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THE NORWEGIAN RESEARCH PROGRAM ON THE
BARENTS SEA CAPELIN STOCK

by

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ABSTRACT

The aim of the Norwegian research program on the Barents Sea capelin stock is to provide information needed for management of the fishery. The cruise program for 1977 and the objectives of each cruise is discussed. The sampling program and processing of information is also described.

INTRODUCTION

Since 1964 the Norwegian capelin fishery in the Barents Sea has gradually increased in importance. In 1964 the Norwegian catch

was 19.626 metric tonnes, and in 1976 it was 1.929.567 metric tonnes. The Barents Sea capelin fishery is now by far the largest industrial fishery in Norway.

Parallel to the increase in importance of the Barents Sea capelin stock, the research effort on that stock has also increased. The Institute of Marine Research started its program of capelin investigations with a cruise in September 1960. In 1961 there was one cruise in February/March and one in August (MØLLER and OLSEN, 1962). In 1977 there is planned a number of Norwegian research cruises throughout the year to investigate the capelin stock in the Barents Sea.

The short range aim of the research is to obtain knowledge on the present state of the stock in order to advice the fishing industry and governmental planning agencies on the prospects for the next season and on possible management actions which may be necessary.

The long range aim of the research is to obtain a better understanding of the biological aspects governing the dynamics of the population: its growth pattern; changes in the growth pattern of individual fish and of the population as such when the physical or biological environment changes; factors that influence the place and time for spawning; factors that influence the survival of the larvae; and the reaction of the population to fishing pressure.

THE CRUISE PROGRAM

Since the Institute of Marine Research started its research program on the Barents Sea capelin, a pattern of yearly research cruises has developed to obtain the information that is necessary for management of the fishery. Vessels, time and area for the

cruises are chosen depending on what information is needed, when it is needed, and when and where the information is most readily available. As an example, the cruise program for 1977 is given in Table 1.

The two winter cruises in January, February and March (cruises no. 1a and 1b) have as their most immediate task to locate commercial concentrations of maturing capelin and follow the migration run towards the coast, collect samples of the capelin and record the hydrographic conditions in the area. In March some time is also set aside for an acoustic survey of immature capelin. An important aspect of these cruises is to describe the spawning run in terms of routes taken, hydrographic conditions and length and age composition of the spawning stock.

The next research cruise, no. 2, is concerned with investigations in coastal waters to locate the spawning sites and determine the time of spawning. The spawning areas are located mainly by collecting bottom samples with a Petersen grab, but also the school pattern seen on the echo sounder is used, and information obtained from the fishermen. Information from this cruise is used to decide whether any areas should be closed to fishing and, eventually, how the closed areas should be delineated.

The "summer cruise" (no. 3a) has as its immediate purpose to provide fresh information on the size of the capelin stock, its age composition, the average length of each yearclass, and the geographical distribution of the capelin before the summer fishery. In addition, the distribution of capelin 0-group is recorded from plankton samples. With the information from this cruise, it is decided whether regulation of the summer fishery is necessary and, eventually, which regulations should be introduced. This year conditions for employing the echo integration technique were very poor in June, mostly due to ice conditions, and the cruise had to be partly repeated in July (cruise no. 3b).

Cruises 4a and 4b in August-September are part of the International O-group fish survey in the Barents Sea. These cruises combine acoustics and trawling to obtain distribution maps and abundance indices of the O-groups of the most important species of fish in the area.

The capelin cruises in September - October, no. 5a and 5b, provide information on the state of the capelin stock before the winter fishery that starts in January. Management decisions concerning this fishery are based to a large extent on information from those cruises.

The "summer cruise" (no. 3a) in June and the "autumn cruises" (no. 5a and 5b) are the cruises where the capelin stock is assessed, using a combined trawl survey/echo integration technique (NAKKEN and DOMMASNES, 1975 and 1977).

SAMPLING, RECORDING OF DATA

Sampling of commercial catches at the fish meal plants is carried out as for herring and mackerel and is described by HAMRE, ULLTANG and ØSTVEDT (1974).

Fishing from the research vessels is done by means of pelagic trawl, bottom trawl or purse seine. A random sample of approximately 100 fish is taken from the catch. Non-random samples, and smaller or larger samples, are taken for special purposes.

The information is recorded on the standard form in Fig. 1. This form is also used for herring, sprat, and mackerel, and therefore has some columns that are not used for capelin.

In addition to sample number, date, geographical position, gear, etc., the following parameters may be recorded for each fish:

Length in mm, measured from the tip of the lower jaw (mouth closed) to the end of the ventral lobe of the caudal fin with the fin in natural position

Volume in milliliters

Sex

Maturity according to the revised Johansen scale drawn up for Atlanto-scandian herring (ANON. 1962).

Stomach fullness

Degree of digestion

Age, from otoliths

Radius of year-rings and total radius of otoliths.

On board the research vessels "G.O. Sars" and "Johan Hjort" capelin otoliths are usually measured on board, but when the samples are taken on other vessels measuring has to be done ashore.

Not all of the above parameters are recorded always. Often, particularly when the number of samples is large, only the length frequencies are recorded. In that case the form in Fig. 2 is used. If information on sex is wanted, a separate length frequency is recorded for each sex.

On most cruises with the "G.O. Sars" and "Johan Hjort" it is also standard procedure to record integrated echo intensity of the different species of fish encountered, as described by NAKKEN and DOMMASNES (1975).

PROCESSING OF SAMPLE DATA

During the stock assessment cruises punching of all material is done on board the "G.O. Sars". In the case of the "autumn cruise" (5a and 5b) the sample forms are transferred from the "Johan Hjort" to "G.O. Sars" for this purpose.

After the samples have been punched and recorded on tape they are run through a test program that is designed to detect errors in the recording and punching of data.

Programs to utilize the sample data have now been developed. The main purpose of the programs is to present the data in easily surveyable tables.

The following standard printouts are available:

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Age versus length
Weight versus length
Weight versus age
Maturity stage versus length
Maturity stage versus age
Sex versus length
Sex versus age
Stomach fullness versus length
Stomach fullness versus age
Back-calculated average length for each yearclass
Back-calculated average growth each year for each
yearclass

The tables can be presented for any chosen area and time period, or for any selection of samples. For routine printouts standard time periods and areas will be chosen. Application of the data in the tables to special problems can then be done either with a small desk-top calculator or with special computer programs.

In addition there is available from the stock assessment cruises biomass and number of each yearclass in the total stock and biomass of the spawning stock (NAKKEN and DOMMASNES, 1975 and 1977).

Most of these printouts can also be obtained from the computers on board the "G.O. Sars". As an example is shown in Fig. 3 a printout that gives total numbers,

mean lengths and biomass for each yearclass and for the spawning stock.

The calculation of age composition in the catches, based on a combination of age-length material from the research vessels and length frequencies from the commercial catches (HAMRE, ULLTANG and ØSTVEDT, 1974) will also be computerized.

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Table 1. Norwegian research cruises to investigate the Barents Sea capelin stock in 1977.

Cruise no	Time period	Vessel	Purpose
1a	6 Jan.- -12 Mar.	"G.O. Sars"	Distribution, migration routes, age and size composition of capelin before and during the winter fishery. Combined with investigations on cod.
1b	6 Jan.- -20 Feb.	Chartered vessel	Distribution, migration routes, age and size composition of capelin before and during the winter fishery.
2	13-30 March	Chartered vessel	Localization of capelin spawning areas along the Norwegian coast. Time of spawning.
3a	30 May - -2 July	"G.O. Sars"	Distribution, quantity, age and size composition of capelin before the summer fishery. Distribution of 0-group capelin.
3b	10-27 July	"G.O. Sars"	Distribution, quantity, age and size composition of capelin before the summer fishery.
4a	17 Aug.- -14 Sept.	"G.O. Sars"	International 0-group survey in the Barents Sea. Distribution and quantity of 0-group fish, including capelin.
4b	17 Aug.- -14 Sept.	"Johan Hjort"	As above.
5a	16 Sept.- -7 Oct.	"G.O. Sars"	Distribution, quantity, age and size composition of capelin before the winter fishery.
5b	16 Sept.- -7 Oct.	"Johan Hjort"	As above.

KORT	ART	PRÖVE NR.			DAG	REDSKAP	DYP	N.S.O.V.	BREDD (OMR. LOK.)	LENGDE	KONS.	FANGST VEKT	OT/SKJ
		NR.	ÅR	MND									
1	2 3 4	5 6 7 8	9 10 11 12	13 14	15 16	17 18 19	20	21 22 23 24	25 26 27 28	29	30 31 32 33	34	
A													

ART
ST. NR.
KONS.
LEST

SKIP
REDSKAP
PRÖVETAKER
MÅLT

TILF. PRÖVE / UTPLUKK

KORT	FISKE NR.	VOL/VE	VEKT	LENGDE	FETT	KJÖNN	STADIUM	MAGEF.	FORDGR	VIRVLER	ALDER	LESB.H.	TYPE	RAND	KJERNE	KALIBR.	VEKSTSONER MÅLT								
																	1	2	3	4	5	6	TOT.		
1	13 14 15	16	17 18 19	20	21 22 23	24	25	26	27	28	29 30	31 32	33	34	35	36	37 38	39 40	41 42	43 44	45 46	47 48	49 50	51 52	
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INDIVIDSKJEMA FOR PELAGISK FISK - KORTTYPE A & B

Fig. 1. Form used at the Institute of Marine Research, Bergen, for recording data from individual pelagic fish.

LENGDE	1	2	3	4	5+	G	TOT	VOLUM
50- 55	858						858	86.
55- 60	1576						1576	158.
60- 65	2913						2913	291.
65- 70	3898						3898	390.
70- 75	3439						3439	516.
75- 80	3092						3092	464.
80- 85	273	157					430	85.
85- 90	237	206					438	88.
90- 95	103	375					478	120.
95-100		884					884	256.
100-105		2753					2753	945.
105-110		4366					4366	1701.
110-115		4042	102	16			4144	1817.
115-120		3395	180	38			3595	1823.
120-125		2671	653	107			3366	1992.
125-130		2003	1676	199			3787	2661.
130-135		1348	2069	498	31	32	3654	2974.
135-140		891	2196	580	62	21	3648	3410.
140-145		373	2114	622	160	93	3229	3343.
145-150		120	1426	572	197	82	2368	2735.
150-155		96	1417	439	153	72	2241	2969.
155-160		19	862	379	207	91	1527	2196.
160-165			512	287	151	32	1042	1670.
165-170			137	132	183	69	605	1085.
170-175			58	52	49	18	238	487.
175-180			11	7	37	11	99	206.
180-185					3		10	24.
185-190					4		4	10.
ANTALL:	16389.	23699.	13413.	3928.	1237.	521.	58682.	
GJ.LGD	6.85	11.52	14.05	14.99	15.52	15.28	11.11	
VOLUM:	2032.	12111.	13667.	4965.	1733.	705.	34501.	

Fig. 3. Printout from a computer program on board the "G.O.Sars" that gives total numbers in 5 mm groups, lengths and biomass for each yearclass, and the maturing stock (G) based on integrated echo intensities and trawl samples. Numbers are given multiplied by 10^{-7} , volumes as hectoliters $\times 10^{-3}$.