International Council for the
Exploration of the Sea

C.M.1971/H:3
Pelagic Fish (Northern) Committee

ICES WORKING GROUP ON THE BLØDEN TAGGING EXPERIMENT
Report on the Meeting at Charlottenlund
29 March to 2 April 1971

1. Introduction

The purpose of this meeting of the Working Group was to review the 1969-70 Bløden Tagging Experiment, to appraise the material so far available and to consider the most useful methods of analysing the data.

The participants at this meeting were:-

Mr. J. J. Zijlstra (Netherlands), Convenor
Mr. H. Ackefors (Sweden)
Mr. A. C. Burd (United Kingdom)
Mr. O. J. Østvedt (Norway)
Mr. J. A. Pope (Scotland)
Mr. K. Popp Madsen (Denmark)
Mr. G. Wagner (Germany)
Mr. G. Sangolt, Supervisor of Experiment,
Mr. J. Møller Christensen, ICES, Secretary of the Working Group.

M. A. Maucorps and Professor J. Popiel were unable to attend the meeting.

The purpose in carrying out the Bløden Tagging Experiment was to provide estimates of the proportion of the juvenile herring stock in the eastern North Sea and Skagerrak taken by the fisheries operating in these areas. Samples of herring were to be collected in the hope of providing, by means of 'racial' analysis, additional information on the mechanism of recruitment of the juvenile herring to the adult stocks.

2. Description of the Experiment

2.1 Following the plans laid down by the Working Group during its meeting in January 1969, the tagging experiment started on 15 July 1969 and finished on 15 March 1970, a duration of eight months. For the experiment, the Norwegian purse-seiner "Gerda Marie" was hired. Mr. G. Sangolt, a member of the Institute of Marine Research in Bergen (Norway), with special experience in herring tagging, acted as Supervisor on board the vessel. The tagging teams, which were kept unchanged during the experiment, were recruited from the crew of the "Gerda Marie". Research vessels from Denmark, France, Germany, Norway, Poland and the Netherlands supported at various times the purse-seiner in locating herring. In addition, assistance in this respect was obtained from vessels taking part in the International Young Herring Surveys in the North Sea in February 1970.

2.2　A total of 57 496 herring were tagged with internal tags in 29 experiments, mostly in batches of 2 000 herring (Table 1). The tagging positions are shown on Chart I. The number of tagged fish released in Skagerrak and in the north-eastern North Sea was lower than planned, due to a scarcity of herring in these areas at the time of the experiment.

An analysis of the samples, taken from the catches used for tagging showed that of the 29 liberations, 13 comprised mainly herring of the 1967 year class, 11 of the 1968 year class, while 5 liberations consisted of mixtures of both year classes.

2.3　Up to 1 December 1970 a total of 5 635 tags were reported back to ICES' Secretariat: 3 830 by Denmark, 757 by Germany, 954 by Norway, 80 by Scotland and 14 by Sweden.

2.4　Mortality experiments to determine the survival rate of the tagged herring were conducted both on board "Gerda Marie", making use of the ship's large tanks, and also in keep-nets.

2.5　The efficiencies of the magnets installed in the fish-meal plants have been tested from the beginning of the experiment. These tests will be continued.

2.6　Although statistics of catch, effort and the quantities of herring reduced in the fish-meal plants have been collected in varying detail, the Working Group recognises that the analysis of the data will be limited by the quality of the material. The same holds for the information on the length and age composition of the catches.

2.7　Samples of herring were collected on board "Gerda Marie" and from the commercial catches in Esbjerg and were analysed during the winter of 1970/71. These will be used for a discriminant function analysis at a later date, when the characters of the tagged year classes for the Downs, Banks and Buchan stocks are available after their recruitment to the adult stocks.

3. Effective Numbers Tagged

3.1　The tagged herring will suffer an initial mortality from the effect of catching, handling and tagging. Thus the numbers liberated will not equal the effective numbers tagged. The number of fish effectively tagged in each experiment was estimated using the results of the mortality experiments, and the ratios between recaptures by the two tagging teams. A comparison was made between the returns of fish liberated at different hours after recapture.

3.2　Seven mortality experiments showed that on average 87% of the untagged fish and 79% of the tagged fish survived after 3-5 days. It was decided, as a first approach, to work with a survival rate of 0.80 for the tagged fish put out in the sea.

The ratio between the numbers of recaptured fish tagged by Team 1 and Team 2 was estimated to be 0.74 (99% confidence limits 0.60 to 0.88). Thus the number of fish effectively tagged in each experiment was calculated as follows:-

Let N_1　=　total number tagged by Team 1

Let N_2　=　total number tagged by Team 2.

Only a proportion of these tagged fish is effectively tagged. Let this proportion be p_1 for Team 1 and p_2 for Team 2.

From the tank experiments $p_1 = 0.80$, so effective number tagged is

$$0.8\ N_1 +\ p_2\ N_2$$

The recoveries from this total are r_1 and r_2 say, and from the records of returns it is estimated that

$$(r_1/N_1) = 0.74 (r_2/N_2)$$

Assuming that

$$r_1 \propto 0.8 \ N_1 \quad \text{and} \quad r_2 \propto p_2 \ N_2 \quad \text{i.e.}$$

$$(r_1/N_1) : (r_2/N_2) = 0.8 : p_2$$

then we may say that $p_2 = 0.74 \ (0.8) = 0.59$

Hence effective number tagged is

$$0.8 \ N_1 + 0.59 \ N_2$$

This is the same as $0.8 \ (N_1 + 0.74 \ N_2)$, so that effective number tagged is obtained by <u>first</u> correcting N_2 for Team effect and <u>second</u> correcting this figure for the Team 1 effect.

3.3   So far no effect can be detected in the recapture rates of fish liberated at varying times from initial capture. From the above, the 57 496 fish actually tagged are reduced to 39 987 fish effectively tagged. However, this is only a preliminary estimate.

4. The Analysis

Apart from the obvious difference in the quantity of fish tagged and the higher percentage of tags recovered the main contrast between this and the previous experiment of 1957/1958 is the long period over which tags have been returned from the fishery. This enables a more extensive analysis to be made than was possible with the short-term returns of the previous experiment. Firstly, the short-term tag returns may be considered with respect to their use in the study of dispersion of fish from the tagging position into the fishery. Secondly, the longer-term returns may be used to provide estimates of stock size, mortality and passage of different groups of fish through the fishery.

4.1   Dispersion model

The analysis of the 1957/1958 experiment depended largely upon the use of a simple model of the dispersal of tagged fish from the tagging position. In the new experiment it is proposed to examine various theoretical dispersion models to simulate the distribution of tagged fish in the area of fishing to facilitate an analysis of the short-term tagging returns, using the present data from the Danish fishery.

4.2   Regression Analysis

The seasonal pattern of the juvenile fishery varies both in area covered and in intensity of effort. This means that any tagged herring population will be exposed to varying fishing mortalities. A method of analysis of data of this type has already been developed by Beverton and Holt. A preliminary examination of the tag data suggests that these are suitable for this type of analysis.

4.3   Other Methods

The tagging returns per 1 000 tons processed per 10 000 tags
liberated were examined for a number of the experiments. Similar
values were observed for the period January - April 1970 for the
Danish, German and Norwegian fisheries. The data were further
examined for differences between the returns from experiments
in which different year classes were tagged. It appeared that
differences existed between these which suggested that by
refining the analysis, stock sizes of the 1968 and 1967 year
classes could be made separately.

The full analysis might not be simply limited to the above techniques.

5. Data Required for the Next Meeting

5.1   Before the next meeting Denmark, Germany, Norway, Scotland and
Sweden are asked to provide the following information:-

5.1.1   Processed quantity of herring for each factory
from June 1969 - June 1971 in tons and numbers
by year classes by months corrected for magnet
efficiency.

5.1.2   Monthly maps giving catch and effort data by
statistical areas from June 1969 - June 1971.

5.1.3   Length distribution by year class of samples from
commercial catches by year class, month and area
(North Sea Assessment Working Group areas) for
the period June 1969 - June 1971.

5.1.4   Recaptured tags up to 30 April 1971 to be reported
to ICES before 1 June 1971.

5.2   Countries which assisted "Gerda Marie" with research vessels
in scouting for herring are requested to report on their
echo-surveys, hydrographic data and catch compositions.

5.3   In addition, the Secretary is requested to provide:-

5.3.1   Summaries of tag returns by months, separately for
Esbjerg (Factories 11 and 12), Tyborøn, Skagen,
for all Norwegian factories summed and for the German
Factories 1, 2, 4, and 7 separately.

5.3.2   Length/age distribution of the "Gerda Marie" samples.

5.4   The Working Group requires for assessment a break-down of
all North Sea catches in weight and numbers for year classes
1967 and 1968, by months and areas.

6. Recommendation

The Working Group recommends that the next meeting of the Group be
held from 6 - 10 September 1971 at ICES Headquarters in Charlottenlund,
Denmark.

Table 1. Review of Tagging Experiments.

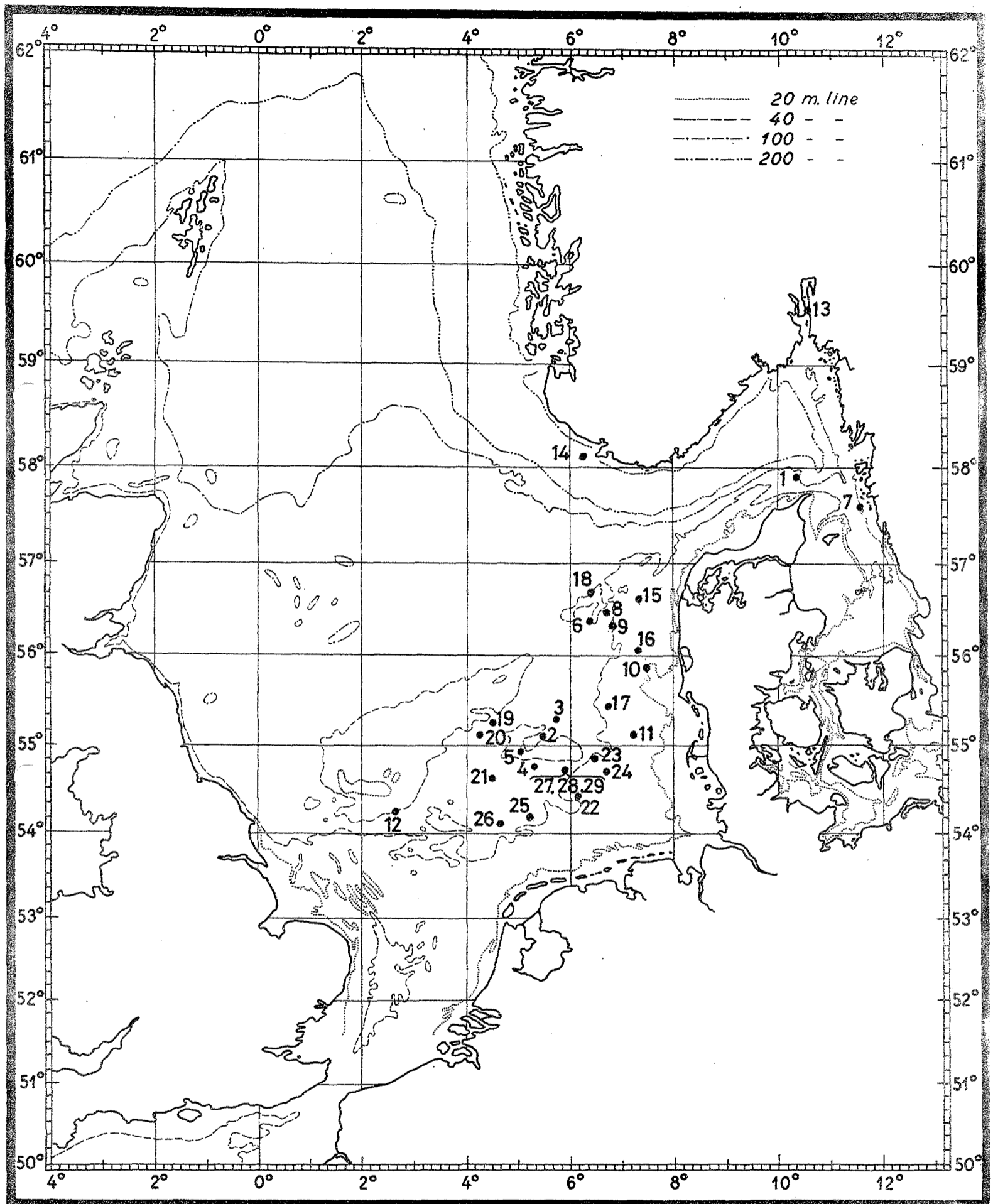| Experiment Nos.	Tagging Positions	Tag Nos.			Numbers Tagged
1	57°52'N–10°30'E	1	–	2 000	1 996
2	55°02'N–05°36'E	2 101	–	3 900	1 800
3	55°04'N–05°56'E	4 001	–	6 000	2 000
4	54°41'N–05°30'E	6 001	–	10 000	4 000
5	54°57'N–05°20'E	10 000	–	12 000	2 000
6	56°25'N–06°33'E	12 001	–	14 000	2 000
7	57°34'N–11°38'E	14 001	–	16 000	2 000
8	56°28'N–06°45'E	16 001	–	18 000	2 000
9	56°24'N–06°48'E	18 001	–	20 000	2 000
10	55°59'N–07°17'E	20 001	–	22 000	2 000
11	55°01'N–07°03'E	22 001	–	23 000)	
	. .	23 101	–	23 200)	1 100
12	54°13'N–03°40'E	23 001	–	23 100)	
	. .	23 201	–	23 900)	1 600
		24 001	–	24 800)	
13	59°35'N–10°39'E	25 001	–	26 000	1 000
14	58°05'N–06°31'E	26 001	–	27 000	1 000
15	56°30'N–07°02'E	27 001	–	29 000	2 000
16	56°05'N–07°15'E	29 001	–	31 000	2 000
17	55°28'N–06°53'E	31 001	–	33 000	2 000
18	56°40'N–06°32'E	33 001	–	36 000	3 000
19	55°06'N–04°34'E	36 001	–	38 000	2 000
20	55°05'N–04°23'E	38 001	–	40 000	2 000
21	54°32'N–04°27'E	40 001	–	42 000	2 000
22	54°29'N–06°12'E	42 001	–	44 000	2 000
23	54°43'N–06°31'E	44 001	–	44 300)	
		45 001	–	45 300)	600
24	54°45'N–06°34'E	44 301	–	45 000)	
		45 301	–	47 000)	2 400
25	54°12'N–05°06'E	47 001	–	49 000	2 000
26	54°01'N–04°54'E	49 001	–	52 000	3 000
27	54°41'N–05°56'E	52 001	–	54 000	2 000
28	54°41'N–05°56'E	54 001	–	56 000	2 000
29	54°41'N–05'56'E	56 001	–	58 000	2 000

57,496

Figure 1. Tagging positions.