Ödsmål, Kville sn, Bohuslän

Hällristning	Rock carving
Fiskare från	Bronze age
bronsåldern	fishermen

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Abundance and horizontal distribution of pelagic fish eggs and larvae in the Baltic Sea 1967-1971

by

Roger Lindblom

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CONTENTS

ABSTRACT

An investigation of pelagic fish eggs and larvae in the Baltic (up to the Åland Sea) has been in progress since 1967. The present report of the first five-year period deals with their abundance and horizontal distribution. For sampling, which is performed several times yearly at stations over most of the sea, vertical hauls were made, using a 1-m-ring-net with a mesh size of 280 µ. - The main interest was focused on eggs and larvae of cod and sprat, but fish as flounder, plaice and dab, as well as other species, were also studied. The results of the sampling expeditions with research vessels are reported in tables and maps (after the text). The distribution of the various species, their spawning regions and spawning seasons are also considered.

The abundance of eggs and larvae during different years and seasons of the year is discussed in general terms in relation to such environmental factors as salinity, oxygen content and temperature, and in view of the new recruitment to the stocks of fish. Comparisons are also made between the results reported in the present investigations and earlier ones made during the 20th century of ichthyoplankton in the Baltic. The influence of the environmental factors mentioned will be treated further in a later work on the vertical distribution of eggs and larvae, but some of the principal features are reported here.

The great dependence of the cod on a minimum salinity (10 - 11 ‰) for successful spawning restricts the recruitment to the stock to the deep waters of the Baltic proper, below the halocline. (Cod eggs sink in water of lower salinity.) During the most recent decades, however, there has been a rather general lack of oxygen, due chiefly to the low exchange of water in the deep basins. Investigations have shown that the content of oxygen at present restricts the area of effective cod spawning, particularly north and west of Gotland. Years with a marked lack of oxygen in the deep waters, 1968 and 1971, for example, also generally give low numbers of eggs and still lower catches of larvae. After the influx of new deep water during the winter and early spring of 1969, the numbers of cod eggs and larvae in the southern Baltic increased almost immediately in 1969, but not until 1970 in the central Baltic proper.

The sprat is less dependent on salinity, and spawns in all parts of the region, even in the Åland Sea (occasional eggs have been reported from the Bothnian Sea). Sprat eggs float in water of such low salinity as c. 6 ‰. The dependece of the species on deep water is also less, due to the pelagic way of life. Low oxygen content in the depths, therefore, has not the same negative effect as on the recruitment of cod. In 1968, however, a decline in the numbers of sprat eggs and larvae was reported. The years 1969 to 1971 all gave high frequencies of eggs and larvae, in spite of a great impairment of the oxygen situation in 1971, during which year a high abundance was reported particularly from the Arkona Basin and east of Gotland.

A comparison with earlier investigation results shows that the numbers of cod eggs, e.g. in the southern Baltic, are lower than those reported during 1938 and 1947, in spite of much more intensive investigation activities during the period 1967-71. This - like the stagnating catches of cod - is evidence that the stock has become smaller. For sprat, our observations of eggs and larvae may imply an increase of the stock spawning in the open sea in the central and northern parts of the Baltic proper.

Eggs of plaice require high salinity to float, and the number of eggs obtained during the investigations was very small. In spite of the large plaice stock during the 1920's, the number of eggs was low even then. This is an indication that the stock of plaice in the southern Baltic consists mainly of immigrants from the waters around the Danish islands. - The dab now occurs very rarely in the southern Baltic, and a great reduction in the

numbers of eggs and larvae of this species has been reported since the 1930's. Only occasional dab eggs and larvae were obtained during 1967-71.

The flounder, too, shows a great reduction in the number of eggs since the first decades of the 20th century. But the total catches of flounder do not reveal the same reduction. One explanation of this may be that the flounder is nowadays mostly fished in waters close to the coasts. During the 1920's and 30's there was a rich fishery in the deeper parts of the southern Baltic. The populations spawning in the inshore waters of the Baltic ("bank-flounder") have non-pelagic eggs which develop lying on the bottom. This stock is clearly a rich one, while the population spawning in the deep water of the southern Baltic has become greatly reduced.

Comparisons made with observations 60 years ago, show that Ammodytes larvae were much more abundant at that time than to-day.

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INTRODUCTION

In order to study the effect of the decreasing oxygen content of the deep water layers in the Baltic during the 1960's, regular sampling surveys for fish eggs and larvae were started in 1967 by Dr. Gunnar Otterlind at the Institute of Marine Research, Lysekil, Sweden. The purpose was primarily to study the recruitment of cod, and the ichthyoplankton sampling had mainly to be performed together with other activities, such as cod tagging and trawling for cod in the Bornholm and Gotland areas. The number of stations were few and did not cover the whole Baltic proper.

During 1968 the oxygen content below the halocline deteriorated further and hydrogensulphide (H_2S) was commonly noted in the bottom water of the deep basins of the central Baltic, where the oxygen was completely exhausted. The chemical processes during stagnant conditions have been studied by Fonselius (1962, 1967, 1969). A detailed study of the influence of the environmental factors on the recruitment of cod became more important.

Through a grant from the National Swedish Environment Protection Board in 1969 it was possible to initiate a special research program on the abundance of pelagic fish eggs and fish larvae in relation to oxygen content, salinity, temperature and other environmental factors. The number of stations was increased considerably and the station net expanded. Several yearly investigation cruises comprising the whole or major parts of the Baltic proper (south of the Åland Sea) have since then been regularly carried out. The purpose is to follow the recruitment of cod and other fish species with pelagic eggs. Among the latter the sprat is the most important one.

This report deals with the abundance and horizontal distribution of pelagic fish eggs and larvae during the years 1967 - 1971. Comparisons are made particularly with the very valuable investigations made in this field by the Soviet scientist G.B. Grauman. Another paper will present the findings concerning the vertical distribution in the various water layers, and a more comprehensive discussion of the results will therefore follow later.

I am deeply indebted to my supervisor, Dr. Gunnar Otterlind, of the Institute of Marine Research, for his guidance, support and never failing interest in this work. I wish to extend my sincere thanks to the director of the Institute, Dr. Armin Lindquist, for teaching me about ichthyoplankton sampling and species determination. Dr. Otterlind and Dr. Lindquist have also given valuable criticisms on the manuscript. I wish to thank the staff of our hydrographical department for their information on the hydrological conditions of the Baltic. - I am much obliged to Prof. Anders Enemar at the Department of Zoology, University of Gothenburg, who has provided the laboratory facilities. The collaboration of my collegue FK Anders Hagberg on our joint cruises was extremely valuable and my thanks also go to the crews of the Swedish research vessels, the "Skagerak", the "Thetis" and the "Eystrasalt". - I am much obliged also to Dr. Alajos Müller of the Institut für Meereskunde, Kiel, for 12 ichthyoplankton samples collected on board the FRV "Anton Dohrn".- The project was supported financially by the National Swedish Environment Protection Board, grants nos. 7-142/69, 7-68/70, 7-65/71, and 7-65/72.

MATERIAL AND METHODS

Area of investigation

The investigation area is shown in Fig. 1. It includes the whole Baltic proper and the Åland Sea. According to Wattenberg (1949) this area can be divided into the following sub-areas (cf. Fig. 1, solid lines):

1. Arkona Sea	(AS)
2. Bornholm Sea	(BS)
3. Gotland Sea	(GS)
4. Gulf of Finland	(GF)
5. Åland Sea	(ÅS)

Wattenberg divided the GS into one eastern and one western part (Fig. 1, broken lines). Ackefors (1969) separated those areas further (Fig. 1, dotted lines) into the

a. Southern Gotland Sea	(SGS)
b. Middle Eastern Gotland Sea	(MEGS)
c. Middle Western Gotland Sea	(MWGS)
d. North-Western Gotland Sea	(NWGS)
e. North-Eastern Gotland Sea	(NEGS)

The most important sampling stations are shown in Fig. 1, with their Swedish names or symbols as well as with the symbols used during the Intern. Baltic Year 1969 - 1970. The positions and depths are given in "Legend to Fig. 1" (cf. below). The aim was to visit the stations mentioned at least once every season. However, the stations in the NEGS, GF, and in the ÅS were visited fewer times, the others more often.

When not otherwise mentioned hydrographical data are taken from the series Medd. fr. Havsfiskelab., Lysekil, nos. 38, 41, 51, 52, 63, 70, 80, 93, 104, 112, and 116, or they are unpublished records from our sampling cruises.

Sampling the ichthyoplankton

An 1-m-ring-net was used for the sampling (cf. Fig. 2). The over-all length of the net was 280 cm of which the 80 cm nearest to the net opening consisted of sail cloth, almost impermeable to water, and the rest of the net (200 cm) was made of nylon gauze, through which the water was filtered. The mesh-size was 280 µ (Nytal 4 - 280). A broad-meshed net mounted over the net opening prevented jelly-fish and other large organisms from entering the net and clogging the outlet of the plastic plankton bucket.

As we wanted to learn the vertical distribution of eggs and larvae as well as their horizontal distribution the net was equipped with a closing device. Most egg and larva totals are therefore the sum of the countings of two or more successive hauls. When hauls overlapped or did not reach each other, this has been indicated in the tables (see after the text).

It must be kept in mind that the numbers of fish eggs and larvae observed at any station are a little lower in comparison with the actual numbers present in the water column. Since the flow-meter available is of no value when the closing device is released it has not been possible to estimate the filtration efficiency for individual successive hauls. Lindquist (1970) tested an identical net and found the filtration efficiency for undivided hauls to be about 80 %. Filtration efficiency=the ratio of the volume of

Legend to Fig. 1

Fig. 1 shows the investigated area and its most important stations. The Baltic Sea is divided into areas as proposed by Wattenberg (1949) and Ackefors (1969). The table below presents the stations with their Swedish names/symbols as well as the symbols used during the International Baltic Year 1969-1970 (IBY). The positions and depths are also obvious from the table below.

Area	Station Swedish	IBY	Position N:	E:	Depth (m)
AS	Y 15	1 B	55°00'	13°18'	47
AS	S 12	2 A	55°00'	14°05'	48
BS	Christiansö	4 B	55°23'	15°20'	90
BS	S 24	5 A	55°15'	15°59'	91
BS	N 1	6 B	54°42'	15°15'	64
SGS	S Rysshålan	8 A	55°38'	18°36'	109
SGS	Rysshålan	- -	56°02'	18°51'	115
SGS	Klaipeda	9 A	56°05'	19°10'	127
MEGS	F 81	15A	57°20'	20°03'	249
MEGS	F 80	20A	58°00'	19°54'	203
MWGS	S 41	38A	57°07'	17°40'	112
NWGS	F 78	31A	58°35'	18°14'	459
NEGS	NE Gotska Sandön	- -	58°28'	19°28'	78
NEGS	F 72	27A	59°17'80	21°34'	176
GF	L 5	22A	59°55'	25°36'	73
ÅS	Solovjeva	- -	60°12'5	19°04'5	260

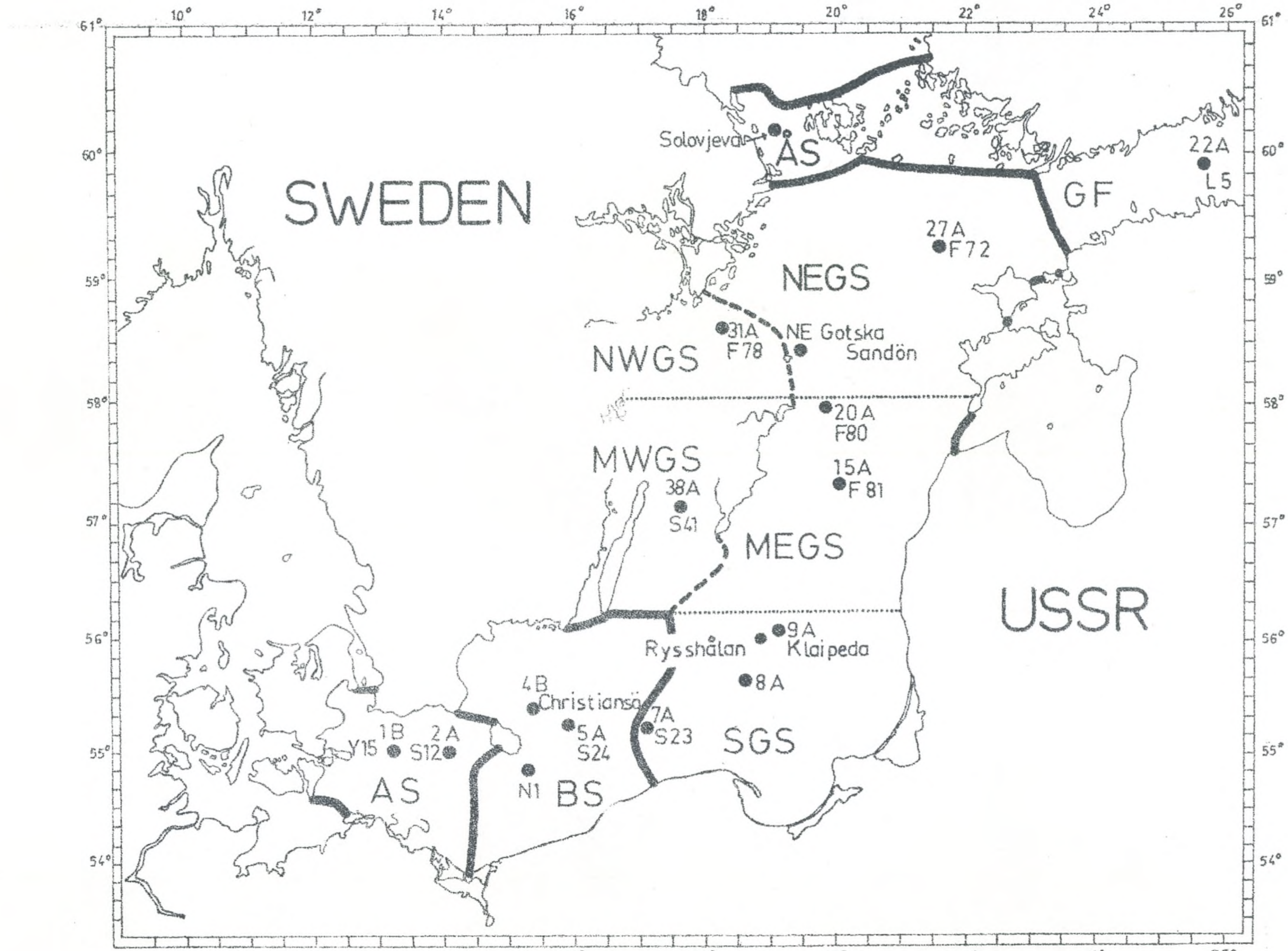
SWEDEN
USSR
Solovjeva
ÅS
GF
22A
L5
27A
F72
NEGS
31A
F78
NE Gotska
Sandön
NWGS
20A
F80
MWGS
15A
F 81
38A
S41
MEGS
9A
Rysshålan
Klaipeda
8A
4B
Christiansö
7A
S23
5A
S24
SGS
1B
2A
Y15
S12
N1
BS
AS

Fig. 1

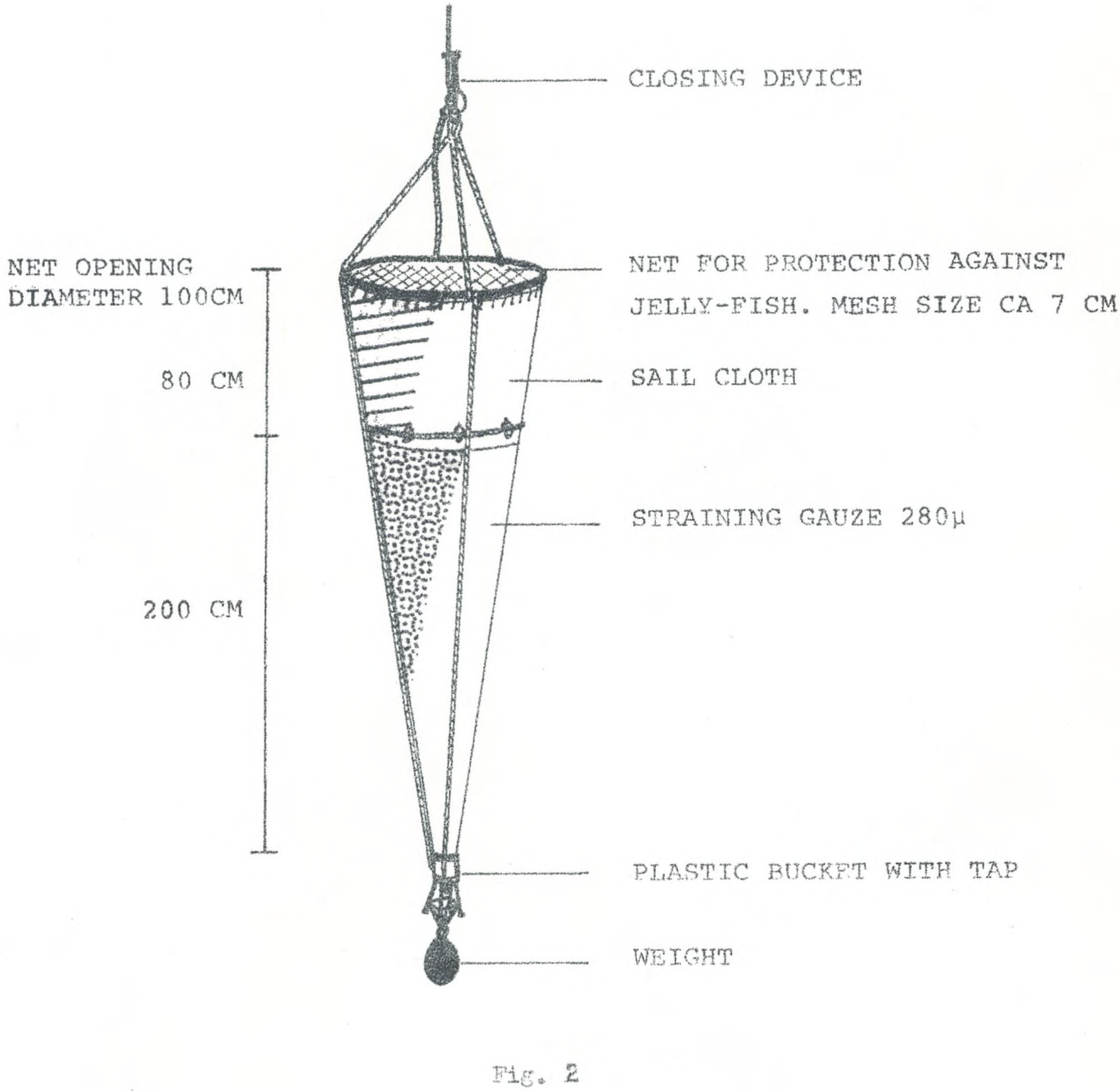
CLOSING DEVICE
NET OPENING
DIAMETER 100CM
NET FOR PROTECTION AGAINST
JELLY-FISH. MESH SIZE CA 7 CM
80 CM
SAIL CLOTH
STRAINING GAUZE 280μ
200 CM
PLASTIC BUCKET WITH TAP
WEIGHT

Fig. 2

water filtered by the net to the volume swept by the net mouth (Tranter 1968). The author's own testing results (not published) showed a mean filtration efficiency of 82 % when hauling at a speed of 45 cm/s. Raising the speed to 80 cm/s increased the efficiency to 85 %. The highest value obtained was 88 %, the lowest 78 %. In the coming paper about the vertical distribution of fish eggs and larvae the methodology will be further discussed.

As can be understood from the figures above, the number of fish eggs and larvae is about 20 % too low. No correction has been made in the tables, maps, etc.

After each haul the net was carefully washed to avoid a cumultative clogging of the meshes. All samples were preserved in a 3 - 4 % solution of formaldehyde in sea water. Determination of species, measurements and countings were made in the laboratory. If larvae have not been determined as to species the family or genus name is given.

In this report we have not separated dead eggs from living ones. Figures mentioned below concerning survival of eggs are all taken from the reports by Grauman in Annls. Biol. As yet we are not ready to judge whether eggs died shortly before they were collected or during the various processes from entering the net until preservation in the bottle. Höglund (1938) published photographs of living and dead sprat eggs. The most apparent difference is that the egg membrane (chorion) of living eggs is transparent, but becomes opaque as soon as the egg dies. Thus, in this meaning, it is not difficult to separate dead eggs from living ones. The problem is to determine whether the eggs died before or after they entered the net.

Dementjeva (1958) made the following experiment. Two horizontal hauls were made at the same place: the first one lasted 5 minutes, the other one 10 minutes. The percentages of living and dead eggs were then counted and were found to be the same. Thus, the duration of the hauls, within these limits, was of no consequence for the survival of eggs. An essential question still remains: What happens to the eggs when the net is flushed with water and when the eggs are agitated by water-currents in the plastic plankton bucket ?

Rollefsen (1929) showed that cod eggs are sensitive to agitation, which need not be especially strong. Another difficulty arises when the numbers of dead and living eggs from different depths of the water column are given. In the deeper layers the number of dead eggs will presumably be overestimated because of the presence of dead eggs originally spawned in the surface layer (if dead eggs sink to the bottom). This problem was mentioned by Apstein as long ago as 1910.

We therefore believe that, with the sampling method used in this study, many eggs die during the handling processes, after the net has left the water surface. Furthermore it has not been possible for us to examine the eggs immediately after capture. It seems likely that it is easier to separate eggs which have died a natural death from those which have died due to sampling procedures, when samples are sorted only a few minutes after collection. Further attention will, however, be paid to this matter in the future.

All hydrographic samples collected have been analysed at the hydrographical department of our institute.

Species determination

For the identification of ichthyoplankton the works of the following authors were consulted: Ehrenbaum & Strodtmann (1904), Ehrenbaum (1905-1909), Petersen (1906), Heinen (1912), and Lindquist (unpublished tables and drawings).

Sometimes larvae are so badly preserved that it is impossible to make a correct identification. This has been the case with some flounder/dab and herring/sprat larvae. Eggs of plaice and cod overlap partly in size. In that case only when an embryo with characteristic pigmentation is present can one be sure of the species. To reduce the errors for plaice/cod questions like: when is the peak of spawning?, what is the mean egg diameter of the species at that time?, are larvae/eggs of the same kind as the doubtful egg/larvae present in the sample(s)?, are considered. Even though some eggs or larvae may have been misinterpreted the number of such errors must be fairly small.

The table below presents the species, year and corresponding numbers of the maps. Species with pelagic eggs are marked with a "p", those with benthic eggs with a "b".

Species	Egg-type	Year	Map no.
Gadus morhua	p	1967	1 - 3
" "	"	1968	4 - 7
" "	"	1969	8 - 11
" "	"	1970	12- 19
" "	"	1971	20- 29
Onos cimbrius	p	1967	30- 32
" "	"	1968	33- 36
" "	"	1969	37- 40
" "	"	1970	41- 48
" "	"	1971	49- 58
Sprattus sprattus	p	1967	59- 61
" "	"	1968	62- 65
" "	"	1969	66- 69
" "	"	1970	70- 77
" "	"	1971	78- 87
Pleuronectes platessa	p	1967	88
" "	"	1970	89- 90
" "	"	1971	91
Platichthys flesus	p&b	1967	92
" "	"	1968	93
" "	"	1969	94a-b
" "	"	1970	95- 98
" "	"	1971	99- 100
Limanda limanda	p	1967	101
" "	"	1968	102
" "	"	1969	103-104
Clupea harengus	b	1967	105-106
" "	"	1968	107
" "	"	1970	108-109
" "	"	1971	110-112
Clupeidae	p&b	1971	110
Pollachius pollachius	p	1967	113
Ammodytes lancea	b	1971	117
Ammodytidae	b	1967	114
"	"	1971	115-117
Pholis gunellus	b	1970	118
" "	"	1971	119
Gobidae	b	1970	120
"	"	1971	121-123
Liparis liparis	b	1970	124-126
" "	"	1971	127-128
Solea solea	p	1967	129

RESULTS AND DISCUSSION

Cod - Gadus morhua

Recruitment and environment

Two environmental factors in particular influence the survival of cod eggs and larvae in the Baltic proper: salinity and oxygen content of the water layers below the halocline.

Cod eggs are pelagic. Kändler (1944) states that the lower salinity limit for their floating ability is about 12 ‰ in the Bornholm Basin (BS) and about 10 ‰ in the Gotland Basin. Berner & Schemainda (1957, 1958) found that the spawning cod in the BS seemed to prefer salinities of more than 13 - 14 ‰. Berner & Wolf (1969)and Wolf & Berner (1970) used the 11 ‰ isohaline as the limit for the spawning cod population in the BS. For the eastern Baltic, Elwertowski (1955) considered a salinity of 11 ‰ to be the distribution border and Lablaika & Lishev (1964) mentioned 10 - 11 ‰ for the Gotland Sea. Grauman (1964, 1969 b) determined the floating ability in relation to egg diameter and observed that the lowest limit was 10.41 - 11.0 ‰ in the BS, SGS and MEGS.

It must be mentioned that cod spawning occurs also in deep areas with a much lower salinity in the Åland Sea and to a very restricted extent in the Bothnian Sea. Obviously the eggs do not survive, however. Accidentally single cod specimens are recorded in the Bothnian Bay. The recruitment to these areas is by way of immigration from the south (Otterlind 1959, 1966, 1971).

The critical oxygen value for the survival of mature cod in aquaria is, according to Sundnes (1957), 0.8 ml O_2/1. Berner & Schemainda (1957, 1958) found by echo-sounding that cod formed a scattered layer just above the isoline for a concentration of 1 ml O_2/1 in the BS. Tiews (1970) noted that very few fishes were caught when the oxygen value was below 1.5 - 2 ml O_2/1 in the actual layers. The critical oxygen level is probably lower for eggs and larvae. This problem will be further considered in connection with the vertical distribution.

When the water of the deep layers is not renewed for a long period, stagnant conditions with increasing oxygen deficit and at last formation of H_2S must follow, as described by Fonselius (1962, 1967, 1969). At the same time the salinity slowly decreases due to mixing with the less saline upper layers. Thus the eggs may sink to deeper layers while the oxygen deficit spreads upwards. If there occurs no influx of oxygen-rich, salty water from the Belt Sea or the Sound (or from the southern to the central Baltic proper) the eggs and hatching larvae will be destroyed in water layers with too low oxygen content. The recruitment to the local stock will in this way be severely retarded, especially as most of the cod may already have emigrated to other areas. Thus the oxygen content is of vital importance both for the spawning concentration of cod and for the survival of eggs and larvae.

Distribution and abundance of cod eggs and larvae in 1967 - 1971

1967. - In the beginning of 1967 the oxygen conditions were bad for the spawning cod all over the Baltic proper. However, in May an influx renewed the bottom water in the BS. Cod migrated to some extent from the Liepaia - Ventspils area to the Slupsk Furrow and the Bornholm Deep (Lablaika 1969, Uzars 1969). Such migrations must take place particularly when the oxygen situation makes it impossible for the cod to remain for spawning e.g. in the central Baltic (Otterlind 1961, 1966, 1967 a, 1968 a, 1969 a,b, Lablaika & Lishev 1964), or when the concentration of the spawning shoals is said to exceed a certain "critical value" (Lablaika & Lishev 1964). A more or less regular migration from the northern areas of the Baltic Sea to the southern parts is well-known from tagging experiments (Otterlind 1957, 1959, and later publ.). Migrations of maturing young cod from the MEGS to the SGS and the BS in winter-spring have been noted in all Swedish taggings off the east coast of Gotland.

In 1967 the two good year-classes 1963 and 1964 (Otterlind 1967 a, 1968 a, Lablaika & Uzars 1968) were spawning. The relatively small egg-number and the absence of a pronounced spawning centre suggests that the spawning peak was passed when our sampling began at the end of May. Most eggs were noted during the Maj-June cruise at stations within the 70 m isobath, north-east of Bornholm (the Christiansö stations and S 24). The average number of eggs in this area amounted to 22 eggs/m^2. Grauman (1969 b) observed 34 eggs/m^2 as an average for the whole spawning period (April-June) in the BS, while rather more eggs were present in the southern Gotland area (37 eggs/m^2). In the Slupsk (Stolpen) area and Gdansk area 10 eggs/m^2 and 23 eggs/m^2 were found, respectively. Spawning occurred according to our results even in September; 13 eggs/m^2 were collected in this month at S 24 (BS).

Larvae were noted in many of our samples from 1967. They were not abundant, however. At Rysshålan 5 larvae/m^2 were caught, while at all other stations where they were present only one was captured per station. During the entire spawning period Grauman (1969 b) caught on an average, 7 larvae/m^2 in the BS, 2 larvae/m^2 in the Slupsk area, 4 larvae/m^2 in the Gdansk area, and 5 larvae/m^2 in the southern Gotland area. - The 1967 year-class was later classified as abundant (Lablaika 1969).

1968.- Since the oxygen content continuously decreased in the bottom water layers and no important influx took place during the winter of 1967/1968, the spawning cod had, to a large extent, to give up temporarily their demersal or near bottom life for a pelagic one in 1968 - a mode of spawning known already from earlier years with oxygen deficit in the Bornholm Basin. This year, however, the fishermen began to use a new type of gear in cod fishery, the pelagic trawl (Berner 1969, Berner & Wolf 1969, Tiews 1970). The best fishing areas were situated in the northern part of the Bornholm Basin, within the 80-90 m depth, where dense shoals of spawning cod were found in a layer between 60 and 75 m. An increase in the stock number occurred in the BS because of the strong migration from the north-eastern Baltic (Lablaika 1969, Uzars 1969).

In accordance with this observation the number of eggs found in our investigations was low at Rysshålan in April 1968 (5 eggs/m^2), while east of Christiansö, where pelagic cod formed dense concentrations, it was high (116 eggs/m^2). Taking the whole spawning ground (BS) into account Grauman (1969 b) noted 12 eggs/m^2 in April (in 1967: 18 eggs/m^2). If the entire spawning season is considered, 24 eggs/m^2 were found in the BS (in 1967: 34 eggs/m^2), while in the SGS (approximately) a mean of about 9 eggs/m^2 were registered (in 1967: 23 eggs/m^2). Grauman showed furthermore that the percentage of live eggs decreased from 47 % in 1967 to 26 % in 1968 (BS).

No larvae were seen in our samples throughout the year (no sampling was made in May - July, however. Grauman (1969 b) captured on the average 2 larvae/m^2 in all areas investigated (BS to southern Gotland area) during April - June 1968. - The 1968 year-class was considered to be below average strength (Grauman 1969 b, Lablaika 1969).

1969. - At the very end of 1968 and the beginning of 1969 inflowing water raised the oxygen content of the deep water layers in the southern Baltic. The spawning cod returned to the bottom. As a result only bottom trawls could be used in cod fishery in 1969 (Wolf & Berner 1970). This year, spawning cod were most abundant at depths of 80 - 90 m or more, at the same places as for the pelagic spawning in 1968. No fewer than 253 eggs/m^2 were counted at E Christiansö in June 1969, where Wolf & Berner (1970) observed the densest spawning concentrations in May. Grauman (1970 a) recorded regular migration from the northern areas of the Baltic Sea to the southern parts is well-known from tagging experiments (Otterlind 1957, 1959, and later publ.). Migrations of maturing young cod from the MEGS to the SGS and the BS in winter-spring have been noted in all Swedish taggings off the east coast of Gotland.

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<u>1969</u>. - At the very end of 1968 and the beginning of 1969 inflowing water raised the oxygen content of the deep water layers in the southern Baltic. The spawning cod returned to the bottom. As a result only bottom trawls could be used in cod fishery in 1969 (Wolf & Berner 1970). This year, spawning cod were most abundant at depths of 80 - 90 m or more, at the same places as for the pelagic spawning in 1968. No fewer than 253 eggs/m^2 were counted at E Christiansö in June 1969, where Wolf & Berner (1970) observed the densest spawning concentrations in May. Grauman (1970 a) recorded

77 eggs/m^2 as an average value for the BS in June. An increase in the number of eggs, especially in the BS, was obvious in 1969. For the whole spawning period Grauman noted a mean of 60 eggs/m^2 in the BS compared with 24 eggs/m^2 in 1968. East of the BS 18 eggs/m^2 were collected by Grauman during the period April - June (in 1968: 9 eggs/m^2).

It is surprising to find such a low number of larvae (in total only three) in the samples of 1969. Grauman (1970 a) caught on an average, during April - June 4 larvae/m^2 in the BS, 9 larvae/m^2 in the Slupsk area, 3 larvae/m^2 in the Gdansk area and 2.5 larvae/m^2 in the southern Gotland area. The oxygen content and the salinity were high in all layers below the halocline in the BS. A negative factor was the low temperature, mainly below 4°C in the water layers from April to at least June (Fonselius 1970, Filarski 1970, and observations on our cruises). This may have influenced indirectly the survival of larvae by slowing down the formation of suitable food for the fry. However, yolk-sac larvae should at least have been present. Possibly the low temperature of the whole water column may have been fatal for the larvae immediately after hatching. According to Grauman (1970 a) the egg survival (more accurately: the percentage of live eggs) in the BS was no doubt higher in 1969 (38 %) than in 1968 (26 %); nevertheless, it did not reach the same level as in 1967, when 47 % of all cod eggs were alive. In spite of the relatively high egg survival the recruitment did not develop as might have been expected. Maybe fertilization, too, suffered from the temperature conditions mentioned. - The 1969 cod year-class was supposed to be just above average strength (Grauman 1970 a, Lablaika 1972).

1970.-During 1970 the oxygen content of the deep water layers in the BS decreased continuously from the beginning of the year to the end. When cod spawning occurred, the amount of oxygen was, however, still 1.5 ml/l in the deepest parts. On the average 87 eggs/m^2 were found in the BS during the period May 23rd - June 8th (stations N1, Utklippan and Stolpe tröskel excluded). The maximum value obtained was 119 eggs/m^2 at S 24 on May 23rd, the minimum value, 42 eggs/m^2, at ENE Christiansö on May 27th. If all stations within the BS are considered the mean value becomes lower, 46 eggs/m^2. Grauman (1972 a) noted 75 eggs/m^2 for the period April 9th - June 6th (in 1969: 60 eggs/m^2). Most eggs were observed by the present author at S 24, in which area Müller (1971) counted 200 - 300 fish eggs/m^2 during the period May 23rd - June 2nd (oblique hauls). However, the distribution maps of fish eggs made by Müller show the total amount of eggs present and do not distinguish cod eggs from the eggs of other species. Our samples contain about 45 % sprat eggs at S 24 in the period May 23rd - May 27th.

Although the oxygen situation was at the cod's minimum level in the bottom water the number of eggs was thus very high in 1970 in the BS.

In the northern part of the SGS the oxygen content in May, 1970, was higher in layers near the bottom than in the layers above. Lablaika (1972) noted dense concentrations of spawning cod at the bottom in this area. The egg number observed in our investigations changed rapidly in the Klaipeda region: on May 24th - 4 eggs/m^2, on May 28th - 163 eggs/m^2, and on June 3rd - 41 eggs/m^2. The average value for that period was 69 eggs/m^2. South of Klaipeda very few eggs were noted in this basin. In the southern Gotland area (according to Grauman: N 55°20' - N 56°00'), Grauman (1972 a) gives the mean egg number to be 44 eggs/m^2 for the period April 9th - June 6th. The number increased to 62 eggs/m^2 in the middle Gotland area (N 56°01' - N 58°00'), but was lowered to 2 eggs/m^2 in the northern Gotland area (N 58°01' - 58°05'). In the MEGS the oxygen situation was worse than in the SGS. Less than 2 ml O_2/l was present below the 70 m depth at the Gotland Deep in January. A somewhat better situation was found in June when 2 ml O_2/l was recorded down to about 150 m depth. At most 15 eggs/m^2 were observed by us in this area (station 5/9, June 8th).

Grauman(1972 a) noted that the survival of eggs decreased from 38 % in 1969 to 36 % in 1970 in the BS and from 50 % to 42 % in the Slupsk area. An increase took place in the Gdansk region (from 43 % to 44 %) and in the southern Gotland area (from 31 % to 40 %). This probably depends on the more favourable conditions in the near bottom layers in the SGS than in the BS and MEGS.

The increase in the abundance of larvae is striking in 1970. In the third decade of May no fewer than 20 larvae/m^2 were caught at S 24 (BS). They were captured at almost every station, with a sufficiently high salinity, from east of Bornholm to the Gotland Deep during our two cruises in the period May 22nd - June 12th. The increase in the number of larvae observed by us was, however, not confirmed by Grauman's figures (1972 a). In some areas a decrease was even registered (BS - 4 larvae/m^2 in 1969, 3 in 1970, Slupsk area - 9 larvae/m^2 in 1969, 2.5 in 1970). A slight increase in larvae numbers was noted in the Gdansk area (3 larvae/m^2 in 1969, 4 in 1970), and the southern Gotland area (2.5 larvae/m^2 in 1969, 3 in 1970), while the number remained constant (4 larvae/m^2) in the middle Gotland area.

Mankowski & Borkowska (1961) mentioned two essential factors for a good recruitment to the cod stock: 1. high salinity, 2. many spawning females. During 1970 salinity was high enough for the eggs to float in the areas concerned and the spawning population was dense. Tiews (1972) writes that the trawlings with FRV "Anton Dohrn" yielded unusually large catches in April - May, the largest since the work began in 1962. Most abundant were the year-classes 1965, 1966 and 1967. The year-class 1965 was of medium strength in the eastern Baltic, the 1966 and 1967 year-classes of above average strength (Lablaika 1969). Since at least two strong year-classes were present at the same time and the hydrographical situation was not too bad for spawning in the southern Baltic one could consequently expect the numbers of eggs and larvae to be high. According to Grauman (1972 a) the 1970 year-class of cod will be of more than average strength.

1971. - During 1971 the hydrographical conditions were unfavourable for the survival of cod eggs and larvae. In the BS the oxygen content in June decreased sharply, below the 60 m isobath, and in the Gotland Sea the amount of oxygen was too low for the cod below 70 m. When most abundant, eggs in the BS amounted to 62 eggs/m^2 (at S 24, June 9th). The mean values of cod eggs in the BS for the period June 9th - July 7th were: all stations- 14 eggs/m^2, stations where hauls between 60 - 0 m were made - 19 eggs/m^2, stations where hauls between 70 - 0 m were made - 25 eggs/m^2. During the cruise June 7 - 18, 13 eggs/m^2 were observed at F 81 in the MEGS, and only 5 eggs/m^2 were registered at S 22 (Klaipeda, SGS). When the next cruise took place, only one egg was found at Klaipeda, while 19 eggs/m^2 were noted at F 81 in the first days of July.

For the first time since this investigation started, cod eggs were observed at S 41 (MWGS), the Karlsö Deep, at the end of August. The salinity at 70 m was 9.8 ‰ and not more than 0.40 ml O_2/l was available at the same depth. H_2S was present at 80 m where the salinity was 10.2 ‰. Only 4 eggs of the 27 found were alive, however, and no eggs seemed to be fertilized. The eggs may have probably been injured by the low oxygen content, the presence of H_2S or the low salinity. The latter, when not killing the eggs, may block the fertilization process. Cod eggs in small numbers have been reported by Grauman (1970 a, 1972 a) from "the Öland area" in 1969(July 11 eggs/m^2) and 1970.

As can be seen above, the number of eggs had decreased in the southern Baltic compared to the findings in 1970. Müller (1971) noted 300 - 450 fish eggs/m^2 in the surroundings of S 24 on the 10th to 11th of June 1971. However, as in 1970, the maps show the total numbers of eggs counted. Our samples from station S 24 contain about 75 % sprat eggs (June 9th). During the whole of 1971 one single cod larva was caught on our cruises (at S 24, end of June).

As in 1968 we are faced with very small amounts of oxygen in the deep water layers. There are reasons to believe that the 1971 year-class is below average strength.

Spawning areas and changes in the abundance of cod eggs and larvae

The hydrographical situation in the Baltic shows different patterns in different regions. In the AS there is never an acute oxygen deficit but the salinity and temperature changes are of great importance. The variations in the bottom water here are sudden and their amplitude high. They depend mainly on influxes from the Belt Sea, and to some extent from the Sound. The changes are strengthened by the small volume of the basin (with an insignificant sill in the Bornholm Strait). The more east- and northwards in the Baltic one comes the smaller are the changes but the longer their duration. The BS has an intermediate position by its moderate volume and short distance from the Danish sounds (cf. Otterlind 1962, 1968 c, d.). Only when strong influxes of new water occur through the AS are they later easily noticed in the MEGS, sometimes farther away. In the northern parts of the Baltic proper, temperature and salinity do not fluctuate much in the bottom water layers.

The salinity of the new deep water from the south-west decreases slowly by mixing with the upper less saline layers in the Baltic, simultaneously with the adjustment of the water temperature by mixing and radiation. The oxygen content of the deep water deteriorates due to utilization in various processes until the water is renewed again. In the areas north and west of Gotland changes in temperature and salinity are no problem of great immediate importance for cod, but the low salinity and - particularly in the west - the generally low oxygen content of the bottom water reduce, or constitute obstacles for effective spawning.

When cod eggs were noted in the AS they were found at S 12 (at most 4 eggs/m^2, April 1968), the deepest and easternmost of our stations in the AS. Kändler (1944) summarized the German observations in the AS from 1925 to 1938. According to him at most 22 cod eggs/m^2 were observed in the AS (at a station close to S 12, April 1933). Only seldom were more than 5 eggs/m^2 found. - The low abundance is due to the unusually very thin (5-10 m) and instable saline bottom water layer of this shallow basin with a maximum depth of 53 (55) m. The halocline is most frequently to be found at about 40 m. Sometimes a passive transport of eggs and larvae may occur from the Belt Sea and the Sound.

The most important spawning region for cod in the Baltic is the BS, as pointed out by many authors. The oxygen content here below the halocline (at c. 50 m) is at least partly always high enough for cod spawning and egg survival. The bottom water (below 70 m) shows, as mentioned above, periodically an oxygen deficit and sometimes H_2S content. - Other areas of great significance for cod spawning are the Slupsk Furrow, the Gdansk Bay and the southernmost part of the Gotland Basin, all in the SGS. Mass appearance of cod eggs can thus be recorded in the SGS and also in the MEGS when the oxygen situation is favourable.

Only exceptionally have eggs and larvae been detected north of Gotland. Hessle (1923) found in the first decade of June 1921 4 cod eggs in the Landsort Deep (MWGS) and on two occasions in September 1921 one larva was caught at the same place. Mielck (1926) found cod eggs as far north as N 58°51' E 19°20' (ESE Huvudskär). The eggs he collected seemed to be undeveloped and they remained so although artificial development was tried. The station mentioned is situated about 30 n. miles west of the most northerly locality where we found cod eggs in the NEGS (at station F 75 in June 1970, map 15). Grauman (1972a) reported a mean number of 2 eggs/m^2 but no larvae in 1969 and 1970 from the area between latitude 58°00' and 59°05' N. - No eggs have been recorded in the NWGS or north of latitude 59° N during the present investigations. Only once were cod eggs caught in the MWGS (S 41, 1971), where Grauman (1970 a, 1972 a) collected a few eggs in 1969 and 1970 in the "Öland Area" ("Åland Area" in 1970 obviously is a misprint).

East and north of the BS the halocline of the Baltic proper is situated approximately in the layer 60-70 m from the surface (in the far north at a depth of c. 70-80 m). A salinity sufficient to keep the cod eggs floating is found some metres below the halocline. Between latitude 59° N in the south and the shallow sill area (depth: c. 40 m) to the Åland Sea and the entrance (depth:c. 80 m) to the Gulf of Finland in the north the water at a depth of 100 m or more has a salinity of c.10-11 ‰ or just sufficient to keep the cod eggs floating. Here, as well as in the waters north and west of Gotland, in general the cod had a sparse stock and the oxygen conditions have been too bad since the fifties for successful spawning in water of appropriate salinity (at least c. 11 ‰, cf. p. 9). The oxygen content as a rule has been below 1.5 ml/l or none at all (Fonselius 1969 and later reports). Due to these facts no eggs or larvae could be obtained from the NWGS (where they were found by Hessle in the beginning of the twenties) and only occasionally from the NEGS and the MWGS.

Though the present material is fairly restricted, the connection between the oxygen content of the Baltic deep-water and the distribution and abundance of cod eggs and larvae is apparent. The Swedish observations coincide also with the results obtained yearly by Grauman (op. cit.) mainly in the period April - June. The years showing a large oxygen deficit, 1968 and 1971, are characterized by a low number of eggs and larvae in the areas in question. The renewal of a great part of the deep-water in 1969 was followed by a greater abundance of eggs and larvae, particularly in 1970. An increase in the number of eggs occurred already in 1969 in the BS. The number of larvae was generally small, however, possibly a consequence of the low bottom temperature here and the oxygen deficit in the central Baltic. The oxygen conditions were more favourable in the latter waters during the 1970 spawning period. This year we obtained the highest number of eggs in the SGS and the northernmost record mentioned (just south of latitude 59° N.). Furthermore the abundance of larvae was the greatest one noted by us.

The general trend towards a higher salinity of the Baltic deep water in recent decades(cf. e.g. Mankowski 1951, Dementjeva 1957, Fonselius 1962, 1969) should have had only a positive effect on the spawning of cod - enlarging the appropriate spawning area both horizontally and vertically - if not the oxygen conditions had deteriorated. Of course, an influx of water from the southwest, for instance to the central parts of the Baltic proper, giving a higher salinity and oxygen content in the depths, temporarily offers better spawning conditions for cod. In recent years, however, the water exchange has obviously been too slow and the oxygen content the most important limiting factor, particularly in the central and northern parts of the Baltic proper. This problem and the temperature factor will be further considered when dealing with the vertical distribution of pelagic fish eggs and larvae in the Baltic.

The changes in the strength of the southern Baltic cod stock may be followed roughly from the egg numbers. Kändler (1949) compared all German data and those obtained by Mankowski (1948) on ichthyoplankton sampling in the Baltic proper during the period 1903 - 1947. In the period 1903 - 1911 the highest number of cod eggs was 96 eggs/m^2 in the BS (June 23rd, 1911). The cod population was at this time almost unexploited. During the years of 1926 - 1935 at most 78 eggs/m^2 were collected in the BS (July 8th, 1926). In the beginning of August 1938 no fewer than 344 eggs/m^2 were registered in the BS. In 1947 Mankowski (1948) noted a new record for the Gulf of Gdansk: 439 eggs/m^2 on August 5th. These high figures occurred during a period with a great increase in the Baltic cod catch from the late 1930's and onwards (until the 1950's). They indicate a growth of the cod stock coincident with a heavy increase in the fishing activity as suggested by Kändler (1949) and others. According to Otterlind (1966 and verb. communication) the last mentioned factor is, no doubt, the most important one for the general increase of the catches.

During the period 1967 - 1971 at most 253 eggs/m^2 have been found in the BS. This happened in the middle of June, 1969 - the year when a great influx of salt-water took place and renewed the bottom water of this basin. Thus, in spite of a much more intense investigation activity during the last five years, the highest figures obtained are lower than those reported from 1938 and 1947. This observation may support the general view of fishery biologists that now the Baltic cod stock cannot be exploited more intensively without risk for over-fishing. Further investigations into the abundance of eggs and larvae will, however, give more reliable grounds for the assessment of stock size and recruitment.

The problem of distinguishing two populations of Baltic cod in relation to observed differences in egg size will be considered in connection with the vertical distribution of fish eggs and larvae.

Spawning time of cod

A very prolonged spawning occurs in the BS. The only months when eggs have not been found here are November, December, January, and February. This was noted by Kändler in 1944. Spawning obviously takes place during at least eight months of a year (cf. maps nos. 8-11). From the AS eggs are reported already in February according to Kändler (1949). These facts are in agreement with the statement of Otterlind (1967 b) that ripe cod can be recorded all the year round in the southern Baltic. The peak of spawning is noted in different months due to the varying hydrographical conditions. Most eggs are collected in the southern Baltic in April - June. The samples from the SGS and MEGS are too few to say anything definite about the spawning time of cod in those regions. It is, however, observed that spawning occurs there from April and even late in October (map 18). In the deeps of the Åland Sea and the Bothnian Sea the main period for the (ineffective) spawning is July - August (Otterlind 1967 b), but even in April ripe cod have been caught in the Bothnian Sea (Lönnberg 1895, Hessle 1923).

Sprat - Sprattus sprattus

Recruitment and environment

Eggs of sprat are known to float at lower salinities than cod eggs. Kändler (1949) writes that the eggs in the Baltic can float at a salinity of only 6 ‰. The distributional situation of the sprat is also quite different from that of cod in this sea. For effective spawning the sprat is not exclusively dependent on deep water below the halocline. Eggs and larvae have been found both in the surface water and in the depths - according to Hessle (1927) down to 100 - 200 m.

The spawning area northwards includes the Åland Sea and the Gulf of Finland. The northernmost egg record during the present investigation is from the station Solovjeva (lat. 60°12,5'N) in the Åland Sea on July 28th, 1970. In the Bothnian Sea this species is a fairly regular immigrant up to the Northern Kvark, particularly off the southern part of the Finnish coast. Malmgren (1863) stated that the sprat was present as far north as at least to Björneborg in the Bothnian Sea (N 61°30'), but was not commercially fished north of Raumo (about N 61°10'). In 1910 (Anon. 1910) the northern spawning border was drawn about where the southern border of the Åland Sea is placed in Fig. 1. It has long been known that sprat spawn in the Gulf of Finland. Nordqvist (1901) observed eggs between the Jussarö lighthouse and the island of Odensholm and between Helsingfors and the Wulfö island. In our investigation we noted eggs farther east at the station 22 A (=L 5) in the beginning of June 1970.
No eggs or larvae were found by Hessle (1927) in the areas north of the Åland Sea. Lindquist (1959) collected a few fish eggs in the Bothnian Sea in 1956-58. The species of these eggs were not determined at that time, but two of the samples have now been re-examined and found to be sprat eggs (recorded at the

positions N 61°44', E 20°32' and N 61°05', E 20°37', 22-23rd of July, 1958). This species has been noted only sparsely in the Bothnian Bay (Otterlind, verb. communic.)

Swedish fishermen report that there is intense spawning at the end of April and in May outside the skerries off the Swedish east coast at the bottom in a depth of 60 - 70 (80) m, for example north of Öland. It happens at times that the herring trawlers in this area get their trawls ruptured by catching the very dense shoals of ripe sprat. In the Hanö Bay at the Swedish south coast, sprat spawning seems to be less regular in spring. Some years, however, ripe sprat are very common here at depths of 35-45 m outside the skerries or off the coast of Scania in May - June. Hessle (1927) made his investigations later, mainly during June - July, and found spawning fish almost exclusively in the uppermost water layers (in the surface or some few metres beneath). Obviously spawning in the surface water begins when the temperature is high enough. The earlier deep spring spawning goes on below the cold surface layer (cf. Mankowski 1958).- These observations are in agreement with Grauman's (1965) finding of two groups or types of sprat eggs: one occurring in the bottom water layers of the south-eastern Baltic in March - May, at temperatures between 4 and 7°C, salinity 9 - 13 ‰. The other group of eggs occurred in the surface layers of the water in June, at temperatures between 7 and 12°C, salinity 7 - 8 ‰. According to Grauman the difference in the seasonal distribution of sprat corresponds with the temperature situation. This matter will in the present author's next report about the vertical distribution of ichthyoplankton be further discussed.

Grauman (1965) states that the (necessary) conditions for the development and survival of sprat eggs in the bottom layers are found to be considerably more favourable than those in the surface layer, where the sprat eggs are under the influence of many external factors such as storms, changes in temperature, etc. Furthermore the quality of the spawned eggs is said to be important. In June younger sprat, which probably have less vital eggs, spawn in the surface layers.

As an consequence of the minor demand - compared with that of the cod - on high salinity, the sprat stock is less influenced by the oxygen conditions in the deep water. An oxygen deficit here is, however, followed by a concentration of the sprat shoals just above, in or close to the halocline, if the temperature conditions permit (cf. Rechlin 1967). In this way the convenient space for spawning must, to some extent at least, have been reduced in recent years, e.g. in the central Baltic. The fish may be forced to migrate and eggs and larvae may show a lower survival rate with decreasing oxygen content after spawning in deeper layers. The pelagic life of the sprat and the minor dependence of the eggs on salinity are, however, great advantages in this connection.

Distribution and abundance of sprat eggs and larvae in 1967 - 1971

1967.- In our samples from the Baltic in 1967 the eggs of sprat were abundant. At the end of May and the beginning of June the average number of egg in the AS was 42 eggs/m^2. The corresponding value for the BS was 76 eggs/m^2. During April to May 1967 Grauman (1969 c) found on an average 59 eggs/m^2 in the BS. In May - June we visited two stations in the eastern Baltic, Rysshålan and E Hoburgen, where 127 eggs/m^2 and 94 eggs/m^2 respectively were observed. Grauman's mean value was 52 eggs/m^2 for the southern Gotland area. - Sprat larvae were not caught in the AS in 1967, and very few were captured during our cruises in the BS. They were, however, abundant in the eastern Baltic (average value of two stations: 22 larvae/m^2). This difference is also obvious from Grauman's tables (1969 c) and can be explained at least partly by the greater proportion of living eggs noted in the eastern Baltic (35 %) compared with the BS (25 %). It is not impossible, however, that the distribution of larvae might have shown another picture one or two weeks earlier or later, depending on the different spawning times of the sprat in the BS and the eastern Baltic.

It may be interesting to note that the observed difference in the abundance of larvae was still present in the distribution of mature sprat three years later. Thus, in 1970 the 1967 year-class predominated in the catches from the eastern Baltic while in the catches from the BS the 1965 and 1966 year-classes were most abundant (Polivaiko 1972). On the whole the 1967 year-class was considered to be abundant (Seletskaya 1969) Veldre (1971) writes that the 1967 year-class was very rich in the NE parts of the Baltic proper (including the GF).

1968. - In April 1968 only 7 eggs/m^2 were found, as a mean for the BS. Grauman's value for the period April - May was 34 eggs/m^2 (Grauman 1969 c). At Rysshålan (SGS) and S 41 (MWGS) 30 eggs/m^2 and 25 eggs/m^2 respectively were observed in August, indicating late spawning this year. No eggs were found in the samples from the AS at any time of the year.

Bad oxygen conditions greatly influenced the egg survival rate in 1968. In the BS survival decreased from 25 % in 1967 to 6.9 % in 1968, and in the southern Gotland area from 35 % in 1967 to 6.2 % in 1968 (mean values for the period April - May according to Grauman 1969 c).

Not only the number of eggs decreased, but also, at least partly as a result of the impaired egg survival rate, the number of larvae. During 1968 only one larva was captured (at N 1, in April). Grauman (1969 c) observed the same number of larvae in the BS in 1968 as in 1967 (2 larvae/m^2; mean value for the period April - May), but the number decreased in the southern Gotland area from 8 larvae/m^2 in 1967 to 2 larvae/m^2 in 1968. The 1968 year-class was below average according to Grauman (1969 c), Seletskaya (1970), Grauman & Polivaiko (1972), Polivaiko (1972). In the north-eastern parts of the Baltic proper (including the GF) the 1968 year-class was poor to medium according to Veldre (1971).

1969. -In 1969 dense concentrations of eggs were observed. As early as in February Mańkowski (1970 b) noted 131 eggs/m^2 in the BS. Because of the more favourable oxygen content and salinity of the bottom water layers this year, the spawning efficiency increased, egg survival rose from 6.9 % in 1968 to 28 % in 1969 in the BS, from 6.2 % in 1968 to 23.5 % in 1969 in the southern Gotland area, and from 9.3 % in 1968 to 23.5 % in 1969 in the Gdansk area (Grauman 1970 b). However, as for cod, the survival of sprat eggs was lower in 1969 than in 1967 east of the BS. At the end of March we found 60 eggs/m^2 at S 24 (BS). Mańkowski (1970 a) counted 181 eggs/m^2 this month at the same station. Some eggs were present in our samples from the AS in June (19 eggs/m^2, S Trelleborg). According to Mańkowski (1970 a) the number of eggs found at S 12 (AS) in July exceeded 300/m^2. Mańkowski (1970 b) collected at most 257 eggs/m^2 in the BS in May - June. According to our findings the centre of spawning was now situated in the areas north and north-east of Christiansö. The average number in the BS was then 82 eggs/m^2. For the period April - June Grauman (1970 b) observed 72 eggs/m^2 in this area.

In the southern Gotland area the average number during the same period was 51 eggs/m^2 according to Grauman. The only stations we visited here were Rysshålan and Yttre Gdanskbukten, where 28 eggs/m^2 and 77 eggs/m^2 respectively were noted in the first half of June. No eggs were caught at Rysshålan in March. When the spawning period was ended in August in the BS, eggs were still abundant east, south and west of Gotland. The mean value for the stations in the SGS + MEGS was 21 eggs/m^2, for the stations in the MWGS + NWGS 45 eggs/m^2. Thus, intensive spawning occurred around Gotland during late summer in 1969.

In the BS the average number of larvae in June 1969 was 2 larvae/m^2. Grauman (1970 b) noted 3.5 larvae/m^2 in the same area during the period April - June. We observed only one larva east of the Slupsk Furrow (at Rysshålan in June), while Grauman for the period mentioned above collected on an average 5 larvae/m^2 in the southern Gotland area. Mańkowski (1970 b) showed that the Gdansk Deep with its surroundings was the most important recruitment area in 1969. 542 eggs/m^2 were noted at one station in June and 816 larvae/m^2 were caught at another station. Mańkowski writes: "in the Bornholm Deep, there are single larvae, in the Gdansk Deep there are hundreds per square meter".

According to the observations made, it seems possible for the 1969 year-class to be of about average strength or somewhat above, at least in the BS. The recruitment to the Bay of Gdansk stock was presumably very strong. Veldre (1971) considered the 1969 year-class to be good in the southern Baltic proper and of medium strength in the Gulf of Finland and other parts of the NE Baltic proper. Grauman & Polivaiko (1972) estimated the 1969 year-class to be above average strength in the Gdansk and Gotland areas. - Polivaiko (1972) observed that the 1969 year-class was much more abundant during 1970 in the samples from the BS than in samples from the Gdansk and Gotland regions.

<u>1970</u>.- In 1970 the abundance of eggs and larvae was high in almost all areas. The survival of eggs increased from 28 % in 1969 to 32.2 % in 1970 in the BS, from 23.5 % in 1969 to 24.0 % in 1970 in the Gdansk area and from 23.6 % in 1969 to 32.9 % in 1970 in the southern Gotland area (Grauman 1972 b). Polivaiko (1972) pointed out that the very strong 1967 year-class was predominant in the eastern areas, while the weaker 1965 and 1966 year-classes were more abundant in the BS. The number of eggs and larvae was also higher in the GS than in the BS, according to our findings.

In the first days of March 1970 eggs were found in the BS. The mean value of the three stations investigated (S 24, ENE Christiansö, and Inre U 10) was 11 eggs/m^2. In May most eggs were observed at Klaipeda (210 eggs/m^2). The mean number of eggs for the period May 22nd - June 10th was 42 eggs/m^2 in the BS, 111 eggs/m^2 in the SGS and 15 eggs/m^2 in the MEGS. The figures given by Grauman (1972 b) for the period April - June are 82 eggs/m^2 in the BS, and the mean for the Slupsk, Gdansk and southern Gotland regions (approximately the same as the SGS) was 101 eggs/m^2. This year much fewer eggs were observed in August in the MWGS and NWGS compared with 1969. In 1970 the AS was obviously of no importance as a spawning area. - For the period May 22nd - June 10th 1970, on an average 6 larvae/m^2 were registered in the BS, 34 larvae/m^2 in the SGS and 10 larvae/m^2 in the MEGS. Grauman (1972 b) noted during April - June 3 larvae/m^2 in the BS, 19 larvae/m^2 in the SGS (approximately this area), and 31 larvae/m^2 in the middle Gotland area.

The 1970 year-class was estimated to be strong, especially the Gotland stock (Grauman 1972 b, Grauman & Polivaiko 1972). Veldre (1971) estimates this year-class to be of medium strength in the NE part of the Baltic proper, including the Gulf of Finland. The year-class was good in the southern part of the Baltic proper according to the same author.

<u>1971</u>. - In 1971 the AS was very important as a spawning area for sprat in June and July. Large numbers of eggs were found within this region in the first half of June (period I, map 81). A high abundance was noted also as far north as the Gotland Deep. Judging from the higher number of larvae present in the SGS and the MEGS, spawning had obviously started earlier east of the Slupsk Furrow, than in the AS and the BS. Few eggs and no larvae were obtained north and west of Gotland in the first half of June.

The distribution of eggs and larvae had changed when the next expedition took place during the end of June and the beginning of July (period II, map 82). The number of eggs and the amount of larvae in particular had increased west of the Slupsk Furrow, while fewer larvae were recorded east of its threshold. North of Gotland the number of eggs had risen and west of this island larvae were present at the Karlsö Deep (23 larvae/m^2). Thus, spawning started earlier in 1971 in the deep-water of the eastern parts of the Baltic (SGS, MEGS) than in the western parts (AS, BS). North of Gotland spawning was more retarded in time than in other regions, as indicated by the absence of larvae.

The average numbers of eggs and larvae for the two periods mentioned (Period I, June 7 - 18, Period II, June 28 - July 9) were as follows:

Period I		Period II		Area
Eggs/m^2	Larvae/m^2	Eggs/m^2	Larvae/m^2	
210	0.5	208	34	AS
164	4.5	258	23	BS
204	21	137	8	SGS
67	9	93	8	MEGS
26	0.3	125	22	MWGS
15	0	137	0	NWGS
11	0	61	0	NEGS

During the late summer of 1971 only a very insignificant spawning could be observed in the northern areas (cf. map 83).

The 1971 sprat year-class must be expected to be of a strength much above average. The total egg and larva numbers noted this year were the highest observed during the last five years (1967 - 1971). Three facts should be pointed out for 1971 as they differ from experience gained in the preceding years:

1. AS was one of the most important spawning areas, and larvae were more abundant there than elsewhere.

2. The number of eggs was higher in the BS and the AS than during any other year since the beginning of the investigations in 1967.

3. Intensive spawning occurred simultaneously in the AS, BS, SGS, MEGS, MWGS, NWGS and in the NEGS (period II).

Recruitment and sprat migrations

As mentioned above Polivaiko (1972) in 1970 found the 1967 year-class to be more dominant in the eastern Baltic than in the BS; i.e. they were more abundant within the area in which the highest larva abundance was noted in 1967 (cf. map 59). Egg survival was higher in 1967 in the eastern parts of the Baltic compared with the BS (Grauman 1969 c). In 1969 we caught more sprat larvae in the BS, in comparison with the SGS (cf. map 67). Egg survival was this time highest in the BS (Grauman 1970 b). One year later, i.e. 1970, Polivaiko (1972) noted that the 1969 year-class was much more abundant in the catches from the BS than from the eastern Baltic.

In this connection it can be stressed firstly that the numbers of larvae noticed were higher in areas where the egg survival, according to Grauman (1969 c, 1970 b) was highest. This may support the statement by Grauman (1965) that rich year-classes of sprat are characteristic of years with great quantities of sprat eggs and larvae and good survival of eggs. Secondly, we are now faced to the fact that on two occasions during the period 1967 - 1970, the year-class which was most numerous as larvae within a certain region was also most abundant in the catches from this area one to three years later. This might very well be a mere coincidence and it does not preclude the possibility that different results might have been obtained during other time periods. Nevertheless, it may be an indication that at least young sprat do not to any great extent make migrations across the Slupsk Furrow, from the BS to the SGS or vice versa. However, there must still exist some exchange between the two areas, possibly mainly, by migrating adult fish (cf. below). When large inflows of salt water through the Danish sounds occur they are often followed by a renewal of the bottom water even in the central Baltic proper. Such events include dispersal of water with oxygen deficit from the depths and may force sprat to make long migrations.

Elwertowski (1958) showed that "sub-populations" can live in such nearby places as the BS and the Bay of Gdansk. The differences observed between such "sub-populations" are, however, not large enough to justify the name "races". It is a well-known fact that differences in number of vertebrae, growth, etc. in fish species are mainly the result of external factors such as temperature, food supply and so on. According to Mulicki (1948), the eastern Baltic sprat was separated from the western one on the basis of growth differences also by Ehrenbaum (1919) and Dixon (1937). Mulicki considered sprat fished in the Gulf of Gdansk as peculiar to that region on account of variations in the yearly catches from various areas of the Baltic.

Elwertowski (1965) observed that during the spring spawning period sprat of mainly young year-classes of smaller size made up the catches in the coastal fishing grounds of the Bay of Gdansk, whereas in the areas of the Gdansk Basin in the open sea, older and larger sprat were more common. Lindquist(1971, 1972) also noted that in the open sea there exists a "pool of seniors", i.e. a population of mainly older fish, where young fish were rare. The three- and four-year-old sprat predominated. Obviously there is a change in the migration pattern of the fish when they reach this age and many of them do not return towards the coastal areas after spawning. Instead they stay in the open sea to go down or migrate to the deep water layers of the southern, central and northern Baltic proper in late autumn and winter. In these areas the sprat can find good wintering conditions (Rechlin 1967, Lindquist 1971, 1972). Sprat are caught in large numbers northeast of Gotland and elsewhere in the GS during the winter (Rechlin 1967), but sprat can also be abundant in the BS at this time and during certain years at least in the AS too (Otterlind, verb. communic.). Changes in the distribution may be due to hydrographical factors.

During spring concentrations of sprat for spawning take place - at least of younger fish - in the deeper coastal areas, for instance off the Swedish east coast (cf. p. 16). A very strong invasion, possibly from the north, and mass spawning is known to occur in the Gdansk region (Mańkowski 1970 b).

A scrutiny of the maps, e.g. nos. 73, 75, 81 and 82, confirms that the sprat spawn all over the Baltic proper and in the Åland Sea. This is quite different from the situation off the Swedish west-coast. Höglund (1938) observed that spawning mainly occurred within the 50 m and 100 m depth contours in the Skagerrak - Kattegat area (end of May 1933 and 1934). Most eggs were found from the border of Norway - Sweden, along the Swedish coast to the middle of the Kattegat (N of Anholt). A tongue protruded into the Skagerrak to north of Hanstholm. Lindquist's works (1968 a,b, and 1970) confirm these findings (investigation period: May - June, 1959 - 1963). Very few eggs were present west of Hirshals. In a narrow zone between Skagen and Marstrand the most dense egg concentrations were registered, but north and south of this area only minor amounts were recorded. Most eggs were present where the cold water border (remaining winter water) at depths of about 10 m to 30 m was situated. Lindquist supposed that the ripe sprat started spawning as soon as they met with the cold water. The spawning area of the Skagerrak was completely isolated from the North Sea spawning regions.

Such a temperature border - a more or less oblique one between different currents - does not exist in the Baltic. In the Baltic proper, however, there is an important layer of cold "winter-water" from the winter all through the spring, summer, and autumn between the surface water and the permanently warmer bottom water below the halocline (Otterlind 1968 c,d). If low temperature is a factor of importance for the sprat to start spawning, cold water is generally available all over the sea area mentioned.

There are no distinct concentrations of eggs at particular places in the Baltic, though a tendency towards more eggs being found in the open sea than in the shallower coastal areas may exist. Hessle (1927) pointed out that the greater part of the sprat stock spawned outside the archipelagos, very often at comparatively short distances from the coast. When favourable conditions occur, as in 1971, high numbers of eggs and larvae are recorded at all places, regardless of whether the areas are shallow or deep. Drift of eggs and larvae with the currents must be considered, however. As a rule the southern parts of the Baltic proper contain more eggs and larvae than other areas.

Changes in the abundance of sprat eggs and larvae

High numbers of sprat eggs and larvae have seldom been reported earlier in the AS. Kändler (1949) stated that the AS was of little importance for the spawning of sprat. Nevertheless, in certain years, e.g. 1967, 1969 (cf. Mańkowski 1970 a), high egg numbers can be found and especially in 1971 the AS was one of the most important areas for high egg and larvae abundance. To some extent transport with currents from the west or east may be involved here. It is quite obvious, however, that great changes in abundance of spawning sprat sometimes are a consequence of migration.

Kändler (1949) summarized the German results from the ichthyoplankton surveys in the Baltic and the results gained by Mańkowski (1948). During the period 1903 - 1938 more than 42 sprat eggs/m^2 were never found in the AS. In July 1969 Mańkowski (1970 a) observed 343 sprat eggs/m^2 in the AS and we noted 315 eggs/m^2 in June 1971. - In the BS 63 eggs/m^2 were collected in June 1911, 286 eggs/m^2 in June 1931 and 30 eggs/m^2 were registered in July 1938 (all figures maximum values). Mańkowski (1970 a) found 320 eggs/m^2 in July 1969. We noted no fewer than 466 eggs/m^2 in July 1971. - The number of eggs in the Bay of Gdansk has changed considerably during the years. The maximum value in May 1903 was 155 eggs/m^2, at the end of May 1931 1273 eggs/m^2, while in the beginning of June 1938 only 4 eggs/m^2 were caught. On July 1st 1947, 259 eggs/m^2 were observed. Mańkowski (1970 b) obtained at most 942 sprat eggs/m^2 in the Gdansk Deep in May - June 1969. In our samples from the Bay of Gdansk in June 1970, 121 eggs/m^2 were present.

In the southern part of Gotland Basin (in SGS) the maximum figures for sprat eggs were, according to Kändler (1949), 72 eggs/m^2 in May 1931 (for the period 1907 - 1931) and 1 egg/m^2 in July 1938 (one exp. only). During the present investigations the highest egg number noted in this area was 251 in May, 1970 (at the station Klaipeda). Our observations and those of Grauman (op. cit.) indicate a general increase in the open sea spawning of sprat in the central and northern Baltic. It must be stressed, however, that the earlier observations are sparse. The figures from the southern Baltic mentioned by Kändler (1949) show great variations connected with fluctuations mainly in the local abundance of sprat.

The increase in salinity and higher temperature of the deep water of the Baltic proper during recent decades (cf. Otterlind 1968 b) probably favour the sprat stock and so does the periodical stagnation of the bottom water. When stagnant deep water, enriched with nutrients, is brought up by inflowing salt water the surface layer becomes fertilized. This may result in a plankton blooming, as was noted in 1969 and 1970. Such enormous amounts of available food for the sprat larvae must have a very positive effect on the recruitment to the stock. It is well-known that the catches of Baltic sprat have risen very much in recent years - in 1970 the total catch passed 140,000 tons.

Spawning time for sprat

The Baltic sprat has a long spawning period, lasting from at least March to August. In 1972 sprat eggs were even observed at the end of January in the waters below 50 m depth in the BS. From the fact that larvae were present one can conclude that spawning had gone on for some time. In August only individual eggs are caught in the BS and the centre of spawning is situated in the regions mainly east, west, and north of Gotland. The peak of spawning is in May - July in the southern Baltic. As for cod spawning is retarded in in the northern areas of the Baltic and in some years at least the peak seems to be in July - August. A later spawning here is of course - particularly in the surface water layers-a consequence of the delayed seasons and colder climate. In the Kattegat the eggs are found from the middle of April to the middle of August, the highest frequencies occurring in April - May (Heegaard 1947). Variations from year to year must depend on hydrographical factors, partly directly influenced by the climatological development of the year and the year before.

Four-bearded rockling - Onos cimbrius

1967. - In May - June relatively large numbers of eggs were found in the BS and at Rysshålan (SGS). At most 66 eggs/m^2 were present (at N 1, BS). Even in September spawning was going on in the BS (26 eggs/m^2 were noted at N 1), and in November one single egg was observed at S 2 (BS). - Two larvae were caught in the BS in September.

1968. - The number of eggs/m^2 amounted to 29 at N 1 (BS) in April. Spawning was ended as early as in August. - No larva was captured this year.

1969. - Eggs were present both in the BS and the SGS in June 1969. Most eggs were noted at Yttre Gdanskbukten in the SGS (32 eggs/m^2). During the July - August cruise a few eggs (6 eggs/m^2) were observed at N 1. One single egg was seen in the samples from the Bornholm Strait in October. - The only larva registered was caught in the BS in June.

1970. - At the end of May one egg was recorded in the AS. The eggs were more abundant in the south-western part of the SGS (S 23) where 32 eggs/m^2 were found. At Klaipeda 4 eggs/m^2 were present at this time. Four days later the number increased to 57 eggs/m^2 at Klaipeda, but they remained at the same level at S 23. During this cruise eggs were present from south of Trelleborg to the Gotland Deep. A few eggs were noted in the middle of October in the AS (5 eggs/m^2 at S 12), BS (one egg at S 24), and SGS (one egg at S 23). - One larva was caught at the Gotland Deep (MEGS) in the beginning of June, one at station S 12 (AS) in the beginning of October and one at the end of this month at the same station.

1971. - In June eggs were found in the BS (36 eggs/m^2 at S 2), SGS (at most 23 eggs/m^2 at Klaipeda), and MEGS (4 eggs/m^2 at F 81). At the end of June 55 eggs/m^2 were noted in the AS (at S 12), while in the BS and the SGS the number had decreased considerably. Only one egg was observed in the BS (at station 532) and at most 10 eggs/m^2 were registered in the SGS (at Klaipeda). No egg was present in the MEGS. Late spawning was not observed in 1971. - One larva was caught in the BS and one in the SGS in July. In the AS 4 larvae/m^2 were captured in August (S 12) and one in September (S 12).

In the Baltic the four-bearded rockling can be very abundant in the bottom trawl catches from the southern parts of the sea. It is found up to Gotland and the Gulf of Finland. The distribution of eggs is in accordance with the findings by Mielck (1926). Eggs are present from the AS to the MEGS, but are missing west of Gotland and in the Landsort area (NWGS). The spawning fish seems to prefer shallower areas west of the Slupsk Furrow than the cod. Eggs are mainly found north and south of Bornholm in the BS. At Slupsk Furrow large numbers of eggs are sometimes found (cf. maps nos. 43 and 44). East of Slupsk Furrow great numbers of eggs are observed even in the deepest parts (e.g. Klaipeda, Yttre Gdanskbukten, Gotland Deep). The AS contains mostly very small numbers of eggs but occasionally, as in 1971 (map 53), eggs are abundant in this area, too. The spawning time is long and eggs have been found from April to October.

The low number of larvae is peculiar. During the investigation period 1967 - 1971, only 12 larvae were recorded. Of these 7 larvae were found in 1971. Older investigations, e.g. Apstein (1911) and Heinen (1912), do not contain any larvae of the four-bearded rockling, although about the same amount of eggs was present. Mielck (1926) did not find any larvae east of the BS. In our investigation larvae were observed from the AS to the MEGS. At most 4 larvae/m^2 were noted at one station (at S 12, August 1971, map 54).

As can be seen from maps nos. 30 - 58, eggs of the four-bearded rockling are observed very often in the southern Baltic. The numbers of eggs are, however, mostly smaller than those of e.g. cod and sprat. Kändler's work (1949) shows that during the period 1903 - 1938 at most 29 eggs/m^2 were obtained in the AS (July 19th, 1938). In our investigation we registered 55 eggs/m^2 in 1971 (June 29th). Kändler writes that 92 eggs/m^2 were caught in the BS in 1906 (August 4th), while in the period 1925 - 1938 a maximum of 126 eggs/m^2 were found 1931 (May 22nd). The highest number of eggs noted by us in the BS for the period 1967 - 1971 was 66 eggs/m^2 (May 31st, 1967). No more than 26 eggs/m^2 were counted in the samples from the Slupsk Furrow during the years 1903 - 1938 according to Kändler. 34 eggs/m^2 were present at S 23 in May 1970. The maximum egg number in the Bay of Gdansk during the period 1903 - 1911 was, according to Kändler, 93 eggs/m^2, in 1925 - 1938, 267 eggs/m^2 (both figures from the end of July). In 1947 81 eggs/m^2 were collected at the beginning of August. We noted only 13 eggs/m^2 at Inre Gdanskbukten (June 3rd, 1970). 32 eggs/m^2 were counted at Yttre Gdanskbukten in June 1969. In the eastern Gotland Sea 116 eggs/m^2 were once recorded (August 3rd, 1907). We observed at most 57 eggs/m^2 at Klaipeda at the end of May, 1970.

Plaice - Pleuronectes platessa

Eggs of plaice were found only sporadically during the present investigations and always in very small numbers (at most 5 eggs/m^2 were collected at one station). No eggs were noted before 1970. However, in 1967, no expedition was made in the first months of the year. In the middle of January 1970 3 eggs/m^2 were recorded at S 24(BS) and at the end of this month 3 eggs/m^2 were found at SW Utklippan (BS) and 1 egg/m^2 was registered at Y 17 (AS). At the beginning of March 3 eggs/m^2 were again noted at S 24. During 1971 eggs were observed only once: at S 12 (AS) 5 eggs/m^2 were present at the beginning of April. - During the whole period 1967 - 1971 only one plaice larva was collected, namely at SW Utklippan at the end of May 1967.

Thus eggs of plaice were found from January to April. They were only present in the AS and BS. Schneider (1908) recorded plaice eggs only in the BS, while Mortensen (1896) could not find any eggs in the BS that, with certainty, belonged to the plaice. Petersen(1894) did not believe that successful spawning could take place in the Baltic with its low salinity. Instead the plaice probably immigrated from the west where spawning conditions were more favourable. Plaice eggs need a higher salinity to float than eggs of the cod, sprat, flounder, etc. Hensen (1884) found that the density of plaice eggs in the Kiel region corresponded to a salinity of 17.8 ‰ (17.5°C). Petersen (1894) reports that no plaice egg from the Faenö Sound (Belt Sea) was able to float below 14.4 ‰ (10°C), about half of them floated at 17.0 ‰ salinity (9.8°C), and all floated at 18.5 ‰ (9.8°C). Experiments by the present author showed that plaice eggs from the AS (fertilized immediately before the experiment) floated in water with a salinity of 17.61 ‰ (18.0°C) but sank to the bottom when the salinity was lowered to 17.05 ‰ (17.6°C). Eggs spawned in the BS may have a lower limit for their floating ability. Ehrenbaum & Strodtmann (1904) found one plaice egg in the eastern part of the BS floating at a salinity of 13.73 ‰ (4.57°C).

The absence of plaice eggs and larvae in most samples from the AS and BS does not necessarily indicate that the eggs are unable to float at these stations. Eggs and larvae may very well be present in the water layer close to the bottom where the net does not fish (0 - 3 m). Even if one ascertains that the weight at the lower end of the net is in contact with the bottom before the hauling begins, there are still up to 3 metres which will not be searched through and where eggs and larvae may be present. To reduce this sampling error the net is, if possible, allowed to sink until the ring around the net opening lies on the bottom. However, in many cases the net is then filled with mud, making the sample impossible to investigate. - Furthermore few expeditions have been made in January when ripe females are most abundant.

Even in the beginning of the twentieth century plaice eggs were noted in small numbers, although higher than during the present investigation, e.g. 33 eggs/m^2 were observed in the middle of February 1909 close to S 24 in the BS (Apstein 1911). At the same station 21 eggs/m^2 were still found at the beginning of April 1909 together with 6 plaice larvae/m^2. Heinen (1912) registered 21 plaice eggs/m^2 in the middle of January 1911 at S 24 (approximately) and 12 eggs/m^2 were recorded at the end of March. In 1911 no larvae were caught. Neither of these two investigators could find eggs of plaice in the AS or east of the BS. However, Nybelin (1923) writes that plaice eggs had been noted in the Gotland Deep (MEGS). The species is only a sparse immigrant into this area, however. According to Mulicki (1959) plaice do not spawn in the Gdansk Bay.

According to Kändler (1949) 33 plaice eggs/m^2 were noted in the AS (February) as a maximum value for the period 1903 - 1911. In 1925 - 1938 at most 12 eggs/m^2 were collected (April). We found 5 eggs/m^2 on the first of April 1971. The highest egg record during the period 1903 - 1935 in the BS was 42 eggs/m^2. The number was reduced to 21 eggs/m^2 in 1938 (both figures from March). We noted 3 eggs/m^2 in the BS in January and March 1970. East of the BS (Slupsk Furrow) Kändler writes that at most 6 eggs/m^2 were obtained from 1903 to 1938. In our investigation no plaice egg was present east of the BS. The generally low egg numbers observed in the Baltic may indicate that the recruitment is mainly by immigration of young fish from the west.

One may assume that the number of plaice (born or grown up in the Baltic) which enters the commercial stock each year is fairly low nowadays and the stock is generally small. The situation was different in the 1920's, when an intensive fishery for plaice started after the discovery of large unexploited populations in the deeper parts of the southern Baltic. After about 10 years of fishing the plaice stock was severely reduced. In spite of regulations and a fishery convention in the 1930's the plaice has not recovered. Fifty years ago about 4000 - 5000 tons of plaice were caught while nowadays only about 1000 tons are landed (cf. Otterlind 1972).

Reibisch (1911) mentioned that the plaice population in the eastern Baltic would continuously decrease unless older fish from the western part immigrated. A strong migration from the western Baltic to the eastern really exists, as shown by Otterlind (1967 c). Otterlind draws the conclusion that the easterly migrations, from the eastern Danish islands and to the AS and the BS, depended upon hydrographical factors, mainly the salinity. Plaice which have grown up in the western AS or entered into this area from the west, are as a rule forced by the thresholds in the west to stay here or to reach water with sufficient salinity for effective spawning in the BS.

Kändler & Pirwitz (1957) observed that the plaice from the Belt Sea (including the Kiel Bay) are more fecund than plaice from the AS and the BS (see also Bagenal 1966). Kändler & Pirwitz thought it possible that the higher number of eggs was an adaptation to the harder conditions of life in the brackish water. Bagenal points out that the conditions in the Baltic favour the selection of more fecund fish and that this appears to be true for all species investigated so far. A large number of eggs is necessary for the population in the southern parts of the Baltic and the Belt Sea because of the low salinity of the water, which complicates recruitment, and even because of the currents, induced by the water exchange through the Belt Sea, presumably transporting eggs and larvae away from the spawning places.

Flounder - Platichthys flesus

During the first decades of the 20th century there were large unexploited populations of flounder in the deep basins. After the trawl had been introduced to the fisheries of the southern Baltic in the 1920's the flatfish stock was fished intensively. The flounder, being less attractive for the fishmarket and more tolerant to low salinity and consequently having a wider distribution, could withstand the fishing pressure better than plaice and dab (Otterlind 1967 a, 1969 b, 1972).

Pelagic flounder eggs are known to float at salinities higher than 10 - 11 ‰ in the southern Baltic (e.g. Mielck 1926). In the northern Baltic proper the flounder spawn only non-pelagic or eggs that float in the immediate vicinity of the bottom (Sandman 1906). North of the Åland Sea the flounder is sparse and probably recruited by way of immigration.

Kändler (1949) writes that in the AS at most 48 eggs/m^2 were collected during the period 1903 - 1938. Apstein (1911) noted in the BS no fewer than 1,362 flounder eggs/m^2 in April 1909. Heinen (1912) collected 1,461 flounder eggs/m^2 in the BS at the end of March 1911 (both observations made close to station S 24). Apstein (1911) did not find any flounder larvae in the egg-net samples from the Baltic (1909), while Heinen (1912) captured 63 larvae/m^2 in the BS on May 24th, 1911. In the period 1925 - 1938 at most 465 eggs/m^2 were noted in the BS (Kändler 1949) - April 6th, 1925. In our investigation the greatest frequency of pelagic eggs was observed in March 1969 (27 eggs/m^2) at S 24 (BS) and in March 1970 (33 eggs/m^2) at the same station (cf. maps nos. 94 a and 95). - In the middle of March 1935 192 eggs/m^2 were observed at the Slupsk Furrow. In our investigation at most 3 eggs/m^2 have been present at S 23, but on that occasion (May 23rd, 1970) 10 larvae/m^2 were at the same time collected. In the Gotland Sea 35 flounder eggs/m^2 were noted in April 1933. We counted at most 9 eggs/m^2 at the Gotland Deep (May 24th, 1970).

The numbers of pelagic eggs found today thus are far below the numbers registered in the beginning of this century - probably a consequence of reduced populations in the deep areas with low oxygen content. As in the northern Baltic the flounder, however, also spawns non-pelagic eggs in the coastal areas of the southern and central Baltic ("Bankflundern"). These eggs develop on the bottom (Mielck 1926, Kändler 1949).

In the period 1967 - 1971 eggs and/or larvae have been found in all areas except for the regions west and north-west of Gotland and the Åland Sea. The most northernly observation of eggs in our investigation was made at F 72 (N 59°17', E 21°34'). - Larvae were not taken during 1967 and 1968. In June 1969 4 flounder larvae/m^2 were registered at the Slupsk Furrow. An increase in number was noted in 1970. No fewer than 20 larvae/m^2 were caught in May at S 24 (BS), 10 larvae/m^2 at Slupsk Furrow (SGS) and 19 larvae/m^2 at F 81 (MEGS). The number of larvae decreased rapidly at station S 24 from May 23rd to June 8th: May 23rd - 20 larvae/m^2, May 27th - 6 larvae/m^2, June 8th - 1 larva/m^2. - Both eggs and larvae were much fewer in 1971 than in the previous year. At most 6 eggs/m^2 were seen in April at S 12 (AS). Larvae were only found in the MEGS (June), where 3 larvae/m^2 were present at Hoburg Bank, and 3 larvae/m^2 at F 81.

The higher numbers of larvae in 1970 east of Bornholm were probably due to the salt-water influx in 1969. The salinity and oxygen content of the deep water layers increased, allowing the flounder to spawn in wider areas of the deep basins. The better hydrographical conditions presumably raised the egg and larva survival too. Thus the pelagic abundance of flounder eggs and larvae is in approximately the same relation to the oxygen conditions as in cod, though on a lower level as a consequence of the smaller stock of flounder.

Dab - Limanda limanda

Dab are very rare today in the trawl catches from the BS. A drastic decline of the stock of common dab in the Bornholm area and adjacent waters of the southern Baltic took place in the 1930's (Otterlind 1968 b). Early in the twentieth century (about 1910) eggs were much more abundant than nowadays. Kändler (1949) summarized the findings of dab eggs from 1903 to 1938. The maximum number of eggs in the BS during the period 1903 - 1911 was found in July 1907 (428 eggs/m^2). In the period 1926 - 1931 the maximum value was noted in July 1926 (203 eggs/m^2). In July 1938 only 12 eggs/m^2 were registered as the maximum value. - The number of eggs found today is very low. Since 1967 we have only found dab eggs on two occasions: 1 egg was caught at S 24 and 6 eggs/m^2 at S 23; both stations were visited in May 1970. - Larvae were taken more often. At most 3 larvae/m^2 were present at one station (cf. maps nos. 101, 102, and 103). During 1969 and 1971 no larvae were observed. Larvae were not present north of Rysshålan nor were they found in the AS. They were caught during April, May, and June.

Mielck (1926) investigated the floating ability of dab eggs, artificially fertilized from fish captured in the BS, where eggs were present in the bottom water at a salinity of 18.08 ‰. The former eggs were found to sink to the bottom at this salinity, but were observed to develop very well at the bottom. To keep the eggs floating a salinity of 19.25 ‰ was needed. This may partly explain the rare findings of eggs in the Baltic. As mentioned for plaice, dab eggs may float in the layers close to the bottom, where it is very difficult to collect them with the plankton net.

Herring - *Clupea harengus*

Larvae of herring were rare in the samples from 1967 to 1970. One larva was caught in the BS in May 1967 at SE Utklippan. Other larvae were observed during November 1967 (5 larvae/m^2 at N 1, and 1 larva at S 2, BS), December 1968 (1 larva at Y 18, AS), January 1970 (1 larva at SW Utklippan, BS), and November 1970 (1 larva at S 24, BS). They had obviously been hatched from eggs of autumn spawning herring (except for the larva caught in May 1967).

In 1971 the Hoburg Bank (S Gotland) was visited in the middle of June. The depth of the station was only 18 m. Nevertheless, 213 herring larvae/m^2 were recorded. Taking into account the few metres of water available one understands that the production of herring larvae on this bank might be enormous. In map no.110 the number of "Clupeidae" is also indicated (black dots). The "Clupeidae" may either be herring or sprat. They were so badly damaged that it is not possible to measure the length of the larvae, to count their myomeres, to determine the appearence of the yolk-sac, eyes, etc., all important characters when determining the species. At the Norra Midsjöbanken (depth 18 m) 46 "Clupeidae" and 3 herring larvae were collected. - During the next cruise, three weeks later, only one singlelarva was noted (at Norra Midsjöbanken). All the larvae found hitherto during 1971 belong to spring-summer-spawning herring. In November one larva was noted at S 41 (MWGS), thus belonging to the autumn-spawning stock.

The Hoburg Bank and the Norra Midsjöbanken are obviously very important areas for the recruitment of Clupeidae (cf. maps nos. 82 and 110). Because of the small depth these banks are especially sensitive to environmental disturbances, such as oil pollution and oil detergents. It is essential that such areas are safely protected against pollution.

Pollack - *Pollachius pollachius*

Occasional appearances of pollack in the southern Baltic have been known since the nineteenth century (Lilljeborg 1891). A short-term immigration took place in the early 1960's, described by Otterlind (1963). The cause of this immigration is unknown. Otterlind assumes that the pollack made an error in orientation because of changes in the hydrographical condition of the Kattegat. During the period 1967 - 1971 only one pollack larva was found, in June 1967, at NE Christiansö, map no. 113.

Sand-eels - Ammodytidae

The Ammodytidae (Ammodytes lancea, Ammodytes lanceolatus) are found along the whole Swedish coast up to and including the Bothnian Bay.

Eggs and larvae of this family have mostly not been determined as to species. Only once, when a grown-up specimen was caught, is the species given (map no. 117).

In June 1967 one larva was collected in the AS (at Y 15). No larvae were found during the period 1968 - 1970. In 1971 larvae were again caught. In the beginning of June one larva was found at Y 15 and one at S 12 (AS). In the NEGS (NE Gotska Sandön) 5 larvae/m^2 were registered. At the end of June 3 larvae/m^2 were noted at S 12 and one at S 11 (AS). In August one larva was present at S 12 (AS) and one adult Ammodytes lancea was captured at Christiansö. Such large fishes are seldom trapped in an ichthyoplankton net. When this haul was made a dense shoal of sand-eels appeared just below the surface. Judging from the behaviour of the fishes they were being hunted by other fishes.

In our samples sand-eel larvae are observed from June to August, mostly in the AS. Once larvae were found in June at NE Gotska Sandön (NEGS). - In the AS(approximately Y 15) Apstein (1911) collected 81 larvae/m^2 in February 1909. Heinen (1912) caught in January 1910 30 larvae/m^2 north of Y 15, and 21 larvae/m^2 at the end of March at the same station. Apstein (1911) observed 21 larvae/m^2 in February 1909 in the BS, and 156 larvae/m^2 in the Bay of Gdansk. In the second half of May only 6 larvae/m^2 were present in the BS. Heinen (1912) noted 15 larvae/m^2 in December 1910 in the BS. The number increased to 42 larvae/m^2 in January 1911 and declined to 15 larvae/m^2 in March. Only 6 larvae/m^2 were found at the end of April.

It is obvious that Ammodytes larvae were more abundant 60 years ago than to-day. It is also noteworthy that larvae were observed in the highest numbers during the first four months of the year in 1909 and 1910, while they were present in our samples only during the summer months. Furthermore we have not observed any larvae in samples from the BS although Apstein and Heinen found them in this area. It is possible that the larvae we observed belong to another species than the larvae captured by Apstein and Heinen. This will be further discussed when the species are determined.

Butterfish - Pholis gunellus

The butterfish occurs at the Swedish west-coast, in the Sound and the Baltic up to the middle of the Bothnian Sea. - Only two larvae were seen in the samples from the period 1967 - 1971. One larva was captured in March 1970 at Y 15 (AS) and one at the end of March 1971 at S 41 (MWGS). Thus, spawning occurs during the first months of the year. Heinen (1912) observed 3 larvae/m^2 in the BS in January 1911.

Gobies - Gobiae

The distribution border of the gobies differs depending on the species. Gobius niger can be found up to the Åland Sea, and Gobius minutus up to the Bothnian Bay. - Gobies larvae were observed in 1970 and 1971 only. One larva was caught in the ÅS (at Svartklubben) at the end of July in 1970. In 1971, 6 larvae/m^2 were collected at S 12 at the end of June and one larva was registered at Y 17 in the first decade of July (both stations in the AS). At Norra Midsjöbanken (MWGS) one larva was found early in July. In August one larva was found in the samples from F 81 (MEGS) and in September one was caught at S 12 (AS). - Larvae were found from June to September. The egg-net samples from the ichthyoplankton surveys in 1909 and 1911 (Apstein 1911 and Heinen 1912 respectively) did not contain Gobius larvae.

Sea snail - Liparis liparis

The Baltic race <u>Liparis liparis barbatus</u> is distributed mainly from Gotland up to the northern part of the Bothnian Bay. Another smaller race, <u>L.l. liparis</u> is to be found off the Swedish west-coast and possibly also occurring in south-western Baltic.- Larvae were found during 1970 and 1971 only. They were present from May to August. With one exception larvae were not caught in the deeper parts of the basins. At the end of May 1970 one larva was observed at S 23 (SGS) and one at S Trelleborg 3 (AS). In the middle of August one larva was registered at Segerstad 3 (MWGS). In June 1971 one larva was noted at S 41 (MWGS) and one at Hoburg Bank (MEGS). One larva was caught at S 23 (SGS) in August 1971. Apstein (1911) and Heinen (1912) did not find any sea snail larvae in their egg-net samples from the Baltic.

Sole - Solea solea

The sole can be found along the whole Swedish west-coast but only occasionally in the southern Baltic (to Smygehuk in Scania). - Only once was an egg of the sole found: in June 1967 at S 2 (BS). The sole was known to occur at least as larvae in the Kiel-Eckenförder area at the end of the nineteenth century according to Apstein (1905), but was not observed by Müller (1970) in the Kiel Bay in 1965. It is likely that the egg found by us had been shed by a ripe sole after immigration into the Baltic.

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Explanation of the tables

The tables contain all data on the ichthyoplankton samples obtained during the years of 1967 - 1971. The position of oné and the same station may differ somewhat from cruise to cruise, but the name of the station has not been changed. All sampling depths are given after correction for the wire angle. If hauls were overlapping or not reaching each other, this has been indicated in the far right column, where also other information concerning the hauls is to be found. Figures without brackets mean egg number, figures within brackets mean larva number - both under one square meter. Expeditions are separated from each other by horizontal lines. A year-index always begins a new expedition. On some occasions two expeditions were active simultaneously.

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1967												
26/5	E Hoburgen	56°50'8	18°53'	84 – 0	–	–	94 (14)	–	–	–	–	
26/5	Rysshålan	56°02'	18°51'	92 – 0	32 (5)	20	127 (29)	–	–	(3)	–	
29/5	SW Utklip-n	55°53'9	15°37'5	45 – 0	–	–	(1)	(1)	–	–	–	
29/5	SE Utkl. I	55°51'	15°51'9	48 – 0	–	–	–	–	–	(1)	(1) Clupea harengus	
29/5	SE Utkl. II	55°47'8	16°07'	47 – 0	3 (1)	–	18	–	–	–	–	
29/5	ENE Chr-ö	55°28'2	15°50'2	87 – 0	18	–	109 (1)	–	–	(1)	–	Overlap 48 – 58
30/5	NE Chr-ö	55°30'7	16°17'1	75 – 0	28 (1)	–	103	–	–	(1)	(1) Pollachius pollachius	
31/5	N 1	54°51'	15°18'8	68 – 0	6 (1)	66	69	–	–	–	–	
1/6	ENE Nexö	55°07'	15°25'	69 – 0	10 (1)	22	191	–	–	–	–	
1/6	S 24	55°14'8	15°58'5	89 – 0	34	18	132 (1)	–	1	–	–	
1/6	E Chr-ö	55°20'	15°50'	92 – 0	15 (1)	8	116	–	–	–	–	
2/6	NNE Chr-ö	55°22'	15°25'1	20 – 0	18	–	–	–	–	–	–	Only sample available:20–0 m
2/6	N Chr-ö	55°33'	15°09'	72 – 0	20	4	151 (3)	–	–	–	–	
3/6	E Vik	55°38'	14°31'	48 – 0	–	–	28	–	–	–	–	
3/6	S 2	55°28'7	14°44'5	70 – 0	6	33	77	–	–	–	1 Solea solea	
6/6	S 12	55°00'	14°05'	40 – 0	–	–	43	–	–	–	–	
6/6	Y 17	55°13'	13°40'7	36 – 0	–	–	6	–	–	–	–	
7/6	Y 15	54°54'7	13°17'4	39 – 0	–	–	76	–	–	–	(1)Ammodytidae	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1967												
8/9	S 2	55°26'7	14°38'9	64 – 0	3	16	–	–	–	–	–	
11/9	E Simrish-n	55°31'4	14°53'3	Ca 65 – 0	3 (1)	1 (1)	–	–	–	–	–	wire angel uncertain
11/9	N Chr-ö	55°33'	15°09'	85 – 50	(1)	–	–	–	–	–	–	50 – 0 m is missing
11/9	E Chr-ö	55°22'2	15°31'5	82 – 45	(1)	18	–	–	–	–	–	45 – 0 m is missing
11/9	S 24	55°15'	15°59'	84 – 0	13 (1)	–	–	–	–	–	–	
12/9	N 1	54°52'6	15°30'4	61 – 0	–	20 (1)	–	–	–	–	–	Overlap 43 – 48 m
13/9	ENE Chr-ö	55°29'5	16°21'3	43 – 0	(1)	–	–	–	–	–	–	
1967												
15/11	S 2	55°27'2	14°43'6	47 – 0	–	1	–	–	–	–	(1) Clupea harengus	
15/11	N 1	54°51'2	15°21'	50 – 0	–	–	–	–	–	–	(5) Clupea harengus	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1968												
7/2	S 12	55°00'	14°05'0	39 – 0	–	–	–	–	–	–	–	
8/2	N 1	54°51'	15°13'	61 – 0	–	–	–	–	–	–	–	
8/2	E Chr–ö	55°14'5	15°30'8	69 – 56	–	–	–	–	–	–	–	56 – 0 m is missing
8/2	S 24	55°15'	15°58'	81 – 0	–	–	–	–	–	–	–	
9/2	SE Utklip-n	55°43'6	15°59'3	61 – 0	–	–	–	–	–	–	–	
13/2	Rysshålan	56°02'	18°53'	115 – 0	–	–	–	–	–	–	–	
16/2	S 2	55°26'6	14°39'0	56 – 0	–	–	–	–	–	–	–	
19/2	N Chr–ö	55°30'0	15°08'1	90 – 0	–	–	–	–	–	–	–	
19/2	E Chr–ö	55°14'5	15°30'8	75 – 0	–	–	–	–	–	–	–	
1968												
17/4	S 2	55°26'	14°36'	66 – 0	8	1	–	–	1	–	–	
18/4	Rysshålan	56°03'	18°57'	110 – 0	5	–	1	–	–	–	–	
19/4	SE När	57°03'	18°57'	66 – 0	–	–	–	–	–	–	–	
22/4	SE Utklip-n	55°43'2	16°01'	61 – 0	10	–	6	–	1	(1)	–	
22/4	ENE Chr–ö	55°28'	15°53'	82 – 0	116	3	10	–	3	–	–	
22/4	S 24	55°15'	15°59'	81 – 0	51	1	8	–	–	–	–	
23/4	N 1	54°53'	15°13'	60 – 0	10	29	11 (1)	–	–	(3)	–	
24/4	S 12	55°00'	14°02'	42 – 0	4	–	–	–	–	–	–	
25/4	Y 17	55°13'	13°35'	36 – 0	–	–	–	–	–	–	–	
25/4	Y 15	55°01'	13°17'	40 – 0	–	–	–	–	–	–	–	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1968												
1/8	S 24	55°15'	15°59'	85 – 0	47	–	5	–	–	–	–	
2/8	Rysshålan	56°01'	18°52'	115 – 0	3	–	30	–	–	–	–	
5/8	S 41	57°01'	17°40'	105 – 0	–	–	25	–	–	–	–	
1968												
27/11	NE G.Sandön	58°26'5	19°26'5	75 – 0	–	–	–	–	–	–	–	
28/11	N G.Sandön	58°35'	19°17'	75 – 0	–	–	–	–	–	–	–	
29/11	SE Fårön	57°53'3	19°25'6	45 – 0	–	–	–	–	–	–	–	
3/12	Station A	58°02'5	20°48'5	73 – 0	–	–	–	–	–	–	–	
3/12	Station B	57°47'	20°45'	108 – 0	–	–	–	–	–	–	–	
3/12	F 81	57°20'	20°03'	135 – 0	–	–	–	–	–	–	–	
3/12	SE När	57°11'	18°50'5	42 – 0	–	–	–	–	–	–	–	
5/12	Rysshålan	56°02'	18°51'	113 – 0	–	–	–	–	–	–	–	
6/12	ENE Chr-ö	55°29'5	16°15'5	70 – 0	–	–	–	–	–	–	–	
9/12	I U 10	55°43'5	15°52'5	64 – 0	–	–	–	–	–	–	–	
9/12	S 24	55°15'	15°59'	82 – 0	–	–	–	–	–	–	–	
10/12	N 1	54°51'	15°13'	62 – 0	–	–	–	–	–	–	–	
10/12	S 2	55°27'	14°42'	64 – 0	–	–	–	–	–	–	–	
11/12	Y 18	55°00'5	13°58'	45 – 0	–	–	–	–	–	–	(1) Clupea harengus	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1969												
21/3	SE Utkl. II	55°47'	16°10'	56 - 0	-	-	-	-	-	-	-	
24/3	ESE När	57°05'5	18°52'7	79 - 0	-	-	-	-	-	-	-	
25/3	Rysshålan	56°02'	18°51'	118 - 0	-	-	-	-	-	-	-	
25/3	S 24	55°15'	15°59'	87 - 0	29	-	60	-	27	-	-	
26/3	N 1	54°51'3	15°27'7	58 - 0	3	-	-	-	-	-	-	
27/3	Y 15	54°55'3	13°16'9	35 - 0	-	-	-	-	-	-	-	
28/3	S Trelleb-g	55°12'6	13°16'8	30 - 0	-	-	-	-	-	-	-	
1969												
4/6	N Chr-ö	55°32'	15°08'	69 - 0	24 (1)	4 (1)	199 (5)	-	-	-	-	
5/6	Rysshålan	56°02'	18°49'	111 - 0	29	3	28 (1)	-	-	-	-	
5/6	ESE När	57°07'6	18°49'5	89 - 0	-	-	-	-	-	-	-	
9/6	Y Gdansk-b	55°20'3	18°55'0	85 - 0	10	32	77	-	-	-	-	
10/6	S 23	55°13'	17°04'	84 - 0	5	-	64 (1)	-	(4)	-	-	
11/6	S 24	55°14'6	15°58'5	85 - 0	52	-	70	-	-	-	-	
11/6	N 1	54°51'	15°27'2	70 - 0	1	13	36 (1)	-	-	-	-	
12/6	ENE Chr-ö	55°21'6	16°05'3	80 - 0	36	-	28 (3)	-	-	-	-	
12/6	E Chr-ö	55°23'2	15°37'6	90 - 0	253	3	97 (1)	-	-	-	-	
13/6	S 2	55°27'1	14°44'0	65 - 0	8 (1)	20	64 (1)	-	-	-	-	
16/6	S Trelleb-g	55°11'0	13°19'4	38 - 0	-	-	19	-	-	-	-	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1969												
30/7	F 78	58°35'2	18°14'	98 – 0	–	–	32	–	–	–	–	
31/7	W Visby	57°37'7	17°56'	100 – 0	–	–	56	–	–	–	–	
31/7	S 41	57°01'	17°40'	98 – 0	–	–	90	–	–	–	–	
4/8	E Herrvik	57°17'	19°08'	89 – 0	–	–	29	–	–	–	–	
4/8	F 81	57°20'	20°04'	97 – 0	(1)	–	10	–	–	–	–	
6/8	Rysshålan	56°19'	18°43'	118 – 0	–	–	24	–	–	–	–	
7/8	N Midsjö-b	56°11'	17°12'	28 – 0	–	–	–	–	–	–	–	
12/8	NNE Chr-ö	55°21'	15°[illegible]3'	96 – 0	10	–	1	–	–	–	–	
12/8	S 24	55°16'	15°57'	95 – 0	10	–	–	–	–	–	–	
14/8	N 1	54°49'	15°18'	70 – 0	4	6	–	–	–	–	–	
15/8	S 12	55°00'	14°07'	45 – 0	–	–	–	–	–	–	–	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area							Observations
					Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	
1969												
14/10	S Trelleb-g	55°16'5	13°10'	33 – 0	–	–	–	–	–	–	–	
14/10	S 11	55°17'5	14°24'	48 – 0	–	1	–	–	–	–	–	
14/10	N Chr-ö	55°32'0	15°01'	85 – 0	–	–	–	–	–	–	–	
16/10	ESE När	57°01'	18°58'5	104 – 0	–	–	–	–	–	–	–	
17/10	F 78	58°23'5	18°08'5	121 – 0	–	–	–	–	–	–	–	
20/10	S 41	57°07'	17°40'	107 – 0	–	–	–	–	–	–	–	
21/10	Rysshålan	56°04'	18°40'	110 – 0	–	–	–	–	–	–	–	
21/10	Y Gdansk-b	55°19'	18°38'	80 – 0	–	–	–	–	–	–	–	
22/10	S 23	55°13'	17°04'	93 – 0	–	–	–	–	–	–	–	
23/10	ENE Chr-ö	55°32'5	16°18'2	73 – 0	–	–	–	–	–	–	–	
24/10	E Chr-ö	55°21'	15°43'	82 – 0	10	–	–	–	–	–	–	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1970												
13/1	Y 15	55°00'	13°18'	47 – 0	–	–	–	–	–	–	–	
13/1	S 12	55°00'	14°05'	35 – 0	–	–	–	–	–	–	–	
14/1	S 24	55°15'	15°59'	87 – 0	–	–	–	3	–	–	–	
14/1	S 23	55°13'	17°04'	82 – 0	–	–	–	–	–	–	–	
20/1	F 78	58°35'	18°14'	200 – 0	–	–	–	–	–	–	–	
21/1	S 41	57°07'	17°40'	108 – 0	–	–	–	–	–	–	–	
21/1	När I	56°50'5	18°50'	100 – 0	–	–	–	–	–	–	–	
21/1	När II	56°59'	18°47'	70 – 0	–	–	–	–	–	–	–	
21/1	När III	57°05'	18°42'	25 – 0	–	–	–	–	–	–	–	
22/1	6/9	57°23'5	19°26'	125 – 0	–	–	–	–	–	–	–	
22/1	2/9	57°15'5	20°38'5	96 – 0	–	–	–	–	–	–	–	
23/1	F 81	57°20'	20°03'	240 – 0	–	–	–	–	–	–	–	
27/1	Klaipeda	56°05'	19°10'	124 – 0	–	–	–	–	–	–	–	
27/1	Segerstad I	56°33'	17°04'	70 – 0	–	–	–	–	–	–	–	
29/1	SW Utklip-n	55°42'	15°18'5	59 – 0	–	–	–	3	–	–	(1) Clupea harengus	
29/1	N Chr-ö	55°31'5	15°01'5	80 – 0	–	–	–	–	–	–	–	
29/1	S 2	55°26'6	14°27'5	45 – 0	–	–	–	–	–	–	–	
29/1	Y 17	55°13'	13°42'2	42 – 0	–	–	–	1	–	–	–	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platesse	Platichthys flesus	Limanda limanda	Other	Observations
1970												
27/2	Y 17	55°12'8	13°36'	42 – 0	–	–	–	–	–	–	–	
2/3	S 12	55°00'	14°06'	43 – 0	–	–	–	–	–	–	–	
3/3	S 24	55°14'5	15°58'	39 – 0	–	–	15	3	33	–	–	
4/3	ENE Chr-ö	55°31'5	16°18'	69 – 0	–	–	3	–	3	–	–	
4/3	Inre U 10	55°43'	15°58'	64 – 0	–	–	14	–	8	–	–	
5/3	Y 15	54°56'7	13°13'	45 – 0	–	–	–	–	–	–	(1) Pholis gunellus	
5/3	S Trelleb-g	55°13'5	13°16'	40 – 0	–	–	–	–	–	–	–	
1970												
22/5	S 12	55°00'	14°05'	45 – 0	–	–	–	–	–	–	–	Mesh size: 0,30 mm
23/5	S 24	55°15'	15°59'	80 – 0	119 (20)	8	67 (13)	–	(20)	–	–	"
23/5	S 23	55°13'	17°04'	80 – 0	47 (5)	32	109 (3)	–	3 (10)	–	(1) Liparis liparis	"
24/5	S Rysshålan	55°38'	18°36'	80 – 0	(1)	–	39 (23)	–	(3)	–	–	"
24/5	Klaipeda	56°05'	19°10'	80 – 0	4	4	210 (58)	–	(3)	–	–	"
24/5	F 81	57°20'	20°03'	80 – 0	10 (4)	–	18 (34)	–	9 (19)	–	–	"
25/5	F 80	58°00'	19°54'	80 – 0	–	–	(1)	–	–	–	–	"
25/5	29 A	58°53'	20°19'	80 – 0	–	–	4	–	–	–	–	"
26/5	27 A	59°17'48"	21°34'	80 – 0	–	–	3	–	–	–	–	"
27/5	F 78	58°35'	18°14'	80 – 0	–	–	–	–	–	–	–	"
27/5	S 41	57°07'	17°40'	80 – 0	–	–	–	–	–	–	–	"
29/5	S 12	55°00'	14°05'	43 – 0	–	1	–	–	1	–	–	"

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1970												
26/5	Kullagrund	55°18'	13°16'	13 – 0	–	1	–	–	–	–	–	
26/5	S Trelleb-g	55°13'5	13°16'	37 – 15	–	–	–	–	–	–	–	15 – 0 m is missing
26/5	S Tbg 2	55°07'5	13°16'	36 – 0	–	–	–	–	–	–	–	
26/5	S Tbg 3	55°02'	13°16'	43 – 0	–	–	–	–	–	–	(1) Liparis liparis	
26/5	Y 15	54°55'	13°16'	45 – 0	–	1	1	–	–	–	–	
26/5	S 12	55°00'	14°05'	47 – 0	1	–	–	–	3	–	–	
27/5	Inre U 10	55°45'	15°56'	63 – 0	14 (1)	–	9	–	–	–	–	
27/5	ENE Chr-ö	55°31'	16°16'	70 – 0	42 (5)	10	36 (1)	–	(4)	–	–	
27/5	S 24	55°15'	15°59'	85 – 0	88 (5)	6	94 (27)	–	(6)	1	–	
27/5	Stolpe tr.	55°17'	16°30'	60 – 0	5 (4)	1	8 (1)	–	(4)	–	–	
28/5	S 23	55°13'	17°04'	90 – 0	58 (10)	34	76 (4)	–	1 (5)	6 (3)	–	
28/5	S Rysshålan	55°38'	18°36'	90 – 0	3	1	97 (70)	–	–	–	–	
28/5	Klaipeda	56°05'	19°10'	125 – 0	163 (9)	57	251 (118)	–	1	–	–	
28/5	När I	56°50'5	18°52'	103 – 0	1	–	6 (4)	–	–	–	–	
29/5	När II	56°59'	18°47'	55 – 0	–	–	(1)	–	–	–	–	
29/5	När III	57°05'	18°42'	20 – 0	–	–	–	–	–	–	–	
29/5	S 41	57°07'	17°40'	110 – 0	–	–	–	–	–	–	–	
1/6	W Visby(9/9)	57°40'	17°56'	100 – 0	–	–	13	–	–	–	–	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1/6	13/9	57°45'7	16°50'	24 - 0	-	-	-	-	-	-	-	
1/6	11/9	57°43'	17°22'	140 - 0	-	-	3	-	-	-	-	
2/6	F 78	58°35'	18°14'	97 - 0	-	-	-	-	-	-	-	
2/6	F 75 (L 19)	58°53'	20°19'	100 - 0	1	-	-	-	-	-	-	
3/6	F 72	59°17'48	21°34'	100 - 0	-	-	6	-	3	-	-	
3/6	L 11	59°35'	23°18'	65 - 0	-	-	-	-	-	-	-	
3/6	L 5	59°55'	25°36'	65 - 0	-	-	3	-	-	-	-	
4/6	Solovjeva	60°12'5	19°04'5	100 - 0	-	-	-	-	-	-	-	
8/6	F 81	57°20'	20°03'	100 - 0	8 (6)	4 (1)	55 (34)	-	(1)	-	-	
8/6	5/9	57°21'5	19°44'	98 - 0	15	-	38 (10)	-	(3)	-	-	
8/6	6/9	57°23'5	19°26'	100 - 0	-	-	23 (5)	-	-	-	-	
8/6	7/9	57°25'5	19°07'5	45 - 0	-	-	8	-	-	-	-	
9/6	F 80	58°00'	19°54'	100 - 0	-	-	11 (6)	-	1	-	-	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1970												
1/6	F 78	58°35'	18°14'2	125 – 0	–	–	–	–	–	–	–	
2/6	ESE När	57°03'8	18°54'2	78 – 0	–	–	4 (1)	–	(1)	–	–	
3/6	Rysshålan	56°01'0	18°55'5	100 – 0	41 (1)	–	37 (3)	–	–	–	–	
3/6	I Gd-b	54°47'0	18°59'5	95 – 0	8 (1)	13	121 (25)	–	–	(1)	–	overlap 65–70 m
4/6	Y Gd-b	55°21'0	18°53'6	87 – 0	–	6	55 (5)	–	–	–	–	
5/6	Y U 10	55°40'0	16°01'5	66 – 0	3	–	17	–	–	–	–	
8/6	S 24	55°15'	15°59'	85 – 0	100	9	51 (1)	–	(1)	–	–	overlap 65–75 m
9/6	N 1	54°50'5	15°20'0	65 – 0	–	4	52 (3)	–	(1)	–	–	
10/6	S 12	55°00'3	14°04'3	44 – 0	–	5	11	–	6	–	–	
10/6	Y 17	55°12'9	13°45'1	35 – 0	–	–	–	–	(3)	–	–	
10/6	S Trellebg	55°12'8	13°18'6	35 – 0	–	–	1	–	–	–	–	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1970												
28/7	Solovjeva	60°12'5	19°04'5	260 – 0	–	–	6	–	–	–	–	
30/7	Svartklubben	60°09'	18°54'	135 – 0	–	–	1	–	–	–	(1) Gobidae	
31/7	Kanholmsfj.	59°20'	18°46'5	84 – 0	–	–	–	–	–	–	–	
4/8	F 78	58°35'	18°14'	100 – 0	–	–	11	–	–	–	–	
6/8	När II	56°59'	18°48'	65 – 0	–	–	29	–	–	–	–	
6/8	S 41	57°07'	17°40'	100 – 0	–	–	17	–	–	–	–	
18/8	Västervik A	57°45'5	16°51	28 – 0	–	–	–	–	–	–	–	
18/8	Västervik	57°38'	17°12'	89 – 0	–	–	4	–	–	–	–	
19/8	Segerstad 3	56°20'	16°42'	38 – 0	–	–	(1)	–	–	–	(1) Liparis liparis	
19/8	Segerstad 5	56°16'	17°02'	45 – 0	–	–	5	–	–	–	–	
24/8	Inre U 10	55°45'	17°56'	60 – 0	3	–	–	–	–	–	–	
24/8	ENE Chr-ö	55°31'	16°16'	70 – 0	15	1	–	–	–	–	–	
25/8	S 24	55°15'	16°00'	90 – 0	19 (1)	3	–	–	–	–	–	
26/8	S 12	55°00'	14°06'	45 – 0	–	5	–	–	–	–	–	
26/8	Stn 3	55°10'	14°06'	39 – 0	–	–	–	–	–	–	–	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1970												
13/10	S Trelleb-g	55°09'5	13°20'	36 – 0	–	–	–	–	–	–	–	
13/10	S 12	55°00'	14°05'	45 – 0	–	5 (1)	–	–	–	–	–	
13/10	S 11	55°17'5	14°24'	48 – 0	–	–	–	–	–	–	–	
13/10	Christiansö	55°23'	15°20'	82 – 0	–	–	–	–	–	–	–	
14/10	S 24	55°15'	15°59'	78 – 0	3	1	–	–	–	–	–	
14/10	S 23	55°13'	17°04'	87 – 0	–	1	–	–	–	–	–	
14/10	S Rysshålan	55°38'	18°36'	89 – 0	–	–	–	–	–	–	–	
14/10	Klaipeda	56°07'5	19°17'	116 – 0	–	–	–	–	–	–	–	
15/10	F 81	57°20'	20°03'	239 – 0	3	–	–	–	–	–	–	
15/10	F 80	58°00'	19°57'	190 – 0	(1)	–	–	–	–	–	–	
16/10	W Visby	57°40'	17°56'	103 – 0	–	–	–	–	–	–	–	
21/10	F 90	58°00'	18°00'	100 – 0	–	–	–	–	–	–	–	
21/10	F 78	58°35'	18°14'	93 – 0	–	–	–	–	–	–	–	
23/10	SS 31 a	61°04'5	18°37'	40 – 0	–	–	–	–	–	–	–	
23/10	SS 32 a	61°12'	17°52'	73 – 0	–	–	–	–	–	–	–	
24/10	Solovjeva	60°11'5	19°09'	270 – 0	–	–	–	–	–	–	–	
26/10	F 72	59°17'48	21°31'4	142 – 0	–	–	–	–	–	–	–	
26/10	F 79	58°26'5	20°20'	113 – 0	–	–	–	–	–	–	–	
27/10	S 41	57°07'	17°40'	99 – 0	–	–	–	–	–	–	–	
28/10	Christiansö	55°23'	15°20'	94 – 0	–	–	–	–	–	–	–	
28/10	S 12	55°00'	14°05'	45 – 0	–	(1)	–	–	–	–	–	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1970												
13/11	NE Chr-5	55°29'	15°34'	77 – 0	–	–	–	–	–	–	–	
16/11	S 24	55°15'	15°39'	70 – 0	–	–	–	–	–	–	(1) Clupea harengus	
17/11	Yttre Gd-b	55°23'	18°54'	83 – 0	–	–	–	–	–	–	–	
17/11	Rysshålen	56°01'5	18°54'	104 – 0	–	–	–	–	–	–	–	
20/11	F 78	58°36'	18°12'5	66 – 0	–	–	–	–	–	–	–	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1971												
13/1	S 23	$55^{o}13'$	$17^{o}04'$	82 – 0	–	–	–	–	–	–	–	
13/1	Klaipeda	$56^{o}07'5$	$19^{o}17'$	97 – 0	–	–	–	–	–	–	–	
14/1	F 81	$57^{o}20'$	$20^{o}03'$	98 – 0	–	–	–	–	–	–	–	
14/1	S 41	$57^{o}07'$	$17^{o}40'$	94 – 0	–	–	–	–	–	–	–	
18/1	F 78	$58^{o}35'$	$18^{o}14'$	97 – 0	–	–	–	–	–	–	–	
1971												
13/1	När I	$56^{o}51'$	$18^{o}52'$	100 – 0	–	–	–	–	–	–	–	
19/1	S 24	$55^{o}15'$	$16^{o}00'$	85 – 0	–	–	–	–	–	–	–	
21/1	S 12	$55^{o}00'$	$14^{o}06'$	47 – 0	–	–	–	–	–	–	–	
1971												
26/3	F 78	$58^{o}35'$	$18^{o}14'$	300 – 0	–	–	–	–	–	–	–	
30/3	S 41	$57^{o}07'$	$17^{o}40'$	110 – 0	–	–	–	–	–	–	(1) Pholis gunellus	
1/4	S 24	$55^{o}15'$	$16^{o}00'$	90 – 0	9	–	25	–	5	–	–	
1/4	S 12	$55^{o}00'$	$14^{o}06'$	45 – 0	–	–	–	5	6	–	–	
1/4	Y 15	$54^{o}55'$	$13^{o}16'$	44 – 0	–	–	–	–	–	–	–	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m² surface area: Gadus morhua	Osos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda-limanda	Other	Observations
1971												
8/6	Y 15	55°00'	13°18'	44 – 0	–	–	138	–	–	–	(1) Ammodytidae	
8/6	S 12	55°00'	14°05'	44 – 0	–	–	233 (1)	–	–	–	(1) Ammodytidae	
9/6	S 24	55°15'	16°00'	84 – 0	62	–	173 (5)	–	–	–	–	
9/6	S 23	55°13'	17°04'	87 – 0	15	8	347 (4)	–	–	–	–	
9/6	Y Gd-b	55°20'	18°48'	84 – 0	–	–	118 (18)	–	–	–	–	
10/6	S 22	56°05'	19°10'	118 – 0	5	23	146 (42)	–	–	–	–	
10/6	När I	56°51'	18°52'	103 – 0	–	–	144 (1)	–	–	–	–	
10/6	ESE När	57°10'	18°50'	39 – 0	–	–	15	–	–	–	–	
10/6	S 41	57°07'	17°40'	110 – 0	–	–	43	–	–	–	(1) Liparis liparis	
14/6	F 90	58°00'	18°00'	190 – 0	–	–	25	–	–	–	–	
14/6	F 78	58°35'	18°14'	100 – 0	–	–	15	–	–	–	–	
15/6	NE G.S-ön	58°28'	19°28'	80 – 0	–	–	11	–	–	–	(5) Ammodytidae	
15/6	F 80	58°00'	19°54'	100 – 0	–	–	23 (5)	–	–	–	–	
15/6	F 81	57°20'	20°03'	208 – 0	13	4	149 (20)	–	(3)	–	–	
15/6	Hoburgs b.	56°43'	18°35'	18 – 0	–	–	5 (8)	–	(3)	–	(1) Liparis liparis, (213) Clupea harengus, (50) Clupeidae	
16/6	N. Midsjöb.	56°10'	17°20'	18 – 0	–	–	11 (1)	–	–	–	(3) Clupea harengus, (46) Clupeidae	
17/6	S 2	55°26'	14°36'	75 – 0	3	36	156 (4)	–	–	–	–	

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1971												
29/6	Y 15	55°00'	13°18'	32 – 0	–	–	315 (23)	–	–	–	–	
29/6	S 12	55°00'	14°05'	43 – 0	1	55	222 (18)	–	–	–	(3) Ammodytidae, (6) Gobidae	
29/6	S 11	55°17'5	14°24'	42 – 0	–	–	152 (30)	–	–	–	(1) Ammodytidae	
29/6	ENE Simr.h-n	55°36'	14°36'	52 – 0	–	–	225 (52)	–	–	–	–	Overlap 17 – 22 m
30/6	NE Simr.h-n	55°54'	14°45'	23 – 0	–	–	29 (3)	–	–	–	–	
30/6	Christiansö	55°23'	15°20'	82 – 0	18	–	295 (36)	–	–	–	–	
30/6	N 1	54°51'	15°15'	63 – 0	5	–	382 (9)	–	–	–	–	
30/6	S 24	55°19'	15°59'	89 – 0	22 (1)	–	174 (18)	–	–	–	–	
1/7	S 23	55°13'	17°04'	85 – 0	–	–	124 (3)	–	–	–	–	Overlap 61 – 72 m
1/7	S Rysshålan	55°39'	18°40'	85 – 0	–	4 (1)	142 (9)	–	–	–	–	Overlap 21 – 27 m Not sampled 42 – 56 m
1/7	Klaipeda	56°05'	19°10'	118 – 0	1	10	144 (13)	–	–	–	–	
2/7	W Steinort	56°50'	19°40'	127 – 0	8	–	104 (8)	–	–	–	–	Overlap 95 – 98 m
2/7	F 81	57°20'	20°03'	235 – 0	19	–	147 (15)	–	–	–	–	Overlap 52 – 56 m
5/7	F 80	58°00'	19°54'	200 – 0	5	–	83 (6)	–	–	–	–	
5/7	NE G.S-ön	58°27'	19°28'	80 – 0	–	–	61	–	–	–	–	
6/7	F 78	58°35'	18°14'	200 – 0	–	–	137	–	–	–	–	

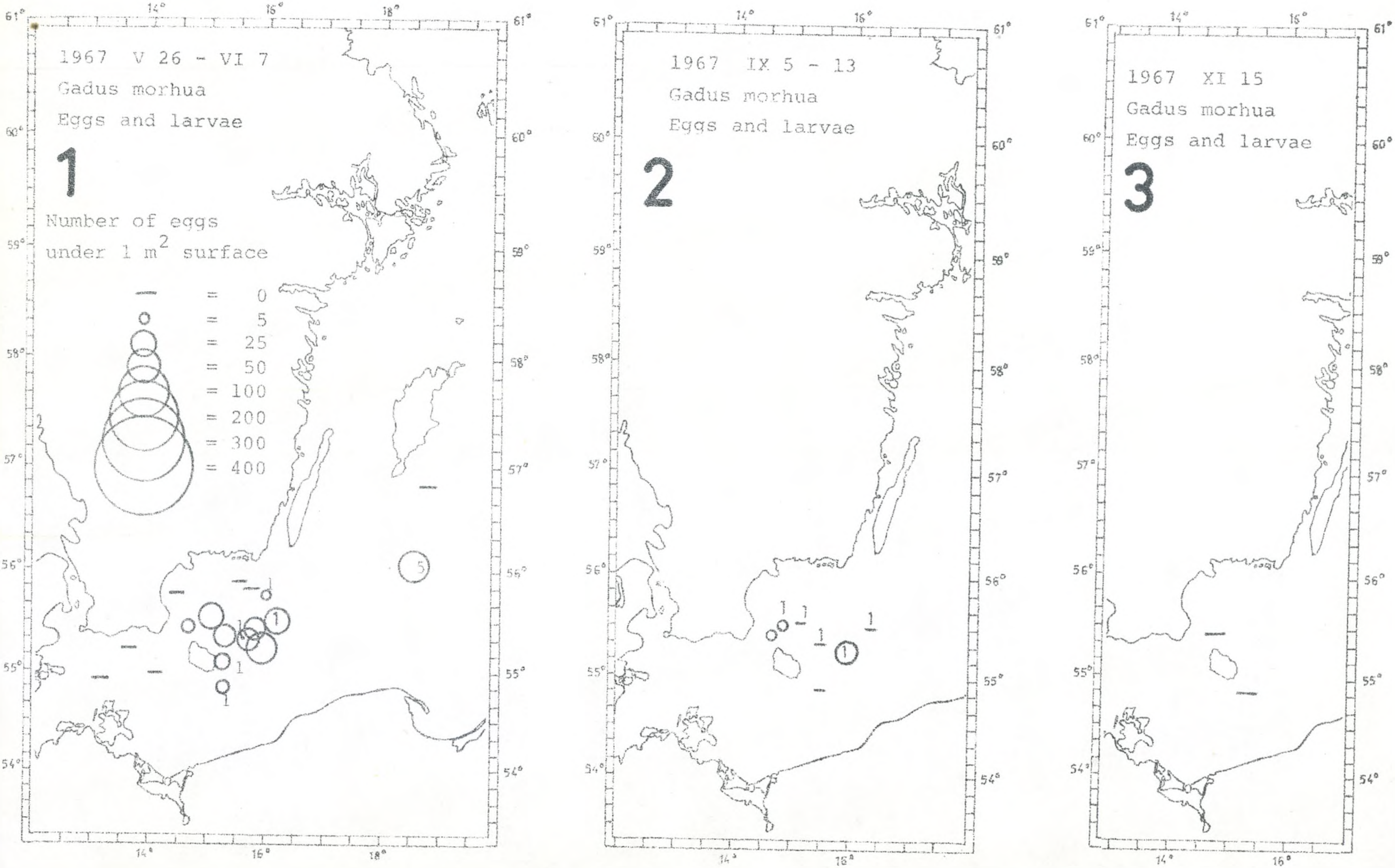
Date	Station	Position N	E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area							Observations
					Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	
6/7	S 41	57°07'	17°40'	110 – 0	–	–	65 (23)	–	–	–	–	
6/7	När I	56°49'	18°45'	65 – 0	–	–	109 (5)	–	–	–	–	
6/7	Hoburgs b.	56°43'	18°35'	13 – 0	–	–	20 (6)	–	–	–	–	
7/7	N. Midsjöb.	56°10'	17°20'	16 – 0	–	–	86 (32)	–	–	–	(1) Clupea harengus, (1) Gobidae	
7/7	U 10	55°45'	16°06'	65 – 0	5	–	466 (22)	–	–	–	–	
8/7	Stn 532	54°45'	15°26'	70 – 0	19	1 (1)	335 (41)	–	–	–	–	
8/7	NW Kolberg	54°30'	15°17'	37 – 0	1	–	156 (1)	–	–	–	–	
8/7	Y 17	55°12'4	13°31'8	40 – 0	–	3	135 (61)	–	–	–	(1) Gobidae	Overlap 10 – 20 m

Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1971												
17/8	S 12	55°00'	14°05'	48 – 0	–	11 (4)	–	–	–	–	(1) Ammodytidae, (3) Gobidae	
18/8	Christiansö	55°23'	15°20'	90 – 0	8	–	–	–	–	–	(1) Ammodytes lancea	
18/8	S 24	55°15'	15°59'	90 – 0	3	–	–	–	–	–	–	
18/8	S 23	55°13'	17°04'	93 – 0	5	3	–	–	–	–	(1) Liparis liparis	
18/8	S Rysshålan	55°38'	18°36'	90 – 0	–	–	–	–	–	–	–	
19/8	Klaipeda	56°05'	19°10'	125 – 0	1	–	–	–	–	–	–	
19/8	F 81	57°20'	20°03'	236 – 0	1	–	3	–	–	–	(1) Gobidae	
19/8	F 80	58°00'	19°54'	190 – 0	–	–	1	–	–	–	–	
20/8	F 78	58°35'	18°14'	191 – 0	–	–	(1)	–	–	–	–	
23/8	F 90	58°00'	18°00'	94 – 0	–	–	–	–	–	–	–	
24/8	F 72	59°17'5	21°34'	150 – 0	–	–	–	–	–	–	–	
24/8	F 79	58°26'5	20°20'	120 – 0	–	–	–	–	–	–	–	
25/8	S 41	57°07'	17°40'	110 – 0	27	–	–	–	–	–	–	
1971												
6/9	S 12	55°00'	14°06'	45 – 0	–	(1)	–	–	–	–	(1) Gobidae	
8/9	S 24	55°15'	16°00'	89 – 0	–	–	–	–	–	–	–	

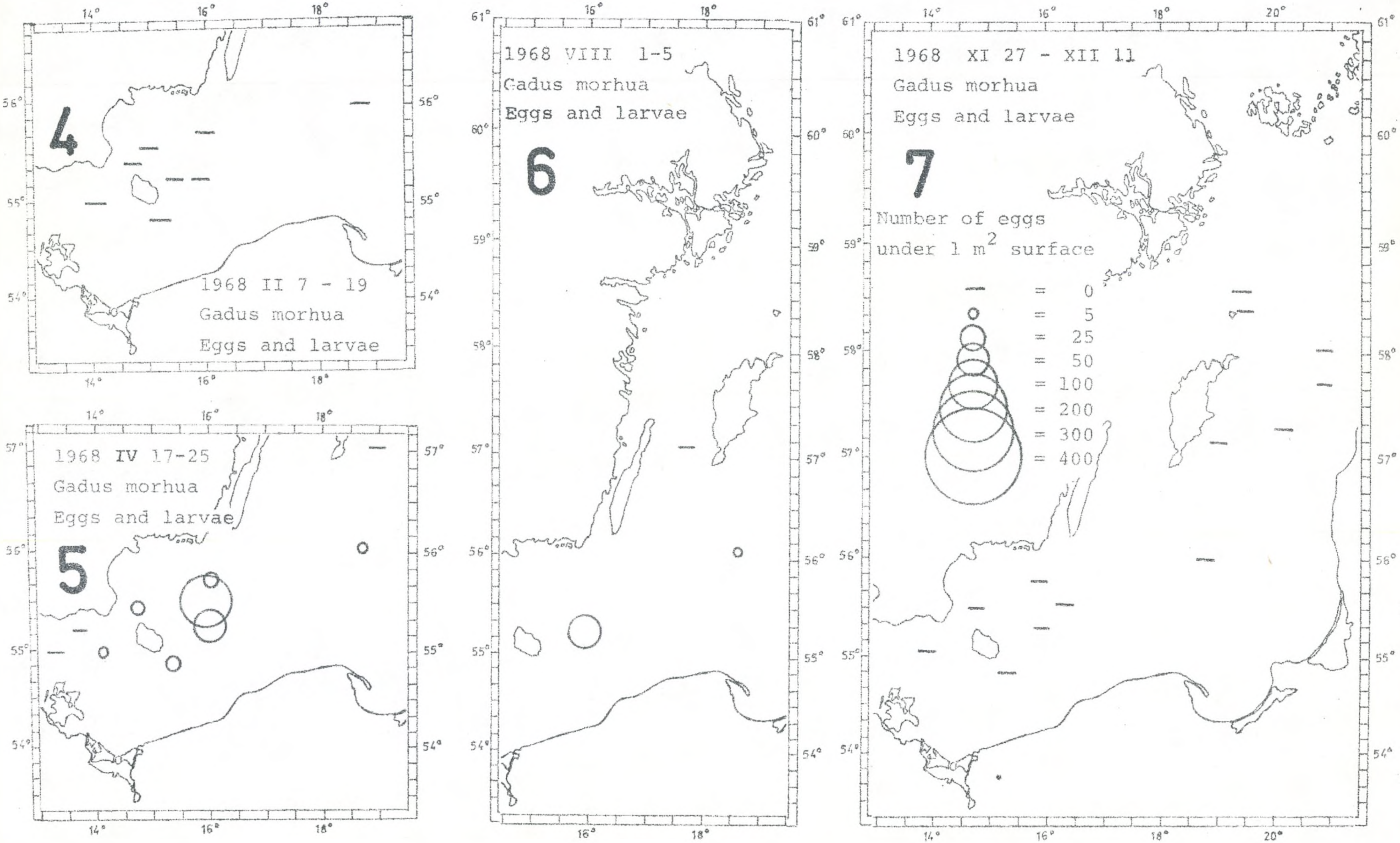
Date	Station	Position N	Position E	Sampling depth (m)	Eggs and (larvae) under 1 m^2 surface area: Gadus morhua	Onos cimbrius	Sprattus sprattus	Pleuronectes platessa	Platichthys flesus	Limanda limanda	Other	Observations
1971												
28/9	F 78	$58^{0}35'$	$18^{0}14'$	200 – 0	–	–	–	–	–	–	–	
29/9	13 B	$57^{0}23'5$	$19^{0}26'$	119 – 0	–	–	–	–	–	–	–	
30/9	ESE När	$57^{0}10'$	$18^{0}50'$	42 – 0	–	–	–	–	–	–	–	
30/9	Hoburgs b.	$56^{0}47'5$	$18^{0}34'5$	19 – 0	–	–	–	–	–	–	–	
1/10	S 41	$57^{0}07'$	$17^{0}40'$	108 – 0	–	–	–	–	–	–	–	
1971												
9/11	S 12	$55^{0}00'$	$14^{0}06'$	44 – 0	–	–	–	–	–	–	–	
10/11	S 24	$55^{0}15'$	$16^{0}00'$	85 – 0	–	–	–	–	–	–	–	
15/11	S 41	$57^{0}07'$	$17^{0}40'$	103 – 0	–	–	–	–	–	–	–	
1971												
30/11	S 12	$55^{0}00'$	$14^{0}05'$	38 – 0	–	–	–	–	–	–	–	
1/12	S 24	$55^{0}15'$	$15^{0}59'$	80 – 0	–	–	–	–	–	–	–	
1/12	Klaipeda	$56^{0}07'5$	$19^{0}17'$	100 – 0	–	–	–	–	–	–	–	
2/12	F 81	$57^{0}20'$	$20^{0}03'$	200 – 0	–	–	–	–	–	–	–	
10/12	S 41	$57^{0}07'$	$17^{0}40'$	100 – 0	–	–	–	–	–	–	(1) Clupea harengus	

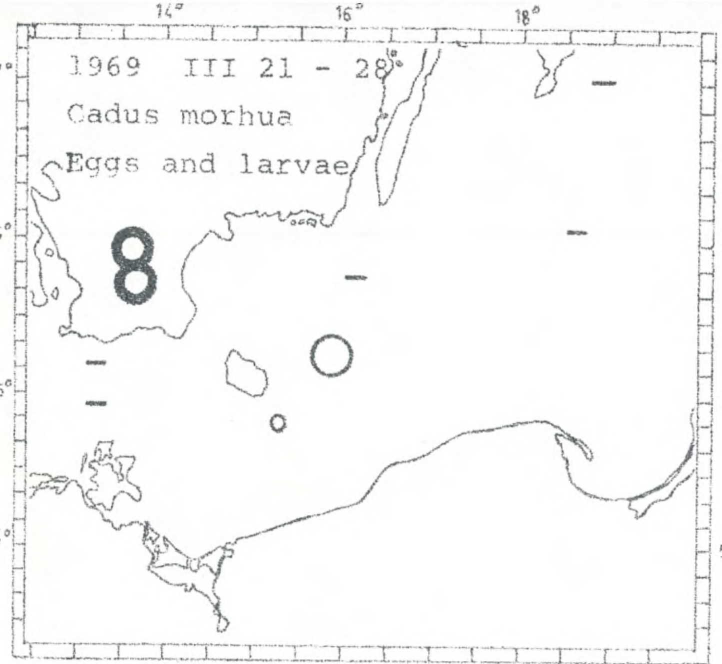
Maps

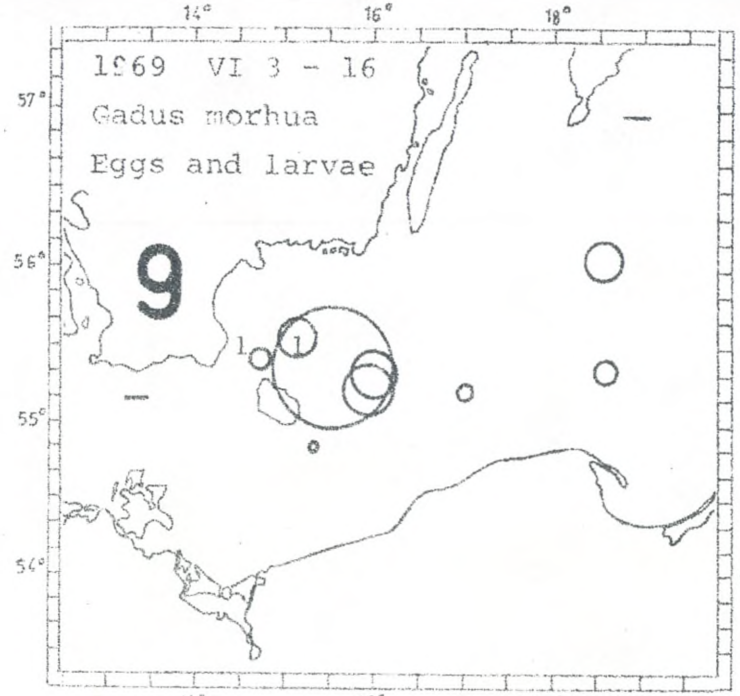
In all maps a circle indicates the presence of eggs, the circle diameter is related to the egg abundance under one square meter (the square root of the egg number = circle diameter). A "-" means that the station was visited but no eggs found. By a mistake the scale of egg abundance has been reproduced on all map pages whether pelagic eggs are spawned or not by the species in question. In the last case only the larva numbers are of interest. They are indicated by figures (larvae under one square meter).

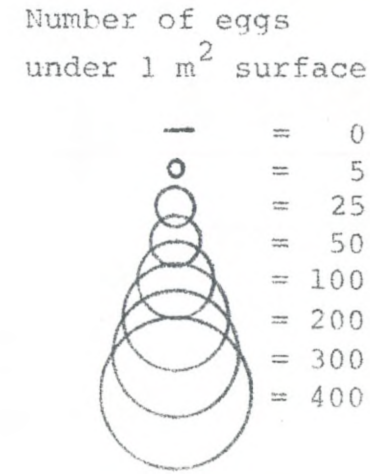


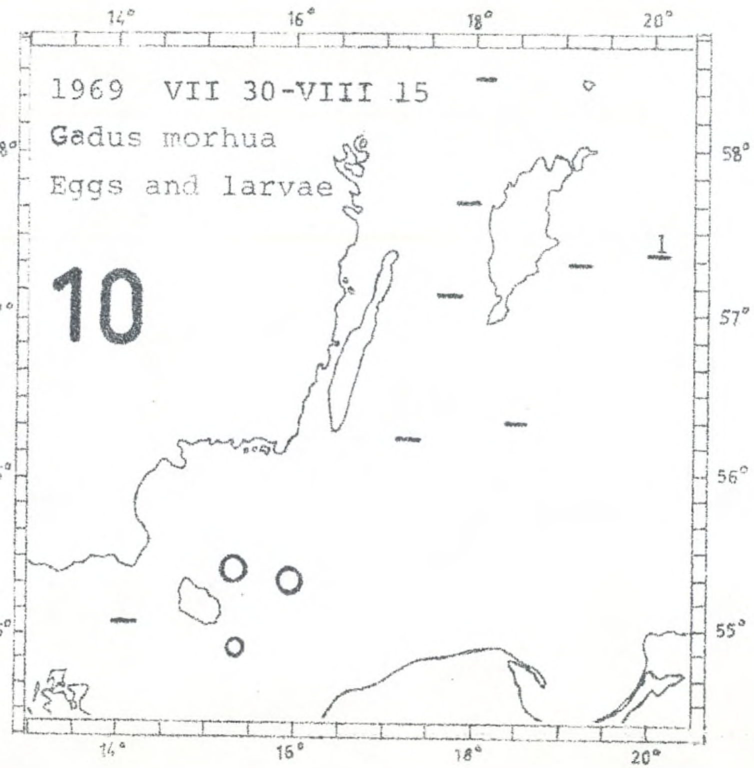
1967 V 26 - VI 7
Gadus morhua
Eggs and larvae
1
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
1967 IX 5 - 13
Gadus morhua
Eggs and larvae
2
1967 XI 15
Gadus morhua
Eggs and larvae
3
14°
16°
18°
54°
55°
56°
57°
58°
59°
60°
61°

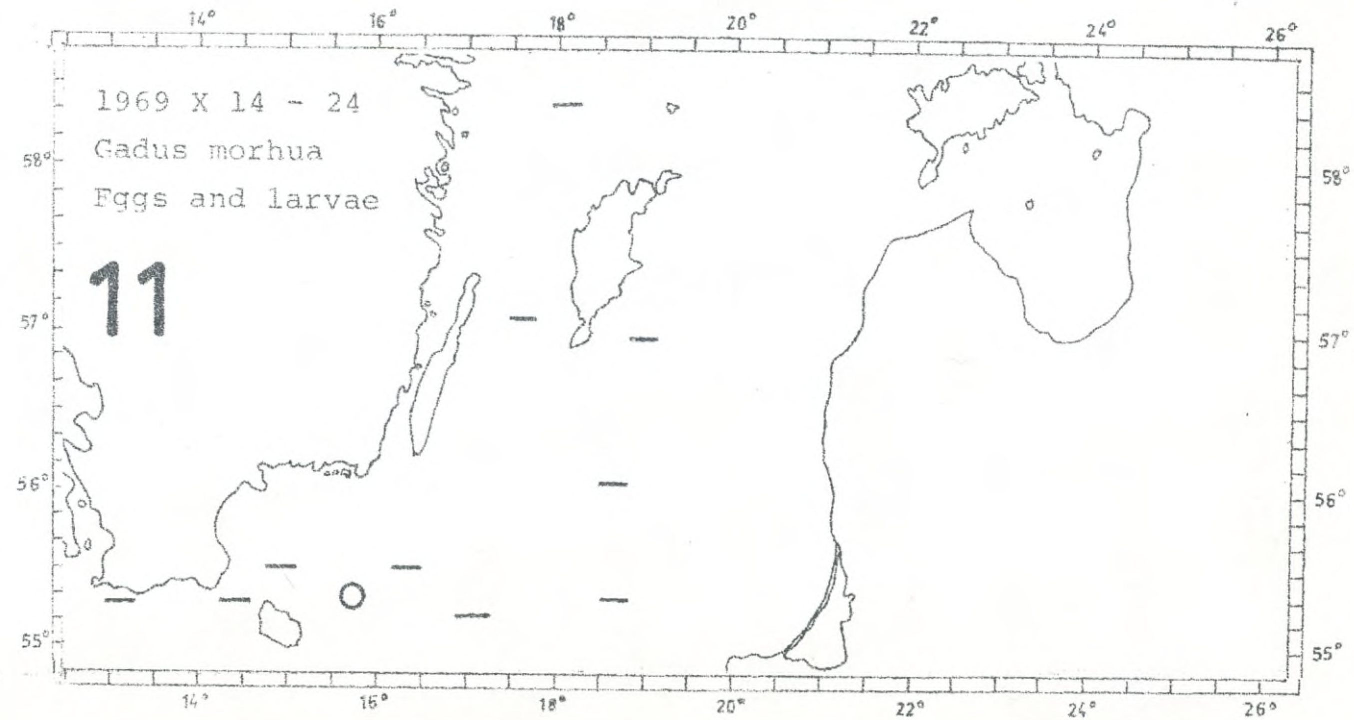

4
1968 II 7 - 19
Gadus morhua
Eggs and larvae
5
1968 IV 17-25
Gadus morhua
Eggs and larvae
6
1968 VIII 1-5
Gadus morhua
Eggs and larvae
7
1968 XI 27 - XII 11
Gadus morhua
Eggs and larvae
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
14°
16°
18°
20°
54°
55°
56°
57°
58°
59°
60°
61°

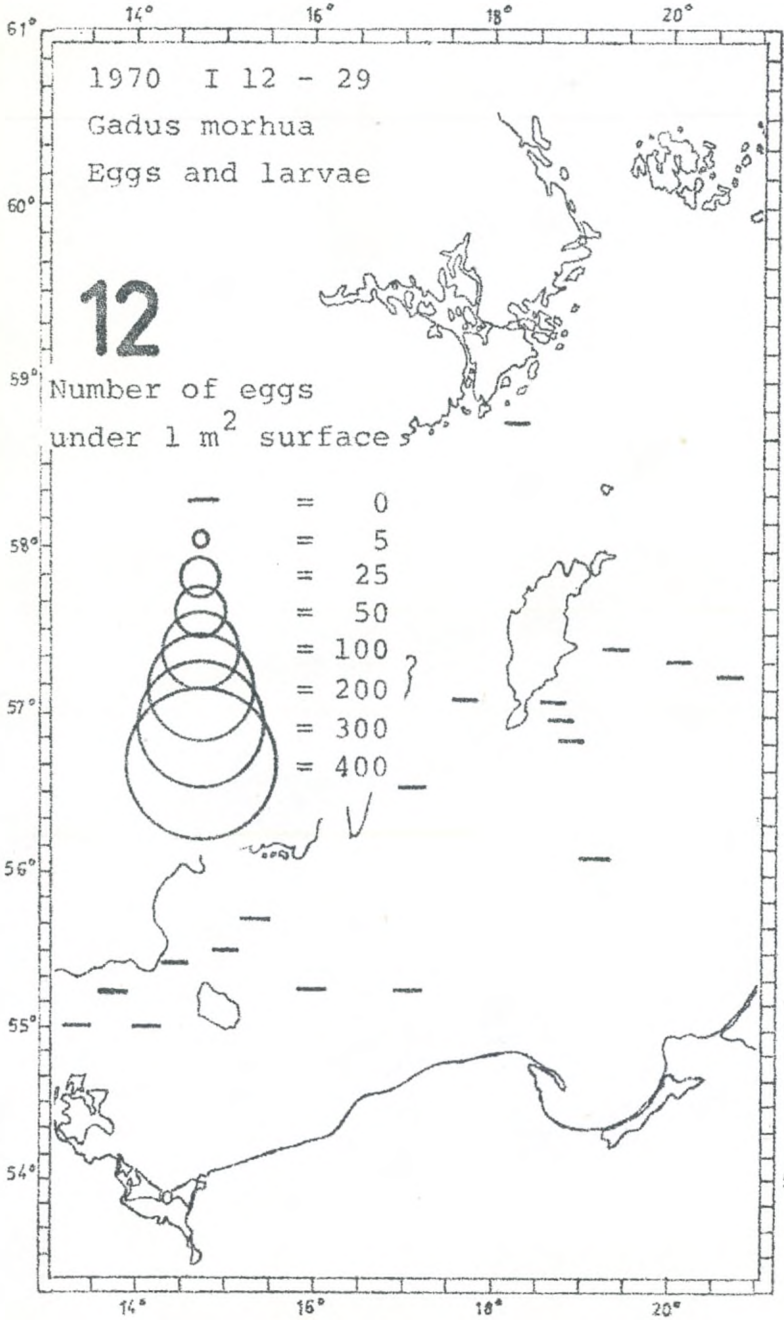

1969 III 21 - 28
Cadus morhua
Eggs and larvae
8


1969 VI 3 - 16
Gadus morhua
Eggs and larvae
9

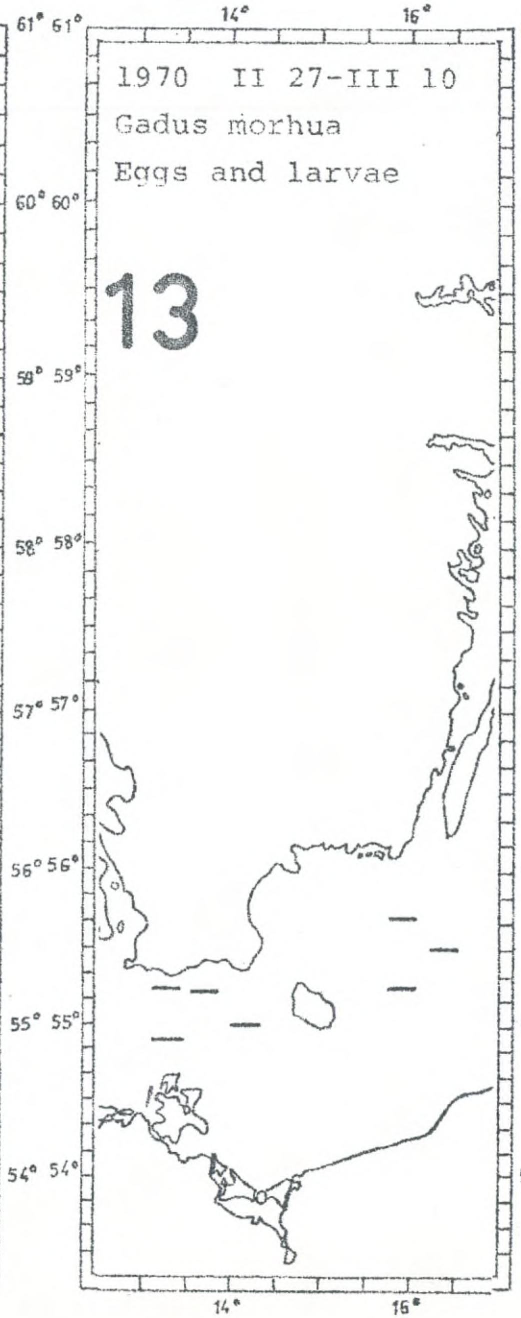

Number of eggs
under 1 m^2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400


1969 VII 30-VIII 15
Gadus morhua
Eggs and larvae
10

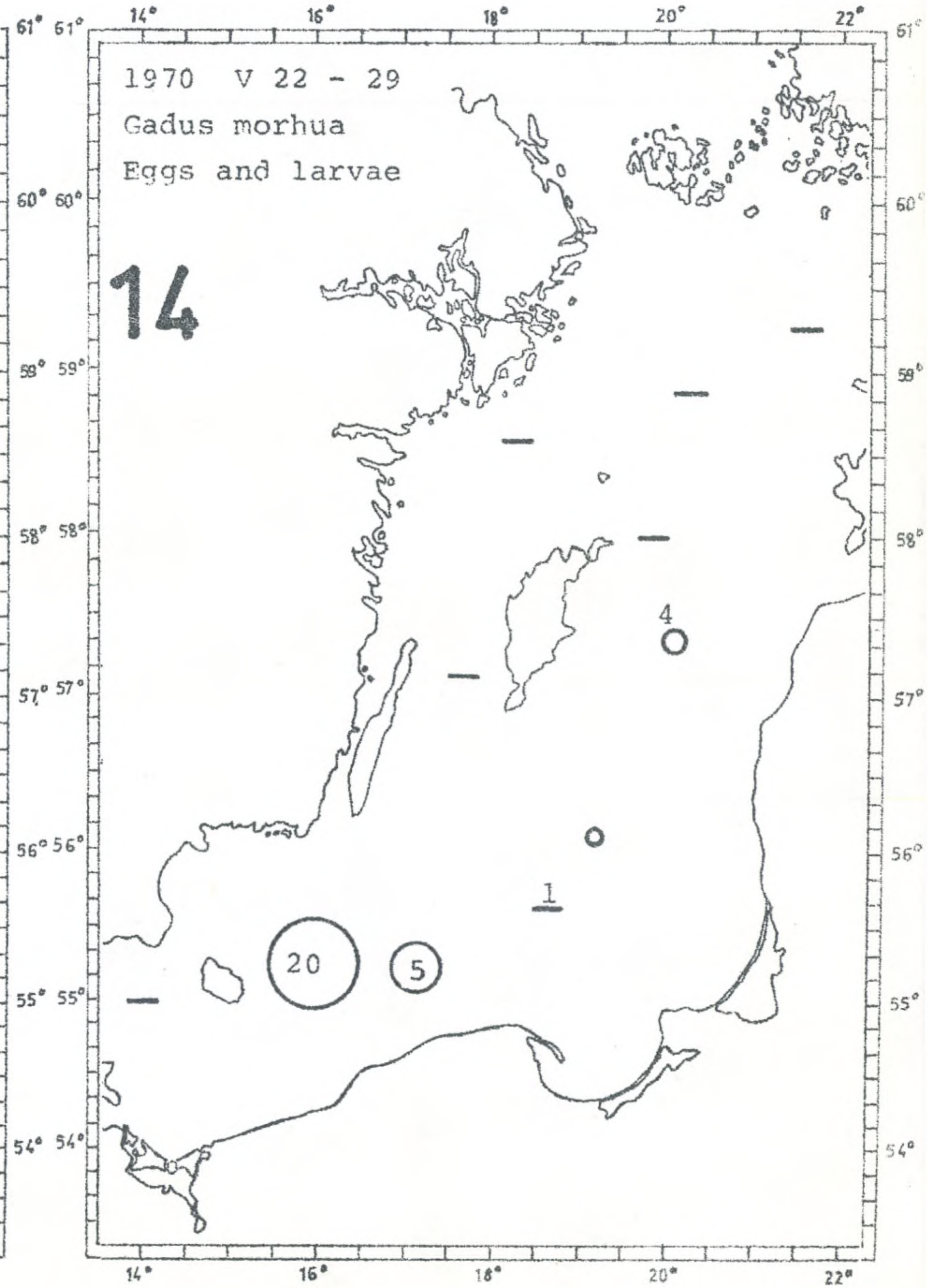

1969 X 14 - 24
Gadus morhua
Fggs and larvae
11



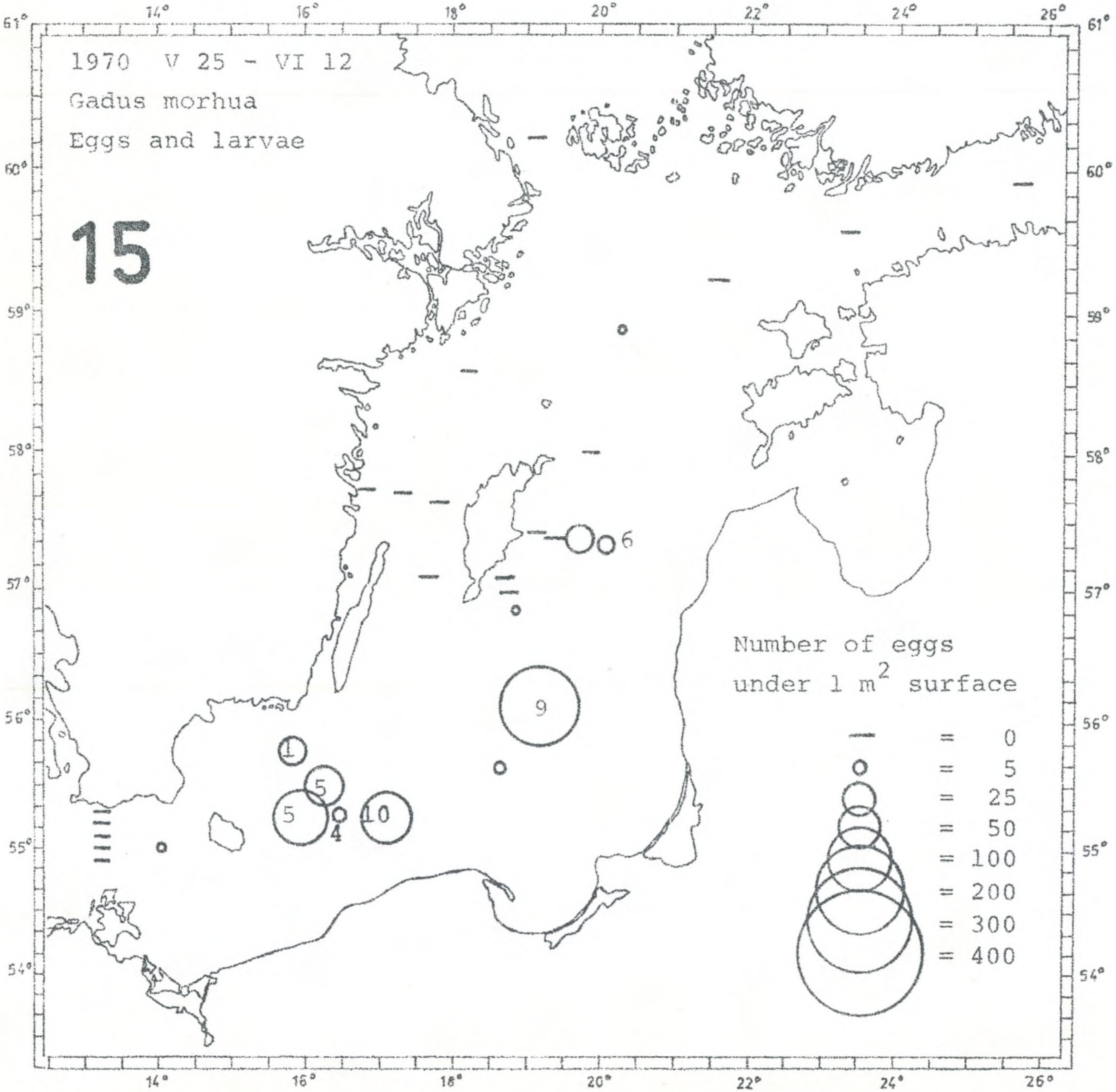
1970 I 12 - 29
Gadus morhua
Eggs and larvae
12
Number of eggs
under 1 m² surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400

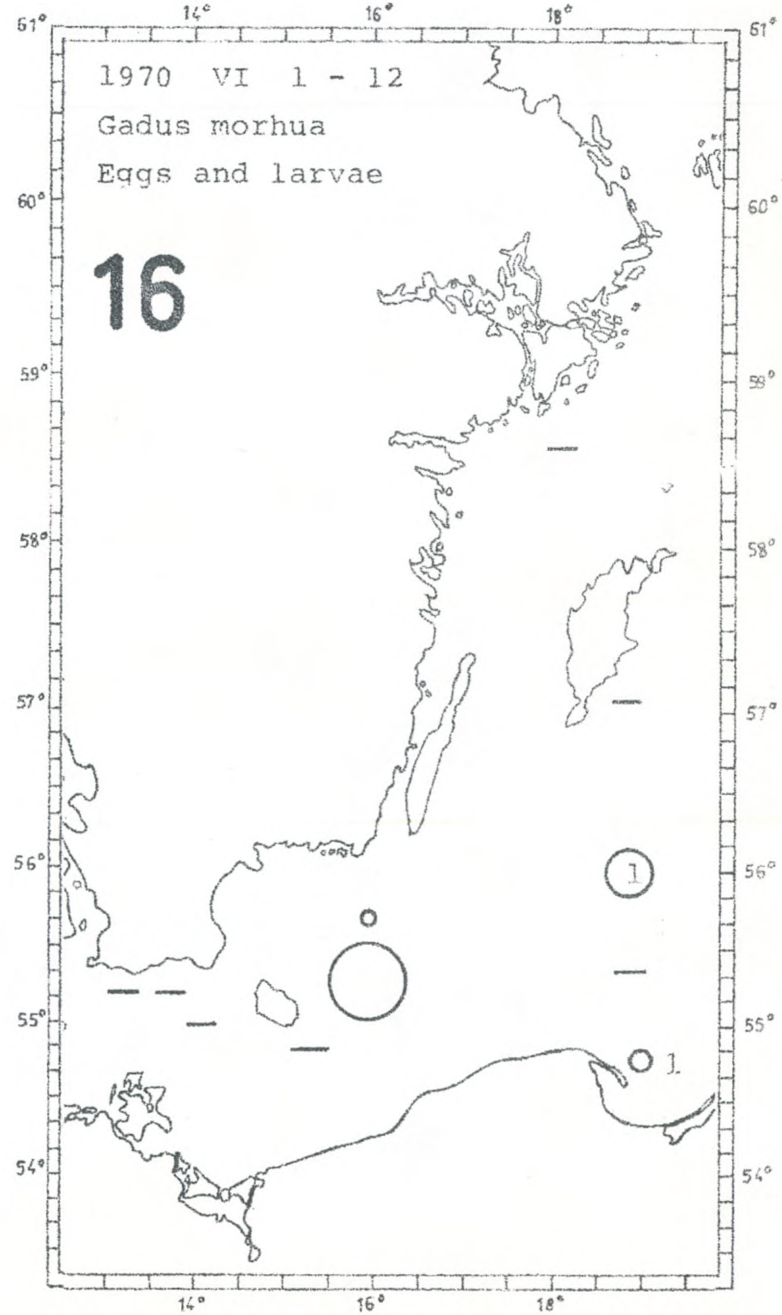


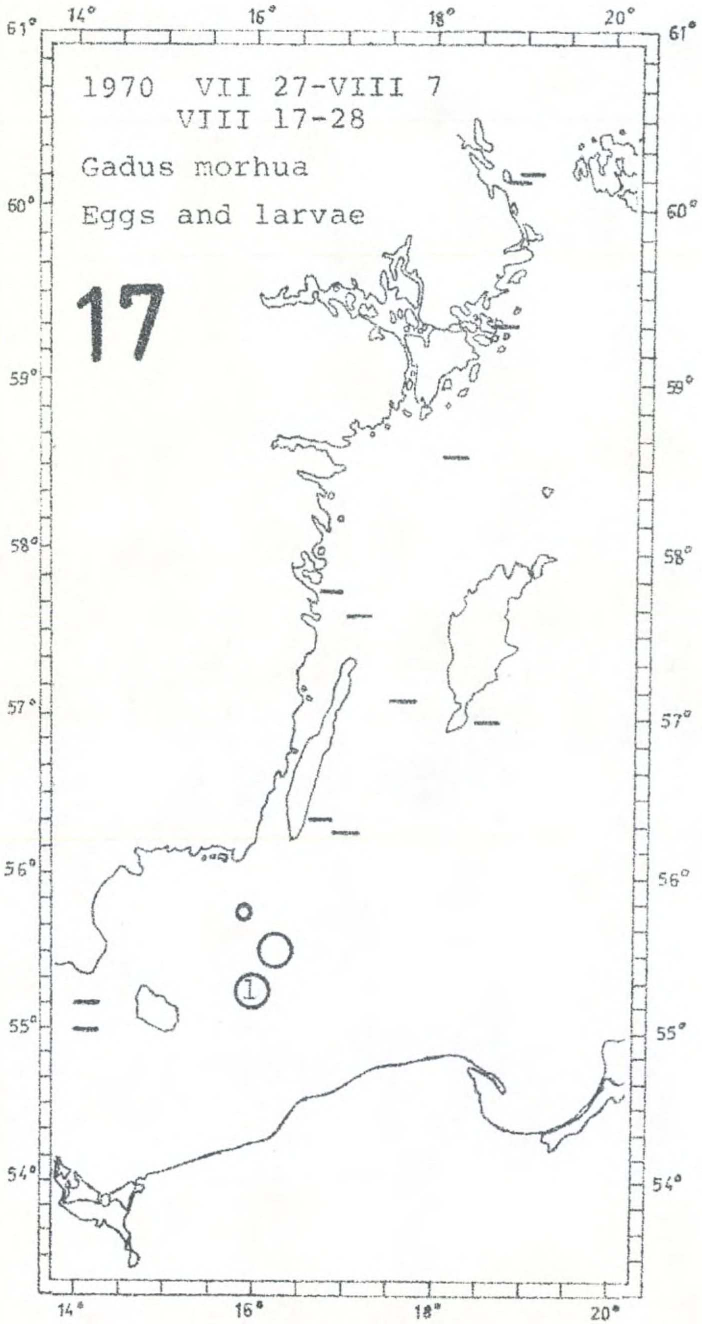
1970 II 27-III 10
Gadus morhua
Eggs and larvae
13



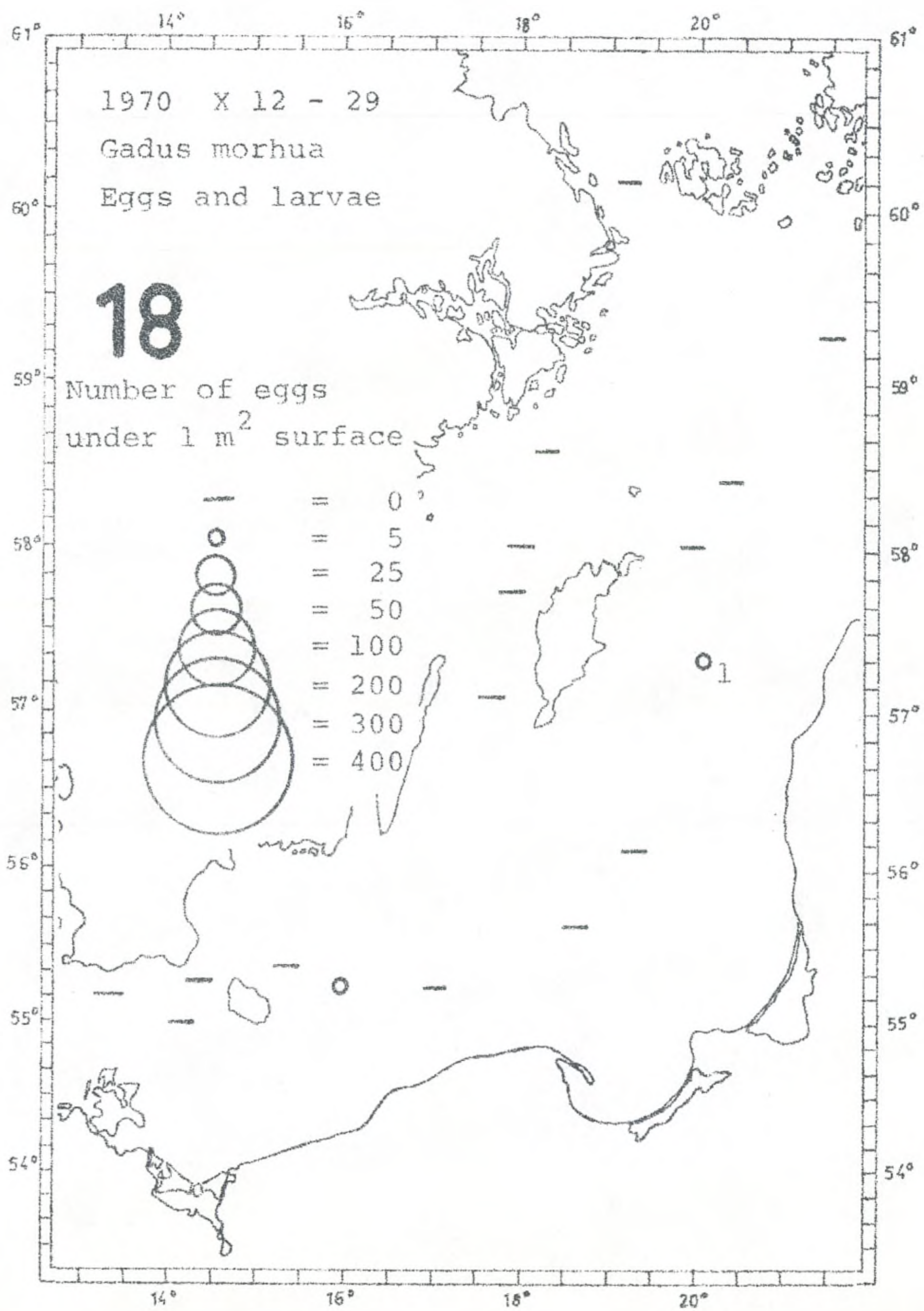
1970 V 22 - 29
Gadus morhua
Eggs and larvae
14
4
1
20
5


1970 V 25 - VI 12
Gadus morhua
Eggs and larvae
15
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
14°
16°
18°
20°
22°
24°
26°
54°
55°
56°
57°
58°
59°
60°
61°

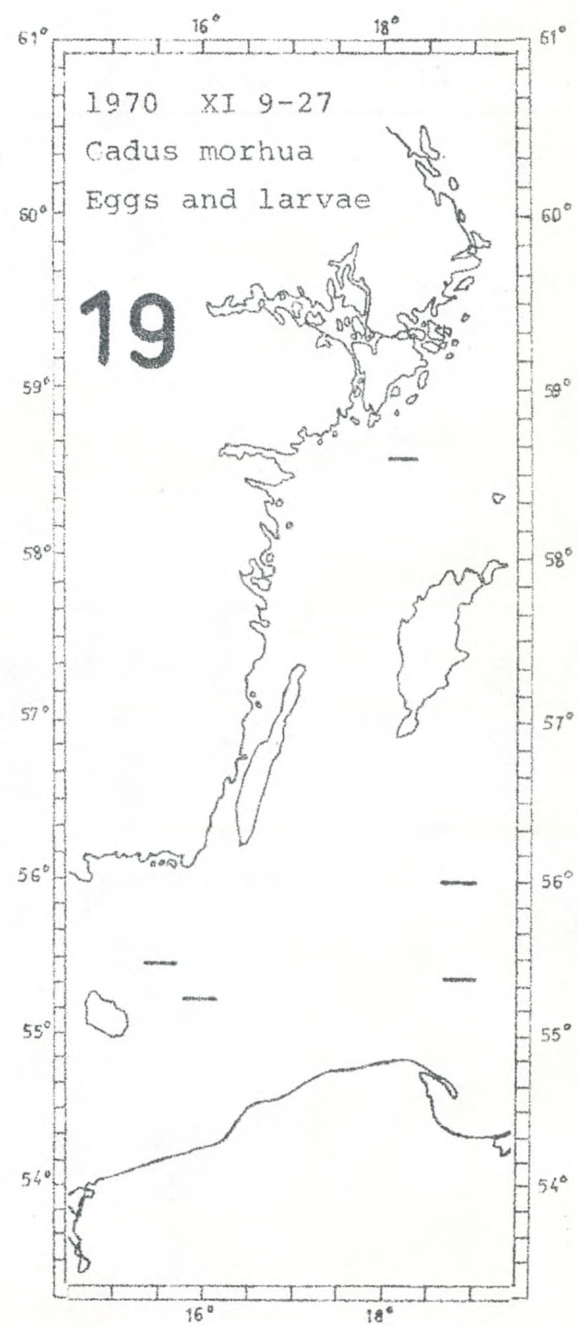

1970 VI 1 - 12
Gadus morhua
Eggs and larvae
16
14°
16°
18°
54°
55°
56°
57°
58°
59°
60°
61°



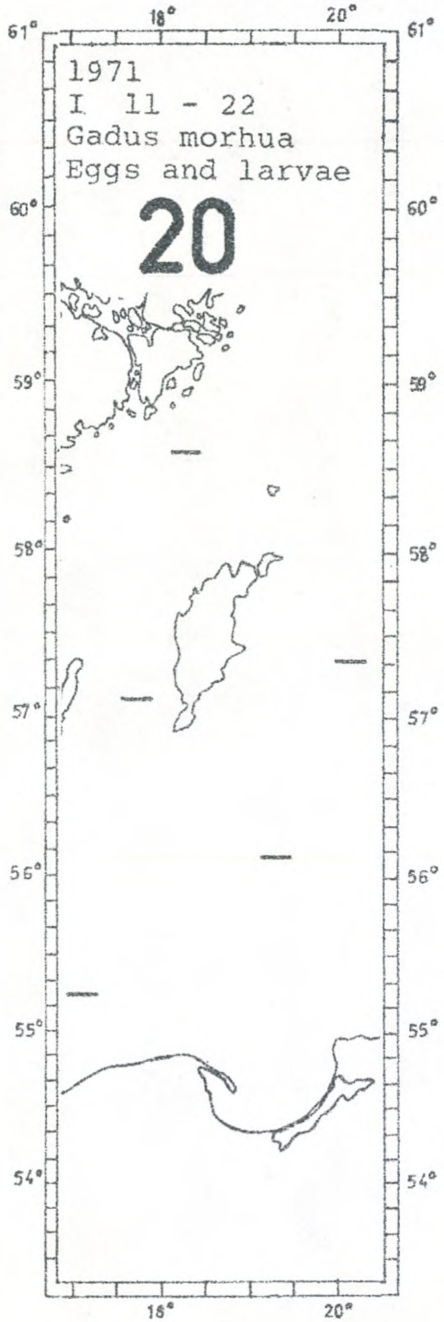
1970 VII 27-VIII 7
VIII 17-28
Gadus morhua
Eggs and larvae
17

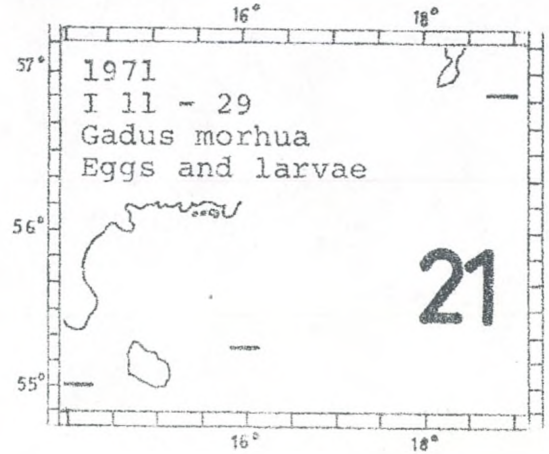


1970 X 12 - 29
Gadus morhua
Eggs and larvae
18
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400

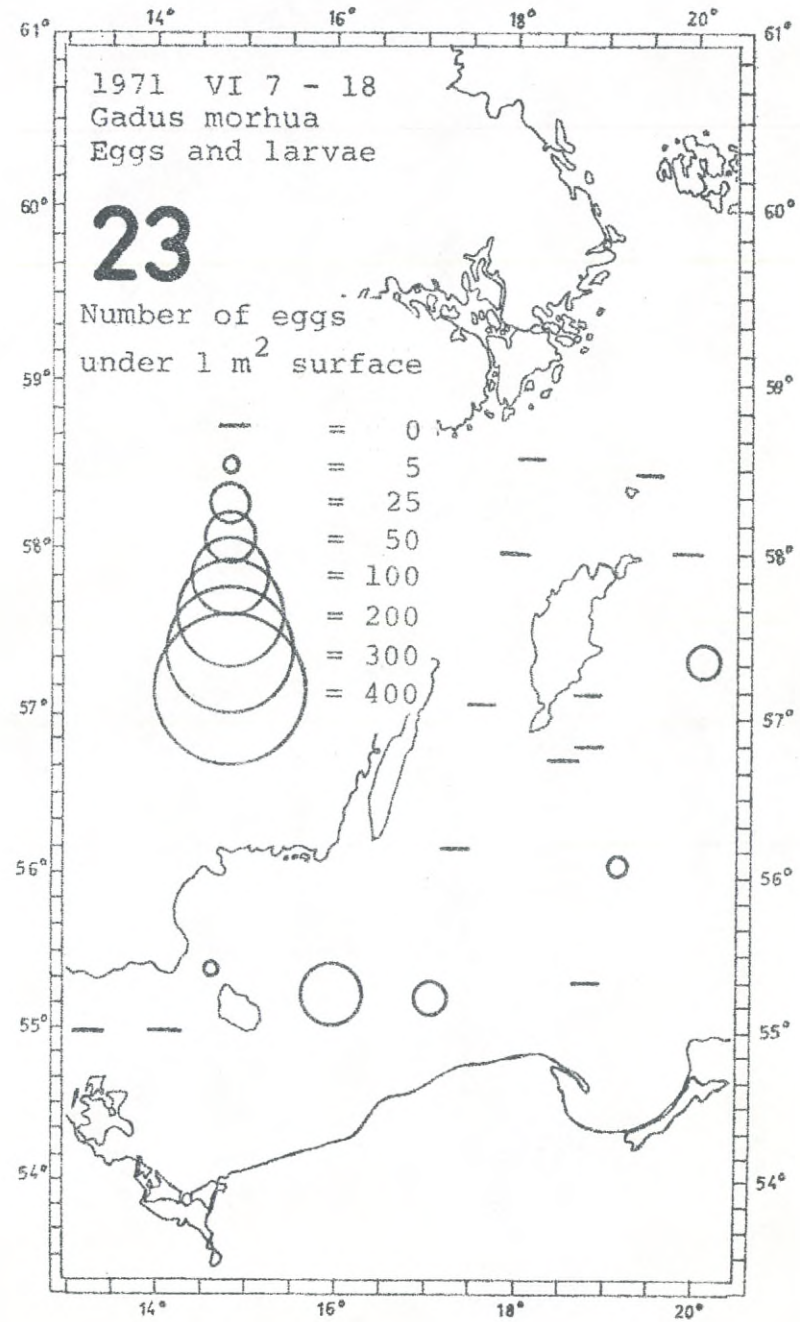


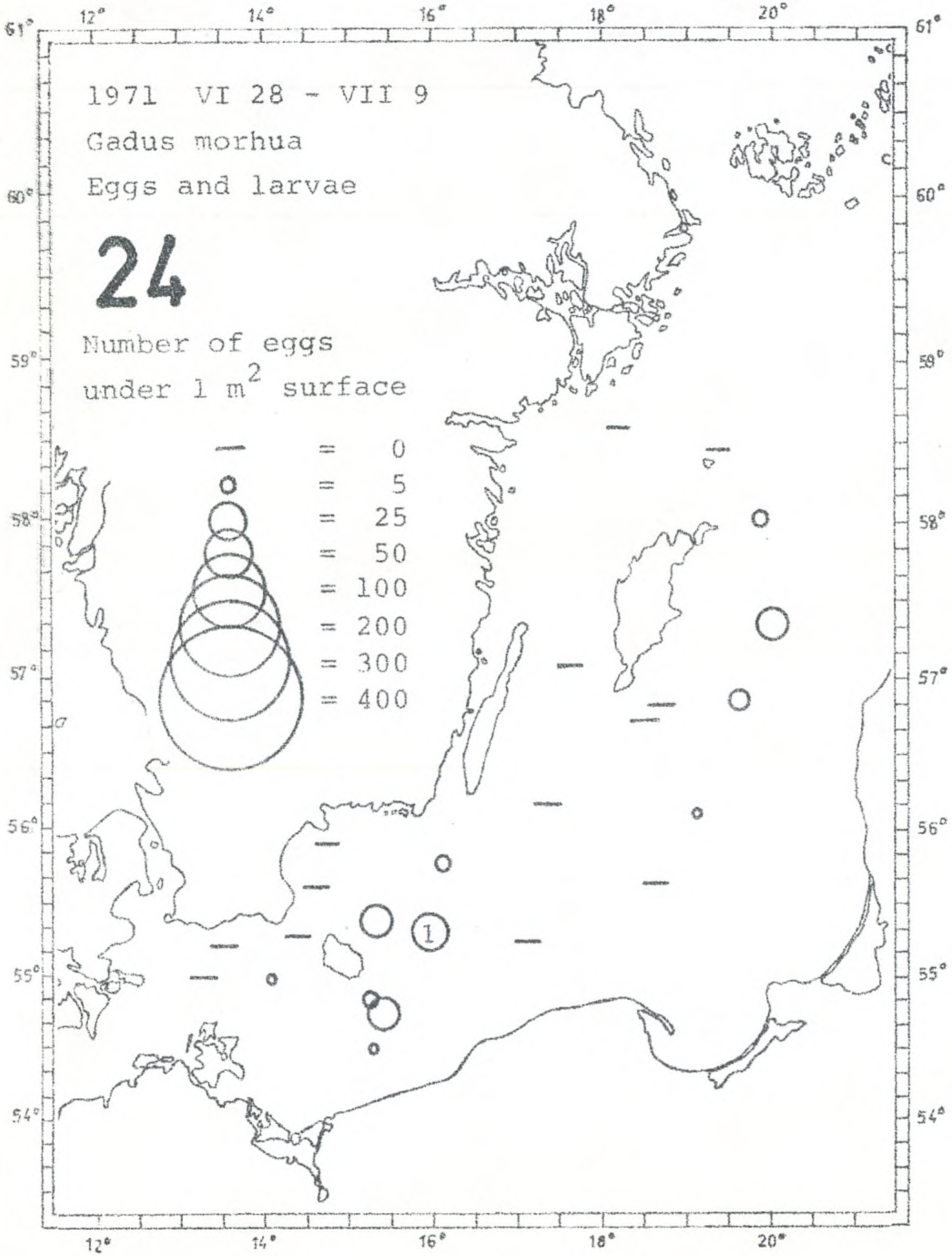
1970 XI 9-27
Gadus morhua
Eggs and larvae
19

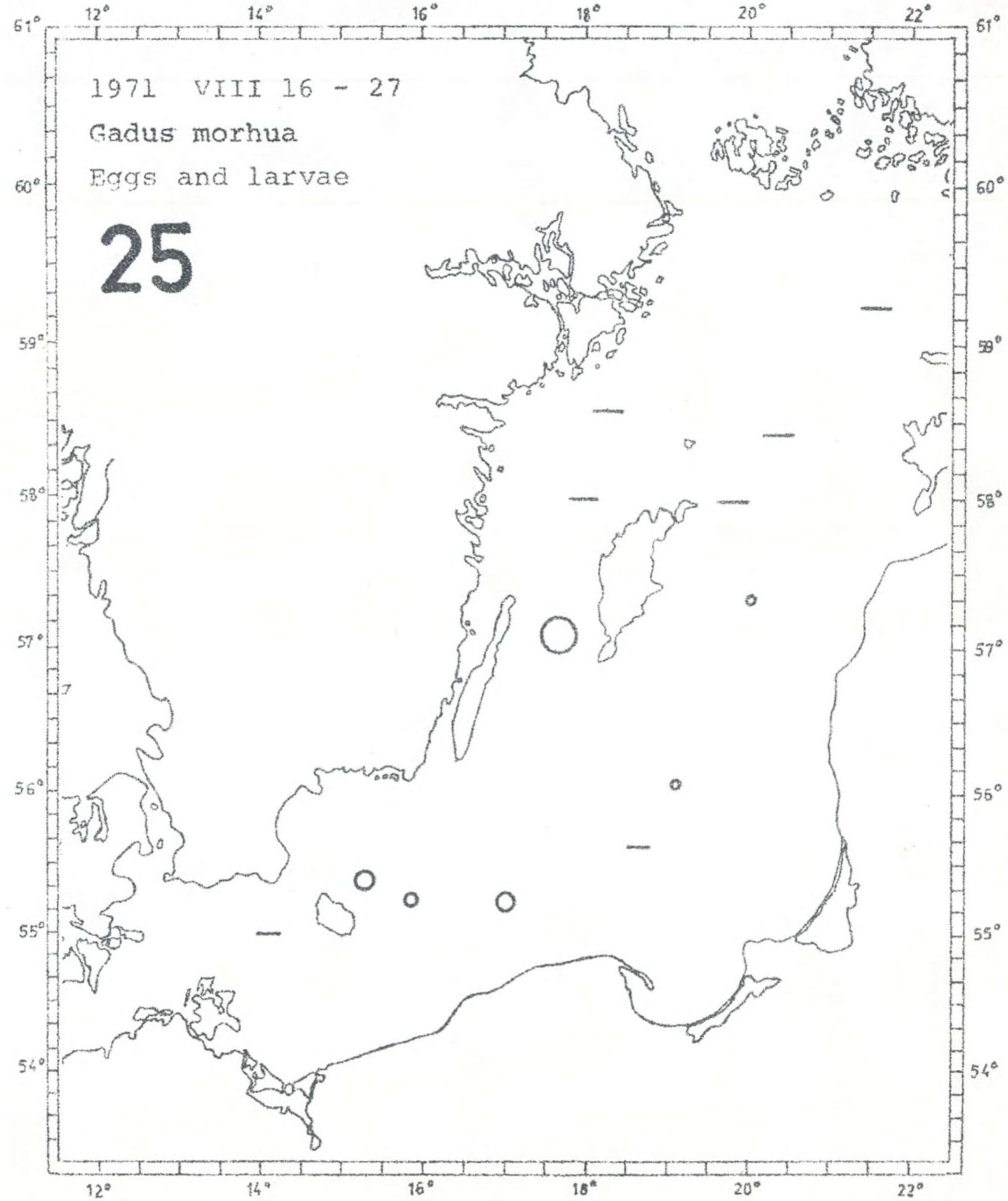

1971
I 11 - 22
Gadus morhua
Eggs and larvae
20

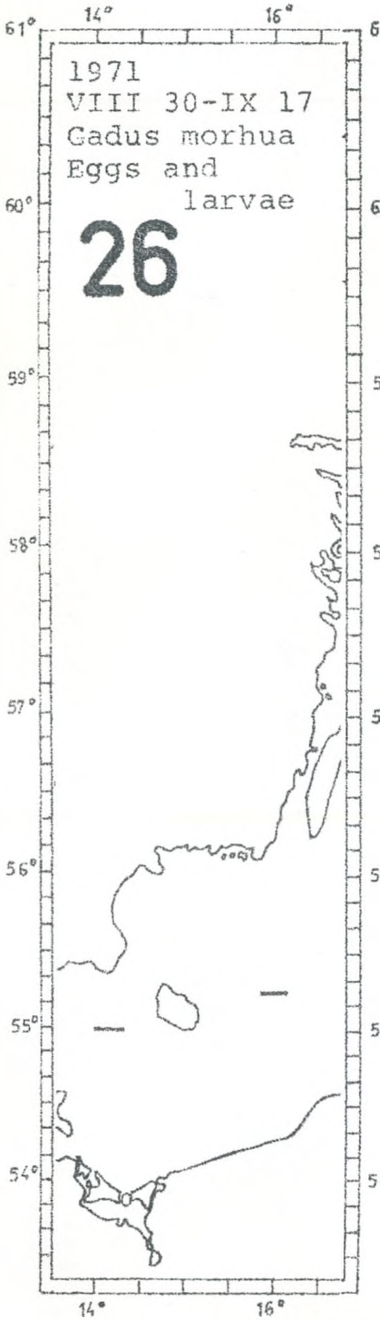

1971
I 11 - 29
Gadus morhua
Eggs and larvae
21


1971 III 22-IV 5
Gadus morhua
Eggs and larvae
22

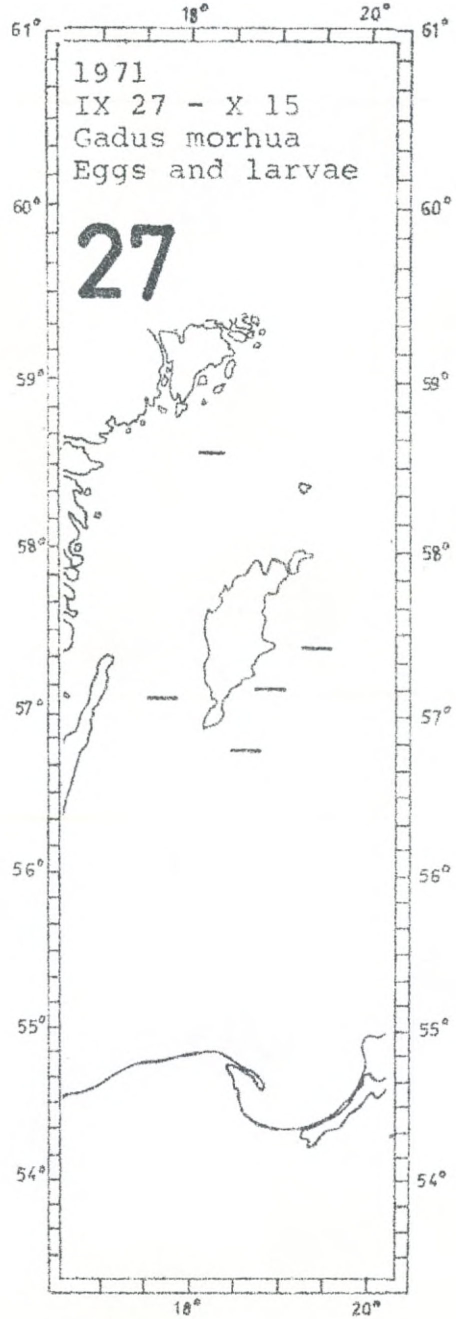

1971 VI 7 - 18
Gadus morhua
Eggs and larvae
23
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400


1971 VI 28 - VII 9
Gadus morhua
Eggs and larvae
24
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
1
12°
14°
16°
18°
20°
54°
55°
56°
57°
58°
59°
60°
61°

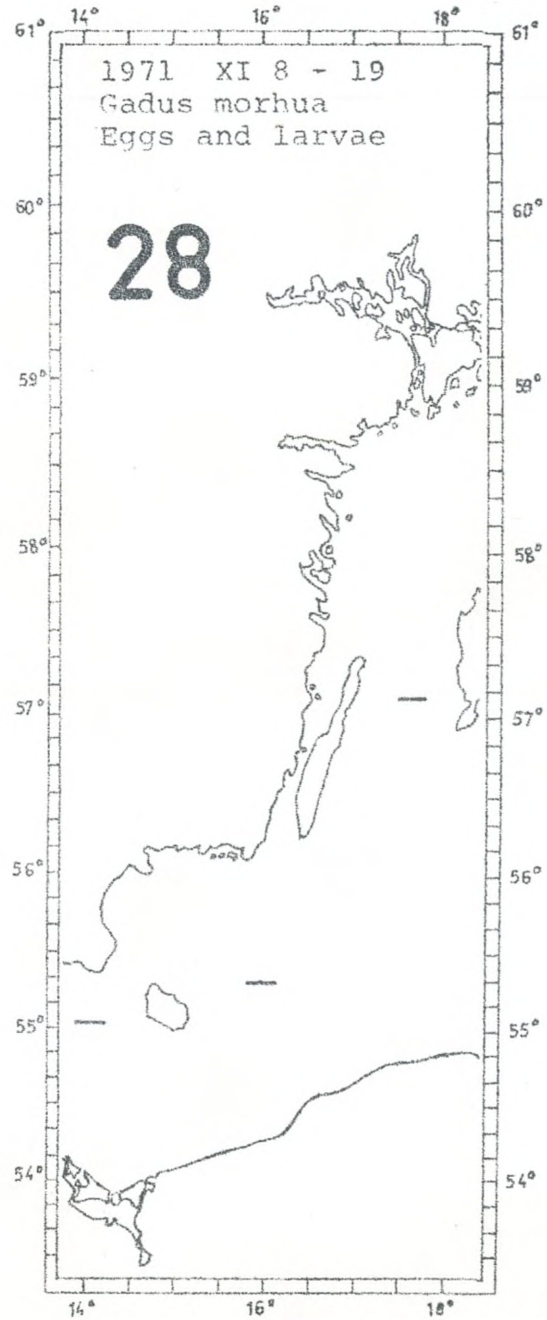

1971 VIII 16 - 27
Gadus morhua
Eggs and larvae
25
12°
14°
16°
18°
20°
22°
54°
55°
56°
57°
58°
59°
60°
61°



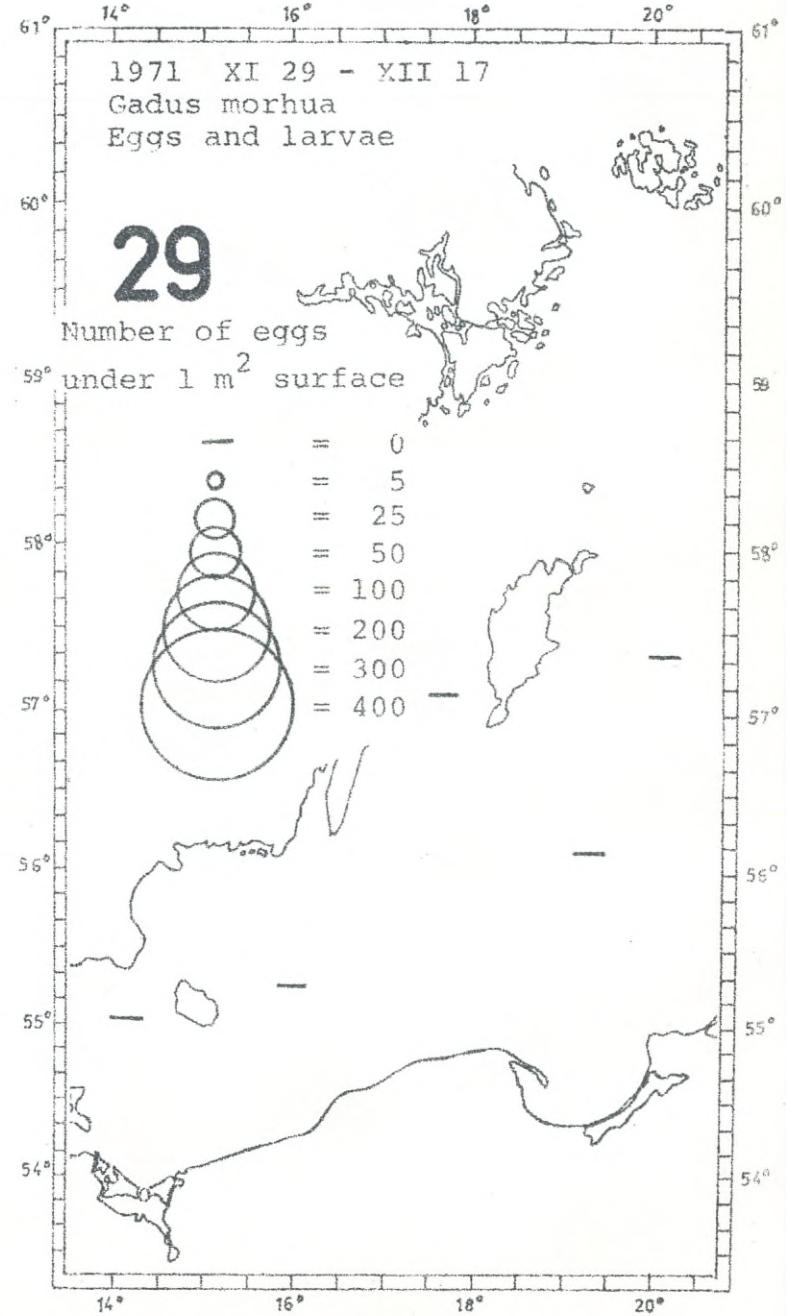
1971
VIII 30-IX 17
Gadus morhua
Eggs and
larvae
26



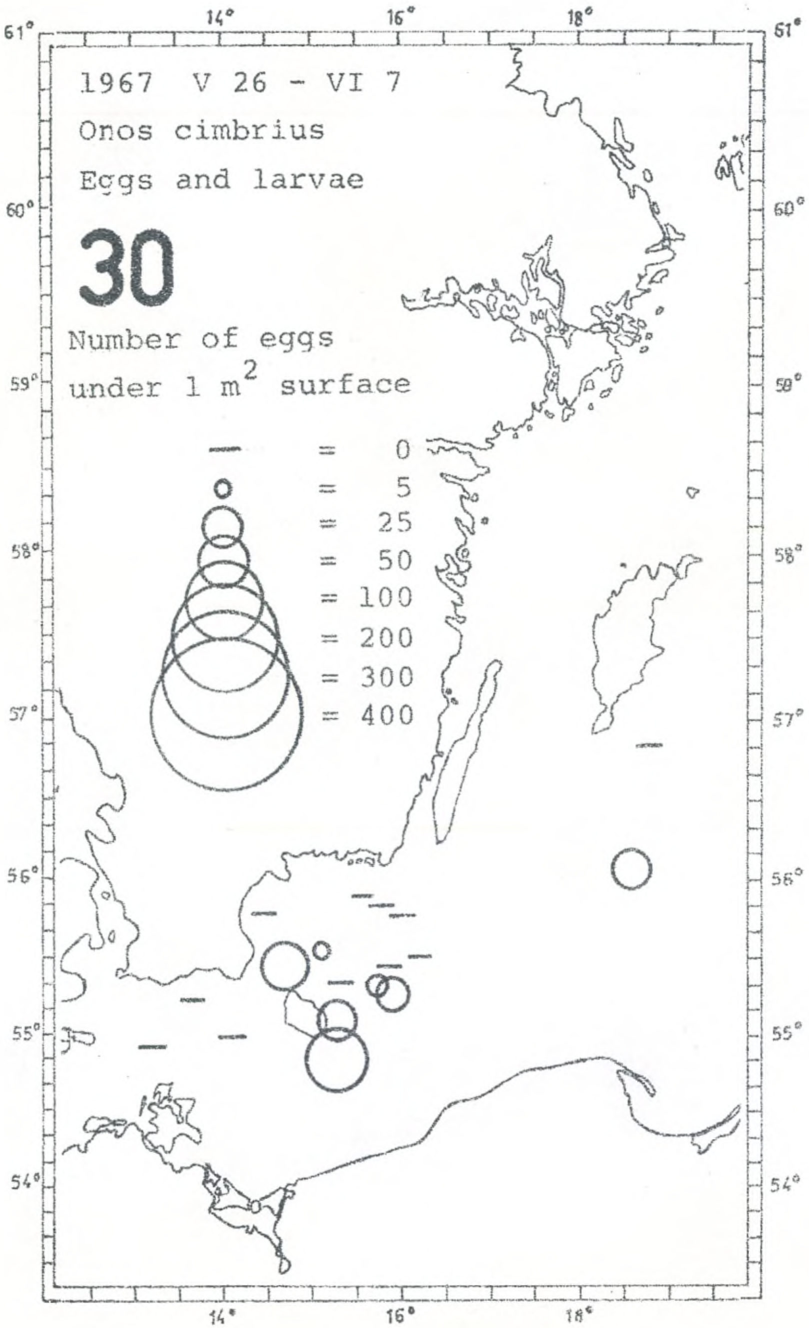
1971
IX 27 - X 15
Gadus morhua
Eggs and larvae
27

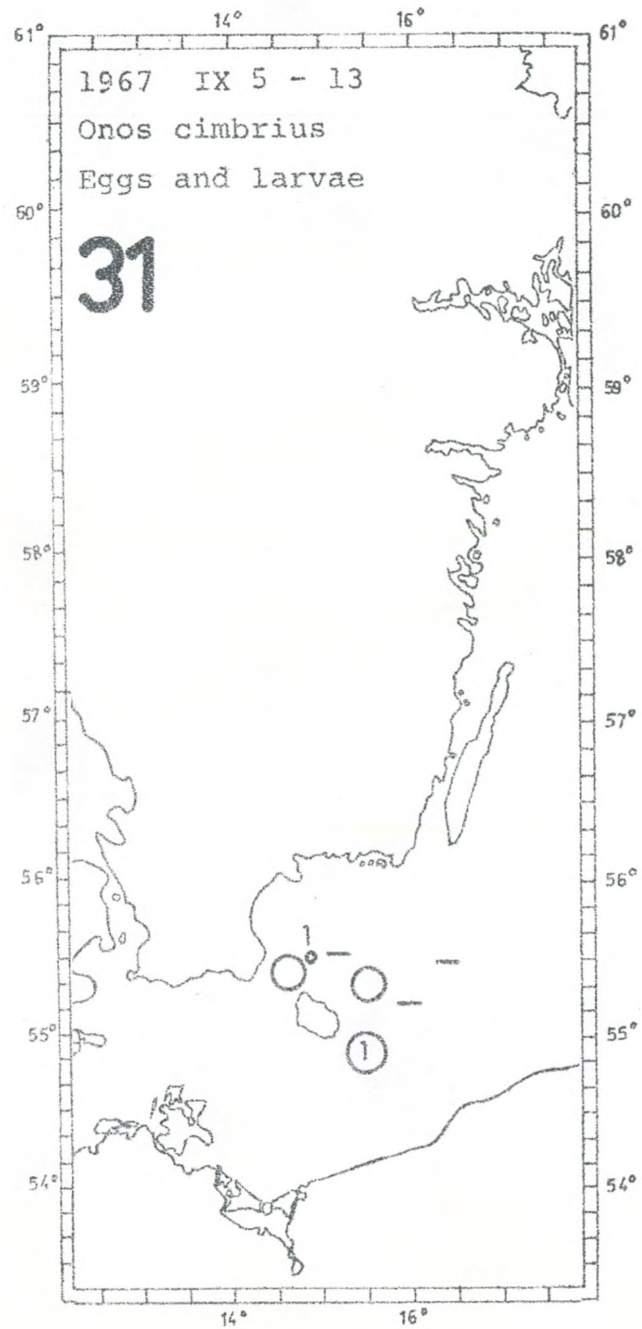


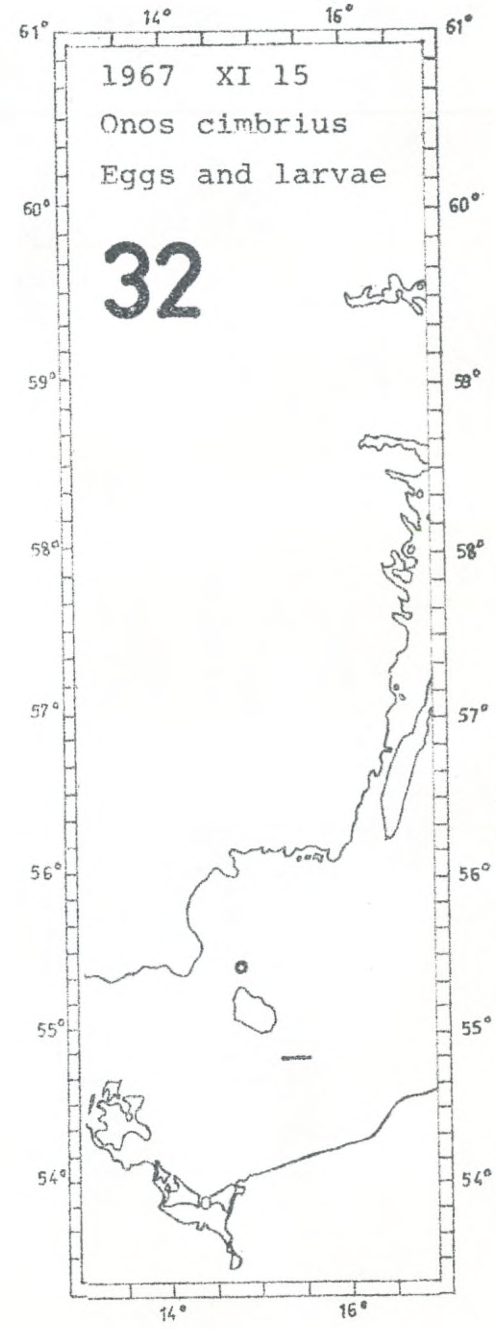
1971 XI 8 - 19
Gadus morhua
Eggs and larvae
28

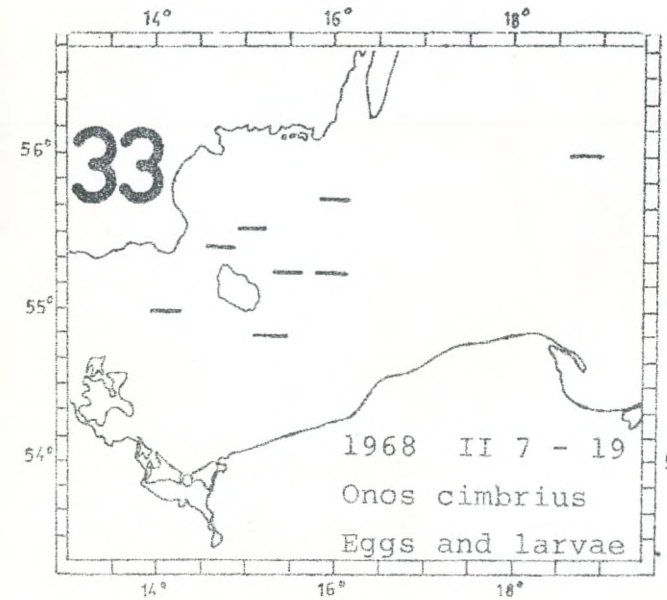


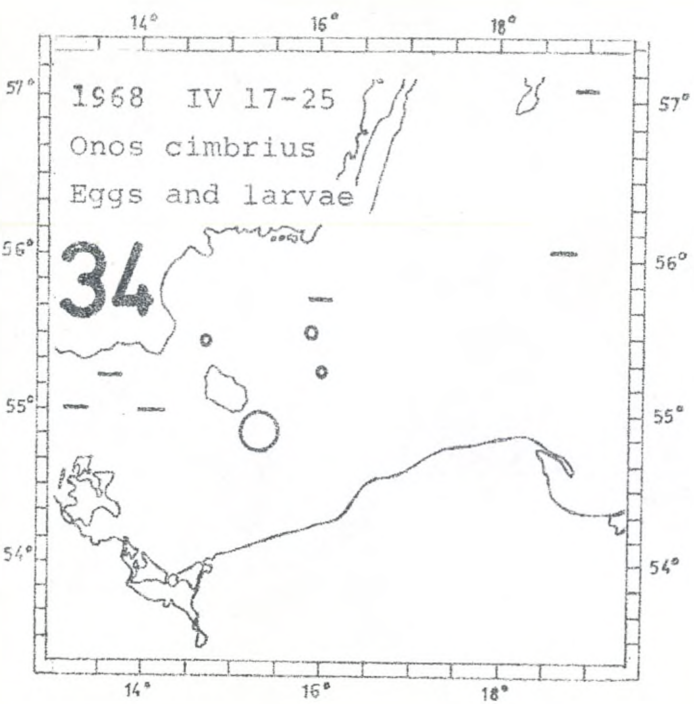
1971 XI 29 - XII 17
Gadus morhua
Eggs and larvae
29
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400

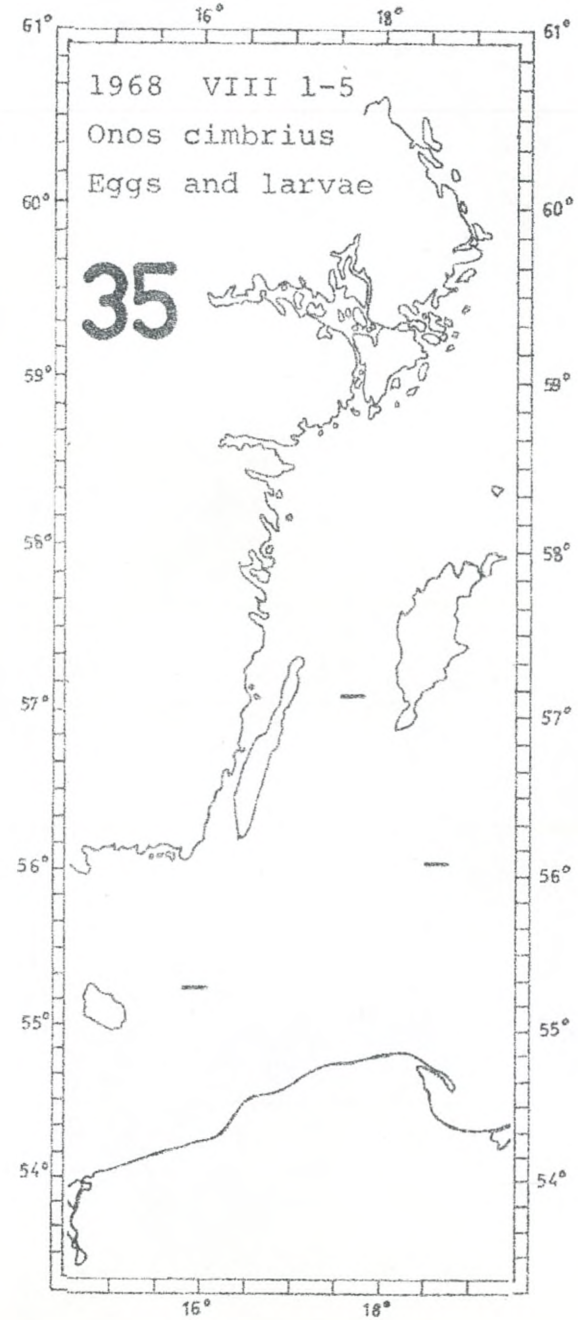

1967 V 26 - VI 7
Onos cimbrius
Eggs and larvae
30
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
14°
16°
18°
54°
55°
56°
57°
58°
59°
60°
61°

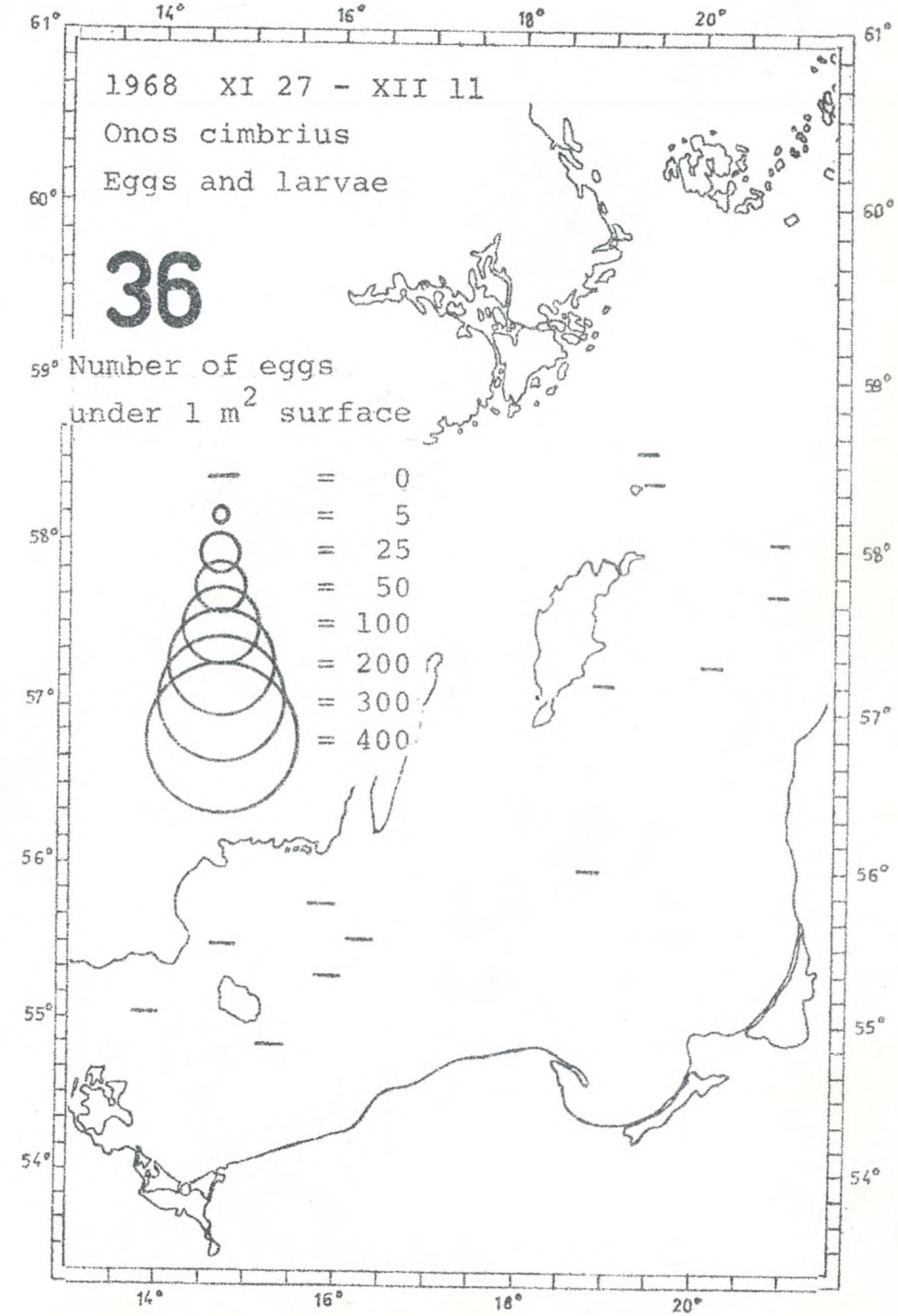

1967 IX 5 - 13
Onos cimbrius
Eggs and larvae
31
1
14°
16°
54°
55°
56°
57°
58°
59°
60°
61°

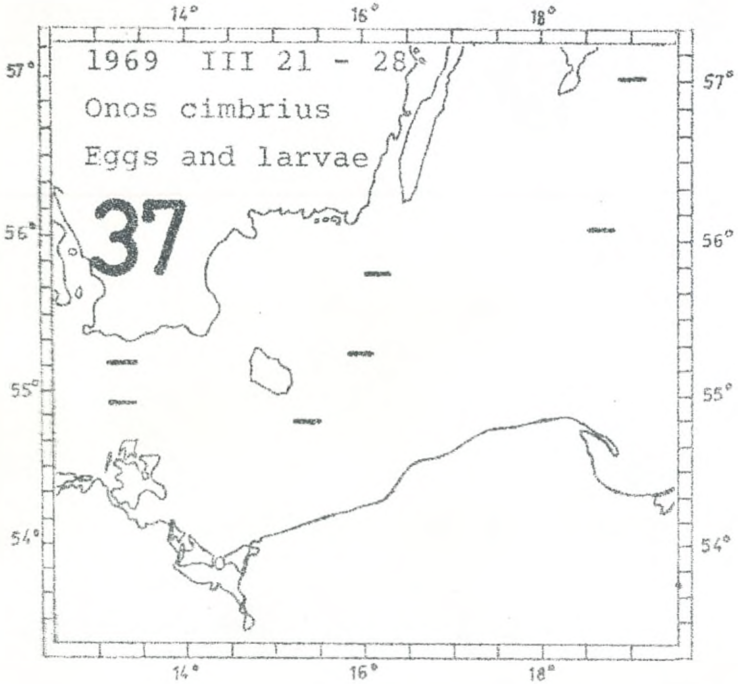

1967 XI 15
Onos cimbrius
Eggs and larvae
32
14°
16°
54°
55°
56°
57°
58°
59°
60°
61°

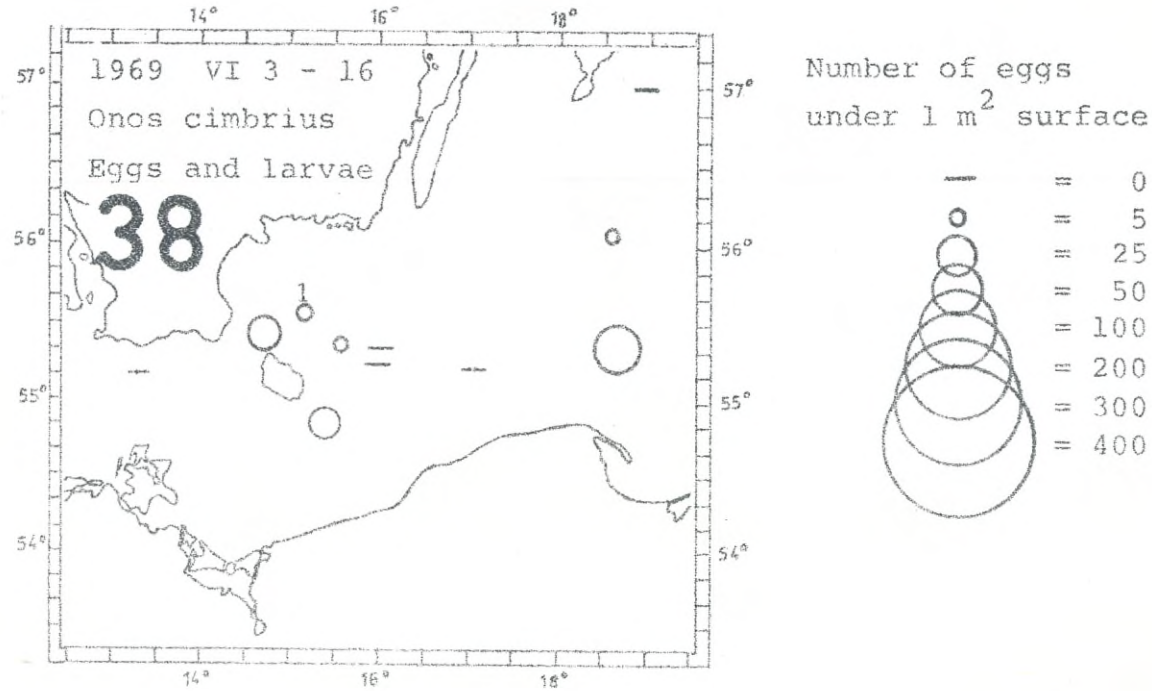

33
1968 II 7 - 19
Onos cimbrius
Eggs and larvae

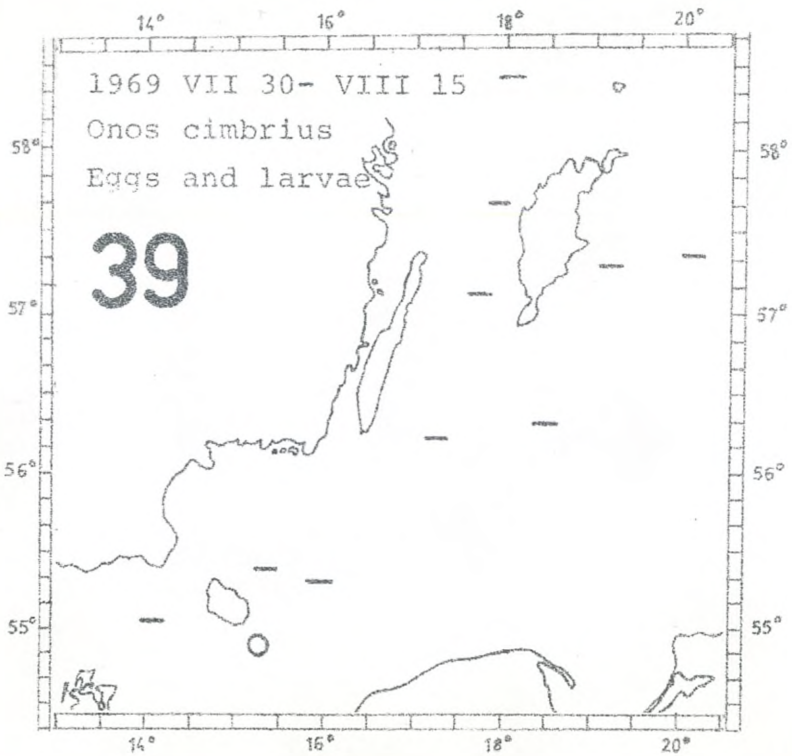

34
1968 IV 17-25
Onos cimbrius
Eggs and larvae

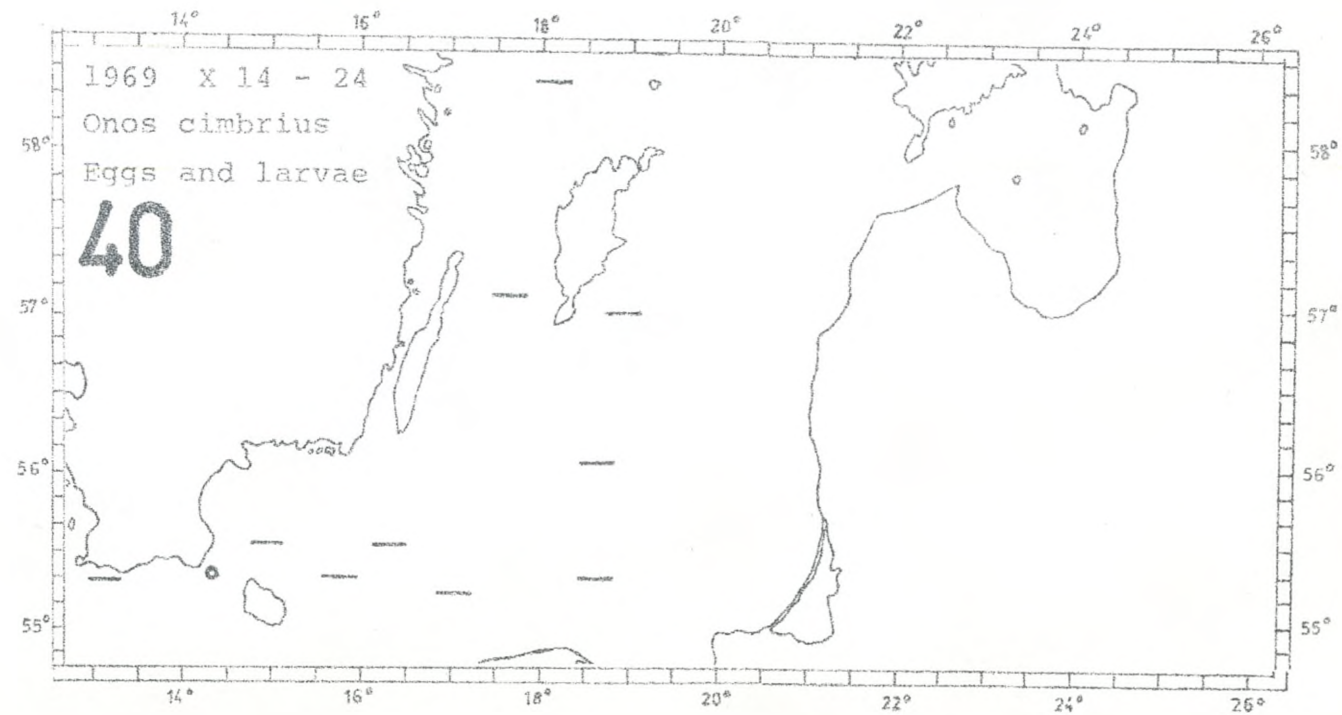

35
1968 VIII 1-5
Onos cimbrius
Eggs and larvae

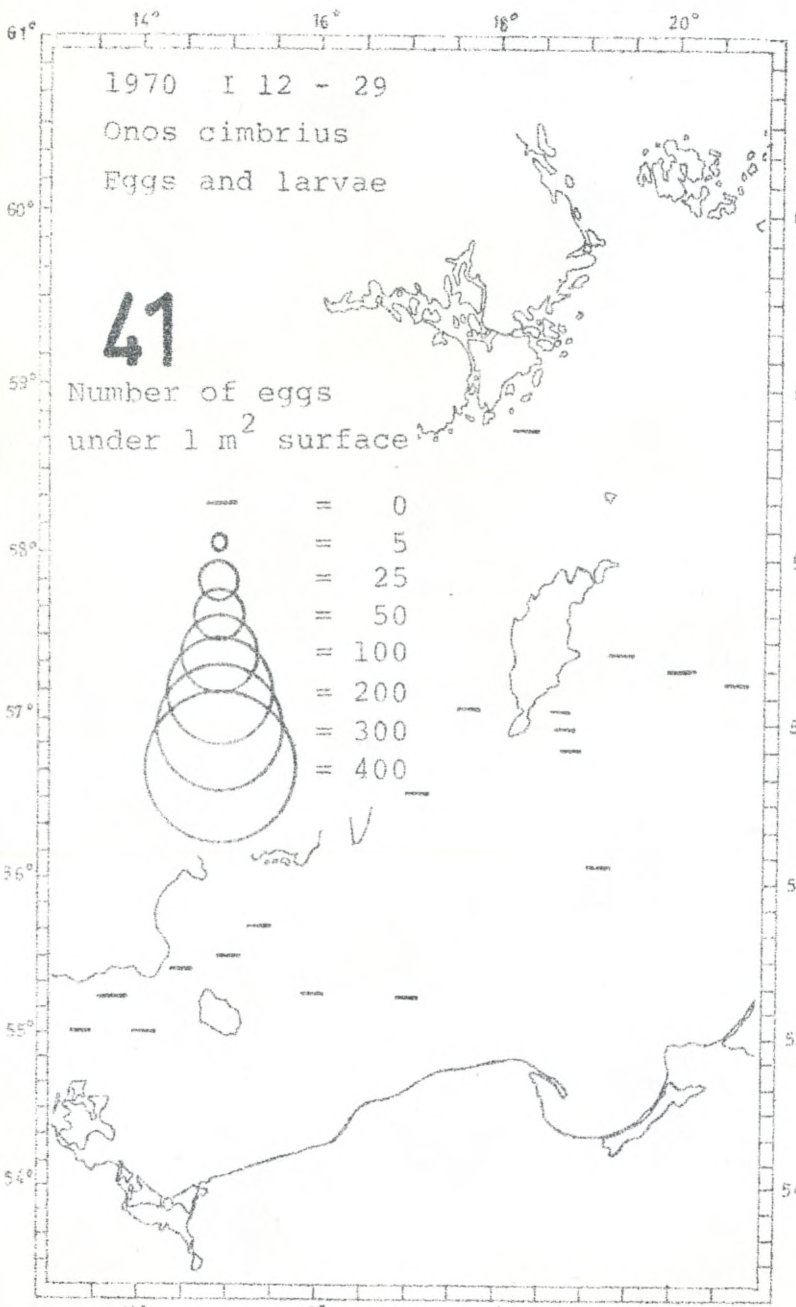

36
1968 XI 27 - XII 11
Onos cimbrius
Eggs and larvae
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400


1969 III 21 - 28
Onos cimbrius
Eggs and larvae
37


1969 VI 3 - 16
Onos cimbrius
Eggs and larvae
38
Number of eggs
under 1 m^2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400

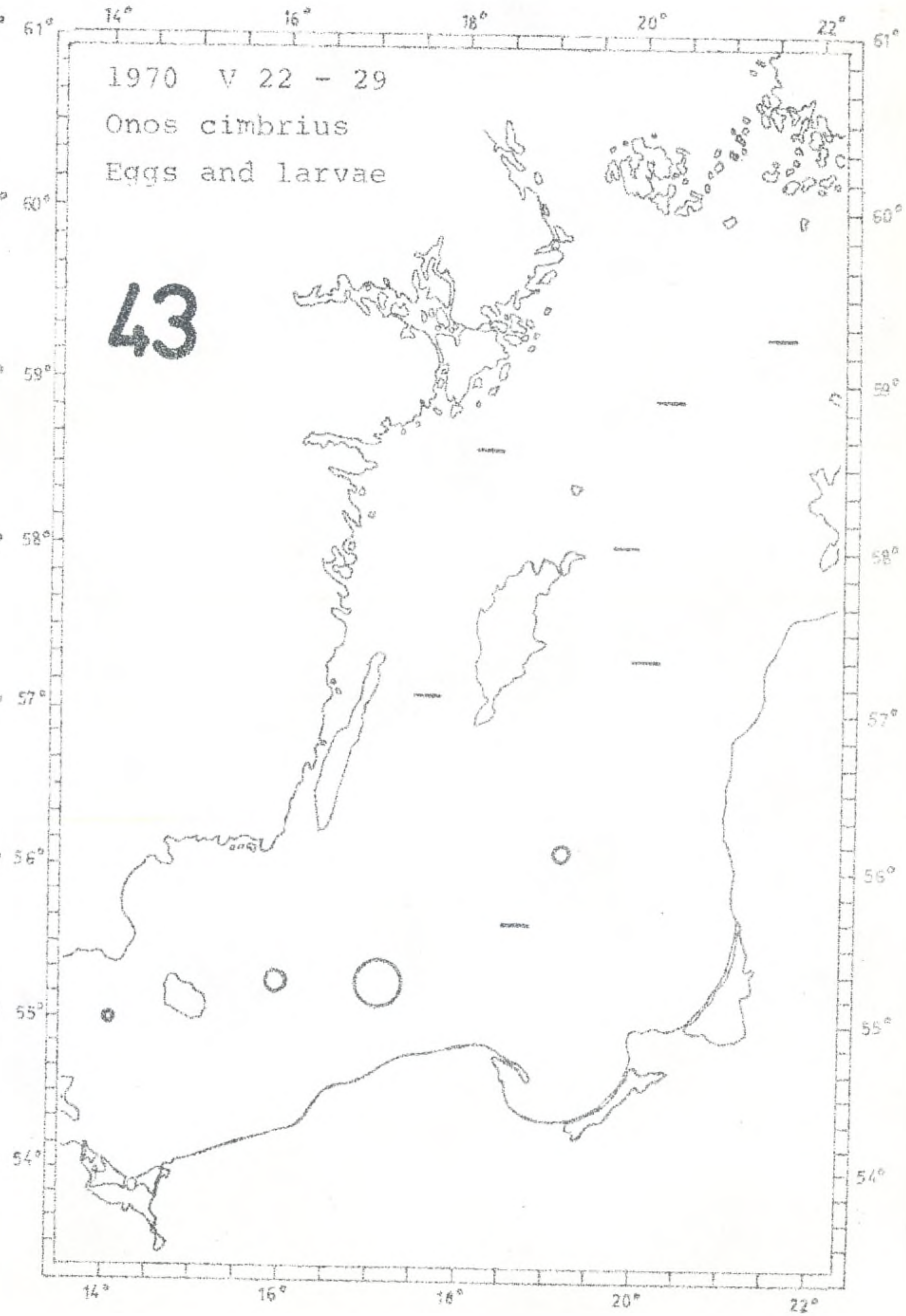

1969 VII 30- VIII 15
Onos cimbrius
Eggs and larvae
39


1969 X 14 - 24
Onos cimbrius
Eggs and larvae
40

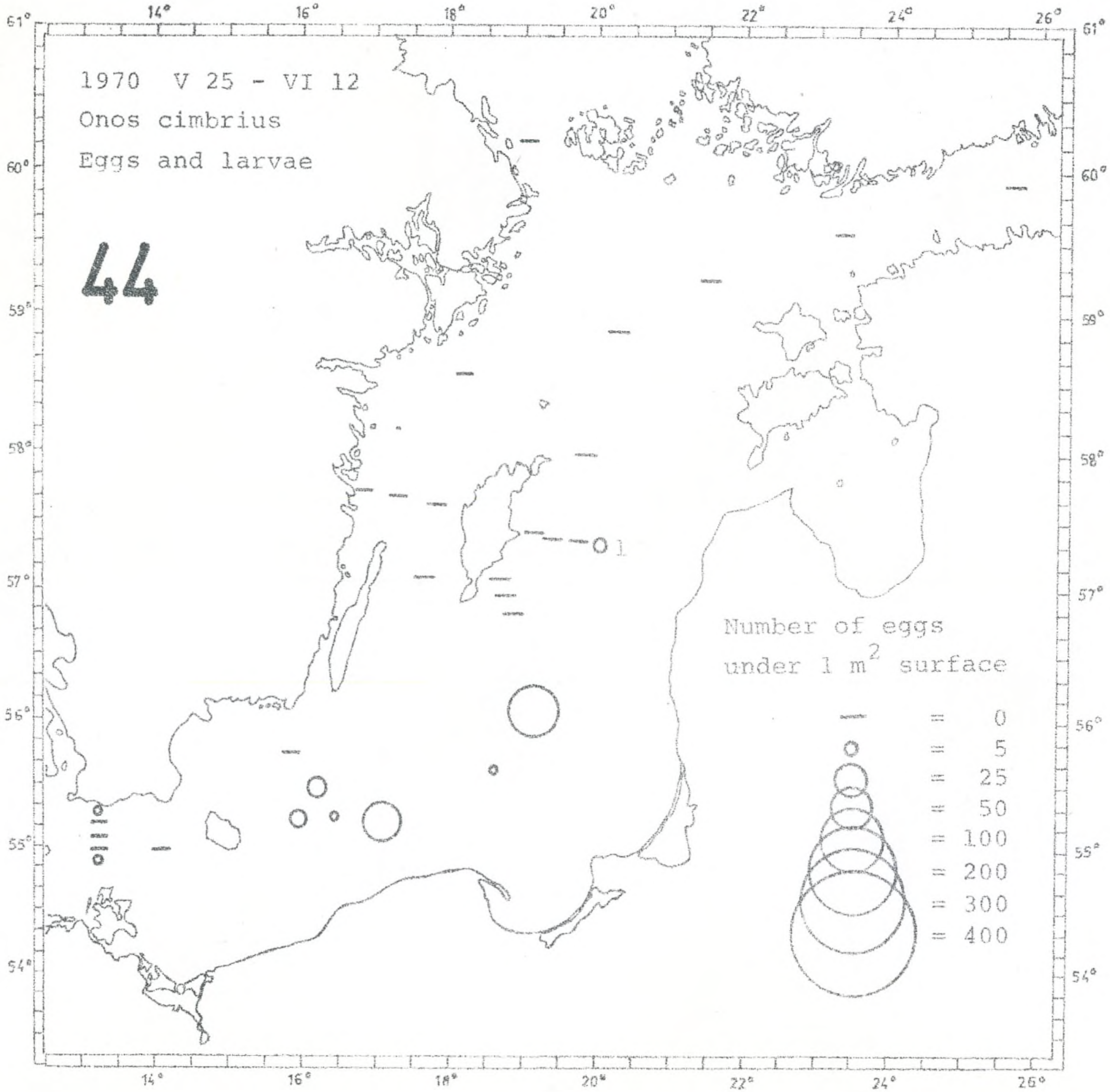


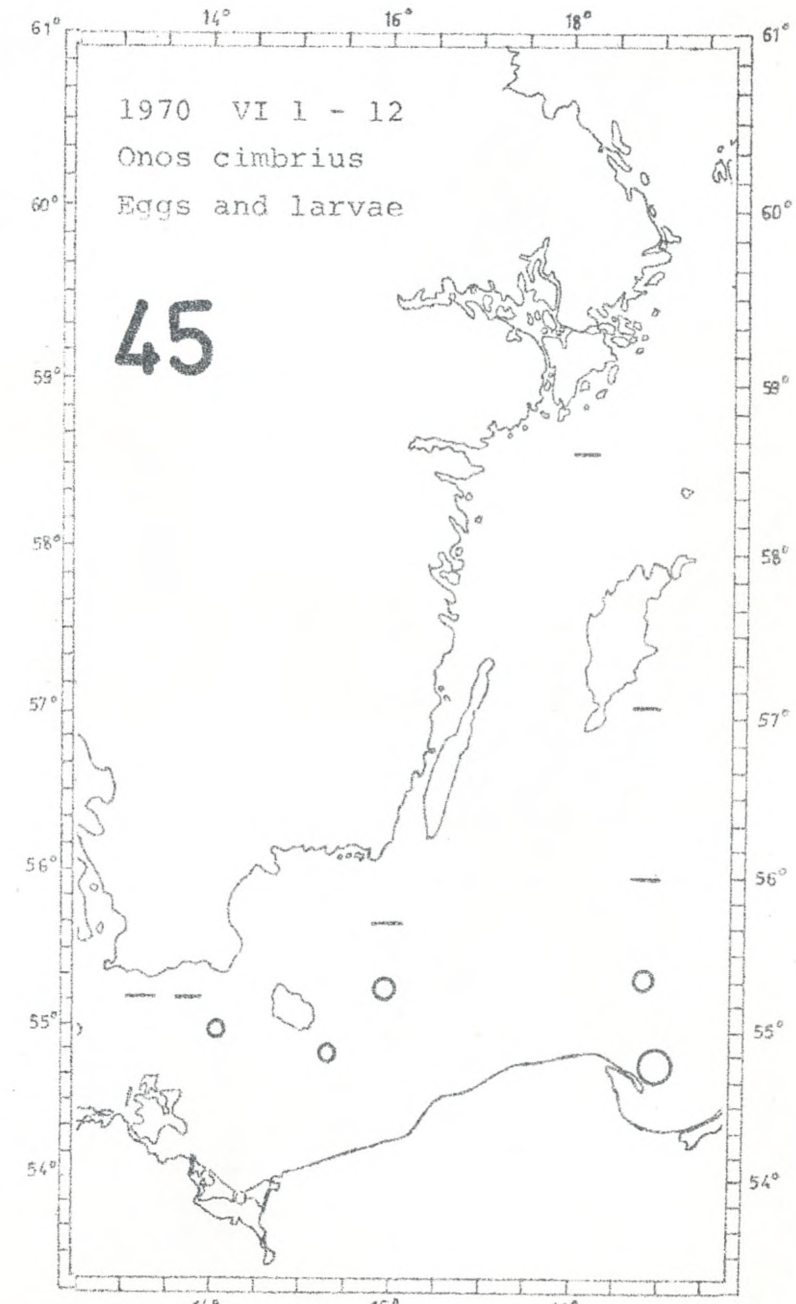
41
1970 I 12 - 29
Onos cimbrius
Eggs and larvae
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
14°
16°
18°
20°
54°
55°
56°
57°
58°
59°
60°
61°

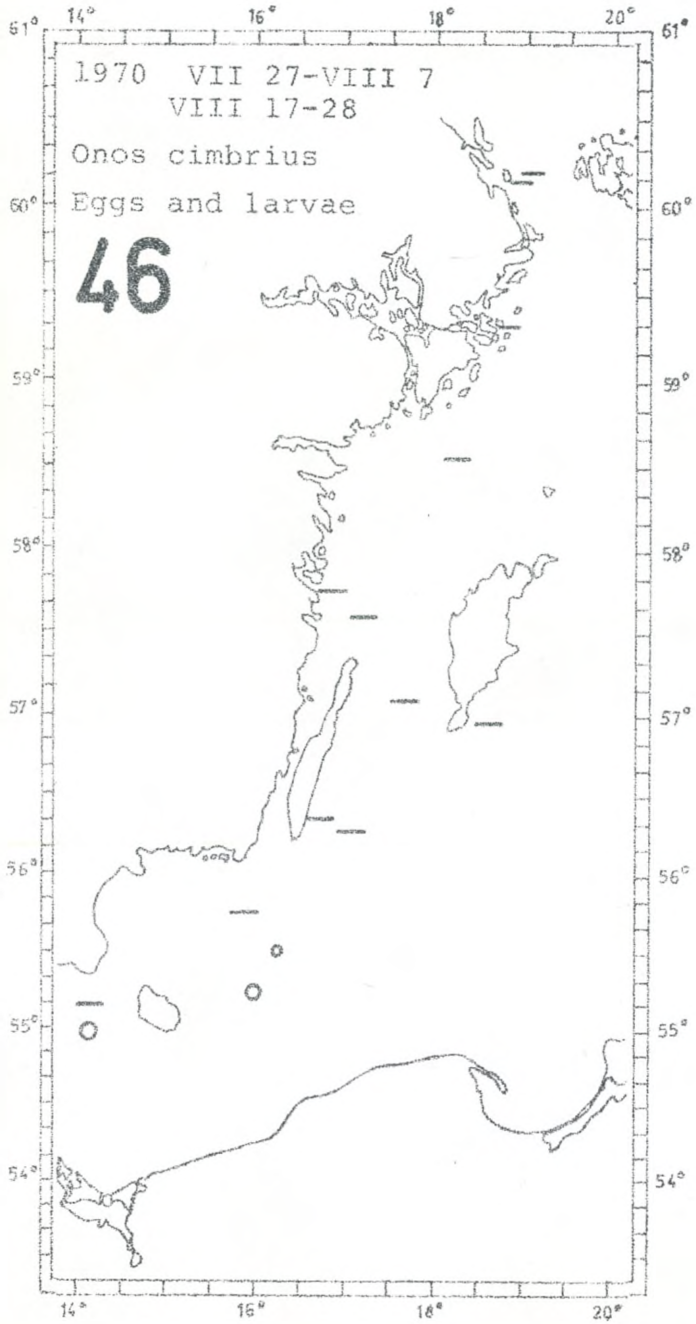
42
1970 II 27-III 10
Onos cimbrius
Eggs and larvae
14°
16°
54°
55°
56°
57°
58°
59°
60°
61°

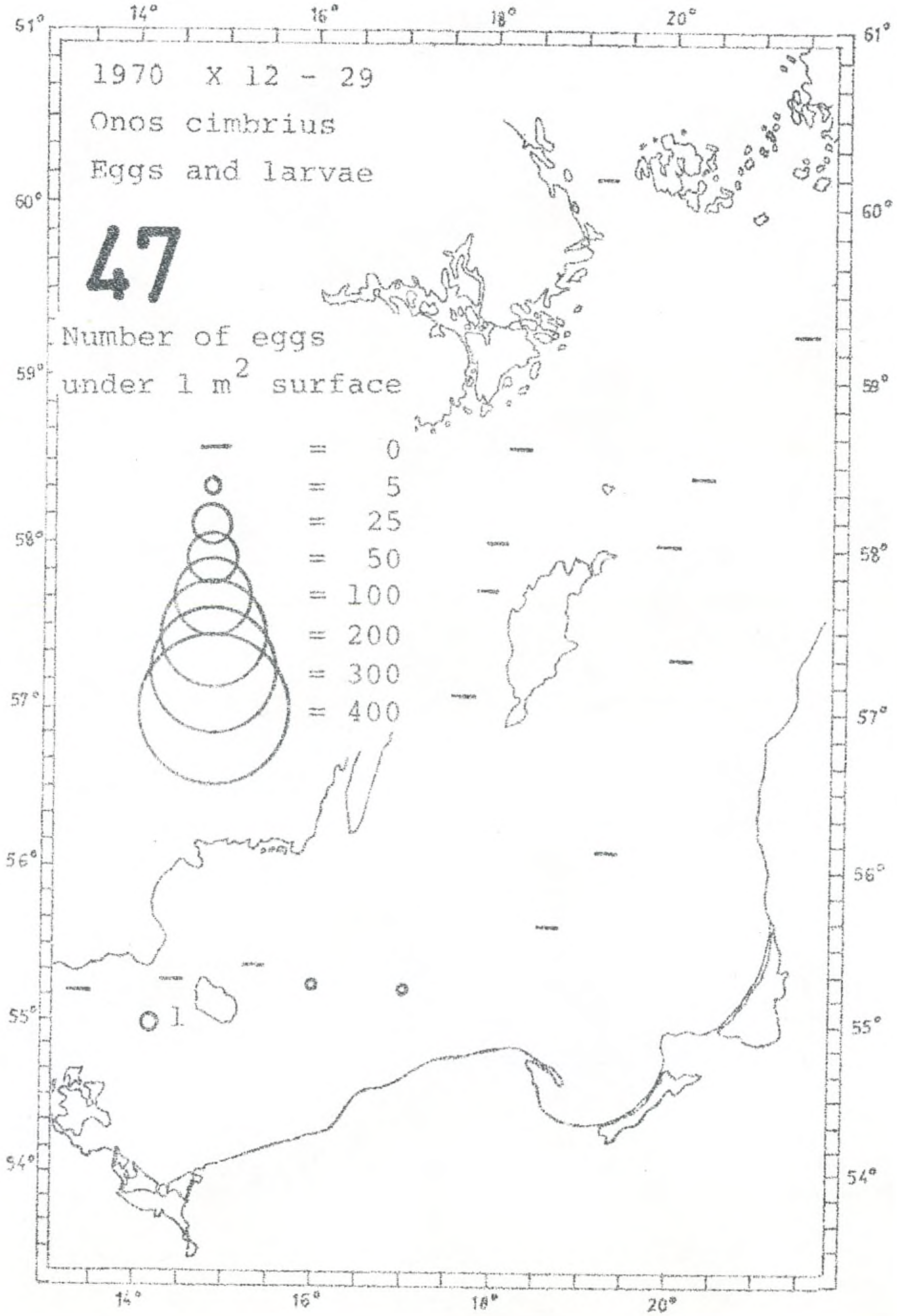


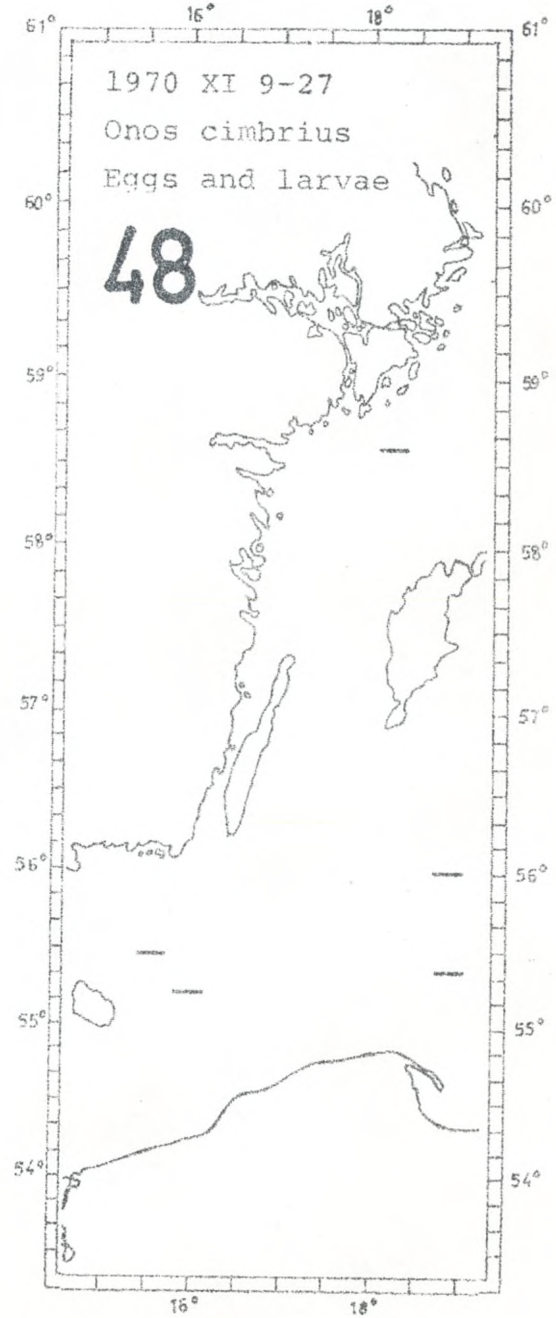
43
1970 V 22 - 29
Onos cimbrius
Eggs and larvae
14°
16°
18°
20°
22°
54°
55°
56°
57°
58°
59°
60°
61°

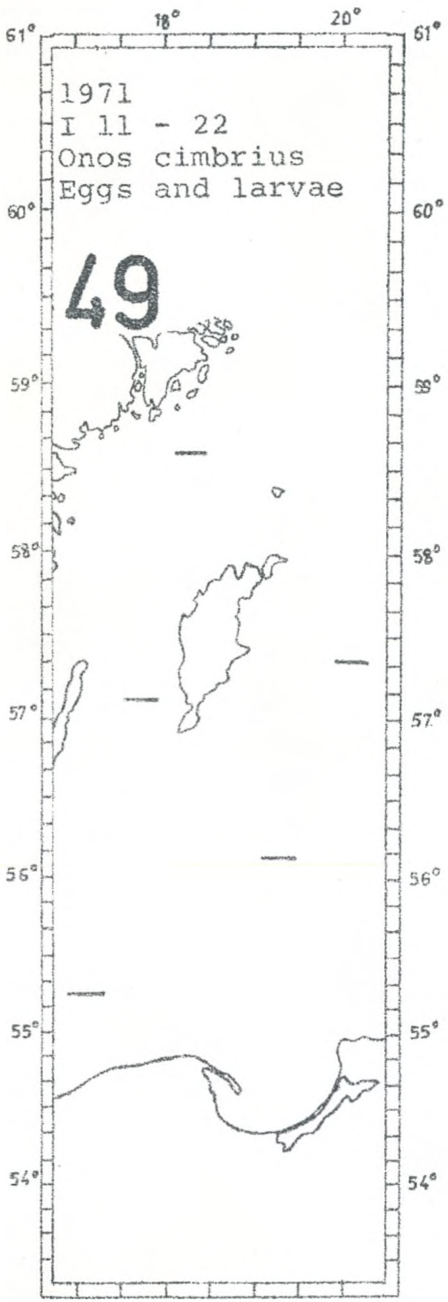

1970 V 25 - VI 12
Onos cimbrius
Eggs and larvae
44
Number of eggs
under 1 m^2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
1

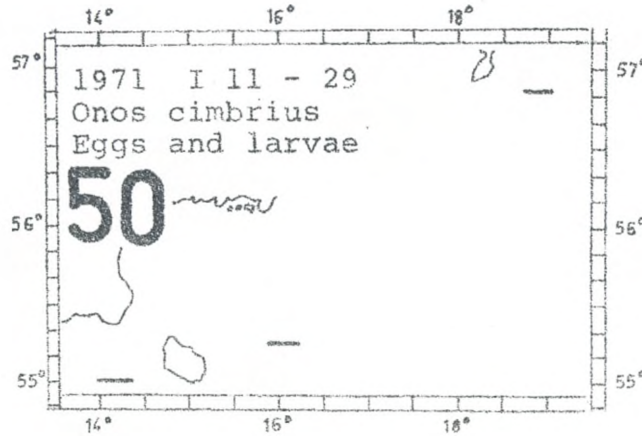

1970 VI 1 - 12
Onos cimbrius
Eggs and larvae
45

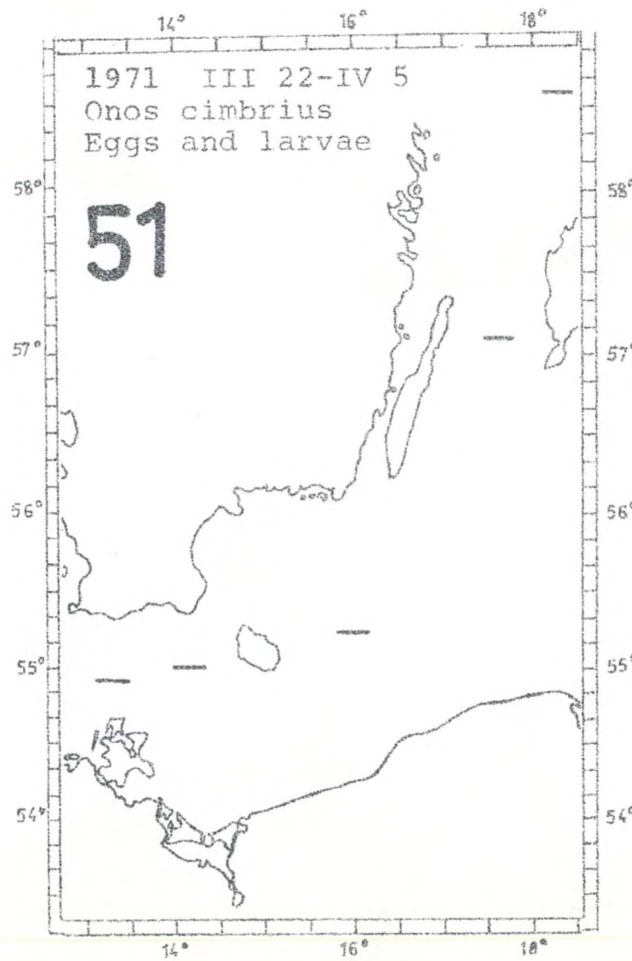

1970 VII 27-VIII 7
VIII 17-28
Onos cimbrius
Eggs and larvae
46
14°
16°
18°
20°
61°
60°
59°
58°
57°
56°
55°
54°

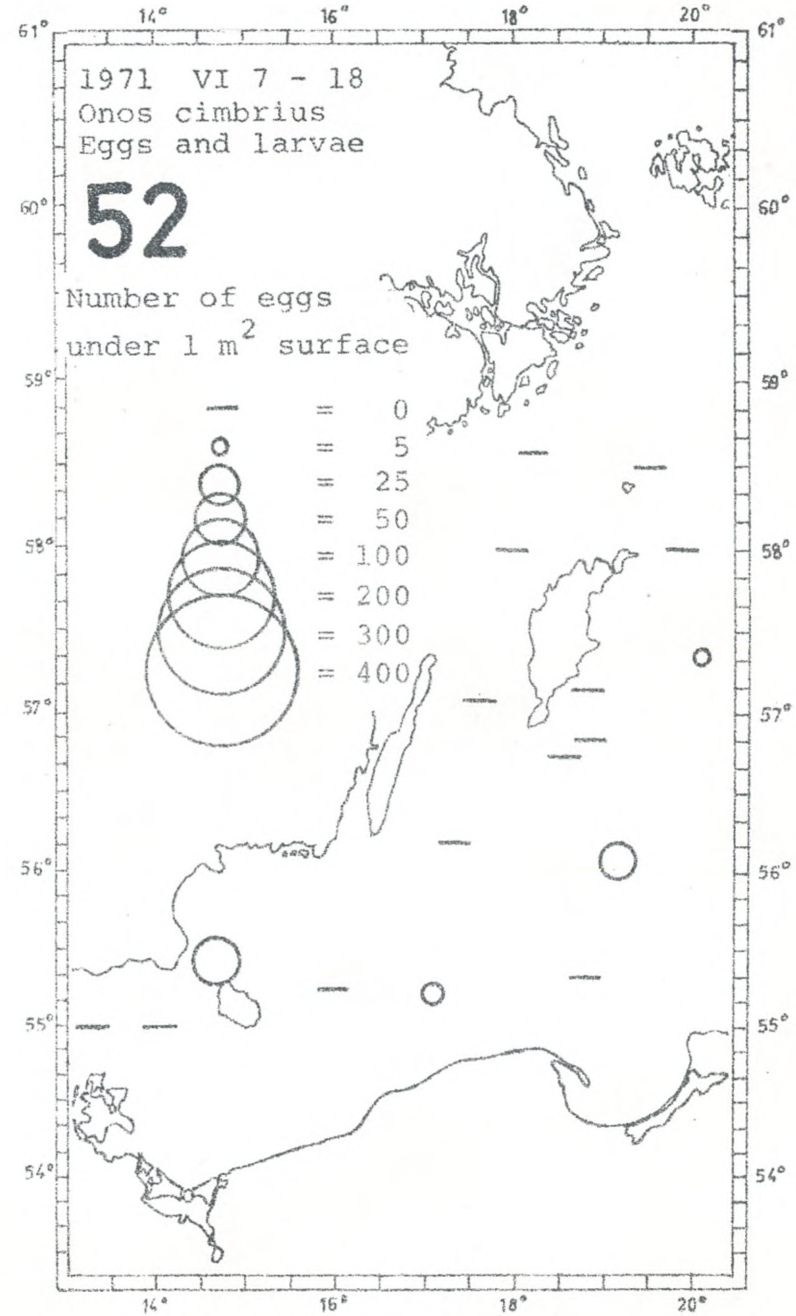

1970 X 12 - 29
Onos cimbrius
Eggs and larvae
47
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
1
14°
16°
18°
20°
61°
60°
59°
58°
57°
56°
55°
54°

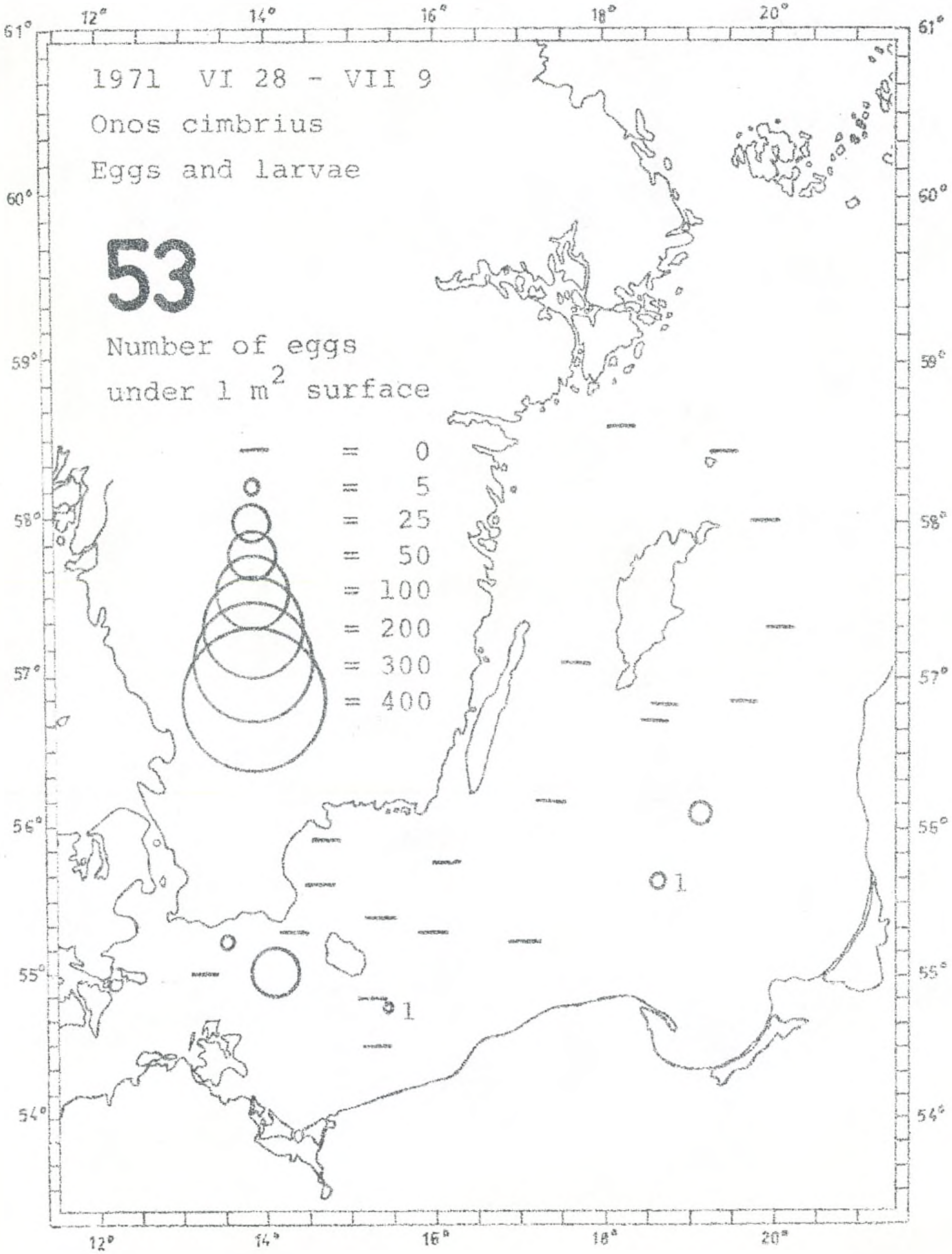

1970 XI 9-27
Onos cimbrius
Eggs and larvae
48
16°
18°
61°
60°
59°
58°
57°
56°
55°
54°

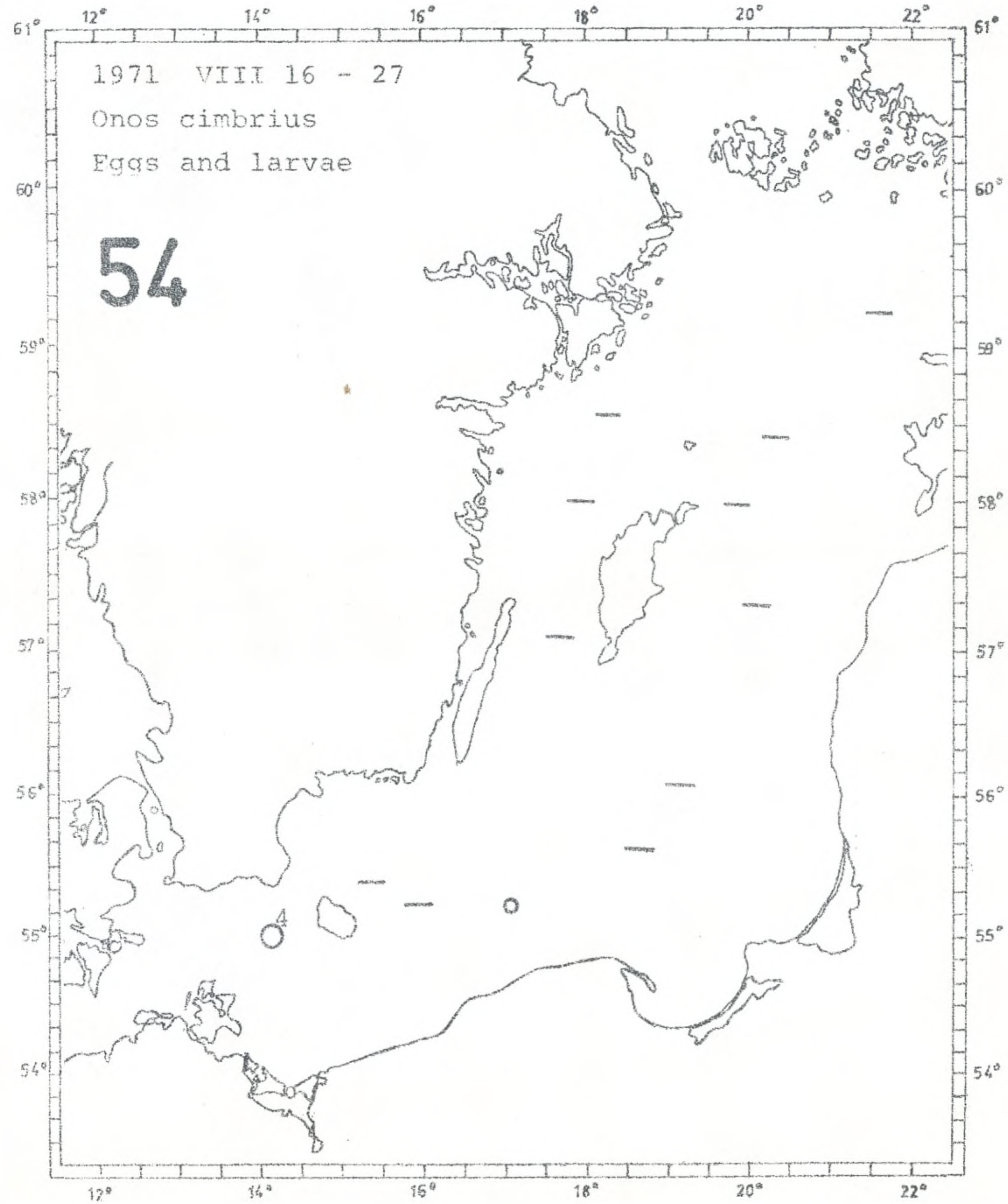

1971
I 11 - 22
Onos cimbrius
Eggs and larvae
49
61°
60°
59°
58°
57°
56°
55°
54°
18°
20°

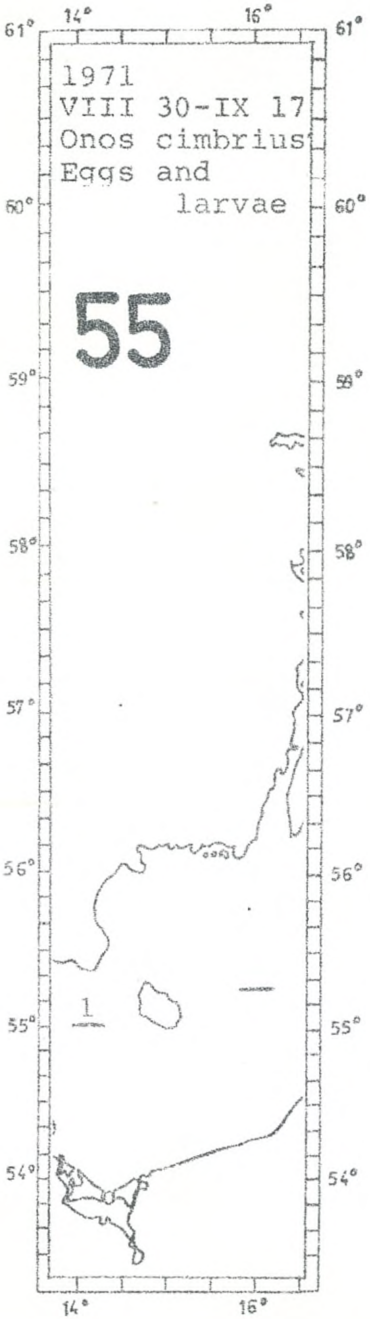

1971 I 11 - 29
Onos cimbrius
Eggs and larvae
50
57°
56°
55°
14°
16°
18°

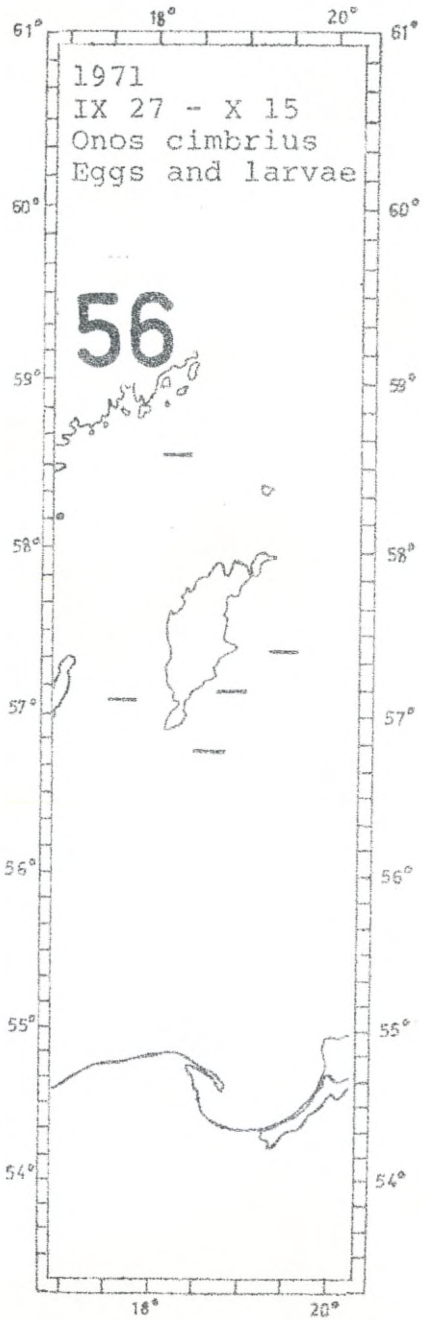

1971 III 22-IV 5
Onos cimbrius
Eggs and larvae
51
58°
57°
56°
55°
54°
14°
16°
18°

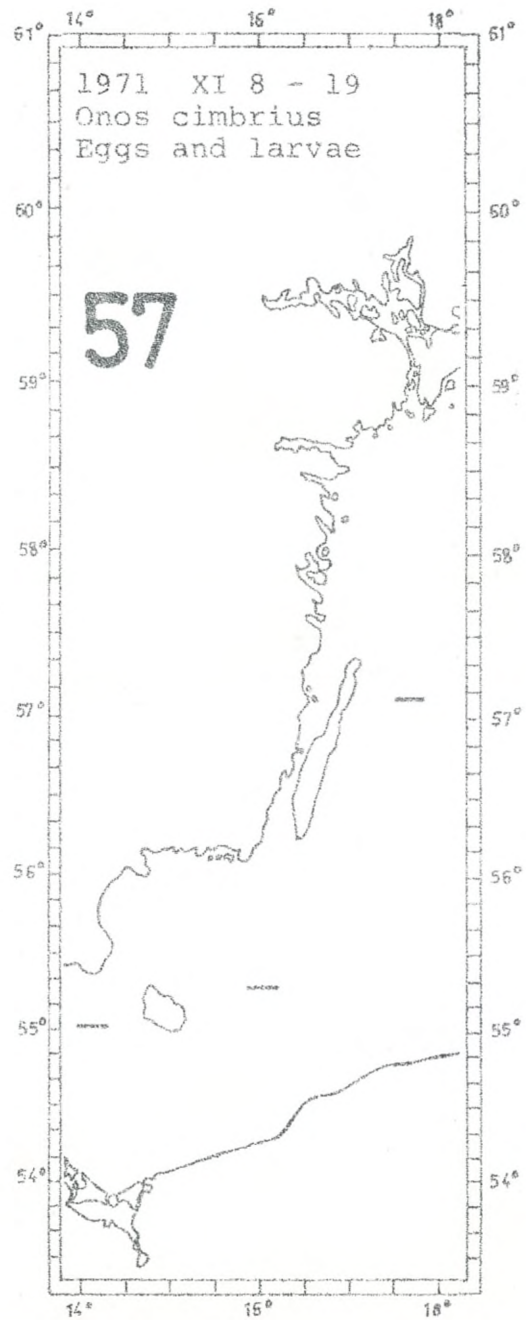

1971 VI 7 - 18
Onos cimbrius
Eggs and larvae
52
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
61°
60°
59°
58°
57°
56°
55°
54°
14°
16°
18°
20°

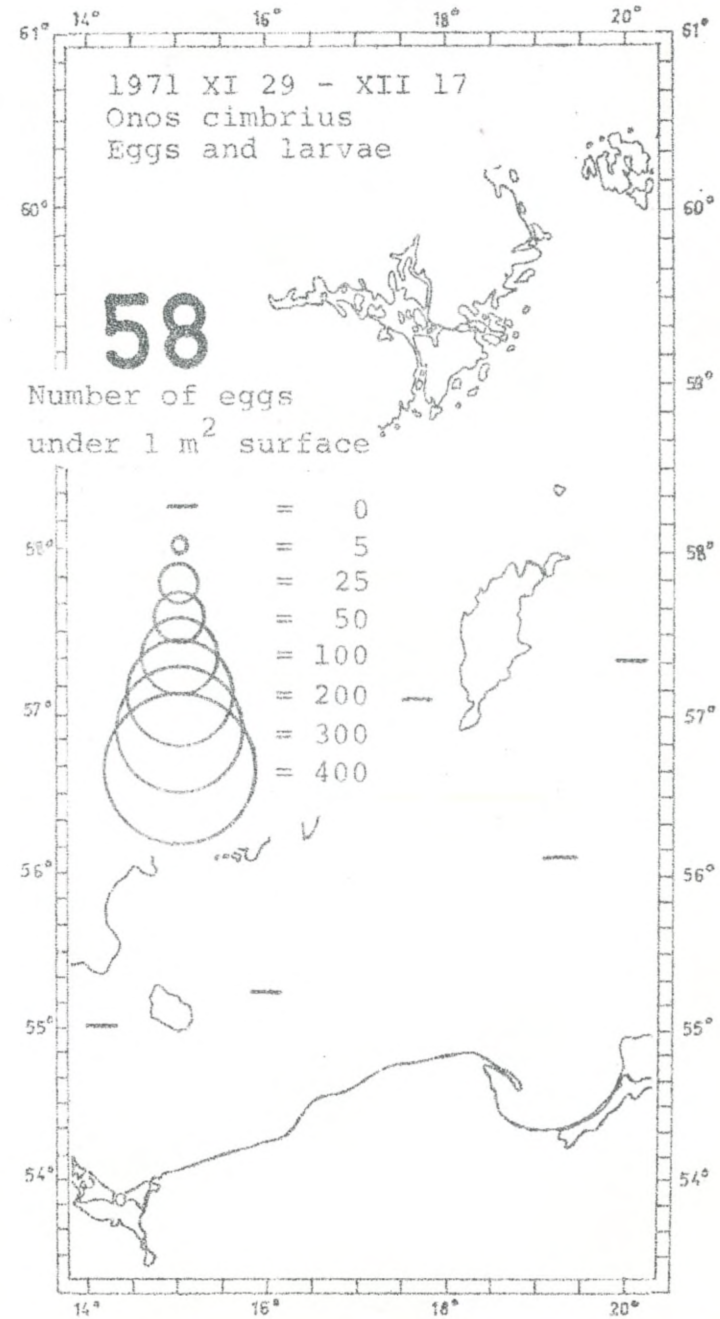

1971 VI 28 - VII 9
Onos cimbrius
Eggs and larvae
53
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
1
1
12°
14°
16°
18°
20°
54°
55°
56°
57°
58°
59°
60°
61°

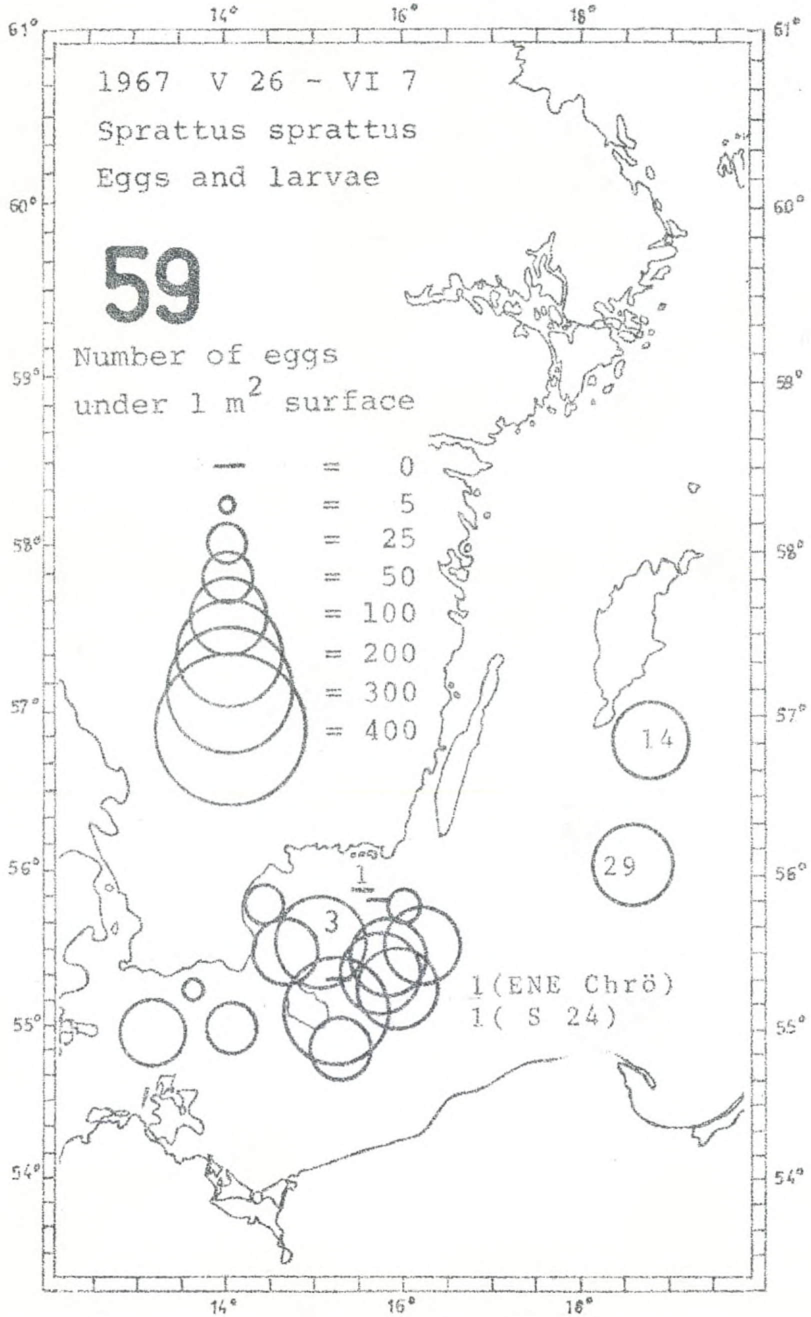

1971 VIII 16 - 27
Onos cimbrius
Eggs and larvae
54
4
12°
14°
16°
18°
20°
22°
54°
55°
56°
57°
58°
59°
60°
61°

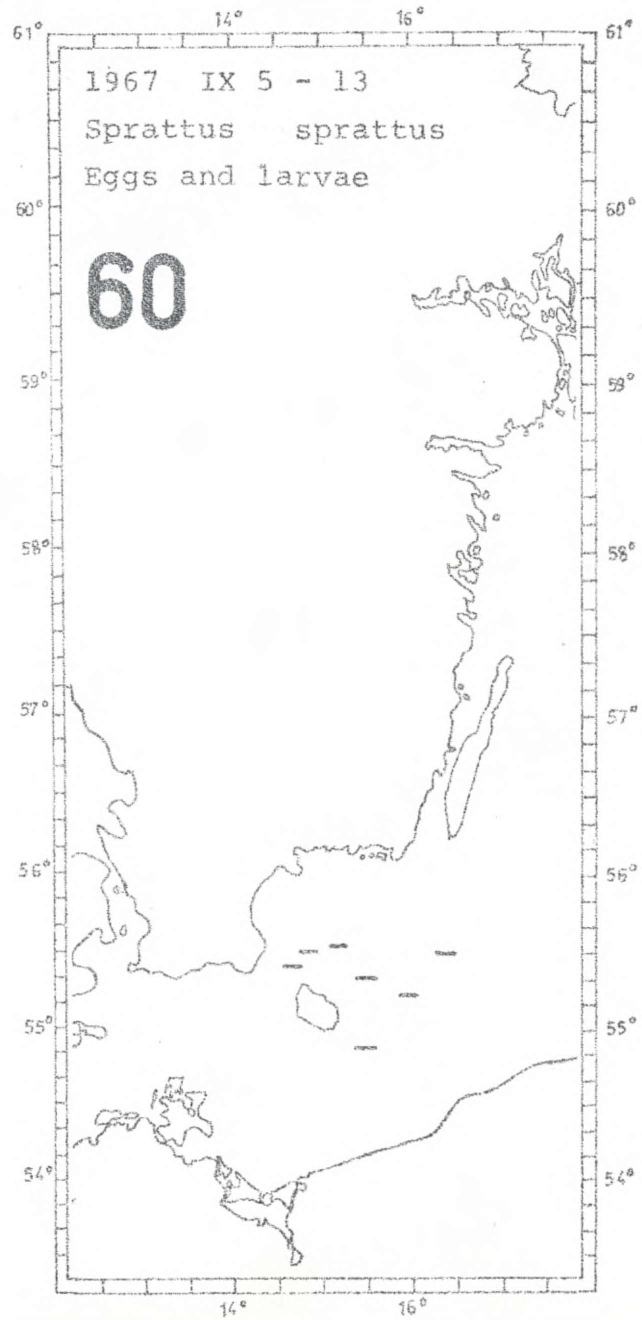

1971
VIII 30-IX 17
Onos cimbrius
Eggs and
larvae
55
1

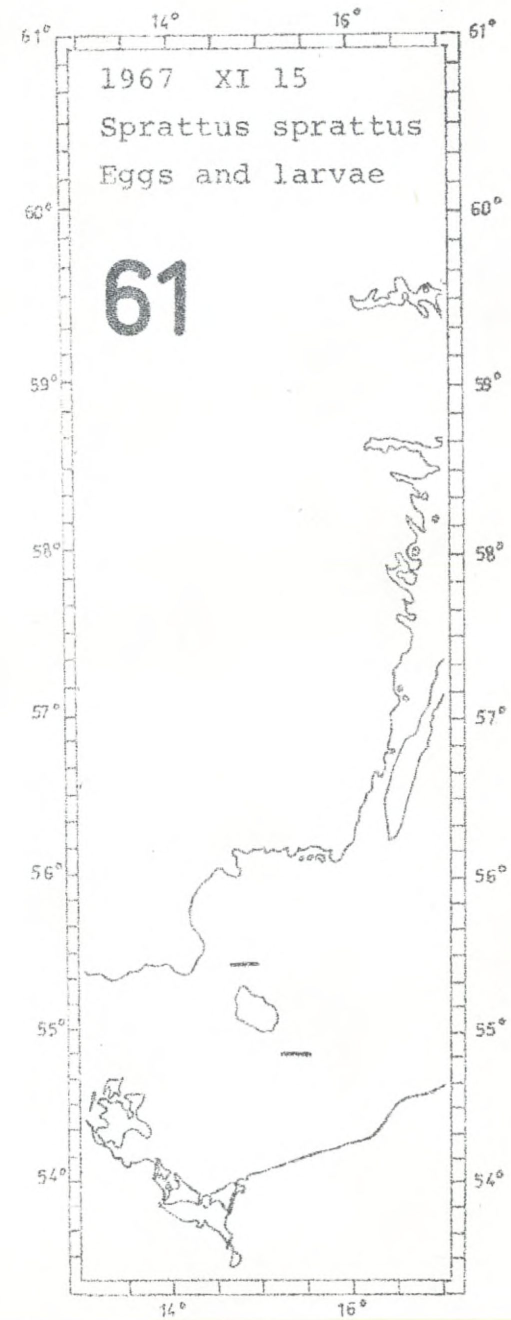

1971
IX 27 - X 15
Onos cimbrius
Eggs and larvae
56

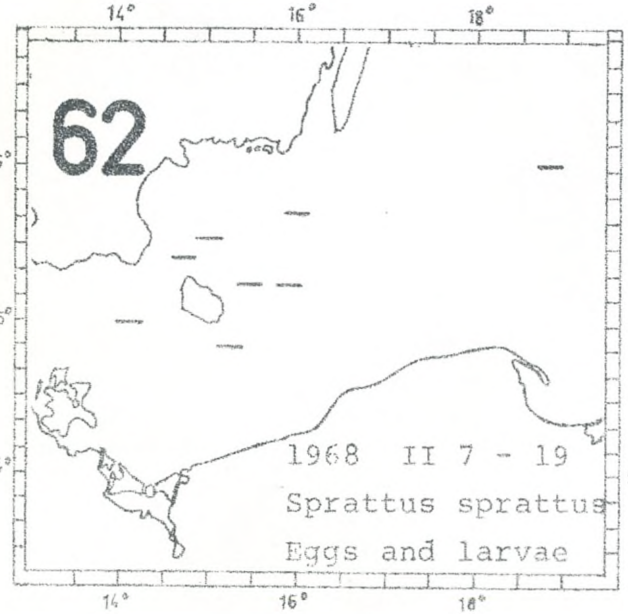

1971 XI 8 - 19
Onos cimbrius
Eggs and larvae
57

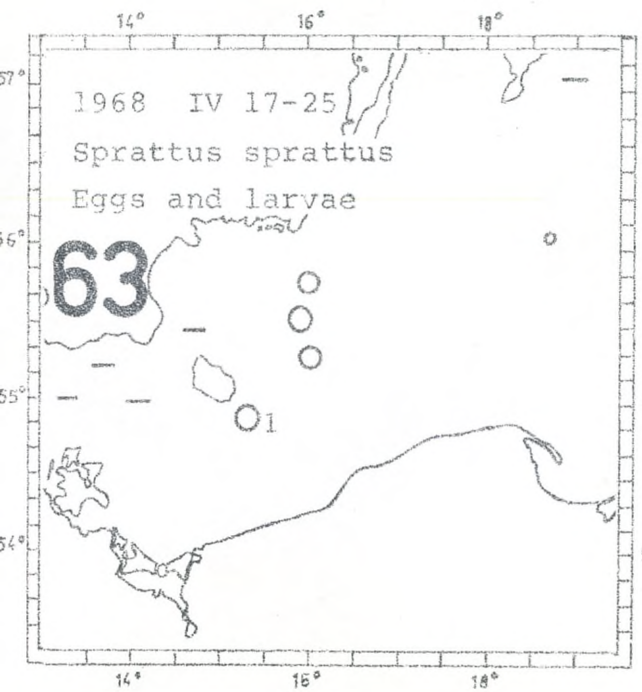

1971 XI 29 - XII 17
Onos cimbrius
Eggs and larvae
58
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400

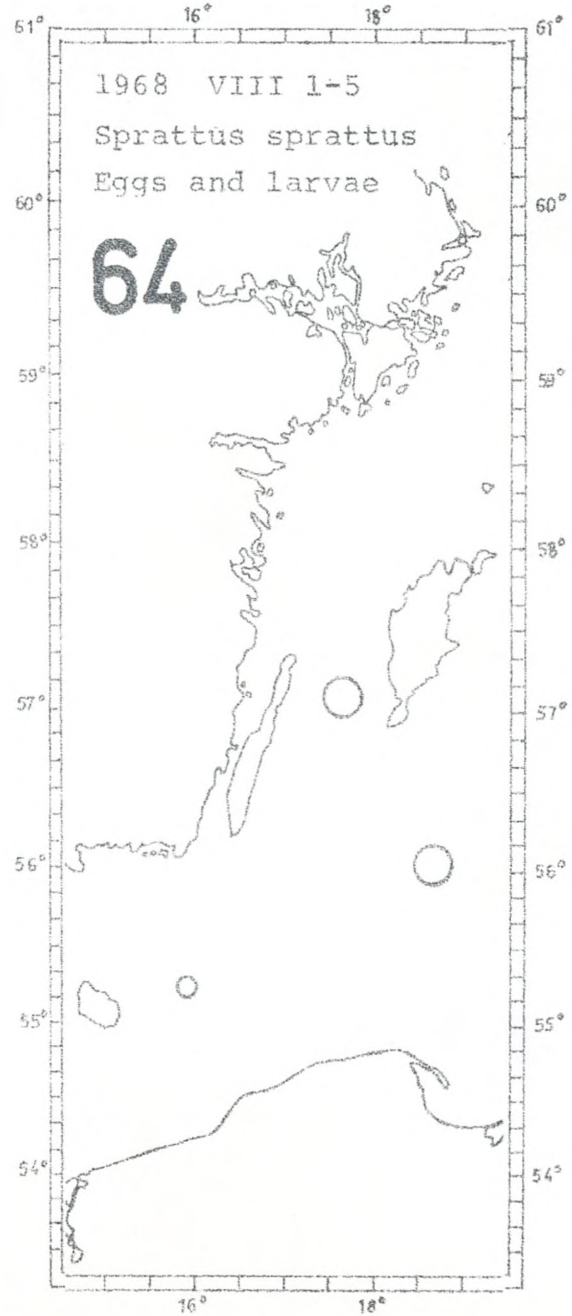

1967 V 26 - VI 7
Spratus sprattus
Eggs and larvae
59
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
14
29
1
3
1(ENE Chrö)
1(S 24)

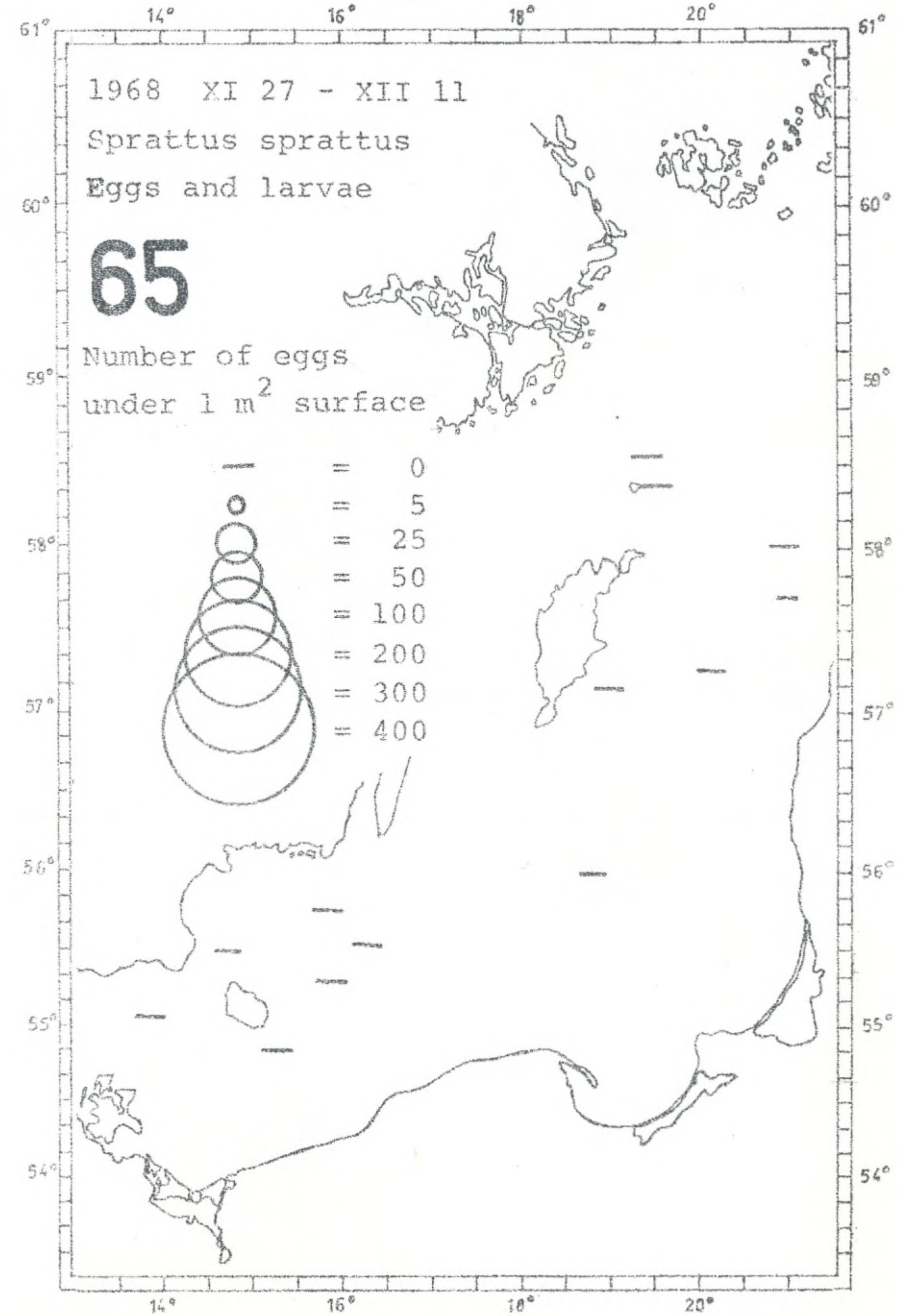

1967 IX 5 - 13
Sprattus sprattus
Eggs and larvae
60

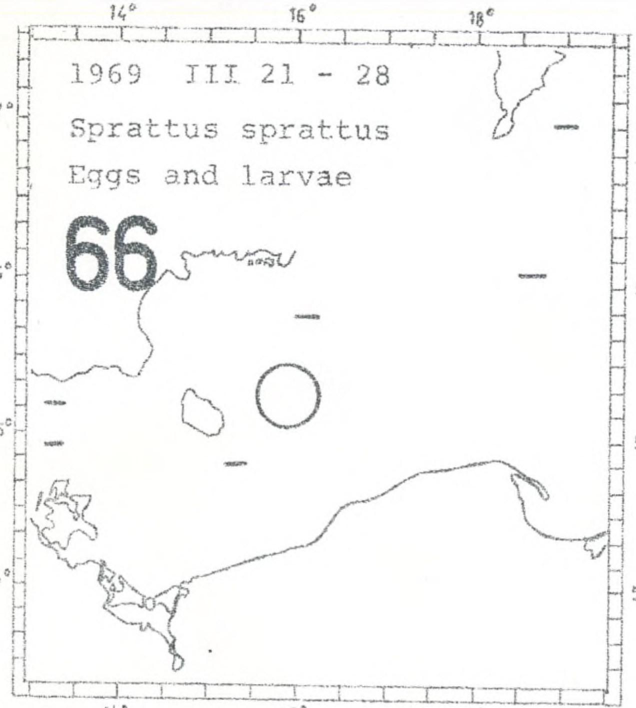

1967 XI 15
Sprattus sprattus
Eggs and larvae
61


62
1968 II 7 - 19
Sprattus sprattus
Eggs and larvae

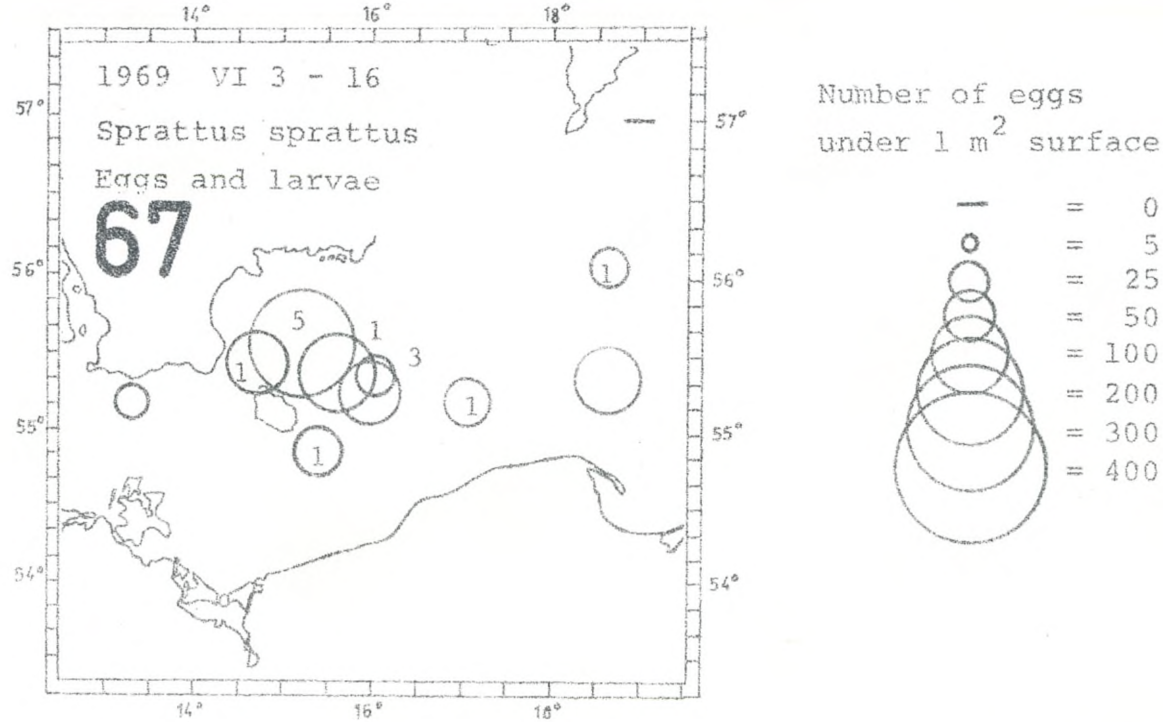

1968 IV 17-25
Sprattus sprattus
Eggs and larvae
63
1


1968 VIII 1-5
Sprattus sprattus
Eggs and larvae
64

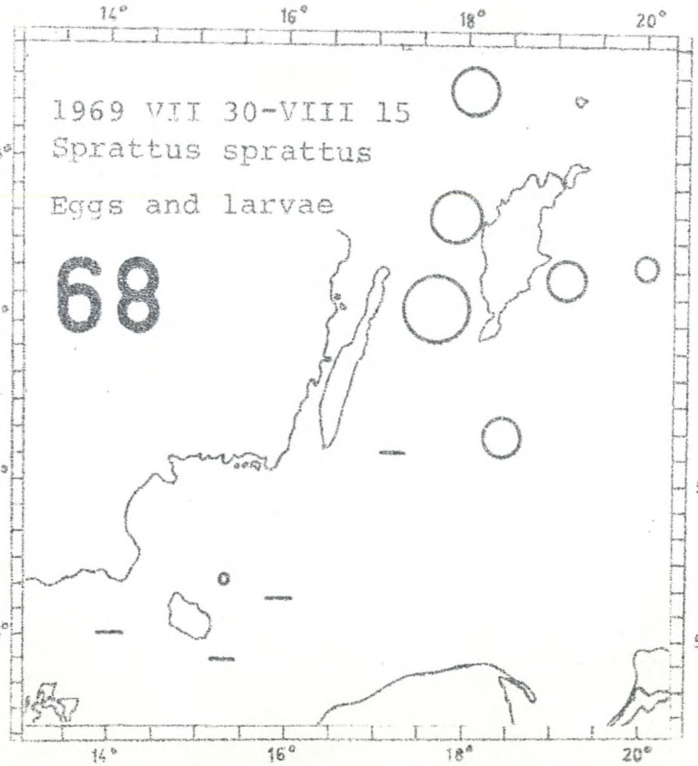

1968 XI 27 - XII 11
Sprattus sprattus
Eggs and larvae
65
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400



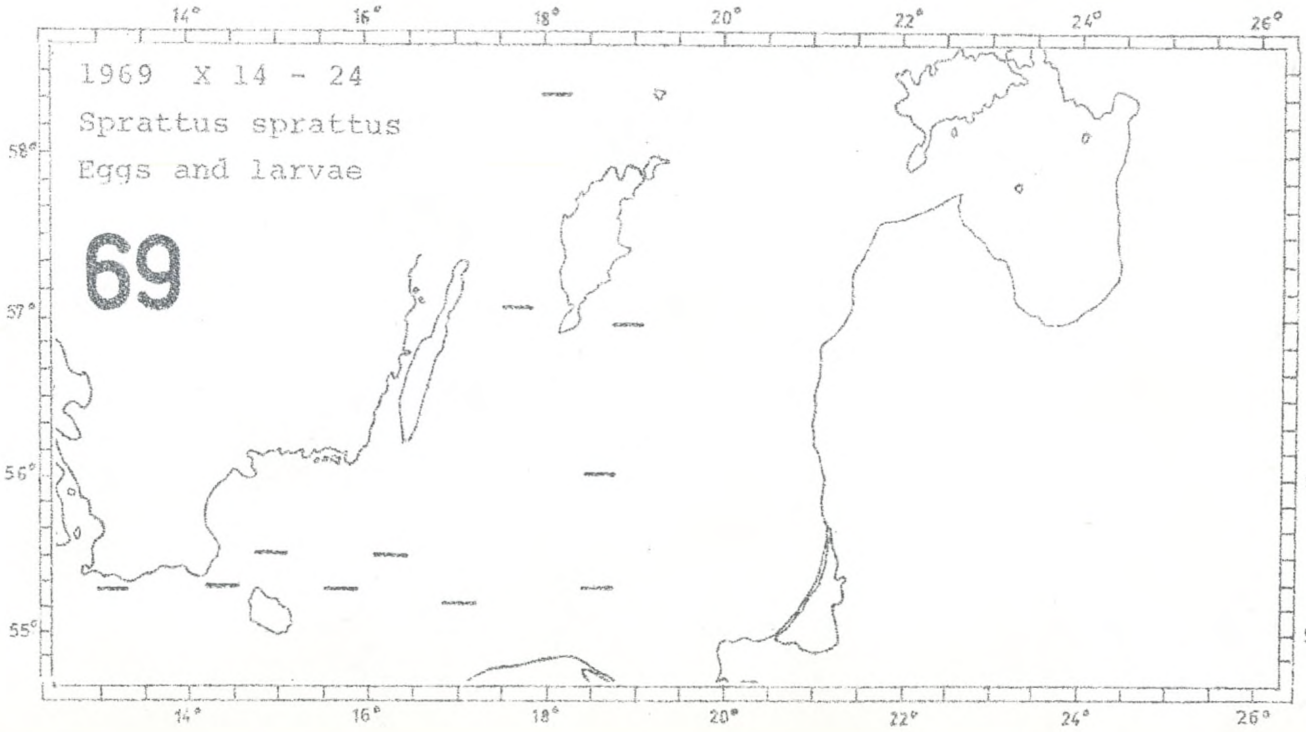
1969 III 21 - 28
Sprattus sprattus
Eggs and larvae
66
14°
16°
18°
54°
55°
56°
57°



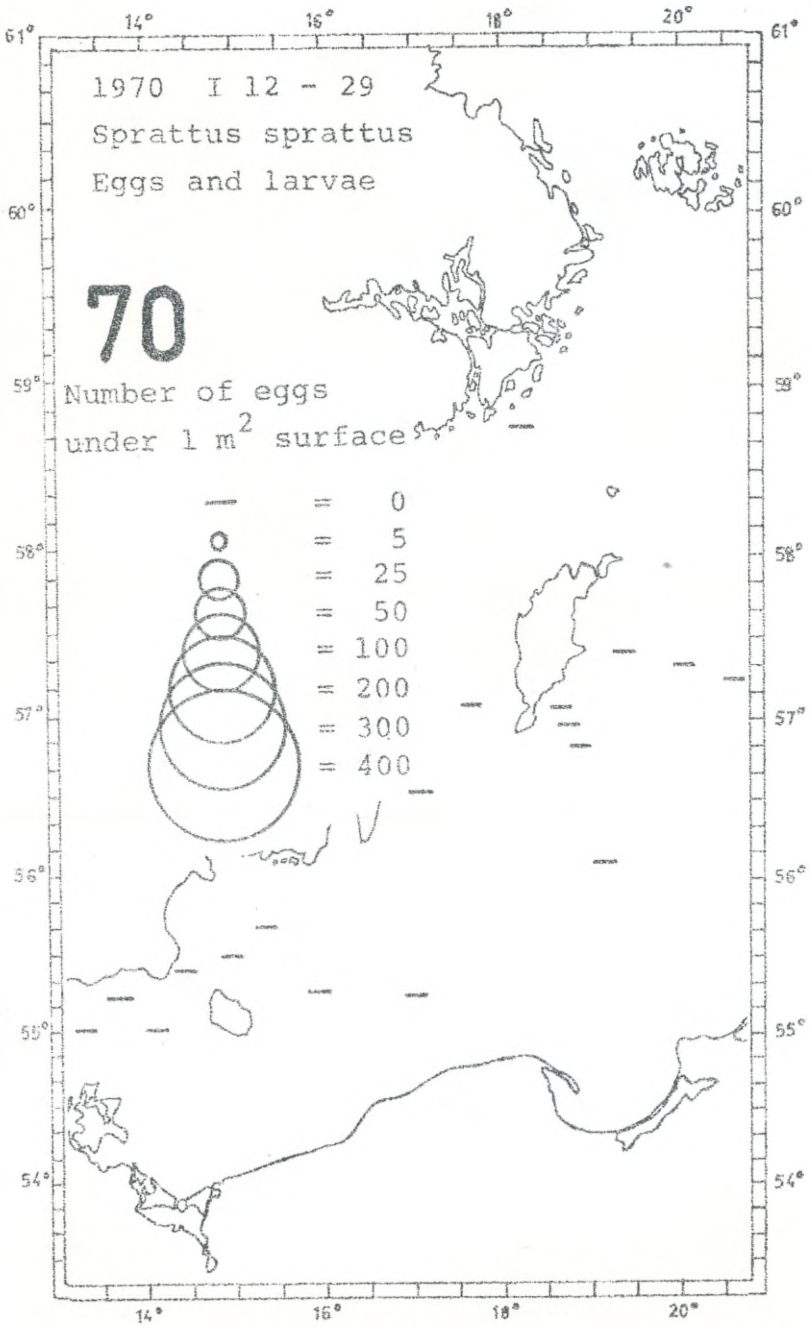
1969 VI 3 - 16
Sprattus sprattus
Eggs and larvae
67
5
1
1
3
1
1
1
14°
16°
18°
54°
55°
56°
57°
Number of eggs
under 1 m^2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400



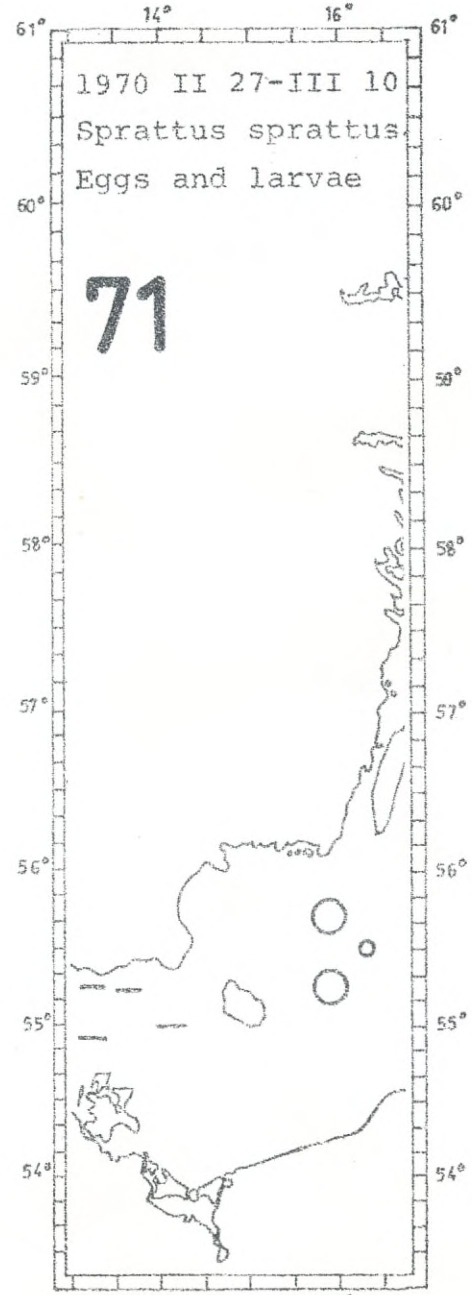
1969 VII 30-VIII 15
Sprattus sprattus
Eggs and larvae
68
14°
16°
18°
20°
55°
56°
57°
58°



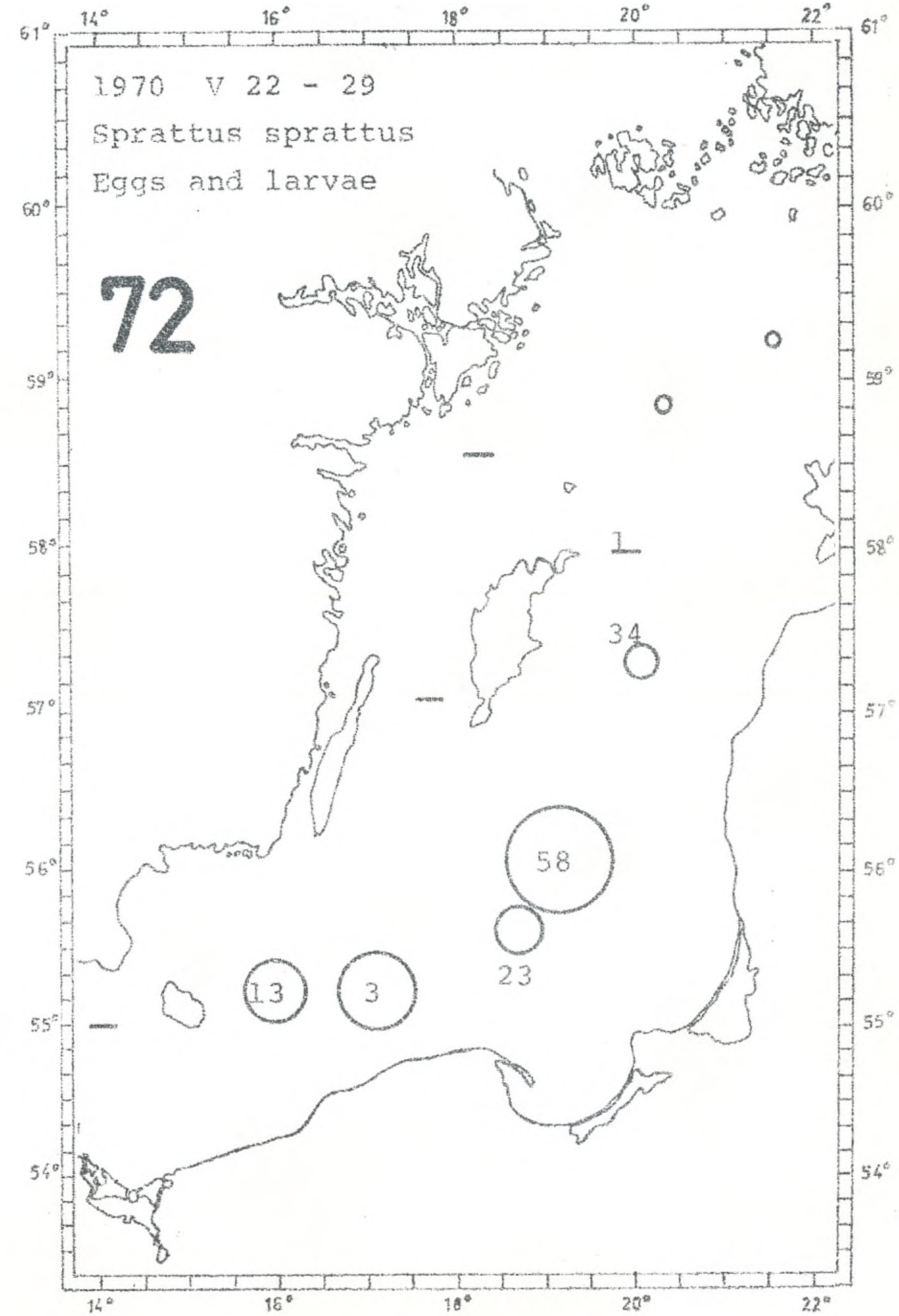
1969 X 14 - 24
Sprattus sprattus
Eggs and larvae
69
14°
16°
18°
20°
22°
24°
26°
55°
56°
57°
58°



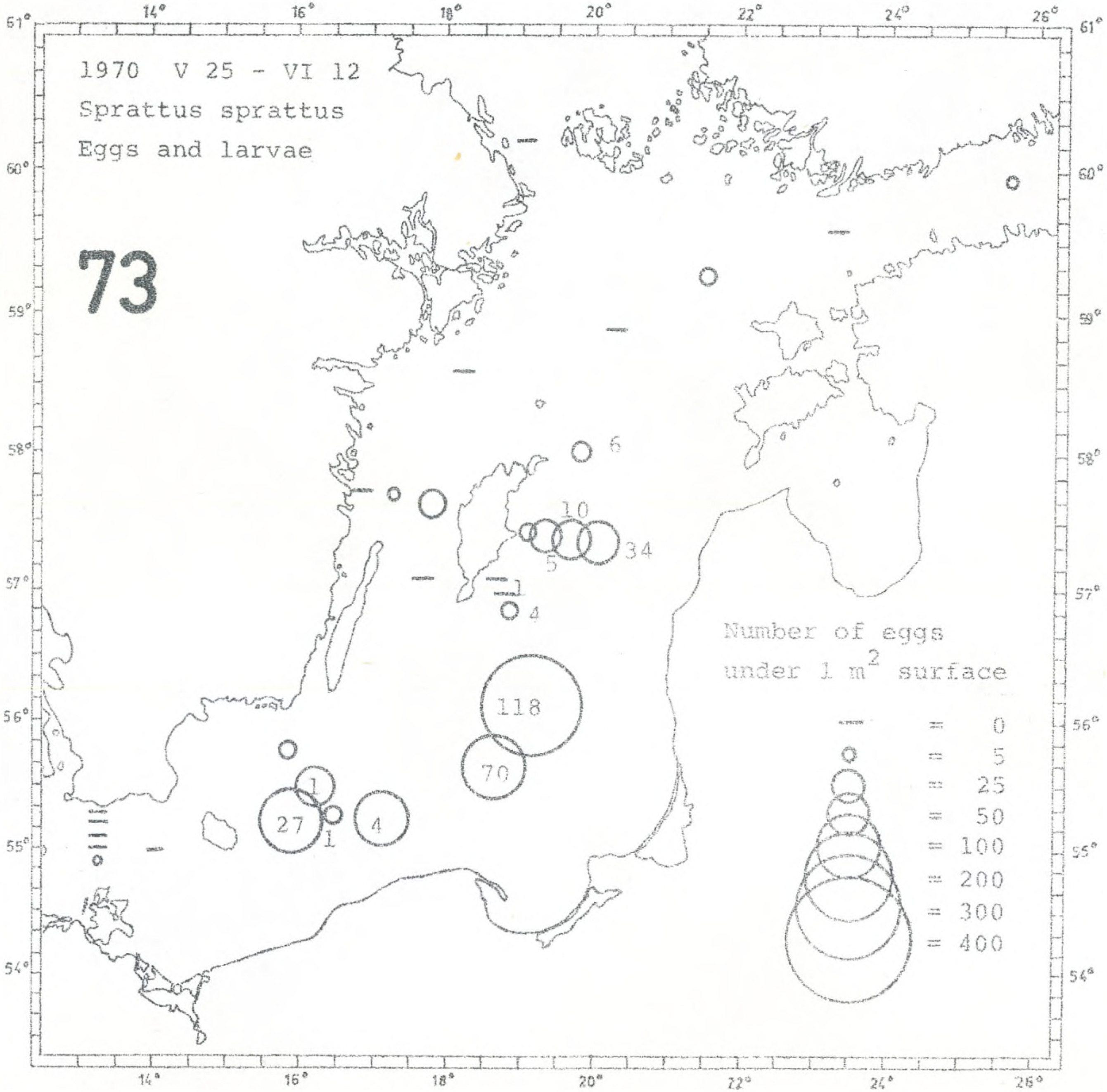
1970 I 12 - 29
Spratus sprattus
Eggs and larvae
70
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400

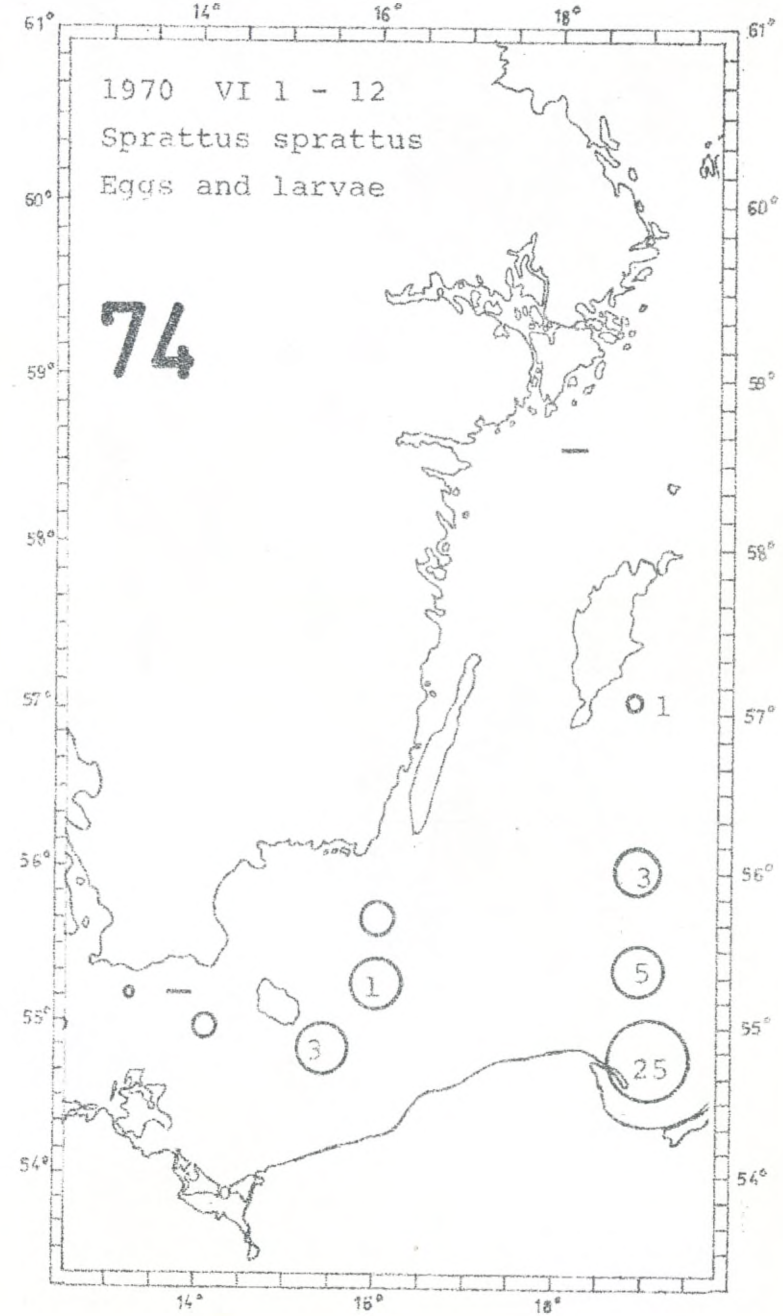


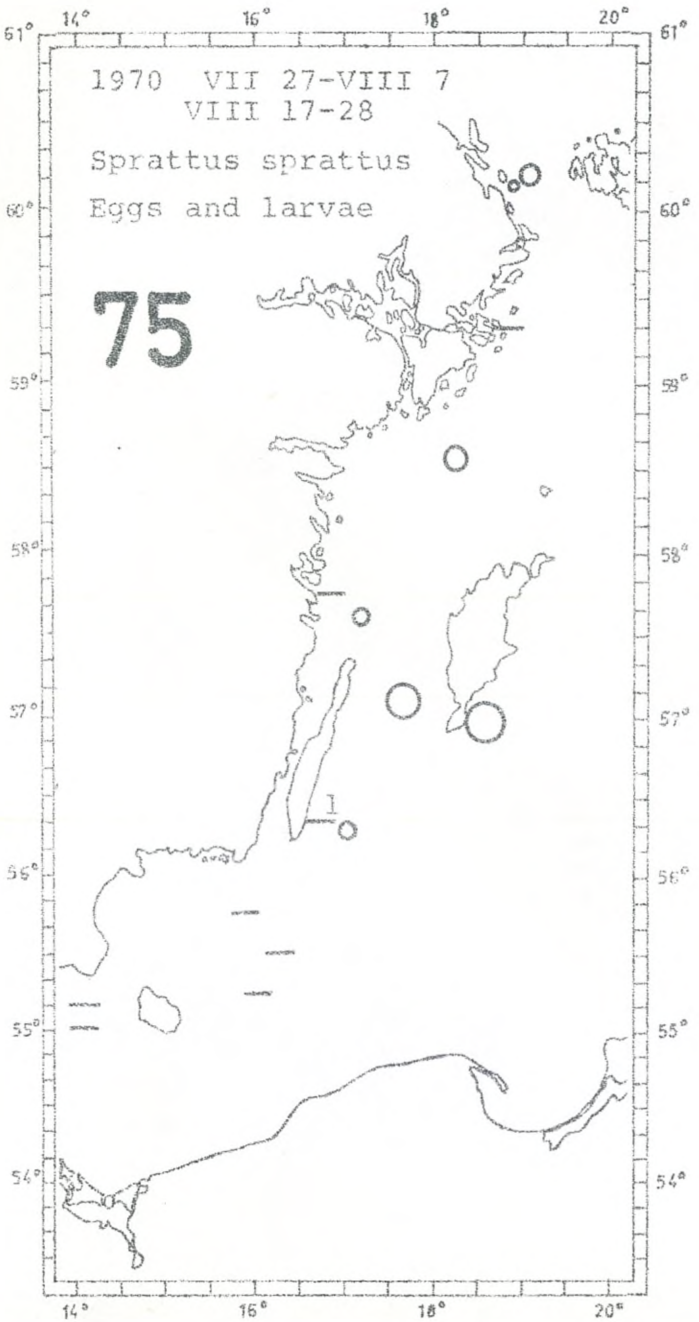
1970 II 27-III 10
Sprattus sprattus
Eggs and larvae
71

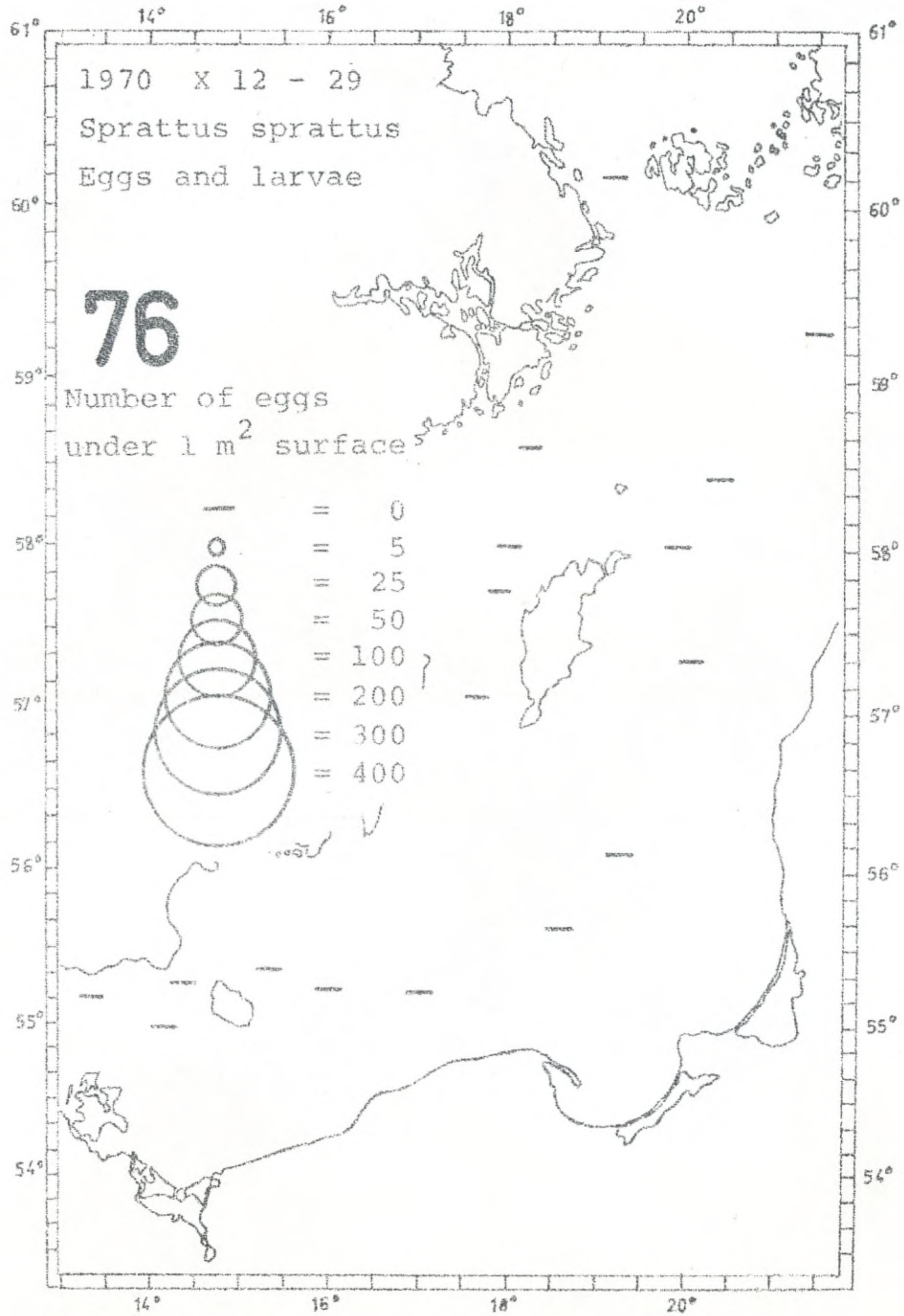


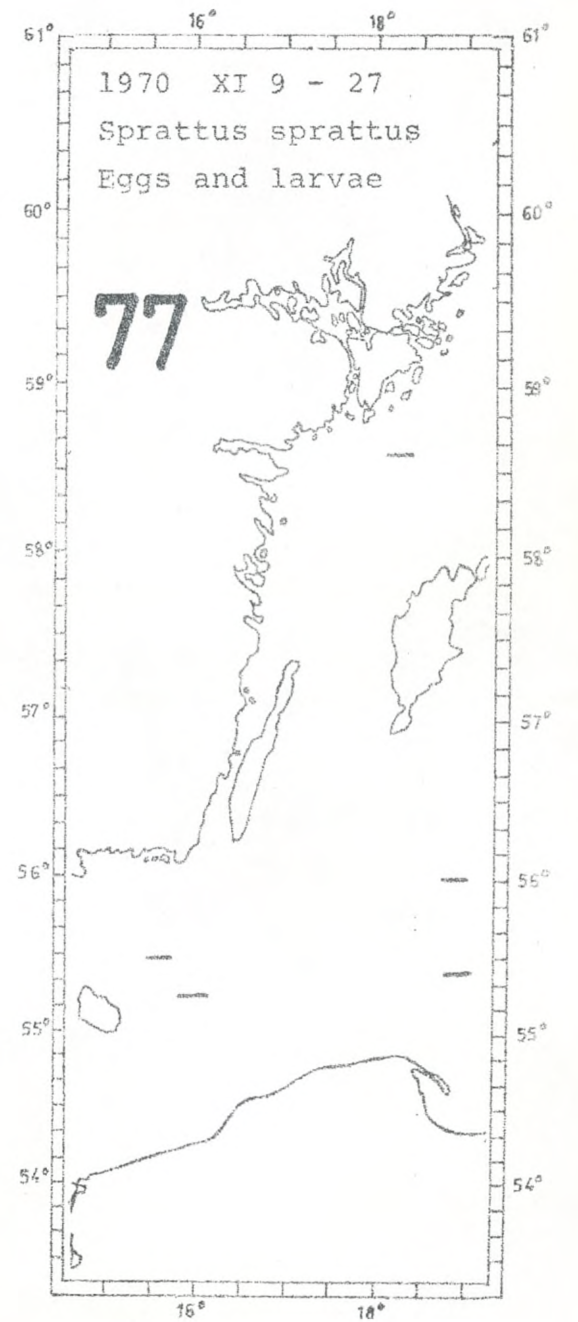
1970 V 22 - 29
Sprattus sprattus
Eggs and larvae
72
1
34
58
23
3
13

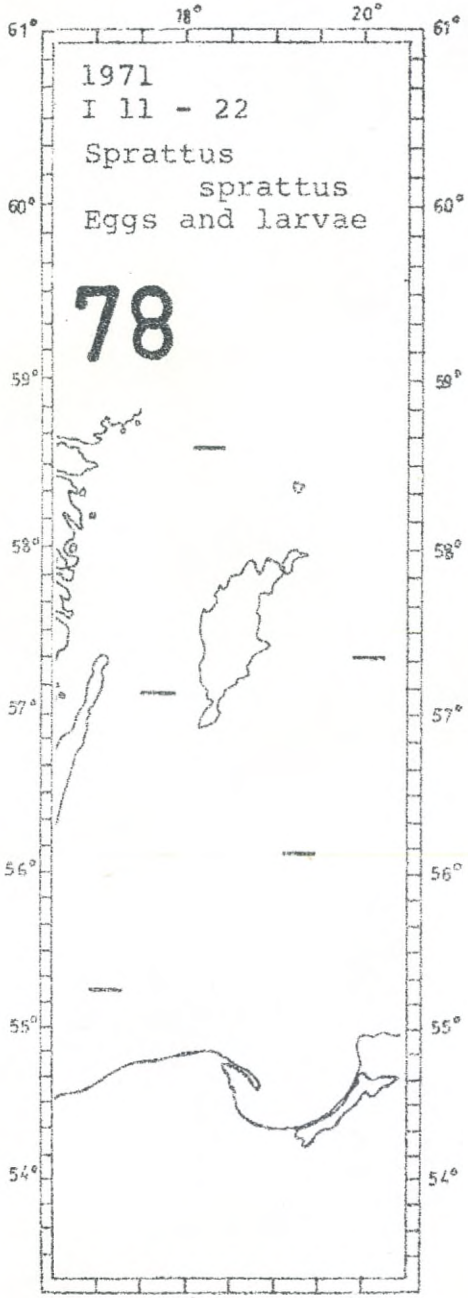

1970 V 25 - VI 12
Sprattus sprattus
Eggs and larvae
73
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
118
70
27
4
1
1
10
34
5
6
4
1

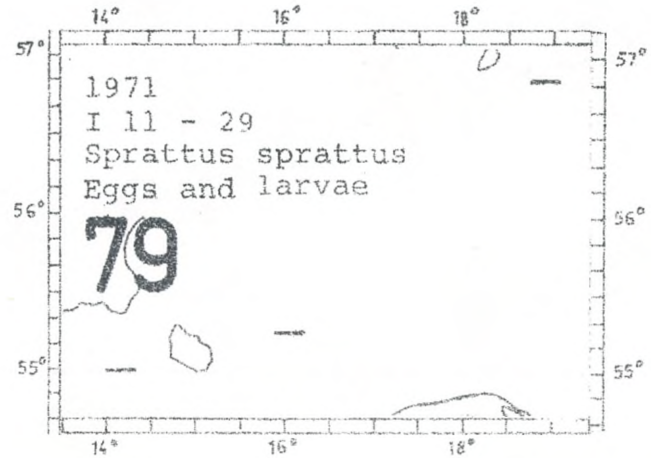

1970 VI 1 - 12
Sprattus sprattus
Eggs and larvae
74
1
3
5
25
1
3

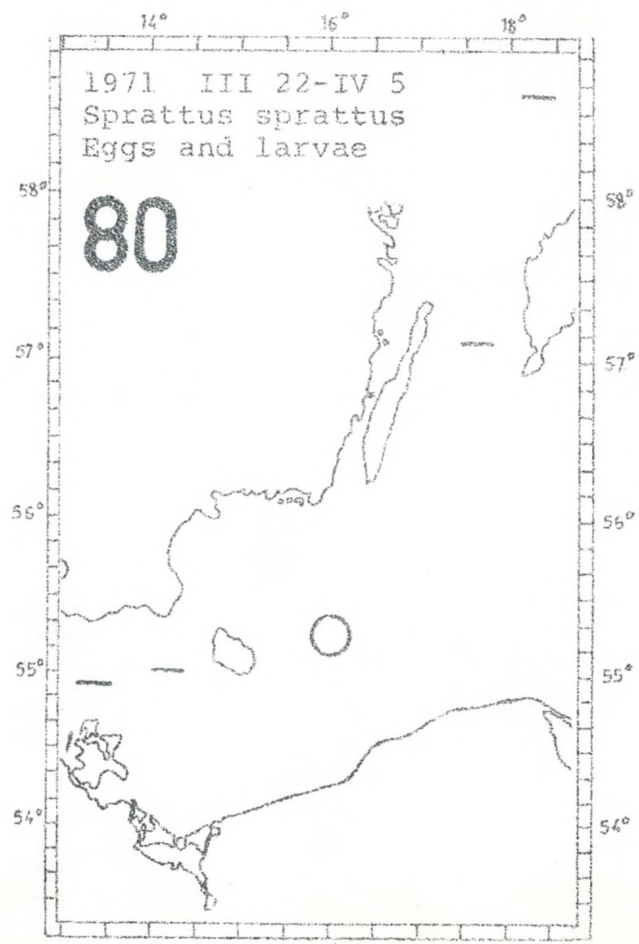

1970 VII 27-VIII 7
VIII 17-28
Sprattus sprattus
Eggs and larvae
75

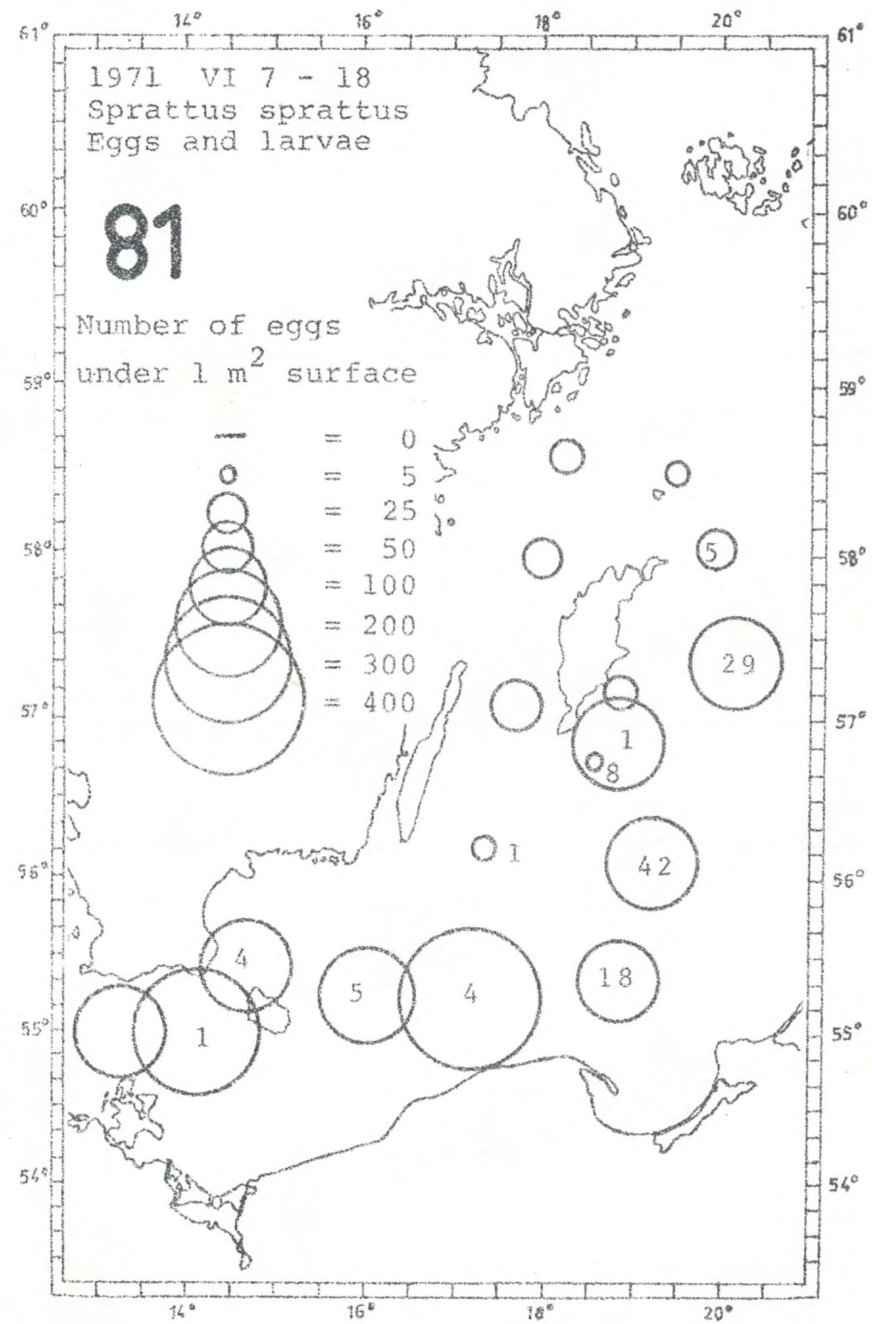

1970 X 12 - 29
Sprattus sprattus
Eggs and larvae
76
Number of eggs
under 1 m^2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400

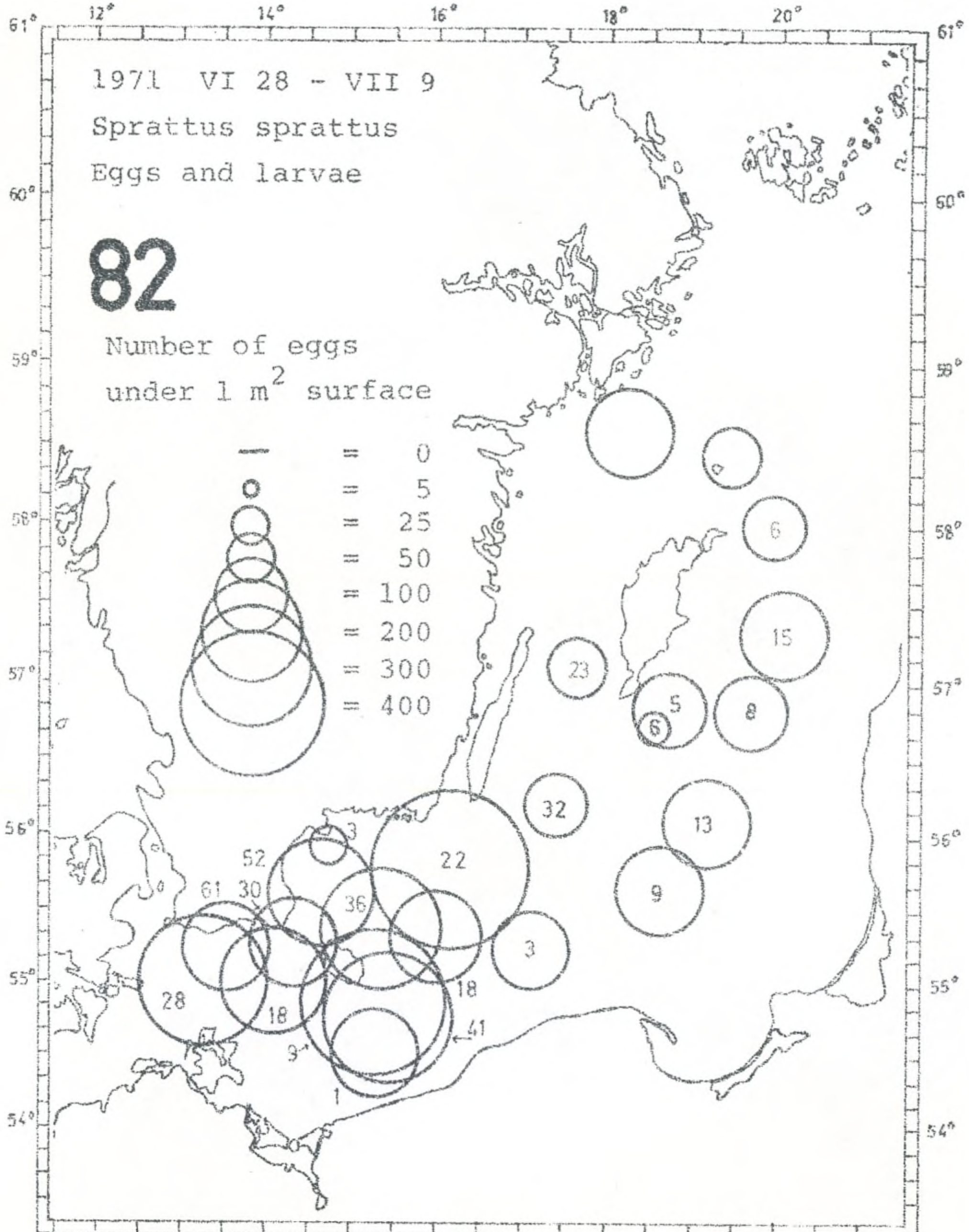

1970 XI 9 - 27
Sprattus sprattus
Eggs and larvae
77

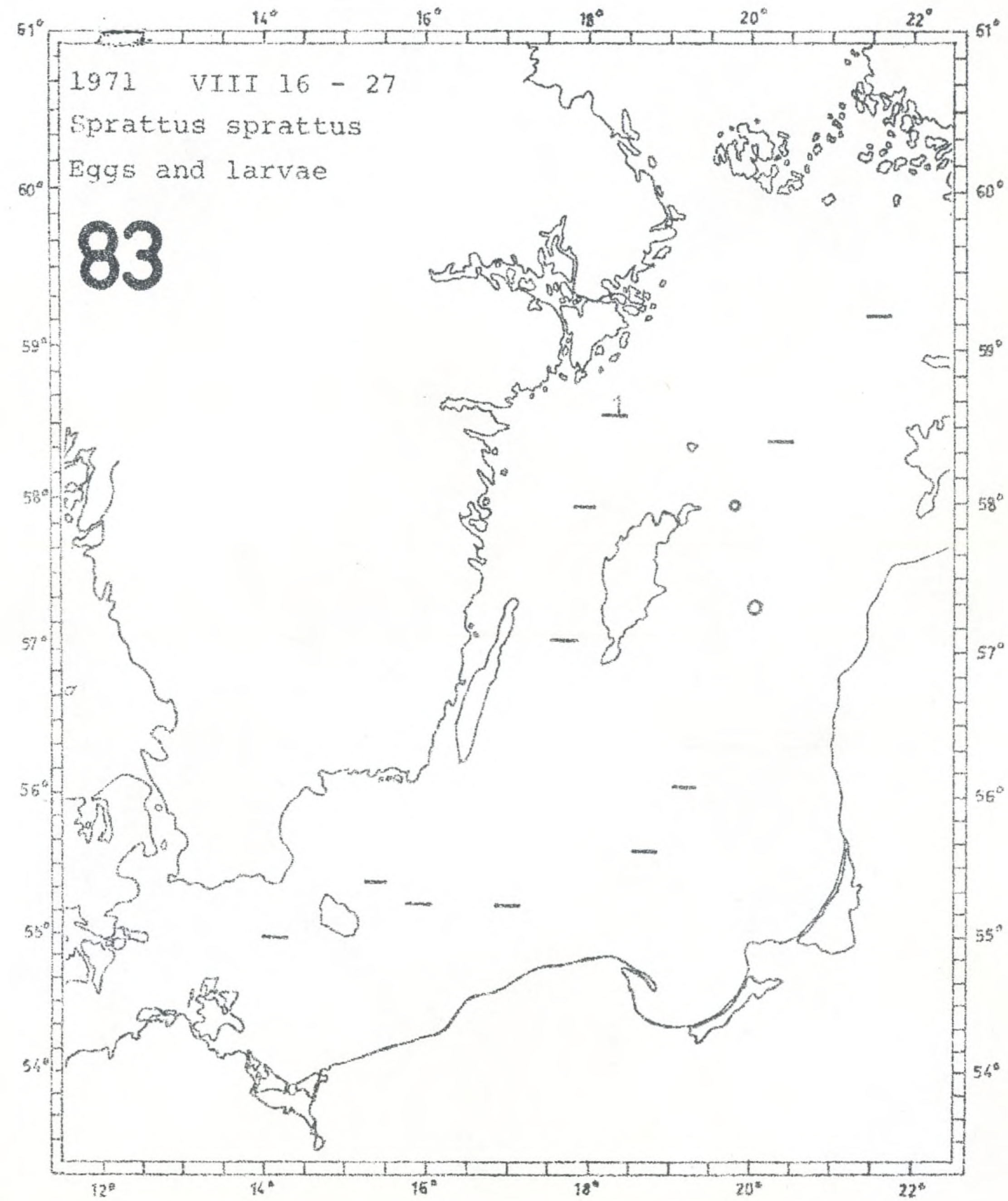

1971
I 11 - 22
Sprattus
sprattus
Eggs and larvae
78

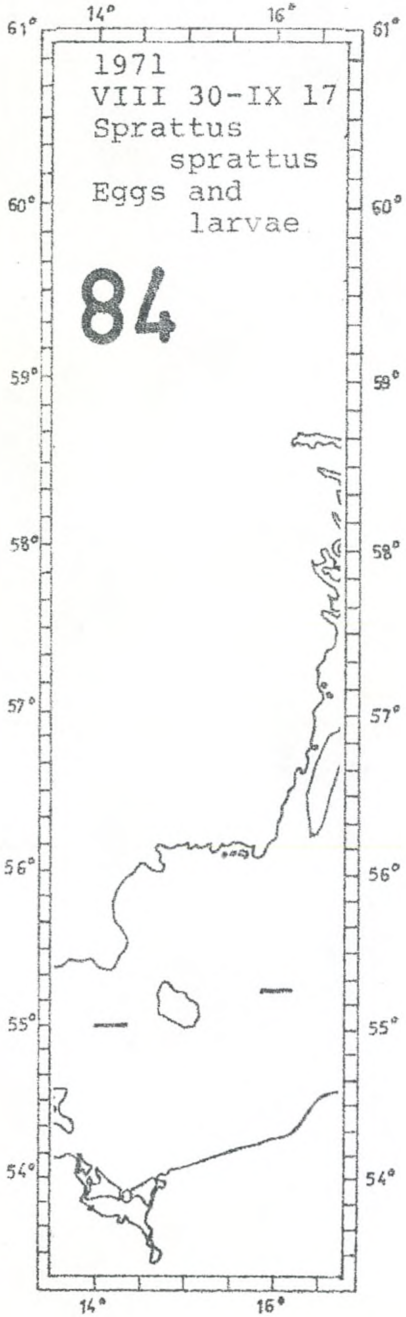

1971
I 11 - 29
Sprattus sprattus
Eggs and larvae
79

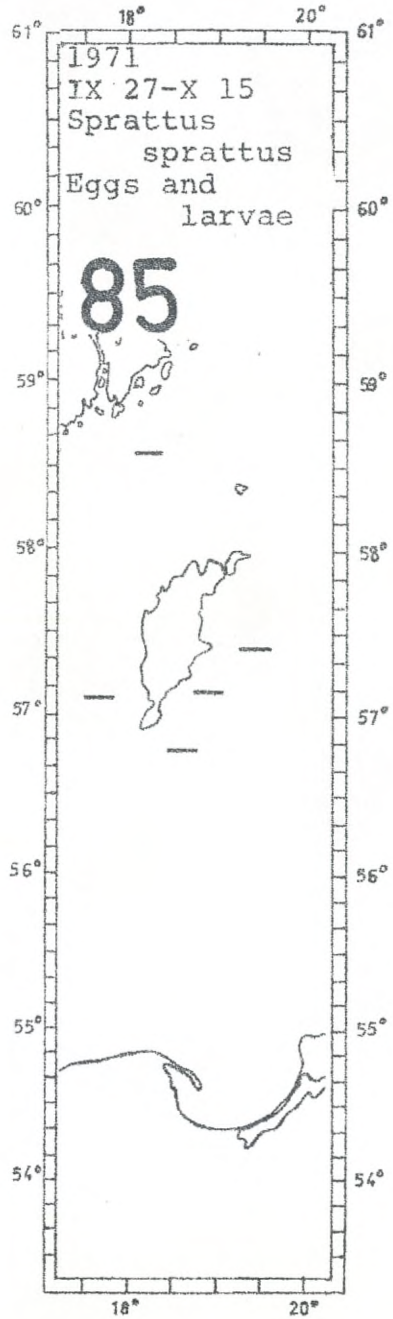

1971 III 22-IV 5
Sprattus sprattus
Eggs and larvae
80

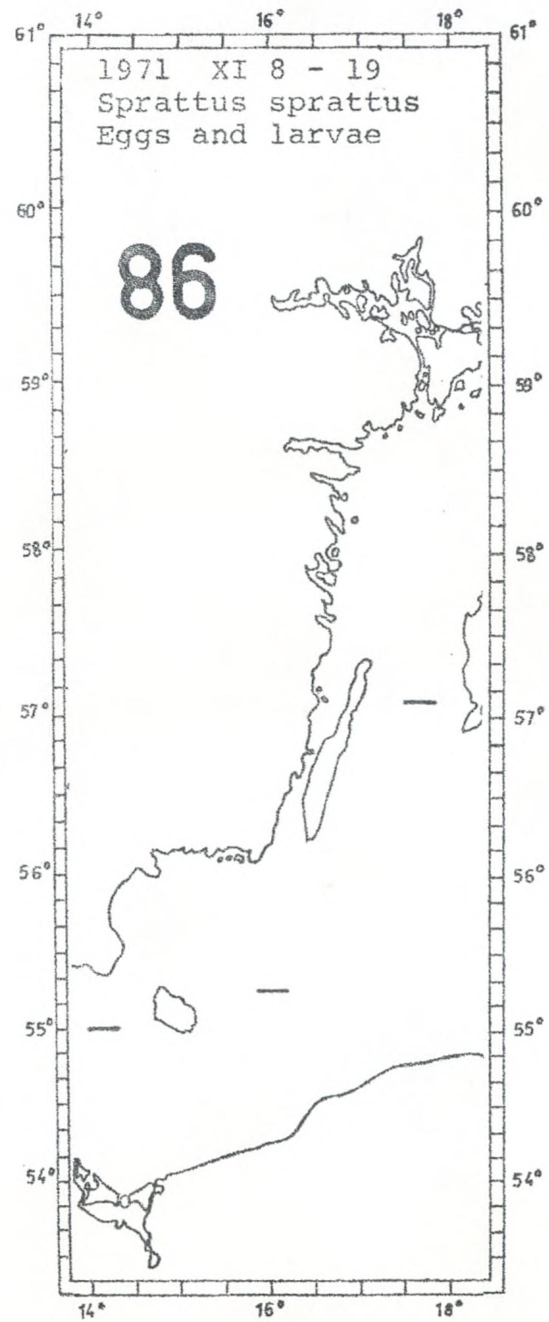

1971 VI 7 - 18
Sprattus sprattus
Eggs and larvae
81
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400

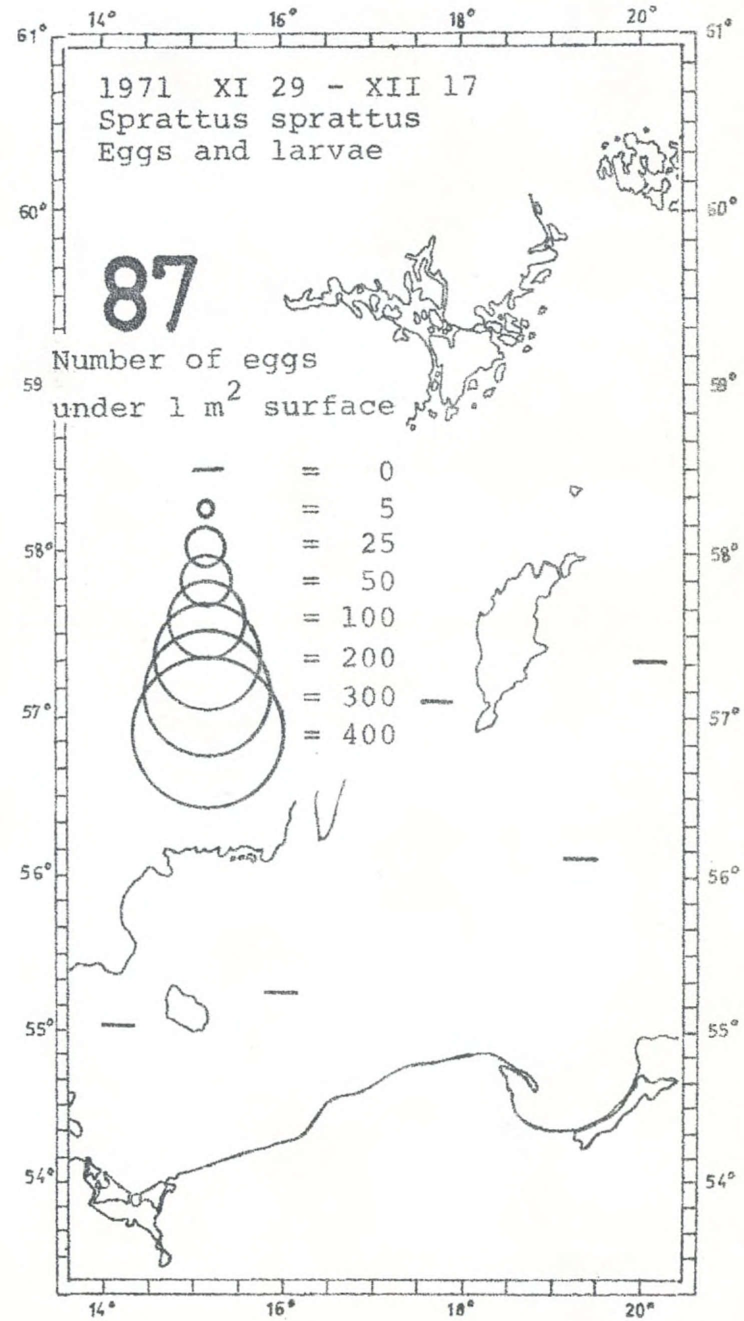

1971 VI 28 - VII 9
Spprattus sprattus
Eggs and larvae
82
Number of eggs
under 1 m2 surface
— = 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
12°
14°
16°
18°
20°
61°
60°
59°
58°
57°
56°
55°
54°

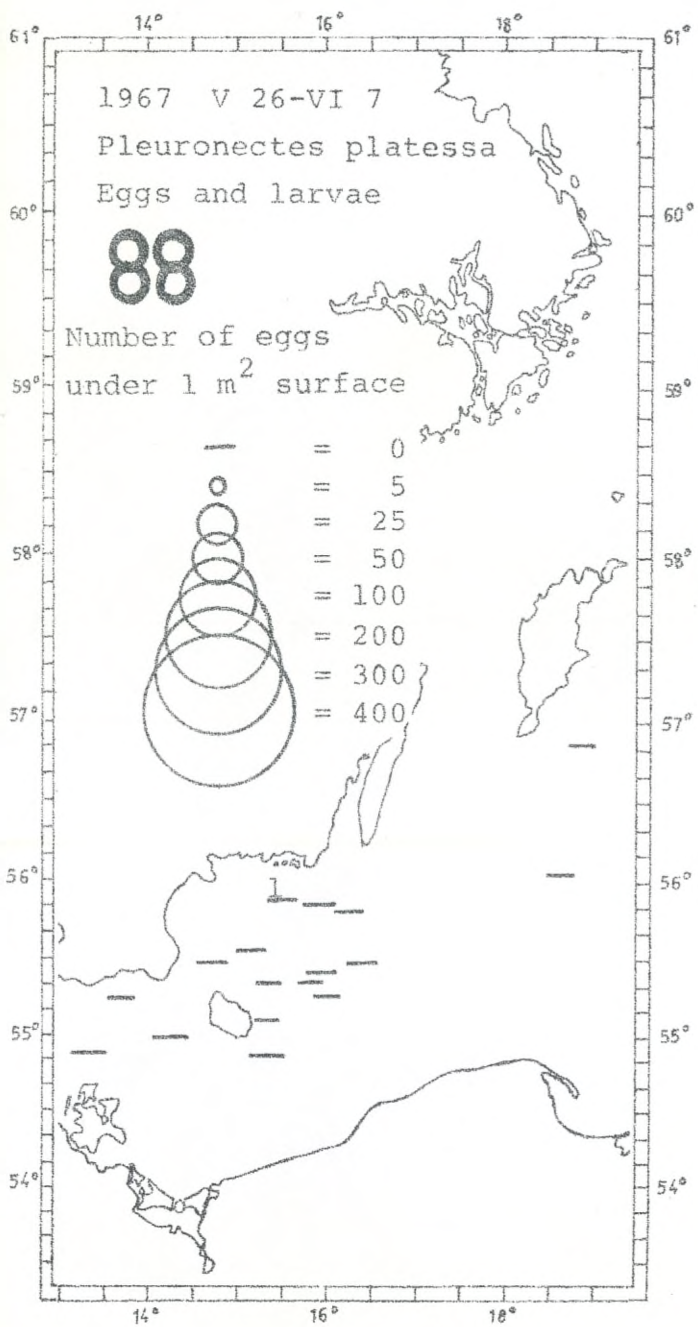

1971 VIII 16 - 27
Sprattus sprattus
Eggs and larvae
83
12°
14°
16°
18°
20°
22°
61°
60°
59°
58°
57°
56°
55°
54°

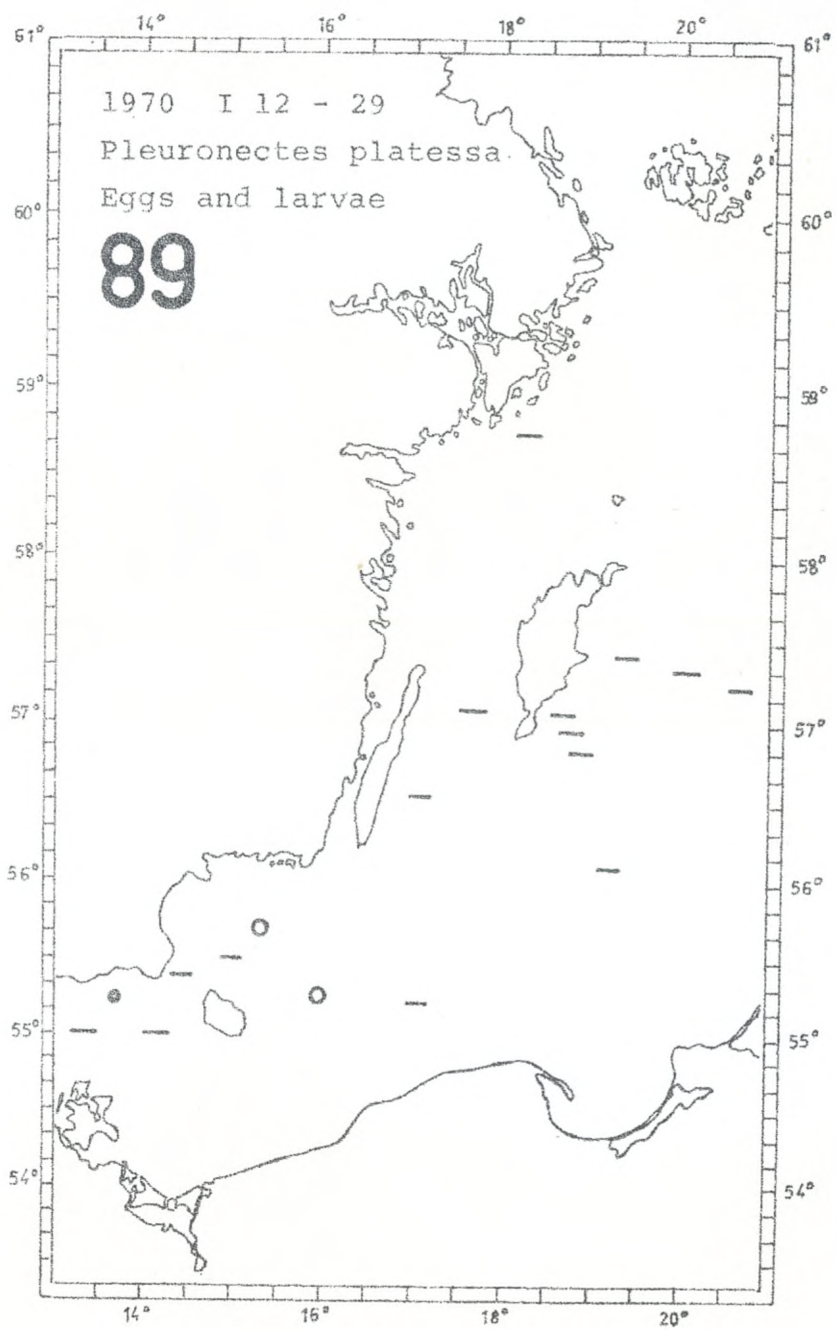

1971
VIII 30-IX 17
Sprattus sprattus
Eggs and larvae
84

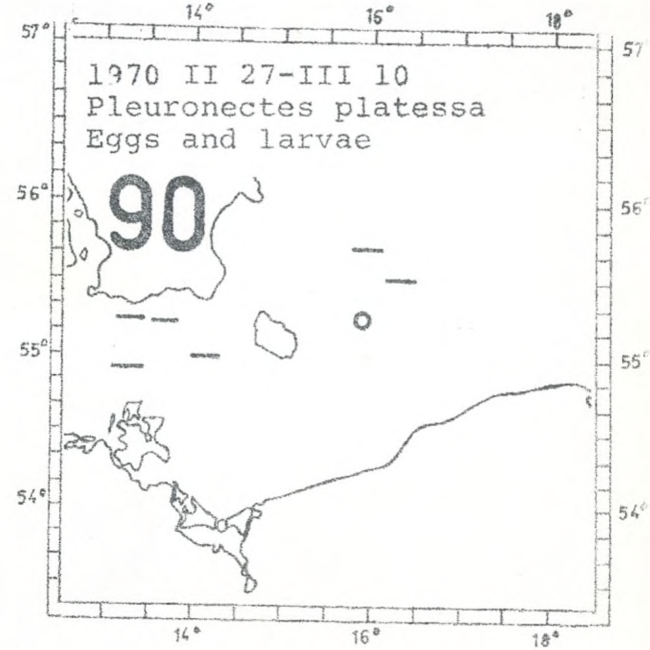

1971
IX 27-X 15
Sprattus sprattus
Eggs and larvae
85

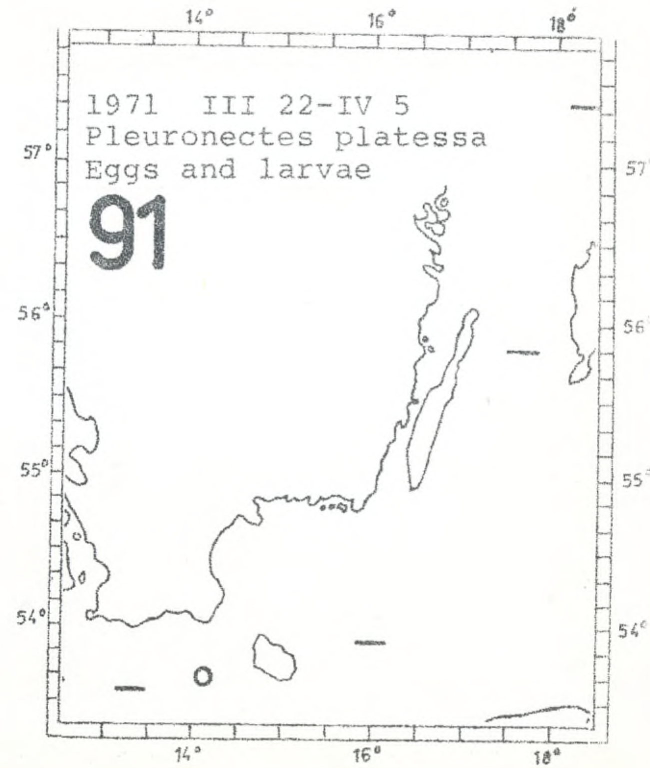

1971 XI 8 - 19
Sprattus sprattus
Eggs and larvae
86

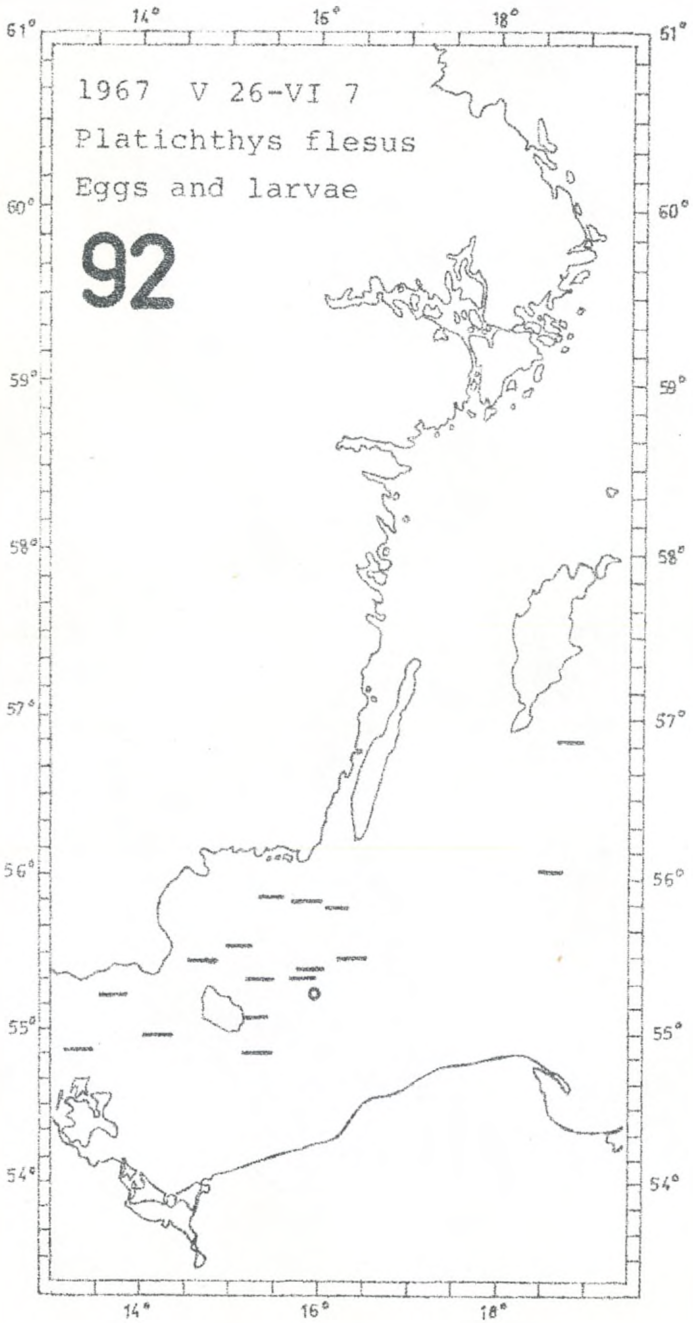

1971 XI 29 - XII 17
Sprattus sprattus
Eggs and larvae
87
Number of eggs under 1 m² surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400

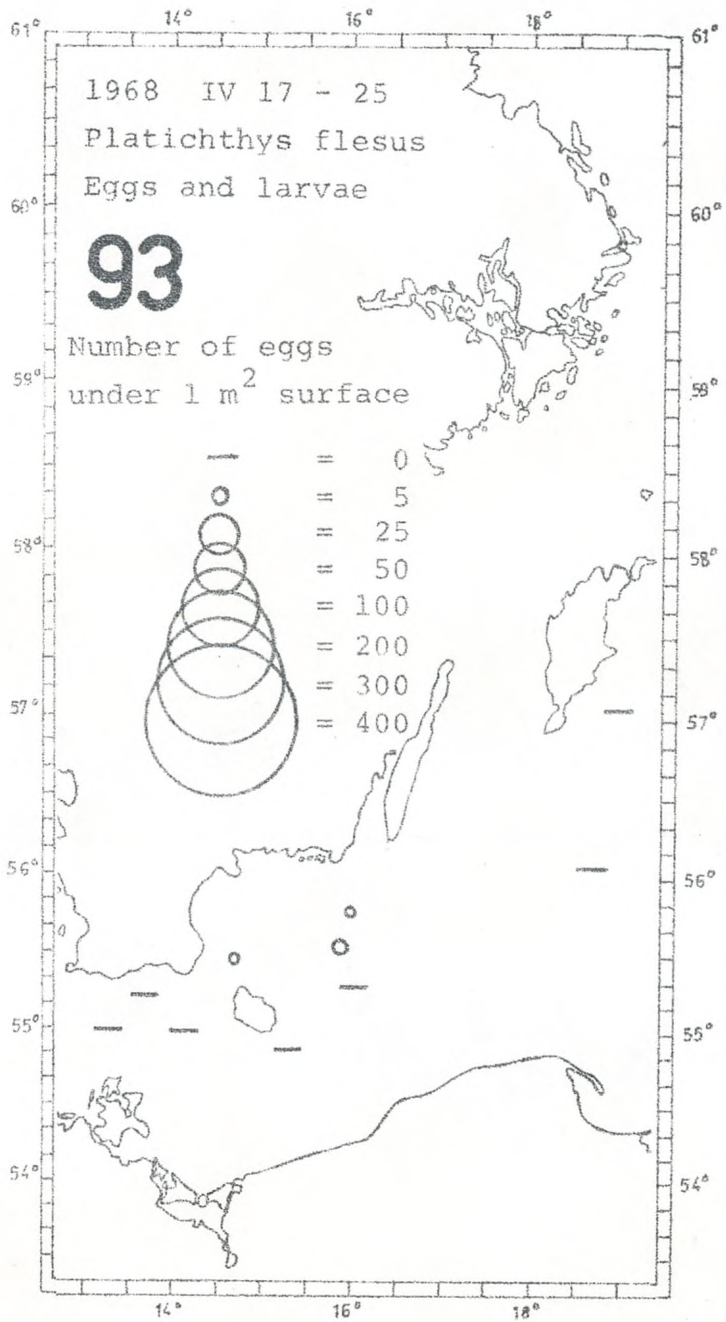

1967 V 26-VI 7
Pleuronectes platessa
Eggs and larvae
88
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400

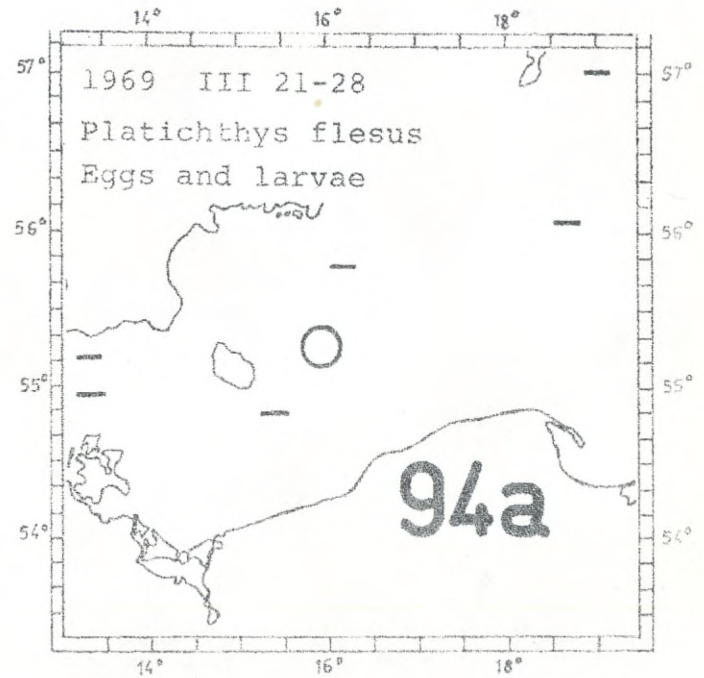

1970 I 12 - 29
Pleuronectes platessa
Eggs and larvae
89

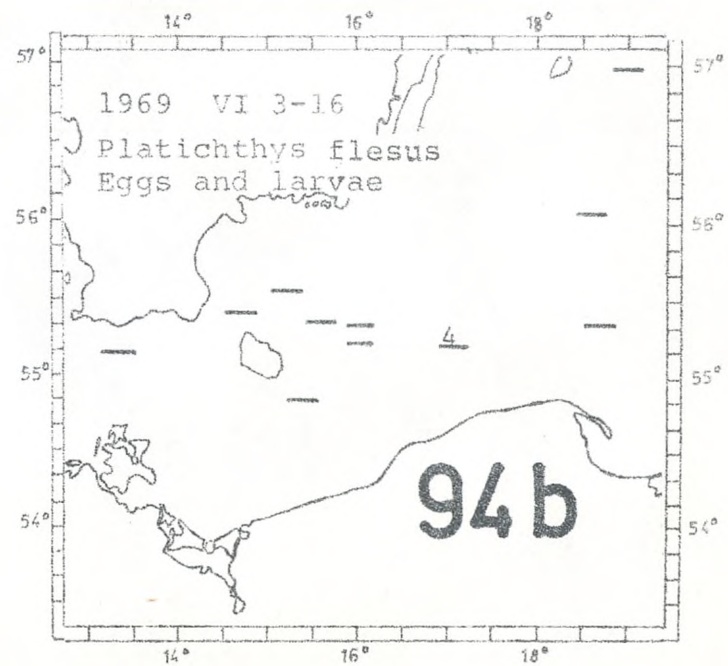

1970 II 27-III 10
Pleuronectes platessa
Eggs and larvae
90

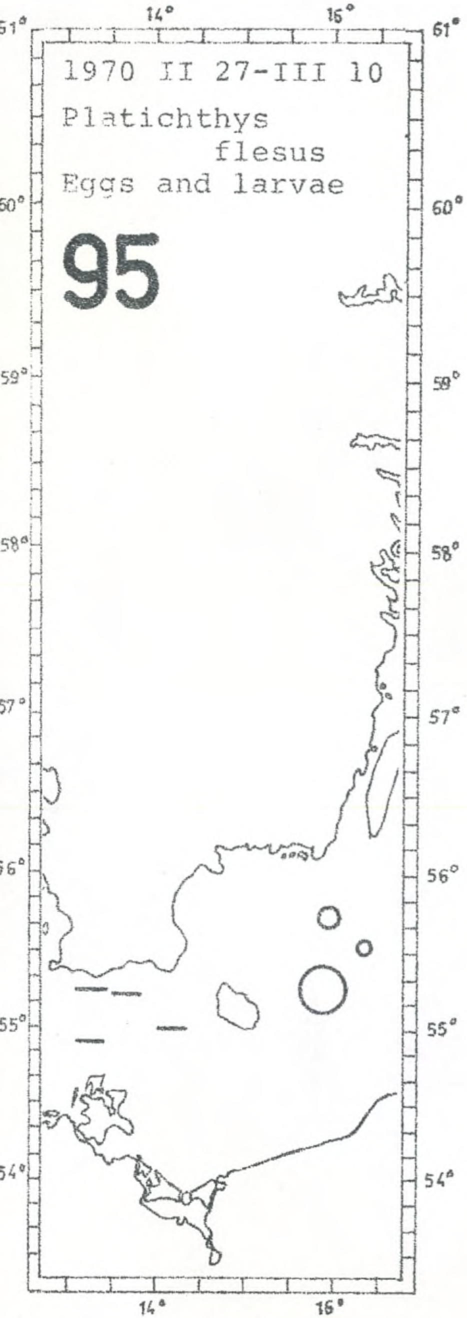

1971 III 22-IV 5
Pleuronectes platessa
Eggs and larvae
91

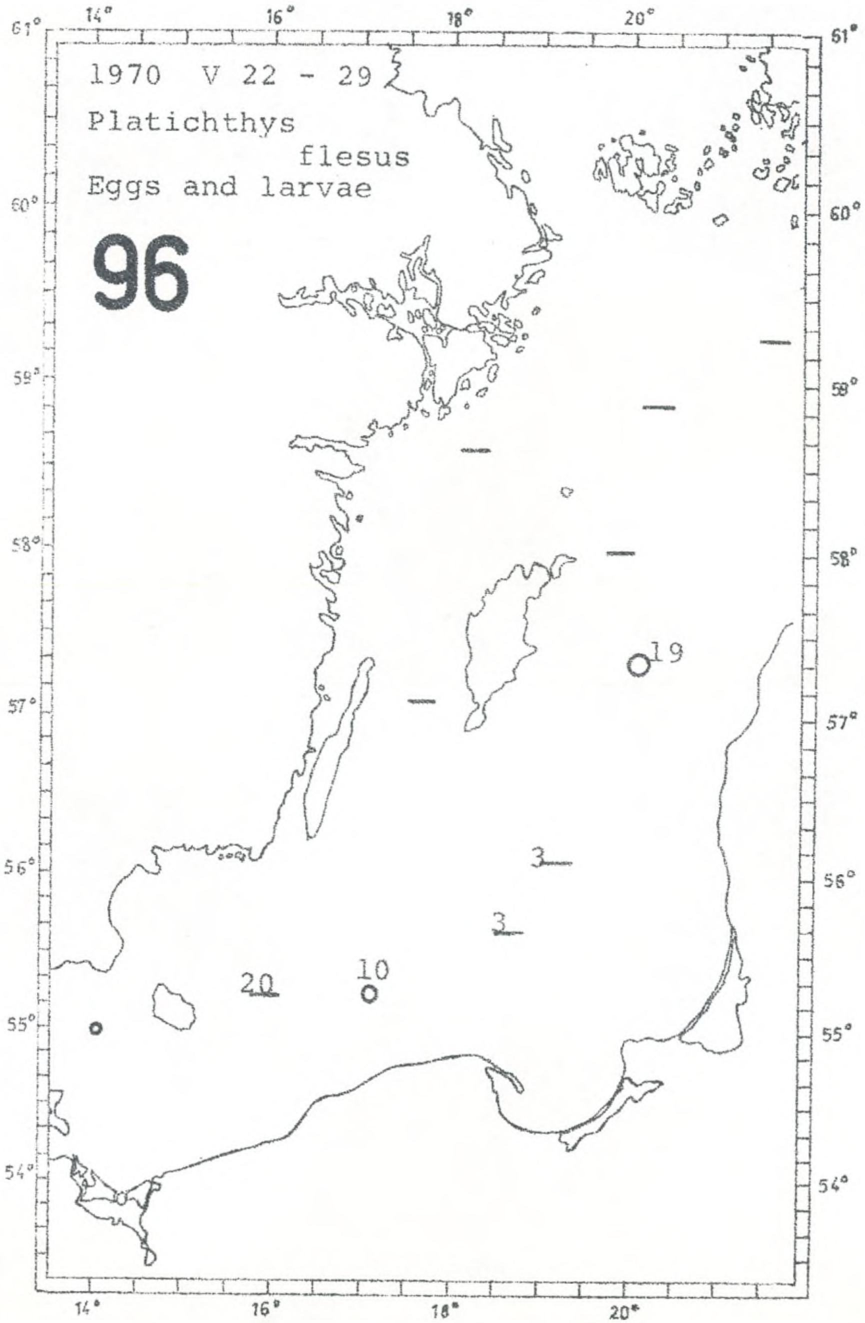

1967 V 26-VI 7
Platichthys flesus
Eggs and larvae
92
14°
16°
18°
61°
60°
59°
58°
57°
56°
55°
54°


1968 IV 17 - 25
Platichthys flesus
Eggs and larvae
93
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
14°
16°
18°
61°
60°
59°
58°
57°
56°
55°
54°


1969 III 21-28
Platichthys flesus
Eggs and larvae
94a
14°
16°
18°
57°
56°
55°
54°

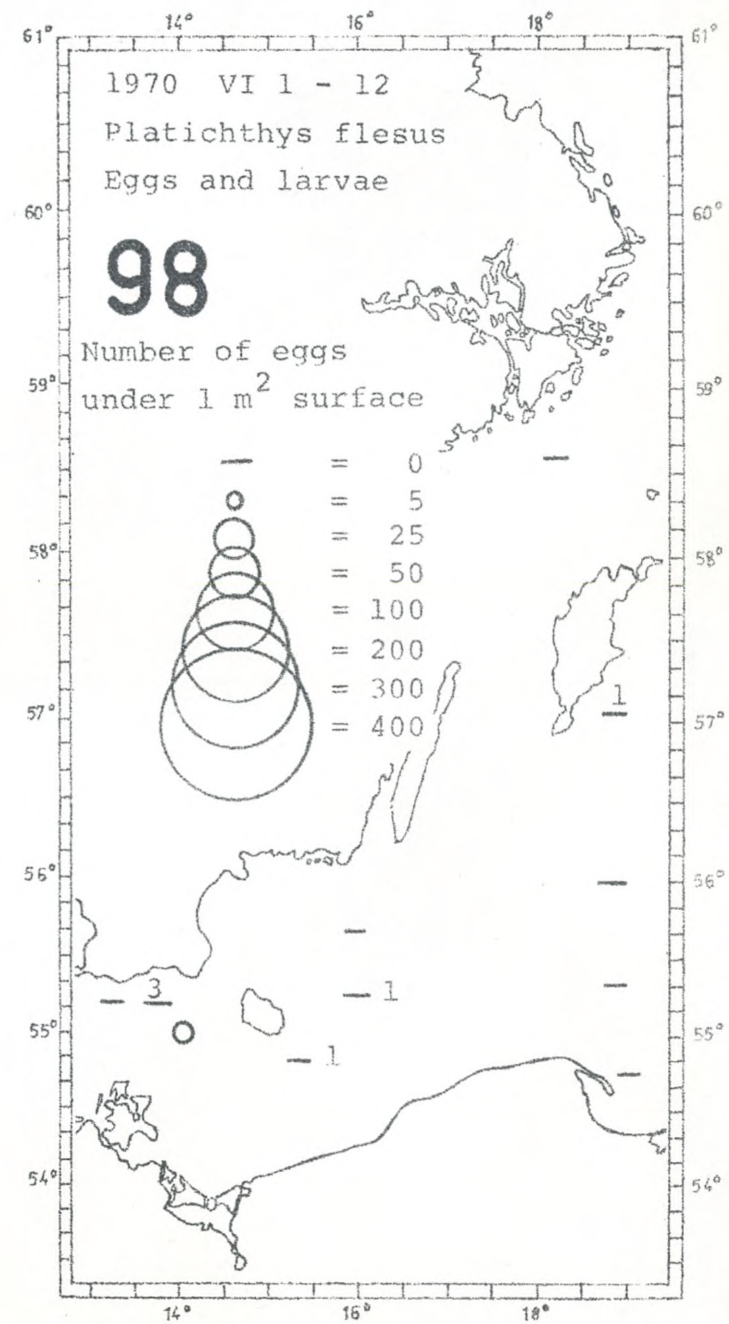

1969 VI 3-16
Platichthys flesus
Eggs and larvae
4
94b
14°
16°
18°
57°
56°
55°
54°

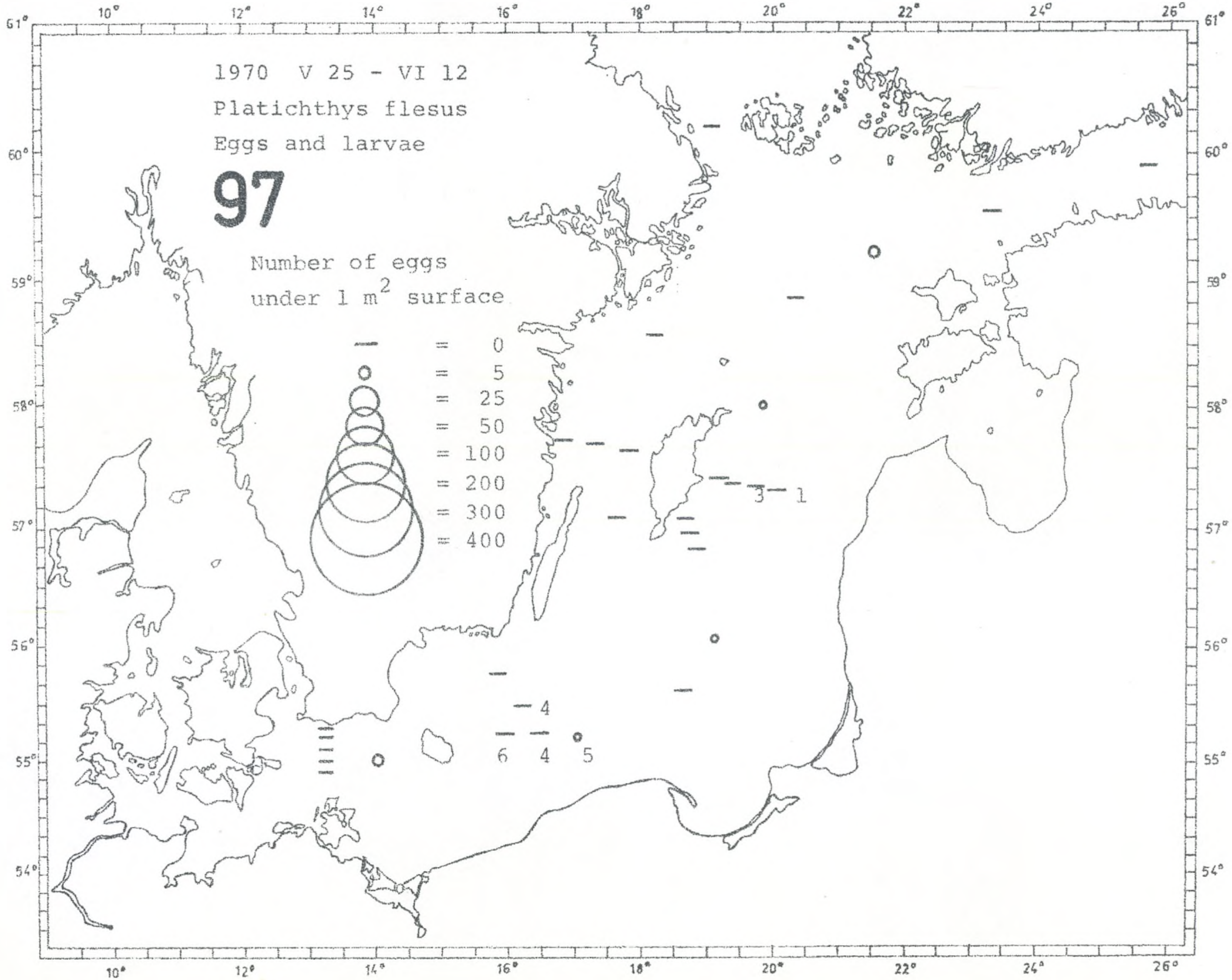


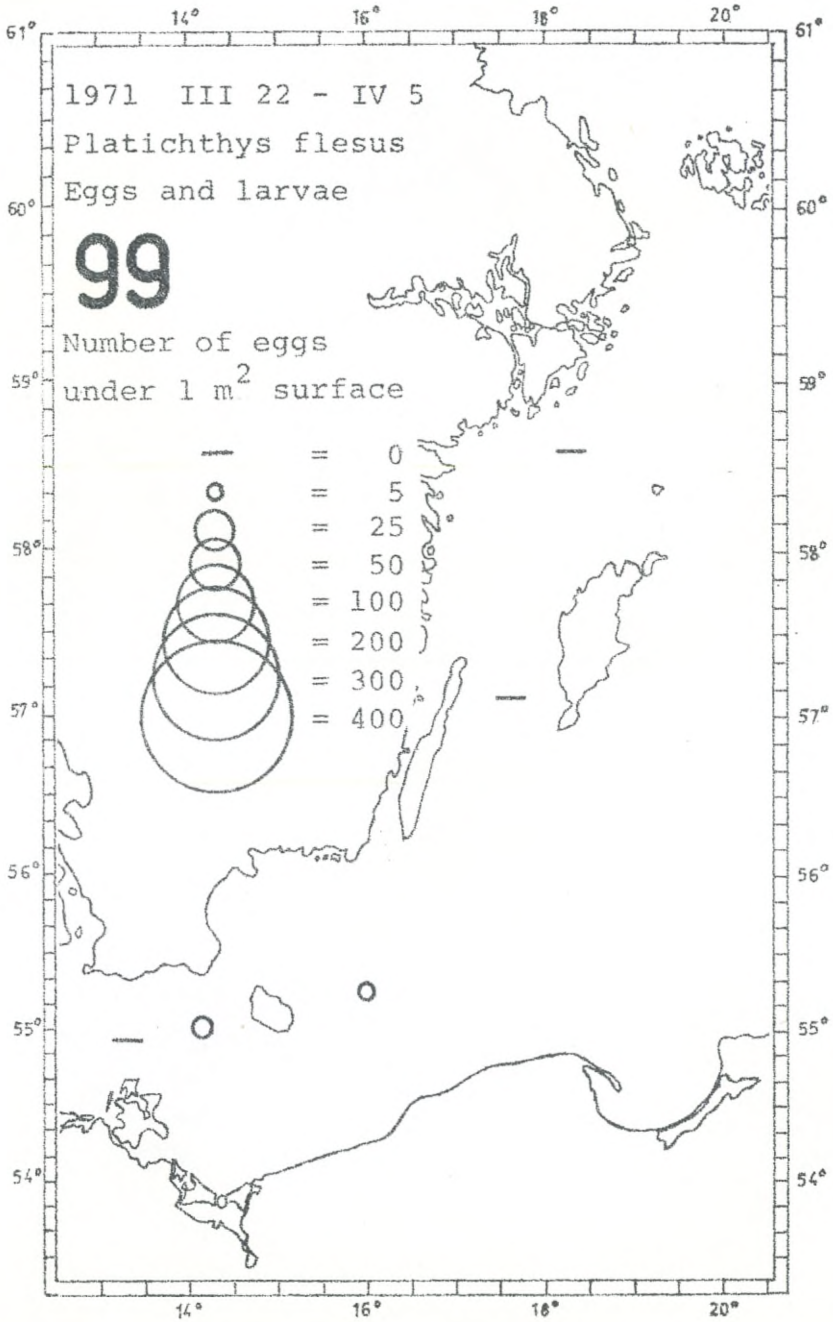


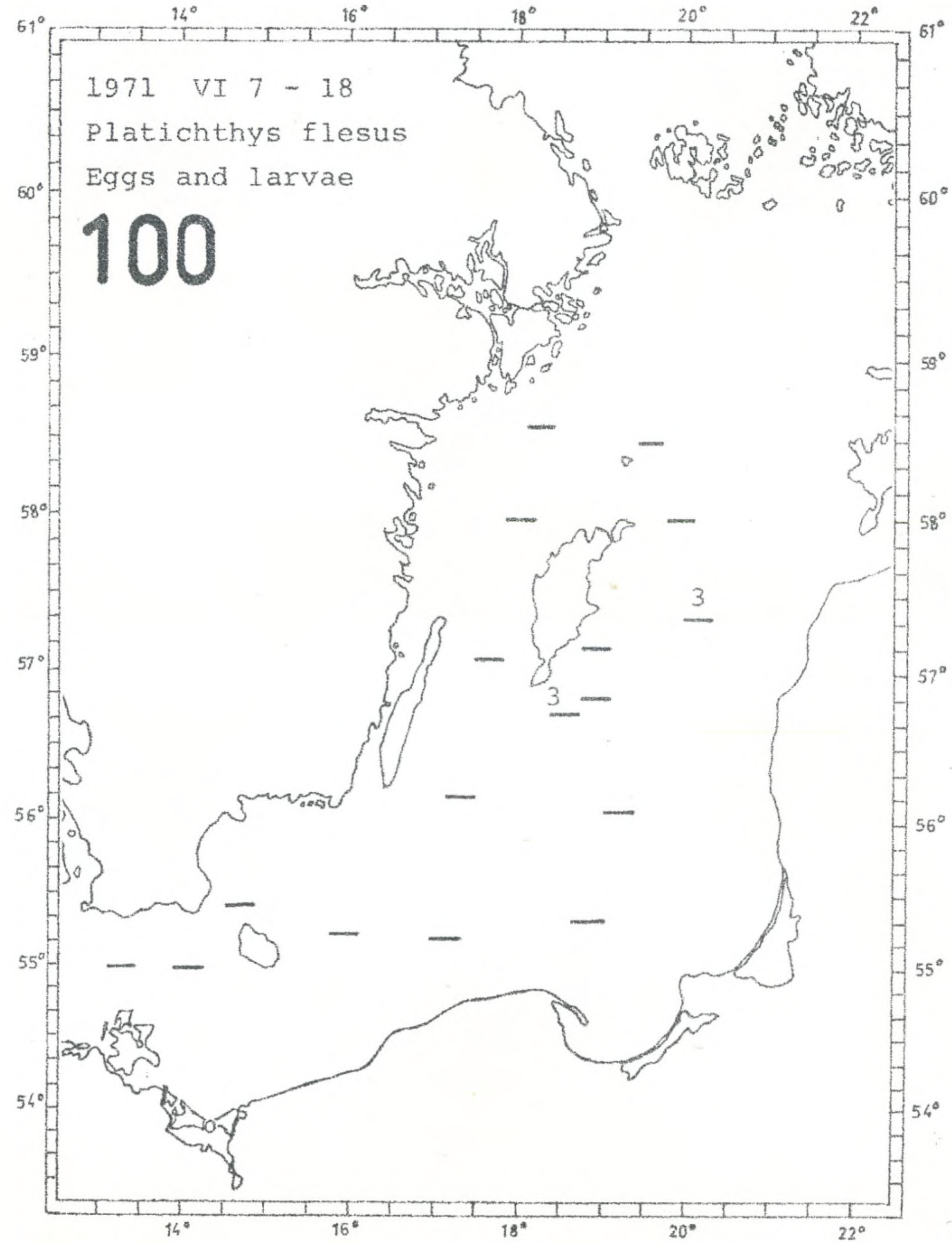
97

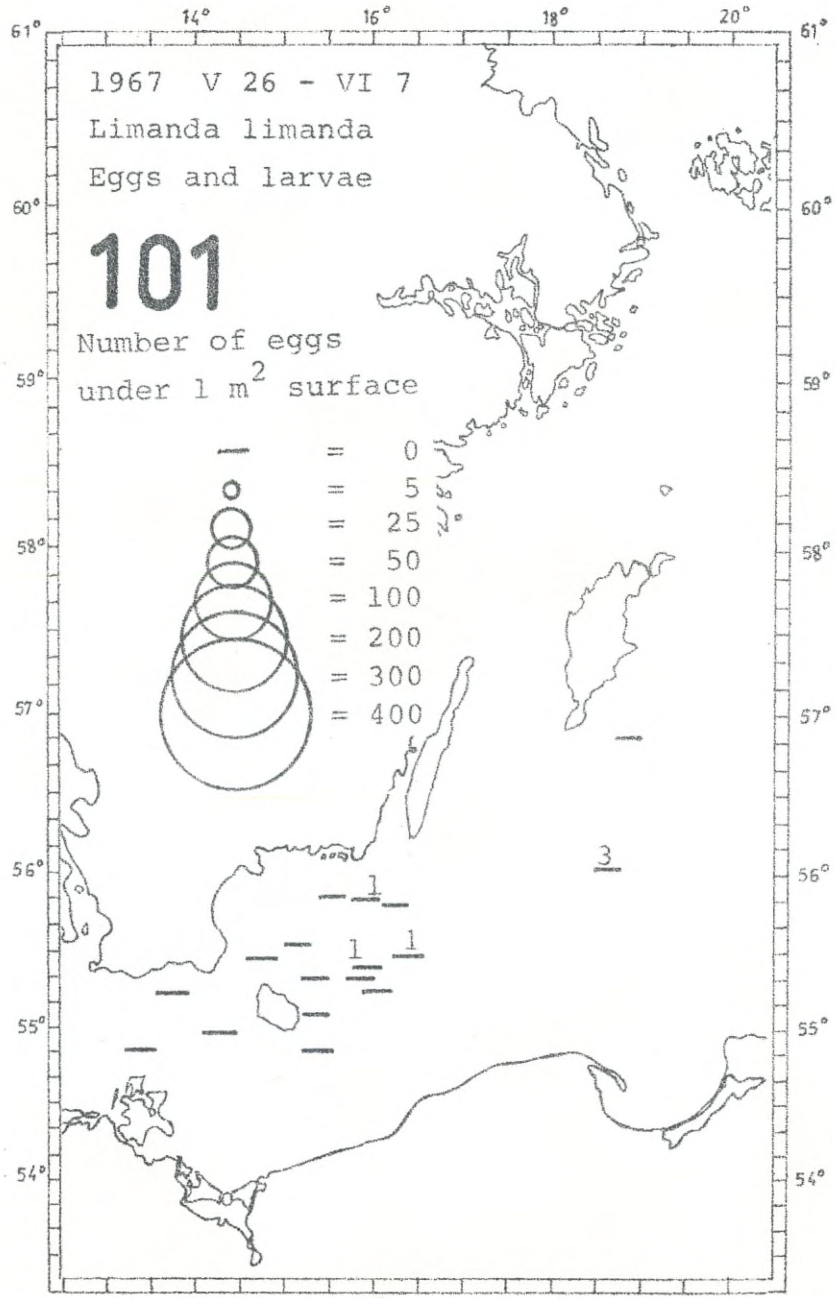
See next page



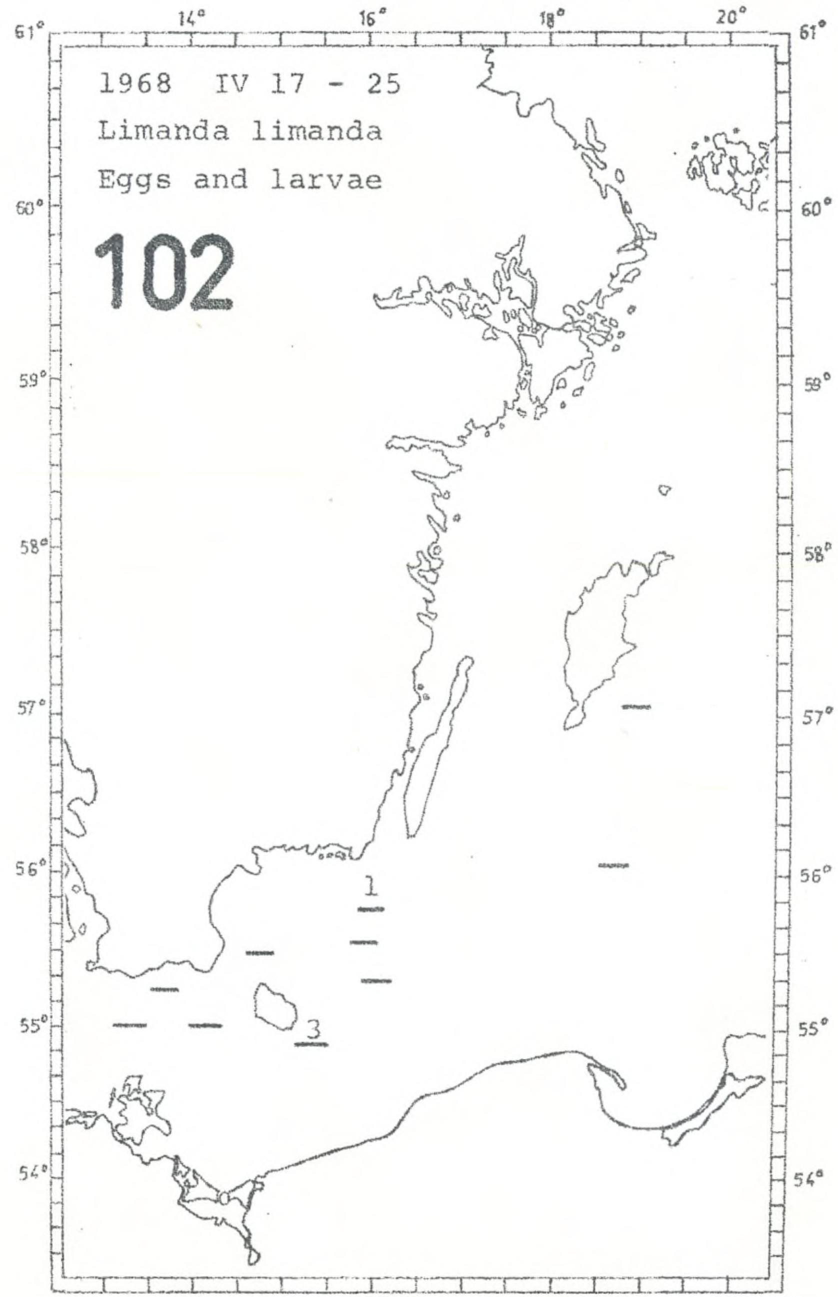

1970 V 25 - VI 12
Platichthys flesus
Eggs and larvae
97
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
3
1
4
6
4
5
61°
60°
59°
58°
57°
56°
55°
54°
10°
12°
14°
16°
18°
20°
22°
24°
26°


1971 III 22 - IV 5
Platichthys flesus
Eggs and larvae
99
Number of eggs
under 1 m^2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
14°
16°
18°
20°
61°
60°
59°
58°
57°
56°
55°
54°

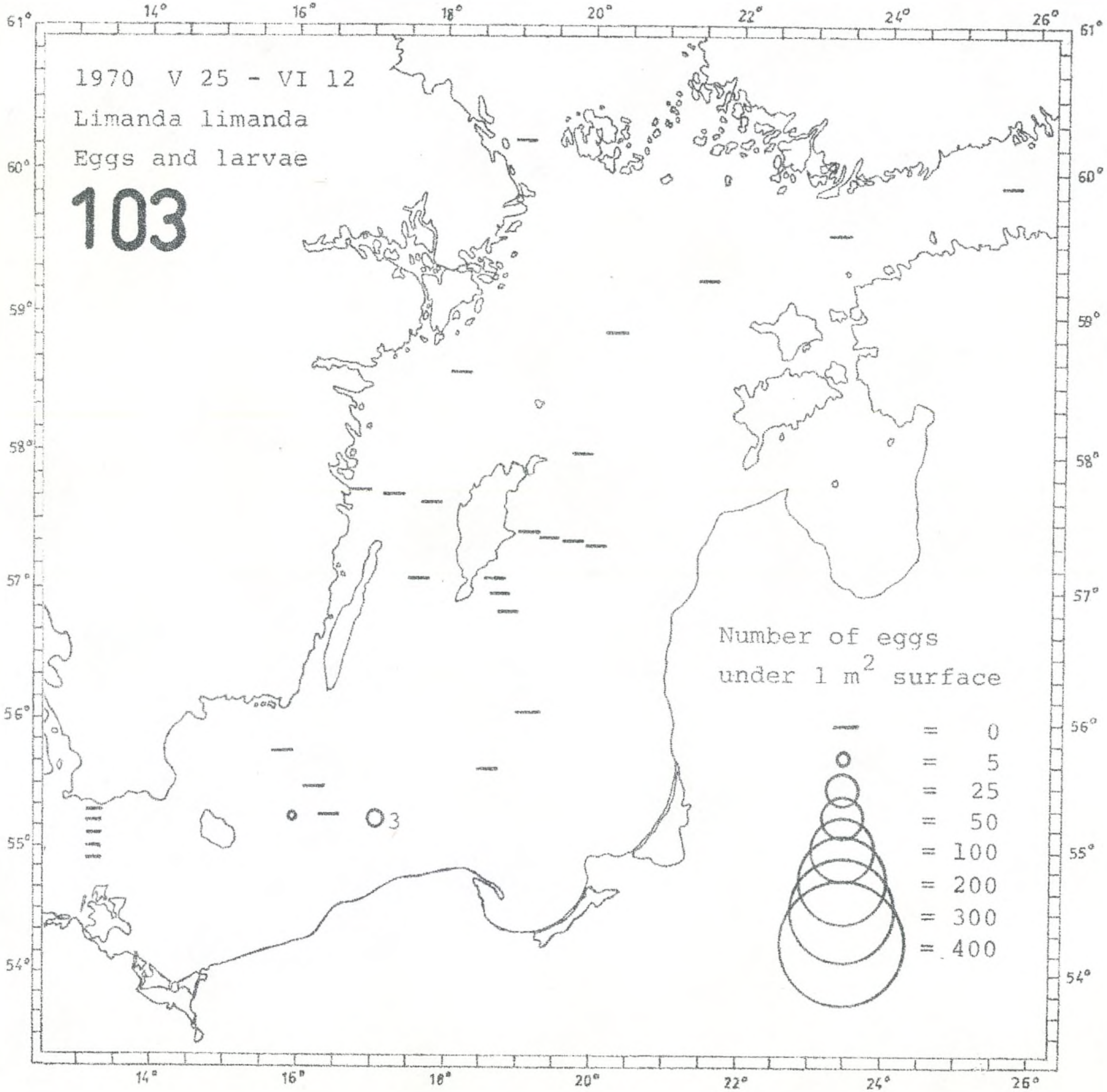

1971 VI 7 - 18
Platichthys flesus
Eggs and larvae
100
3
3
14°
16°
18°
20°
22°
61°
60°
59°
58°
57°
56°
55°
54°



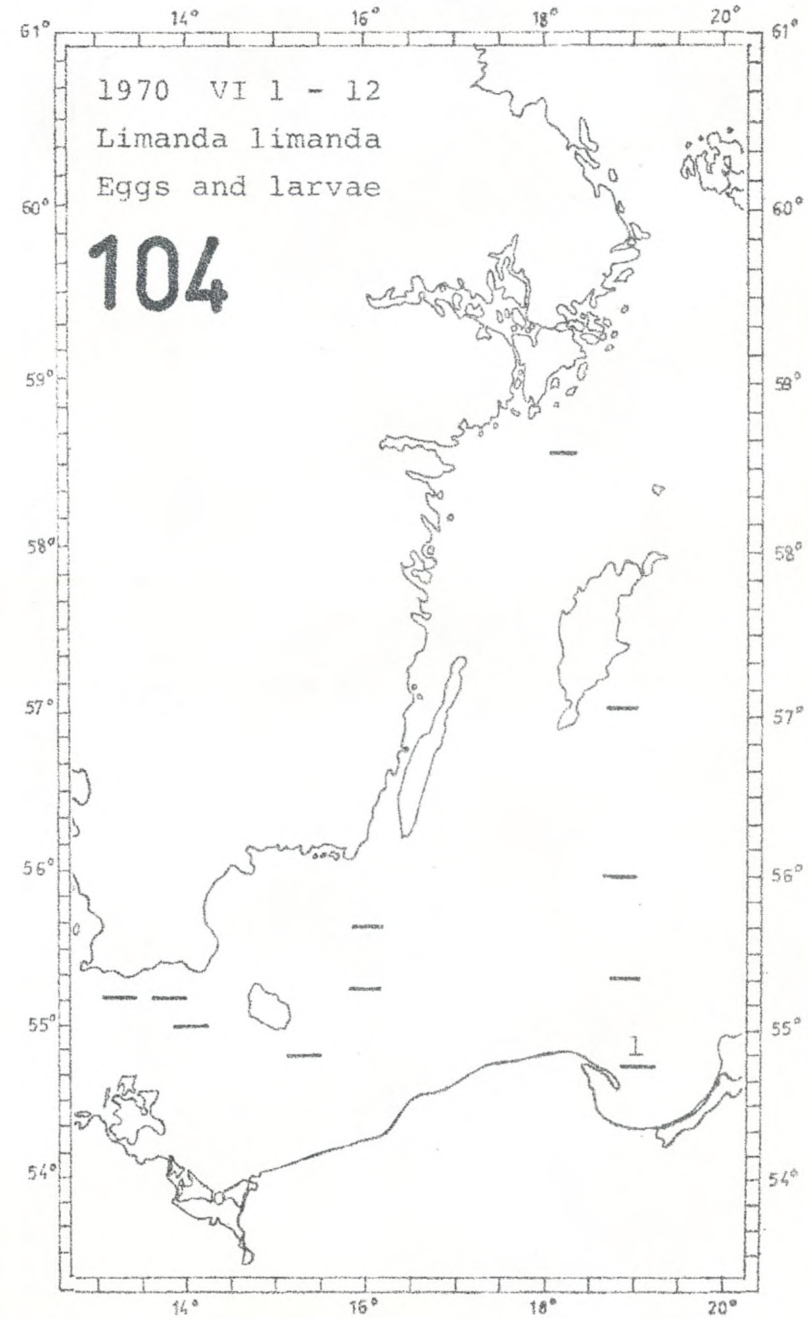
1967 V 26 - VI 7
Limanda limanda
Eggs and larvae
101
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
14°
16°
18°
20°
61°
60°
59°
58°
57°
56°
55°
54°
1
1
1
3



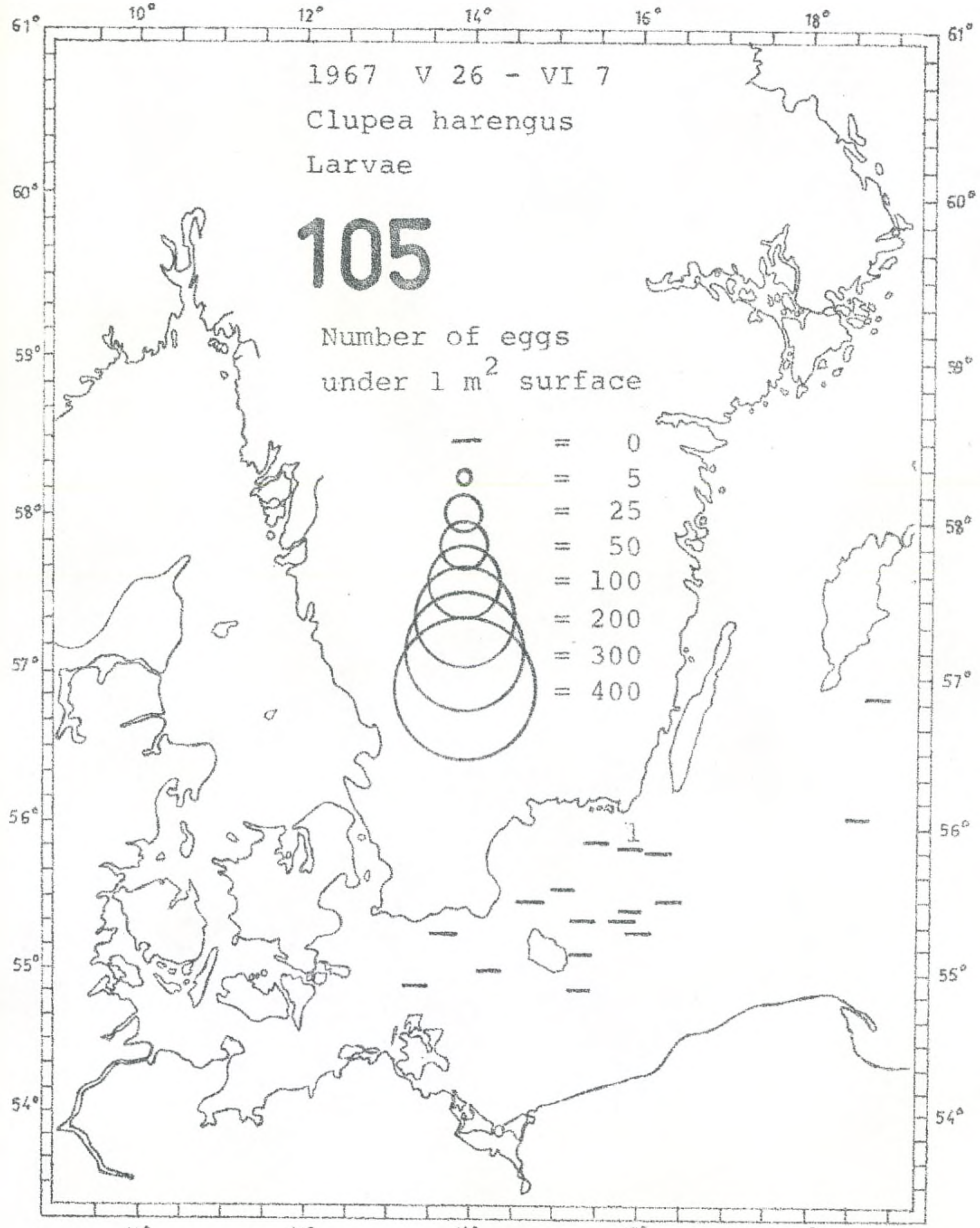
1968 IV 17 - 25
Limanda limanda
Eggs and larvae
102
14°
16°
18°
20°
61°
60°
59°
58°
57°
56°
55°
54°
1
3

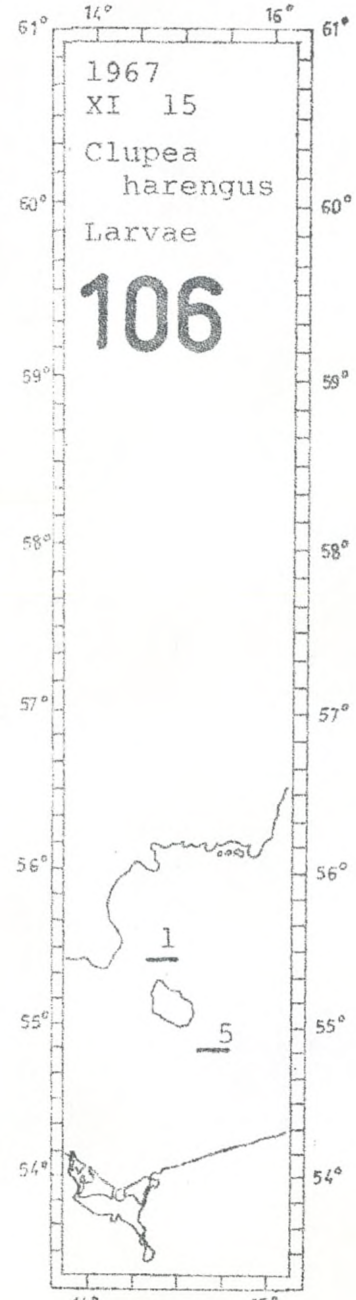


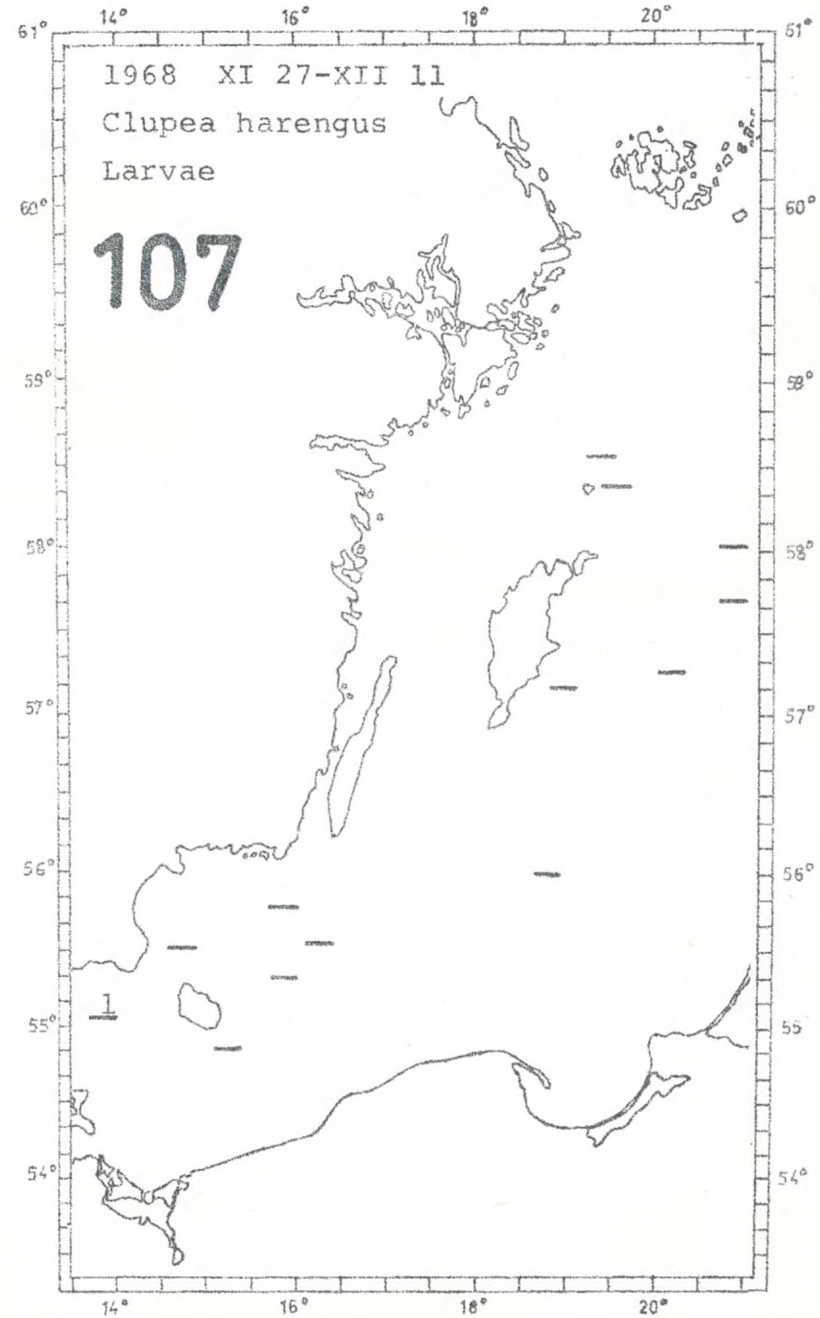
1970 V 25 - VI 12
Limanda limanda
Eggs and larvae
103
Number of eggs under 1 m^2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
3
14°
16°
18°
20°
22°
24°
26°
54°
55°
56°
57°
58°
59°
60°
61°

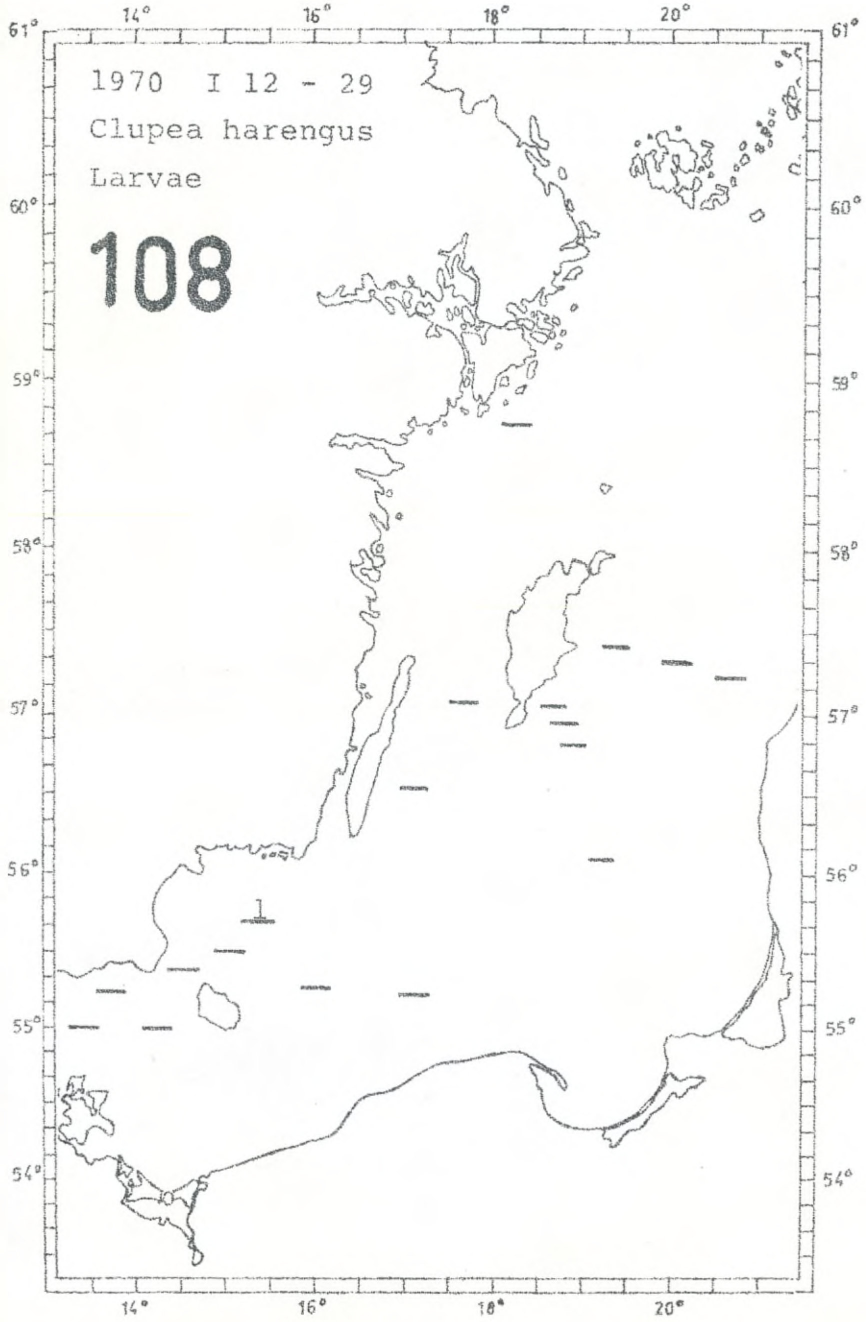


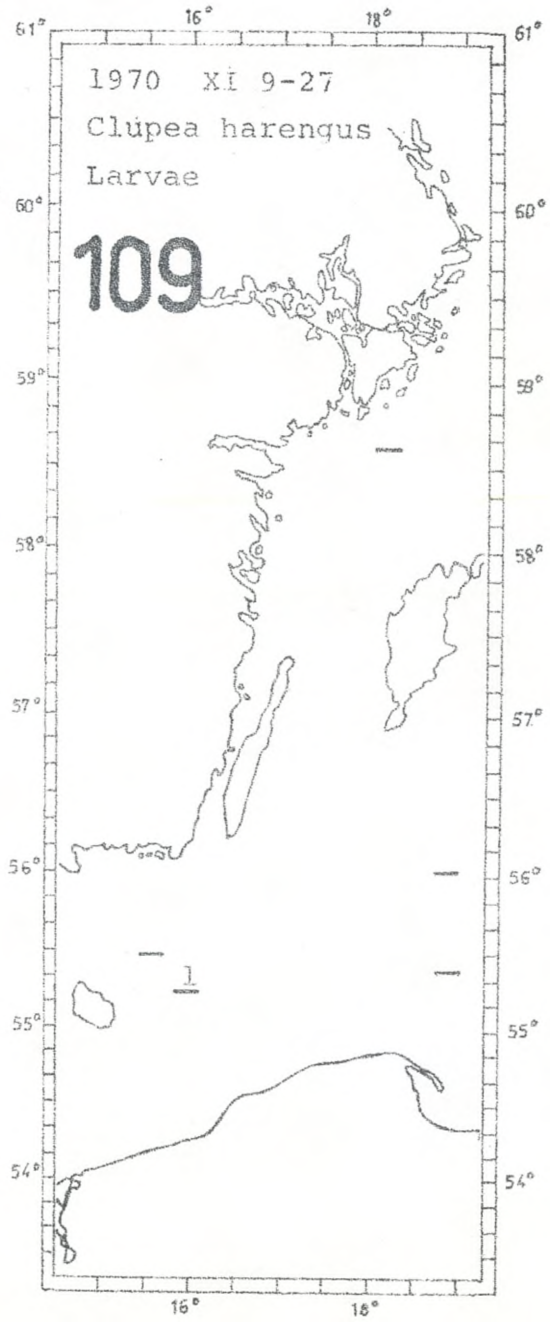
1970 VI 1 - 12
Limanda limanda
Eggs and larvae
104
1
14°
16°
18°
20°
54°
55°
56°
57°
58°
59°
60°
61°

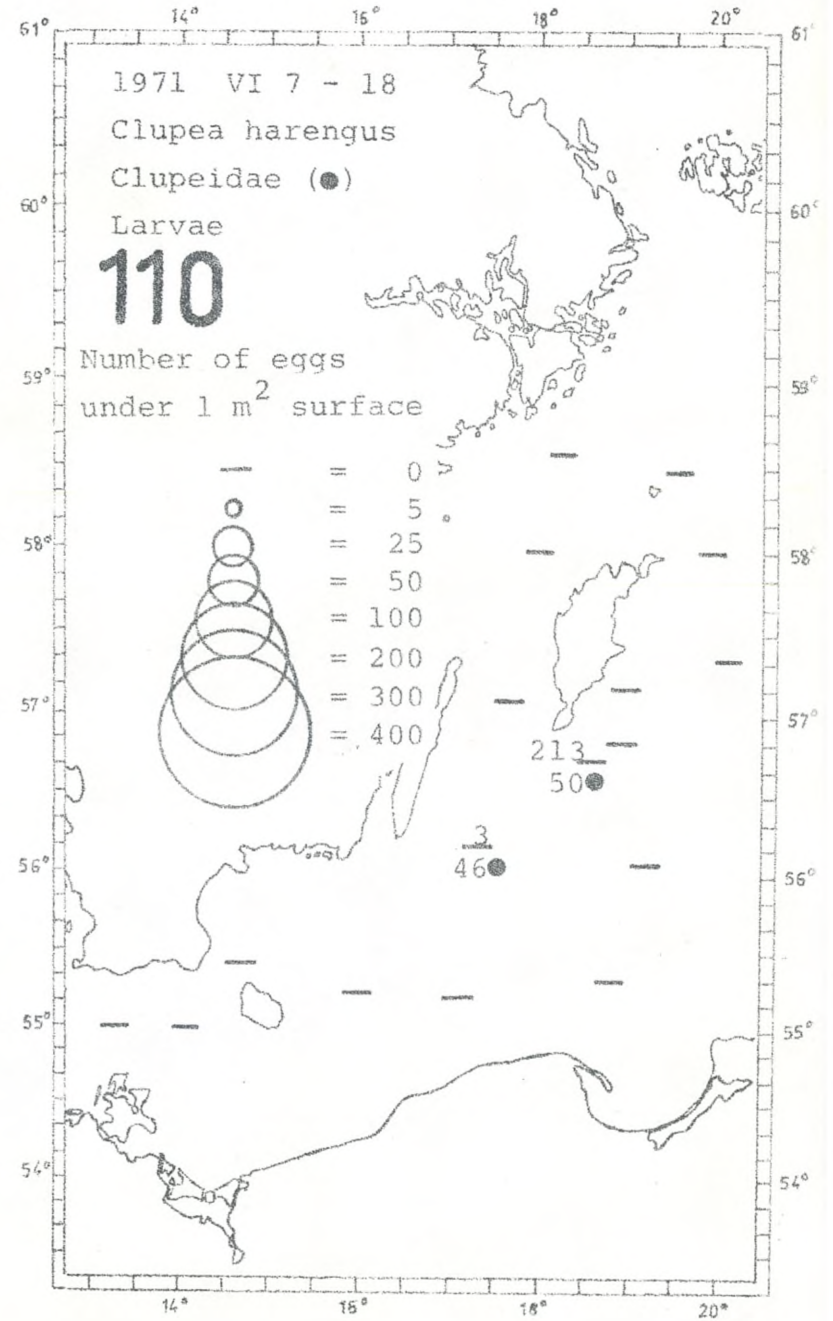

1967 V 26 - VI 7
Clupea harengus
Larvae
105
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
1

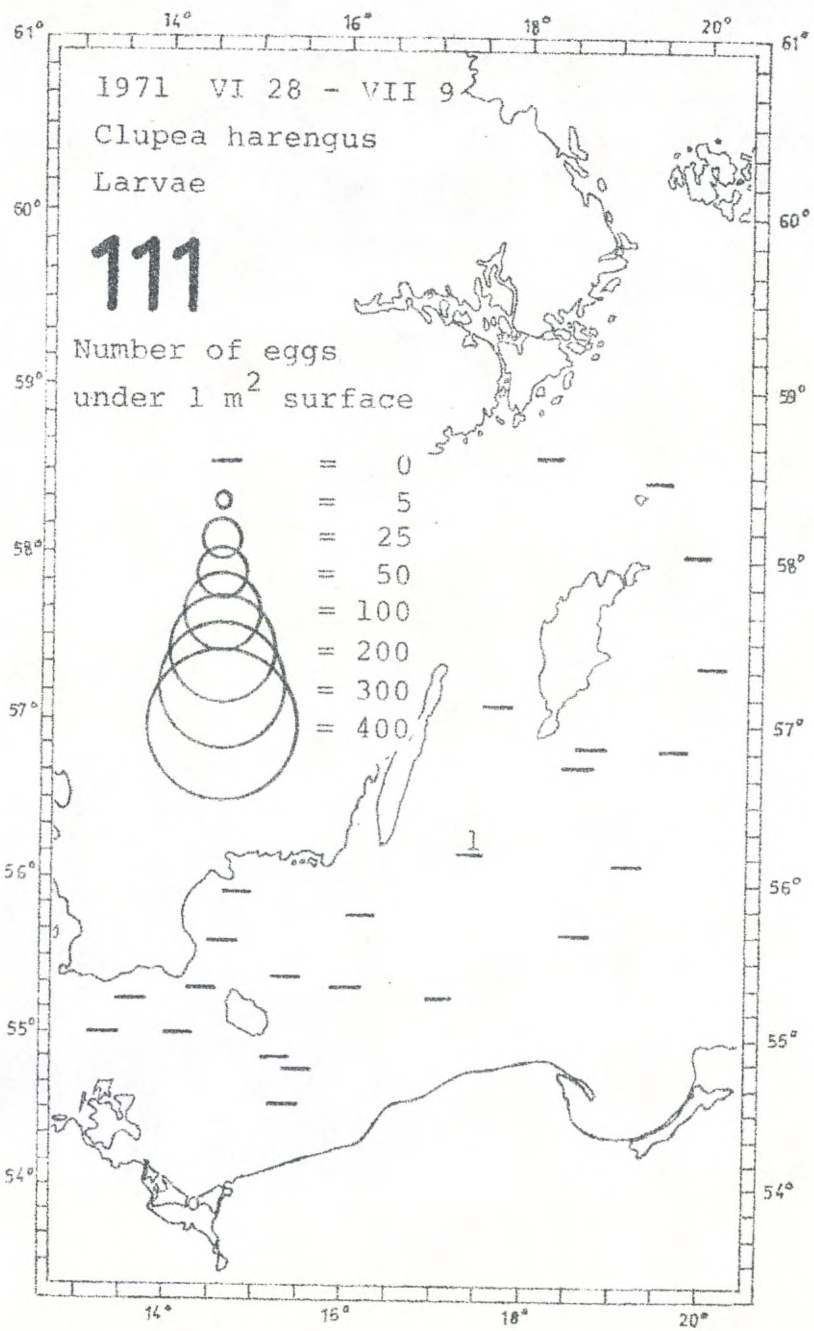

1967
XI 15
Clupea
harengus
Larvae
106
1
5

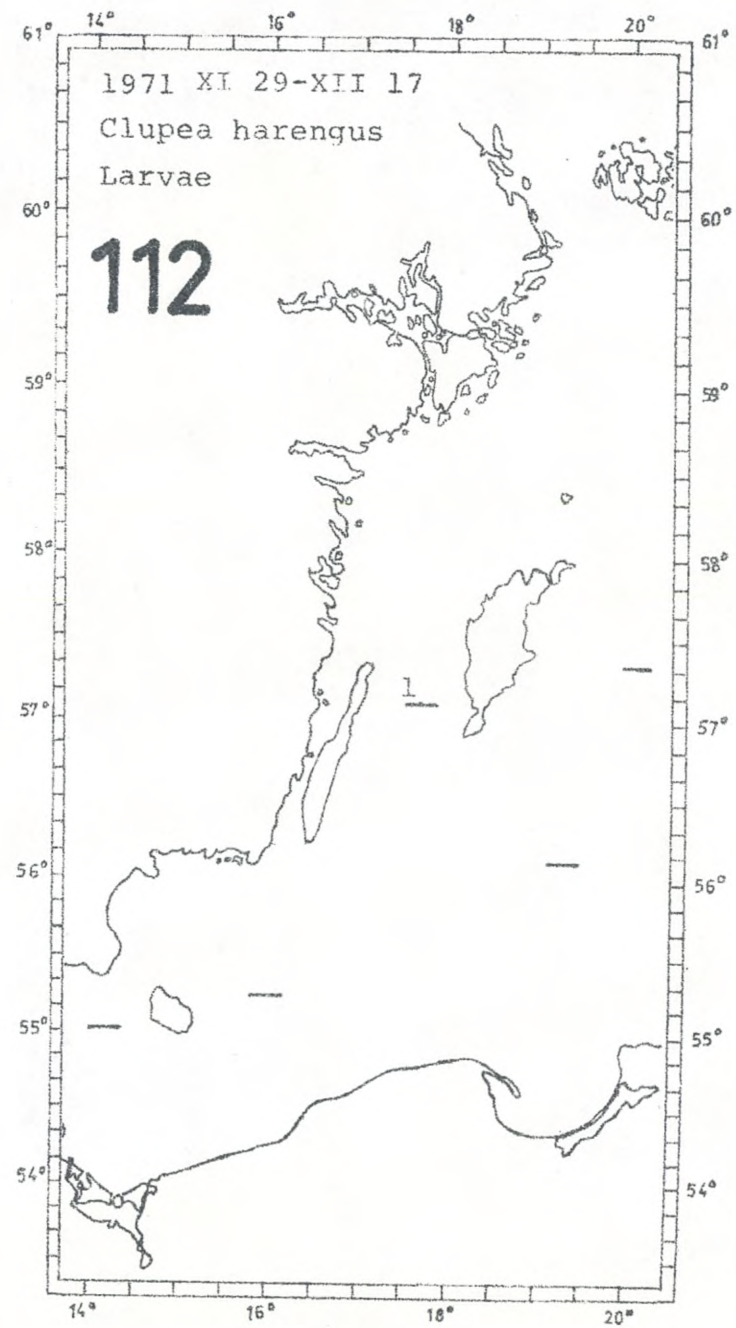

1968 XI 27-XII 11
Clupea harengus
Larvae
107
1

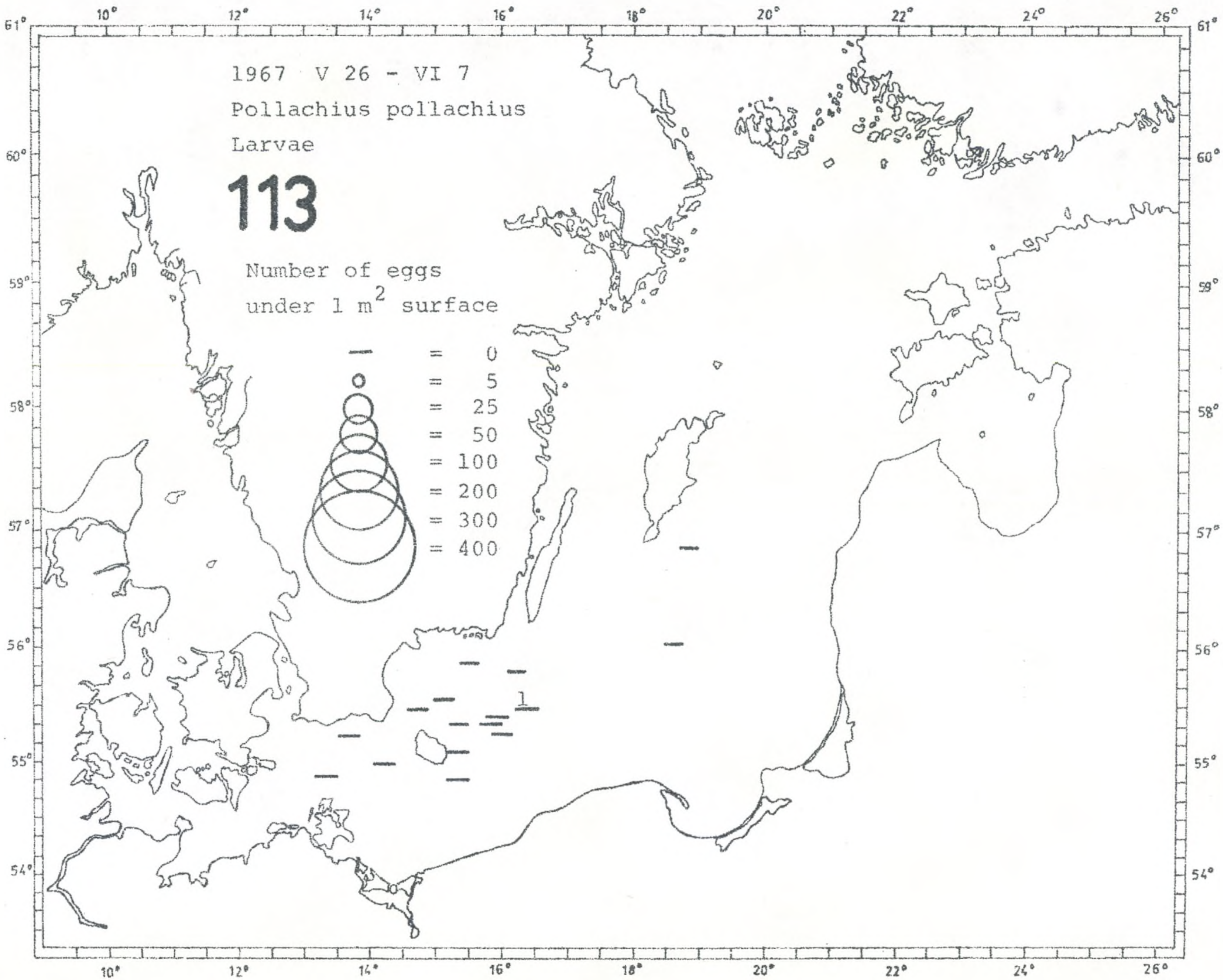

1970 I 12 - 29
Clupea harengus
Larvae
108
1

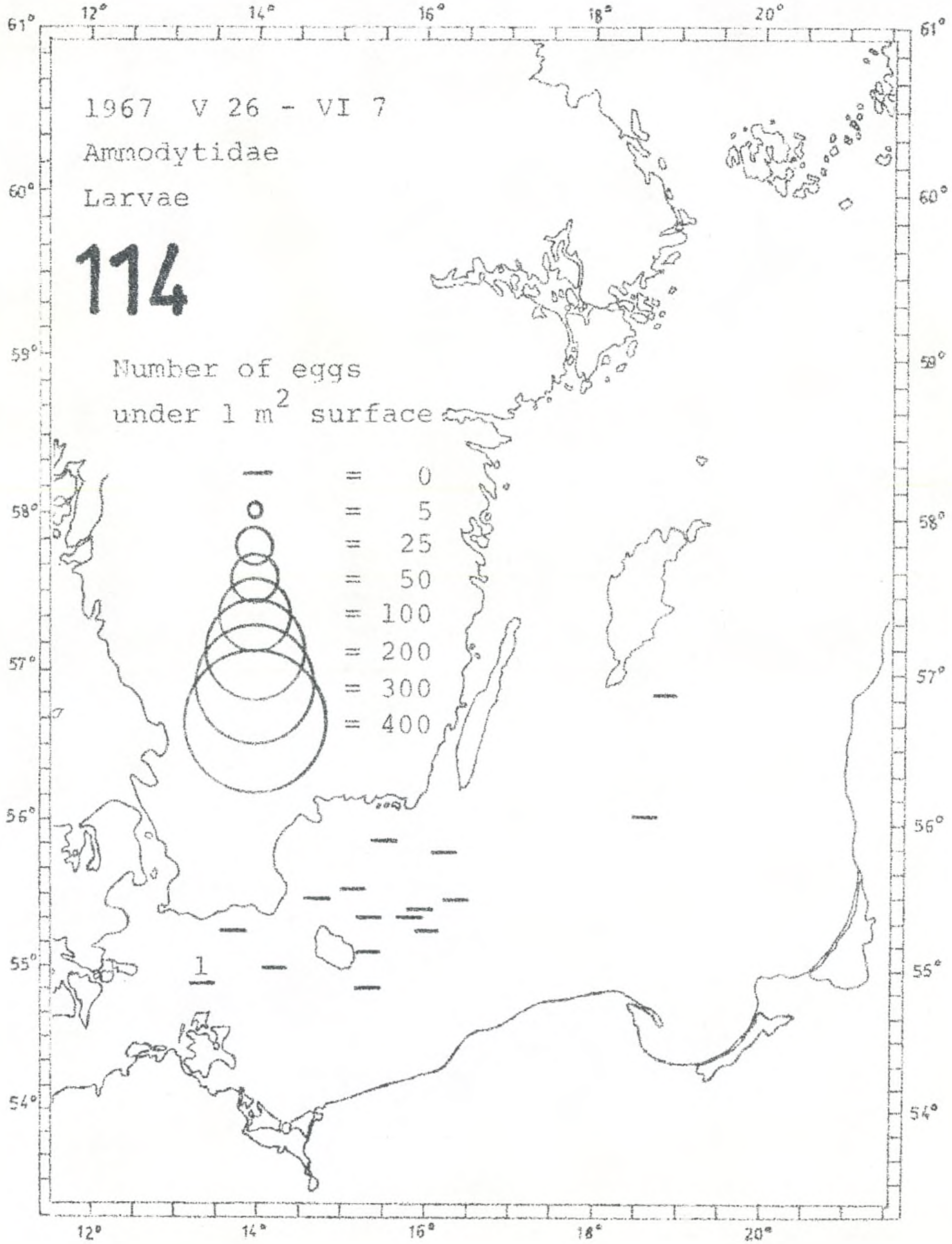

1970 XI 9-27
Clupea harengus
Larvae
109
1

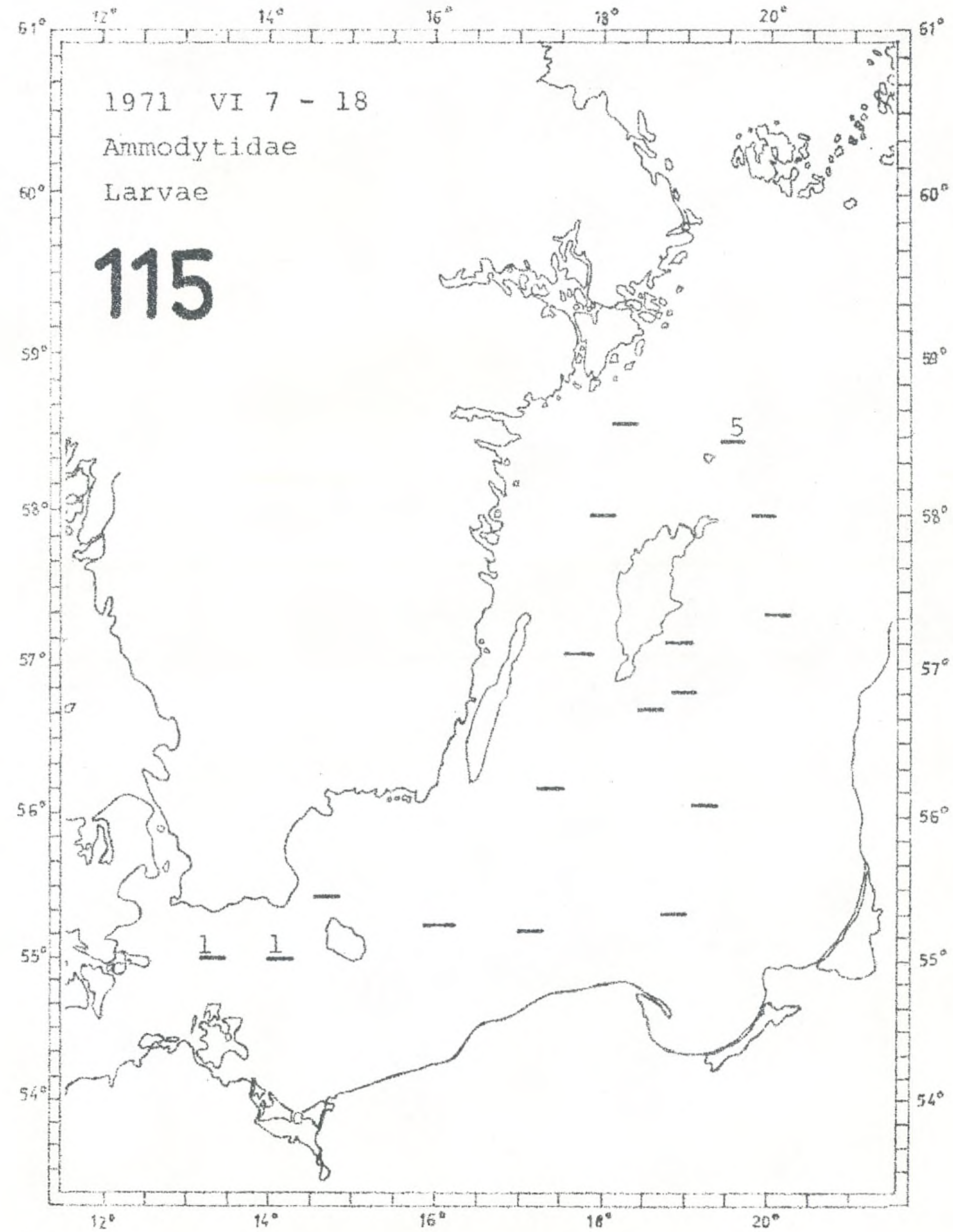

1971 VI 7 - 18
Clupea harengus
Clupeidae (●)
Larvae
110
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
213
50
3
46

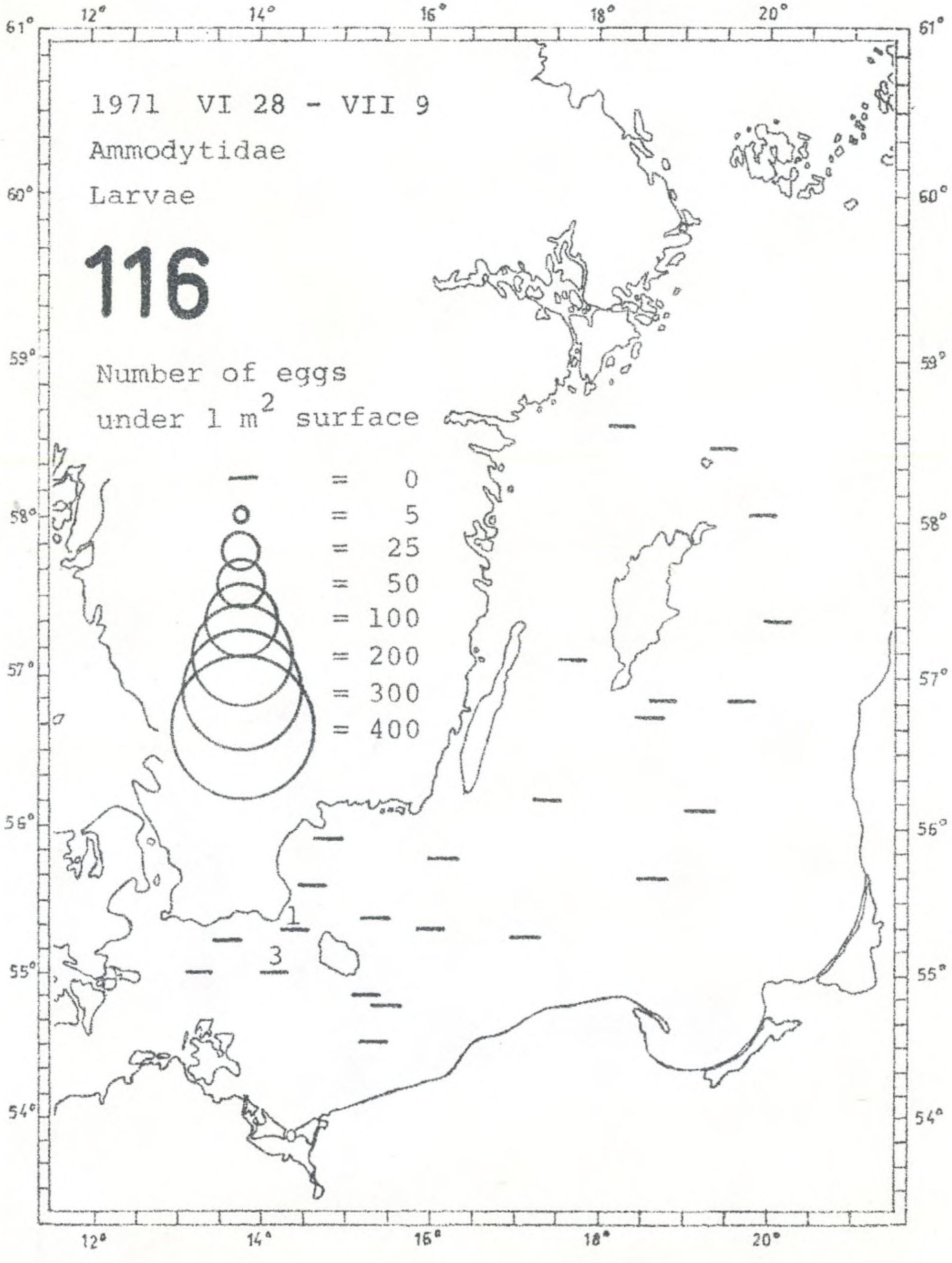

1971 VI 28 - VII 9
Clupea harengus
Larvae
111
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
1


1971 XI 29-XII 17
Clupea harengus
Larvae
112
1

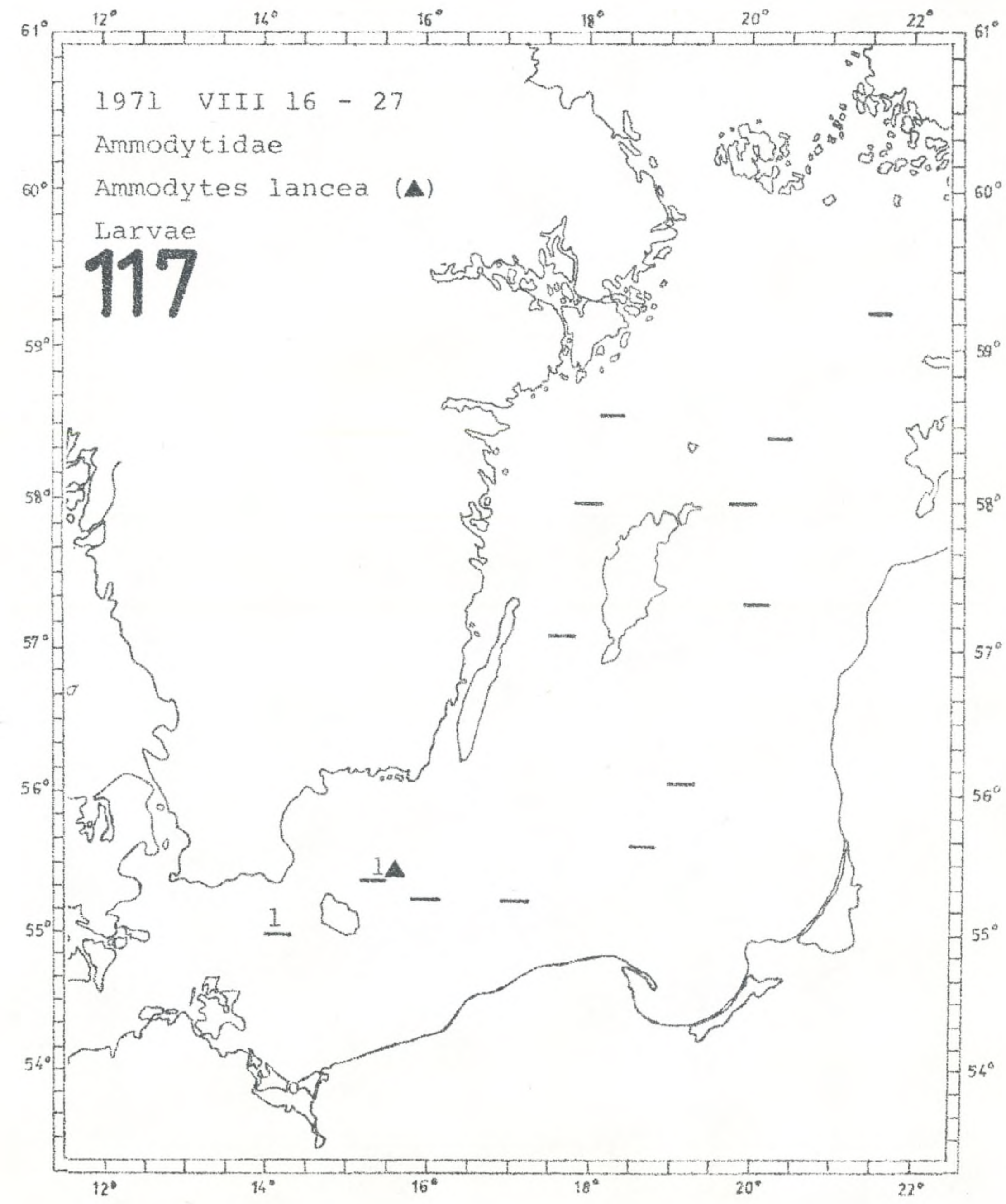

1967 V 26 - VI 7
Pollachius pollachius
Larvae
113
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
1
10°
12°
14°
16°
18°
20°
22°
24°
26°
54°
55°
56°
57°
58°
59°
60°
61°


1967 V 26 - VI 7
Ammodytidae
Larvae
114
Number of eggs
under 1 m² surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
1
12°
14°
16°
18°
20°
54°
55°
56°
57°
58°
59°
60°
61°

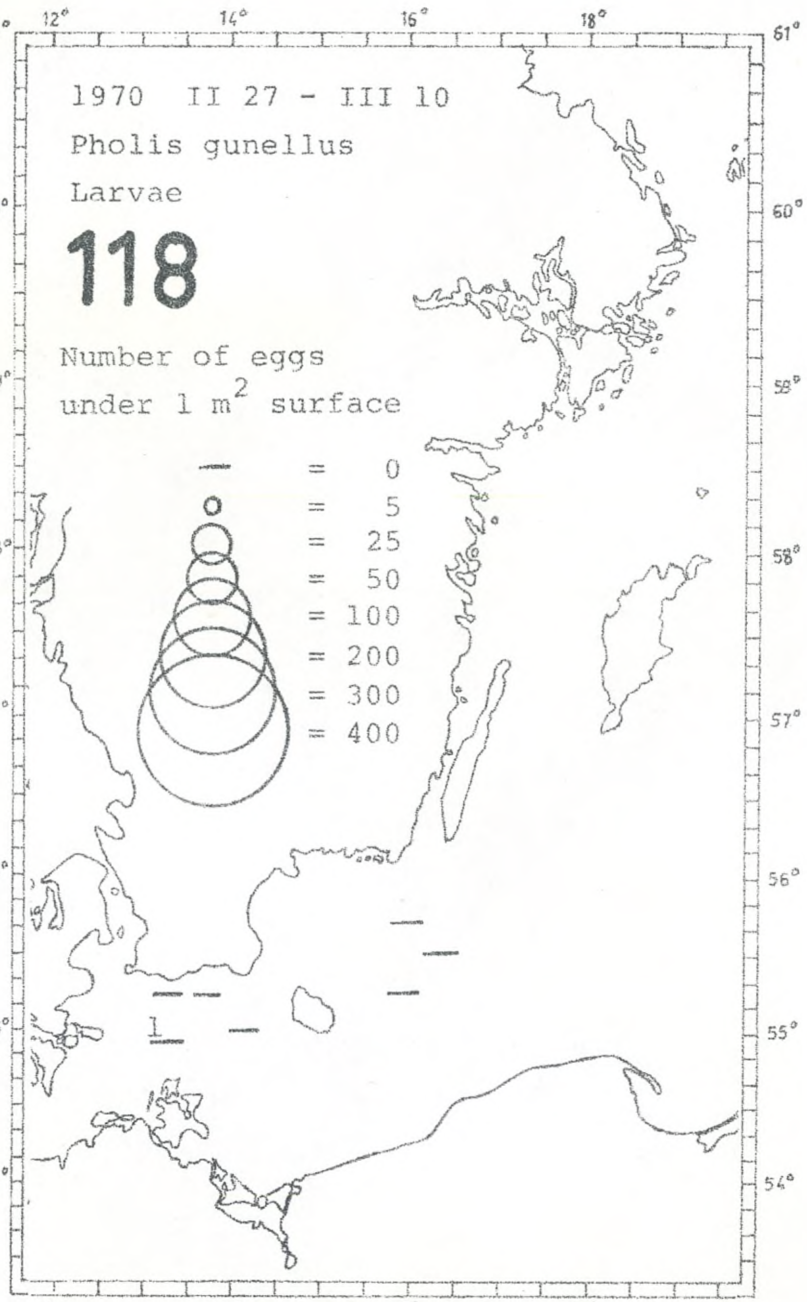

1971 VI 7 - 18
Ammodytidae
Larvae
115
5
1
1
12°
14°
16°
18°
20°
54°
55°
56°
57°
58°
59°
60°
61°

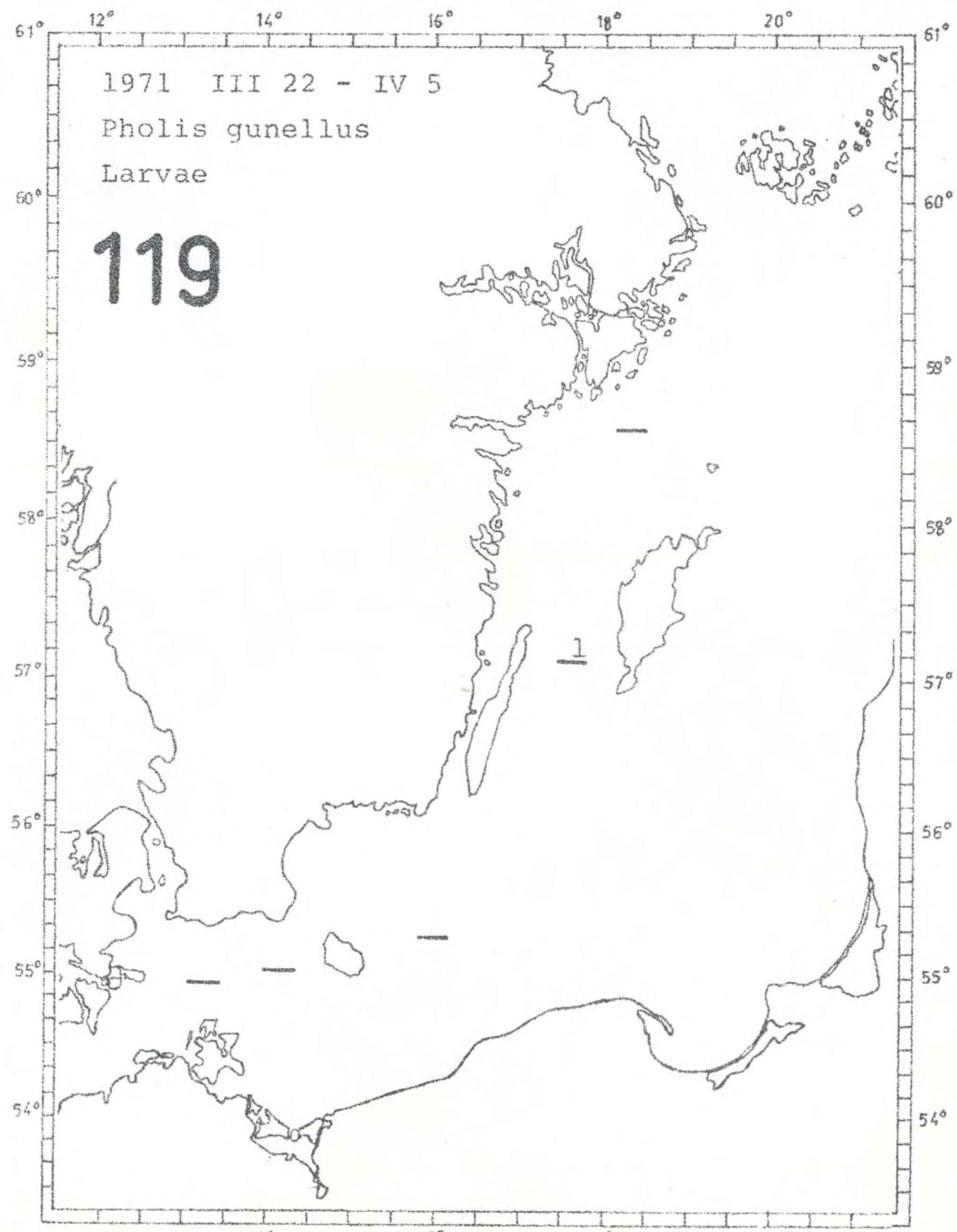


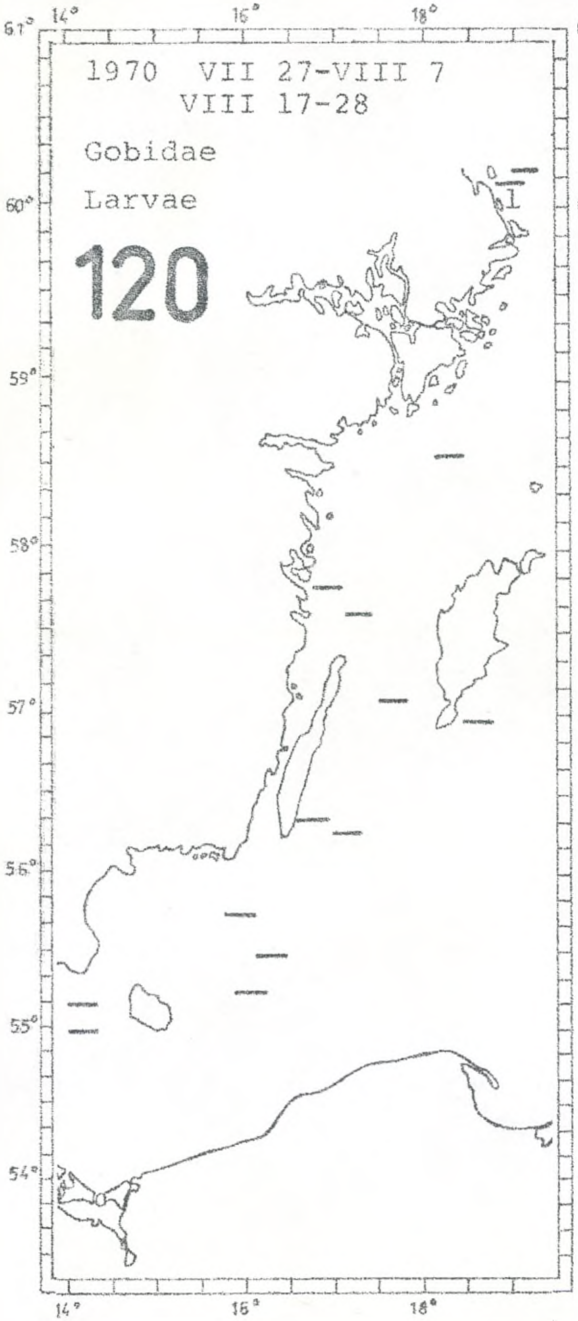
1971 VI 28 - VII 9
Ammodytidae
Larvae
116
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
1
3

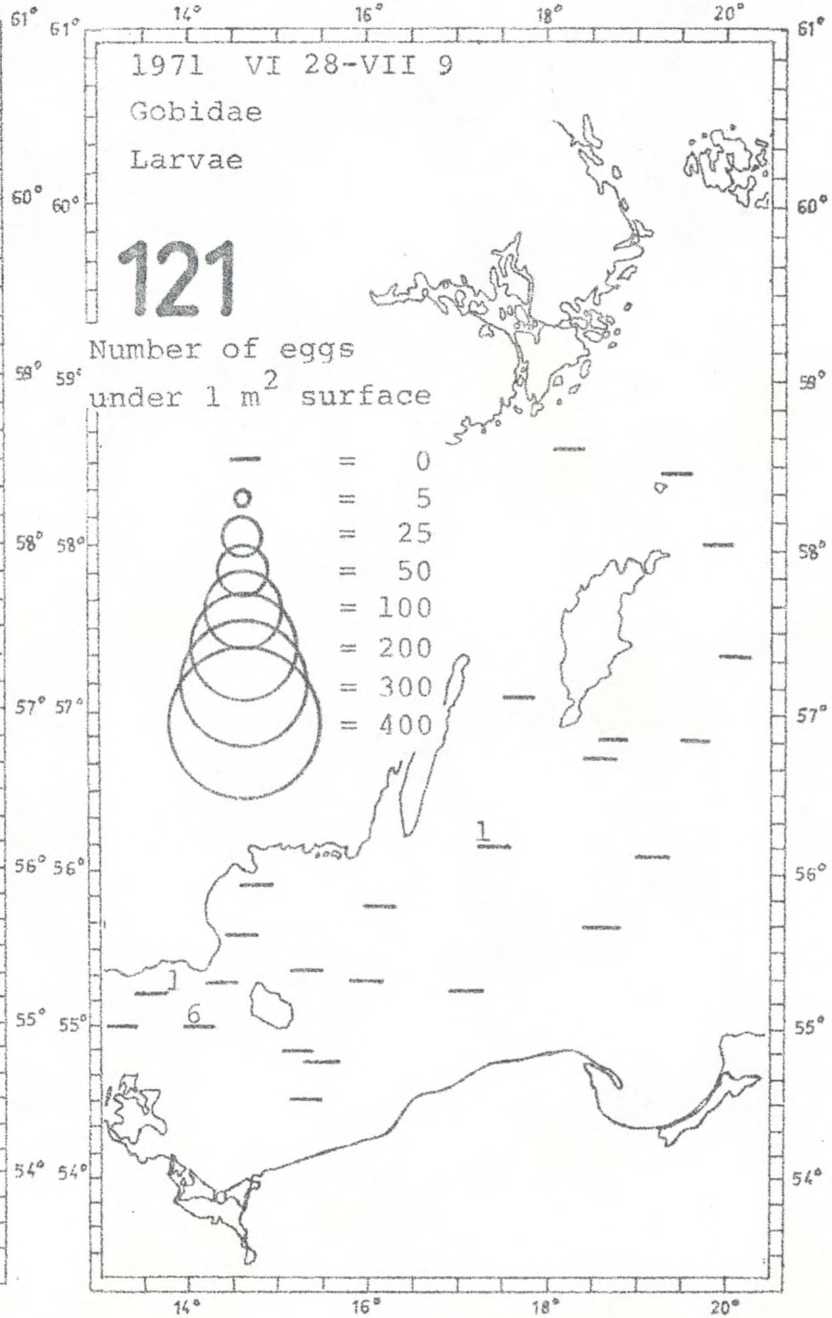


1971 VIII 16 - 27
Ammodytidae
Ammodytes lancea (▲)
Larvae
117
1
1

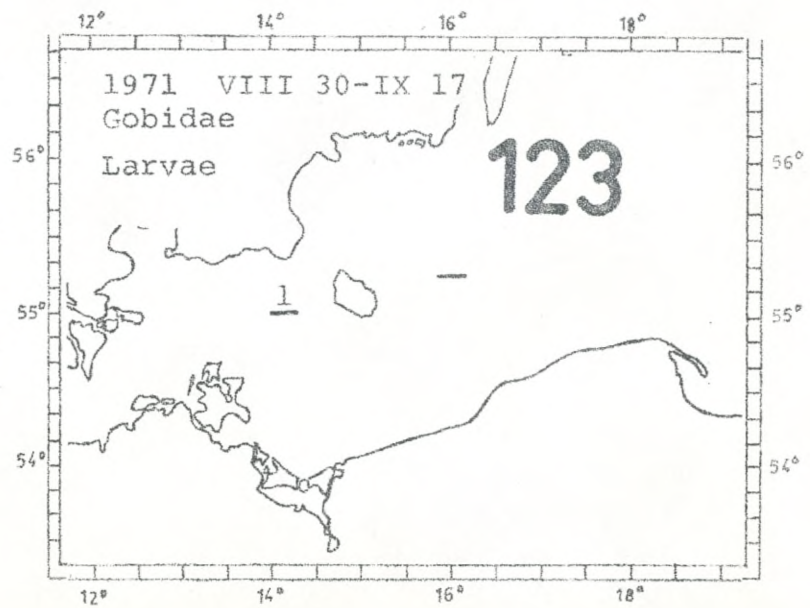

1970 II 27 - III 10
Pholis gunellus
Larvae
118
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
1
12°
14°
16°
18°
54°
55°
56°
57°
58°
59°
60°
61°

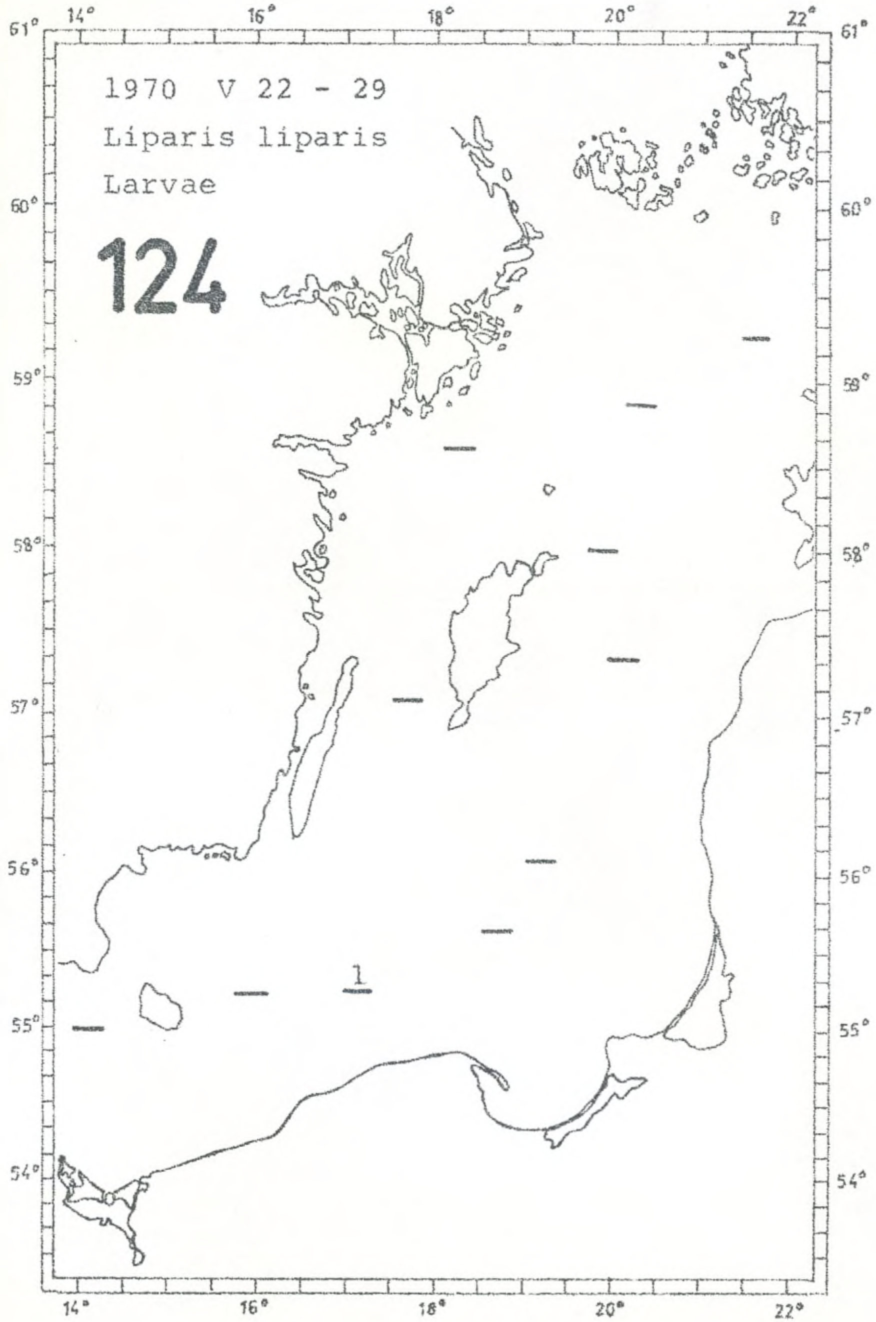

1971 III 22 - IV 5
Pholis gunellus
Larvae
119
1
12°
14°
16°
18°
20°
54°
55°
56°
57°
58°
59°
60°
61°

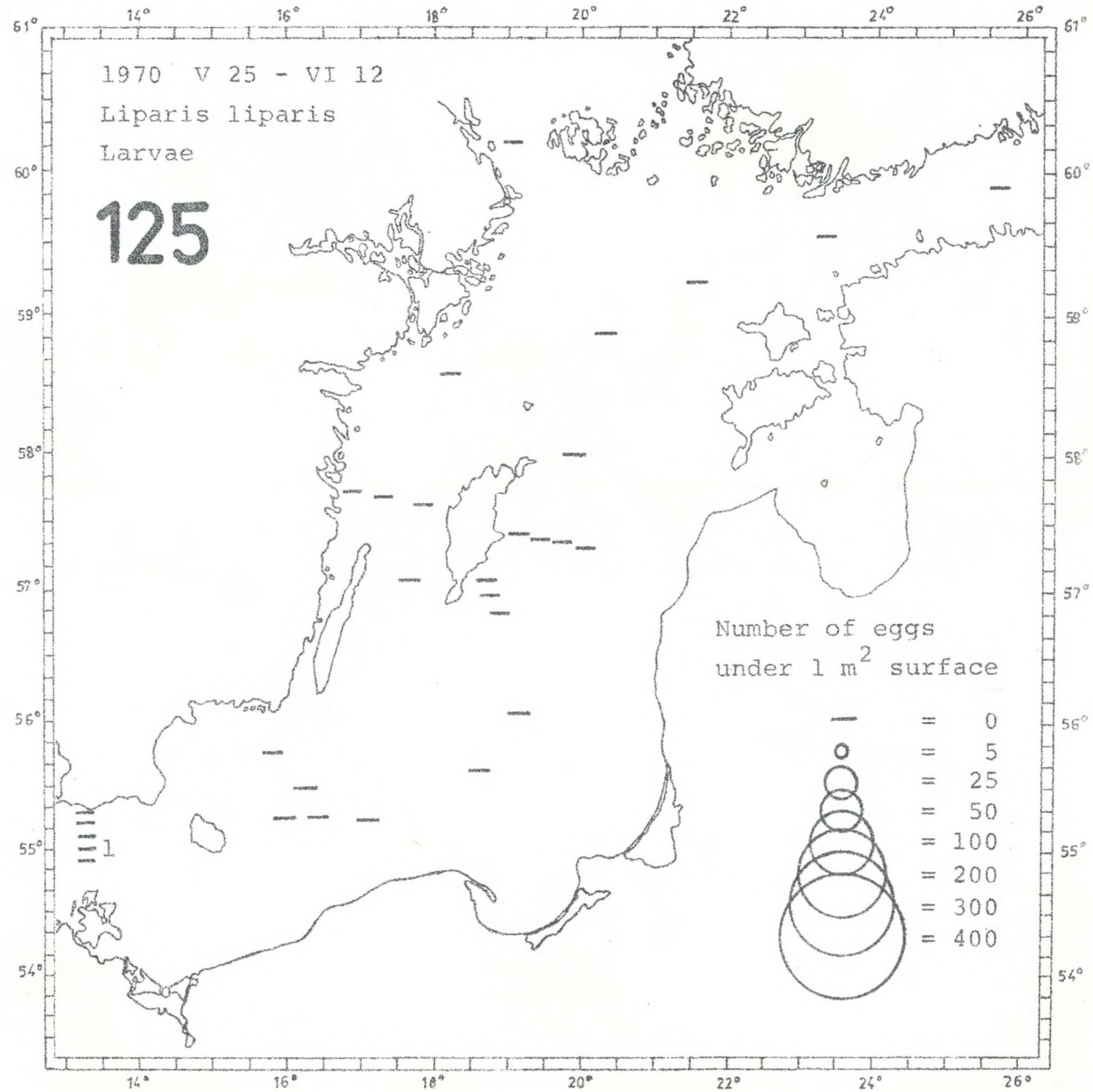

1970 VII 27-VIII 7
VIII 17-28
Gobidae
Larvae
120
1

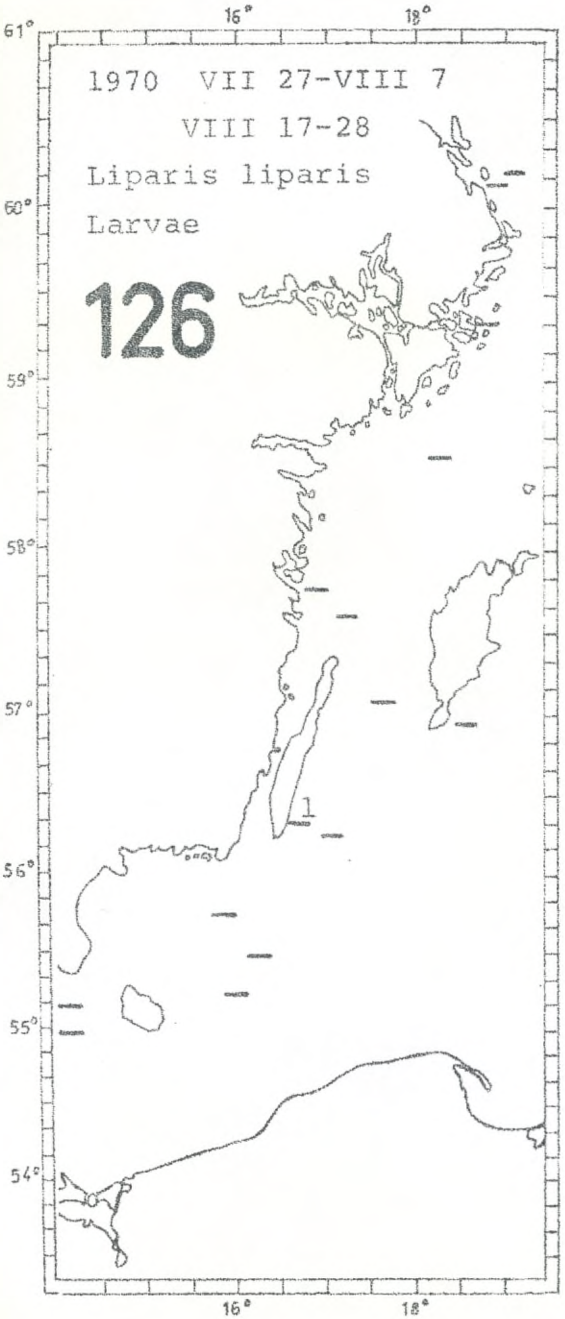

1971 VI 28-VII 9
Gobidae
Larvae
121
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
1
1
6

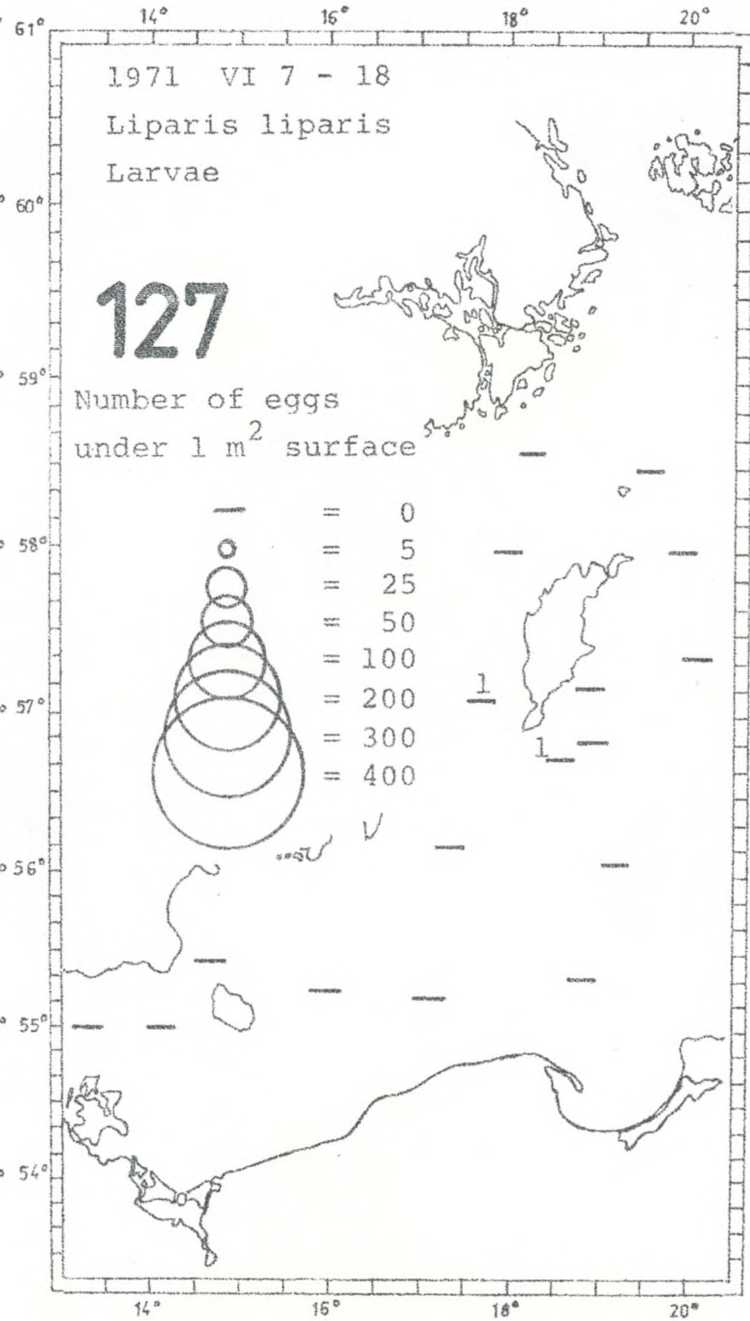

1971 VIII 16 - 27
Gobidae
Larvae
122
1
3

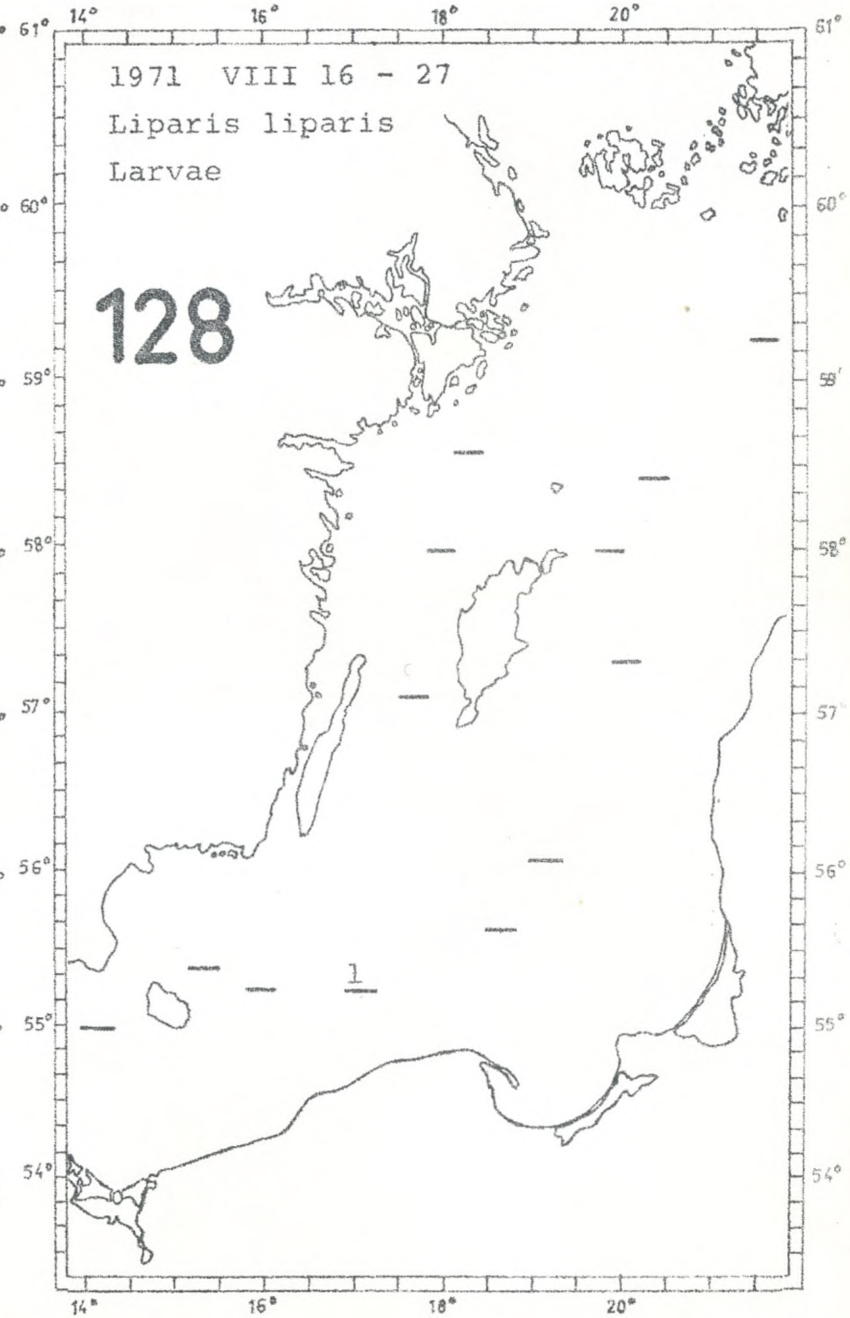

1971 VIII 30-IX 17
Gobidae
Larvae
123
1

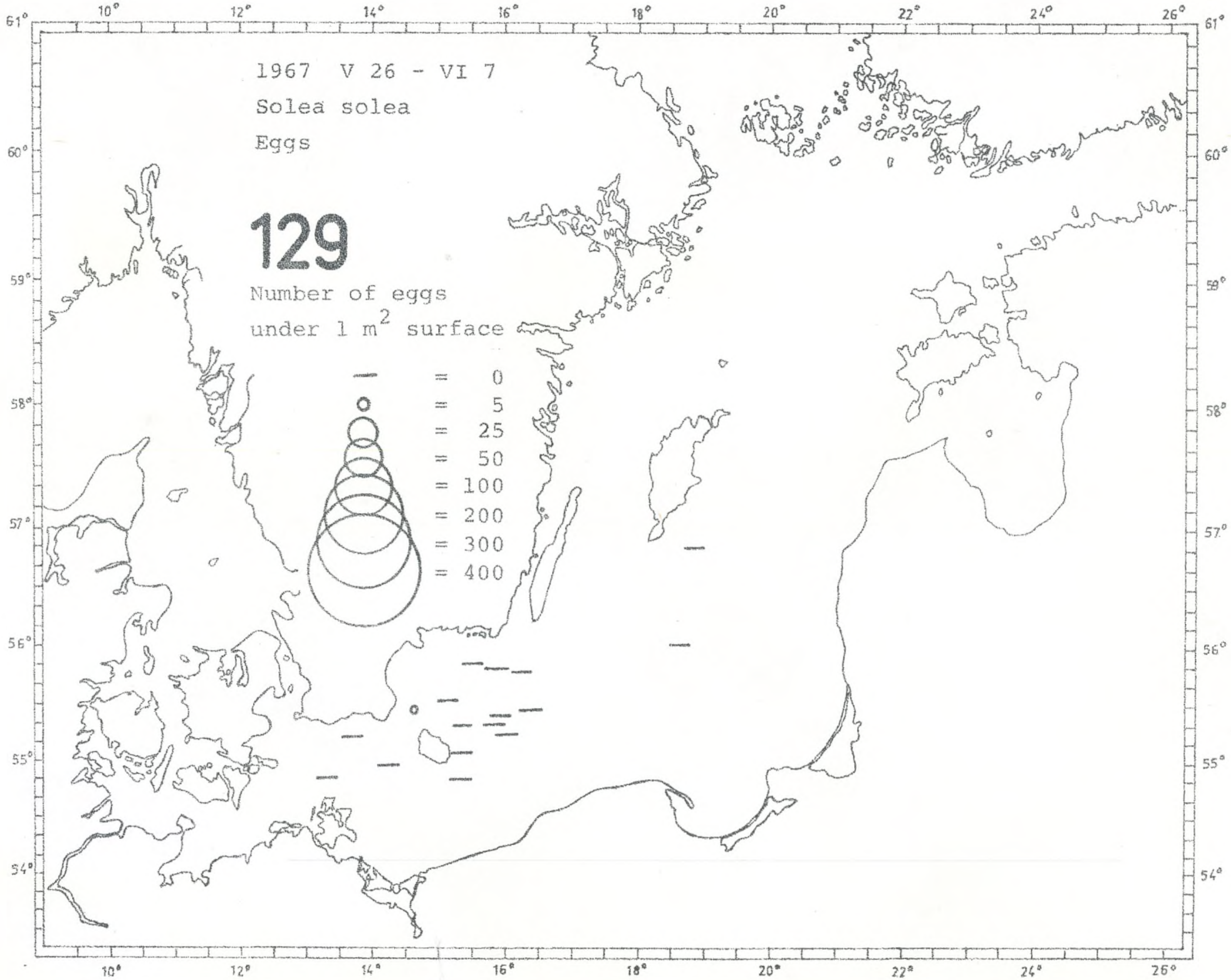

1970 V 22 - 29
Liparis liparis
Larvae
124
1


1970 V 25 - VI 12
Liparis liparis
Larvae
125
1
Number of eggs
under 1 m² surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400


1970 VII 27-VIII 7
VIII 17-28
Liparis liparis
Larvae
126
1


1971 VI 7 - 18
Liparis liparis
Larvae
127
Number of eggs
under 1 m² surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
1
1


1971 VIII 16 - 27
Liparis liparis
Larvae
128
1


1967 V 26 - VI 7
Solea solea
Eggs
129
Number of eggs
under 1 m2 surface
= 0
= 5
= 25
= 50
= 100
= 200
= 300
= 400
10°
12°
14°
16°
18°
20°
22°
24°
26°
54°
55°
56°
57°
58°
59°
60°
61°