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 pergens* 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.

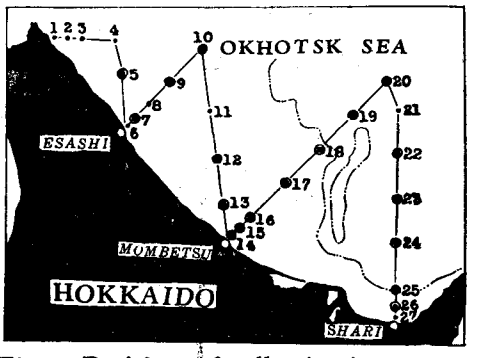

Fig. 1. Positions of collection in summer, 1949

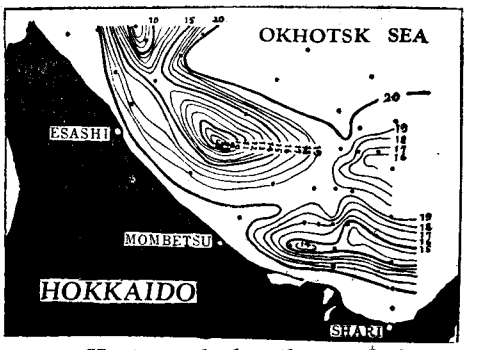

Fig. 4. Horizontal distribution of temperature at five metre layer in summer, 1950 (Data provided by Hokkaido Regional Fisheries Research Laboratory)

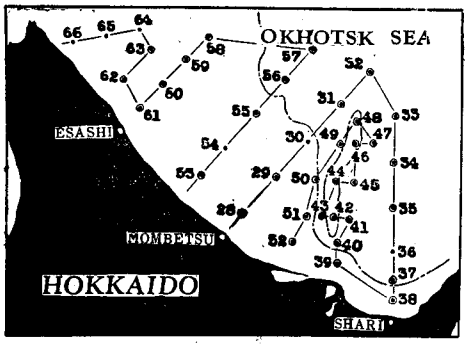

Fig. 2. Positions of collection in summer, 1950

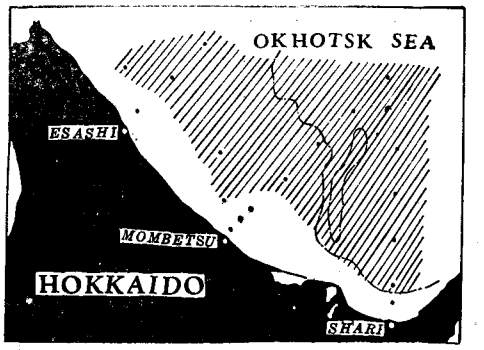

Fig. 5. Distribution of *Calanus plumchrus* in summer, 1949

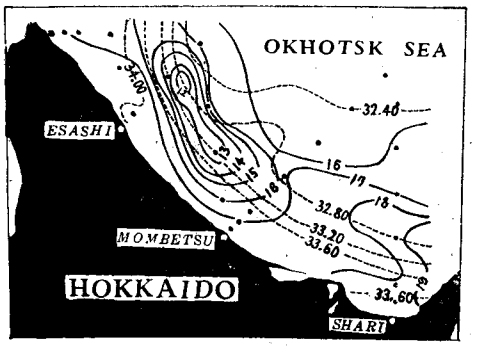

Fig. 3. Horizontal distribution of temperature and salinity at the surface in summer, 1949 (Data provided by Hokkaido Regional Fisheries Research Laboratory)

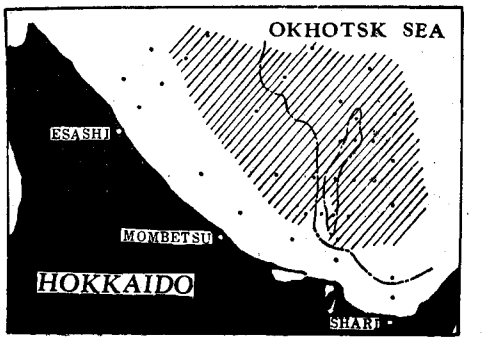

Fig. 6. Distribution of *Calanus plumchrus* in summer, 1950

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

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

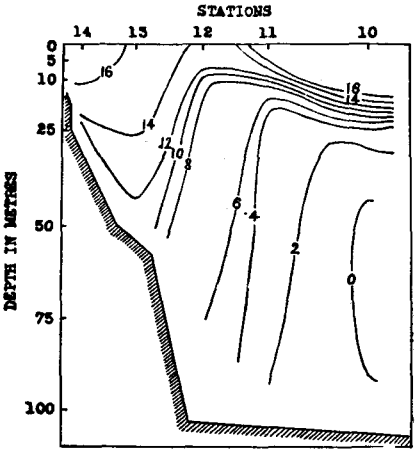

Fig. 7. Isotherms in vertical section of St. 10–14 in summer, 1949 (Data provided by Hokkaido Regional Fisheries Research Laboratory)

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	*Calanus plumchrus* (immature)	rr
	Calanus cristatus	rr
	Eucalanus bungii bungii	rr
	Paracalanus parvus	r
	Clausocalanus pergens	rr
	Pseudocalanus minutus	r
	Scolecithricella minor	+
	Oithona similis	rr
	Microsetella norvegica	c
400–200m	*Calanus plumchrus* (immature)	rr
	〃 (adult, ♀, ♂)	rr
	Eucalanus bungii bungii	rr
	Scolecithricella minor	rr
	Gaetanus armiger	rr
	Metridia lucens	cc
	Heterorhabdus papilliger	rr
	Microsetella norvegica	rr
700–400m	*Calanus plumchrus* (adult, ♀, ♂)	rr
	Eucalanus bungii bungii	rr
	Euchaeta japonica	rr
	Gaetanus armiger	rr
	Metridia lucens	+
	Pleuromamma abdominalis	rr
	Candacia pacifica	rr
	Oncaea conifera	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/VIII	〃	〃	〃	〃	25/VIII	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	26/VIII	〃	〃	〃	〃	〃	〃	29/VIII	〃	〃	〃	〃	〃	〃	〃	30/VIII	
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
Calanus helgolandicus	r							r	rr	+	rr											rr	+	r							rr	rr	
Calanus plumchrus		c	rr	+	r	r	+				rr	+	rr		r	+	r	+	rr	r	rr	rr			r	r	rr	r	rr				
Calanus cristatus		+		rr	rr	rr										rr											rr						
Calanus tenuicornis	rr							r		r														r									
Eucalanus bungii bungii		rr		rr	r	r	r				rr	rr				rr		r	rr		rr					rr	rr		rr				
Paracalanus parvus	+	rr	rr	rr	rr	r	rr	+	r	+	+	r	+	rr	rr	rr	rr	rr	+	r	rr	rr	r	+	rr	rr	rr	cc	cc	r	+	r	r
Clausocalanus pergens	+	rr		rr				+	rr	+	+												+	+				+	+	r	r	r	+
Pseudocalanus minutus			rr	r	r	r	rr					rr	+		+	c	rr	+	c	cc	+	+			+	+	c						
Euchaeta japonica				+	r	r	r					rr				rr											rr						
Scolecithricella minor					r	rr	rr				rr																						
Gaetanus armiger				rr		rr	rr																				rr						
Centropages abdominalis																										r		r	r	rr	rr		
Metridia lucens		cc		cc	c	cc	cc			rr	rr	cc	+	rr	rr	cc	c	cc						rr			c				rr		
Heterorhabdus papilliger																											rr						
Candacia pacifica					r		r																										
Acartia longiremis																							rr										
Oithona similis	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
Microsetella norvegica						rr	rr	+	r				+								rr	rr	rr	r									rr
Oncaea media	r							r	rr														rr										
Corycaeus 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
Calanus helgolandicus	r	rr	rr			rr		rr	rr								rr	rr
Calanus plumchrus	rr		rr	r	c	rr				rr	rr	rr	r	rr	rr	rr	rr	
Calanus cristatus													rr	rr	rr			
Calanus tenuicornis	rr								rr									rr
Eucalanus bungii bungii										rr	rr	rr	r	rr	rr	rr		
Paracalanus parvus	cc	+	rr	+	r	+	r	+	+	+	c	rr	rr	r	r	r	cc	c
Clausocalanus pergens	r	c				+	+	r	rr	+					rr			
Pseudocalanus minutus	rr	+	rr	+	cc				rr	r				r	r			
Euchaeta japonica		rr								rr			r	rr				
Scolecithricella minor	r				+				rr	r	rr	rr	rr	r	+	rr	+	
Gaetanus armiger												rr	rr	rr				
Centropages bradyi																		rr
Centropages abdominalis				rr		rr												
Metridia lucens	rr			c	rr				rr	+		cc	cc	cc		cc	c	
Pleuromamma abdominalis												rr		rr				
Heterorhabdus papilliger														rr				
Candacia pacifica													rr					
Labidocera japonica						rr												
Acartia longiremis							rr											
Tortanus forcipatus																		rr
Tortanus discaudatus						rr	rr											
Oithona similis	r	rr	rr	rr	rr	r	rr	rr	+	+	c	r	rr		rr	r	rr	r
Microsetella norvegica															c			
Clytemnestra rostrata						rr												
Oncaea conifera										rr	rr	rr	rr	rr		rr	rr	
Corycaeus sp.						r	r											

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