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By

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(Received May 28, 1956)

The spawning ground and the spawning season of the saury, *Cololabis saira*, in the Japan Sea were known in some degree by the investigation made by Hatanaka (1) on the seasonal distribution of the mature fish. And it was presumed that the saury spawns in the entire waters along the eastern side of the Japan Sea between the Hokkaido coast in summer and the Kyushu coast in winter, and in the intermediate region spawning occurs twice a year. Since the spawners in June were fulfilled with the most substantial gonads, the active spawning in the Japan Sea was suggested to occur in June along Honshu.

In this study, the spawning ground and season of the saury in the Japan Sea were confirmed basing on the seasonal distribution of the eggs and the larvae collected during the cruises systematically designed on the occasions of the investigation for the development of the waters concerning the Tsushima Current, a project of the Government. And also the place and the time for main spawning of the saury were studied by means of the vertebral counts on the larvae and the adult fish.

Before proceeding further we express our hearty thanks to Prof. K. Uchida, Kyushu University, and to the Regional Fisheries Research Laboratories of Hokkaido and Nihonkai, for the kind offerings of the larval specimens. The vertebral counts on the adult specimens were made by Mr.T. Ogata. This study was in part supported financially by a grant from the Agency of Fisheries, the Ministry of Agriculture and Forestry. We gratefully acknowledge for each and all.

Using the locally obtained results already published (2) (3) (4) (5) (9) (10), the number of eggs and larvae of the saury collected in the Japan Sea, were summarized in Table 1 in each 10 days throughout the year, separately for the Hokkaido, the Honshu and the Kyushu (including the Loochoo Islands) Region. It is obviously known from this table that the saury spawns in Kyushu in winter, in Honshu in spring, in Hokkaido in summer and again in Honshu in

Table 1. Collections of eggs and larvae of the saury in the Japan Sea in each 10 days throughout the year, separately for the Hokkaido, the Honshu and the Kyushu Region.

Date		The Hokkaido Region		The Honshu Region		The Kyushu Region	
		Eggs	Larvae	Eggs	Larvae	Eggs	Larvae
Mar.	1～10						1
	11～20				1		79
	21～31						
Apr.	1～10					1	17
	11～20						21
	21～30						65
May	1～10					4	12
	11～20			752	54	3	81
	21～31	7		150	3		2
June	1～10	758		43	16		
	11～20	thousands			62		
	21～30	thousands	39				
July	1～10	thousands	203		12		
	11～20	thousands	281	1	3		
	21～31	2	185				
Aug.	1～10	62	19		1		
	11～20	2273	105				
	21～31	854	145				
Sept.	1～10	56	9				
	11～20		1				
	21～30		1				
Oct.	1～10						
	11～20		1				
	21～31		2		1		
Nov.	1～10				2	54	6
	11～20		1	hundreds	1	1	
	21～30				6		
Dec.	1～10				2		1
	11～20				12	3	44
	21～31				7		
Jan.	1～10					1	4
	11～20			hundreds	5		221
	21～31						34
Feb.	1～10						21
	11～20						
	21～28						16

autumn, followed by Kyushu in winter, moving its spawning range in time and space overlapped with one another in each month of the year. The extremity of the spawning area in the north was near the Strait of Soya and in the south near Loochoo Island. The fact coincides with the result obtained by the investigation on the mature fish and may be explained as follows: The saury spawns in the Kyushu Region, being attained at first maturity at the end of the three years of age, migrates between the Kyushu Region in winter and the Hokkaido Region in summer through the Honshu Region in spring and autumn, successively taking place the spawning by the individual fish at a few month interval. And a few survive at the age of five keeping over the winter.

It is necessary to define the main place and time responsible for the recruitment of the saury in the Japan Sea out of the whole spawning range extended over a remarkably wide area and in all seasons. However, the present knowledge on the distribution of eggs and larvae is quite insufficient for the quantitative estimation of the spawning of the saury. The following fact furnishes a reason for the possibility of executing this investigation on this line. The length frequencies of the adult samples collected in June in the Japan Sea have usually a sharp unimode at the length of 29 cm (to the end of the urostyle) and in winter at Goto Island, Kyushu, there can be found the distinctly divided bimode. The existence of the two groups, each constituting with the fish in nearly equal size, indicates that they were born at nearly one year interval, hence it also suggests that most of the fish generate at a definite season in the year.

The vertebral number, which is determined in the early stage of development by the influences of environment, may be useful for knowing where the fish was born. In the case of the saury, the vertebral count is difficult before the fish attains 10 mm in length, since the ossification of the vertebrae is barely completed over this size. The upper limit permitted to make vertebral count is to be set under the size below 20 mm for ejecting the fish born far apart from the collecting locality. The larval vertebrae. stained after the method by Clothier, were shown in Fig. 1.

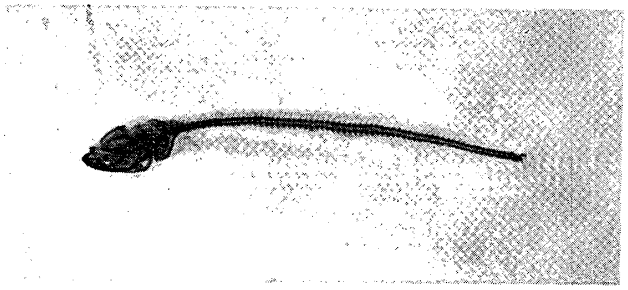

Fig. 1. The vertebrae of a larval specimen, 14.8 mm long, collected off Takashima point on July 28th, 1955, stained after the method by Clothier.

The vertebral counts were performed at first with this object on 180 individuals below 20 mm in length collected at Meshima, Kyushu, in the waters between Iki Island and the Noto Peninsula and off Takashima point, Hokkaido, which are considered as the representatives for the southern, the central and the northern locality of the spawning range respectively (Table 2). As seen

Table 2. Local variation in the vertebral number of the larval saury below 20mm in body length in the Japan Sea.

Date	Locality	Freq. of vert. numb.							No.	Mean vert. numb.
		62	63	64	65	66	67	68		
July & Aug., 1953	Off Takashima, Hokkaido			1	8	3			12	65.16
July, 1955	,,	2	2	18	38	22	7	1	90	65.12
Nov. & Dec., 1954	Off Iki Is. & the Noto Pen.			4	7	2			13	64.85
Apr., 1954	Meshima, Kyushu		5	31	24	5			65	64.45

from Table 2, there seems to exist an inclination in the mean vertebral number of the larvae, which show lower values in the fish born in the south and an increase from the southern to the northern locality, having a significant difference between both the extreme localities. The result accurately correspond with that found in the Pacific saury (1). The relationship between the vertebral number and certain environmental factors was discussed by many authors (e. g. 6) and the temperature in the early life is said at least to be one of the main factors. Hence, the water temperatures in which the saury passed its early life, were compared with the available data between the Regions of the Hokkaido (2) and Kyushu (10). As shown in Table 3, the greatest number of eggs and larvae were collected at the temperature range between 16.0 and 17.9°C in Hokkaido, obviously differing from that in Kyushu (over 20°C).

In the next place, the vertebral counts of the eleven samples, consisting of 869 adult fish in total number, collected at the various localities along the eastern side of the Japan Sea in 1952 were made and its frequency distributions were shown in Table 4. There occured most frequently the vertebral number in the mean for each sample between 64.8 and 65.0 and showed 64.90 in the mean for all over the samples.

It is, of course, possible to occur the intermingling among the fish born in various localities in the course of time for growing up to the adult fish, however each size range of the adult specimens caught in the fishing season is quite narrow, hence the mixing among the different origins is considered

Table 3. Temperatures of the occurrences of eggs and larvae of the saury in the Japan Sea, separately for the Hokkaido and the Kyushu Region.

Temp. °C	The Hokkaido Region				The Kyushu Region			
	Egg		Larva		Egg		Larva	
	Numb. of coll.	Numb. of eggs	Numb. of coll.	Numb. of larvae	Numb. of coll.	Numb. of eggs	Numb. of coll.	Numb. of larvae
10.0～11.9	15	766						
12.0～13.9	3	11						
14.0～15.9	11	1420	5	33			4	8
16.0～17.9	13	*2227*	8	*134*	3	3	26	51
18.0～19.9	1	40			4	9	31	84
20.0～21.9	4	155					26	*222*
22.0～23.9	12	269	3	14	7	*55*	15	45
24.0～25.9							2	2

Table 4. The vertebral number of the saury (the 4 years of age) in the Japan Sea in 1952.

Date	Locality	Freq. of vert. numb.						No.	Mean vert. numb.
		62	63	64	65	66	67		
Feb., 12th	Goto Is.		2	25	36	20	3	86	64.97
16th	,,		1	25	47	24	4	101	65.05
May, 23rd	Tottori			9	22	13		44	65.09
June, 3rd	,,		6	28	32	8	1	75	64.68
8th	Akita			13	34	12	1	60	65.02
28th	,,		6	27	41	17	1	92	64.78
30th	Fukuyama		2	19	51	22	1	95	65.02
31st	Sado Is.		6	18	43	10	2	79	64.80
July, 9th	The Bay of Ishikari	1	5	19	62	22	3	112	65.04
10th	,,		2	22	20	6	1	51	64.65
Dec. 8th	Goto Is.		3	18	39	13	1	74	64.88
Total		1	33	223	427	167	18	869	64.90

to be not so remarkable. And the distribution of the mean vertebral number of each of the adult sample is biassed to the higher values within the range in the larvae. This suggests that the larvae born in the extreme localities of the spawning area do not contribute much to the recruitment and possibly the fish born in the regions north to the central part of Honshu survives for the most part.

Although the most active spawners, which are at the size of 29 cm, are caught in June in the regions between the coasts of the central part of Honshu

and the southern part of Hokkaido, the existence of the same sized fish is known to occur along the Continent or the offshore in the Japan Sea (5) (7) (8) (11) (12). But there are some difficulties at present for a more detailed investigation in this field.

In short, the spawning season of the saury in the Japan Sea was confirmed to extend to almost all the seasons of the year and the spawning grounds to cover over a quite wide area, and the most important part amongst them was considered to be about in June in the regions between the coasts of the central part of Honshu and the southern part of Hokkaido, where the spawners in the four years of age play the most important role.

References

1) Hatanaka, M. (1955). Tohoku Jour. Agr. Res., **6** (3), 227–269.
2) Hokkaido Re. Fish. Res. Laboratory (1954). Progress Rep. on the Fish Resources in the Hokkaido Region, **11**, 17–38, 79–89.
3) ——— , (1955). Invest. on eggs and larvae (in 1954). print.
4) ——— , (1955). ibid. (in 1955). print.
5) Ito, S. (1952). Nihonkai Reg. Fish. Res. Lab., Special Pub., 1952, 51.
6) Johnsen, S. (1936). Bergens Mus. Aarb., **4**, 1.
7) Kasahara, H. and T. Otsuru (1952). Fisheries Science Series, **3**.
8) Kimura, K. (1951). M.S.
9) Kyoto Pref. Fish. Exp. Station (1955). Collections of the larval net. print.
10) Nagasaki Pref. Fish. Exp. Station (1955). The 11th Invest. on the offshore of the Tsushima Current. print.
11) Suehiro, K. (1942). Rep. Central Fisheries Exp. Station, **12**, 41–53.
12) Uchida, K. (1951). M.S.