	S (‰)	σ_t	ΔD
							(μg atoms/l)								
0	29.2	33.390	20.81	4.30	96.7	0.15	0.09	3.3	0.06	0.2	0	29.03	33.401	20.88	0.000
10	28.99	386	88	4.34	97.2	0.12	0.08	3.3	0.05	0.1	10	29.04	407	88	0.069
20	29.01	386	87	4.35	97.5	0.11	0.10	3.2	0.05	0.0	20	29.04	409	88	0.138
30	29.05	386	86	4.36	97.8	0.10	0.08	3.2	0.05	0.0	30	29.04	410	88	0.207
50	28.58	610	21.18	4.52	100.7	-0.03	0.11	3.0	0.05	0.0	50	28.41	630	21.26	0.343
74	23.44	34.286	23.29	4.12	84.5	0.75	0.22	4.8	0.15	1.1	75	23.54	34.266	23.24	0.476
99	21.02	555	24.17	3.55	69.9	1.53	0.62	7.6	0.09	6.3	100	21.24	515	24.08	0.585
124	18.96	632	77	3.06	58.0	2.22	0.89	12.1	0.08	10.9	125	19.35	632	67	0.675
149	17.41	624	25.15	3.03	55.7	2.41	1.08	15.7	0.08	12.4	150	17.58	627	25.11	0.753
198	15.10	586	65	3.06	53.8	2.63	1.17	22.3	0.40	14.9	200	15.33	594	60	0.886
298	12.14	480	26.18	2.58	42.6	3.47	1.72	38.1	0.18	21.2	300	11.82	472	26.23	1.098
397	10.34	428	47	2.59	41.2	3.70	1.95	51.1	0.10	24.6	400	9.90	432	53	1.271
496	8.85	417	71	2.14	32.9	4.36	2.27	67.2	0.07	28.5	500	8.51	425	76	1.419
600*	7.49	439	93	-	-	-	-	-	-	-	600	7.49	439	93	1.549
800*	6.02	469	27.15	1.78	25.6	5.16	2.80	106.5	0.05	34.3	800	6.02	469	27.15	1.775
1000*	4.73	512	34	1.89	26.4	5.27	2.92	127.0	0.06	36.0	1000	4.73	512	34	1.963
1200*	3.76	556	48	2.00	27.3	5.33	3.00	145.3	0.05	38.1	1200	3.76	556	48	2.118
1500*	2.99	591	58	2.13	28.5	5.34	3.05	159.5	0.06	38.0	1500	2.99	591	58	2.316
2000*	2.52	614	64	2.34	31.0	5.21	3.05	164.8	0.05	38.1	2000	2.52	614	64	2.610
2500*	2.38	623	66	2.32	30.6	5.26	3.05	164.6	0.06	37.8	2500	2.38	623	66	2.894
3000*	2.35	626	67	-	-	-	-	-	-	-	3000	2.35	626	67	3.182
3500*	2.37	628	67	-	-	-	-	-	-	-	3500	2.37	628	67	3.481
3850*	2.39	629	67	2.64	34.8	4.94	2.88	164.5	0.08	37.8					

Table 8.

Station	Latitude	Longitude	Date	Ship time	Depth
6	14-40.7N 14-41.7N	114-10.4E 114-09.5E	Sept. 29, 1981	11:15 15:00	4290m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
12:00	29.5°C	SSW - 7.5m/s	3	1	fine

Observed D	T	S	σ_t	DO	O_2-Sat	AOU	PO_4-P	SiO_2-Si	NO_2-N	NO_3-N	CTD D	T	S	σ_t	ΔD
(m)	(°C)	(‰)		(ml/l)	(%)	(ml/l)	(μg atoms/l)				(m)	(°C)	(‰)		
0	29.8	33.583	20.75	4.42	100.5	-0.02	0.09	2.9	0.05	0.0^+	0	29.49	33.584	20.86	0.000
10	29.50	591	86	4.44	100.4	-0.02	0.10	3.2	0.05	0.0	10	29.49	589	86	0.069
20	29.49	600	87	4.47	101.1	-0.05	0.09	3.2	0.05	0.1	20	29.46	600	88	0.138
30	28.65	758	21.27	4.60	102.7	-0.12	0.09	3.2	0.05	0.1	30	29.07	749	21.12	0.206
49	22.76	34.451	23.61	4.53	91.9	0.40	0.21	3.9	0.05	0.1	50	23.76	34.226	23.15	0.325
74	18.87	593	24.76	2.92	55.2	2.37	0.94	13.1	0.14	11.7	75	19.95	559	24.46	0.426
99	17.38	611	25.14	2.82	51.8	2.62	1.03	16.7	0.17	13.5	100	17.64	616	25.09	0.506
124	15.83	603	50	2.97	53.0	2.64	1.13	19.8	0.09	14.4	125	16.04	611	46	0.574
148	14.80	576	71	2.82	49.3	2.90	1.22	22.7	0.07	15.8	150	14.97	578	67	0.636
198	13.36	521	97	2.72	46.1	3.18	1.39	30.0	0.22	18.5	200	13.44	530	96	0.747
297	11.36	463	26.31	2.40	39.0	3.75	-	43.3	0.12	23.1	300	11.34	466	26.32	0.941
396	9.60	431	60	2.16	33.8	4.24	2.03	58.4	0.06	27.0	400	9.55	435	61	1.106
495	8.39	431	79	1.90	28.9	4.67	2.23	70.7	0.08	31.7	500	8.38	435	79	1.249
594	7.32	441	96	1.82	27.0	4.91	2.36	84.7	0.04	31.2	600	7.29	444	96	1.377
800*	5.65	488	27.21	1.86	26.6	5.14	2.56	109.0	0.05	33.6	800	5.65	488	27.21	1.594
1000*	4.44	532	39	1.92	26.6	5.29	2.33	130.2	0.05	35.1	1000	4.44	532	39	1.769
1200*	3.63	568	50	2.08	28.3	5.27	2.69	141.7	0.05	35.5	1200	3.63	568	50	1.916
1500*	2.91	600	60	2.17	29.0	5.31	2.68	156.8	-	36.3	1500	2.91	600	60	2.108
2000*	2.51	618	65	2.39	31.6	5.17	-	-	0.05	36.2	2000	2.51	618	65	2.397
2500*	2.38	625	66	2.42	31.9	5.16	2.68	159.5	0.05	36.0	2500	2.38	625	66	2.679
3000*	2.36	628	67	-	-	-	-	-	-	-	3000	2.36	628	67	2.966
3500*	2.39	629	67	-	-	-	-	-	-	-	3500	2.39	629	67	3.265
4000*	2.43	629	66	2.56	33.8	5.01	2.64	159.5	0.06	35.8	4000	2.43	629	66	3.577

Table 9.

Station	Latitude	Longitude	Date	Ship time	Depth
7	9-42.8N 9-44.5N	112-37.6E 112-38.2E	Oct. 6, 1981	06:19 08:24	1850m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
07:00	27.9°C	S - 4.0m/s	1	1	fine

Observed D	T	S	σ_t	DO	O_2-Sat	AOU	PO_4-P	SiO_2-Si	NO_2-N	NO_3-N	CTD D	T	S	σ_t	ΔD
(m)	(°C)	(‰)		(ml/l)	(%)	(ml/l)	(μg atoms/l)				(m)	(°C)	(‰)		
0	29.5	33.199	20.57	4.35	98.2	0.08	0.00^+	2.8	0.08	0.0^+	0	28.90	33.092	20.69	0.000
10	28.89	189	76	4.32	96.5	0.15	0.00^+	2.8	0.08	0.0	10	28.90	136	72	0.071
20	28.89	188	76	4.32	96.5	0.15	0.01	2.8	0.08	0.0	20	28.91	166	74	0.141
30	28.50	250	94	4.37	97.1	0.13	0.02	2.8	0.08	0.0	30	28.46	222	93	0.211
50	28.16	352	21.13	4.33	95.7	0.19	0.03	2.7	0.07	0.0^+	50	28.21	329	21.09	0.347
75	24.08	34.164	23.01	3.62	75.0	1.20	0.34	6.4	0.22	4.1	75	24.10	34.141	22.98	0.498
100	21.19	425	24.03	3.26	64.3	1.81	0.64	9.3	0.11	8.7	100	20.97	419	24.08	0.609
125	19.22	539	63	2.68	51.0	2.57	0.86	24.0	0.09	13.0	125	18.39	534	84	0.697
150	17.26	567	25.14	2.36	43.3	3.09	1.14	18.7	0.09	16.8	150	16.94	564	25.21	0.772
200	14.73	540	70	2.12	37.0	3.61	1.40	28.2	0.08	21.3	200	14.55	534	73	0.899
300*	12.01	486	26.21	2.04	33.6	4.03	1.76	43.9	0.08	26.2	300	12.01	486	26.21	1.108
400*	10.30	456	50	1.91	30.3	4.39	2.03	58.9	0.08	29.5	400	10.30	456	50	1.282
500*	8.39	444	80	1.75	26.6	4.82	2.28	75.8	0.10	32.7	500	8.39	444	80	1.428
600*	7.55	451	93	1.76	26.3	4.94	2.38	89.3	0.09	34.6	600	7.55	451	93	1.558
800*	5.84	489	27.19	1.69	24.3	5.28	2.55	113.2	0.09	36.7	800	5.84	489	27.19	1.781
1000*	4.68	530	36	-	-	-	-	-	-	-	1000	4.68	530	36	1.963
1200*	3.64	569	50	-	-	-	2.71	156.0	0.06	39.0	1200	3.64	569	50	2.113
1500*	3.00	599	59	2.03	27.2	5.43	2.66	167.4	0.07	38.9	1500	3.00	599	59	2.306
1750*	2.68	612	63	2.13	28.3	5.39	2.74	174.7	0.06	39.7	1750	2.68	612	63	2.454

Table 10.

Station	Latitude	Longitude	Date	Ship time	Depth
8	7-05.3N 7-04.1N	110-06.9E 110-07.5E	Oct. 8, 1981	07:49 09:49	1690m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
08:00	28.7°C	WSW - 4.0m/s	2	1	fine

Observed

D (m)	T (°C)	S (‰)	σ_t	DO (ml/l)	O_2-Sat (%)	AOU (ml/l)	PO_4-P (μg atoms/l)	SiO_2-Si (μg atoms/l)	NO_2-N (μg atoms/l)	NO_3-N (μg atoms/l)
0	29.1	33.230	20.73	4.40	98.7	0.06	0.02	2.7	0.06	0.0
10	29.17	224	70	4.41	99.0	0.04	0.02	2.7	0.06	0.0
20	29.11	216	71	4.41	98.9	0.05	0.03	2.7	0.06	0.0
30	28.74	166	80	4.37	97.4	0.12	0.03	2.6	0.06	0.0
50	26.96	702	21.78	4.34	94.2	0.27	0.07	3.2	0.06	0.0
75	22.12	34.370	23.73	3.49	70.0	1.50	0.44	6.8	0.17	5.4
100	19.04	550	24.69	2.72	51.6	2.55	0.88	13.1	0.12	12.8
125	17.78	577	25.02	2.61	48.3	2.79	1.03	16.0	0.06	14.8
150*	16.95	578	22	2.47	45.0	3.02	1.19	19.4	0.07	17.1
200*	15.10	564	63	2.40	42.2	3.29	1.36	24.0	0.07	19.3
300*	11.84	482	26.24	2.08	34.1	4.01	1.80	39.4	0.07	25.4
400*	9.94	454	56	1.81	28.5	4.54	2.09	53.0	0.06	29.6
500*	8.39	445	80	1.73	26.3	4.84	2.28	66.6	0.08	32.2
600*	7.53	450	93	1.80	26.9	4.90	2.44	76.8	0.05	33.9
800*	5.78	484	27.20	1.71	24.5	5.27	2.64	100.0	0.06	36.5
1000*	4.54	531	38	-	-	-	2.76	118.2	0.06	37.7
1200*	3.58	573	51	-	-	-	2.77	131.7	0.06	38.3
1500*	2.91	602	60	1.97	26.3	5.51	2.77	146.5	0.16	38.9

CTD

D (m)	T (°C)	S (‰)	σ_t	ΔD
0	29.15	33.229	20.71	0.000
10	29.16	234	71	0.071
20	29.02	215	74	0.141
30	28.77	185	80	0.212
50	27.22	652	21.66	0.346
75	22.17	34.343	23.69	0.473
100	19.03	537	24.68	0.567
125	17.95	566	97	0.646
150	16.95	578	25.22	0.719
200	15.10	564	63	0.850
300	11.84	482	26.24	1.061
400	9.94	454	56	1.232
500	8.39	445	80	1.379
600	7.53	450	93	1.508
800	5.78	484	27.20	1.729
1000	4.54	531	38	1.910
1200	3.58	573	51	2.058
1500	2.91	602	60	2.248

Table 11.

Station	Latitude	Longitude	Date	Ship time	Depth
9	6-30.0N 6-30.0N	107-30.6E 107-30.8E	Oct. 9, 1981	07:10 07:28	65m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
07:00	28.2°C	SW - 7.0m/s	3	1	fine

Observed

D (m)	T (°C)	S (‰)	σ_t	DO (ml/l)	O_2-Sat (%)	AOU (ml/l)	PO_4-P (μg atoms/l)	SiO_2-Si (μg atoms/l)	NO_2-N (μg atoms/l)	NO_3-N (μg atoms/l)
0	29.18	32.383	20.06	4.41	98.6	0.06	0.07	2.6	0.08	0.0
2*	29.19	385	06	-	-	-	-	-	-	-
5*	29.19	385	06	4.38	97.9	0.09	0.07	2.6	0.07	0.0
10*	29.18	416	09	4.34	97.0	0.13	0.06	2.5	0.06	0.0
20*	28.81	33.177	78	4.44	99.1	0.04	0.08	1.6	0.07	0.0
30*	28.67	203	85	4.42	98.4	0.07	0.08	1.6	0.07	0.0
40*	28.59	224	89	4.17	92.7	0.33	0.12	1.6	0.08	0.1
50*	27.00	714	21.77	4.43	96.3	0.17	0.12	1.6	0.07	0.0
55*	24.87	34.122	22.74	4.31	90.5	0.45	-	-	-	-

CTD

D (m)	T (°C)	S (‰)	σ_t	ΔD
0	29.18	32.383	20.06	0.000
10	29.18	416	09	0.077
20	28.81	33.177	78	0.151
30	28.67	203	85	0.220
40	28.59	224	89	0.290
50	27.00	714	21.77	0.357
58	24.19	34.194	23.00	0.401

Table 12

Station	Latitude	Longitude	Date	Ship time	Depth
10	5-00.1N 5-01.5N	130-00.0E 129-00.2E	Oct. 23, 1981	07:27 11:25	5030m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
09:00	25.6°C	NE - 6.0m/s	2	1	rainy

Observed D (m)	T (°C)	S (‰)	σ_t	DO (ml/l)	O_2-Sat (%)	AOU (ml/l)	PO_4-P	SiO_2-Si	NO_2-N	NO_3-N	CTD D (m)	T (°C)	S (‰)	σ_t	ΔD
							(μg atoms/l)								
0	29.3	34.121	21.33	4.39	99.3	0.03	0.11	1.1	0.06	0.0	0	29.32	34.190	21.37	0.000
9	29.32	202	38	-	-	-	0.11	1.2	0.06	0.0	10	29.32	207	38	0.064
19	29.35	227	39	4.30	97.4	0.12	0.10	1.2	0.06	0.0	20	29.31	228	40	0.128
28	29.31	222	40	4.32	97.8	0.10	0.11	1.2	0.06	0.0	30	29.23	225	43	0.192
46	29.23	214	42	4.30	97.2	0.12	0.11	1.3	0.06	0.0	50	29.16	247	47	0.320
68	28.59	398	77	4.28	95.8	0.19	0.17	1.3	0.05	0.0	75	28.34	518	94	0.475
89	27.38	686	22.38	3.99	87.7	0.56	0.27	1.5	0.22	1.3	100	26.19	614	22.70	0.613
110	24.76	569	23.11	3.97	83.5	0.79	0.31	4.1	0.30	2.2	125	23.28	724	23.66	0.732
130	23.02	734	23.75	3.91	79.8	0.99	0.40	4.4	0.16	3.0	150	18.52	696	24.93	0.824
171	16.28	692	25.46	3.40	61.2	2.15	0.96	12.7	0.06	11.3	200	13.15	468	25.97	0.953
253	11.10	498	26.39	2.11	34.1	4.08	1.89	27.3	0.05	24.1	300	9.03	494	26.74	1.122
339	8.79	510	79	1.96	30.1	4.55	2.23	36.7	0.04	28.9	400	8.14	570	94	1.249
436	7.84	564	98	1.89	28.4	4.76	2.34	38.6	0.04	31.2	500	7.46	562	27.03	1.366
600*	6.82	549	27.11	2.26	33.2	4.55	2.39	45.4	0.05	31.7	600	6.82	549	11	1.475
800*	5.71	545	25	2.07	29.6	4.92	2.58	58.5	0.05	34.4	800	5.71	545	25	1.674
1000*	4.70	554	38	2.03	28.4	5.13	2.65	69.8	0.06	35.4	1000	4.70	554	38	1.849
1200*	3.94	575	48	2.07	28.4	5.22	2.71	89.7	0.05	34.7	1200	3.94	575	48	2.002
1500*	2.99	600	59	2.28	30.5	5.19	2.71	109.1	0.05	35.7	1500	2.99	600	59	2.202
2000*	2.21	640	69	-	-	-	-	-	-	-	2000	2.21	640	69	2.480
2500*	1.75	668	75	3.01	39.1	4.69	2.60	130.6	0.04	34.5	2500	1.75	668	75	2.720
3000*	1.58	679	77	3.26	42.2	4.47	2.52	125.7	0.04	33.3	3000	1.58	679	77	2.942
3500*	1.55	685	78	3.40	43.9	4.34	2.55	129.8	0.05	33.6	3500	1.55	685	78	3.163
4000*	1.56	689	78	3.49	45.1	4.25	2.48	129.1	0.05	33.1	4000	1.56	689	78	3.387

Table 13.

Station	Latitude	Longitude	Date	Ship time	Depth
11	9-00.1N 8-59.9N	129-59.5E 129-59.0E	Oct. 27, 1981	10:48 14:19	5880m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
12:00	27.5°C	E - 8.0m/s	2	3	cloudy

Observed D (m)	T (°C)	S (‰)	σ_t	DO (ml/l)	O_2-Sat (%)	AOU (ml/l)	PO_4-P	SiO_2-Si	NO_2-N	NO_3-N	CTD D (m)	T (°C)	S (‰)	σ_t	ΔD
							(μg atoms/l)								
0	29.2	33.848	21.16	4.36	98.3	0.08	0.11	1.3	0.07	0.0	0	28.93	33.833	21.24	0.000
10	28.96	839	23	4.21	94.5	0.24	0.12	1.5	0.08	0.0	10	28.93	835	24	0.066
20	28.93	841	24	4.33	97.2	0.13	0.12	1.3	0.07	0.0	20	28.85	843	27	0.131
29	28.94	862	25	4.20	94.3	0.25	0.13	1.3	0.07	0.0	30	28.86	864	28	0.197
49	28.82	931	34	4.31	96.6	0.15	0.11	1.5	0.07	0.0	50	28.85	924	33	0.327
73	27.23	34.450	22.25	4.20	92.0	0.37	0.13	2.0	0.07	0.0	75	27.74	34.326	22.00	0.485
98	23.87	682	23.46	3.80	78.7	1.03	0.39	3.6	0.28	1.9	100	23.61	644	23.51	0.612
122	19.73	770	24.68	3.43	66.0	1.77	0.74	6.0	0.12	6.0	125	19.69	773	24.69	0.708
147	16.68	702	25.38	3.20	58.1	2.31	0.96	9.2	0.09	9.9	150	16.67	658	25.35	0.783
196	12.45	534	26.16	2.46	40.9	3.55	1.72	22.0	0.05	19.9	200	12.65	523	26.11	0.898
294	9.45	542	71	1.56	24.3	4.85	2.37	36.7	0.04	29.2	300	9.52	539	69	1.065
392	8.16	559	92	1.66	25.2	4.94	2.54	42.2	0.04	31.4	400	8.16	558	92	1.195
491	7.45	544	27.02	1.84	27.4	4.87	2.56	46.5	0.04	31.8	500	7.48	545	27.01	1.312
600*	6.78	521	09	1.88	27.6	4.94	2.63	57.7	0.07	33.1	600	6.78	521	09	1.422
800*	5.67	525	24	1.92	27.4	5.08	2.75	74.9	0.07	35.2	800	5.67	525	24	1.623
1000*	4.58	550	39	1.93	26.9	5.25	2.86	92.1	0.07	36.0	1000	4.58	550	39	1.797
1200*	3.69	573	50	2.00	27.3	5.34	2.91	110.5	0.06	36.5	1200	3.69	573	50	1.947
1500*	2.80	604	61	2.29	30.5	5.21	2.87	127.5	0.07	36.4	1500	2.80	604	61	2.136
2000*	2.12	644	70	2.61	34.2	5.02	2.77	138.4	0.09	35.9	2000	2.12	644	70	2.405
2500*	1.78	665	74	2.94	38.2	4.75	2.77	143.2	0.09	35.5	2500	1.78	665	74	2.643
3000*	1.61	678	76	-	39.3	4.69	2.63	135.4	0.04	33.5	3000	1.61	678	76	2.867
3500*	1.55	685	78	3.27	42.2	4.47	2.66	142.4	0.05	34.2	3500	1.55	685	78	3.088
4000*	1.56	689	78	3.41	44.1	4.33	2.63	140.5	0.05	34.0	4000	1.56	689	78	3.312

Table 14.

Station	Latitude	Longitude	Date	Ship time	Depth
12	12-59.4N 12-59.4N	129-58.7E 129-59.2E	Nov. 7, 1981	16:12 19:33	5920m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
18:00	28.4°C	E - 8.0m/s	3	3	cloudy

Observed D (m)	T (°C)	S (‰)	σ_t	DO (ml/l)	O_2-Sat (%)	AOU (ml/l)	PO_4-P	SiO_2-Si (μg atoms/l)	NO_2-N	NO_3-N	CTD D (m)	T (°C)	S (‰)	σ_t	ΔD
0	29.0	34.138	21.44	4.29	96.5	0.15	0.19	1.8	0.08	0.0	0	28.99	34.069	21.39	0.000
10	28.97	136	45	4.19	94.2	0.26	0.20	1.8	0.07	0.0	10	29.00	088	40	0.064
20	28.98	136	44	4.28	96.3	0.16	0.18	1.8	0.08	0.0	20	28.93	100	43	0.128
30	28.97	135	45	4.24	95.4	0.21	0.17	2.2	0.07	0.0	30	28.92	146	47	0.192
49	28.96	166	47	4.25	95.6	0.20	0.17	2.2	0.08	0.0	50	28.92	174	49	0.319
74	27.31	751	22.45	4.40	96.7	0.15	0.27	1.8	0.08	0.0	75	27.27	709	22.43	0.469
99	25.97	904	99	4.30	92.5	0.35	0.29	2.6	0.08	0.1	100	25.96	890	99	0.598
123	24.84	987	23.40	4.20	88.6	0.54	0.32	3.5	0.17	0.7	125	24.32	35.029	23.59	0.714
148	21.99	948	24.20	-	-	-	0.57	4.3	0.13	2.4	150	22.48	34.992	24.10	0.817
197	16.98	741	25.34	3.59	65.5	1.89	1.03	9.1	0.10	8.6	200	18.01	789	25.13	0.983
296	11.12	481	26.37	2.26	36.5	3.92	2.14	26.6	0.09	23.6	300	11.94	420	26.17	1.228
395	8.57	468	79	1.78	27.2	4.76	2.57	39.1	0.09	30.0	400	9.18	477	70	1.395
494	7.43	513	27.00	2.07	30.8	4.64	2.67	43.4	0.09	31.6	500	7.61	449	92	1.526
600*	7.20	537	05	2.00	29.6	4.75	2.66	40.7	0.09	31.9	600	7.20	537	27.05	1.642
800*	5.82	517	22	2.07	29.7	4.90	2.78	58.8	0.09	33.7	800	5.82	517	22	1.852
1000*	5.08	539	32	1.92	27.1	5.17	2.90	71.0	0.10^{-}	35.2	1000	5.08	539	32	2.035
1200*	4.33	543	41	1.95	27.0	5.27	2.92	83.6	0.09	35.2	1200	4.33	543	41	2.202
1500*	3.34	568	53	2.12	28.6	5.28	2.95	99.4	0.09	35.6	1500	3.34	568	53	2.423
2000*	2.31	626	67	2.53	33.3	5.06	2.91	117.7	0.09	35.4	2000	2.31	626	67	2.725
2500*	1.86	656	73	2.76	35.9	4.92	2.90	123.3	0.09	34.8	2500	1.86	656	73	2.975
3000*	1.67	673	76	2.98	38.6	4.74	2.81	117.1	0.09	33.9	3000	1.67	673	76	3.207
3500*	1.60	682	77	3.32	42.9	4.41	2.79	122.0	0.09	33.8	3500	1.60	682	77	3.434
4000*	1.57	687	78	3.48	45.0	4.26	2.79	121.7	0.10^{-}	33.3	4000	1.57	687	78	3.661

Table 15.

Station	Latitude	Longitude	Date	Ship time	Depth
13	17-00.0N 17-00.1N	130-00.0E 130-00.2E	Nov. 11, 1981	06:55 10:15	5170m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
08:00	28.8°C	NE - 14.5m/s	5	4	fine

Observed D (m)	T (°C)	S (‰)	σ_t	DO (ml/l)	O_2-Sat (%)	AOU (ml/l)	PO_4-P	SiO_2-Si (μg atoms/l)	NO_2-N	NO_3-N	CTD D (m)	T (°C)	S (‰)	σ_t	ΔD
0	28.1	34.126	21.73	4.39	97.4	0.12	0.10	1.5	0.06	0.0	0	28.06	34.140	21.75	0.000
10	28.07	128	74	4.38	97.1	0.13	0.09	1.5	0.06	0.0	10	28.06	146	75	0.061
20	28.11	135	73	4.47	99.2	0.04	0.10	1.6	0.07	0.0	20	28.07	147	75	0.121
30	28.10	129	73	4.47	99.1	0.04	0.10	1.5	0.07	0.0	30	28.07	147	75	0.182
49	28.10	137	74	4.34	96.3	0.17	0.10	1.4	0.07	0.0	50	28.07	154	76	0.304
74	26.53	725	22.68	4.48	97.1	0.13	0.15	1.3	0.07	0.0	75	26.57	659	22.62	0.448
98	23.78	35.049	23.76	4.16	86.2	0.66	0.16	1.6	0.13	0.2	100	24.04	35.004	23.66	0.567
123	21.97	012	24.26	4.04	81.1	0.94	0.27	2.5	0.11	1.7	125	22.48	014	24.11	0.669
148	20.87	34.997	55	4.22	83.0	0.86	0.22	2.5	0.09	2.0	150	21.43	032	42	0.762
197	17.79	832	25.21	3.99	74.0	1.40	0.48	5.4	0.08	5.5	200	18.25	34.850	25.12	0.922
295	14.11	535	82	4.09	70.4	1.72	0.76	11.7	0.07	10.6	300	14.23	553	81	1.180
394	10.64	303	26.32	3.34	53.4	2.92	1.46	23.1	0.07	19.3	400	10.35	286	26.35	1.380
492	7.92	282	74	2.07	31.1	4.58	2.28	45.6	0.06	30.5	500	7.68	279	78	1.536
600*	6.22	305	27.00	1.54	22.3	5.37	2.80	70.2	0.06	36.9	600	6.22	305	27.00	1.663
800*	4.90	453	28	1.76	24.7	5.37	2.85	88.5	0.08	38.0	800	4.90	453	28	1.863
1000*	4.04	524	42	1.94	26.7	5.34	2.91	102.6	0.06	38.6	1000	4.04	524	42	2.026
1200*	3.46	550	50	-	-	-	2.89	114.1	0.07	38.5	1200	3.46	550	50	2.170
1500*	2.71	587	60	2.16	28.7	5.36	2.97	124.7	0.06	38.9	1500	2.71	587	60	2.359
2000*	2.08	631	69	2.53	33.1	5.11	2.84	134.8	0.06	38.3	2000	2.08	631	69	2.629
2500*	1.77	657	74	2.83	36.8	4.87	2.86	137.4	0.06	37.6	2500	1.77	657	74	2.869
3000*	1.64	673	76	3.04	39.4	4.68	2.70	134.7	0.06	36.6	3000	1.64	673	76	3.097
3500*	1.58	681	77	3.33	43.1	4.40	2.71	135.5	0.06	36.3	3500	1.58	681	77	3.321
4000*	1.57	686	78	3.41	44.1	4.33	2.63	134.6	0.06	35.7	4000	1.57	686	78	3.548

Table 16.

Station	Latitude	Longitude	Date	Ship time	Depth
14	21-00.0N 20-58.4N	132-00.1E 132-00.9E	Nov. 13, 1981	00:20 04:27	6060m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
02:00	26.2°C	ENE - 9.0m/s	3	3	fine

Observed D (m)	T (°C)	S (‰)	σ_t	DO (ml/l)	O_2-Sat (%)	AOU (ml/l)	PO_4-P	SiO_2-Si	NO_2-N	NO_3-N	CTD D (m)	T (°C)	S (‰)	σ_t	ΔD
							(μg atoms/l)								
0	27.6	34.270	22.00	4.42	97.3	0.12	0.19	0.2	0.07	0.0	0	27.72	34.258	21.95	0.000
10	27.73	255	21.94	4.52	99.7	0.01	0.23	0.2	0.06	0.0	10	27.73	267	95	0.059
19	27.75	254	94	4.52	99.7	0.01	0.18	0.4	0.06	0.0	20	27.73	273	96	0.118
29	27.78	254	93	4.40	97.1	0.13	0.21	0.2	0.06	0.0	30	27.74	274	96	0.176
48	27.75	255	94	4.47	98.6	0.06	0.12	0.4	0.06	0.0	50	27.74	276	96	0.294
72	26.27	513	22.60	4.60	99.6	0.02	0.15	1.0	0.06	0.0	75	25.86	579	22.78	0.434
96	25.17	780	23.14	4.52	95.8	0.20	0.08	0.4	0.06	0.0	100	25.16	824	23.18	0.558
120	23.75	35.005	74	4.25	88.0	0.58	0.08	0.5	0.12	0.3	125	23.74	35.020	75	0.669
144	22.14	056	24.24	3.99	80.3	0.98	0.09	1.2	0.07	1.6	150	22.01	053	24.28	0.768
191	19.55	34.953	86	4.25	81.6	0.96	0.09	1.8	0.08	2.6	200	19.46	34.958	89	0.938
287	16.89	772	25.38	4.36	79.5	1.13	0.20	3.9	0.06	4.8	300	16.87	781	25.40	1.227
383	13.81	514	87	4.04	69.1	1.80	0.31	10.6	0.06	10.5	400	13.09	461	98	1.472
490	10.50	290	26.33	3.46	55.1	2.82	0.55	23.6	0.07	18.0	500	10.51	292	26.33	1.668
600*	7.40	147	71	2.72	40.4	4.01	0.94	45.9	0.07	26.0	600	7.40	147	71	1.831
800*	5.21	288	27.11	1.53	21.6	5.55	1.55	78.6	0.07	34.4	800	5.21	288	27.11	2.076
1000*	3.88	413	35	1.52	20.8	5.79	2.01	105.7	0.07	36.4	1000	3.88	413	35	2.262
1200*	3.13	499	50	1.72	23.1	5.72	2.25	120.5	0.07	36.4	1200	3.13	499	50	2.410
1500*	2.62	572	60	2.14	28.4	5.40	2.45	129.1	0.06	35.4	1500	2.62	572	60	2.598
2000*	2.07	629	69	2.59	33.9	5.05	2.44	133.7	0.08	34.5	2000	2.07	629	69	2.868
2500*	1.78	654	73	2.91	37.8	4.79	2.46	136.0	0.06	34.1	2500	1.78	654	73	3.108
3000*	1.66	669	75	3.08	39.9	4.64	2.38	131.8	0.06	33.1	3000	1.66	669	75	3.338
3500*	1.59	678	77	3.25	42.0	4.48	2.44	135.8	0.08	33.1	3500	1.59	678	77	3.565
4000*	1.58	683	77	3.44	44.5	4.29	2.43	135.2	0.06	32.8	4000	1.58	683	77	3.794

Table 17.

Station	Latitude	Longitude	Date	Ship time	Depth
15	24-59.7N 24-59.0N	133-59.7E 134-00.2E	Nov. 15, 1981	05:38 08:29	4730m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
07:00	22.1°C	ENE - 6.5m/s	3	1	fine

Observed D (m)	T (°C)	S (‰)	σ_t	DO (ml/l)	O_2-Sat (%)	AOU (ml/l)	PO_4-P	SiO_2-Si	NO_2-N	NO_3-N	CTD D (m)	T (°C)	S (‰)	σ_t	ΔD
							(μg atoms/l)								
0	25.5	34.720	23.00	4.70	100.1	-0.01	0.01	0.0	0.08	0.0	0	25.5	34.720	23.00	0.000
10	25.59	696	22.95	4.66	99.4	0.03	0.08	0.6	0.08	0.0	10	25.59	696	22.95	0.049
20	25.61	696	95	4.64	99.0	0.04	0.08	0.6	0.08	0.0	30	25.62	694	94	0.148
30	25.62	694	94	4.64	99.1	0.04	0.01	0.0	0.07	0.0^{+}	50	25.61	694	94	0.246
50	25.61	694	94	4.66	99.5	0.02	0.01	0.5	0.08	0.0^{+}	75	25.61	693	94	0.370
75	25.61	693	94	4.66	99.5	0.02	0.01	0.8	0.08	0.0^{+}	100	24.89	718	23.18	0.492
100	24.89	718	23.18	4.64	97.8	0.10	0.01	1.2	0.10	0.1	125	22.39	928	24.07	0.599
124	22.47	923	24.05	4.72	95.5	0.22	0.10	1.9	0.20	0.4	150	20.81	990	56	0.691
149	20.85	990	55	4.56	89.7	0.52	0.02	2.1	0.11	0.7	175	19.89	986	80	0.774
199	19.33	954	92	4.51	86.2	0.72	0.03	1.8	0.09	2.4	200	19.31	953	92	0.854
297	17.54	859	25.30	4.78	88.3	0.63	0.04	2.6	0.08	3.4	300	17.49	854	25.30	1.148
395	15.82	683	56	4.44	79.2	1.16	0.10	6.0	0.08	7.1	400	15.71	674	58	1.413
493	13.57	511	92	4.36	74.2	1.51	0.18	12.3	0.07	10.9	500	13.43	500	94	1.650
592	11.62	365	26.19	4.00	65.3	2.12	0.32	21.1	0.08	15.4	600	11.39	351	26.22	1.857
790	6.40	140	84	2.58	37.4	4.31	1.07	65.4	0.10^{-}	29.0	700	8.67	214	58	2.034
986	4.56	281	27.18	1.47	20.4	5.73	1.71	99.0	0.08	35.3	800	6.25	143	87	2.179
1183	3.67	389	36	1.38	18.8	5.97	2.03	116.5	0.09	36.3	1000	4.48	290	27.19	2.407
1480	2.76	503	53	1.70	22.6	5.81	2.30	134.0	0.08	36.5	1200	3.60	397	37	2.586
											1500	2.72	509	54	2.804

Table 18.

Station	Latitude	Longitude	Date	Ship time	Depth
16	29-59.9N 29-59.4N	136-30.1E 136-29.9E	Nov. 17, 1981	11:47 12:57	4340m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
12:00	21.2°C	NW - 4.5m/s	2	1	fine

Observed											CTD				
D (m)	T (°C)	S (‰)	σ_t	DO (ml/l)	O_2-Sat (%)	AOU (ml/l)	PO_4-P	SiO_2-Si (μg atoms/l)	NO_2-N	NO_3-N	D (m)	T (°C)	S (‰)	σ_t	ΔD
0	23.1	34.759	23.74	-	-	-	-	-	-	-	0	23.1	34.759	23.74	0.000
25	22.93	752	79	-	-	-	-	-	-	-	25	22.93	752	79	0.104
50	22.90	759	80	-	-	-	-	-	-	-	50	22.90	759	80	0.207
74	22.87	768	82	-	-	-	-	-	-	-	75	22.87	770	82	0.310
99	22.63	830	93	-	-	-	-	-	-	-	100	22.58	833	95	0.412
149	19.91	939	24.76	-	-	-	-	-	-	-	150	19.88	939	24.77	0.593
198	18.85	918	25.02	-	-	-	-	-	-	-	200	18.82	917	25.02	0.749
297	17.84	865	23	-	-	-	-	-	-	-	300	17.81	863	23	1.042
494	15.33	677	67	-	-	-	-	-	-	-	500	15.19	665	69	1.572
691	10.48	302	26.34	-	-	-	-	-	-	-	700	10.25	290	26.38	1.998
888	6.26	175	89	-	-	-	-	-	-	-	900	6.12	181	91	2.305
1083	4.73	325	27.19	-	-	-	-	-	-	-	1100	4.62	335	27.21	2.529
1278	3.69	422	38	-	-	-	-	-	-	-	1300	3.60	431	40	2.706
1474	3.04	482	49	-	-	-	-	-	-	-	1500	2.98	487	50	2.854

Table 19.

Station	Latitude	Longitude	Date	Ship time	Depth
17	34-11.0N 34-11.4N	138-29.9E 138-30.7E	Nov. 18, 1981	16:52 18:00	3620m
Time	**Air temp.**	**Wind**	**Sea**	**Swell**	**Weather**
17:00	13.5°C	NNW - 3.0m/s	2	3	clear

Observed											CTD				
D (m)	T (°C)	S (‰)	σ_t	DO (ml/l)	O_2-Sat (%)	AOU (ml/l)	PO_4-P	SiO_2-Si (μg atoms/l)	NO_2-N	NO_3-N	D (m)	T (°C)	S (‰)	σ_t	ΔD
0	21.25	34.531	24.09	-	-	-	-	-	-	-	0	21.25	34.531	24.09	0.000
25	21.79	508	23.92	-	-	-	-	-	-	-	25	21.79	508	23.92	0.098
49	21.79	510	93	-	-	-	-	-	-	-	50	21.83	509	91	0.198
74	21.82	528	93	-	-	-	-	-	-	-	75	21.67	536	98	0.298
98	17.87	724	25.11	-	-	-	-	-	-	-	100	17.70	728	25.16	0.383
146	15.95	680	53	-	-	-	-	-	-	-	150	15.84	674	55	0.517
196	14.75	602	74	-	-	-	-	-	-	-	200	14.66	596	75	0.637
293	12.62	465	26.07	-	-	-	-	-	-	-	300	12.41	453	26.10	0.852
486	7.26	215	79	-	-	-	-	-	-	-	500	7.01	217	82	1.182
679	4.82	315	27.18	-	-	-	-	-	-	-	700	4.69	324	27.20	1.408
872	4.01	386	32	-	-	-	-	-	-	-	900	3.91	395	34	1.586
1062	3.37	446	43	-	-	-	-	-	-	-	1100	3.24	459	45	1.740
1252	2.79	507	53	-	-	-	-	-	-	-	1300	2.69	518	55	1.874
1440	2.53	539	58	-	-	-	-	-	-	-	1500	2.51	543	59	1.995

Table 20. Data on brachyuran larvae samplings with ORI-69 net at surface layer.

Station	Date	Ship's time	Position		Vol. of water	No. of larvae	
			Latitude	Longitude	filtered (m^3)	zoea	megalopa
S-2	Oct. 17	2004-2034	3°16.0'N	109°24.4'E	2241.77	878	720
S-4	Oct. 18	1959-2029	4°27.6'N	112°58.1'E	3211.19	490	1426
S-6	Oct. 19	2000-2030	7°02.4'N	115°46.9'E	3006.52	942	1121
S-8	Oct. 20	2006-2036	7°48.2'N	119°32.3'E	3124.45	3695	1290
S-10	Oct. 21	1958-2028	6°08.1'N	122°42.2'E	2935.84	1647	286
S-12	Oct. 22	1958-2028	5°20.2'N	127°47.6'E	5041.65	13	15
10	Oct. 26	0333-0403	5°23.9'N	130°14.3'E	2623.52	16	25
10'	Oct. 26	1958-2028	6°17.8'N	130°16.1'E	2910.95	1655	643
11	Oct. 28	1903-1933	9°01.0'N	129°54.2'E	3091.28	34	11
11'	Nov. 6	1958-2028	12°56.5'N	126°48.8'E	3323.29	1	4
12	Nov. 8	2051-2121	12°57.8'N	130°01.1'E	3518.98	0	1
12'	Nov. 9	1959-2029	15°13.6'N	129°59.9'E	3735.54	0	1
13	Nov. 10	1934-2024	17°04.6'N	129°59.7'E	3655.07	0	0
13'	Nov. 12	2000-2030	20°26.3'N	131°42.3'E	3443.44	0	1
14	Nov. 13	2132-2202	21°00.7'N	132°05.5'E	2452.66	0	0
14'	Nov. 14	1959-2029	23°22.1'N	133°11.7'E	3603.06	0	17
15	Nov. 14	2348-0018	25°03.3'N	133°52.5'E	2543.76	0	2
15'	Nov. 16	1959-2029	27°15.4'N	135°08.9'E	3135.19	0	762
15''	Nov. 17	2002-2032	31°03.8'N	137°00.3'E	2967.22	44	63

Table 21. Wet weight of zooplankton and micronekton collected by oblique tow with an ORI-69 net and a 10-feet IKMT (g/1000 m^3)*

Net	ORI-69 (Mesh size 0.69 mm)									10-feet IKMT (Mesh size 5 mm)							
Station	3	5	6	7	8	10	11	13	15	3	5	6	7	8	11	12	14
Location (Middle point) N	22-03.5	18-08.5	14-40.4	09-41.6	07-05.3	05-16.4	09-03.0	17-12.0	25-04.1	21-59.2	18-05.5	14-39.0	09-43.7	07-02.6	08-01.2	12-59.0	20-59.3
E	125-03.4	117-05.0	114-10.0	112-38.2	110-07.3	130-05.0	129-53.3	129-00.8	133-55.0	124-59.8	117-06.0	114-07.0	112-40.1	110-09.8	129-52.8	129-59.8	131-02.2
Date	Sept. 15	Sept. 27	Sept 29 -30	Oct. 6	Oct. 7	Oct. 24	Oct. 28	Nov. 11	Nov. 15	Sept. 15 -16	Sept. 28	Sept. 30	Oct. 6	Oct. 7-8	Oct. 28	Nov. 8	Nov. 13
Time	03:35 -05:02	20:14 -21:49	22:43 -00:20	02:33 -04:14	18:45 -20:13	04:50 -06:28	21:01 -21:39	16:30 -17:58	00:52 -02:15	23:09 -01:44	03:05 -05:39	00:44 -03:37	16:06 -17:23	23:23 -00:53	02:06 -04:55	16:43 -19:33	18:22 -20:56
Sampling layer** (m)	0-680	0-(939)	0-1240	0-1200	0-(1439)	0-1800	0-1550	0-880	0-1300	0-1300	0-1400	0-1380	0-(876)	0-750	0-1900	0-2300	0-1400
Mollusca																	
Pteropoda	0.03	0.11	0.33	0.36	0.40	0.19	0.10	0.67	0.09	+	0.03	0.02	0.02	0.03	0.01	0.02	+
Atlantidae	+	+	0.01	+	+	+	+	+	+	+	0.01	+					
Cephalopoda	+	0.01	0.02	0.34	+	0.02	+	+		+	0.08	0.06		0.11	0.02	0.01	0.29
Polychaeta	0.02	0.05	0.01	0.04	0.02	0.01	+	0.01	0.03			+	+	+			
Crustacea																	
Ostracoda	0.02	0.02	0.02	0.05	0.03	0.02	0.02	0.01	0.02	0.01		+			0.03		
Copepoda	0.66	2.82	1.52	1.92	1.65	1.73	1.29	0.84	1.43	+	0.01	0.02	0.02	0.02	+	+	+
Mysidacea	0.02	0.15	0.13	0.13	0.28	0.08	0.20	1.62		0.01	0.26	0.23		0.14	0.11		0.09
Isopoda	+				+		+	+									
Amphipoda	0.06	0.06	0.07	0.44	0.03	0.06	0.31	0.02	0.06	0.01	0.07	0.03	0.05	0.05	+	+	0.01
Euphausiacea	0.40	0.66	0.64	0.22	0.33	0.26	0.58	0.26	0.56	0.05	0.16	0.28	0.25	0.35	0.14	0.05	0.20
Luciferinae	+	0.04	0.02	0.05	0.03	0.01	+	+	0.01								
Sergestinae	0.05	0.14	0.01	0.05	+	0.03	0.05	0.02	0.02	0.04	0.05	0.14	0.05	0.38	0.19	0.04	0.10
Penaeidae	0.02	0.15	0.18	0.21	0.14	0.07	0.06	0.10	0.09	0.12	0.21	0.12	0.14	0.30	0.07	0.02	0.07
Caridea	0.23	0.11	0.09	0.07	0.66	0.22	0.03	0.04	0.04	0.11	0.27	0.54	0.57	0.58	0.58	0.19	0.16
Larvae of Decapoda	0.02	0.06	0.04	0.10	0.11	0.02	0.04	0.01	0.03		+	+	0.02	0.03	+	+	+
Larvae of Stomatopoda	+		0.02	0.04	0.04	0.03	0.02	0.04	0.03	+	0.01	0.02	0.06	0.07	+	0.02	0.02
Chaetognatha	0.53	0.75	0.65	1.50	0.84	0.39	0.41	0.24	0.55	+	0.01	0.02	0.06	0.05	0.01	0.01	0.01
Tunicata																	
Appendiculata	+	+	+	+			+		+								
Pyrosomata	0.01	0.26	0.02	0.02		0.01	0.01		0.01	0.02	0.27	0.41	0.07	0.06	0.05		0.08
Pisces	2.41	3.30	1.34	1.53	0.88	0.71	0.45	1.89	1.61	0.52	0.73	2.28	1.37	2.46	0.91	0.10	1.04
Others	+		0.03		0.04			0.01		+						+	
Total	4.48	8.69	5.15	7.12	5.48	3.86	3.57	5.78	4.58	0.89	2.17	4.17	2.68	4.63	2.12	0.46	2.06

*: Radiolaria, Coelenterata, Ctenophora, Heteropoda other than Atlantidae, and Taliacea are excluded.

**: Sampling layer was estimated from the record of depth-distance meter and depth-time meter, but that in parentheses was estimated from wire angle.

Table 22. Biomass of zooplankton collected by day and night series of horizontal tows with an ORI-100 net at Stn 6 (g in wet weight/1000 m^3)*

Series		Day					Night					
Wire out (m)		200	400	800	1400	2000	200	400	800	1400	2000	3000
Sampling layer** (m)		0-155	170-340	(388-459)	530-540	950-1750	0-70	162-226	402-525	670-820	920-1150	(1075-1172)
Date		Oct. 2	Oct. 2	Oct. 2	Oct. 2	Oct. 3	Oct. 3	Oct. 1	Oct. 2	Oct. 2	Oct. 2-3	Oct. 3
Time		07:29 -07:44	07:59 -08:30	12:20 -12:59	16:25 -16:57	07:42 -08:38	20:32 -20:42	21:09 -21:40	00:05 -00:36	21:00 -21:28	23:05 -00:02	03:25 -04:22
Location	N	14-43.0	14-41.9	14-39.4	14-38.5	14-42.0	14-44.2	14-45.7	14-40.8	14-43.8	14-50.3	14-40.3
(Middle point)	E	114-09.8	114-09.9	114-10.3	114-15.0	114-09.2	114-10.0	114-10.7	114-12.2	114-13.2	114-09.8	114-10.2
Mollusca												
Pteropoda		0.03	2.20	0.46			2.43	+	0.10	0.10	+	0.01
Atlantidae		+					0.01			0.01		
Cephalopoda		+				0.10	0.01	0.02		0.01		+
Polychaeta		0.01	0.04	0.02	+	0.02	0.01	0.06	0.01	+	+	0.01
Crustacea												
Ostracoda		+	0.02	0.04	+	0.02	0.01	0.01	0.01	0.01	0.05	0.03
Copepoda		0.14	0.75	2.73	0.35	1.10	1.12	0.48	1.32	1.00	0.54	0.69
Mysidacea			+			0.28	+		+	0.60	0.44	0.24
Isopoda											+	
Amphipoda		0.04	0.15	0.63	0.01	0.03	0.27	0.03	0.02	0.01	0.01	0.08
Euphausiacea		0.04	0.11	1.71	4.30	0.10	1.45	0.80	0.28	0.16	0.01	+
Luciferinae		0.02	0.01				0.25	0.01		+		
Sergestinae				0.01		0.01	0.01				+	0.10
Penaeidae				0.03		0.35	0.01		0.22	0.06		0.05
Caridea				0.06	1.41	0.83		0.53	0.49	0.15		0.15
Larvae of Decapoda		0.02	0.03	0.01			0.14	0.02		+	+	
Larvae of Stomatopoda		0.02	0.02				0.12	0.02		+		
Chaetognatha		0.39	1.06	0.56	0.10	0.36	2.95	0.56	0.54	0.50	0.27	0.34
Tunicata												
Appendiculata												
Pyrosomata		+	+	2.45		0.19	0.43					
Pisces		0.08	0.82	2.53	0.51	1.94	8.25	0.05	1.27	1.49	0.77	1.18
Others		0.02	0.03	0.01		0.02	0.01	+	+		+	0.21
Total		0.81	5.32	11.25	6.68	5.35	17.48	2.59	4.26	4.10	2.09	3.09

*: Radiolaria, Coelenterata, Ctenophora, Heteropoda other than Atlantidae, and Taliacea are excluded.

**: Sampling layer was estimated from the record of depth-distance meter and depth-time meter, but that in parentheses was estimated from wire angle.

Table 23. Water sampling log for ^{15}N abundance assessment.

Stn. 1 (Shallow);	15:32, 9 Sept. 1981, 31°33.1'N, 133°35.9'E 0, 10, 30, 40, 50, 60, 65, 70, 80, 90, 100, 125, 150 m.
Stn. 1 (Deep) ;	03:52, 10 Sept. 1981, 31°41.6'N, 133°47.8'E 190, 277, 456, 669, 879, 1644, 2416, 3254 m.
Stn. 3 (Shallow);	09:25, 16 Sept. 1981, 21°59.2'N, 124°59.9'E 10, 30, 50, 60, 70, 80, 90, 100, 110, 120, 130, 150 m.
Stn. 3 (Deep) ;	04:51, 16 Sept. 1981, 21°59.2'N, 125°00.7'E 200, 299, 498, 747, 995, 1990, 2984, 3980 m.
Stn. 5 (Shallow);	12:42, 27 Sept. 1981, 18°04.7'N, 117°01.6'E 10, 30, 50, 60, 70, 79, 89, 99, 109, 129, 149 m.
Stn. 5 (Deep) ;	08:49, 27 Sept. 1981, 18°04.5'N, 116°59.1'E 188, 323, 473, 708, 941, 1903, 2872, 3606 m.
Stn. 6 (Shallow);	22:14, 29 Sept. 1981, 14°40.7'N, 114°10.7'E 10, 19, 29, 48, 58, 68, 87, 106, 125, 145, 164 m.
Stn. 6 (Deep) ;	17:55, 29 Sept. 1981, 14°40.1'N, 114°09.8'E 198, 297, 495, 743, 992, 1985, 2981, 3977 m.

Table 24. Station 6 W series.

P2-1
Sept. 30, 1981 08:02-08:30 14-40.0N 114-11.0E

D (m)	T (°C)	S (‰)	PO_4-P (μg at/l)	SiO_2-Si (μg at/l)	NO_2-N (μg at/l)	NO_3-N (μg at/l)	Chl.a (μg/l)	pH (μg/l)	O_2 (ml/l)
63	23.55	34.326	0.26	4.4	0.06	0.03	0.166	0.135	-
70	22.28	34.465	0.31	5.7	0.06	0.08	0.202	0.157	-
76	21.01	34.565	0.56	9.6	0.37	3.56	0.275	0.287	-
82	20.51	34.573	0.71	11.0	0.41	6.32	0.291	0.293	-
85	20.17	34.576	0.81	12.9	0.24	7.93	0.250	0.398	-
90	19.83	34.583	0.98	14.8	0.14	9.32	0.086	0.089	-
100	18.83	34.638	1.03	17.2	0.09	11.03	0.130	0.194	-
110	17.79	34.643	1.08	17.9	0.08	11.11	0.067	0.138	-
120	16.67	34.635	1.20	23.1	0.09	12.96	0.046	0.091	-
121	16.65	34.632	-	-	-	-	-	-	-

P2-2
Sept. 30, 1981 12:07-12:32 14-44.3N 114-14.0E

D (m)	T (°C)	S (‰)	PO_4-P (μg at/l)	SiO_2-Si (μg at/l)	NO_2-N (μg at/l)	NO_3-N (μg at/l)	Chl.a (μg/l)	pH (μg/l)	O_2 (ml/l)
59	23.29	34.426	0.30	4.5	0.06	0.00	0.187	0.149	4.53
63	22.29	34.462	0.34	5.7	0.06	0.00	0.229	0.204	4.36
66	22.04	34.497	0.37	6.1	0.08	0.07	0.284	0.278	4.34
72	21.37	34.523	0.46	6.8	0.28	0.02	0.385	0.362	3.88
78	20.42	34.611	0.61	8.0	0.31	1.55	0.211	0.279	3.60
84	19.10	34.635	0.94	12.7	0.11	4.93	0.135	0.232	3.14
90	18.37	34.637	0.98	13.8	0.09	9.65	0.103	0.172	3.17
100	17.83	34.649	1.09	16.7	0.09	10.01	0.072	0.147	3.21
109	17.29	34.653	1.10	16.7	0.08	11.41	0.071	0.127	3.08
120	16.04	34.619	1.20	17.9	0.08	11.88	0.023	0.057	2.91

P2-3
Sept. 30, 1981 15:59-16:23 14-40.2N 114-11.7E

D (m)	T (°C)	S (‰)	PO_4-P (μg at/l)	SiO_2-Si (μg at/l)	NO_2-N (μg at/l)	NO_3-N (μg at/l)	Chl.a (μg/l)	pH (μg/l)	O_2 (ml/l)
60	21.40	34.531	-	-	-	-	-	-	-
63	21.10	34.547	0.42	6.8	0.34	1.99	0.412	0.320	-
66	21.06	34.561	0.58	7.4	0.42	3.71	0.433	0.348	-
70	20.73	34.561	0.67	7.9	0.48	5.04	0.392	0.345	-
75	20.17	34.584	0.70	7.1	0.23	5.98	0.280	0.317	-
81	19.47	34.596	0.94	10.8	0.12	9.94	0.264	0.267	-
90	18.87	34.646	1.16	11.8	0.10	10.97	0.182	0.199	-
100	18.18	34.637	0.95	10.4	0.08	9.32	0.104	0.146	-
109	17.61	34.641	1.19	14.0	0.09	12.38	0.072	0.154	-
120	17.10	34.462	1.15	15.2	0.08	12.69	0.056	0.143	-

Table 25. Station 6 W series.

P2-4
Sept. 30, 1981 20:04-20:34 14-40.0N 114-09.4E

D (m)	T (°C)	S (‰)	PO_4-P (μg at/l)	SiO_2-Si (μg at/l)	NO_2-N (μg at/l)	NO_3-N (μg at/l)	Chl.a (μg/l)	pH (μg/l)	O_2 (ml/l)
60	22.08	34.518	-	-	-	-	-	-	-
65	21.72	34.499	0.39	4.6	0.12	0.41	0.412	0.352	-
68	21.31	34.553	0.47	4.9	0.24	1.54	0.378	0.316	-
72	20.94	34.563	0.61	5.7	0.41	3.63	0.400	0.414	-
80	20.15	34.607	0.76	7.3	0.34	6.47	0.275	0.367	-
85	19.62	34.603	0.86	8.6	0.14	7.94	0.231	0.342	-
95	18.80	34.650	0.82	9.2	0.08	7.80	0.130	0.219	-
109	17.97	34.638	1.14	13.7	0.09	-	0.084	0.147	-
120	17.55	34.638	1.17	14.6	0.09	11.08	0.059	0.159	-
135	17.03	34.628	1.05	12.4	0.07	10.94	0.041	0.071	-

P2-5
Oct. 1, 1981 00:00-00:29 14-40.4N 114-09.1E

D (m)	T (°C)	S (‰)	PO_4-P (μg at/l)	SiO_2-Si (μg at/l)	NO_2-N (μg at/l)	NO_3-N (μg at/l)	Chl.a (μg/l)	pH (μg/l)	O_2 (ml/l)
56	23.96	34.315	0.24	3.0	0.05	0.00	0.224	0.001	-
62	22.84	34.317	0.33	3.6	0.07	0.05	0.277	0.010	-
66	22.22	34.486	0.35	4.1	0.12	0.40	0.330	0.027	-
69	21.90	34.510	0.35	4.2	0.07	0.07	0.269	0.024	-
73	21.56	34.523	0.43	5.0	0.16	0.92	0.348	0.074	-
80	20.79	34.575	0.64	6.5	0.52	4.65	0.313	0.077	-
93	19.36	34.601	0.98	9.8	0.13	10.43	0.224	0.114	-
100	18.89	34.645	1.04	10.6	0.10	10.99	0.147	0.108	-
121	17.48	34.642	1.13	11.6	0.09	11.28	0.072	0.043	-
137	16.99	34.650	1.15	12.3	0.09	11.41	0.051	0.046	-

P2-6
Oct. 1, 1981 04:08-04:35 14-41.2N 114-08.2E

D (m)	T (°C)	S (‰)	PO_4-P (μg at/l)	SiO_2-Si (μg at/l)	NO_2-N (μg at/l)	NO_3-N (μg at/l)	Chl.a (μg/l)	pH (μg/l)	O_2 (ml/l)
50	23.94	34.341	0.27	3.2	0.06	0.00	0.213	0.142	4.58
54	23.04	34.427	0.29	3.6	0.06	0.00	0.238	0.214	4.39
59	22.63	34.473	0.23	2.9	0.05	0.00	0.249	0.165	4.52
63	21.89	34.499	0.29	3.5	0.06	0.03	0.277	0.287	4.23
66	21.61	34.488	0.45	5.2	0.20	1.04	0.279	0.282	4.01
70	21.18	34.527	0.42	3.2	0.26	1.87	0.242	0.363	3.67
80	20.03	34.594	0.87	8.6	0.25	8.78	0.225	0.304	3.15
89	19.27	34.613	0.95	9.3	0.10	9.55	0.200	0.189	2.99
101	18.48	34.631	1.01	10.8	0.08	10.95	0.116	0.152	3.08
110	17.81	34.645	0.96	9.3	0.07	7.75	0.085	0.145	3.00

Table 26. Station 6 W series.

P2-7
Oct. 1, 1981   07:57-08:30   14-40.6N 114-09.5E

D (m)	T (°C)	S (‰)	PO_4-P	SiO_2-Si (μg at/l)	NO_2-N	NO_3-N	Chl.a (μg/l)	P^H	O_2 (ml/l)
44	26.06	34.143	0.17	2.1	0.05	0.00	0.200	0.076	-
49	25.19	34.246	0.16	2.0	0.05	0.00	0.189	0.087	-
59	23.43	34.366	0.17	2.7	0.05	0.03	0.209	0.109	-
62	22.71	34.368	0.32	4.1	0.09	0.03	0.225	0.202	-
64	22.55	34.458	0.28	3.5	0.09	0.19	0.337	0.303	-
68	21.97	34.511	0.37	4.6	0.08	0.04	0.275	0.265	-
73	21.27	34.532	0.40	4.2	0.17	1.22	0.258	0.353	-
85	19.53	34.610	0.60	4.6	0.09	4.11	0.202	0.291	-
99	18.19	34.639	0.90	9.0	0.08	8.90	0.094	0.179	-
115	16.98	34.624	1.00	10.4	0.08	9.31	0.058	0.045	-

Table 27. Water sampling Niskin-N

Station 1
Sept. 9, 1981 15:32 (shallow 0 - 150m) 31-33.1N 133-35.9E
Sept.10, 1981 03:54 (deep 200 - 4000m) 31-41.6N 133-47.8E

D (m)	T (°C)	S (‰)	O_2 (ml/1)	PO_4-P	SiO_2-Si (μg atoms/1)	NO_2-N	NO_3-N
0	27.8	34.449	4.46	0.21	2.2	0.09	0.10
10	27.36	413	54	0.31	1.8	0.10	0.15
30	27.19	437	54	0.19	1.9	0.09	0.10
40	26.99	477	49	0.05	2.0	0.10	0.01
50	27.06	663	54	0.03	1.6	0.08	0.03
60	27.01	706	52	0.01	1.6	0.08	0.03
65	26.65	597	49	0.02	2.0	0.15	0.17
70	25.90	486	47	0.05	2.6	0.27	0.64
80	24.69	517	40	0.11	3.2	0.47	1.29
90	24.29	697	42	0.11	2.5	0.32	1.06
100	22.90	782	37	0.12	2.7	0.25	1.58
125	21.20	843	32	0.17	3.7	0.14	3.00
150	20.43	864	31	0.22	3.9	0.12	3.39
189	19.08	-	-	-	-	-	-
191	18.95	34.841	4.26	0.35	3.1	0.03	4.11
276	16.50	-	-	-	-	-	-
278	16.53	34.711	4.14	0.64	8.9	0.03	7.75
455	11.38	-	-	-	-	-	-
457	11.26	34.390	3.31	1.43	32.5	0.02	16.78
668	6.01	-	-	-	-	-	-
670	5.98	34.281	2.06	2.51	84.3	0.02	32.78
878	3.89	-	-	-	-	-	-
880	3.86	34.406	1.52	2.96	120.9	0.02	37.94
1643	2.28	-	-	-	-	-	-
1645	2.28	34.568	2.10	2.94	149.9	0.03	37.81
2415	1.79	-	-	-	-	-	-
2417	1.79	34.637	2.81	-	150.9	0.02	36.32
3253	1.57	-	-	-	-	-	-
3255	1.57	34.673	3.23	-	-	-	35.06

Station 3
Sept. 16, 1981 04:51 (deep) 21-59.2N 125-00.7E
Sept. 16, 1981 09:25 (shallow) 21-59.2N 124-59.9E

D (m)	T (°C)	S (‰)	O_2 (ml/1)	PO_4-P	SiO_2-Si (μg atoms/1)	NO_2-N	NO_3-N
0	-	-	-	-	-	-	-
10	-	33.886	4.33	0.08	1.2	0.09	0.05
30	29.06	957	35	0.10	1.4	0.12	0.04
50	28.86	34.038	42	0.09	1.4	0.10	0.06
60	27.26	292	58	0.10	1.6	0.10	0.06
70	26.86	350	53	0.10	1.6	0.10	0.06
80	26.51	390	49	0.11	1.6	0.11	0.05
90	26.25	431	44	0.13	1.4	0.21	0.04
100	25.97	469	38	0.14	1.8	0.50	0.00
110	25.84	536	35	0.15	1.6	0.55	0.00
120	25.81	683	41	0.15	1.4	0.43	0.03
130	25.36	817	44	0.15	1.2	0.36	0.14
150	24.29	947	37	0.17	2.1	0.12	0.57
199	23.11	35.009	25	0.15	1.6	0.10	0.22
201	23.05	-	-	-	-	-	-
298	19.10	34.855	4.29	0.43	3.9	0.08	4.06
300	18.90	-	-	-	-	-	-
497	12.19	34.407	3.76	1.22	21.8	0.10	16.32
499	12.08	-	-	-	-	-	-
746	6.17	34.252	1.95	2.46	78.4	0.15	34.26
748	6.14	-	-	-	-	-	-
994	4.31	34.373	1.49	2.90	113.3	0.12	40.43
996	4.30	-	-	-	-	-	-
1989	2.12	34.605	2.51	2.43	153.8	0.36	36.67
1991	2.10	-	-	2.42	153.3	0.36	36.71
2983	1.72	34.659	3.15	2.52	155.5	0.28	35.82
2985	1.72	-	-	2.51	155.7	0.28	35.84
3979	1.59	34.671	3.39	2.61	155.6	0.05	37.54
3981	1.79	-	-	2.56	155.0	0.06	37.31

Table 28. Water sampling Niskin-N.

Station 5
Sept. 27, 1981 08:49 (deep) 18-04.5N 116-59.1E
Sept. 27, 1981 12:42 (shallow) 18-04.7N 117-01.6E

D (m)	T (°C)	S (‰)	O_2 (ml/1)	PO_4-P	SiO_2-Si (μg atoms/1)	NO_2-N	NO_3-N
0	-	-	-	-	-	-	-
10	29.09	33.365	4.44	0.03	2.8	0.06	0.03
30	27.32	464	45	0.04	2.4	0.06	0.00
50	27.48	812	58	0.05	2.4	0.06	0.00
60	25.73	34.015	62	0.08	2.9	0.06	0.00
70	24.36	196	36	0.12	3.7	0.09	0.12
79	23.54	326	3.90	0.29	5.3	0.18	2.24
89	22.84	451	83	0.34	4.6	0.13	3.50
99	21.60	524	62	0.42	5.6	0.10	5.19
109	20.99	561	42	0.52	6.7	0.08	6.88
129	19.52	603	22	0.70	10.0	0.07	9.54
149	17.84	632	05	0.84	13.0	0.06	11.81
169	16.84	624	02	0.96	15.2	0.06	13.20
187	-	-	-	-	-	-	-
189	15.78	34.594	2.91	0.92	19.2	0.09	14.06
322	-	-	-	-	-	-	-
324	11.29	34.454	2.54	1.71	40.7	0.08	22.14
472	-	-	-	-	-	-	-
474	8.88	34.426	2.47	1.82	52.5	0.10	23.86
707	-	-	-	-	-	-	-
709	6.44	34.459	1.90	2.52	97.8	0.10	32.54
940	-	-	-	-	-	-	-
942	4.91	34.508	1.92	2.79	127.1	0.13	34.68
1902	-	-	-	-	-	-	-
1904	2.59	34.605	2.29	2.87	171.4	0.12	36.94
2871	-	-	-	-	-	-	-
2873	2.38	34.618	2.51	2.91	172.1	0.13	36.61
3605	-	-	-	-	-	-	-
3607	2.41	34.625	2.56	2.98	169.7	0.06	37.04

Station 6
Sept. 29, 1981 17:55 (deep) 14-40.1N 114-09.8E
Sept. 29, 1981 22:14 (shallow) 14-40.7N 114-10.7E

D (m)	T (°C)	S (‰)	O_2 (ml/1)	PO_4-P	SiO_2-Si (μg atoms/1)	NO_2-N	NO_3-N
0	-	-	-	-	-	-	-
10	29.54	33.594	4.44	0.07	2.8	0.08	0.14
19	29.47	603	46	0.05	2.7	0.08	0.11
29	28.70	820	58	0.06	2.7	0.08	0.05
39	-	-	-	0.07	2.7	0.08	0.05
48	23.77	34.294	59	0.13	2.9	0.08	0.05
58	22.26	455	32	0.21	4.1	0.08	0.00
68	21.55	474	3.81	0.36	5.3	0.51	2.81
87	19.50	601	04	0.79	9.9	0.16	10.36
106	18.30	610	2.92	0.92	12.6	0.11	11.71
125	16.82	613	89	1.06	15.8	0.10	13.70
145	16.00	600	80	1.04	17.9	0.32	14.47
164	15.13	585	69	1.29	21.2	0.08	16.39
197	13.95	-	-	-	-	-	-
199	13.89	34.540	2.88	1.16	25.6	0.09	14.79
296	11.48	-	-	-	-	-	-
298	11.46	34.463	2.37	1.91	40.8	0.08	23.21
494	8.44	-	-	-	-	-	-
496	8.40	34.429	1.84	2.32	68.5	0.10	29.08
742	6.19	-	-	-	-	-	-
744	6.19	34.464	1.87	2.62	97.4	0.10	32.83
991	4.44	-	-	-	-	-	-
993	4.43	34.526	1.85	2.80	126.4	0.12	35.14
1984	2.49	-	-	-	-	-	-
1986	2.50	34.607	2.29	2.86	154.7	0.11	35.91
2980	2.37	-	-	-	-	-	-
2982	2.43	34.616	2.50	2.86	153.8	0.10	36.15
3976	2.46	-	-	2.83	151.9	0.07	36.14
3978	2.46	34.619	2.52	2.81	153.3	0.07	36.46

Table 29. Surface data.

Date	Time	Latitude	Longitude	T (°C)	S (‰)	Chl.a (μg/l)	$NO_3 + NO_2$ (μg at N/l)
Leg. 1							
Sept. 9	00:00	32-02.8N	134-05.6E	27.9	34.833	0.262	-
"	03:00	31-41.0N	133-41.8E	27.6	34.728	0.313	-
(Station 1)							
Sept. 10	18:00	31-34.6N	133-39.1E	27.7	34.205	-	-
"	21:00	31-08.4N	133-22.0E	27.5	34.336	0.192	-
Sept. 11	00:00	30-46.2N	133-06.2E	27.9	34.650	0.162	-
"	03:00	30-14.1N	132-38.1E	28.0	34.623	0.157	-
"	06:00	29-47.4N	132-28.6E	28.3	34.650	0.142	-
"	09:00	29-20.6N	132-10.1E	28.0	34.702	0.142	-
"	12:00	28-52.6N	131-51.7E	28.3	34.650	0.152	-
"	15:00	28-23.1N	131-31.6E	28.3	34.545	0.142	-
"	18:00	27-52.8N	131-11.9E	28.5	34.623	0.102	-
"	21:00	27-22.0N	130-52.3E	28.1	34.650	0.097	-
Sept. 12	00:00	26-52.6N	130-33.8E	28.0	-	-	-
"	03:00	26-23.4N	130-14.7E	28.0	34.754	0.082	-
(Station 2)							
Sept. 13	00:00	26-02.5N	129-58.7E	28.0	34.702	0.072	-
"	03:00	25-42.4N	129-28.9E	27.9	34.780	0.072	-
"	06:00	25-14.5N	128-58.0E	27.8	34.702	0.082	-
"	09:00	24-49.2N	128-28.8E	28.3	34.571	0.082	-
"	12:00	24-27.8N	127-57.1E	29.0	34.440	0.057	-
"	15:00	24-06.2N	127-29.7E	29.1	34.571	0.062	-
"	18:00	23-40.5N	127-02.1E	29.3	34.493	0.072	-
"	21:00	23-16.3N	126-33.8E	28.7	34.597	0.077	-
Sept. 14	00:00	22-49.7N	126-05.5E	29.5	34.127	0.082	-
"	03:00	22-26.9N	125-35.3E	29.3	34.179	0.087	-
"	06:00	22-05.1N	125-04.0E	29.3	34.074	0.062	-
(Station 3)							
Sept. 18	06:00	21-49.2N	124-25.8E	29.4	33.970	0.090	-
"	09:00	21-35.6N	123-49.3E	29.3	33.944	0.090	-
"	12:00	21-24.3N	123-10.0E	29.7	33.944	0.085	-
"	15:00	21-15.2N	122-28.0E	29.5	33.891	0.090	-
"	18:00	21-06.5N	121-48.8E	28.9	34.074	0.119	-
"	21:00	21-01.6N	121-11.6E	29.3	34.022	0.095	-
Sept. 19	00:00	20-59.2N	120-18.0E	29.1	33.970	0.103	-
"	03:00	20-58.0N	119-37.5E	29.0	33.708	0.103	-
"	06:00	20-59.2N	119-02.3E	29.0	33.447	0.106	-
(Station 4)							
Sept. 19	21:00	21-07.5N	118-26.1E	28.8	33.447	-	-
Sept. 20	00:00	21-17.4N	117-51.4E	28.0	33.656	-	-
"	03:00	21-27.0N	117-16.1E	-	33.682	-	-
"	06:00	21-35.0N	116-43.3E	-	-	-	-
"	09:00	21-41.7N	116-07.6E	28.4	33.813	0.197	-
"	12:00	21-51.6N	115-28.7E	28.3	33.787	0.185	-
"	15:00	22-00.8N	114-51.4E	28.8	33.682	0.209	-
"	18:00	-	-	28.8	33.133	0.245	-
(Hong Kong)							
Leg. 2							
(Hong Kong)							
Sept. 26	12:00	19-27.8N	116-03.8E	29.2	33.317	-	-
"	15:00	18-54.5N	116-24.0E	29.4	33.250	-	-

Table 30. Surface data.

Date	Time	Latitude	Longitude	T (°C)	S (‰)	Chl.a (μg/l)	$NO_3 + NO_2$ (μg at N/l)
Leg. 2							
Sept. 26	18:00	18-32.2N	116-41.6E	29.4	32.952	-	-
"	21:00	18-05.0N	117-00.0E	29.3	33.218	-	-
(Station 5)							
Sept. 28	12:00	17-52.0N	116-49.6E	30.0	33.118	-	0.10
"	15:00	17-26.1N	116-23.9E	30.0	33.583	-	0.10
"	18:00	16-59.0N	116-04.4E	29.8	33.516	-	0.10
"	21:00	16-32.5N	115-44.3E	29.8	33.251	-	0.10
Sept. 29	00:00	16-12.6N	115-31.2E	29.9	32.919	-	0.10
"	03:00	15-47.4N	115-10.3E	30.1	32.919	-	0.09
"	06:00	15-22.3N	114-46.8E	-	-	-	0.09
"	09:00	14-59.0N	114-23.1E	29.9	33.616	-	0.09
"	12:00	14-41.0N	114-10.4E	30.0	33.516	-	0.09
(Station 6)							
Oct. 4	21:00	14-40.2N	114-09.3E	29.5	33.437	-	0.13
Oct. 5	00:00	14-06.6N	113-59.8E	29.4	33.171	-	0.13
"	03:00	13-32.1N	113-50.6E	29.2	33.450	-	0.13
"	06:00	12-56.7N	113-42.6E	29.2	33.383	-	0.13
"	09:00	12-21.8N	113-31.8E	29.2	33.264	-	0.13
"	12:00	11-49.5N	113-16.3E	29.3	33.224	-	0.13
"	15:00	11-19.1N	112-59.9E	29.4	33.158	-	0.11
"	18:00	10-45.1N	112-48.3E	-	-	-	0.11
"	21:00	10-16.3N	112-43.0E	29.5	32.893	-	-
Oct. 6	00:00	09-41.3N	112-36.5E	29.3	33.118	-	0.11
(Station 7)							
Oct. 7	00:00	09-40.9N	112-40.7E	29.6	33.350	0.068	0.11
"	03:00	09-11.5N	112-21.1E	29.2	33.483	0.068	0.11
"	06:00	08-43.8N	111-57.4E	29.3	33.549	0.063	0.11
"	09:00	08-21.2N	111-31.3E	29.6	33.449	0.045	0.11
"	12:00	07-56.8N	111-03.0E	-	-	0.023	0.11
"	15:00	07-32.6N	110-36.4E	30.3	33.350	0.023	0.11
"	18:00	07-08.4N	110-08.6E	30.1	33.350	0.023	0.11
(Station 8)							
Oct. 8	18:00	06-55.6N	109-42.3E	29.7	33.417	0.023	0.12
"	21:00	06-50.0N	109-14.3E	29.7	33.450	0.045	0.12
Oct. 9	00:00	06-43.9N	108-44.2E	29.5	33.516	0.023	0.12
"	03:00	06-39.0N	108-09.5E	29.5	33.483	0.023	0.12
(Station 9)							
Oct. 9	21:00	06-29.6N	107-32.0E	29.6	32.322	0.068	0.13
Oct. 10	00:00	06-27.9N	107-37.3E	29.4	32.395	0.068	0.13
"	03:00	06-29.8N	107-37.3E	29.4	32.388	0.079	0.13
"	06:00	05-58.2N	107-18.6E	29.5	32.455	0.079	0.13
"	09:00	05-27.5N	106-58.3E	29.7	32.959	0.090	0.13
"	12:00	04-57.0N	106-37.8E	29.9	33.052	0.068	0.13
"	15:00	04-28.5N	106-17.1E	30.4	33.317	0.079	0.13
"	18:00	03-58.3N	105-55.9E	30.5	33.450	0.090	0.13
"	21:00(20:30)	03-26.6N	105-37.0E	30.3	33.151	0.090	0.13
"	23:30	02-57.6N	105-17.1E	30.1	32.853	0.135	0.13
Oct. 11	02:30	02-28.9N	105-00.3E	30.1	32.687	0.124	0.13
"	05:30	01-58.4N	104-45.7E	30.1	32.521	0.158	0.13
"	08:30	01-25.8N	104-28.7E	29.8	31.128	1.01	0.13
"	11:30	-	-	30.1	31.128	1.06	-
(Singapore)							

Table 31. Surface data.

Date	Time	Latitude	Longitude	T (°C)	S (‰)	Chl.a (μg/l)	$NO_3 + NO_2$ (μg at N/l)
Leg. 3							
	(Singapore)						
Oct. 16	15:00	-	-	-	-	-	-
"	18:00	01-25.6N	104-30.8E	29.3	31.991	-	-
"	21:00	01-41.2N	105-04.2E	29.1	32.896	-	-
Oct. 17	00:00	01-53.8N	105-37.7E	29.4	32.973	-	0.16
"	03:00	02-05.8N	106-11.8E	29.4	33.103	-	0.15
"	06:00	02-16.9N	106-46.4E	29.3	33.024	-	0.15
"	09:00	02-30.5N	107-19.0E	29.3	33.190	0.164	0.14
"	12:00	02-44.2N	107-51.5E	29.3	33.247	0.144	0.14
"	15:00	03-00.5N	108-24.2E	29.8	32.611	0.244	0.14
"	18:00	03-10.6N	109-00.7E	29.8	32.627	0.244	0.14
"	21:00(21:30)	03-18.2N	109-27.0E	29.6	32.653	0.154	0.14
Oct. 18	00:00	03-24.9N	109-55.3E	29.3	33.206	0.134	0.14
"	03:00	03-32.3N	110-29.0E	29.1	33.206	0.164	0.14
"	06:00	03-38.0N	111-02.3E	29.1	33.071	0.164	0.14
"	09:00	03-46.9N	111-34.6E	29.0	32.027	0.110	0.14
"	12:00	03-53.2N	112-02.9E	29.3	32.327	0.114	0.15
"	15:00	03-55.6N	112-23.7E	29.3	32.301	0.144	0.16
"	18:00	04-07.9N	112-45.0E	29.1	32.741	0.204	0.17
"	21:00	04-19.0N	113-01.4E	29.0	32.782	0.154	0.17
Oct. 19	00:00	04-41.0N	113-25.2E	28.8	33.051	0.164	0.18
"	03:00	05-04.0N	113-50.7E	28.8	33.051	0.164	0.19
"	06:00	05-24.4N	114-19.7E	28.8	32.896	0.204	0.19
"	09:00	05-50.5N	114-40.6E	29.0	33.077	0.134	0.19
"	12:00	06-12.0N	115-00.3E	29.1	32.782	0.124	0.19
"	15:00	06-26.0N	115-14.1E	29.1	32.792	0.154	0.17
"	18:00	06-48.4N	115-33.9E	29.1	32.689	0.124	0.16
"	21:00	07-03.0N	115-48.5E	28.8	32.518	0.124	0.17
Oct. 20	00:00	07-18.6N	116-14.0E	29.1	33.413	0.084	0.17
"	03:00	07-32.4N	116-42.1E	29.2	33.284	0.124	0.18
"	06:00	07-45.6N	117-03.3E	29.1	33.377	0.094	0.18
"	09:00	08-03.5N	117-34.5E	29.4	33.542	0.114	0.20
"	12:00	08-13.0N	118-10.1E	29.5	33.526	0.064	0.19
"	15:00	08-09.5N	118-34.7E	29.5	33.221	0.084	0.19
"	18:00	07-57.0N	119-07.0E	29.5	33.309	0.064	0.19
"	21:00	07-47.7N	119-33.6E	29.1	33.103	0.074	0.19
Oct. 21	00:00	07-35.5N	120-01.6E	29.2	33.077	0.074	0.19
"	03:00	07-21.8N	120-36.1E	29.3	33.268	0.074	0.19
"	06:00	07-09.9N	121-10.2E	29.4	33.258	0.070	0.16
"	09:00	06-54.9N	121-44.7E	29.1	33.294	0.134	0.16
"	12:00	06-42.2N	122-25.3E	28.5	33.775	0.703	0.67
"	15:00	06-27.1N	122-53.8E	29.6	33.775	0.194	0.16
"	18:00	06-15.7N	123-23.4E	30.3	33.702	0.164	0.16
"	21:00	06-09.7N	123-41.5E	29.4	33.837	0.164	0.16
Oct. 22	00:00	05-55.8N	124-11.7E	29.2	33.542	0.164	0.16
"	03:00	05-40.9N	124-43.3E	29.1	33.682	0.154	0.16
"	06:00	05-29.5N	125-15.2E	28.9	33.878	0.144	0.16
"	09:00	05-30.4N	125-50.8E	29.1	33.950	0.114	0.16
"	12:00	05-31.8N	126-23.3E	29.5	33.852	0.084	0.16
"	15:00	05-28.9N	126-49.0E	30.1	33.759	0.084	0.16
"	18:00	05-23.8N	127-24.0E	30.0	33.645	0.104	0.16
"	21:00	05-21.3N	127-53.1E	29.5	33.713	0.104	0.16

Table 32. Surface data.

Date	Time	Latitude	Longitude	T (°C)	S (‰)	Chl.a (μg/l)	$NO_3 + NO_2$ (μg at N/l)
Leg. 3							
Oct. 23	00:00	05-16.2N	128-30.9E	29.3	33.790	0.104	0.16
"	03:00	05-11.1N	129-09.1E	29.1	33.981	0.134	0.16
"	06:00	05-03.6N	129-44.6E	29.3	34.105	0.164	0.16
	(Station 10)						
Oct. 26	18:00	05-55.2N	130-19.0E	29.2	34.137	0.166	0.17
"	21:00	06-22.8N	130-15.6E	29.1	33.930	0.138	0.17
Oct. 27	00:00	06-57.1N	130-08.6E	29.0	33.800	0.138	0.17
"	03:00	07-32.5N	130-03.8E	29.0	33.862	0.103	0.17
"	06:00	08-07.4N	130-01.2E	29.0	33.852	0.103	0.17
"	09:00	08-42.0N	129-59.9E	29.1	33.697	0.082	0.17
	(Station 11)						
Oct. 29	00:00	09-12.7N	129-28.4E	29.1	33.857	0.040	0.15
"	03:00	09-26.6N	128-53.6E	29.1	33.749	0.040	0.15
"	06:00	09-39.0N	128-18.3E	29.2	34.033	0.026	0.15
"	09:00	09-51.3N	127-42.2E	29.3	33.966	0.026	0.15
"	12:00	10-04.6N	127-07.1E	29.6	33.821	0.012	0.15
"	15:00	10-18.1N	126-32.1E	29.7	33.878	0.026	0.15
"	18:00	10-30.2N	125-56.7E	29.5	33.811	0.026	0.16
"	21:00	10-20.2N	125-23.0E	29.1	33.904	0.096	0.16
Oct. 30	00:00	09-47.2N	125-09.7E	29.1	33.909	0.159	0.16
"	03:00	09-36.2N	124-44.2E	29.0	33.904	0.124	0.16
"	06:00	09-33.0N	124-31.6E	28.6	34.002	0.208	0.16
"	09:00	09-26.5N	124-07.2E	29.3	33.775	0.110	0.16
"	12:00	09-25.5N	123-40.4E	30.1	33.806	0.082	0.15
"	15:00	09-49.3N	123-37.8E	30.7	33.904	0.110	0.15
"	18:00	10-07.7N	123-46.3E	30.0	33.738	0.117	0.15
	(Cebu)						

Table 33. Chlorophyll-a, pheophytine (μg/l)

Station 1
Sept. 9, 1981
22:18-23:43
31-35.7N
133-40.8E

D	Chl.a	Ph.
0	0.164	0.062
10	0.186	0.088
20	0.130	0.075
30	0.155	0.086
50	0.209	0.117
60	0.330	0.157
65	0.302	0.168
75	0.380	0.241
100	0.114	0.107
125	0.070	0.092
150	0.034	0.064
200	0.010	0.025
300	0.006	0.024

Station 2
Sept.12, 1981
17:38-18:40
26-59.0N
129-59.6E

D	Chl.a	Ph.
0	0.043	0.019
10	0.042	0.017
20	0.043	0.018
30	0.039	0.013
50	0.043	0.015
75	0.097	0.049
90	0.092	0.066
100	0.088	0.083
110	0.117	0.102
125	0.092	0.105
150	0.051	0.061
200	0.004	0.014
300	0.003	0.010

Station 3
Sept.14, 1981
10:53-11:56
21-58.8N
124-58.6E

D	Chl.a	Ph.
0	0.054	0.026
10	0.057	0.028
30	0.043	0.024
50	0.120	0.023
65	0.068	0.047
77	0.095	0.077
86	0.163	0.087
92	0.136	0.151
98	0.206	0.154
102	0.284	0.246
106	0.332	0.363
115	0.334	0.265
130	0.173	0.158
150	0.099	0.126

Station 4
Sept.19, 1981
09:47-11:03
20-59.9N
119-00.5E

D	Chl.a	Ph.
0	0.154	0.086
10	0.186	0.047
20	0.156	0.081
30	0.092	0.042
50	0.254	0.138
75	0.664	0.039
90	0.360	0.280
100	0.199	0.154
110	0.182	0.240
125	0.169	0.094
150	0.106	0.180
200	0.114	0.073
300	0.019	0.019

Station 5
Sept.27, 1981
01:40-03:31
18-02.8N
116-58.5E

D	Chl.a	Ph.
0	0.059	0.031
10	0.052	0.032
20	0.061	0.030
30	0.057	0.028
50	0.100	0.061
65	0.158	0.119
75	0.238	0.227
90	0.247	0.314
100	0.211	0.215
110	0.093	0.141
125	0.031	0.060
150	0.021	0.035
200	0.003	0.020
300	0.006	0.017

Station 6
Sept.29, 1981
15:03-16:03
14-41.8N
114-09.4E

D	Chl.a	Ph.
0	0.064	0.033
10	0.070	0.021
20	0.064	0.034
30	0.079	0.026
50	0.213	0.101
65	0.284	0.350
75	0.106	0.155
90	0.097	0.140
100	0.061	0.108
110	0.031	0.071
125	0.018	0.031
150	0.006	0.021
200	0.004	0.017
300	0.003	0.025

Station 7
Oct. 6, 1981
08:37-09:52
09-44.8N
112-38.2E

D	Chl.a	Ph.
0	0.051	0.028
10	0.081	0.025
20	0.088	0.025
30	0.093	0.042
50	0.148	0.078
65	0.321	0.281
75	0.284	0.326
90	0.116	0.141
100	0.093	0.124
110	0.074	0.121
125	0.059	0.078
150	0.016	0.032
200	0.007	0.021
300	0.006	0.015

Station 8
Oct. 8, 1981
09:50-10:59
07-03.8N
110-07.6E

D	Chl.a	Ph.
0	0.026	0.011
10	0.027	0.053
20	0.036	0.049
30	0.052	0.028
50	0.125	0.135
65	0.292	0.419
75	0.218	0.224
90	0.063	0.134
100	0.037	0.068
110	0.014	0.061
125	0.008	0.028
150	0.003	0.019
200	0.002	0.012
300	0.002	0.012

Table 34. Chlorophyll-a, pheophytine (μg/l)

Station 9
Oct. 9, 1981
14:23-14:50
06-31.0N
107-37.1E

D	Chl.a	Ph.
0	0.099	0.032
10	0.086	0.031
20	0.070	0.028
30	0.049	0.024
40	0.071	0.034
50	0.201	0.089
60	0.510	0.467
70	0.557	0.393

Station 10
Oct. 23, 1981
11:26-13:03
05-03.0N
129-01.5E

D	Chl.a	Ph.
0	0.056	0.032
10	0.091	0.045
20	0.082	0.054
30	0.094	0.025
50	0.124	0.080
60	0.110	0.068
75	0.245	0.143
90	0.311	0.289
100	0.253	0.199
110	0.115	0.149
125	0.146	0.168
150	0.052	0.079
200	0.006	0.015
300	0.006	0.016

Station 11
Oct. 27, 1981
14:18-15:32
08-59.3N
129-58.4E

D	Chl.a	Ph.
0	0.045	0.038
10	0.048	0.021
20	0.056	0.029
30	0.050	0.038
50	0.106	0.055
60	0.126	0.094
75	0.186	0.188
90	0.107	0.123
100	0.120	0.130
110	0.062	0.158
125	0.088	0.105
150	0.029	0.039
200	0.003	0.015
300	0.005	0.026

Station 12
Nov. 7, 1981
19:47-20:59
12-59.8N
129-59.3E

D	Chl.a	Ph.
0	0.039	0.040
10	0.043	0.036
20	0.047	0.026
30	0.042	0.027
50	0.048	0.026
60	0.071	0.036
75	0.085	0.051
90	0.081	0.061
100	0.120	0.136
110	0.157	0.188
125	0.169	0.194
150	0.070	0.108
200	0.005	0.012
300	0.004	0.012

Station 13
Nov. 11, 1981
10:34-11:48
17-00.1N
130-00.2E

D	Chl.a	Ph.
0	0.048	0.040
10	0.050	0.029
20	0.043	0.039
30	0.045	0.029
50	0.055	0.027
60	0.071	0.049
75	0.132	0.069
90	0.127	0.170
100	0.185	0.152
110	0.163	0.170
125	0.131	0.135
150	0.055	0.079
200	0.004	0.012
300	0.003	0.004

Station 14
Nov. 13. 1981
05:27-07:19
20-58.0N
132-00.9E

D	Chl.a	Ph.
0	0.067	0.031
10	0.064	0.028
20	0.053	0.022
30	0.061	0.026
50	0.068	0.031
60	0.091	0.034
75	0.170	0.072
90	0.171	0.122
100	0.167	0.140
110	0.167	0.116
125	0.072	0.102
150	0.025	0.031
200	0.004	0.014
300	0.003	0.007

Station 15
Nov. 15, 1981
08:30-09:35
24-58.8N
134-00.8E

D	Chl.a	Ph.
0	0.107	0.046
10	0.125	0.047
20	0.108	0.044
30	0.104	0.048
50	0.108	0.042
60	0.103	0.054
75	0.134	0.048
90	0.108	0.059
100	0.115	0.084
110	0.217	0.158
125	0.147	0.147
150	0.060	0.075
200	0.014	0.025
300	0.002	0.006

Table 35. Bacterial population.

Depth (m)	Station 1 V.C.	Station 1 D.C.	Station 2 V.C.	Station 2 D.C.	Station 3 V.C.	Station 3 D.C.	Station 6 V.C.	Station 6 D.C.	Station 7 V.C.	Station 7 D.C.
0	$7.0x10^{2}$	15.7	$2.4x10^{2}$	12.4	$2.8x10^{2}$	9.7	$3.6x10^{2}$	10.2	$2.2x10^{2}$	8.6
10							$1.5x10^{2}$	10.7	$7.1x10^{1}$	8.8
	*$1.8x10^{2}$	*14.9	**$4.2x10^{1}$	**12.2	*$9.7x10^{1}$	*8.0				
30							$1.1x10^{2}$	10.4	$8.9x10^{1}$	11.3
50	$1.4x10^{2}$	13.5	$9.8x10^{1}$	13.7	$8.4x10^{1}$	7.7	$8.7x10^{1}$	15.4	$1.2x10^{2}$	9.0
75	$2.1x10^{2}$	13.3	$6.5x10^{1}$	12.5	$1.1x10^{2}$	6.7	$7.0x10^{1}$	9.9	$8.0x10^{1}$	10.0
100	$2.5x10^{2}$	10.5	$7.9x10^{1}$	10.2	$1.7x10^{2}$	8.1	$7.7x10^{1}$	3.8	$1.2x10^{2}$	4.8
125	-	-	-	5.3	$1.1x10^{2}$	7.1	$5.0x10^{1}$	3.2	$1.3x10^{2}$	4.9
150	$4.6x10^{1}$	5.2	$5.9x10^{1}$	7.6	$7.9x10^{1}$	2.9	$2.9x10^{1}$	3.6	$5.7x10^{1}$	3.4
175	-	-	-	-	-	-	$5.3x10^{1}$	6.2	$8.5x10^{1}$	4.5
200	$9.9x10^{1}$	6.1	$8.7x10^{1}$	4.5	$6.2x10^{1}$	3.1	$4.8x10^{1}$	4.3	$4.7x10^{1}$	5.3
300	$3.5x10^{1}$	2.7	$2.8x10^{1}$	2.7	$3.4x10^{1}$	3.7	$1.0x10^{1}$	2.3	$5.6x10^{1}$	2.6
400	$3.5x10^{1}$	3.7	$1.4x10^{1}$	2.3	$1.9x10^{1}$	2.1	$1.8x10^{1}$	2.2	$3.2x10^{1}$	2.1
600	$2.1x10^{1}$		$9.1x10^{0}$		$2.7x10^{0}$					
800	-		$1.7x10^{0}$		$2.0x10^{-1}$					
1200	$6.5x10^{0}$		$1.3x10^{1}$		$1.0x10^{1}$					

Depth (m)	Station 8 V.C.	Station 8 D.C.	Station 10 V.C.	Station 10 D.C.	Station 11 V.C.	Station 11 D.C.	Station 12 V.C.	Station 12 D.C.	Station 13 V.C.	Station 13 D.C.	Station 14 V.C.
0	Δ	13.3	$3.0x10^{3}$	14.4	$4.0x10^{1}$	9.7	3.7	10.3	Not	8.1	4.2
10	Δ	12.4	$4.5x10^{1}$	13.4	$5.5x10^{1}$	13.0	4.2	9.1	counted	8.1	4.2
30	Δ	10.9	$7.3x10^{1}$	12.7	$1.1x10^{2}$	12.1	4.2	9.0		7.1	4.0
50	Δ	16.4	$3.6x10^{1}$	12.1	$1.5x10^{2}$	12.8	4.2	8.7		9.6	3.8
75	Δ	7.8	$6.6x10^{1}$	14.1	$6.1x10^{2}$	8.8	4.4	9.1		10.2	-
100	Δ	4.6	$5.5x10^{1}$	11.9	$4.9x10^{1}$	5.0	4.3	10.0		8.5	3.8
125	Δ	5.6	$5.2x10^{2}$	9.0	$1.9x10^{1}$	3.2	-	6.3		7.1	3.9
150	Δ	4.5	$2.8x10^{2}$	6.0	$1.4x10^{2}$	3.1	3.9	4.6		4.5	4.1
175	Δ	6.0	$6.8x10^{1}$	4.6	$1.1x10^{1}$	3.1	3.5	3.1		3.5	3.9
200	Δ	4.8	$1.8x10^{2}$	3.4	$2.2x10^{1}$	3.7	3.6	2.8		3.0	3.4
300	Δ	2.5	$2.6x10^{1}$	3.4	-	1.8	3.9	1.7		3.0	2.9
400	Δ	2.7	$1.4x10^{1}$	2.0	$7.8x10^{0}$	1.9	2.8	1.5			2.8

V.C. ; Viable counts of bacteria (c.f.u./10ml)　　D.C. ; Total counts of bacteria ($No.x10^{6}/10ml$)
* ;Bacterial numbers at 20m-depth　　** ;Bacterial numbers at 25m-depth
Δ ;Counting was not available because of too many colonies on the plates　　- ; No samples were obtained

Table 36. Data of the MTD net (mesh size 0.33 mm).

Station	Date Time	Latitude	Longitude	Wire out (m)	Depth of Traw. (m)	Vol. of Water Filtered (m^3)	No. of Larvae
1	Sept. 9, 1981	31-31.5N	133-29.9E	0	0	189.05	19
		31-32.7N	133-30.6E	21	10	207.94	20
	09:15			35	20	189.44	48
	09:50			77	50	367.47	74
				113	75	-	46
				148	100	176.22	37
				184	125	271.59	28
				219	150	344.38	18
				332	230	513.01	3
				459	320	513.43	4
				629	440	409.33	9
2	Sept.12, 1981	25-56.9N	129-58.9E	0	0	196.09	1
		25-57.8N	129-59.7E	14	10	188.30	17
	09:05			28	20	261.84	14
	09:39			42	30	374.41	77
				70	50	261.97	18
				106	75	-	7
				141	100	374.13	25
				212	150	243.03	26
				594	420	-	1
				622	440	366.04	1
				679	480	382.05	12
5	Sept.27, 1981	18-04.9N	116-59.4E	0	0	378.94	14
		18-03.9N	116-59.9E	14	10	474.81	99
	06:27			28	20	355.49	36
	07:00			42	30	-	34
				71	50	361.55	25
				106	75	-	27
				141	100	336.48	30
				177	125	-	8
				212	150	384.19	1
				247	175	-	2
				283	200	-	1
7	Oct. 6, 1981	09-44.2N	112-42.7E	0	0	223.11	4
		09-44.4N	112-43.8E	14	10	240.66	11
	21:26			28	20	244.28	164
	22:00			42	30	300.35	218
				71	50	361.39	250
				106	75	355.77	131
				141	100	683.93	114
				177	125	486.86	63
				212	150	524.07	150
				247	175	518.96	20
				283	200	546.31	200

Table 37. Data of the MTD net (mesh size 0.33 mm).

Station	Date Time	Latitude	Longitude	Wire out (m)	Depth of Traw. (m)	Vol. of Water Filtered (m^3)	No. of Larvae
8	Oct. 7, 1981	07-04.5N	110-09.6E	0	0	149.49	7
		07-04.4N	110-10.6E	14	10	140.52	28
	21:21			28	20	288.29	151
	21:54			42	30	234.79	120
				71	50	297.61	127
				106	75	313.25	48
				141	100	466.95	36
				177	125	450.09	15
				212	150	390.44	19
				247	175	363.16	10
				283	200	353.54	10
9	Oct. 9, 1981	06-28.7N	107-35.6E	0	0	229.09	213
		06-28.2N	107-36.7E	14	10	256.16	193
	23:05			28	20	518.95	122
	23:37			42	30	587.39	192
10	Oct. 24, 1981	05-07.9N	130-03.6E	0	0	161.07	4
		05-08.9N	130-03.9E	14	10	206.99	31
	18:26			28	20	173.06	50
	19:00			42	30	89.58	29
				71	50	124.52	23
				106	75	356.26	54
				141	100	362.44	110
				177	125	561.18	218
				212	150	598.28	40
				247	175	695.61	89
				283	200	699.21	57
10	Oct. 26, 1981	05-17.8N	130-14.1E	331	230	385.86	
		05-16.7N	130-14.9E	374	260	518.89	
	10:56			416	290	530.73	
	11:40			458	320	473.90	
				501	350	537.15	
				543	380	445.84	
				585	410	486.71	
				627	440	490.47	
				670	470	549.43	
				712	500	447.57	
11	Oct. 28, 1981	09-01.1N	129-54.3E	0	0	300.09	0
		09-01.7N	129-54.1E	14	10	374.32	2
	18:58			28	20	477.98	15
	19:30			42	30	455.24	41
				71	50	438.48	35
				106	75	399.09	41
				141	100	428.27	45
				177	125	372.06	33
				212	150	346.79	17
				247	175	302.97	9
				283	200	156.52	0

Table 38. Data of ORI-69 surface trawl.

Station	Date	Time	Latitude	Longitude	Vol.of Water Filtered(m^3)	No. of Larvae
1	Sept.10, 1981	00:24-00:54	31-37.7N	133-42.2E	4022.77	1694
2-1	Sept.12, 1981	09:15-09:35	25-57.0N	129-59.0E	1319.23	1
2-2	Sept.12, 1981	20:45-21:15	26-00.7N	130-00.9E	4012.70	33
3-1	Sept.15, 1981	03:38-04:08	22-03.2N	125-02.8E	4076.88	177
3-2	Sept.17, 1981	22:54-23:24	21-57.7N	125-00.3E	3840.53	392
4	Sept.19, 1981	17:40-18:10	21-59.6N	118-59.1E	3900.46	75
5	Sept.27, 1981	20:23-20:53	18-09.3N	117-03.8E	3813.48	221
5'	Sept.28, 1981	21:25-21:55	16-29.5N	115-42.0E	3353.98	50
6	Sept.29, 1981	22:55-23:25	14-40.6N	114-10.4E	3913.43	96
6'	Oct. 5, 1981	19:01-19:31	10-34.1N	112-46.1E	3638.18	66
7-1	Oct. 6, 1981	02:33-03:03	09-40.6N	112-38.6E	2506.77	33
7-2	Oct. 6, 1981	20:30-21:00	09-43.5N	112-40.9E	3099.97	42
8	Oct. 7, 1981	20:26-20:56	07-04.9N	110-08.4E	2464.06	141
8'	Oct. 8, 1981	19:00-19:30	06-52.9N	109-31.6E	3371.87	1074
8"	Oct. 8, 1981	23:28-23:58	06-44.9N	108-45.1E	2714.49	1100
9	Oct. 9, 1981	21:53-22:23	06-29.4N	107-33.0E	3407.65	1456
S-2	Oct. 17, 1981	20:04-20:34	03-16.0N	109-24.4E	2241.77	632
S-4	Oct. 18, 1981	19:59-20:29	04-27.6N	112-58.1E	3211.19	113
S-6	Oct. 19, 1981	20:00-20:30	07-02.4N	115-46.9E	3006.52	646
S-8	Oct. 20, 1981	20:06-20:36	07-48.2N	119-32.3E	3124.45	280
S-10	Oct. 21, 1981	19:58-20:28	06-08.1N	122-42.2E	2935.84	112
S-12	Oct. 22, 1981	19:58-20:28	05-20.2N	127-47.6E	5041.65	55
10	Oct. 26, 1981	03:33-04:03	05-23.9N	130-14.3E	2623.52	18
10'	Oct. 26, 1981	19:58-20:28	06-17.8N	130-16.1E	2910.95	585
11	Oct. 28, 1981	19:03-19:33	09-01.0N	129-54.2E	3091.28	33
11'	Nov. 6, 1981	19:58-20:28	12-56.5N	126-48.8E	3323.29	85
12	Nov. 8, 1981	20:51-21:21	12-57.8N	130-01.1E	3518.98	21
12'	Nov. 9, 1981	19:59-20:29	15-13.6N	129-59.9E	3735.54	29
13	Nov. 10, 1981	19:34-20:04	17-04.6N	129-59.7E	3655.07	81
13'	Nov. 12, 1981	20:00-20:30	20-26.3N	131-42.3E	3443.44	294
14	Nov. 13, 1981	21:32-22:02	21-00.7N	132-05.5E	2452.66	238
14'	Nov. 14, 1981	19:59-20:29	23-22.1N	133-11.7E	3603.06	183
15	Nov. 15, 1981	00:55-01:25	25-03.3N	133-52.5E	2543.76	82
15'	Nov. 16, 1981	19:59-20:29	27-15.4N	135-08.9E	3135.19	417
15"	Nov. 17, 1981	20:02-20:32	31-03.8N	137-00.3E	2967.22	240

Table 39. Data of ORI-69 surface trawl.

Station	Date Time	Latitude	Longitude	Wire out(m)	Depth of Traw.(m)	Vol.of Water Filtered(m^3)	No. of Larvae
12	Nov. 7, 1981	12-59.9N	129-59.2E	0	0	241.38	4
		12-59.9N	129-59.4E	14	10	322.81	3
	21:42			28	20	309.02	4
	22:12			42	30	267.84	5
				71	50	283.36	12
				106	75	397.87	3
				141	100	418.51	2
				177	125	435.92	3
				212	150	329.55	2
				247	175	316.85	5
				283	200	334.76	4
12	Nov. 8, 1981	12-58.5N	130-00.0E	219	150	394.30	
		12-58.6N	130-01.0E	261	180	344.40	
	07:01			303	210	324.65	
	07:33			345	240	370.21	
				388	270	414.72	
				430	300	374.07	
				472	330	318.04	
				515	360	285.76	
14	Nov. 13, 1981	20-57.2N	132-55.9E	501	350	637.15	
		20-56.9N	132-54.5E	543	380	675.29	
	12:31			585	410	285.94	
	13:34			627	440	685.45	
				670	470	621.64	
				712	500	621.57	
				754	530	-	
				797	560	496.09	
14	Nov. 13, 1981	21-00.7N	132-05.5E	0	0	331.27	76
		21-01.2N	132-06.3E	14	10	370.85	56
	21:27			28	20	312.84	71
	22:00			42	30	275.49	126
				71	50	310.06	135
				106	75	-	182
				141	100	345.87	66
				177	125	381.20	23
				212	150	379.35	11
				247	175	337.26	2
				283	200	283.67	2
15	Nov. 15, 16, 1981	25-03.3N	133-52.4E	0	0	267.72	58
		25-03.3N	133-53.3E	14	10	232.02	95
				28	20	335.36	154
	23:45			42	30	198.66	98
	00:15			71	50	341.41	171
				106	75	299.11	140
				141	100	300.63	258
				177	125	307.22	25
				212	150	338.55	11
				247	175	312.27	5
				283	200	283.50	14

Table 40. Routine quanta meter.

Station	Date	Time	Latitude	Longitude	Depth (m)	Absolute value at the sea surface (10^{21}Quanta$\cdot m^{-2}\cdot sec^{-1}$)	Depth of underwater relative irradiance to the surface (m)					
							50%	25%	10%	5%	2.5%	1%
1-1	Sept. 9	13:07-13:51	31-30.6N	133-31.4E	4880	0.87	8	16	32	47	61	*81
1-2	Sept.10	10:24-10:49	31-41.2N	133-43.0E	4880	0.84	10	23	42	54	62	*84
2	Sept.12	12:44-13:07	25-27.6N	129-59.6E	5350	0.79	4	16	45	67	*89	*123
3-1	Sept.15	14:01-14:24	22-00.4N	125-00.2E	5840	1.02	6	11	45	*71	*96	*131
3-2	Sept.15	17:04-17:37	21-59.8N	125-00.5E	5800	0.37	13	28	*51	*66	*83	*106
4	Sept.19	11:13-11:37	20-59.8N	118-59.9E	2700	0.93	3	15	*35	*50	*65	*85
5	Sept.27	10:49-11:13	18-07.0N	116-57.6E	3930	1.2	3	14	35	56	76	*103
6	Sept.30	10:48-11:10	14-42.8N	114-13.1E	4300	0.30	9	31	58	*80	*101	*109
7	Oct. 6	10:51-11:11	09-41.0N	112-39.9E	1850	1.17	2	14	35	50	66	*86
8	Oct. 8	11:15-11:43	07-03.6N	110-07.9E	1690	1.17	5	13	25	50	*67	*77
9	Oct. 9	13:09-13:35	06-30.1N	107-32.7E	72	1.0	2	7	28	45	58	64
10	Oct. 24	12:03-12:35	05-14.6N	130-07.0E	5220	0.39	3	15	38	56	*75	*98
11	Oct. 28	11:20-11:27	08-57.5N	130-01.4E	5700	1.23	2	14	38	54	66	*82
12	Nov. 8	12:37-12:46	12-58.9N	129-00.4E	5920	0.96	4	15	40	64	*85	*113
14	Nov. 13	11:23-11:49	20-57.3N	131-56.4E	5840	1.11	1	7	32	52	*68	*89
15	Nov. 15	12:08-12:15	25-00.2N	133-51.4E	4800	1.08	1	8	28	47	*68	*88

* Extrapolated values