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"NORWEGIAN INVESTIGATIONS ON BLUE WHITING
(MICROMESISTIUS POUTASSOU, RISSO 1810) IN
THE NORTH SEA 1970 - 1973"

By

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INTRODUCTION

Blue whiting is in the North Sea mostly found in the Norwegian Deep at 150 meters or deeper (SARHAGE 1964). It can here be found in quite large quantities (HAMRE and NAKKEN 1970, 1971) and constitutes a considerable part of the Norwegian trawlfishery for industrial purposes, registered as Norway pout in the fishery statistics (LAHN-JOHANNESSEN, OLSEN & STÅLESEN 1964, LAHN-JOHANNESSEN and RADHA-KRISHNAN 1970).

The industrial trawlers use most commonly bottom trawls, and in the North Sea the largest catches of blue whiting are taken on the Shelfedge off the North Sea plateau towards the Norwegian Deep. Over deeper water the fish is mostly found pelagic and unavaliabile for the trawls.

The Norwegian trawlfishery for industrial purposes has increased considerably since 1967, when the total landings were at a minimum of 13000 t. The total Norwegian landings were in 1972 175000 t. and in 1973 154000 t.

The Institute of Marine Research, Bergen has investigated the trawlfishery for industrial purposes since 1961 (LAHN-JOHANNESSEN, OLSEN og STÅLESEN 1964, LAHN-JOHANNESSEN and RADHA-KRISHNAN 1970). These investigations were owing to the increased effort in the fishery the last years extended in 1971 (LAHN-JOHANNESSEN 1973). In this contribution some preliminary results concerning blue whiting from these extended investigations will be presented.

MATERIAL AND METHODS

The material includes data and samples of blue whiting collected from the industrial fishery and data from research vessels surveys.

A. Collection of data from the industrial fishery.

The sampling method is described by LAHN-JOHANNESSEN (1973). The system is based on local controllers at the meal factories who in connection with their work on the industrial fishery also take samples for the Institute of Marine Research. A random sample of approximately 30 l is taken from the catch at the landing site. This is sorted on species and the amount of each specie weighed. From a number of samples each month the most imported species are length measured. The results with other data about the catch as fishing area, depth, number of days at sea etc. are filled on special forms and sent to the Institute.

Most of the landings sampled these years come from the northernmost part of North Sea plateau. Table 1 shows the number of samples taken each month.

B. Surveys

On several cruises to the North Sea since 1970 investigations on the resources of industrial fishes has been incorporated as part of the program.

The weight laid upon these investigations and the areas investigated have varied with the main program for the cruise, but the execution of this part has mainly followed the same pattern and the results

are to a certain degree comparable. During the surveys maps of relative echo-abundance coming from fish and other scatterers have been made using the echo-integrator technique (FORBES and NAKKEN 1972).

The first survey was with the "old" "G.O. Sars" the other with either the "new" "G.O. Sars" or "J. Hjort" or both. The settings of the echosounder and integrator used on "new" "G.O. Sars" have been the same as described by BLINDHEIM et al. (1971). The settings on "old" "G.O. Sars" is described by HAMRE and NAKKEN (1970) and the settings on "J. Hjort" is described by BAKKEN et al. (1973). Data obtained by "J. Hjort" have been multiplied by 2 in order to be comparable with data obtained by the "new" "G.O. Sars" (NAKKEN personal communication). No exact conversion factor exist which makes data obtained with "old" "G.O. Sars" comparable with data obtained with the "new" "G.O. Sars". But they should at least be multiplied with a factor greater than 1 (NAKKEN personal communication). Identification of the registrations have been done with small meshed industrial trawls, Granton trawl with a small meshed codend, and 3 types of pelagic trawls.

For biological analysis the first 100 specimens were taken from a basket chosen at random from the catch. The length was measured to the nearest half cm below.

RESULTS

A. Material from the commercial catches.

In Table 1 is shown the monthly catches of industrial fish registered as norway pout in the fishery statistics. The number of samples pr month, the average weight in percent of blue whiting in the samples, and the calculated amount of blue whiting caught. In Fig. 1 is shown the length distribution of blue whiting in the samples.

The most characteristic feature of the length distribution is the recruitment of small fish 10 - 17 cm in the autumn. This supposedly 0-group fish seems to dominate the blue whiting catches throughout the winter and spring. This group disappear almost in the

summer, when the catches of blue whiting are dominated of fish larger than 25 cm.

In Fig. 2 the average daily catches of blue whiting are shown. The figures are calculated on the basis of those samples where blue whiting constituted 20 % or more of the weight. The figure indicate that the catches of blue whiting are relatively small during the winter. They increase in the spring and reach a peak in June. A decrease during July and August, is followed by a new peak later in the autumn. The good catches in the autumn coincides with the recruitment of the new yearclass while the good catches in May - July are on adult blue whiting.

The surveys

Survey routes and trawl stations are shown in Fig. 3. Relative echoabundance coming from fish, recorded during the surveys is shown in Fig. 4. The length distribution of blue whiting in the trawl catches is shown in Fig. 1. In this last figure the fish is grouped by the following areas. Area I is north of 61°N , area II is between 61°N and 59°N , area III south of 59°N and west of 7°E and area IV south of 59°N and east of 7°E . These areas are the same as used by HAMRE and NAKKEN (1970).

Survey nr. 1 Spring 1970 (Fig. 3A)

The survey report (HAMRE and NAKKEN 1970) states that blue whiting was a dominant specie in area I, II and III. The concentrations followed the inflow of atlantic water along the North Sea plateau (Fig. 4A). The fish caught during the cruise (Fig. 1A) was mainly 16 - 22 cm in length i.e. one year old fish.

Survey nr. 2 Autumn 1970 (Fig. 3B)

The largest echo registrations were recorded along the shelfedge towards the North Sea plateau (4B). On these approximately 80 % came from blue whiting (HAMRE and NAKKEN 1971). The length distribution of blue whiting from this cruise are unfortunately not in existence.

Survey nr. 3 Spring 1970 (Fig. 3C)

Significant concentrations of blue whiting were on these cruise found only in two small areas (Fig. 4C). In area I the catches were dominated by two year old fish (20 - 25 cm) and in area III by one year old fish (16 - 20 cm) (Fig. 1C).

Survey nr. 4 Autumn 1971 (Fig. 3D)

The values of echoabundance recorded (Fig. 4D) were on this cruise considerably lower than one year previously. The catches were mostly small and the occurrence of blue whiting insignificant. The length distribution (Fig. 1D) shows that the catches of blue whiting in area III and IV were dominated by adult fish. One- and two year old blue whiting were caught in area II.

Survey nr. 5 Spring 1972 (Fig. 3E)

The extension of fish concentrations in the Norwegian Deep (Fig. 4E) showed the same picture as in the spring 1970. The amount of blue whiting in these concentrations was relative insignificant. Trawl-houls were made in area III only, and the catches considered of I-group fish (Fig. 1E).

Survey nr. 6 Summer 1972 (Fig. 3F)

On this cruise blue whiting was found to contribute to approximately 80 % of the echoabundance recorded in the Norwegian Deep (Fig. 4F). The largest concentrations were found along the shelf-edge in depths between 150 and 250 m. The concentrations showed a relation to the hydrographic milieu. Blue whiting was found in the colder deep water of atlantic origin in the Norwegian Deep. Towards the gradient of the incoming Atlantic water (DANIELSEN, LAHN-JOHANNESSEN and LJØEN 1972, IVERSEN et al. 1974). In Fig. 5 is shown echorecordings of blue whiting towards the shelf edge and in Fig. 6 the distribution of blue whiting recordings in relation to the salinity on a hydrographic section.

The length distribution of blue whiting in the catches (Fig. 1F)

show that these were dominated by adult fish as the contemporary commercial catches (Fig. 1).

Survey nr. 7 Autumn 1972 (Fig. 3G)

The picture of total echo abundance recorded coming from fish is approximately the same as in the autumn 1970, but the magnitude is somewhat smaller. Blue whiting was the dominating specie in the Norwegian Deep. In the northern part only 0-group fish was caught (Fig. 1G), while farther south also adult fish was caught.

In Fig. 7 the average lengths of blue whiting caught in the trawlcatches are plotted against fishing depths. This indicates that the 0-group fish were found higher in the water column than the adult fish. In Fig. 8 is shown the average lengths of blue whiting caught in the trawlcatches against salinity at the corresponding trawldepths. This shows that during the cruise adult blue whiting was only caught in water with a salinity higher than 35,17 ‰, and 0-group blue whiting only in water with a salinity higher than 35,25 ‰. Salinities higher than 35,25 ‰ is in the Norwegian Deep found only in the core of the incoming atlantic water.

Survey nr. 8 Spring 1973 (Fig. 3H)

Only relatively small concentrations of fish were recorded in the Norwegian Deep during this cruise (Fig. 4H). The dominant species were in the Norwegian Deep blue whiting and silver smelt, and along the shelfedge blue whiting and Norway pout.

The catches of blue whiting consisted mainly of I-group fish in area I, while in area II and III also adult fish was caught (Fig. 1H).

Survey nr. 9 Autumn 1973 (Fig. 3I)

The concentrations of fish in the Norwegian Deep were rather small during this cruise (Fig. 4 I). The concentrations consisted mainly of blue whiting. The length distribution of blue whiting showed

the same picture as one year previously (Fig. 1I).

DISCUSSION

The material from the surveys and from the commercial fishery indicates that each fall since 1971 0-group blue whiting has migrated into the North Sea. A similar migration seems to have occurred during the fall and winter of 1969 and 1970. As I-group fish disappears out of the fishery in the summer as registered in the samples from the commercial fishery, so it seems to migrate out of the North Sea. Apart from the existence of the 1969 yearclass in the catches from the spring and autumn 1971, the existence of 1 year old fish in the fall and 2 year old fish in the spring seems negligible compared to 0-group in the fall.

No spawning of blue whiting is recorded neither in the Norwegian Sea nor in the North Sea and the fish has supposedly its origin in the spawning areas west of the British Isles. The distribution of the 0-group fish before it enters the fishery in the fall is only scarcely known. In June - July 1955 7 - 14 cm long blue whiting was recorded over a large area west of the British Isles (RAITT 1968). The recordings extended northwards between the Faroes and Shetland to approximately 100 n. m. north of the Wyville-Thomson ridge, with a tongue extending northwards over the deep water between the Faroes and Iceland.

As for other gadoid fishes the migration of blue whiting larvae is most likely a passive drift. And the magnitude of 0-group blue whiting in the Norwegian Deep in the autumn is therefore not only dependent upon the yearclass strength but also upon how much of the North Atlantic current is entering into the Norwegian Deep during the late summer and autumn.

As the effort regarding blue whiting research on the surveys has varied it is not possible to give any estimate of the yearclass strength of blue whiting in the North Sea this years. From a general evaluation however, of the contribution of blue whiting to the integrator readings taken during the surveys a variation of the yearclass strength appears. The 1969 yearclass seems in^{February} 1970 to

have been considerably stronger in the North Sea than the yearclass of 1970 and 1971 in respectively February 1971 and February 1972. The amount of the 1972 yearclass seems further-more to have been larger than the 1971 and 1973 yearclasses. The relations between the yearclasses of 1972 and 1973 seems to be supported by the average daily catches of the industrial trawlers these two years.

The largest concentrations of adult blue whiting in the North Sea seems to be found in the summer according to both the industrial catches and to the surveys. This is supported by an investigation by THOMASSEN (1974) on the bycatches of the Shrimptrawlers. THOMASSEN (1974) investigated catches taken in the Norwegian Deep on "Turøyfeltet" west of Sotra. This is on approximately the same latitude as the Viking Bank where a majority of the industrial catches sampled are from. The best catches of blue whiting were taken by the shrimptrawlers in May - July. The length distribution of blue whiting in the shrimpcatches varied some with the time of the year, but was through out the year dominated by adult fish. While the industrial catches mainly are taken from water shallower than 250 m, the shrimp trawling at "Turøyfeltet" is in depths of 280 - 310 m, and the difference in the length distribution of blue whiting caught in these two fisheries, emphasize the variation found with the depth in the length distribution of blue whiting (Fig. 7).

As the adult fish lives in a wider salinity spektrum than the younger fish, it is probably to be found in a larger part of the Norwegian Deep than the young fish. Furthermore, as the adult fish seems to be found more often pelagic than the younger fish, it is probable that neither the industrial fishery nor the shrimp fishery gives a true picture of the concentrations of adult blue whiting in the North Sea.

Investigations the last years on the blue whiting stock in the Norwegian Sea and west of the British Isles (HAMRE, JÁKUPSSTOVU and NAKKEN 1972, JÁKUPSSTOVU og NAKKEN 1972, BLINDHEIM et al. 1971) indicate that the fish after the spawning is migrating rapidly northwards. The adult fish caught in the Norwegian Deep in May - June have recently spawned and are probably fish returning from the spawning areas west of the British Isles.

SUMMARY

Samples from commercial trawl landings for reductional purposes show that the Norwegian catches recorded as Norway pout in the fishery statistics consists of 50 - 70 % blue whiting during the autumn and 30 - 60 % during late spring and summer. The contribution is somewhat lower in the winter. Blue whiting of the 0-group enters the fishery in the autumn, and this yearclass dominates the catches then and throughout winter and spring. The catches in the summer consist of older, spent fish.

Material collected during 9 research vessel surveys support this pattern. The 0-group fish entering the area in the autumn seem all the years, apart from the 1969 yearclass, to have left the area as I-group fish the succeeding summer.

Hydrographic observations made during the cruises indicate that the young fish and the older fish inhabit different water and depth regimes. The 0-group seems in the autumn to be confined to the incoming Atlantic water along the shelfedge of the North Sea plateau towards the Norwegian Deep. The older fish are found somewhat deeper in the colder, deep water of the Norwegian Deep.

Echo integrator recordings made during the surveys indicate that the 1969 yearclass was stronger represented in the North Sea than the 1970 and 1971 yearclasses. Similarly the 1972 yearclass seems to have been stronger in the North Sea than the 1971 and 1973 yearclasses.

No spawning is recorded neither in the Norwegian Sea nor in the North Sea, and it is concluded that the immigration of 0-group fish in the autumn and of older, spent fish in the late spring and summer originates from the spawning areas west of the British Isles.

Apart from yearclass strength, it is suggested that the amount of 0-group fish entering the Norwegian Deep each autumn is influenced by the influx of Atlantic water at that time.

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Table 1. Norwegian commercial trawl landings for reduction purposes recorded as Norway pout in the fishery statistics in the period January 1972 - December 1973 in 1000 hl. Number of samples taken each month of such landings, percent weight of blue whiting in these samples and quantity blue whiting in 1000 hl calculated from the samples are given.

	Jan.	Febr.	Mars	April	May	June	July	Aug.	Sept.	Okt.	Nov.	Dec.
Landings "Norway" pout	36	78	70	73	78	342	160	142	349	215	35	30
Number of samples		13	11	16	17	32	7	11	41	11	1	3
% blue whiting		4	20	20	37	36	14	41	50	67	0	6
Calculated catch blue whiting		3	14	15	29	123	22	58	174	144	0	2
Landings "Norway" pout	78	57	10	66	169	256	117	256	274	177	3	
Number of samples	17	10	19	9	7	8	-	3	16	7	3	
% blue whiting	23	16	51	68	60	33	-	28	73	70	76	
Calculated catch blue whiting	18	9	5	45	101	84	-	72	200	124	2	

1972

1973

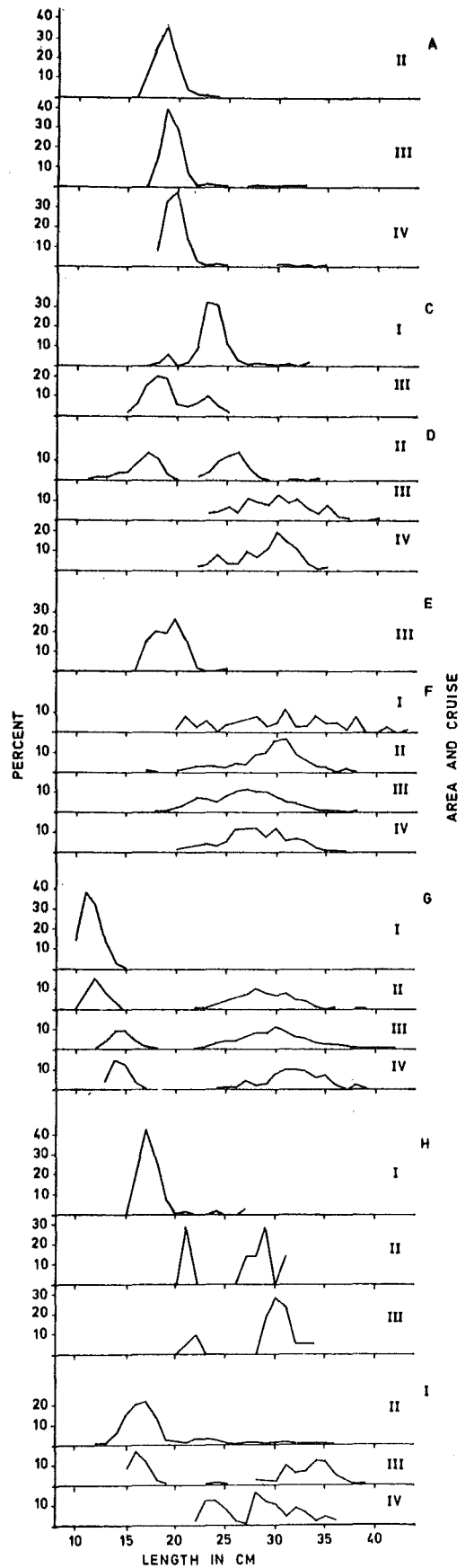
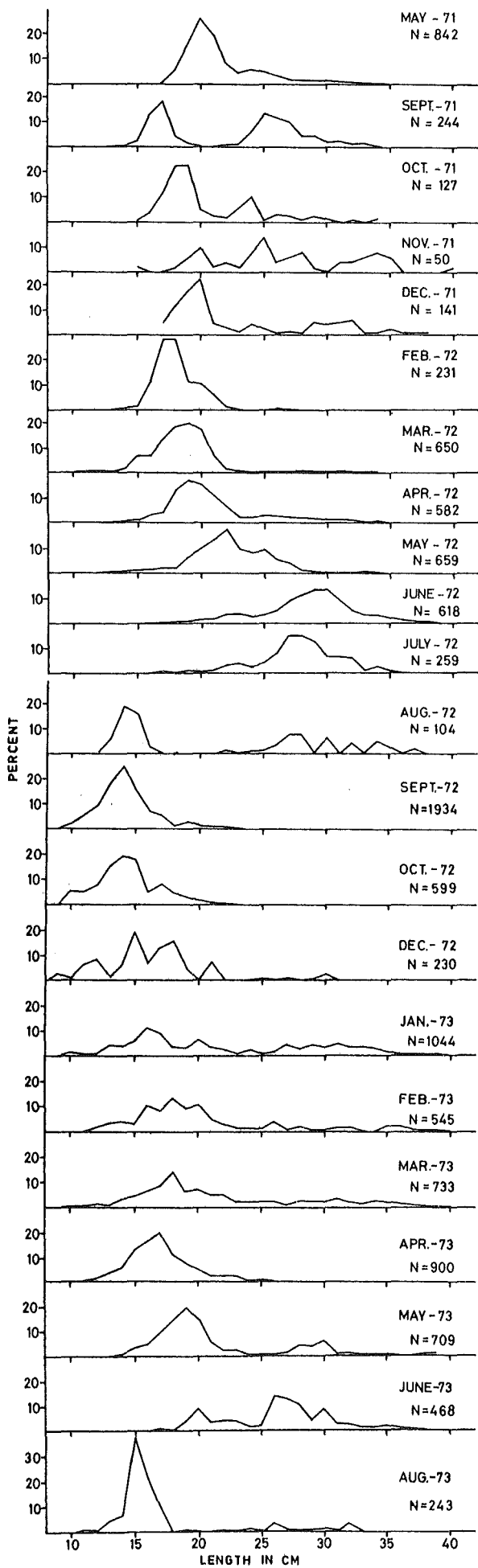


Fig. 1. Left. Length distribution of blue-whiting from the commercial landings
 Mai 1971 - August 1973.
 Right. Length distribution of blue-whiting caught during the cruises.

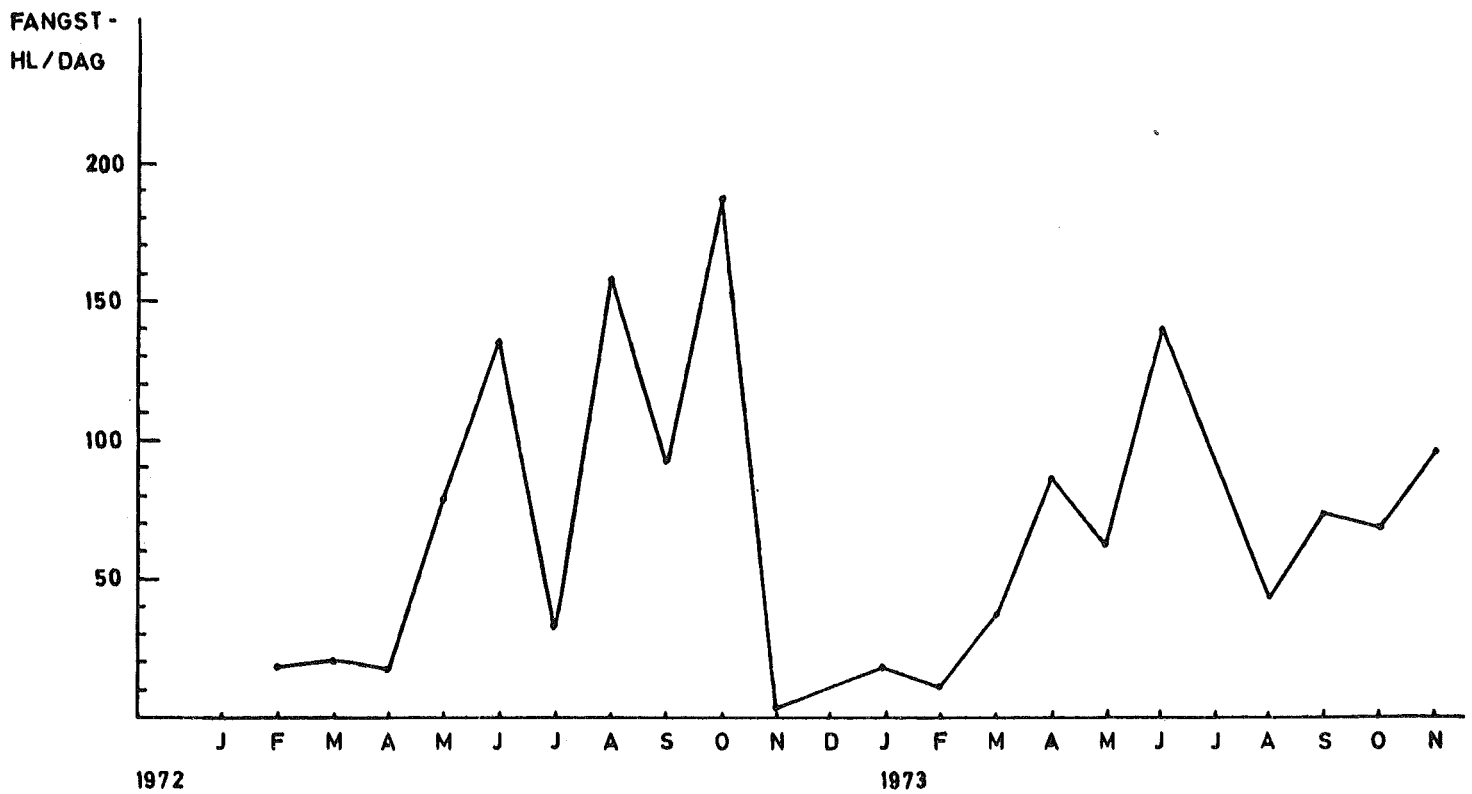


Fig. 2. Average catches per day of blue-whiting by industrial trawlers. February 1972 - November 1973.

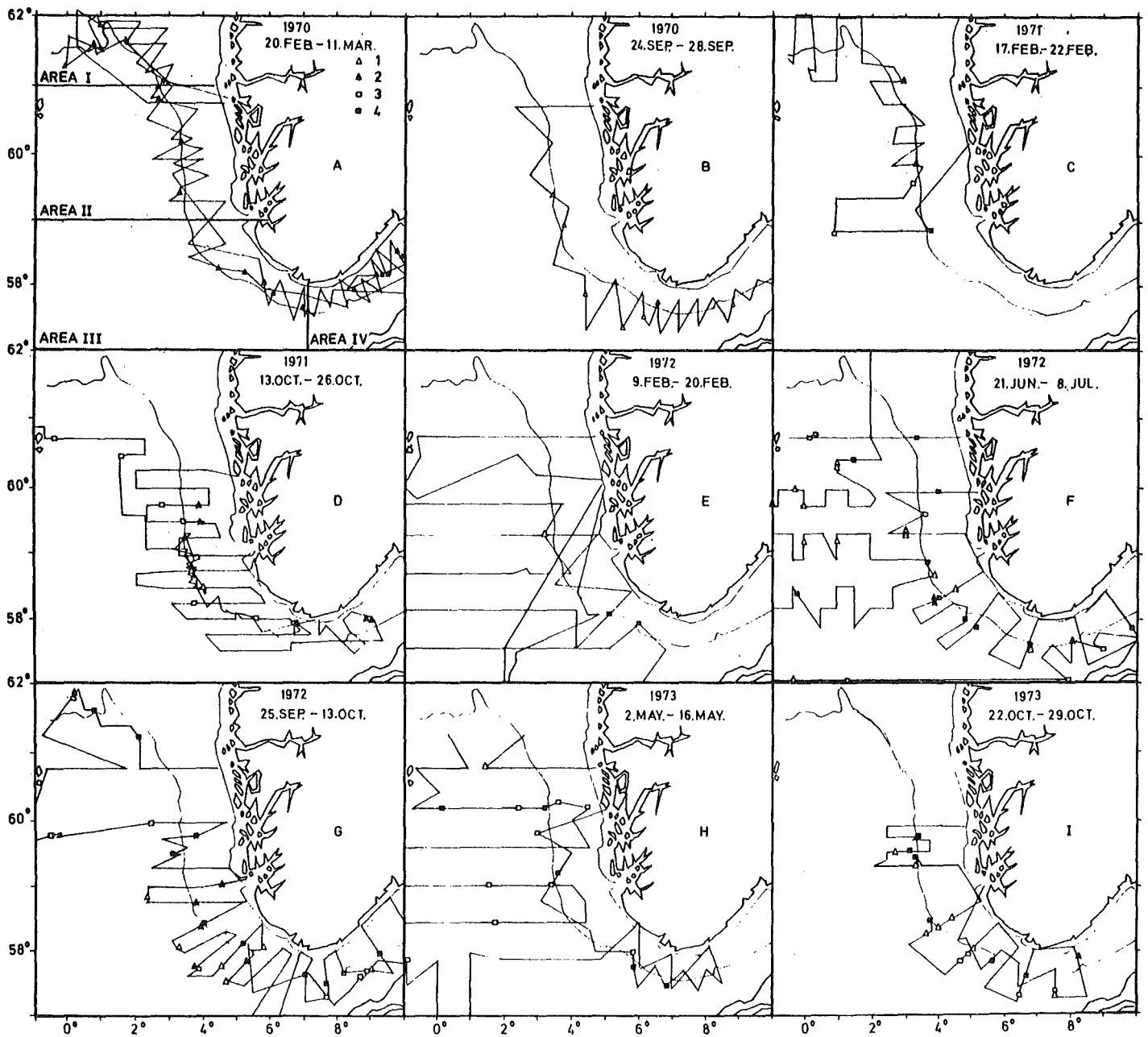
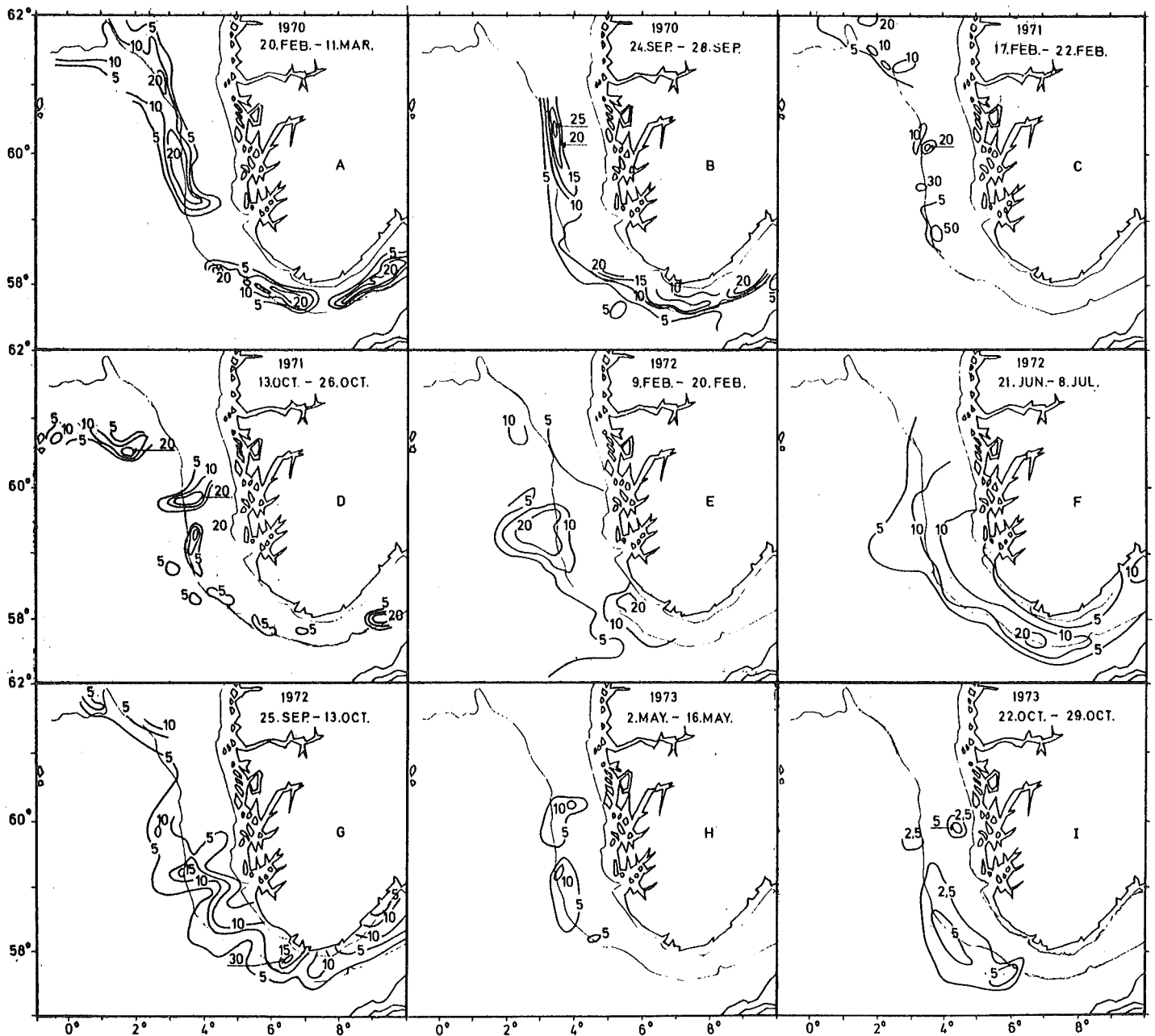


Fig. 3. Survey grids and trawl-stations 1) Pelagic trawl-station without catch of blue-whiting, 2) pelagic trawl-station with catch of blue-whiting, 3) bottom trawl-station without catch of blue-whiting, 4) bottom trawl-station with catch of blue-whiting.



Figs. 5. *Side.*

Fig. 4. Distribution of fishabundance (relative units $\times 10^{-1}$) measured with echo-integrator during the cruises.

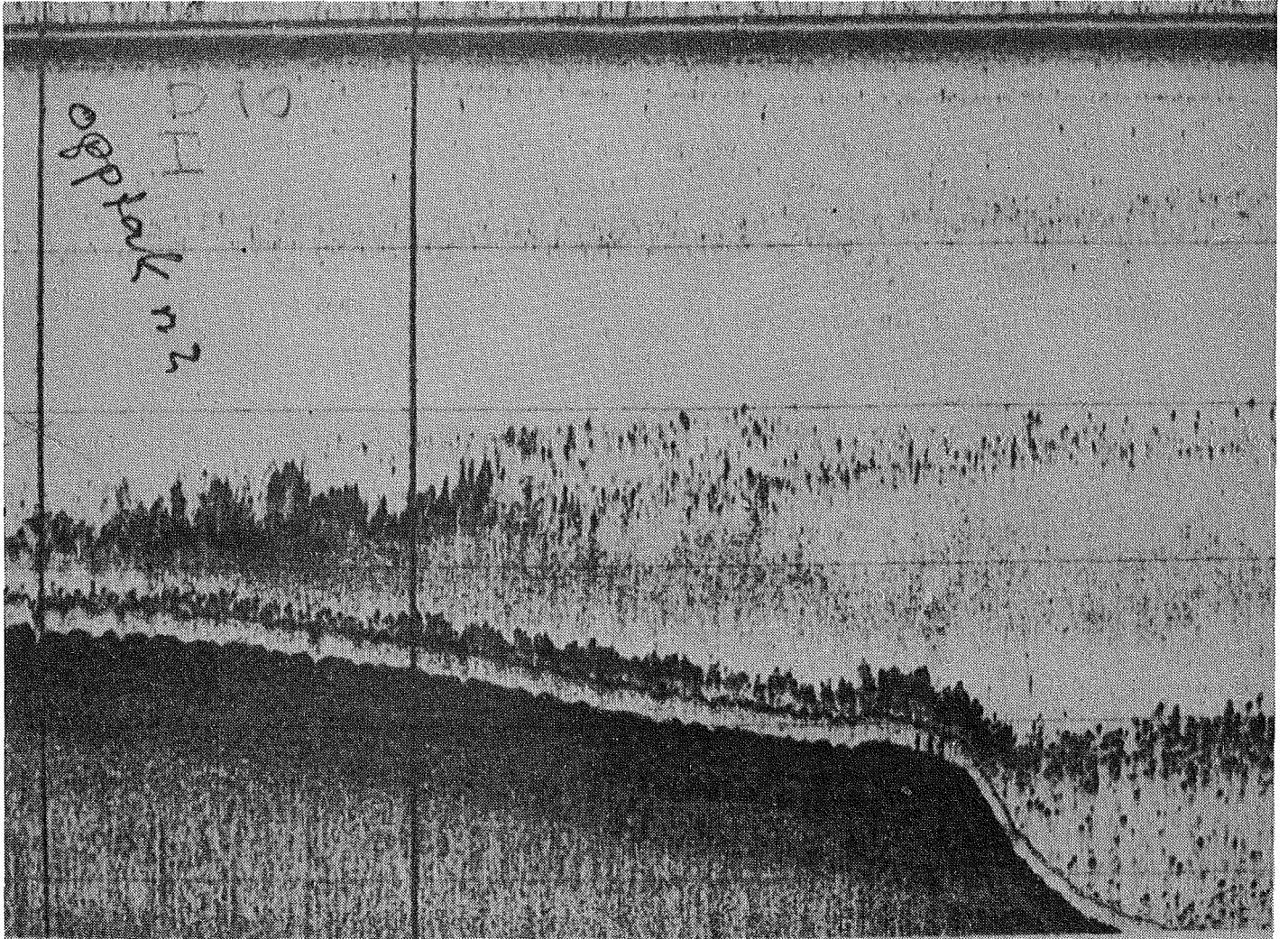


Fig. 5. Echorecord showing Müller's pearlside, euphausiids and blue-whiting. Echosounder 38 KHz, depth 0 - 250 m, effect 10/1, gain 20 logR 0db, recorder gain 3 (Hamre and Nakken 1971).

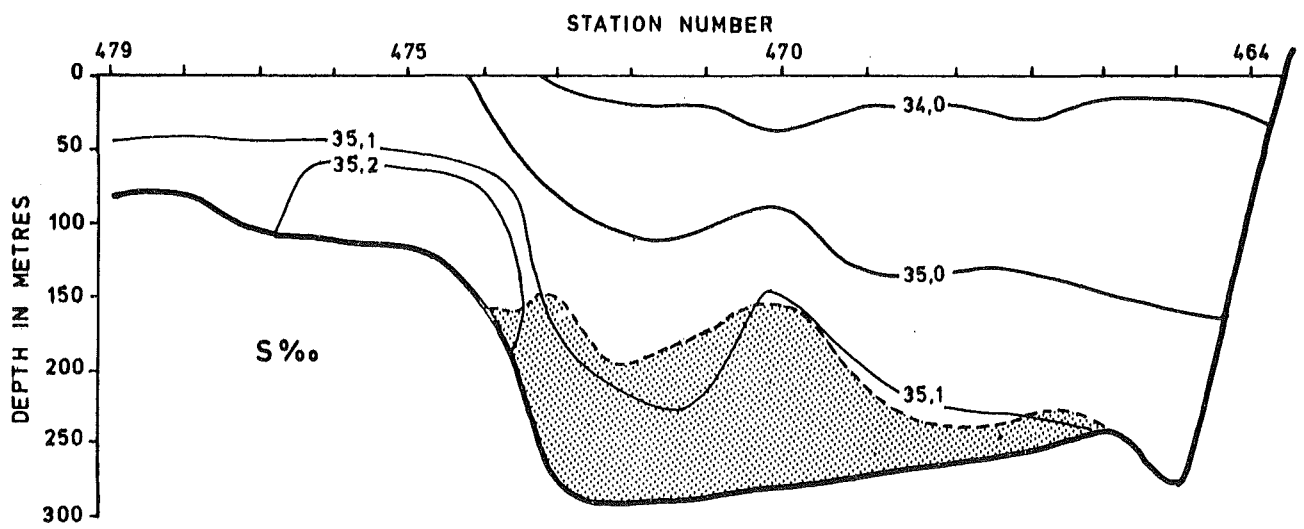


Fig. 6. Salinity distribution in the section Jærø Rev - Southwest observed during the summercruise 1972. Depth distribution of simultaneously made echorecordings of blue-whiting is shaded.

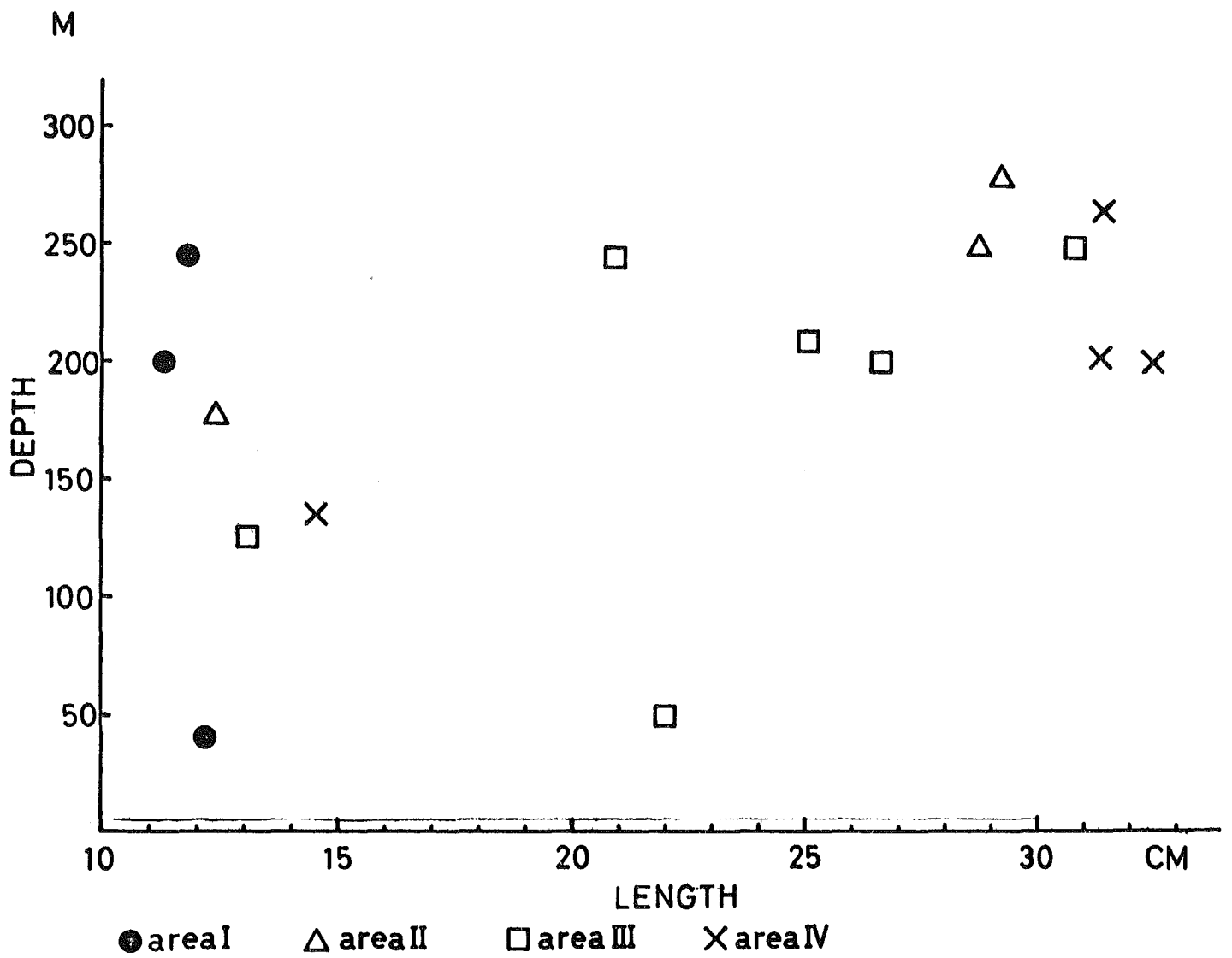


Fig. 7. Mean length of blue-whiting caught on the various trawl-stations during the autumn cruise 1972 and the corresponding fishing depths.

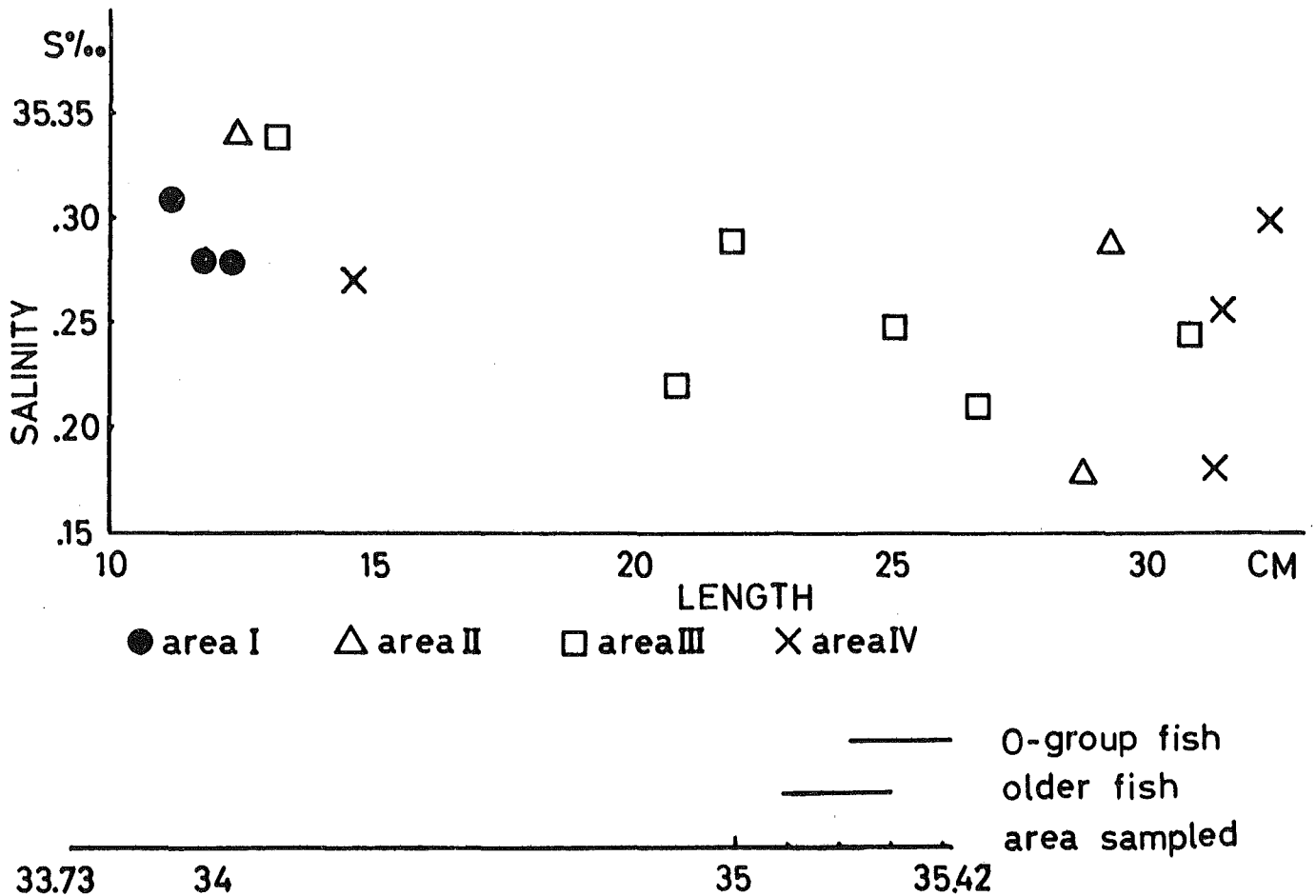


Fig. 8. Mean length of blue-whiting caught on the various trawl-station during the autumn cruise 1972 and the salinity at the corresponding trawldepths. Below is indicated the salinity of the water where blue-whiting was caught and the total salinity spektrum sampled during the cruise.