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# The Oceanographical Research in the Southern Region of the Hawaiian Islands—I

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**Abstract**

The oceanographical observation and biological research in the southern region of the Hawaiian Islands were carried out on the fisheries training and research ship "Keiten Maru" of Kagoshima University in May, 1977.

The oceanic characteristics and the distribution of zooplankton observed during our research are described in this paper.

1) The surface water is at the depth of about 75 m and the surface temperature gradually increases from the north to the south.

2) The thermocline is found a depth of between 75 m and 150 m, and becomes deeper northward from 14°N.

The vertical gradient of the thermocline is great between 8°N and 12°N.

3) The upwelling phenomenon is suspected to occur as the equator is approached from around 10°N.

4) The Eastern North Pacific Central Water is present in the layer at a depth of about 125 m–250 m at 15°N.

The Pacific Equatorial Water is found in the layer between 200 m and 400 m depth.

5) The current axis of the eastward flow is situated around 10°–30′N and the numerical value of the maximum velocity is ca 20 cm/sec. The current axis of the westward flow is situated around 11°–30′N and 9°–30′N, and the numerical value of the maximum velocity is ca 20 cm/sec.

6) The zooplankton communities are represented by *Copepoda*, *Ceratium*, *Radiolaria*, *Appendicularia* and *Foraminifera*. *Chaetognatha*, *Polychaeta*, *Ostracoda* and *Thaliacea* occurred, though the number of individuals is very small.

The total number of zooplankton varied between 37 to 545 per cubic meter with an average of 252, and there seems to be a tendency for the number to increase from high latitude to low latitude.

## 1. Introdiction

It has been well known that high productivity among species of tuna, marlin and skipjak in the southern region of the Hawaiian Islands around Ridging and Dome, is caused by the upwelling of cold lower water.

Studies have been published concerning this region by many oceanographers: Sverdrup, Johnson and Fleming (1942), Cromwell (1953), Knauss (1963), Graham (1941), Montgomery (1940) and Masuzawa (1964).

As part of the university student training program, the oceanographical observation and biological research of tuna fishing grounds were carried out on the

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training ship Keiten Maru of Kagoshima University in the southern region of the Hawaiian Islands in May, 1977.

Some information was gained on the general features of the oceanic conditions and the distribution of zooplankton. The results are reported here.

## 2. Materials and Methods

The oceanographical observations were made on the Keiten Maru (G.T. 860

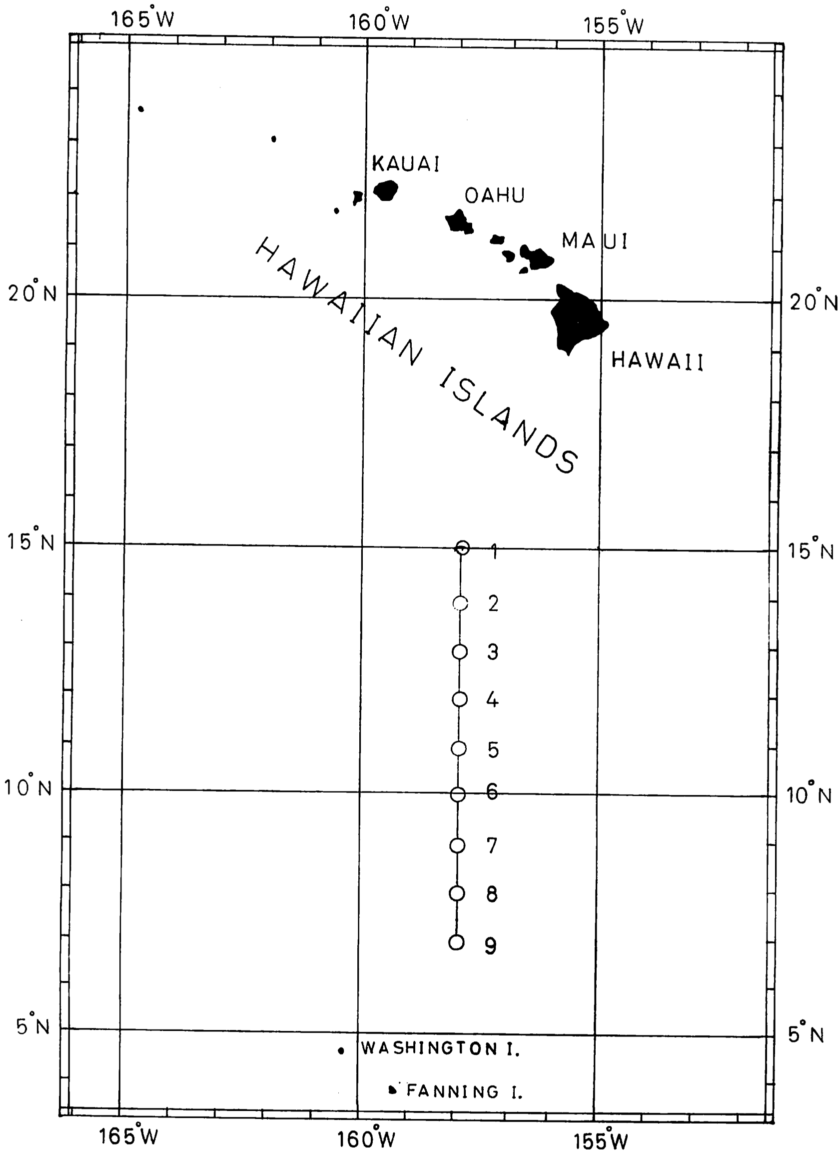


Fig. 1. Map showing the oceanographic station by the S. T. D. system and collections of plankton.

TONS), the fisheries training and research ship of Kagoshima University, between 7°N and 15°N along the meridian of 158° W in the southern region of the Hawaiian Islands in May, 1977.

The observation points are shown in Fig. 1.

The oceanographical data was obtained by the S. T. D. (Plessy Model 9040) and zooplankton were collected with a Marutoku Net (45 cm in mouth diameter, 100 cm in length, bolting silk net G.G 54).

The methods of the oceanographical observation and the sampling of zooplankton were quite similar to those reported in the previous paper (Henmi, 1976).

The values of temperature and salinity at each station are shown in the appendix Table 1 and the individual number of zooplankton in one cubic meter are shown in the appendix Table 2.

## 3. Results and Discussions

(1) The vertical distribution of water temperature and salinity.

The vertical distribution of water temperature and salinity between 7°N and 15°N along the meridian of 158°W in the southern region of the Hawaiian Islands are shown in Fig. 2 and Fig. 3, respectively. Regarding the vertical distribution of water temperature (Fig. 2), the aspect of isotherms in this region shows that the water is divided into the surface water and upper water owing

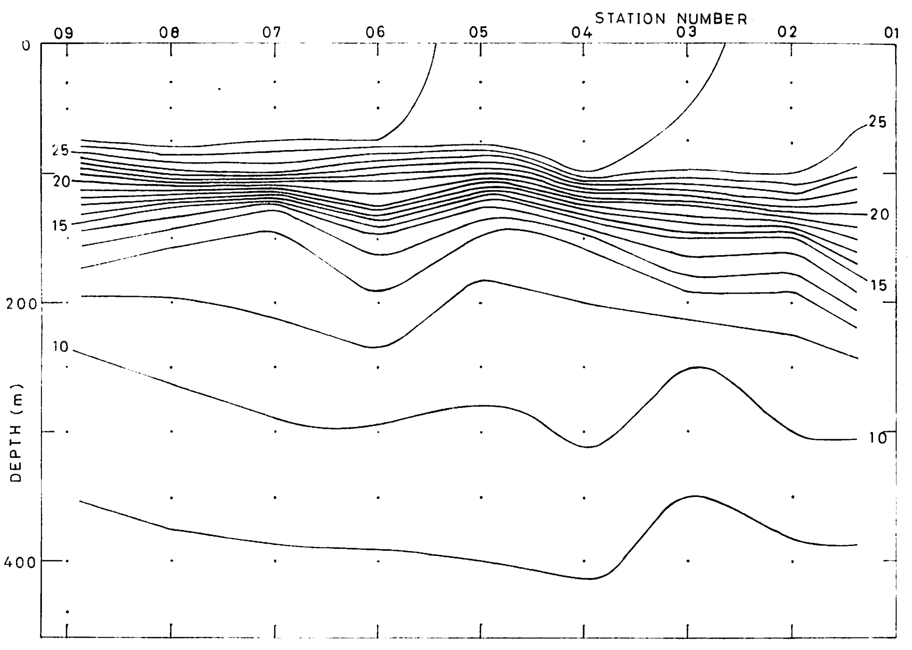


Fig. 2. Temperature distridution (°C) between 7°N and 15°N along the meridian of 158°W.

to the presence of the thermocline. The depth of surface water is about 75 m and the numerical values of the temperature of the surface water at 15°N and 7°N are ca 25.1°C and ca 27.7°C. The surface temperature gradually increases from the north to the south.

Below the surface layer, the thermocline is found at a depth of between 75 m and 150 m and becomes deeper northward from 14°N. The isotherms in the layer at a depth of 100 m–200 m assume an aspect of divergence.

The variation range of the numerical value of temperature between the thermoclines is ca 14.0°C and the vertical gradient of the thermocline is great between 8°N and 12°N. The isotherms below the thermocline slope slightly up from 10°N toward the equator, which may indicate an upwelling of lower water.

Regarding the vertical distribution of salinity (Fig. 3), there is water of comparatively high salinity at the surface layer. The numerical value of the high salinity is ca 34.76‰. A lip of the high salinity water over 34.90‰ is found in the layer at a depth of about 100 m at 15°N.

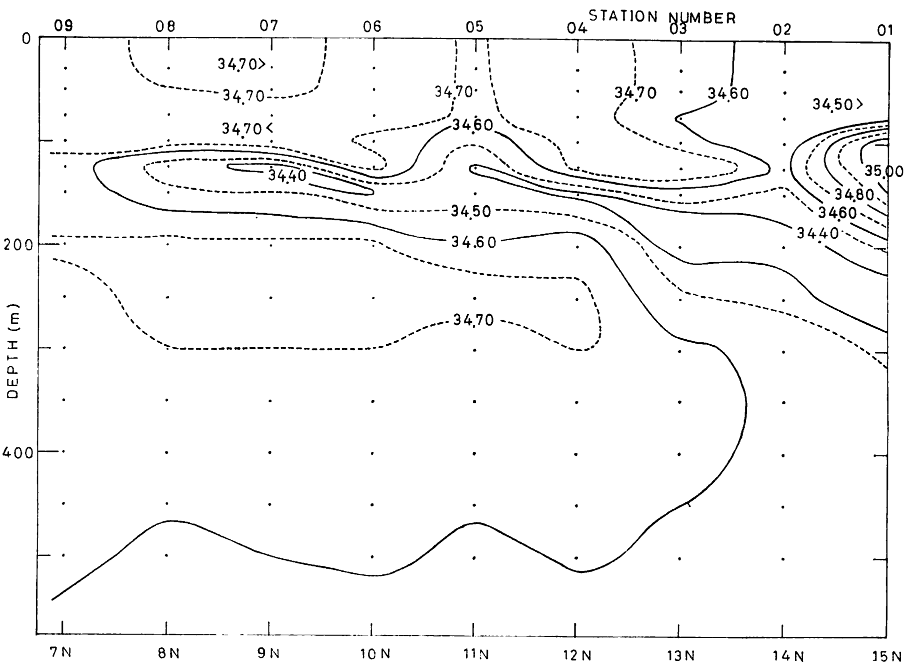


Fig. 3. Salinity distribution (‰) between 7°N and 15°N along the meridian of 158°W.

Below the surface water, a tonguelike protuberance of salinity minimum lower than 34.50‰ extends from the north to the south in the layer between 100 m and 150 m depth, and a part of this salinity minimum creeps around 7°N. This salinity minimum water corresponds to the 26°C–12°C water between the thermoclines.

It is thought that this salinity minimum water is a water mass from the Subarctic Pacific Water in the North Pacific Ocean, which have obtained a relatively high temperature and salinity owing to heating and evaporation, and which have been mixed with waters of the tropical region and descends slowly spreading to the west and the south, making an invasion below the surface layer in this region. A tonguelike protuberance of high salinity more than 34.60 ‰ extends to the north from the south in the layer between 200 m and 300 m depth and reaches to around 12°N. This high salinity water corresponds to 11°C–12°C water.

This water mass is considered to be the Pacific Equatorial Water Mass, which has its greatest south-north extension along the American coast, where it is present between latitudes 18°S and 20°N, and appears to become narrower towards the west.

(2) Temperature-Salinity diagram

Figure 4 shows the temperature-salinity diagram at each station between 7°N and 15°N along the meridian of 158°W. The representative temperature-salinity curves of the Eastern North Pacific Water and the Equatorial Pacific Water (Sverdrup, Johnson and Fleming, 1942) are indicated by dotted bands.

Figure 4 shows the temperature-salinity curves which change with the latitudes. At 15°N, it is seen that there is a salinity maximum of ca 35.00 ‰ at a depth of about 125 m, and a salinity minimum of ca 34.25 ‰ at a depth of about 250 m. It is thought that the salinity maximum water found in the northeast region of the Hawaiian Islands around 29°N, 148°W (Henmi, 1977) spreads to the south and enters this region. The salinity minimum water may be water mass composed of the Subarctic Pacific Water mixed with water of the tropical region. The Eastern North Pacific Water is present in the layer between the salinity maximum and the salinity minimum, as is evident in the Fig. 4, (a). The temperature-salinity curves between 8°N and 14°N show considerable similarity to each other, but as the equator is approached the salinity maximum of ca 35.00 ‰ disappear, while the salinity minimum increases gradually. The numerical values of the salinity minimum are ca 34.40 ‰ at 10°N and ca 34.60 ‰ at 7°N, respectively.

The temperature-salinity curves (Fig. 4, b–g) below the depth of 400m coincide fairly well with those of the so-called Pacific Equatorial Water mass. The Pacific Equatorial Water is probably formed off the coast of South America by the gradual transformation of the Subantarctic Water and spreads to the north and to the west (Sverdrup. et al. 1942).

(3) Eastward and westward flow

The distribution of east-west component of geostrophic current referred to 1,500 m depth between 7°N and 15°N along the meridian of 158°W is shown in Fig, 5.

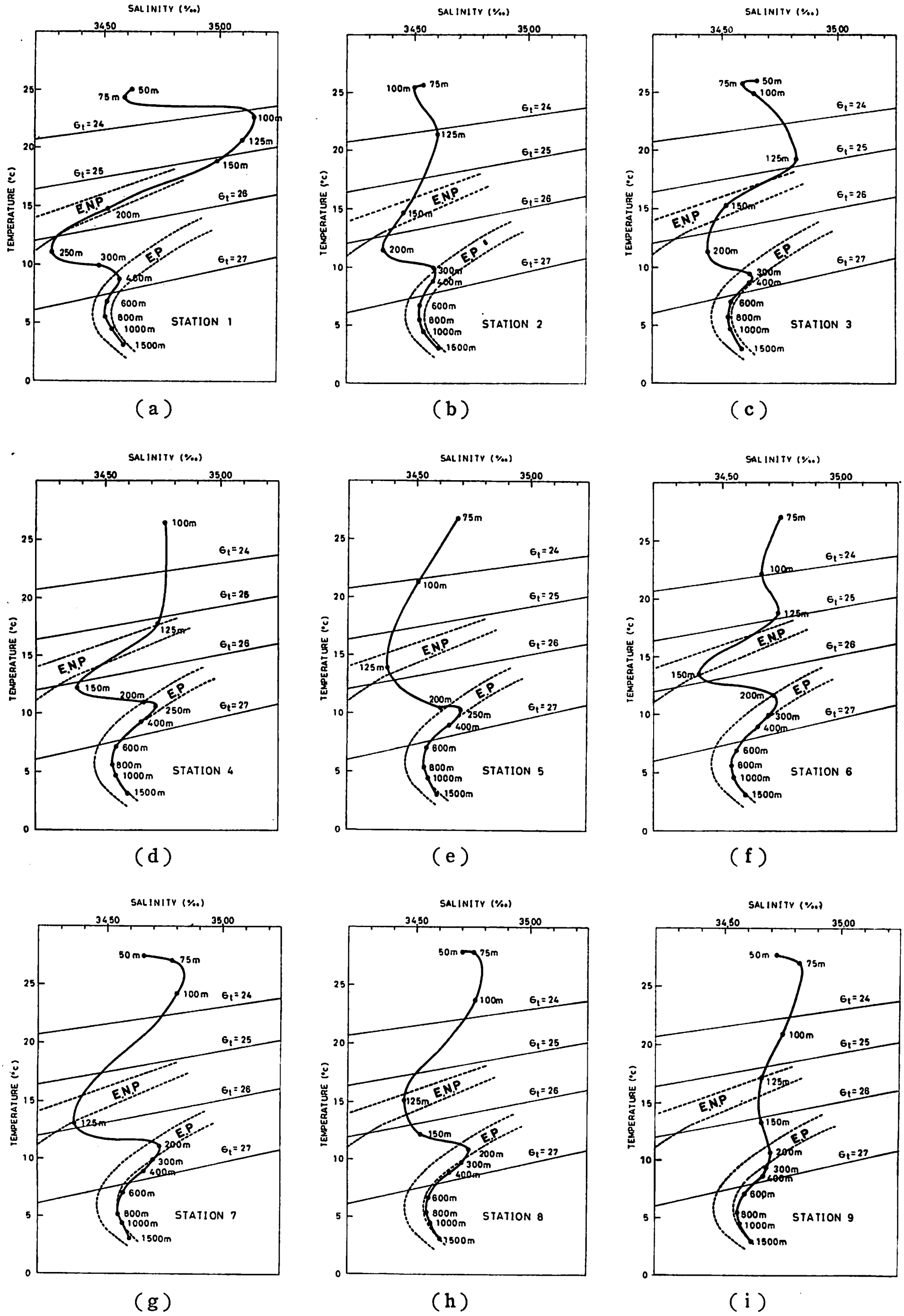


Fig. 4. T-S diagrams between 7°N and 15°N along the meridian of 158°W. Number of station and the observing depths are indicated. The thick dotted bands show the Eastern North Pacific Water and the Equatorial Pacific Water defined by Sverdrup et al. (1942).

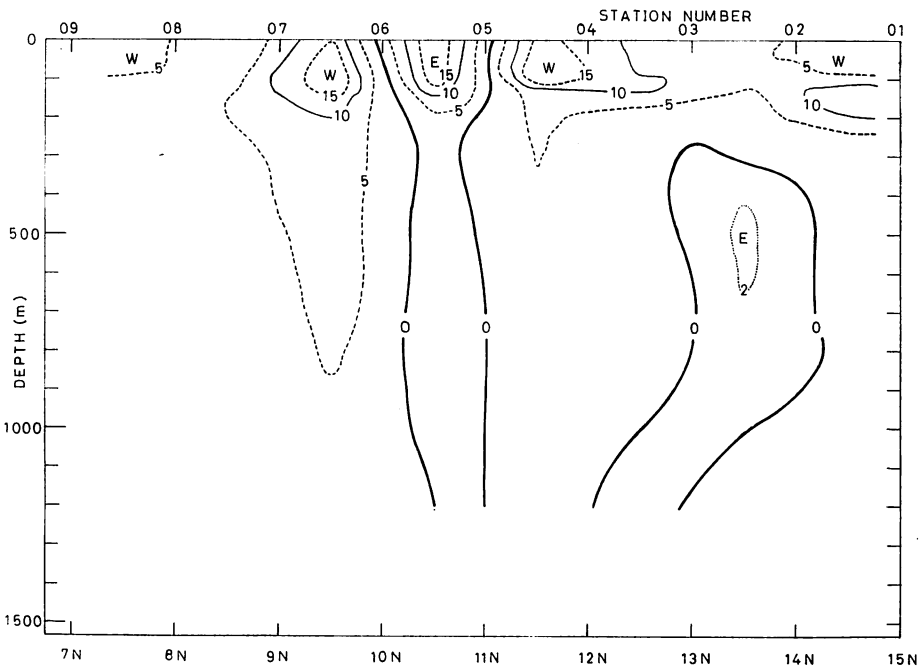


Fig. 5. The east-west component (cm/sec) of calculated relative current velocity across 158°W referred to 1,500m.

The currents in this region are the westward-flowing North and South Equatorial Currents, and between them, the eastward-flowing Equatorial Countercurrent. These currents relates closely to the northeast and southeast trades. There is marked seasonal and longitudinal variation in the trade wind. It is, therefore, to be expected that the intension and the situation of the current are not constant. The Equatorial Countercurrent is present at all seasons of the year, lying always in the Northern Hemisphere and flows toward the east in a zone of the doldrums from Mindanao Island to the Gulf of Panama.

The beginning of the North Equatorial Current is found where the waters of the Equatorial Countercurrent turn to the north off Central America, and to these water masses are added the waters of the California Current. The main current axis of the North Equatorial Current is situated almost around 15°N and runs from the east to the west in a zone of comparatively broad latitude, increasing in volume transport because new water masses join the current from the north. The South Equatorial Current is present on both sides of the Equator and extends to about 5°N from 20°S and flows toward the west from off Peru to New-Guinea.

From the current structure (Fig. 5), the current axis of the eastward flow, corresponding to the Equatorial Countercurrent, is situated around 10°-30′N. The numerical value of the maximum velocity of the eastward flow is ca 20 cm/

sec and the volume transport of the eastward flow is ca $4.7\times10^6$ $m^3$/sec. In the report by Sverdrup et al (1942), the maximum velocity of the Equatorial Countercurrent is a little over 50 cm/sec and the volume transport of the Countercurrent is ca $25\times10^6$ $m^3$/sec. The maximum velocity and the volume transport of the Countercurrent observed in the present research is very small compared with that reported by Sverdrup. Though the velocity and the volume transport of the current are expected to vary widely according to many changing factors, it is not clear whether these differences are actually caused by these expected seasonal and annual variations. However, the differences of the volume transport are probably caused by the method of taking the motionless surface in the Dynamic calculation or are perhaps due to the width of the current. The westward-flow in the northern side and southern side of the Equatorial Countercurrent corresponds to the North and South Equatorial Current. The current axis of the North Equatorial Current is situated around 11°-30′N. The numerical value of the current velocity is ca 20 cm/sec and the volume transport is ca $12.3\times10^6$ $m^3$/sec. The current axis of the South Equatorial Current is situated around 9°-30′N. The numerical value of the current velocity is ca 21 cm/sec and the volume transport is ca $15.3\times10^6$ $m^3$/sec.

Sverdrup et al. (1942) described that within the Equatorial Countercurrent descending motion taked place at the southern boundary and ascending motion at the northern boundary, and between the Equator and the countercurrent descending motion taked place at the boundary of the Equatorial Countercurrent and ascending motion at the Equator. Thus, two cells appear with a divergence at the northen limit of the Equatorial Countercurrent and at the Equator, and a convergence at the southern boundary of the Equatorial Countercurrent. In accordance with this theory, the divergence appears around 8°N, 11°N and the convergence appears around 10°N in the present research. The divergences appear to be of biological importance because the ascending motion maintains the replenishment of nutrients to the surface layers, thus favoring the development of phytoplankton.

(4) Zooplankton

The distribution of zooplankton between 7°N and 15°N along the meridian of 158°W is shown in Fig, 6. The zooplankton communities in this region are represented by *Copepoda, Ceratium, Radiolaria, Appendicularia* and *Foraminifera*. *Chaetognatha, Polychaeta, Ostracoda* and *Thaliacea* occurred, though the number of individuals is very small.

*Copepoda* occupied the greater part of the plankton and the rate of the number of occurrence is about 50% at each station. The total number of zooplankton varies from 37 to 545 per cubic meter with an average of 252.

It is well known that a strong stratification of water usually develops in the tropics and warm temperature latitudes. This opposes any vertical mixing of the water so that a depletion or near depletion of nutrients in the photic zone

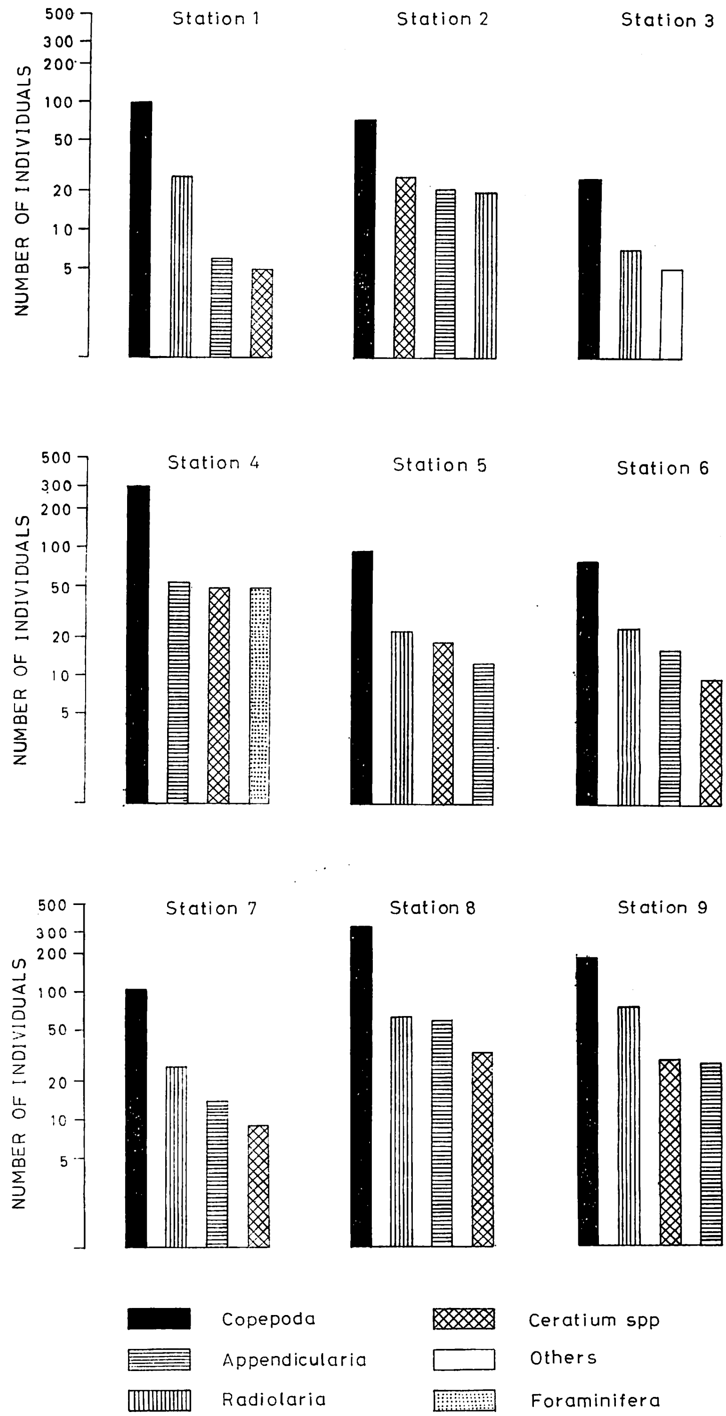


Fig. 6. Occurrence of the estimated number of zooplankton organisms per cubic meter of sea water at each station.

results.

Characteristically, the plankton communities of the tropical region are extremely sparse as compared with those of the subpolar region and it is known that they are more abundant in the cold sea than in the warm sea.

However, based on our observation, there seems to be a tendency for the number to increase from high latitudes to low latitudes; i. e., the numerical values of the water temperature at the surface layer in 15°N and 7°N are ca 25.1°C and ca 27.7°C, respectively, but the occurrence of plankton is higher in the warm warters than in the cold waters. This shows reversed correlation with the above mentioned phenomenon. It is not clear whether this correlation is caused by such inorganic salts as phosphates and nitrates needed by the plankton communities, but it does seem that the greater production of plankton may be due to the upwelling phenomenon, as the upwelling of lower water is indicated around the low latitude of 7°N. (Chapter 1). On the other hand, the numerical values of the salinity at the surface layer in 15°N and 7°N are ca 34.60‰ and 34.70‰, respectively. It seems that the variations in salinity show no correlation with variations in plankton content. Sverdrup and Allen (1940) stressed the importance of the "age" of the different water masses supporting plankton populations off the coast of southern California. In connection with the ability of the water to support plankton, the terms "old water" and "new water" may be useful in describing the different water masses of the open Pacific. The warm Pacific characteristically has "old water" at the surface ; water which supports a sparse plankton population.

However, where there are diverging currents, such as the Equatorial and California Currents, upwelling subsurface water is brought to the surface. The resultant surface water is relatively new or eutrophic water and supports a higher plankton production.

In the present research, there found a greater production of plankton around 8°N, 12°N. These regions of greater production of plankton may correspond approximately to the above mentioned area of divergence. (Chapter 3).

## 4. Summary

The oceanographical research in the southern region of the Hawaiian Islands was carried out in May, 1977. The results obtained are summarized as follows:

1) The depth of surface water is about 75 m and the numerical values of the temperature of the surface water at 15°N and 7°N are ca 25.1°C and ca 27.7°C, respectively. The surface temperature gradually increases from the north to the south.

2) The thermocline is found at a depth of between 75 m and 150 m, and becomes deeper northward from 14°N. The variation range of the numerical value of the temperature between the thermoclines is ca 14°C and the vertical

gradient of the thermocline is great between 8°N and 12°N.

3) The upwelling phenomenon is suspected to occur as the equator is approached from around 10°N.

4) The salinity maximum of ca 35.00‰ is found in the layer at a depth of about 125 m; the salinity minimum of ca 34.25‰, in the layer at a depth of about 250 m at 15°N. The Eastern North Pacific Central Water is present in the layer between the salinity maximum and salinity minimum. The Pacific Equatorial Water is found below the depth of 400 m.

5) The current axis of the eastward flow, corresponding to the Equatorial Countercurrent, is situated around 10°-30′N and the numerical value of the maximum velocity of the eastward flow is ca 20 cm/sec. The current axis of the westward flow, corresponding to the North and South Equatorial Current, is situated around 11°-30′N and 9°-30′N and the numerical value of the maximum velocity of the westward flow is ca 20 cm/sec.

6) The zooplankton communities in this region are represented by *Copepoda*, *Ceratium*, *Radiolaria*, *Appendicularia* and *Foraminifera*. *Chaetognatha*, *Polychaeta*, *Ostracoda* and *Thaliacea* occurred, though the number of individuals is very small. *Copepoda* occupies the greater part of the plankton and the total number of zooplankton varied from 37 to 545 per cubic meter with an average of 252. The regions of greater production of plankton correspond approximately to the area of divergence.

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Table 1. S. T. D. data at each observing station.

| Depth | Station 1 Lat. 15°-00.'0N Long.158°-00.'5W May. 14, 1977 | | Station 2 Lat. 13°-57.'8N Long.158°-05.'3W May. 15, 1977 | | Station 3 Lat. 13°-01.'9N Long.158°-01.'1W May. 16, 1977 | | Station 4 Lat. 12°-02.'3N Long.158°-01.'2W May. 17, 1977 | | Station 5 Lat. 11°-00.'4N Long.158°-03.'8W May. 18, 1977 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Temp. (°C) | Salinity (‰) | Temp. (°C) | Salinity (‰) | Temp. (°C) | Salinity (‰) | Temp. (°C) | Salinity (‰) | Temp. (°C) | Salinity (‰) |
| 0 | 25.10 | 34.62 | 25.70 | 34.55 | 26.00 | 34.65 | 26.40 | 34.75 | 26.70 | 34.68 |
| 10 | 25.10 | 34.62 | 25.70 | 34.55 | 26.00 | 34.65 | 26.40 | 34.76 | 26.70 | 34.68 |
| 30 | 25.10 | 34.62 | 25.60 | 34.54 | 26.00 | 34.65 | 26.40 | 34.76 | 26.70 | 34.68 |
| 50 | 25.00 | 34.62 | 25.60 | 34.54 | 26.00 | 34.65 | 26.40 | 34.76 | 26.70 | 34.68 |
| 75 | 24.30 | 34.59 | 25.60 | 34.53 | 25.80 | 34.59 | 26.40 | 34.76 | 26.70 | 34.68 |
| 100 | 22.70 | 35.15 | 25.40 | 34.50 | 24.90 | 34.64 | 26.30 | 34.76 | 21.30 | 34.51 |
| 125 | 20.60 | 35.10 | 21.40 | 34.60 | 19.30 | 34.82 | 17.70 | 34.73 | 13.90 | 34.38 |
| 150 | 18.80 | 34.99 | 14.70 | 34.45 | 15.30 | 34.52 | 12.20 | 34.38 | 11.90 | 34.45 |
| 200 | 14.80 | 34.52 | 11.50 | 34.36 | 11.40 | 34.40 | 11.00 | 34.67 | 10.50 | 34.61 |
| 250 | 11.10 | 34.28 | 10.50 | 34.46 | 10.00 | 34.52 | 10.60 | 34.72 | 10.30 | 34.70 |
| 300 | 10.00 | 34.48 | 10.00 | 34.58 | 9.50 | 34.62 | 10.10 | 34.70 | 9.80 | 34.67 |
| 350 | 9.30 | 34.54 | 9.40 | 34.57 | 9.00 | 34.63 | 9.70 | 34.68 | 9.40 | 34.66 |
| 400 | 8.80 | 34.57 | 8.80 | 34.58 | 8.70 | 34.62 | 9.20 | 34.66 | 9.00 | 34.65 |
| 450 | 8.20 | 34.56 | 8.30 | 34.56 | 8.30 | 34.60 | 8.60 | 34.64 | 8.40 | 34.61 |
| 500 | 7.70 | 34.54 | 7.70 | 34.54 | 7.90 | 34.59 | 8.20 | 34.61 | 7.90 | 34.58 |
| 600 | 6.80 | 34.52 | 6.70 | 34.52 | 7.00 | 34.54 | 7.10 | 34.55 | 7.00 | 34.55 |
| 700 | 6.20 | 34.51 | 6.10 | 34.52 | 6.40 | 34.54 | 6.20 | 34.54 | 6.20 | 34.54 |
| 800 | 5.50 | 34.51 | 5.50 | 34.52 | 5.70 | 34.53 | 5.60 | 34.54 | 5.40 | 34.54 |
| 1000 | 4.50 | 34.54 | 4.50 | 34.54 | 4.70 | 34.54 | 4.70 | 34.55 | 4.50 | 34.56 |
| 1200 | 3.90 | 34.56 | 3.90 | 34.56 | 3.90 | 34.57 | 3.90 | 34.57 | 3.90 | 34.57 |
| 1500 | 3.10 | 34.59 | 3.10 | 34.60 | 3.00 | 34.59 | 3.10 | 34.60 | 3.10 | 34.60 |

Table 1. (Continued)

| Depth | Station 6 Lat. 10°-07.'6N Long.158°-02.'8W May. 19, 1977 | | Station 7 Lat. 08°-59.'4N Long.158°-00.'5W May. 20, 1977 | | Station 8 Lat. 08°-02.'0N Long.157°-57.'1W May. 21, 1977 | | Station 9 Lat. 07°-01.'1N Long.158°-00.'7W May. 22, 1977 | |
|---|---|---|---|---|---|---|---|---|
| | Temp. (°C) | Salinity (‰) | Temo. (°C) | Salinity (‰) | Temp. (°C) | Salinity (‰) | Temp. (°C) | Salinity (‰) |
| 0 | 27.00 | 34.75 | 27.60 | 34.66 | 27.70 | 34.69 | 27.70 | 34.72 |
| 10 | 27.00 | 34.75 | 27.60 | 34.66 | 27.70 | 34.69 | 27.70 | 34.72 |
| 30 | 27.00 | 34.75 | 27.50 | 34.66 | 27.70 | 34.69 | 27.70 | 34.72 |
| 50 | 27.00 | 34.75 | 27.50 | 34.66 | 27.80 | 34.70 | 27.70 | 34.72 |
| 75 | 27.00 | 34.75 | 27.10 | 34.78 | 27.80 | 34.75 | 27.00 | 34.82 |
| 100 | 22.20 | 34.67 | 24.20 | 34.80 | 23.70 | 34.76 | 20.90 | 34.75 |
| 125 | 18.80 | 34.74 | 13.20 | 34.36 | 15.10 | 34.45 | 17.20 | 34.66 |
| 150 | 13.50 | 34.40 | 11.70 | 34.49 | 12.20 | 34.52 | 13.40 | 34.66 |
| 200 | 11.70 | 34.72 | 11.20 | 34.73 | 10.90 | 34.73 | 10.70 | 34.70 |
| 250 | 10.70 | 34.73 | 10.40 | 34.72 | 10.10 | 34.71 | 9.70 | 34.69 |
| 300 | 9.90 | 34.70 | 9.90 | 34.70 | 9.70 | 34.70 | 9.30 | 34.68 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 350 | 9.40 | 34.68 | 9.30 | 34.68 | 9.20 | 34.68 | 9.00 | 34.67 |
| 400 | 8.90 | 34.65 | 8.90 | 34.66 | 8.80 | 34.65 | 8.60 | 34.67 |
| 450 | 8.50 | 34.63 | 8.50 | 34.63 | 8.20 | 34.61 | 8.20 | 34.63 |
| 500 | 8.00 | 34.59 | 8.10 | 34.60 | 7.50 | 34.58 | 7.90 | 34.62 |
| 600 | 6.90 | 34.56 | 7.00 | 34.57 | 6.60 | 34.56 | 7.00 | 34.59 |
| 700 | 6.20 | 34.54 | 5.90 | 34.55 | 6.00 | 34.55 | 6.30 | 34.57 |
| 800 | 5.60 | 34.54 | 5.20 | 34.55 | 5.40 | 34.55 | 5.50 | 34.56 |
| 1000 | 4.60 | 34.55 | 4.40 | 34.57 | 4.50 | 34.57 | 4.50 | 34.57 |
| 1200 | 3.90 | 34.57 | 3.80 | 34.58 | 3.80 | 34.58 | 3.89 | 34.59 |
| 1500 | 3.10 | 34.60 | 3.10 | 34.60 | 3.10 | 34.61 | 3.00 | 34.62 |

Table 2. Occurrence of zooplankton at each collecting station.

| Date<br>Station No.<br>Latitude<br>Longitude | May. 14, 1977<br>1<br>15°-00.'0N<br>158°-00.'5W | May. 15, 1977<br>2<br>13°-57.'8N<br>158°-05.'3W | May. 16, 1977<br>3<br>13°-01.'9N<br>158°-01.'0W | May. 17, 1977<br>4<br>12°-02.'3N<br>158°-01.'2W | May. 18, 1977<br>5<br>11°-00.'4N<br>158°-03.'8W |
|---|---|---|---|---|---|
| Radiolaria | 26 | 20 | 7 | 47 | 23 |
| Ceratium | 5 | 26 | 1 | 50 | 19 |
| Chaetognatha | 4 | 1 | | 7 | 10 |
| Polychaeta | 2 | 1 | 1 | 7 | 1 |
| Pteropoda | 4 | 2 | | 8 | 2 |
| Ostracoda | 3 | 2 | 1 | | 1 |
| Copepoda | 99 | 73 | 25 | 302 | 96 |
| Decapoda larva | 5 | 1 | 1 | 3 | |
| Nauplius | | | | | |
| Appendicularia | 6 | 21 | 1 | 55 | 13 |
| Thaliacea | 1 | | | 2 | 4 |
| larva | | | | | |
| Foraminifera | 2 | 5 | | 50 | 7 |
| The other larval form | | | | | |
| Unidentified Organisms | | | | | |
| Medusa | | | | | |
| Toatal | 157 | 152 | 37 | 531 | 176 |

| Date<br>Station No.<br>Latitude<br>Longitude | May. 19, 1977<br>6<br>10°-07.'6N<br>158°-02.'8W | May. 20, 1977<br>7<br>08°-59.'4N<br>158°-00.'5W | May. 21, 1977<br>8<br>08°-02.'0N<br>157°-57.'1W | May. 22, 1977<br>9<br>07°-01.'1N<br>158°-00.'7W |
|---|---|---|---|---|
| Radiolaria | 25 | 26 | 62 | 72 |
| Ceratium | 10 | 9 | 34 | 28 |
| Chaetognatha | 4 | 5 | 14 | 10 |
| Polychaeta | 1 | 1 | 1 | 1 |
| Pteropoda | 2 | 1 | 7 | 4 |
| Ostracoda | 1 | | | |
| Copepoda | 82 | 103 | 314 | 178 |
| Decapoda larva | 2 | 2 | 4 | 1 |

| | | | | |
|---|---|---|---|---|
| Nauplius | | | | |
| Appendicularia | 17 | 14 | 58 | 26 |
| Thaliacea | 3 | 1 | 2 | 2 |
| larva | | | | |
| Foraminifera | 7 | 8 | 49 | 24 |
| The other larveal form | | | | |
| Unidentified Organisms | | | | |
| Medusa | | | | |
| Total | 154 | 170 | 545 | 346 |