HOMOGENEITY OF BODY LENGTH COMPOSITION OF ANTARCTIC KRILL WITHIN THE COMMERCIAL ZONE

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Abstract

The homogeneity of krill (*Euphausia superba*) length composition in commercial trawl catches (hauls) was investigated by comparing length compositions from different parts of the same haul. There was no significant difference (***P*>0.05**) in 53 out of 60 hauls. Therefore it is concluded that sampling from one part of the haul provides a reasonable estimate of length composition in the entire haul. In contrast to small variations in length composition within the same haul, variation between different hauls was most noticeable in areas where krill length frequency compositions were bimodal.

Résumé

L'homogénéité de la distribution des fréquences de longueurs du krill (*Euphausia superba*) dans les captures commerciales des chaluts (traits) a été examinée en comparant les compositions en longueurs provenant de différentes parties d'un même chalut. Aucune différence significative (***P*>0.05**) n'a été notée dans 53 des 60 chalutages. Cela a permis de conclure que l'échantillonnage provenant d'une partie du trait offre une estimation raisonnable de la composition en longueurs de tout le trait. Contrairement aux variations minimes dans la distribution en fréquences de longueurs dans un même trait, la variation entre plusieurs traits était la plus claire dans les régions où les distributions de fréquences de longueurs du krill sont bimodales.

Резюме

Степень однородности размерного состава коммерческих уловов (за одно траление) антарктического криля (*Euphausia superba*) была изучена путем сравнения размерного состава проб, взятых из различных частей одного улова. В 53 из 60 уловов различие было незначительным (***P*>0,05**). Следовательно, по пробе, взятой из одной части улова, можно получить приемлемую оценку размерного состава всего улова. По сравнению с незначительной изменчивостью размерного состава различных частей одного улова, различия между различными уловами были наиболее существенны в районах распространения криля, характеризующегося бимодальным размерным составом.

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Resumen

Se investigó la homogeneidad de la composición de tallas del krill de las capturas realizadas con arrastres comerciales (lances), comparándola en distintas partes del mismo lance. No se encontraron diferencias significativas (***P*>0.05**) en 53 de los 60 lances estudiados. Se llega a la conclusión pues, de que el muestreo de una parte del lance ofrece una estimación razonable de la composición por tallas de su totalidad. Por contraste a las pequeñas variaciones encontradas en la composición de tallas de un mismo lance, las variaciones entre distintos lances fue más patente en aquellas zonas donde la composición por tallas del krill era bimodal.

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1. INTRODUCTION

In order to accurately estimate length compositions in commercial trawl catches (hauls), it is necessary to take a random sample from the haul. By analyzing length compositions of samples from trawl catches during a survey for blue grenadier (*Macruronus novaezelandiae*), Uozumi and Kawahara (1988) have shown that finfish are not randomly mixed within each haul. They, therefore, recommended the collection of sub-samples from as many different parts of the haul as possible in order to obtain an unbiased estimate of the catch length composition.

In the case of Japanese krill trawlers, krill (*Euphausia superba*) is usually collected only from one part of the haul, on the assumption that the length composition is homogeneous throughout the haul. In order to investigate this assumption, krill length compositions of samples taken from different parts of the same haul were compared.

Variations in length compositions between different hauls are also examined in order to compare within-haul variations.

2. MATERIALS AND METHODS

A total of 60 commercial trawl catches, each containing 7 to 8 tonnes of krill on average, were examined on board FV *Zuiyo Maru No. 2* (3 023 tonnes, Hakodate Kokai Gyogyo Co.) off George V Land in the 1985/86 season. In 58 of these hauls, two krill length composition samples were taken from each haul, one sample being taken from location A and the other from location B in the vessel fish pond (Figure 1). In two hauls, three samples were collected from locations A, B and C, respectively (Figure 1). Each sample contained about 150 krill specimens. Krill body length was measured to the nearest mm from the tip of rostrum to the posterior end of the telson. All length measurements were carried out by one observer to avoid methodological differences in the measurement as described by Watkins *et al.* (1985).

Within-haul length compositions were compared by testing the null hypothesis (H_0) that there was no significant difference in krill length composition within the same haul. This hypothesis was tested using a Chi-square (χ^2) test for a multinomial distribution. The value of the statistic χ^2 was calculated using the following formula;

$$\chi^2 = \Sigma_i \Sigma_j (n_{ij} - n_{i.}n_{.j}/n_{..})^2/(n_{i.}n_{.j}/n_{..})$$

where n_{ij} = the number of krill in the i^{th} (i=1, 2, ..., m) sample in the j^{th} (j=1, 2, ..., k) length class,

$n_{i.}$ = the total number of krill in the i^{th} sample;

$n_{.j}$ = the total number of krill in the j^{th} class,

$n_{..}$ = the total number of krill.

If the calculated value of χ^2 exceeded the critical value of χ^2 with **(m-1) (k-1)** degrees of freedom, H_0 was rejected. This test is not really suitable for n_{ij} smaller than 5. Therefore length classes with $n_{ij}<5$ were lumped with adjacent classes to increases n_{ij} to 5 or larger.

3. RESULTS AND DISCUSSION

Results for each haul are presented in Table 1. The null hypothesis of homogeneity of krill length composition was rejected in only seven out of **60** hauls (***P*<0.05**). Of these seven hauls, one had a monomodal length composition, while the remaining six had bimodal length compositions. In the total 23 hauls had monomodal length composition, while 37 had bimodal length compositions. Therefore the rejected hauls were biased heavily towards those showing bimodality. Differences in length compositions for hauls in which H_0 was rejected are shown in Figure 2. Apart from haul number 31, the differences are not too obvious. Thus, it is concluded that krill length compositions are fairly homogeneous within the same haul and that a sample from one part of the haul may be considered as representative of the entire haul.

In contrast to the observed small variations in length compositions within the haul, variations between sequential hauls were most apparent in areas where length compositions were bimodal. As shown in Figure 3, in areas where the overall length composition was monomodal, between-haul length compositions were consistent throughout the area and exhibited similar mean lengths. Whereas in areas where the overall length composition was bimodal, the proportion of large and small size classes often varied between sequential hauls with the length modes being fairly stable (Figure 4). This may indicate that the proportion of various size classes differed from swarm to swarm. Therefore in areas where length compositions have more than two modes, it is recommended that samples should be taken as frequently as possible from different hauls in order to obtain a more representative sample of the whole population of krill in the area.

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REFERENCES

UOZUMI, Y and S. KAWAHARA. 1988. Are length composition samples being taken at random? Bulletin of West Japan Groundfish Section. *Fisheries Resource Investigations by Scientists of the Fisheries Agency, Japanese Government, 16*: 13-22. (In Japanese).

WATKINS, J.L., D.J. MORRIS and C. RICKETTS. 1985. Nocturnal changes in the mean length of a euphausiid population: vertical migration, net avoidance, or experimental error? *Mar. Biol., 86*: 123-127.

Table 1: Comparisons of within-haul krill length compositions.

Data Set Set	Type of Length Composition	Number of Samples	DF	χ^2	*P*
-1-	-2-	-3-	-4-	-5-	-6-
1	b	3	26	13.091	0.9831
2	m	3	12	26.091	0.0104*
3	m	2	12	16.767	0.1586
4	b	2	18	15.523	0.6258
5	b	2	16	21.605	0.1564
6	b	2	16	11.721	0.7630
7	b	2	14	7.747	0.9021
8	b	2	12	11.807	0.4613
9	b	2	14	9.738	0.7811
10	b	2	13	19.619	0.1051
11	m	2	12	11.273	0.5057
12	m	2	11	14.702	0.1976
13	b	2	14	24.603	0.0387*
14	m	2	11	11.809	0.3782
15	m	2	11	10.615	0.4761
16	m	2	9	10.069	0.3449
17	m	2	12	10.334	0.5867
18	m	2	13	6.582	0.9224
19	m	2	10	13.961	0.1748
20	b	2	11	13.399	0.2680
21	b	2	14	12.040	0.6031
22	b	2	12	11.484	0.4880
23	b	2	15	10.535	0.7848
24	b	2	14	6.216	0.9608
25	b	2	13	10.099	0.6858
26	b	2	15	13.732	0.5459
27	b	2	13	9.622	0.7245
28	m	2	11	11.409	0.4097
29	m	2	11	13.275	0.2757
30	m	2	12	11.741	0.4667
31	b	2	9	28.563	0.0008**
32	b	2	12	20.588	0.0567
33	m	2	11	6.650	0.8267
34	m	2	10	5.695	0.8402
35	b	2	12	16.321	0.1770
36	b	2	15	9.467	0.8519
37	b	2	10	7.054	0.7203
38	b	2	16	7.137	0.9705
39	b	2	14	10.283	0.7412
40	m	2	11	7.908	0.7215
41	b	2	17	11.517	0.8285
42	b	2	16	11.456	0.7805
43	b	2	17	11.226	0.8446
44	b	2	14	15.696	0.3323
45	b	2	18	15.060	0.6578
46	b	2	14	24.702	0.0376*
47	m	2	9	11.670	0.2326
48	b	2	20	23.546	0.2628
49	b	2	16	35.975	0.0029**

Table 1 (continued)

-1-	-2-	-3-	-4-	-5-	-6-
50	b	2	15	8.134	0.9183
51	b	2	14	53.427	0.0000**
52	b	2	18	8.444	0.9713
53	b	2	15	26.912	0.0295*
54	m	2	14	12.340	0.5790
55	b	2	15	9.995	0.8201
56	m	2	10	4.514	0.9212
57	m	2	10	5.837	0.8288
58	m	2	8	4.096	0.8484
59	m	2	9	3.813	0.9233
60	m	2	8	8.570	0.3799

b bimodal length composition
m monomodal length composition
DF degrees of freedom
* $P<0.05$
** $P<0.01$

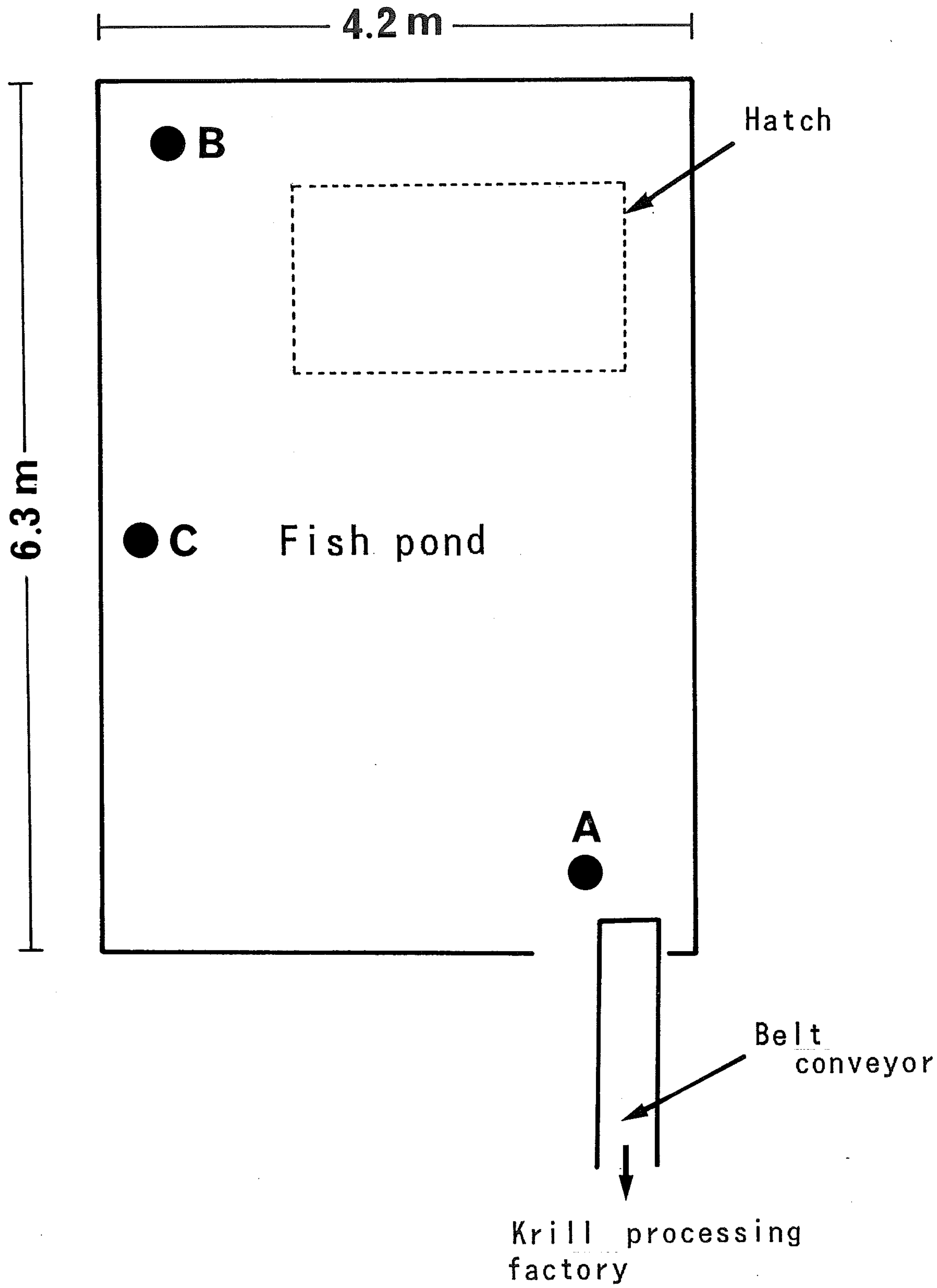


Figure 1: Sampling locations for krill length composition samples in the vessel fish pond. Locations are shown in closed circles.

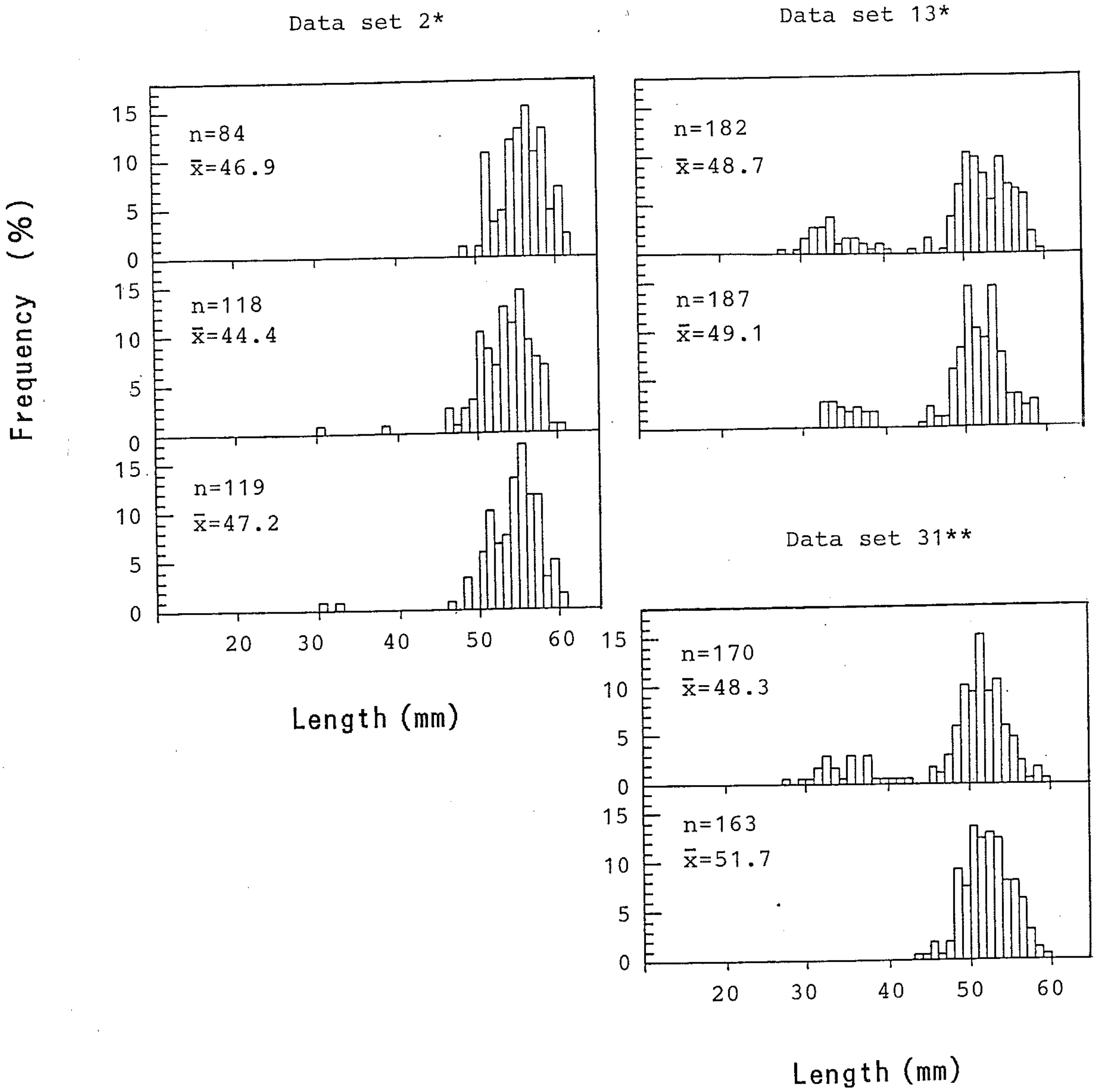
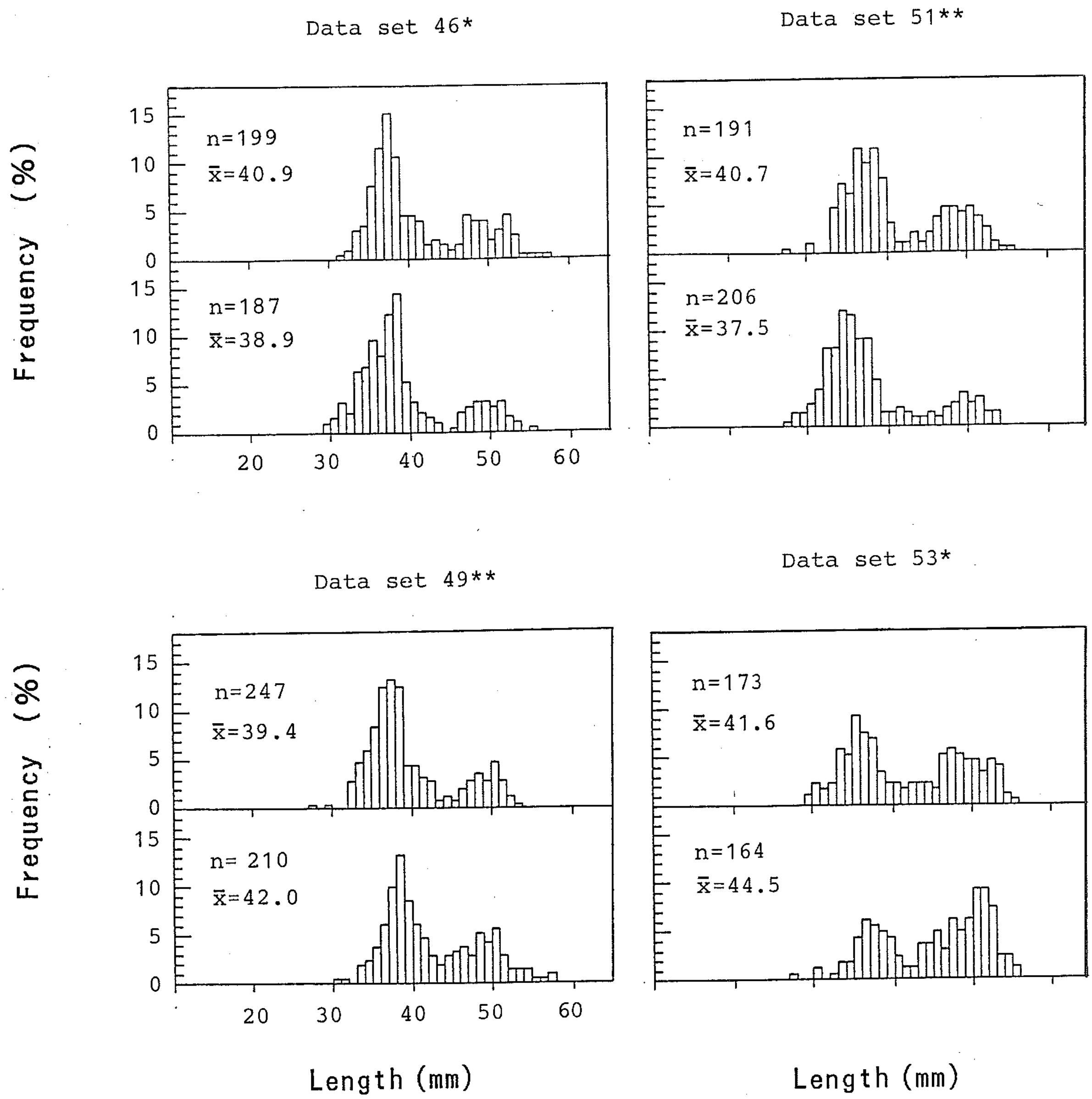


Figure 2: Comparisons of krill length compositions for which significant differences were observed.
* **$P<0.05$**
** **$P<0.01$**



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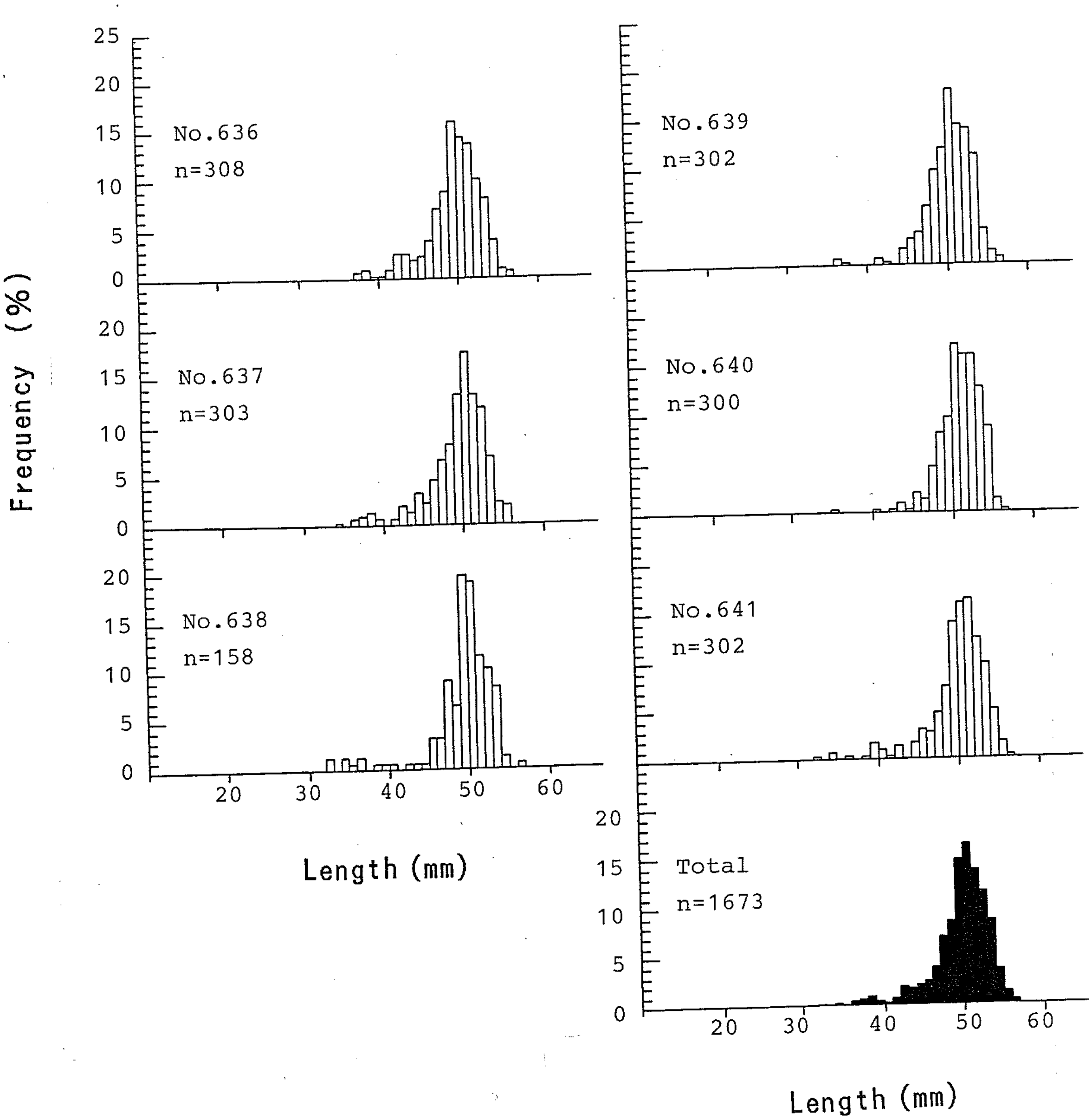

Figure 3: Variations in krill length compositions between sequential hauls in area X. The black-filled length composition picture is the accumulated composition for six sequential hauls (from haul 636 to 641).

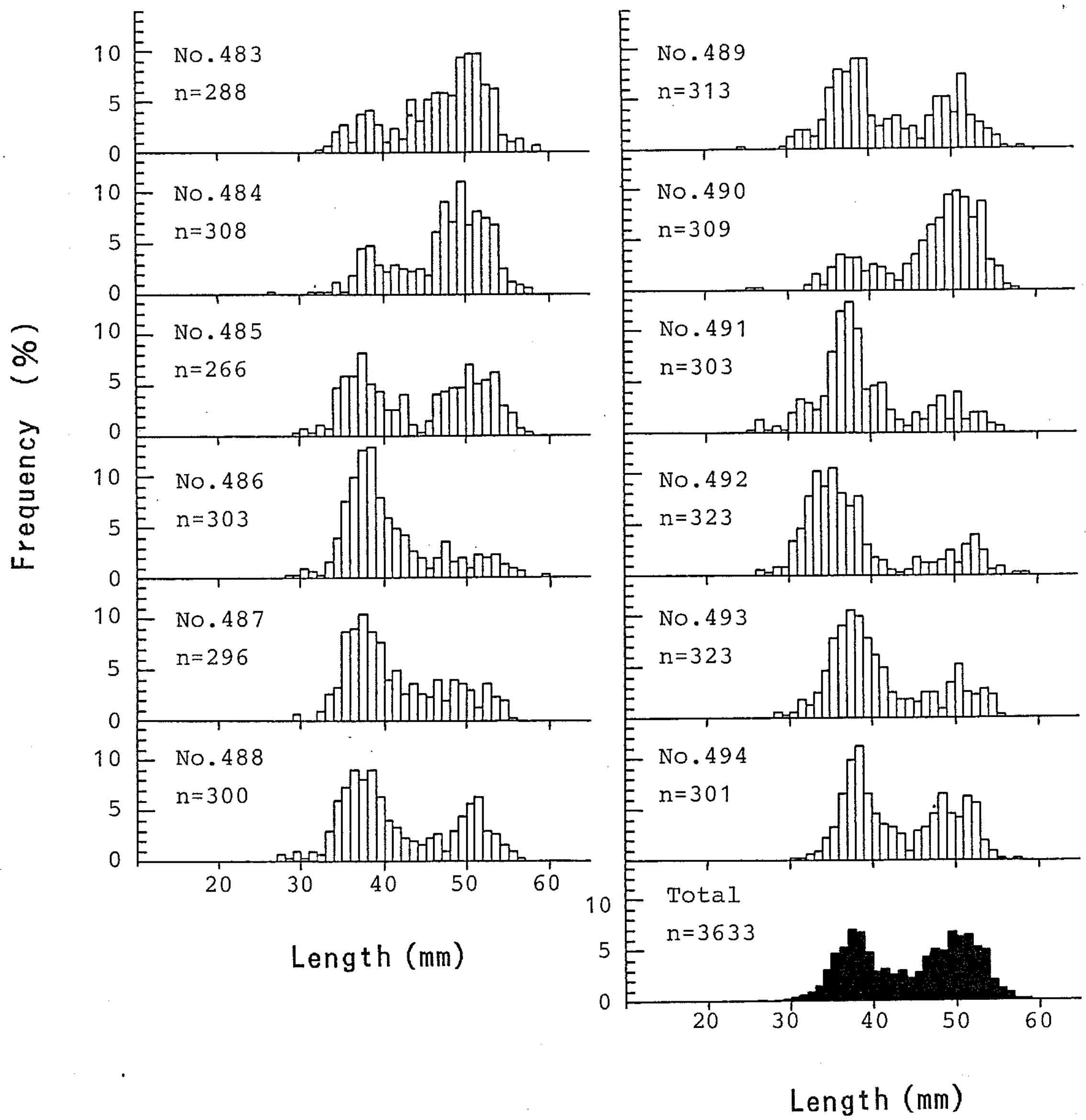

Figure 4: Variations in krill length compositions between sequential hauls in area Y. The black-filled length composition picture is the accumulated composition for 12 sequential hauls (from haul 483 to 494).

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