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Title	STUDY ON HERRING IN THE NORTH-WESTERN PACIFIC OCEAN : I . TWO PECULIAR SHOALS IN KORFO-KARAGINSK HERRING STOCK
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Citation	北海道大學水産學部研究彙報, 20(4), 287-292
Issue Date	1970-02
Doc URL	https://hdl.handle.net/2115/23403
Type	departmental bulletin paper
File Information	20(4)_P287-292.pdf



STUDY ON HERRING IN THE NORTH-WESTERN PACIFIC
OCEAN I. TWO PECULIAR SHOALS IN KORFO-
KARAGINSK HERRING STOCK

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Introduction

Korfo-Karaginsk herring has been exploited for a long time, as Korfo-Karaginsk area is favourably situated geographically and oceanographically, and there have been several reports¹⁾⁻⁵⁾ on the ecological character of Korfo-Karaginsk herring. Panin⁴⁾ reported that there was no significant difference in meristic characters between two spawning herring from Uala Bay and Korfa Gulf. Since then Korfo-Karaginsk herring has been assumed as one local stock. But Yunokawa⁶⁾ suggested that there might be two populations in Korfo-Karaginsk herring stock, because of the general presence of two modes in fork length distribution of every day catches.

Herring is characterized by its abundance, as is well known, at every local stock, which may well be a unit of observation and management. But the racial structure of Korfo-Karaginsk herring is not clear.

The author had the opportunity to go on board the herring mother ship "Banshu Maru No. 5" during the fishing season from April till August 1968, and was able to observe the meristic characters of herring of the two blocks in Olyutorskii Gulf (Fig. 1). As a result it was recognized that the herring of the Middle block was smaller in fork length and had a higher vertebral count than the herring of the Western block.

Material and Method

In Olyutorskii Gulf, the fishing operations for spawning herring were centered mainly in the two blocks in 1968 (Fig. 1). The fork length distribution of about 200 fishes of each catch from the two blocks was measured every day with the perforated card method. Resulting from this, the herring of the Western block was always larger than the one of the Middle block in fork length (Fig. 2). And then samples were collected from these two blocks to observe in detail, the W-sample was for the Western block and the M-sample for the Middle block. These herring were caught in an anchored gill net with 61 mm mesh size by the catcher

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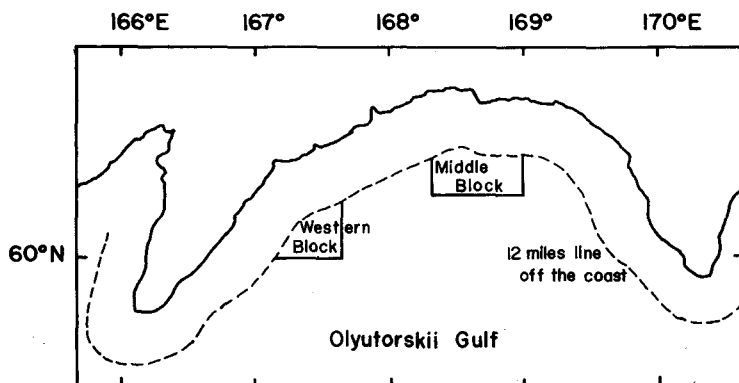


Fig. 1. Sampling blocks where the fishing operation for spawning herring was mainly centered in Olyuforskii Gulf in 1968

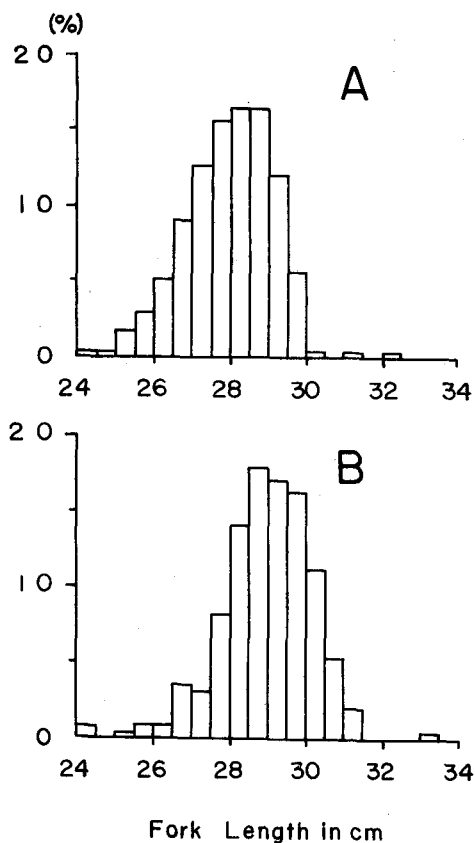


Fig. 2. Fork length distribution of herring catches measured by perforated cards in May 1968

A: Middle block on May 28. Average fork length: 28.0 cm.

B: Western block on May 29. Average fork length: 29.0 cm.

Table 1. List of samples collected in Olyutorskii Gulf on June 1, 1968.

Block	No. of measured fish		Age group	No. of measured fish	
	Keel scales	Vertebrae		Keel scales	Vertebrae
W	230	216	5	34	33
			6	47	47
M	177	191	5	96	106
			6	47	50

boats of the herring mother ship "Banshu Maru No. 5" of Taiyo Gyogyo Co. Ltd.. These fresh samples were measured individually in fork length, body weight and the number of vertebrae and keel scales between the abdominal fin and anus on the board (Table 1). The number of vertebrae included ulostyle. The age of herring was determined by scale reading. Five or six age fishes were picked up from each sample and the averages of the fork length and the number of keel scales and vertebrae in 5-age or 6-age group were compared statistically.

Result and Discussion

The W-sample was composed of 5-age and 6-age fishes and the percentage of a 5-age group was 40.2. The M-sample was composed of 4-age, 5-age and 6-age fishes and their percentage were 12.0, 62.7 and 25.3 respectively.

The average fork length of the W-sample in an age group was calculated from 76 specimens of a 5-age and 96 specimens of a 6-age. And that of the M-sample was calculated from 106 specimens of the 5-age and 42 specimens of the 6-age. The average fork length in the 5-age group of the M-sample was 26.8 cm, that of the W-sample was 27.8 cm, and that in the 6-age group of the M-sample was 27.8 cm, that of the W-sample was 29.1 cm. The average fork length of the W-sample was larger than that of the M-sample in the 5-age group ($t=7.281$, $P<0.01$) and also in the 6-age group ($t=8.768$, $P<0.01$).

Table 2. Frequencies of the number of keel scales

Sample	No. of keel scales							Total	Average
		9	10	11	12	13	14		
W	Mixed		3	61	123	42	1	230	11.900
	Age 5			12	15	7		34	11.853
	Age 6			9	25	13		47	12.085
M	Mixed	1	4	44	95	33		177	11.876
	Age 5		2	29	46	19		96	11.854
	Age 6		1	6	30	10		47	12.043

Table 3. Frequencies of the number of vertebrae

Sample	No. of vertebrae								Total	Average
		50	51	52	53	54	55	56		
W	Mixed	1	1	9	41	111	50	3	216	53.954
	Age 5			3	7	19	3	1	33	53.758
	Age 6			2	11	24	10		47	53.894
M	Mixed			3	21	113	51	3	191	54.157
	Age 5			1	13	62	29	1	106	54.151
	Age 6			2	5	27	14	2	50	54.180

The number of vertebrae and keel scales of fishes collected from West and Middle blocks on July 1 were measured (Tables 2 and 3). In the W-sample, 230 specimens were measured as to the number of keel scales, 81 of these were determined as to their age, 34 of which were 5-age and 47 were 6-age, and 216 specimens were measured as to the number of vertebrae, 33 of which were 5-age and 47 were 6-age. In the M-sample, 177 specimens were measured as to the number of keel scales, 96 of which were 5-age and 47 were 6-age, and 191 specimens were measured as to the number of vertebrae, 106 of which were 5-age and 50 were 6-age (Table 1).

In comparing the W-sample with the M-sample, it can not be said that there are significant differences between them as to the number of keel scales (5-age

Table 4. Test of comparison in the averages of the number of keel scales

Sample	W Age 5	W Age 6	M Age 5	M Age 6	Average
W Age 5		t=1.296 df: 78 P>0.05	t=0.007 df: 127 P>0.05	t=1.081 df: 78 P>0.05	11.853
W Age 6	F=1.819 df: 32,46 P<0.05		t=1.863 df: 141 P>0.05	t=0.303 df: 94 P>0.05	12.085
M Age 5	F=1.524 df: 32,96 P>0.05	F=1.194 df: 95,46 P>0.05		t=1.542 df: 141 P>0.05	11.854
M Age 6	F=1.979 df: 32,46 P<0.05	F=1.088 df: 46,46 P<0.05	F=1.298 df: 95,46 P<0.05		12.043
S ²	0.857	0.433	0.562	0.433	

(F-test)

(t-test)

group $t=0.007$, $P>0.05$, 6-age group $t=0.303$, $P>0.05$ and mixed age group $t=0.880$, $P>0.05$) (Table 4). But as to the number of vertebrae, the M-sample had a higher vertebral count than the other (5-age group $t=2.276$, $P<0.01$ and mixed age group $t=2.365$, $P<0.05$) (Table 5).

Table 5. Test of comparison in the averages of the number of vertebrae

Sample	W Age 5	W Age 6	M Age 5	M Age 6	Average
W Age 5		$t=0.730$ df : 78 $P>0.05$	$t=2.726$ df : 137 $P<0.01$	$t=2.234$ df : 81 $P<0.05$	53.758
W Age 6	$F=1.215$ df : 32,46 $P>0.05$		$t=2.066$ df : 151 $P<0.05$	$t=1.745$ df : 95 $P>0.05$	53.894
M Age 5	$F=1.660$ df : 32,105 $P>0.05$	$F=1.366$ df : 46,105 $P>0.05$		$t=0.230$ df : 154 $P>0.05$	54.151
M Age 6	$F=1.088$ df : 32,49 $P>0.05$	$F=1.116$ df : 47,49 $P>0.05$	$F=1.525$ df : 49,105 $P<0.05$		54.180
S ²	0.752	0.619	0.453	0.691	

(t-test)

(F-test)

From the above it can be assumed that the M-sample was the herring with smaller length and a higher vertebral count than the W-sample.

As the number of vertebrae of fishes is variable correlated with temperature⁷⁾, it could be assumed that the difference in the number of vertebrae is due to the different temperature of their spawning bed during development, and besides, these fishes are offsprings from females belonging to an identical stock. As the herring used in this study were sampled from the catches made with a gill net, they can not be represent the parent population because of the mesh selection. Moreover an ecological observation of these herring is lacking in this study. So what the racial structure of Korfo-Karaginsk herring one may not generalized only is based on the differences in the number of vertebrae and fork length for a given age group. However, we shall have to consider for further observation of Korfo-Karaginsk herring that there are two herring shoals with different characters in the Korfo-Karaginsk region.

The author wishes to express his appreciation to Professor M. Konda of Hokkaido Univ. for his continuing guidance, advice and support and to Comman-

der S. Iwasaki, Subcommander H. Ishida and the crew of the herring mother ship "Banshu Maru No. 5" of Taiyo Gyogyo Co. Ltd. for their help in making the collection of these samples possible.

Summary

The author observed a certain number of vertebrae and keel scales and the average fork length in 5-age and 6-age groups of Korfo-Karaginsk herring obtained from two blocks in Olyutorskii Gulf where the fishing operation for spawning herring was mainly centered in 1968. And the results are summarized as follows:

(1) Average of fork length in both 5-age and 6-age groups of herring of the Western block were larger than those of herring of the Middle block.

(2) The herring of the Middle block had a higher vertebral count than the herring of the Western block.

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