SEASONAL DISTRIBUTION OF PELAGIC COPEPODS AT OSHORO BAY, WEST COAST OF HOKKAIDO.

by

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The routine work of plankton sampling at Oshoro Bay (Fig. 1), about 18 miles west of Otaru Harbour, on the west coast of Hokkaido, has been carried out usually every week, sometimes more unfrequently, throughout the year. The present studies are based on the samples collected from June, 1946, to December, 1950, of which the number of vials reaches to 162 in all. The sampling was made by horizontal haul of plankton net (27 cm in mouth diameter, made of bolting cloth, 128 meshes to an inch) for about 400 metres through a few metres depth in the bay, sometimes collections outside of the bay being also carried out.

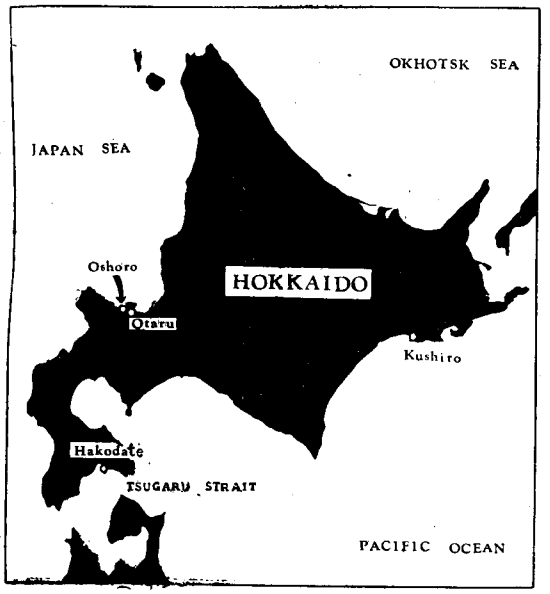

Fig 1. Sketch map of Hokkaido showing the situation of Oshoro Bay.

Fifty-six species of copepods were identified from the collections covering five years (Table 1), including thirty-one species of Gymnoplea and twenty-five species of Podoplea. Among them two Gymnoplea and one Podoplea are considered as new to science, about which a detailed account will be given in the near future. The characteristic feature of seasonal fluctuation of their occurrences is outlined as follows (attached Table, Fig. 2):

January: The community is monotonous, mainly composed of *Oithona similis* and *Paracalanus parvus*, which are distributed throughout the year. *Pseudocalanus minutus*, which has appeared from November of the preceding year, gradually increases in number toward the end of this month.

February: The community is the same as the preceding month, but the number of *Pseudocalanus minutus* greatly increases. The females of this species usually bear eggs.

Table 1 Systematic list of pelagic copepods collected at Oshoro Bay.

Suborder Gymnoplea
- Family Calanidae
  - *Calanus helgolandicus* (Claus)
  - *Calanus plumchrus* Marukawa
  - *Calanus tenuicornis* Dana
  - **Eucalanus bungii bungii* (Giesbrecht)
  - *Paracalanus parvus* (Claus)
  - *Paracalanus aculeatus* Giesbrecht
  - *Acrocalanus gracilis* Giesbrecht
  - *Clausocalanus pergens* Farran
  - *Clausocalanus furcatus* (Brady)
  - *Calocalanus pavo* (Dana)
  - *Calocalanus styliremis* Giesbrecht
  - *Calocalanus plumlosus* Claus
  - *Pseudocalanus minutus* (Kröyer)
  - *Euchaeta marina* (Prestandrea)
  - *Euchaeta ovata* Sato
- Family Centropagidae
  - *Centropages yamadai* Mori
  - *Centropages bradyi* Wheeler
  - *Centropgaes* sp.
  - *Pseudodiaptomus marinus* Sato
  - *Temora styrifera* (Dana)
  - *Temora discaudata* Giesbrecht
  - *Metridia lucens* Boeck.
  - *Lucicutia flavicornis* (Claus)
- Family Candacidae
  - *Candacia bipinnata* Giesbrecht
- Family Pontellidae
  - *Labidocera japonica* Mori
  - ‡*Acartia hamata* Mori
  - *Acartia clausi* Giesbrecht
  - *Acartia bifirosa* Claus
  - *Tortanus discaudatus* (Thompson and Scott)
  - *Tortanus forcipatus* (Giesbrecht)
  - *Tortanus* sp.

Suborder Podoplea
- Family Cyclopidae
  - *Oithona plumifera* Baird
  - *Oithona nana* Giesbrecht
  - *Oithona similis* Claus
  - *Oithona fallax* Farran
  - *Cyclopina longicornis* Boeck
  - *Setella gracilis* Dana
  - *Microsetella rosea* (Dana)
  - *Microsetella norvegica* (Boeck)
  - *Euterpe acutifrons* (Dana)
  - *Clytemnestra rostrata* (Brady)
  - *Harpacticus uniremis* (Kröyer)
  - *Laophonte* sp.
  - *Zaus spinatus* Goodsir
- Family Oncaeidae
  - *Oncaea venusta* Philippe
  - *Oncaea media* Giesbrecht
  - *Oncaea conifera* Giesbrecht
- Family Corycaeidae
  - *Sapphirina nigromaculata* Claus
  - *Copilia mirabilis* Dana
  - *Corycaeus speciosus* Dana
  - *Corycaeus agilis* Dana
  - *Corycaeus catus* F. Dahl
  - *Corycaeus anglicus* Lubbock
  - *Corycaeus concinnus* Dana
  - *Corycaeus* sp.
- Family Monstrillidae
  - *Monstrilla grandis* Giesbrecht

*This species is identical with *Eucalanus elongatus* var. *bungii* Giesbrecht 1892 (Pelagischen Copepoden, Fauna u. Flora d. Golfes v. Neapel, Vol. 19, p. 149) and to *Eucalanus giesbrechti* Mori 1937 (The pelagic copepoda from the neigbouring waters of Japan. p. 22, pl. 7, figs. 6-8). Johnson (1939, The study of species formation in certain *Eucalanus* copepods in the North Pacific. Proc. Sixth Pacific Congr., Vol. 3, p. 565) stated that *Eucalanus elongatus* var. *bungii* in the northern Pacific should be elevated to the rank of species. Wilson (1950, Copepods gathered by the United States Fisheries Steamer "Albatross" from 1887 to 1909, chiefly in the Pacific Ocean. Bull. U. S. National Museum, Vol. 14, Part 4, p. 208) accounted the Pacific specimens as *Eucalanus bungii* and Kokubo (1950, Rep. Surv. Fish. Resour. Aomori Bay, No. 1, p. 106) used the name of *Eucalanus bungii bungii* for the specimens of northern Japan.

‡Preceding the late Wilson' s (1950, *loc. cit.* pp. 152-53, pl. 2, figs. 1-5) new species *Acartia hamata*, Mori (1937, *loc. cit.* pp. 104-105, pl. 51, figs. 1-5) gave a description of new species as *Acartia hamata*, to a species quite different from Wilson's species.

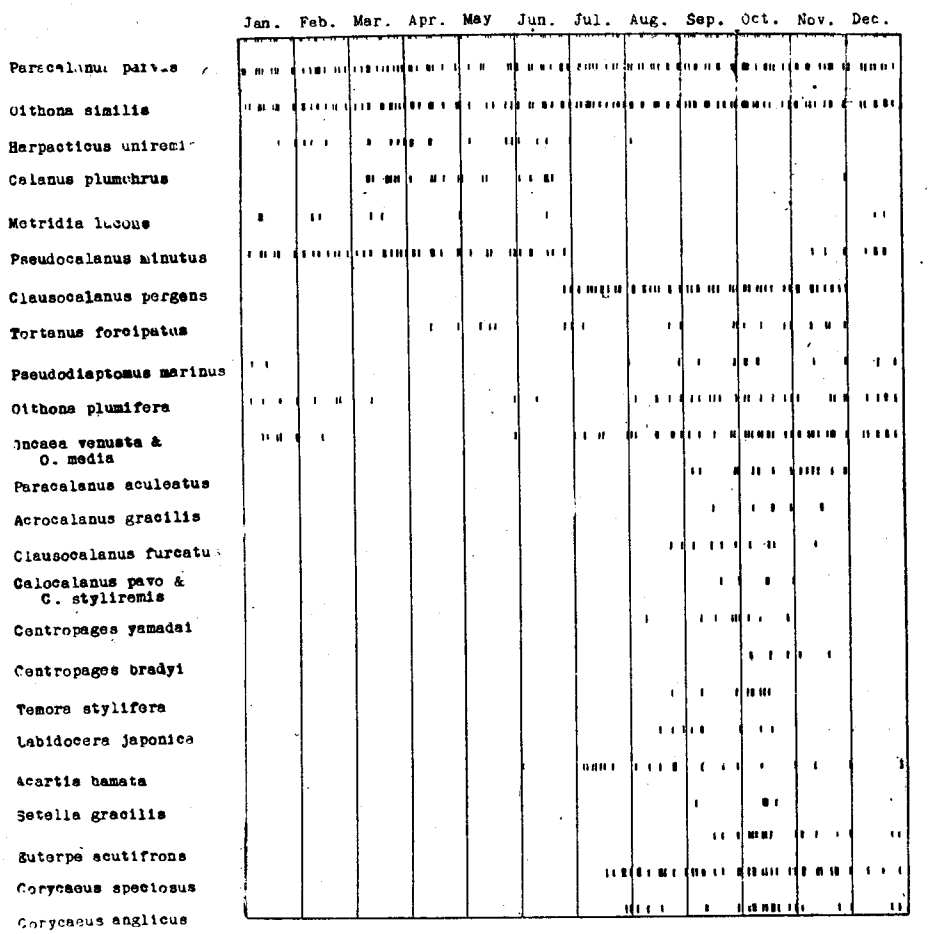

Fig. 2 General features of seasonal distribution of certain copepods based on successive five year observations.

March: Sudden appearance of an oceanic species, *Calanus plumchrus*, is observed in this month, and its appearance continues to about the end of June.

April: *Calanus plumchrus* becomes abundant, supplying the largest part of community.

May: The small-sized species, such as *Paracalanus parvus*, *Pseudocalanus minutus* and *Oithona similis*, are still observable.

June: *Paracalanus parvus*, is the main species, while *Pseudocalanus minutus* entirely disappears in the end of this month.

July: *Clausocalanus pergens* rapidly appears and increases in number to an overwhelming predominance. *Corycaeus speciosus* and *C. anglicus* appear in the middle of this month in some years. *Acartia hamata*, *Oncaea venusta* and *O. media*, also occur in this month.

August: At the beginning of this month *Pseudodiaptomus marinus*, *Oithona plumifera* and several species of *Corycaeus* appear; the former two species are distributed until the end of year or early the next year. *Labidocera japonica* occur at the middle of this month.

September: The community shows more diversity from the intermingling of tropical and subtropical species, such as *Paracalanus aculeatus, Temora stylifera, Setella gracilis, Euterpe acutifrons, Copilia mirabilis* and *Sapphirina nigromaculata.* Some of them have appeared from the preceding month in some years.

October: The above warm current forms still occur abundantly.

November: The warm current species disappear gradually toward the end of this month. A few males of *Pseudocalanus minutus* are collected in the bay at the month end anticipating their general appearance. The females of this species are found only in the off-shore collections in this month.

December: The warm current species almost disappear, though sometimes a few members remain behind. Both sexes of *Pseudocalanus minutus* and *Paracalanus parvus* increase in their number, but the total quantity of copepods in this month is very poor.

It is noticed that the copepod community in autumn includes various species of tropical and subtropical inhabitants, which migrate into the present area having been carried by the Tsushima Current. Iizuka (1950) has also pointed out that the subtropical *Ceratia* were found from October to November, not in the middle summer, at the present bay. Fish (1925) stated that the temperature is the dominant facter in governing the seasonal distribution of local pelagic animals of Woods Hole region. In the present bay, however, the occurrence of the oceanic warm current species is mainly influenced by the effect of the oceanic Tsushima Current, not being affected directly on temperature fluctuation. Thus the predominant appearance of tropical and subtropical species at the present bay lags about two months behind the period of highest temperature (late August) (Fig.3). The same tendency was observed by Kokubo (1946-50) at Aomori Bay into which an offshoot of the Tsushima Current flows.

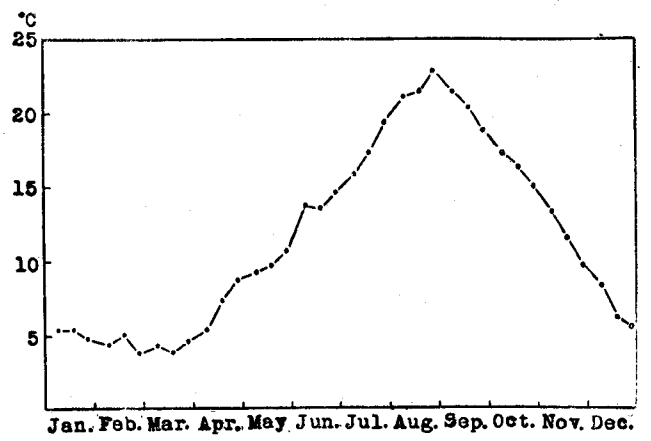

Fig. 3 Seasonal fluctuation of water temperature at Oshoro Bay averaging the data from 1946 to 1950 (Data were provided by Mr. Shinjiro Yamazaki).

The author (Motoda, Iizuka and Anraku, 1950) has assumed that the tropical and subtropical forms, which entered in the Japan Sea passing through the Chosen Strait in the middle summer, would appear at the northern part of the west coast of Japan in the autumn season, because the northward drift in the Tsushima Current from Chosen Strait to Hokkaido would require about two months. It is not yet confirmed whether the tropical and subtropical forms migrate into the Japan Sea from the south or not during the seasons other than the summer.

Yamada (1935) mentioned nine species, such as *Centropages calaninus, C. furcatus,*

Candacia catula, C. aethiopica, C. curta, C. truncata, Labidocera acutifrons, Pontella securifer, P. atlantica, as the characteristic copepods in the Tsushima Current, but all these species did not arrive at our coast.

At the west part of the Tsugaru Strait, Tsushima Current is divided into two flows. The northward current bathes along the west coast of Hokkaido, while the other passes eastward through the Tsugaru Strait into the Pacific Ocean. The tropical and subtropical oceanic copepods found at the present bay are 11 species, while those occurring at Aomori Bay (Kokubo, 1946-50) number 14 species (Table 2).

Table 2. The comparison of warm current copepods occurring at Aomori Bay (Kokubo, 1946-50) and Oshoro Bay.

Aomori Bay	Oshoro Bay
Calocalanus plumlosus	*Calocalanus plumlosus*
Calocalanus pavo	*Calocalanus pavo*
———	*Calocalanus styliremis*
———	*Sapphirina nigromaculata*
Copilia mirabilis	*Copilia mirabilis*
Paracalanus aculeatus	*Paracalanus aculeatus*
Acartia erythrea	———
Corycaeus curtus	———
Corycaeus speciosus	*Corycaeus speciosus*
Setella gracilis	*Setella gracilis*
Aetedius giesbrechti	———
Corycaeus rostratus	———
Euterpe acutifrons	*Euterpe acutifrons*
Labidocera acuta	———
Microsetella rosea	*Microsetella rosea*
Temora stylifera	*Temora stylifera*

The occurrences of *Clausocalanus pergens* and *Tortanus forcipatus* are confined to the months from July to November, while *Pseudocalanus minutus* is collected during the cold season from November to June. The latter species, however, occurs from January to June at Aomori Bay (Kokubo, 1946-50) and from March to September in the Gulf of Maine and Bay of Fundy (Fish, 1936).

Both the number of species and the quantity are more abundant outside of the bay than in the bay. This is also the case of *Ceratia* (Iizuka, 1950).

Besides the above, semibenthic copepods, *Harpacticus uniremis, Laophonte* sp., *Zaus spinatus* and the larval form of parasitic copepod, *Monstrilla grandis,* are collected, but the

latter three species occur only occasionally.

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Occurrence of copepods in hauls during the period from June 1946 to December 1950. The signs used in the table mean as follows: rr(very rare), r(rare), +(present), c(common), cc(abundant); and the parentheses show the result of off-shore collection.