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REPORT OF THE HERRING OTOLITH WORKSHOP HELD AT LYSEKIL 18-19 SEPTEMBER 1979

An otolith workshop was held at Lysekil (Sweden) in accordance with the following recommendation of the Herring Assessment Working Group for the area south of 62°N (ICES C.M. 1979/H:6 PELAGIC FISH COMMITTEE).

The Working Group recommends that otolith samples be collected from both spawning and juvenile herring and a workshop set up at an early date and convened by Dr. R. Rosenberg in Lysekil (Sweden) in order to determine the range of otolith types present in the indigenous stocks, to compare these with otoliths of the North Sea autumn spawners and to report to the 67th Statutory Meeting.

The following participated in the workshop

Dan Andreasson	Lysekil, Sweden	} JOINT CHAIRMEN
Gunnar Aneer	Stockholm, Sweden	
Ad Corten	IJmuiden, Netherlands	
Oddvar Dahl	Bergen, Norway	
Didrik Danielssen	Arendal, Norway	
Bjarke Gloerfeldt-Tarp	Charlottenlund, Denmark	
Olle Hagström	Lysekil, Sweden	
Britt-Maj Karlsson	Lysekil, Sweden	
Niels Lundgaard	Charlottenlund, Denmark	
Marianne Martinsson	Lysekil, Sweden	
Rutger Rosenberg	Lysekil, Sweden	
Jim Wood	Lowestoft, England	

A general discussion was held first of all on differences between the otoliths of spring and autumn spawning herring. Those considered were the appearance and size of the nucleus, the outline and shape of the whole otolith and the combined size of both the first growth and winter zones. It was decided, in view of the short length of time available, that the most profitable approach would be to attempt to separate samples of juvenile herring in Division IIIa into spring and autumn spawned fish on the basis of otolith differences in the size of the combined first growth and winter zones measured along the axis rostrum - post rostrum.

It was therefore necessary as a first step to examine the samples of otoliths which were available to the workshop from spawning herring of known origin. These consisted of spring spawners from:

The Kattegat: Randers Fjord (Denmark), Swedish coast and mid Kattegat.

The Skagerrak: Swedish coast and Norwegian fjords.

The Baltic: Central Swedish coast.

Autumn spawners from:

The Kattegat: Kobbergrund

The Baltic: South coast of Sweden

The North Sea: Orkney - Shetland, Longstone and Whitby

West of Scotland: Minch

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The participants, working in small groups, were able to reach general agreement that the autumn spawners tended to have larger first zones than spring spawners and there was also a satisfactory agreement between measurements made on the same otoliths by the different groups. The results of the measurements made on the various samples of spawners are summarized in Table 1. It is clear that there is an increase in size across the table, northern Baltic spring spawners having the smallest and Orkney-Shetland autumn spawners the highest values. Tests of significance were carried out on mean sample values and the results are presented in Table 2. In most cases a significant difference was obtained between means and in only one of the comparisons between spring and autumn spawning fish could such a difference not be demonstrated.

An examination was then made of the otoliths which were available from juvenile herring caught in both the Skagerrak and Kattegat. The results are shown in Tables 3a and 3b. While the Kattegat samples seem to consist very predominantly of spring spawners, with a possible admixture of Baltic autumn spawners, those from the Skagerrak appear to include an autumn spawning component, particularly amongst the 1 ring fish, having a large first zone more characteristic of the North Sea herring.

On the basis of the results presented in this report it is recommended that measurements of otoliths should be continued in conjunction with counts of VS and  $K_2$ , especially in the Skagerrak, as an additional aid in separation of herring stocks in that area. It is suggested that this type of examination could prove of value in many other areas.

Table 1 Percentage distribution of otolith first zone measurements in samples of spawning herring from various localities.

* epu's	Spring spawners				Autumn spawners				
	A Northern Baltic - Askö area	B Norwegian coast	C Danish coast - Randers fjord	D Swedish coast	E South- western Baltic	F Kattegat - Kobbergrund	G West of Scotland	H Central North Sea	I Orkney/ Shetland
30-34	2.0	1.7							
35-39	20.4	8.0							
40-44	<u>42.9</u>	4.5						1.0	
45-49	28.6	13.6	3.8				0.5	2.0	
50-54	4.1	14.2	5.0	2.4	4.1		3.7	4.1	
55-59	2.0	<u>24.4</u>	28.7	9.5	4.2	5.7	6.4	2.0	
60-64		19.9	<u>30.0</u>	30.9	16.7	20.7	18.7	8.2	2.4
65-69		7.4	28.7	<u>35.7</u>	<u>54.2</u>	<u>39.5</u>	<u>32.7</u>	14.3	16.7
70-74		6.3	3.8	16.7	12.5	23.5	24.6	<u>27.6</u>	28.5
75-79				4.8	8.3	5.7	9.1	26.5	<u>33.3</u>
80-84						4.7	3.2	11.8	16.7
85-89							1.1	2.0	2.4
90-94								1.0	
Mean	45.31	56.60	63.65	67.44	67.83	70.00	70.24	73.97	76.90
(No mea- sured)	(49)	(176)	(80)	(42)	(24)	(106)	(187)	(98)	(42)
Variance	22.87	81.04	31.84	30.64	34.40	25.49	47.66	85.78	33.28
Mean VS	55.29	57.12	55.75	56.54	55.56	56.10	56.18	56.39	56.45
Mean K <sub>2</sub>	13.40	-	13.67	13.88	-	14.27	14.15	14.26	14.11

\* 25 epu's = 1 mm

Table 2. Test of significance between means of otolith measurements given in Table 1. Values of "t" in Student's t-test are given along with the degree of significance. \*\*\* 0.001, \*\* 0.01, \* 0.05; N.S. indicates not significant.

	A	B	C	D	E	F	G	H	I
A		***	***	***	***	***	***	***	***
B	11.7		***	***	***	***	***	***	***
C	19.7	7.6		***	**	***	***	***	***
D	20.2	9.9	3.6		N.S.	*	*	***	***
E	16.3	8.2	3.1	0.3		N.S.	N.S.	***	***
F	29.4	16.0	7.9	2.6	1.7		N.S.	***	***
G	29.3	16.1	8.2	2.8	1.8	0.3		***	***
H	24.7	15.0	9.1	5.1	4.0	3.8	3.5		**
I	28.2	18.1	12.1	7.7	6.1	6.8	6.5	2.7	

Table 3(a) Juvenile herring from the Skagerrak

	1 ring N of Hirtshals 31-8-78	1 ring N of Hirtshals 11-2-76	1 ring N of Hirtshals 12-8-78	2 ring	1 ring N of Hanst- holm 16-7-79	2 ring	1 ring off Fredrikstad 1-8-77	1 ring 15 miles N of Skagen 19-6-78	2 ring	1 ring North of Hansthalm 7-2-78	2 ring
30-34											
35-39											
40-44							2				
45-49							2				1
50-54	1	3				5	1				2
55-59	5	11		10	1	13	5		5		4
60-64	31	20		29	4	15	14		10		3
65-69	25	10		8	20	2	40	1	4		3
70-74	17	2	1	2	19		22			1	4
75-79	11		2	1	10		5	7		2	3
80-84	3		5		4			8		8	
85-89	1		2					2		15	
90-94	1									6	
95-99								1			
Mean	70.21	63.89	81.11	65.00	72.73	61.18	68.33	82.63	62.81	86.48	63.88
Variance	47.32	22.10	26.54	15.00	27.11	16.26	49.80	40.44	9.28	25.58	76.54
No. of fish	95	46	10	50	58	35	91	19	19	32	20
Mean VS	56.28	56.34	56.00	56.06	56.57	56.20	-	55.78	55.95	-	-
Mean K <sub>2</sub>	14.01	-	-	-	-	-	-	14.00	13.68	-	-

continued

Table 3(a) continued

	1 ring NW of Hirtshals 12-8-78	1 ring H of Hirtshals 11-2-76	2 ring
30-34			
35-39			
40-44			1
45-49	1		1
50-54	1		1
55-59	4	1	4
60-64	14	4	16
65-69	7	8	7
70-74	2	5	12
75-79	1	5	6
80-84	4	5	
85-89	2	4	
90-94			
95-99			
Mean	67.43	73.62	66.51
Variance	80.53	61.89	63.41
No. of fish	36	32	48
Mean Vs		56.18	56.34
Mean $K_2$		14.03	14.09

Table 3(b) Juvenile herring from the Kattegat.

	1 ring	2 ring	1 ring	1 ring	2 ring	1 ring	1 ring	2 ring
	Schults ground 3-4-79		North Kattegat 16-11-78	NE of Anholt 9-5-79		Southern Kattegat 10-10-78	10 miles west of Falkenberg 28-11-78	
30-34								
35-39								
40-44								
45-49				3				3
50-54	1	12	1	4	5	16	1	9
55-59	10	45	16	2	15	55	55	36
60-64	20	23	14	8	20	47	78	58
65-69	21	3	4	2	3	16	53	24
70-74	11	3	1	1		4	30	2
75-79	3	1					22	
80-84							7	
85-89							8	
90-94								
95-99								
Mean	67.19	61.38	62.64	59.75	61.59	62.26	67.98	63.36
Variance	29.59	20.51	17.34	51.19	15.17	19.16	46.91	23.83
No. of fish	66	87	36	20	43	128	254	132
Mean VS	55.92	55.88	56.22	55.60	55.72	55.97	56.18	55.88
Mean $K_2$	13.83	13.81	-	-	-	13.92	13.94	13.97