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DISTRIBUTION OF PLANKTON COPEPODS OFF KITAMI, HOKKAIDO,
IN OKHOTSK SEA IN SUMMER, 1949 AND 1950

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AIKAWA (1933) stated that copepod community in southern part of the Okhotsk Sea is represented by small types of copepods, while the larger species, such as *Calanus plumchrus* and *Eucalanus elongatus*, are scarcely ever found. He (1938) again reported that the Phaeoplankton (the phytoplankton mainly composed of *Phaeoceros*) occurs widely over the Okhotsk Sea and Bering Sea. KANNO (1935) worked in the South Okhotsk Sea and off the Pacific Ocean side of Kamchatka, finding the predominance of *Parathemisto oblivia*, *Calanus finmarchicus*, *Eucalanus elongatus*, and some species of both *Oithona* and *Oncaea*. Recently, IIZUKA (1950) carried out the collection off Kitami, Hokkaido, and found that neritic water, oceanic water, mixed water, and up-welling water have their own particular composition of phytoplankton respectively.

The present investigation deals with materials collected by the Surveying Ship "Tankai-maru" of the Hokkaido Regional Fisheries Research Laboratory in the Okhotsk Sea adjacent to Hokkaido in August, 1949, and in August, 1950. The positions of collection and the surface isotherms in these two years are given in figures 1 and 2 and figures 3 and 4 respectively. The collections were made by vertical haul with the ordinary plankton net from 400 metre depth or less.

Twenty-seven species of copepods were identified from the materials (Table 1). The distribution of each species will be mentioned below referring to the hydrographical conditions.

I. Distribution in 1949 (Table 3)

Both *Paracalanus parvus* and *Clausocalanus pargens* were abundantly found in the area inside the 100 fathom line, except at St. 3 and 5, while they were scarce in the outside region. The distribution of these species did not link with the surface isotherms, but the range was somewhat limited by the salinity distribution. They became scarce in the area below 32.80 ‰ S, that is, in the offshore area (Fig. 3).

The two stations, St. 9 and 12, seemed to be different in nature from other neritic stations. The materials obtained at St. 12 included a considerable amount of diatoms and many *Calanus plumchrus*. The vertical section of temperature distribution indicates that an up-welling of cold water appears around St. 12 (Fig. 7). IIZUKA (1950) perceived also plentiful diatoms at both St. 9 and St. 12.

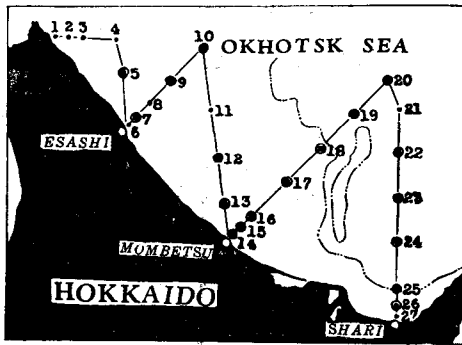


Fig. 1. Positions of collection in summer, 1949

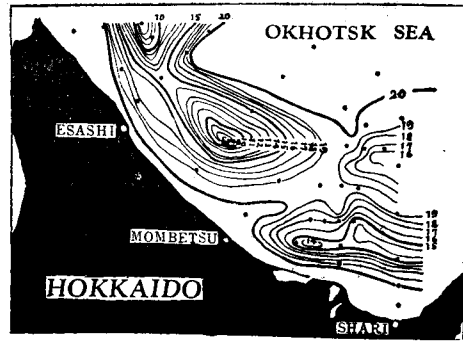


Fig. 4. Horizontal distribution of temperature at five metre layer in summer, 1950 (Data provided by Hokkaido Regional Fisheries Research Laboratory)

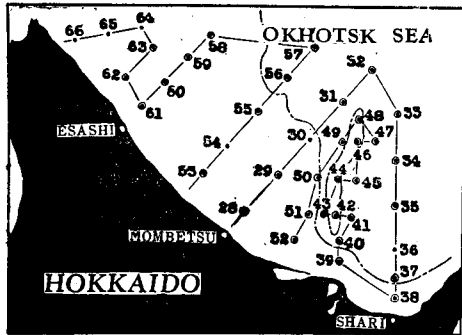


Fig. 2. Positions of collection in summer, 1950



Fig. 5. Distribution of *Calanus plumchrus* in summer, 1949

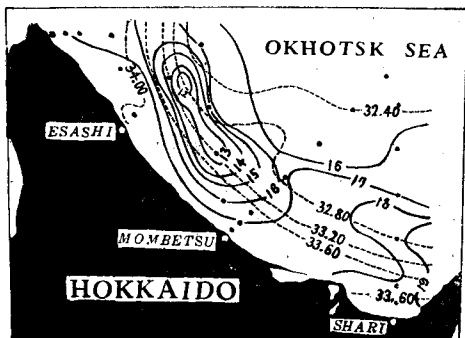


Fig. 3. Horizontal distribution of temperature and salinity at the surface in summer, 1949 (Data provided by Hokkaido Regional Fisheries Research Laboratory)

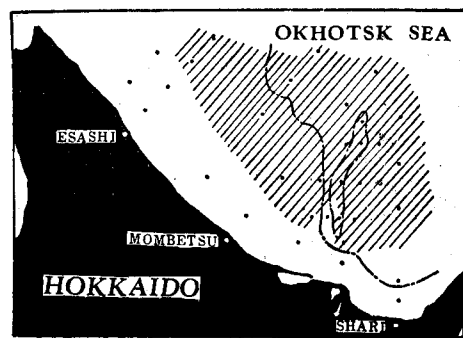


Fig. 6. Distribution of *Calanus plumchrus* in summer, 1950

Table 1. List of species collected in summer, 1949 and 1950

Family Calanidae	<i>Heterorhabdus papilliger</i> (Claus)
<i>Calanus helgolandicus</i> (Claus)	Family Candacidae
<i>C. plumchrus</i> Marukawa	<i>Candacia pacifica</i> Mori
<i>C. tenuicornis</i> Dana	Family Pontellidae
<i>C. cristatus</i> Kröyer	<i>Labidocera japonica</i> Mori
<i>Eucalanus bungii bungii</i> (Giesbrecht)	<i>Acartia longiremis</i> Lilljeborg
<i>Paracalanus parvus</i> (Claus)	<i>Tortanus forcipatus</i> (Giesbrecht)
<i>Clausocalanus pargens</i> Farran	<i>T. discaudatus</i> (Thompson & Scott)
<i>Pseudocalanus minutus</i> (Kröyer)	Family Cyclopidae
<i>Euchaeta japonica</i> Marukawa	<i>Oithona similis</i> Claus
<i>Scolecithricella minor</i> (Brady)	<i>Microsetella norvegica</i> (Boeck)
<i>Gaetanus armiger</i> Giesbrecht	<i>Clytemnestra rostrata</i> (Brady)
Family Centropagidae	Family Oncaeiidae
<i>Centropages bradyi</i> Wheeler	<i>Oncaea conifera</i> Giesbrecht
<i>C. abdominalis</i> Sato	<i>Oncaea media</i> Giesbrecht
<i>Metridia lucens</i> Boeck	Family Corycaeiidae
<i>Pleuromamma abdominalis</i> (Lubbock)	<i>Corycaeus</i> sp.

*Eucalanus bungii bungii** has been considered as one of the boreal species (JOHNSON, 1938; KOKUBO, 1950a; Marine Research Committee, State of California, 1950; MOTODA and ANRAKU, 1952) close to both *Calanus cristatus* and *Calanus plumchrus* (Fig. 5). These three were distributed in the offshore region in the present case. *Scolecithricella minor* is rather oceanic in distribution (SATO, 1913; YAMADA, 1933), having not been found to occur in the coastal waters (ANRAKU, 1953); the present observation confirms previous findings in this respect.

The vertical hauls were made at St. 23, at eleven o'clock, on August 8, from the layers of 200-0 m, 400-200 m and 700-400 m. The species collected from each layer are listed in table 2. A distinct thermocline is observed in very shallow layers between 5 and 10 metre depth (IIZUKA, 1950). Therefore, the most part of the species collected by this haul are those which preferred cold water.

Microsetella norvegica was abundant in the upper layer, and *Metridia lucens* occupied the most part of the population in the middle layer. The adults of *Calanus plumchrus* were collected from the middle layer. Such specimens have usually been collected from the deep water in the Japan Sea (YAMADA, 1938; NAKAI, 1942; MOTODA, IIZUKA and ANRAKU, 1950) and in a part of the Pacific Ocean adjacent to northern Japan (NAKAI, 1942; ANRAKU,

*Johnson (1938) established two subspecies in *Eucalanus bungii*. *E. bungii californicus* has a single seta on the second basipodite of mandible, while *E. bungii bungii* has three setae on this segment. The former subspecies is collected off California, while the latter is distributed in more northern waters. Wilson (1950, p. 208) gave the name *E. bungii* to the specimen collected near the Philippines without remarks on subspecies. The present specimen should be identified as *E. bungii bungii*, depending upon the presence of three setae on the second basipodite of mandible.

1952). However, KOKUBO (1950 b) reported that the adult of *Calanus plumchrus* could not be found in the collection in March from 620 metre depth at 30 miles to the west of Cape Tappi, Aomori Pref., on the Japan Sea side. *Metridia lucens* was dominant in the lower layer, in company with several other cold water species. *Oncaea conifera* occurred also in the deep layer (cf. ANRAKU, 1952).

II. Distribution in 1950 (Table 4)

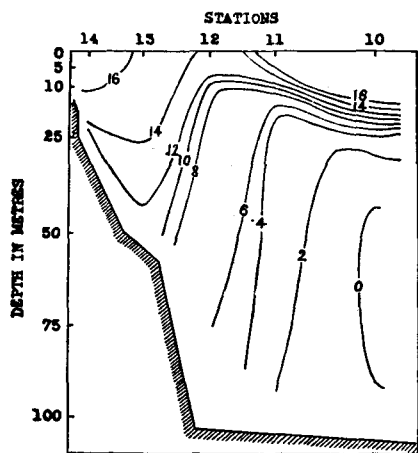


Fig. 7. Isotherms in vertical section of St. 10-14 in summer, 1949 (Data provided by Hokkaido Regional Fisheries Research Laboratory)

The number of species was rather small as compared with that found in the preceding year. Seven species (*Centropages bradyi*, *Pleuromamma abdominalis*, *Labidocera japonica*, *Tortanus forcipatus*, *T. discaudatus*, *Clytemnestra rostrata* and *Oncaea conifera*) could not be found in 1950, though they occurred in 1949. On the other hand, *Oncaea media* appeared only in 1950.

Both *Paracalanus parvus* and *Clausocalanus pergens* were abundantly found in the coastal region without regard to temperature distribution, while *Calanus cristatus*, *C. plumchrus* (Fig. 6) and *Eucalanus bungii bungii* were distributed in the offshore region as in the preceding year.

Scolecithricella minor appeared only in the offshore stations (St. 33, 34, 35, 40) as in 1949, but in less number.

Brief mention will be made of the diatom flora. The quantity of diatoms in 1950 was larger than in 1949. Oceanic cold water species were represented by *Chaetoceros convolutus*, *Thalassiothrix longissima* and *Corethron hystrix*, while coastal water species were mainly represented by *Chaetoceros radicans* as in the case of the observations by IIZUKA and TAMURA (1953) in Ishikari Bay in spring.

In 1950 the oceanic cold water diatoms were abundantly found in the offshore region (St. 29, 43, 50, 51, 55), while the neritic species occurred rather at the coastal region (St. 37, 39, 40, 51, 52, 60, 61, 63).

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Table 2. List of species collected at various depths at St. 23

200-0m	<i>Calanus plumchrus</i> (immature)	rr
	<i>Calanus cristatus</i>	rr
	<i>Eucalanus bungii bungii</i>	rr
	<i>Paracalanus parvus</i>	r
	<i>Clausocalanus pargens</i>	rr
	<i>Pseudocalanus minutus</i>	r
	<i>Scolecithricella minor</i>	+
	<i>Oithona similis</i>	rr
	<i>Microsetella norvegica</i>	c
400-200m	<i>Calanus plumchrus</i> (immature)	rr
	" (adult, ♀, ♂)	rr
	<i>Eucalanus bungii bungii</i>	rr
	<i>Scolecithricella minor</i>	rr
	<i>Gaetanus armiger</i>	rr
	<i>Metridia lucens</i>	cc
	<i>Heterorhabdus papilliger</i>	rr
	<i>Microsetella norvegica</i>	rr
700-400m	<i>Calanus plumchrus</i> (adult, ♀, ♂)	rr
	<i>Eucalanus bungii bungii</i>	rr
	<i>Euchaeta japonica</i>	rr
	<i>Gaetanus armiger</i>	rr
	<i>Metridia lucens</i>	+
	<i>Pleuromamma abdominalis</i>	rr
	<i>Candacia pacifica</i>	rr
	<i>Oncaea conifera</i>	rr

cc: very common c: common +: present r: rare rr: very rare

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Table 4. Relative abundance of species at each station in 1950

station	28	29	31	32	33	34	35	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	55	56	57	58	59	60	61	62	63	
date	24/VII	"	"	"	"	"	25/VII	"	"	"	"	"	"	"	"	"	26/VII	"	"	"	"	"	"	29/VII	"	"	"	"	"	"	"	"	30/VII	
depth (m)	75	150	50	400	"	"	"	100	50	100	200	400	100	150	100	400	100	400	100	150	100	"	75	"	100	200	400	100	"	"	75	20	75	
<i>Calanus helgolandicus</i>	r							r	rr	+	rr												rr	+	r						rr	rr		
<i>Calanus plumchrus</i>		c	rr	+	r	r	+				rr	+	rr		r	+	r	+	rr	r	rr	rr			r	r	rr	r	rr					
<i>Calanus cristatus</i>	+		rr	rr	rr											rr											rr							
<i>Calanus tenuicornis</i>	rr							r		r														r										
<i>Eucalanus bungii bungii</i>	rr		rr	r	r	r					rr	rr				rr		r	rr		rr					rr	rr		rr					
<i>Paracalanus parvus</i>	+	rr	rr	rr	rr	r	rr	+	r	+	+	r	+	rr	rr	rr	rr	rr	rr	+	r	rr	rr	r	+	rr	rr	rr	cc	cc	r	+	r	r
<i>Clausocalanus pergens</i>	+	rr		rr				+	rr	+	+													+	+			+	+	r	r	r	+	
<i>Pseudocalanus minutus</i>			rr	r	r	r	rr					rr	+		+	c	rr	+	c	cc	+	+			+	+	c							
<i>Euchaeta japonica</i>				+	r	r	r					rr				rr												rr						
<i>Scolecithricella minor</i>					r	rr	rr					rr																						
<i>Gaetanus armiger</i>				rr		rr	rr																						rr					
<i>Centropages abdominalis</i>																											r		r	r	rr	rr		
<i>Metridia lucens</i>	cc		cc	c	cc	cc				rr	rr	cc	+	rr	rr	cc	c	cc						rr			c					rr		
<i>Heterorhabdus papilliger</i>																												rr						
<i>Candacia pacifica</i>					r		r																											
<i>Acartia longiremis</i>																								rr										
<i>Oithona similis</i>	r	rr	cc	rr	c	+	cc	+	r	c	c	+	+	r	cc	c	cc	c	+	c	+	+	r	cc	+	cc	cc	cc	cc	r	c	r	r	
<i>Microsetella norvegica</i>						rr	rr	+	r				+									rr	rr	rr	r									rr
<i>Oncaea media</i>	r							r	rr															rr										
<i>Corycaeus</i> sp.	+							r	rr				r											rr	rr								rr	

cc: very common c: common +: present r: rare rr: very rare

Table 3. Relative abundance of species at each station in 1949

station	5	7	9	10	12	13	14	15	16	17	18	19	20	22	23	24	25	26	
date	11/VIII	" 10/VIII	"	"	"	"	7/VIII	"	"	"	"	"	"	8/VIII	"	"	"	"	
depth (m)	50	30	100	"	"	50	25	"	50	150	"	400	"	"	200	400	250	50	
<i>Calanus helgolandicus</i>	r	rr	rr			rr		rr	rr									rr	rr
<i>Calanus plumchrus</i>	rr		rr	r	c	rr				rr	rr	rr	r	rr	rr	rr	rr	rr	rr
<i>Calanus cristatus</i>													rr	rr	rr				
<i>Calanus tenuicornis</i>	rr								rr										rr
<i>Eucalanus bungii bungii</i>										rr	rr	rr	r	rr	rr	rr			
<i>Paracalanus parvus</i>	cc	+	rr	+	r	+	r	+	+	+	c	rr	rr	r	r	r	cc	c	c
<i>Clausocalanus pargens</i>	r	c				+	+	r	rr	+					rr				
<i>Pseudocalanus minutus</i>	rr	+	rr	+	cc				rr	r				r	r				
<i>Euchaeta japonica</i>		rr								rr			r	rr					
<i>Scolecithricella minor</i>	r				+				rr	r	rr	rr	rr	r	+	rr	+		
<i>Gaetanus armiger</i>												rr	rr	rr					
<i>Centropages bradyi</i>																			rr
<i>Centropages abdominalis</i>				rr		rr													
<i>Metridia lucens</i>	rr			c	rr				rr	+		cc	cc	cc		cc	c		
<i>Pleuromamma abdominalis</i>												rr		rr					
<i>Heterorhabdus papilliger</i>														rr					
<i>Candacia pacifica</i>														rr					
<i>Labidocera japonica</i>						rr													
<i>Acartia longiremis</i>							rr												
<i>Tortanus forcipatus</i>																			rr
<i>Tortanus discaudatus</i>						rr	rr												
<i>Oithona similis</i>	r	rr	rr	rr	rr	r	rr	rr	+	+	c	r	rr		rr	r	rr	r	r
<i>Microsetella norvegica</i>																c			
<i>Clytemnestra rostrata</i>						rr													
<i>Oncaea conifera</i>										rr	rr	rr	rr	rr		rr	rr		
<i>Corycaeus</i> sp.						r	r												

cc: very common c: common +: present r: rare rr: very rare