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Spring plankton surveys of the Irish Sea in 2000: hydrography and the distribution of fish eggs and larvae

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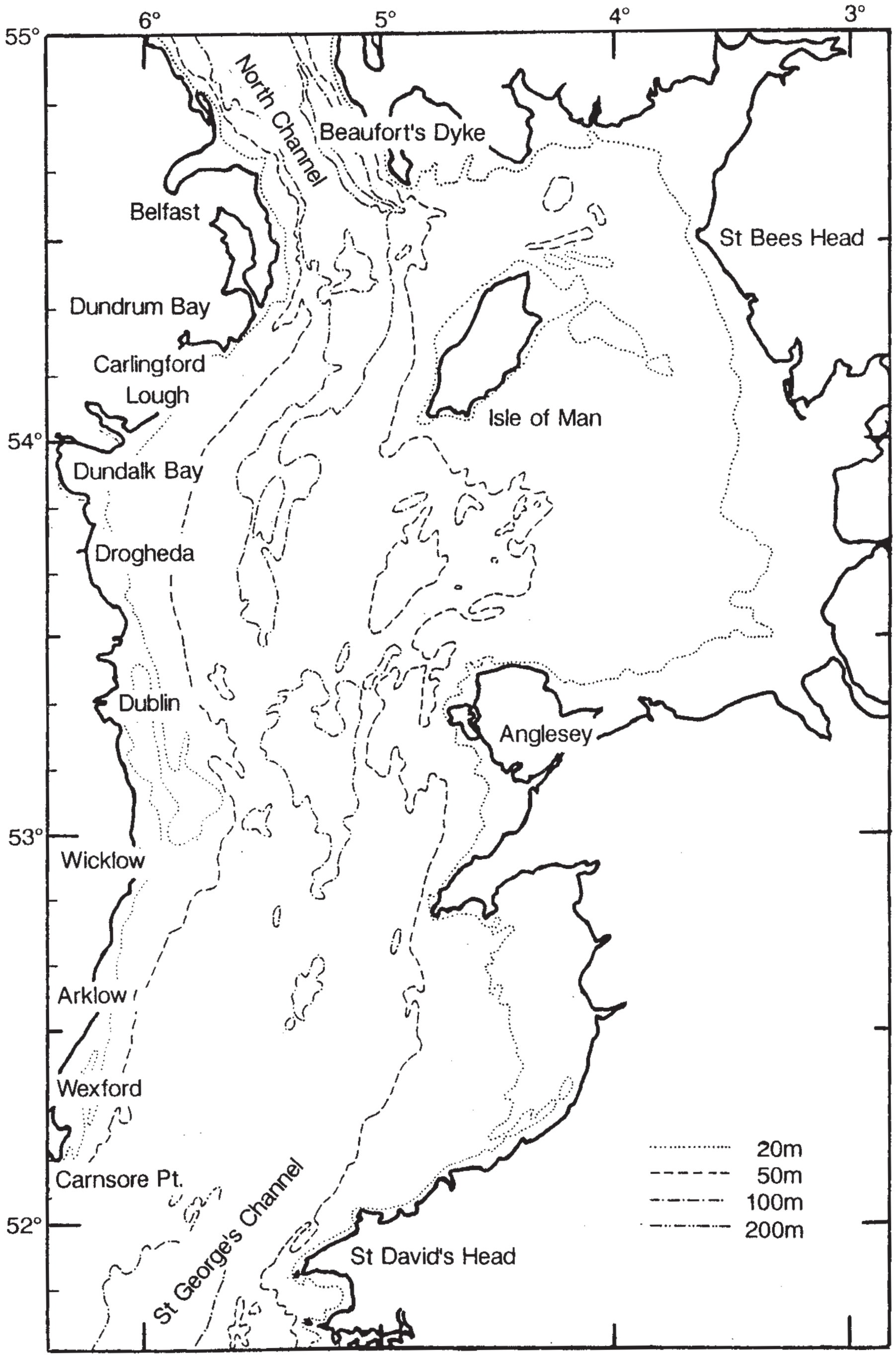


Bathymetry of the Irish Sea (adapted from Dickson and Boelens, 1988)

1. INTRODUCTION

Between January and May of 2000 a series of plankton surveys were carried out in the Irish Sea as part of a programme to further develop the Annual Egg Production Method for estimating spawning stock biomass, using cod and plaice as the target species (Armstrong *et al*., 2002). The surveys were partly funded by the European Commission (Contract 1998/090). Five research institutes took part: The Centre for Environment, Fisheries and Aquaculture Science (CEFAS), The Queen's University of Belfast (QUB)/Department of Agriculture and Rural Development for Northern Ireland (DARDNI, formerly Department of Agriculture for Northern Ireland), Marine Institute Abbotstown, Dublin (MIA), University of Liverpool, Port Erin Marine Laboratory (PEML) and University College, Dublin (UCD). Eggs and larvae from the target species were sorted and identified as part of the EC Contract programme. Several of the participants also analysed the eggs and larvae of all remaining fish species.

2. SURVEY COVERAGE

Table 1 summarises the timing of the eight surveys. A grid covering the northern Irish Sea from 53°N to 55˚N and from 3°W to 6° 15´W was surveyed at approximately three-weekly intervals. The sampling grid was planned to include, both temporally and spatially, the major part of the spawning of cod and plaice. The design was based on the patterns of abundance and distribution of the eggs of these two species in the Irish Sea in previous years (Nichols *et al*., 1993; Armstrong *et al*., 1997; Fox *et al*., 1997; Fox *et al*., 2000).

For a brief overview of the geography and major hydrographic features of the region see Nichols *et al*. (1993), OSPAR (2000).

3. SAMPLING METHODS AND EQUIPMENT

3.1 Shipboard plankton sampling

A Gulf VII high-speed plankton sampler was used as standard on these surveys (Nash *et al*., 1998). This sampler design has a 76 cm diameter un-encased body fitted with a conical nosecone of 40 cm diameter aperture. The body of the net was made of 270 µm mesh as standard. The cod-end consisted of a bag constructed from an impermeable nylon material and incorporating a window of 270 µm mesh net that allowed the water to escape. This configuration was designed to minimise damage to the eggs and larvae by providing maximum protection during collection.

The sampler deployed by CEFAS was fitted with a 'Guildline' conductivity, temperature, depth (CTD) sensor unit (Guildline Instruments Ltd., Smiths Falls, Ontario, Canada). A 'Valeport' flowmeter (blade diameter 12.5 cm) was centrally mounted inside the nosecone (Valeport Ltd., Totnes, Devon, U.K.). A similar flowmeter was mounted externally on the frame to provide a measure of distance travelled through the water. The ratio between internal and external flowmeter revolutions provided an index of clogging of the net, and enabled the volume of water filtered on each deployment to be calculated.

The Gulf VII design has been extensively calibrated over a range of speeds and simulated clogging

Table 1. Details of icthyoplankton surveys carried out in the Irish Sea in 2000

Date	Vessel	Number of stations sampled	Institute
23 Jan - 1 Feb	RV Lough Foyle	101	QUB/DARD
13 - 20 Feb	RV Corystes	104	CEFAS
29 Feb - 7 Mar	RV Lough Foyle	82	QUB/DARD
20 - 29 Mar	RV Celtic Voyager	94	MIA
7 - 10 Apr	RV Celtic Voyager	60 (western Irish Sea)	MIA
	RV Cirolana	49 (eastern Irish Sea)	CEFAS
19 - 25 April	RV Cirolana	105	CEFAS
8 - 15 May	RV Celtic Voyager	104	MIA
16 - 21 May	RV Lough Foyle	105	QUB/DARD

conditions, either in a large circulating water channel or a towing tank (Harding and Arnold, 1971; Arnold *et al*., 1990; Brander *et al*., 1993). From these experiments co-efficients were obtained for the regression:

$$y = a*x + b$$

where, y = volume filtered (litres per internal flowmeter count),
x = ratio of internal to external flowmeter counts,
a = -101.44
and b = 225.52.

These data were used to calculate the volume filtered during each sampler deployment.

The samplers deployed by DARD and MIA used a 'PRO-NET' (Spartel Ltd., Totnes, Devon, U.K.) CTD package. Integral software was used to compute the volume of water filtered during each deployment. Water flow was calculated for both internal and external flowmeters using different regression co-efficients:

$$y = a*x + b$$

where, y = water speed (ms-ı),
x = flowmeter frequency (Hz),
a = 0.0806 for the internal flowmeter and 0.107 for the external flowmeter,
and b = intercept adjusted for each system to allow for slightly different electrical characteristics of each circuit. Typical values for both internal and external flowmeters were 0.005.

Filtered volume was computed by multiplying the speed past the internal flowmeter by the area of the nosecone aperture.

Where clogging occurred (i.e. where the ratio of internal to external flowmeters fell below 0.6), the 270 µm mesh nets were replaced with larger 400 µm mesh ones. If clogging continued to be a problem, a 30 cm diameter aperture nosecone was used.

Samplers were deployed in a double oblique tow, at 4-5 knots, from the surface to within 2 metres of the bottom (or as near as bottom topography would allow) and returned to the surface. The requirement was for an even, 'V' shaped dive profile, filtering the same volume of water per unit of depth. The aim was to shoot and haul at the same rate with the sampler spending 10 seconds in each 1 metre depth band. At shallow stations, more than one double-oblique dive was necessary to enable a sufficient volume of water to be filtered. It was recommended that the sampler remained in the water for a minimum period of 15 minutes.

Temperature/salinity/depth profiles were obtained at each sampling position from the CTD sensors mounted on the frame of the plankton samplers. Salinity bottle samples were taken at regular intervals from the near surface to maintain a check on the quality of the salinity data.

3.2 Preservation of samples

Upon recovery of the sampler, the net was gently washed down from the outside with seawater. The end-bag was removed and the plankton washed into a jar and fixed using buffered formaldehyde solution (4% formaldehyde in distilled water buffered with 2.5% sodium trihydrate (w/v), (Tucker and Chester, 1984). The samples were transported to the participating laboratories for plankton sorting and identification.

3.3 Identification of fish eggs and larvae

Fish eggs and larvae were picked out of all the samples using low power microscopes and whenever practicable the whole sample was sorted. However, sub-sampling was at times necessary. Sub-sampling was carried out using a Folsom splitter and a fraction of the sample (for example ⅛, ¼ or ½) was worked up as appropriate.

Ichthyoplankton from these surveys were identified according to Russell (1976). This was supplemented by various identification guides and keys produced by the International Council for the Exploration of the Sea, (Saville, 1964; Macer, 1967; Nichols, 1971; Demir, 1976; Nichols, 1976). Fish eggs were initially split into groups on the basis of presence or absence of oil globules. Those containing either a single or many oil globules could usually be identified to the species level. Eggs with no oil globules are more difficult to separate, particularly in the early stages before embryonic pigmentation develops. Figure 1 shows the numbers of measured eggs without oil globules at different sizes from each survey. Included are the eggs that were assumed to be cod (or cod-like). The frequencies are distinctly bi-modal for the period from mid-February to the end of April. The peak occurring around 0.8 mm diameter is likely to consist of eggs from species such as dab (*Limanda limanda*) and to a lesser extent flounder (*Platichthys flesus*). Eggs measuring from about 1.0 to 1.2 mm in diameter cover a larger range of species including cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), whiting (*Merlangius merlangus*), witch (*Glyptocephalus cynoglossus*) and others. In May the range of egg diameter was widest and the bi-modal distribution less pronounced. Fish larvae were generally easy to identify unless they had been badly damaged during collection. For some groups such as the sandeels (Ammodytidae) and the rocklings (Gadidae), individuals were not identified to the species level.

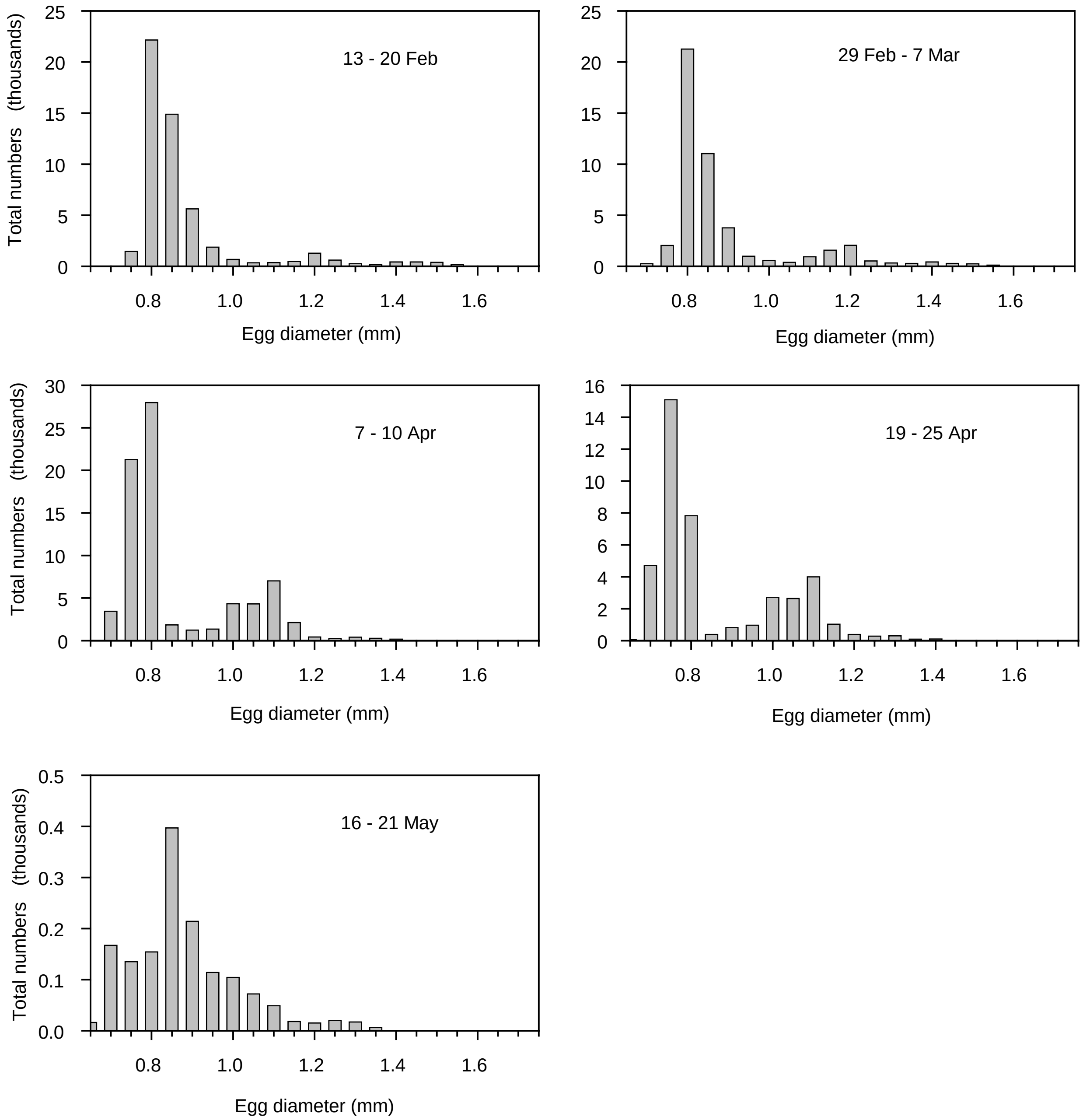


Figure 1. Size-frequencies of measured unidentified eggs in 2000

For samples collected on *RV CELTIC VOYAGER* (Table 1), 'cod-like' eggs were analysed and these data are incorporated into Figure 1. Late-stage eggs of cod and haddock and plaice eggs were also positively identified.

3.4 Data Analysis and data storage

Plankton data were expressed as number of organisms m^{-3} by dividing the numbers per sample by the volume filtered. The plankton distributions in this report are plotted as numbers m^{-2} of sea surface, obtained by multiplying the number m^{-3} by the sampled depth during deployment. Numbers m^{-2} of sea surface were plotted as bubbles on the same linear scale for a species for all the surveys. Bubble diameter is linearly related to numbers m^{-2} above a non-zero baseline of 0.1 m^{-2} (Surfer version 8, Golden Software Inc., Colorado, U.S.A.). Hydrographical data was plotted as contour maps using the same software. Values were obtained from the CTD data recorded during each sampler deployment. The full dataset is stored on ACCESS (Microsoft Inc.) databases held at the institutions that took part in the surveys.

4. RESULTS

4.1 The physical environment

The bathymetry and oceanography of the Irish Sea have been extensively described (Robinson, 1979; Bowden, 1980; Proctor, 1981; Dickson and Boelens, 1988; OSPAR, 2000). However, because the physical environment plays such an important role in determining the biological processes, a brief account is included here. The Irish Sea is characterised by a deep water trough (>80 m) running centrally between the Irish coast and following a line from the southern tip of the Isle of Man to the west of Anglesey. The trough continues northwards through the North Channel reaching a depth of 315 m at Beauforts Dyke. In the central area the trough shallows rapidly to the west whilst to the east it slopes more gently to create a relatively shallow bay (<50 m deep) bordered by the North Wales, English and Scottish coasts (eastern Irish Sea).

Details of the circulation and tidal movements within the Irish Sea can be found in Ramster and Hill (1969), Simpson and Hunter (1974), Slinn (1974), Heaps and Jones (1977), Bowden (1980), Davies and Jones (1992), Hill *et al.* (1994), OSPAR (2000), Young *et al.* (2001). In most of the region, tidal mixing is sufficiently strong to maintain a vertically homogeneous water column throughout the year. An exception to this is the area to the southwest of the Isle of Man where the water is deep and the tidal flows weak. A seasonal stratification is established in this area between April and October that leads to a density driven gyre. In the eastern Irish Sea, haline stratification is marked in winter and spring, especially near the main river inputs, but thermal stratification may develop in the summer.

Sea surface temperature distributions for the Irish Sea surveys in 2000 are shown in Figure 2. Lowest temperatures (down to 6°C) were recorded from mid-February to early March off the English coast. The warmest water, between 7.5 and 8ºC, occurred in the southwestern Irish Sea. Temperatures increased slowly during March and April, reaching a maximum of 8.5ºC. However by the first survey in May, just two or three weeks later, temperatures had risen by an average of 2ºC, and by 4ºC in the waters off the Irish and English coasts. Patterns in bottom temperature were more or less identical to surface values from January through to April (Figure 3) indicating that the water column was well mixed across the region. By May, surface and bottom temperatures remained comparable in the eastern Irish Sea, but differed in the western Irish Sea by about 1ºC. This is consistent with the expected pattern of thermal stratification in this region. Integrated temperatures (temperature averaged over the whole water column) are shown in Figure 4.

The patterns of surface salinity distribution (Figure 5) show a tongue of higher salinity (34) that persisted throughout the survey period over the deeper water of the western Irish Sea. Surface salinities in the eastern part were less than 33.5. Off the English coast in February and March salinity was as low as 31. Surface, bottom and integrated salinity patterns were very similar implying little large-scale haline vertical structure (Figures 5-7).

4.2 The ichthyoplankton

In 2000, fish eggs from 21 species and larvae from 33 species were identified. A further 3 groups of eggs and 7 groups of larvae were, for practical reasons, identified to the family or genus level only (e.g. Rocklings, *Trigla* spp., Ammodytidae, Gobiidae). Clupeoid larvae were not routinely identified to species, but the majority were most likely sprat and for the purposes of presentation they have been grouped together. All species and taxonomic groups are listed in Tables 2 (a-d). These tables also record the maximum density of eggs and larvae found on each survey and their occurrence as a percentage of the stations where a positive record was obtained. Figures 10 to 57 map the egg and larval distributions for each identifiable species by survey. For surveys carried out on *RV CELTIC VOYAGER*, data by species are unavailable for eggs and larvae other than plaice eggs and late-stage eggs of cod and haddock. Shaded areas represent these surveys.

4.2.1 The distributions of total eggs and total larvae (Figures 8 and 9)

Fish eggs were found from January through to May at the majority of positions surveyed. Numbers gradually increased over the area reaching a peak at the beginning of March, in particular off the North Wales and Irish coasts. By April in the eastern part of the Irish Sea the distribution of egg production had spread northward up to the Solway, while off the Irish coast the spread was more localised. Numbers declined during May with a few small areas of spread in coastal regions.

Larvae were recorded in relatively low concentrations throughout the first three surveys. During April peak numbers were caught over a wide area in the eastern Irish Sea off the North Wales coast. Similar numbers were found in the western Irish Sea but covering a smaller area. By the middle of May larval concentrations had declined most noticeably off the Irish coast. In the eastern Irish Sea numbers of larvae remained relatively high.

4.2.2. *Sprattus sprattus (Sprat) and Clupeidae* (Figures 10 and 11)

Sprat eggs were observed on all surveys where they were identified. The maximum density recorded was 278 m^{-2} east of the Isle of Man during 19-25 April (Table 2a). However similar high densities also occurred off the Irish coast in early March and to the north of the eastern Irish Sea in mid-May. Positive separation of sprat and herring larvae involves counts of muscle blocks and is time-consuming. Since the Irish Sea herring stock spawns in the autumn it was therefore assumed that most of the larvae caught in these spring surveys were those of *S. sprattus.* However, a few herring larvae were positively identified during April and May. The distribution of clupeoid larvae followed a similar pattern to the eggs with peak concentrations in shallower coastal waters. Peak numbers (163.3 m^{-2}) were found in April in Dublin Bay. By the final survey of the series the larval numbers had declined in coastal areas, but distribution across the region was widespread.

4.2.3 *Argentina sphyraena (Lesser silver smelt)* (Figures 12 and13)

A few eggs and larvae of this species were caught in the Irish Sea during the survey series. Occurrence was confined to the south/southwest of the Isle of Man. Maximum abundance was 2.7 m^{-2} for the eggs and 0.2 m^{-2} for the larvae.

4.2.4 *Gadidae (Norway Pout and Poor Cod)* (Figure 14)

The eggs of these two species are similar to those of *M. merlangus* (whiting) and so are not identified in plankton samples. The larvae of *Trisopterus minutus* (Norway pout) and *T. esmarkii* (Poor cod) are similar in appearance and have been grouped together. Larvae were recorded from April onwards principally in central waters. Peak numbers occurred in April close to the Isle of Man and declined during May. By the end of the month larvae were recorded across the region in peak abundances. Lower numbers occurred around the Isle of Man and near Anglesey in mid-May.

4.2.5 *Gadus morhua (Cod)* (Figures 15 and 16)

In the early stages of development, before embryonic pigmentation is visible, eggs of cod and haddock (*Melanogrammus aeglefinus*) appear identical. Early stage eggs measuring between 1.24 and 1.7 mm diameter and lacking an oil globule were classified as 'cod-like'. These eggs have not been plotted but are included in Figure 1 showing the numbers at size of measured unidentifiable eggs. Late-stage eggs of cod were recorded on all surveys. Peak abundances occurred off the Irish coasts during March. Numbers declined across the region during by the final survey a few late-stage eggs were found at two stations.

Cod larvae are distinctive and were found as early as mid-February but highest numbers occurred towards the end of April. At this time distribution was concentrated around the Isle of Man and along the Scottish coast. The maximum density of cod larvae recorded was 7.6 m^{-2}.

4.2.6 *Melanogrammus aeglefinus (Haddock)* (Figures 17 and18)

Only later stage eggs of haddock were positively identified when they can be distinguished from eggs of *G. morhua*. Low numbers were found infrequently from mid-February to mid-May. The majority of haddock eggs were caught from 20-29 March with highest numbers in Dublin Bay. Haddock larval distribution data is incomplete and therefore cannot be interpreted in relation to the pattern of egg dispersal. However, highest larval densities were found in central areas during April and at isolated positions in mid-May.

4.2.7 *Merlangius merlangus (Whiting)* (Figure 19)

The eggs of this species are not separately identified but are included in a group of measured eggs with no oil globules (Figure 1). Their eggs are spherical, have no obvious surface features, and range in diameter from 0.97 to 1.32 mm.

Whiting larvae were concentrated in the eastern Irish Sea where peak numbers were observed in late April. Larvae were also caught off the Irish coast during the same period. Numbers had declined across the region by mid-May.

4.2.8 *Trisopterus luscus (Bib, Pout)* (Figure 20)

The eggs of this species lack an oil globule and range in diameter from 0.9-1.23 mm. They cannot readily be separated from those of a similar size (Figure 1). Bib larvae were caught as early as mid-February but began to appear in significant numbers in the eastern Irish Sea and to the west of Anglesey during April. Maximum larval densities reached 5.6 m^{-2}. Lower numbers were still present in the eastern Irish Sea and off Anglesey at the end of the surveys.

4.2.9 *Pollachius pollachius (Pollack)* (Figure 21)

The eggs of this species, which range in diameter from 1.1-1.22 mm, are similar in size to those of *Merlangius merlangus* and *Trisopterus luscus* and therefore are not separately identified (Figure 1). Larvae were caught in low numbers from early April. The highest concentrations were recorded close to the Welsh coast, but the larvae were not identified in samples from the western Irish Sea for the same period.

4.2.10 *Molva molva (Ling)* (Figures 22 and 23)

Eggs of this species were found during a relatively short period from the middle to the end of April. Spawning mainly occurred in the deeper waters of the North Channel and the western Irish Sea. The maximum egg concentration was 11.5 m^{-2}. Small numbers of larvae were found in these areas in April and May. However, larvae were also found in May in the eastern Irish Sea.

4.2.11 *Gadidae (Rocklings)* (Figures 24 and 25)

Four species of rockling are found in the Irish Sea, *Gaidropsarus meditteraneus* (shore rockling), *Gaidropsarus vulgaris* (three-bearded rockling), *Enchelyopus cimbrius* (four-bearded rockling) and *Ciliata mustela* (five-bearded rockling). *G. meditteraneus* spawns inshore in June and July and so is not likely to feature in these surveys. The other three species however may all have been present. *G. vulgaris* spawns in shallow water in January and February, *E. cimbrius* spawns in deeper water (>50 m) from May to August and *C. mustela* spawns offshore in winter and spring (Wheeler, 1978). The egg distributions seen in these surveys largely reflect these patterns of spawning. In January and February small concentrations occurred mainly in coastal areas. By April rockling eggs were caught over most of the study area. Peak numbers were recorded in May in the eastern Irish Sea. Rockling larvae were caught in coastal waters in February. By April their distribution was widespread across the Irish Sea with higher concentrations off the Irish coast and in the central eastern Irish Sea. By mid-May numbers had declined with the exception of a single station in Liverpool Bay.

4.2.12 *Triglidae (Gurnards)* (Figures 26 and 27)

Neither the eggs nor the larvae of this group are routinely identified to genus or species. Four species occur in the Irish Sea, the most common being *Eutrigla gurnardus* (grey gurnard) which spawns from January to June. The three other species are *Aspitrigla cuculus* (red gurnard) which spawns from April to August in the eastern Irish Sea, *Trigla lucerna* (tub gurnard) which spawns from May to July and the less common *Trigloporus lastoviza* (streaked gurnard) which spawns from June to August. Gurnard eggs were caught away from the coast in the western Irish Sea from January. By April eggs were noted in the eastern Irish Sea as well. Maximum abundance (112 m^{-2}) occurred in May near Liverpool Bay. Very low numbers of larvae were caught and only in the western Irish Sea. Triglidae larvae are uncommon in plankton samples but they can be caught with larger gear such as the MIK net.

4.2.13 *Cottidae (Bullheads and Sculpins)* (Figure 28)

These are a shallow water family with a benthic egg that requires a rocky or weedy substrate for adhesion. The younger larval stages of the Cottidae family are not easily identified to species and have therefore been recorded as Cottidae. However, based on larger larvae three species were identified in these surveys *Myoxocephalus scorpius* (Bull-rout), *Taurulus bubalis* (Sea scorpion) and *Taurulus lilljeborgi* (Norway bullhead) (Tables 2b and d). For presentation, their numbers have been combined with unidentified specimens. Larvae were recorded inshore close to the Irish coast in mid-February. During April the larvae became more widespread but still confined to inshore waters at concentrations of <1.8 m^{-2}.

4.2.14 *Agonus cataphractus (Pogge)* (Figure 29)

The eggs of this species are also benthic. Their larvae were found at only a few stations, the highest densities recorded towards the end of April in the waters around the Isle of Man.

4.2.15 *Liparis spp. (Sea-snails)* (Figure 30)

These are another shallow water group with a benthic egg most commonly occurring close to the coast. However these surveys show that their larvae also occur in offshore areas from April onwards.

4.2.16 *Chirolophis ascanii (Yarrell's blenny)* (Figure 31)

The eggs of this species are benthic. Larvae were caught in low numbers at a few stations in April. By May no larvae were recorded.

4.2.17 *Pholis gunnellus (Butterfish)* (Figure 32)

This species has benthic eggs that most commonly occur inshore on rocky substrate. They may also be found offshore on sand or mud laid in the shells of bivalve molluscs (Wheeler, 1978). The spawning period in the Irish Sea is from January to March (Qasim, 1956). Butterfish larvae were found at coastal sites throughout the Irish Sea in early March. The highest density recorded was 39 m^{-2}. By April the distribution of larvae had spread out from the coast. Butterfish larvae were still being caught in low numbers in May scattered throughout the area.

4.2.18 Ammodytidae (Sandeels) (Figure 33)

Four out of the five species of Ammodytidae occur in the Irish Sea although one of these, Ammodytes tobianus, spawns in the autumn and is therefore unlikely to feature as larvae in spring surveys. Of the other three species, *Ammodytes marinus* (Raitt's sandeel) is common offshore and spawns from January to March, *Gymnammodytes semisquamatus* (smooth sandeel) spawns from April to July and *Hyperoplus lanceolatus* (greater sandeel), which is very common and widely distributed, spawns in April and May. The eggs of the whole of this group are benthic and are therefore not caught regularly in the plankton. The larvae in these surveys have not been identified to species, although it is possible using descriptions by Macer (1967) and Russell (1976). In February larvae were found close to the Irish coast and off Liverpool Bay. By April the larvae were widespread occurring over a range of depth and habitat. The highest concentrations (up to 45 m^{-2}) occurred during the fifth survey along the Scottish coast. By May the occurrence of larvae had declined significantly but with some being caught in the eastern Irish Sea and off the Northern Irish coast.

4.2.19 Callionymidae (Dragonets) (Figures 34 and 35)

The eggs of Callionymidae are distinctive having a sculpted egg case. Eggs and larvae of the two species commonly occurring in this area have not been separately identified from these surveys. *Callionymus lyra* (common dragonet) is reported to spawn from late January through to August (Russell, 1976) in water <50 m. *Callionymus maculatus* (spotted dragonet) spawns from April to August and shows a preference for deeper water. There is no information on the spawning in the Irish Sea of a third species, *Callionymus reticulatus* (reticulated dragonet). This species is uncommon but reputed to frequent shallow water. In the English Channel it may spawn from April to September (Demir, 1976). The distributions of eggs and larvae from these surveys are therefore likely to be mainly a mixture of *C. lyra* and *C. maculatus.* The eggs were caught throughout the survey period but were particularly abundant in April in the eastern Irish Sea, reaching densities of 301 m^{-2} (the second highest abundance recorded for all species). Isolated numbers of larvae occurred as early as January. Their pattern of distribution throughout the rest of the survey period generally reflected that of the eggs. Larvae were abundant across the region in April but declined in early May. Numbers increased during the final survey in all areas, but especially at stations east of the Isle of Man where they reached up to 167 m^{-2}.

4.2.20 Gobiidae (Gobies) (Figure 36)

These are a large group of fish common in inshore waters and producing benthic eggs. Up to 11 species are found in the Irish Sea. Their larvae are not well described, and although easy to identify as a group because of their prominent swim bladder and characteristic pigmentation, they are not routinely identified to species level. Larvae were found on all surveys in 2000, predominantly in coastal or shallow waters. Highest densities were recorded in the eastern Irish Sea in mid-May.

4.2.21 Scomber scombrus (Mackerel) (Figure 37)

Although the main spawning area for the western stock of this species is along the continental shelf, the spread of spawning into shallower waters during late spring is known to occur (Nichols *et al.*, 1993). Numbers of eggs were caught at a handful of stations in the deep waters of the North Channel in May. Mackerel larvae were not caught during this survey series.

4.2.22 Phrynorhombus norvegicus (Norwegian top-knot) (Figures 38 and 39)

The eggs of this species were found mainly in April and May where they were distributed in two areas along the Irish/Northern Irish coast and in the waters between Anglesey and the Isle of Man. Larvae were caught in the same areas towards the end of April and in May. Larval concentrations were <6.8 m^{-2}.

4.2.23 Zeugopterus punctatus (Topknot) (Figures 40 and 41)

Eggs were caught in mainly coastal waters across the region in April. In May eggs were recorded in the western Irish Sea only. Concentrations of larvae were relatively low and sporadic. Very few occurred in the western Irish Sea suggesting that some of the eggs could have been misidentified as those of rocklings whose size distribution they overlap.

4.2.24 Pleuronectes platessa (Plaice) (Figures 42 and 43)

Plaice spawning was underway from the start of this survey series. Three main areas of spawning are reported for the Irish Sea, one off the Irish coast, one between the Isle of Man and the Cumbrian coast, and the third off the North Wales coast (Nichols *et al.*, 1993; Fox *et al.*, 1997; Fox *et al.*, 2000). The distributions plotted here confirm this pattern although the data is incomplete for the area off the Isle of Man on the third survey. Extensive spawning occurred off the Irish coast from January to March, then declined during April and had disappeared altogether by May. In the eastern Irish Sea, spawning was widespread from mid-February through until late April. Numbers were generally moderate except off the North Wales coast where the peak abundance (215.4 m^{-2}) of eggs was recorded at the beginning of March. Larvae were caught of the North Wales coast and at a handful of other stations from February. By April higher numbers were distributed off the Irish coast as well as across the eastern Irish Sea. Maximum larval abundance was 97.1 m^{-2}.

4.2.25 *Platichthys flesus (Flounder)* (Figure 44)

The eggs of this species have no oil globule and range in diameter from 0.8-1.13 mm. They are indistinguishable from eggs of a similar size like those of *Limanda limanda* (dab) and *Trisopterus luscus* (bib). The adults inhabit coastal, estuarine and brackish waters, but it is known that their spawning occurs offshore. In this survey series, larval distribution was confined mainly to the eastern Irish Sea. The highest concentrations were recorded here in April in a band running from North Wales to the southeastern coast of the Isle of Man. By May these numbers had drastically reduced.

4.2.26 *Limanda limanda (Dab)* (Figure 45)

Dab are another species that produce small eggs with no oil globule, making them indistinguishable from similar sized eggs produced by other fish. Larvae were recorded from mid-February through until the end of the survey series. In late April larvae were caught at all but one station and were particularly dense off the Irish coast and much of the eastern Irish Sea. Dab larvae remained widespread on the final survey and although numbers had declined, abundances still reached up to 349.4 m^{-2}. Overall dab were the most abundant larvae found during the survey series (Tables 2b and d).

4.2.27 *Microstomus kitt (Lemon sole)* (Figures 46 and 47)

Eggs of this species can only be positively identified at a late stage of development when characteristic pigmentation of the embryo is visible. Late stage eggs were caught on every survey but their distribution was irregular. Peak concentrations (up to 28.5 m^{-2}) occurred at two discrete stations at the beginning of March but otherwise densities were relatively low. Larvae were not found until May when they occurred at a few offshore stations in the eastern Irish Sea. The maximum density was 8.5 m^{-2}.

4.2.28 *Glyptocephalus cynoglossus (Witch)* (Figures 48 and 49)

Like those of Microstomus kitt, witch eggs can only be identified in the late embryonic stages. Wheeler (1978) stated that spawning of this species occurred in the Irish Sea from late March to May. However, in 2000 late stage eggs were caught as early as January and February in the western Irish Sea and scarcely from March to May. Larvae also occurred in low concentrations in February, but then disappeared until mid to late April when they were found at over a third of the stations. Maximum abundance at this time was 17.5 m^{-2}. Larval distribution was limited during May.

4.2.29 *Hippoglossoides platessoides (Long rough dab)* (Figures 50 and 51)

The eggs of this species are large (1.38-2.64 mm in diameter) with a notably wide perivitelline space. As a result they are easy to identify in plankton samples. They were recorded over a limited geographical range, predominantly in the western Irish Sea from mid-February to mid-May. Long rough dab larvae were caught almost exclusively during the fifth survey, again mainly in the western Irish Sea but a little further offshore than the eggs.

4.2.30 *Solea solea (Sole)* (Figures 52 and 53)

In 2000 the main spawning areas were east of longitude 04º 30'W, between the Solway Firth and the North Wales coast. Spawning did occur in other areas of the Irish Sea but in comparatively low numbers. Peak concentrations (up to 63.2 m^{-2}) were recorded in mid to late April. A few larvae were caught from February to April but the highest abundance was observed on the final survey of the series in May. During this period, larval distribution was restricted to the eastern Irish Sea.

4.2.31 *Buglossidium luteum (Solenette)* (Figures 54 and 55)

The eggs were found on all surveys where the samples were analysed. They occurred mainly at coastal stations in the western and eastern regions in April and May. Abundance was highest (41.5 m^{-2}) in May. Larvae were uncommon until the final survey when up to 18.5 larvae m^2 were caught in the eastern Irish Sea. Almost no larvae were observed off the Irish coast despite the high number of eggs distributed there.

4.2.32 *Microchirus variegatus (Thick-back sole)*
(Figures 56 and 57)

Eggs of this species were first identified in low occurrences during April. In May eggs were found in both the eastern and western parts of the Irish Sea, but abundances were highest off the North Wales coast (up to a maximum of 84.2 m^{-2}) and in the waters between the Isle of Man and the Cumbrian coast. Russell (1976) states that this species tends to favour deep-water, but the spawning pattern presented here does not support this. Thick-back sole larvae were caught in the same areas. The peak abundance was 15 m^{-2}.

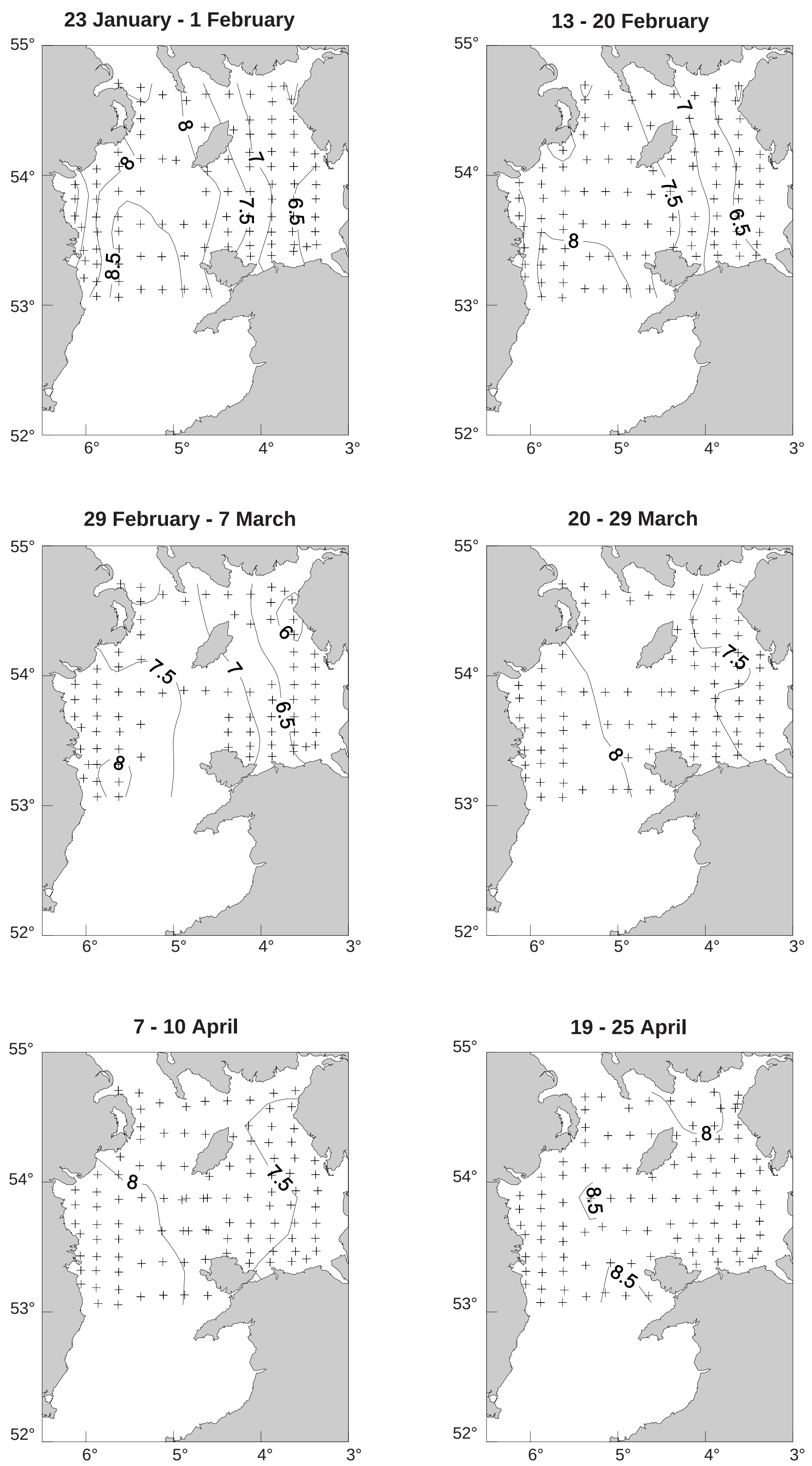
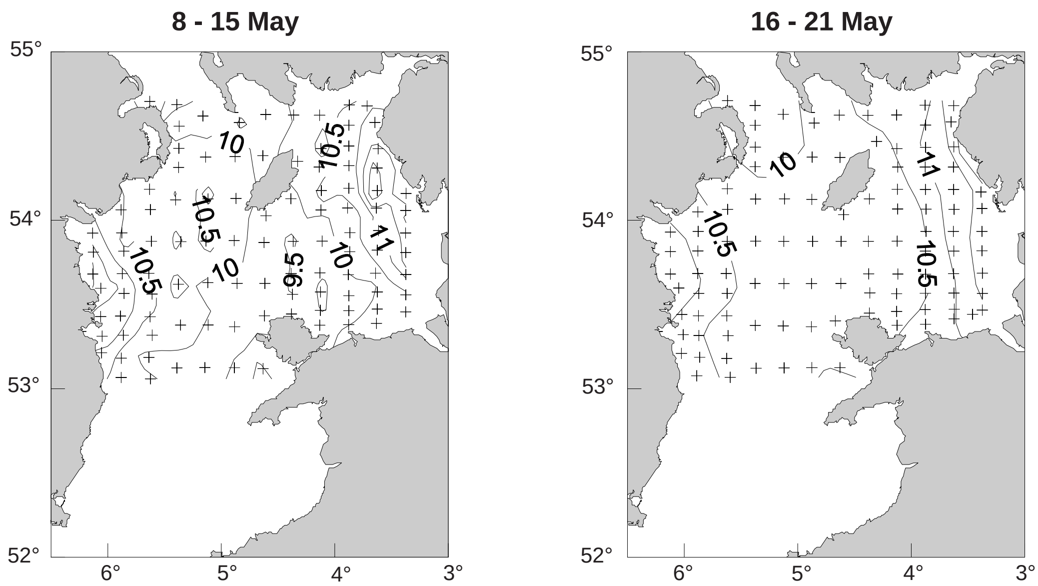


Figure 2. ***Surface temperatures (°C) in 2000***



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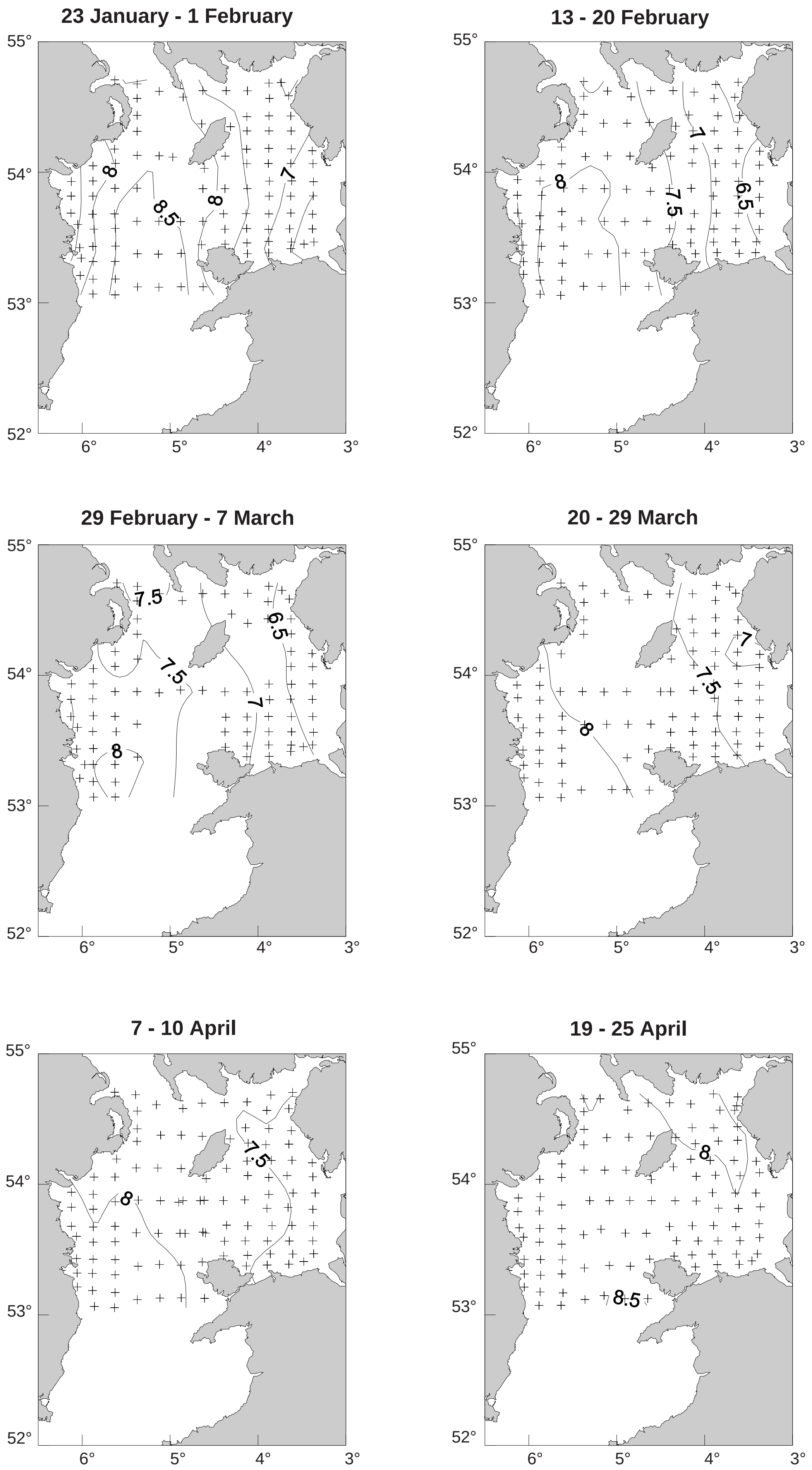


Figure 3. Bottom temperatures (°C) in 2000

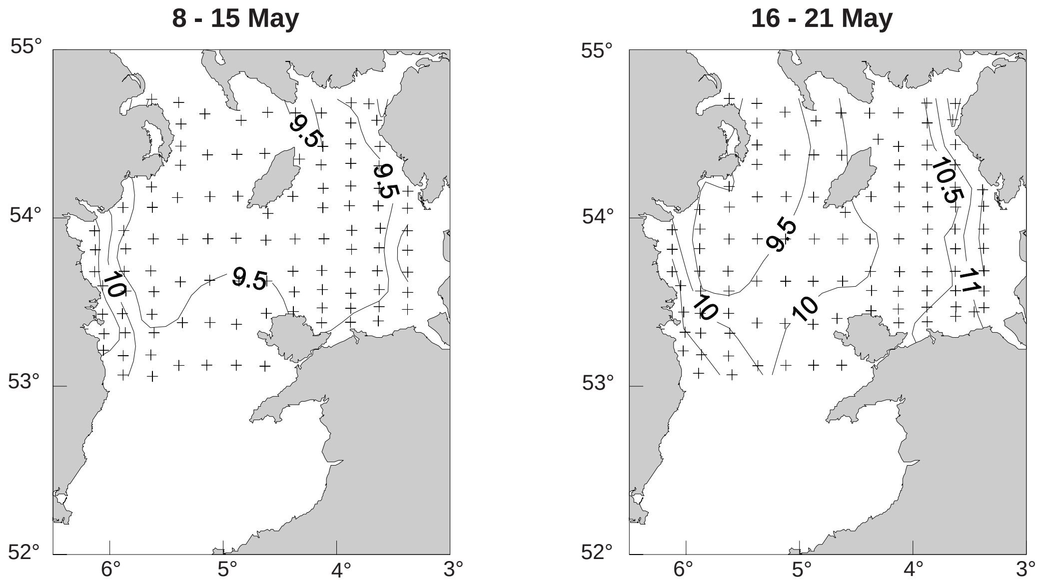


Figure 3. continued

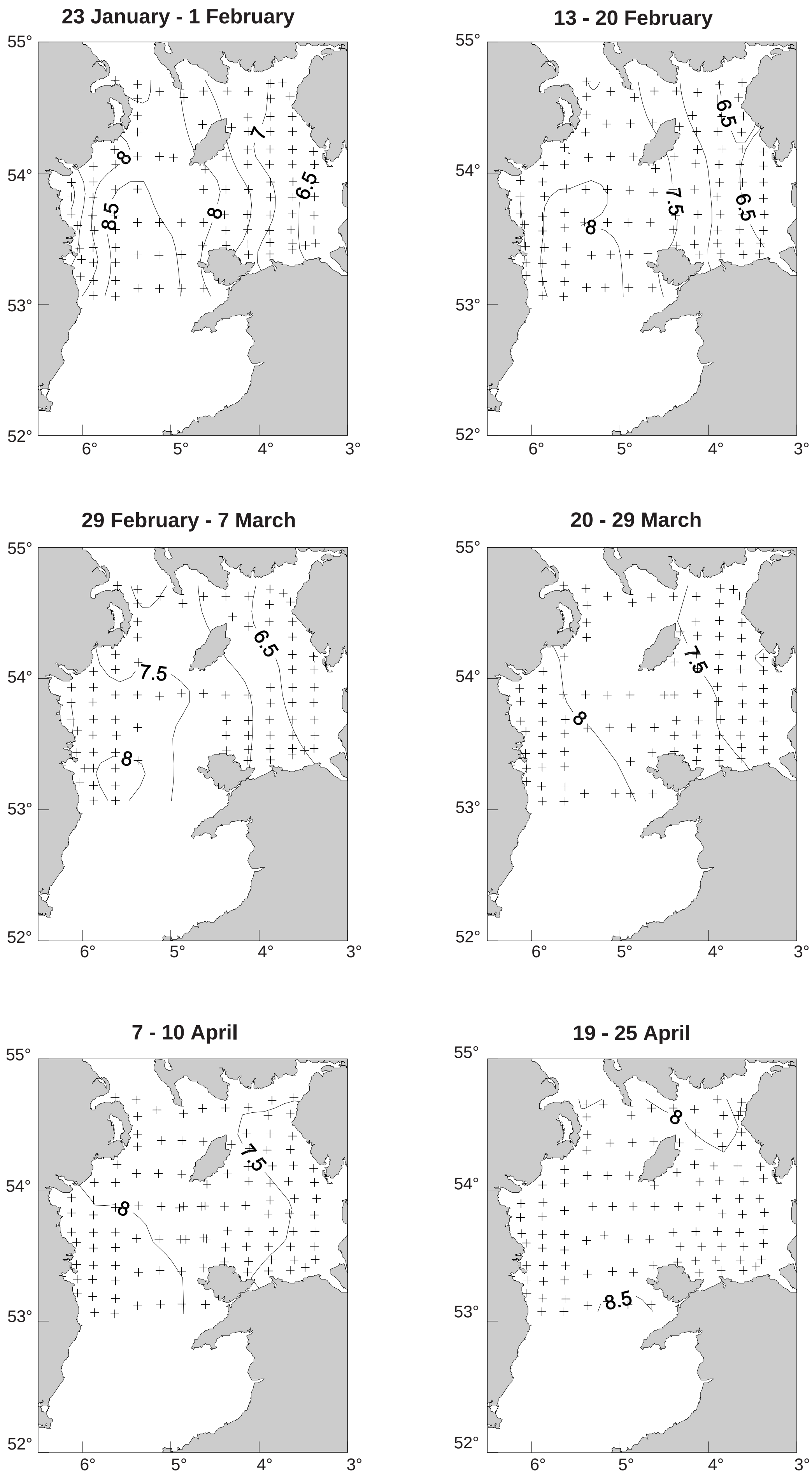
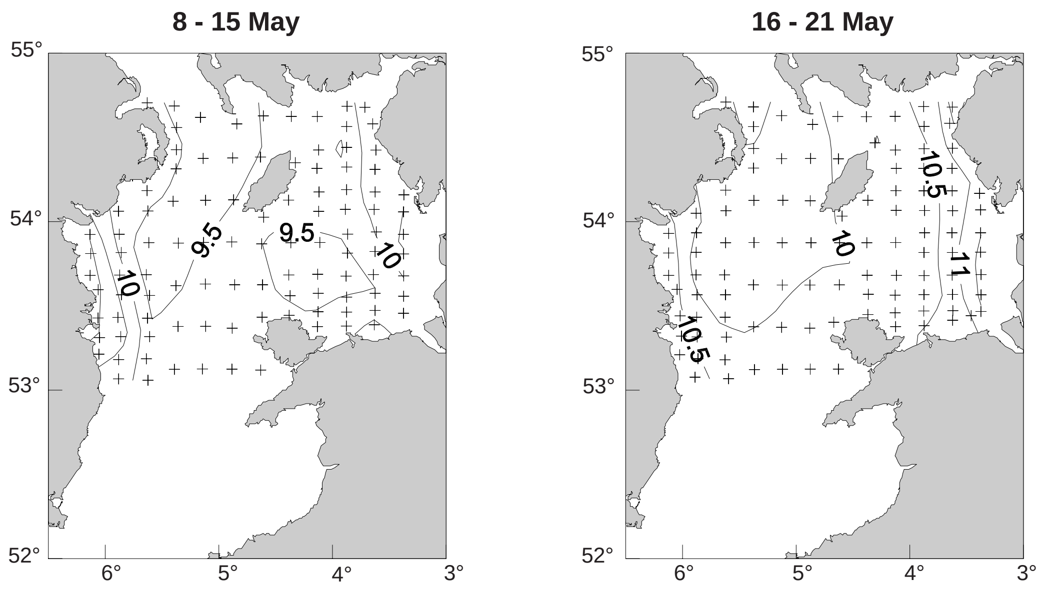


Figure 4. Integrated temperatures (°C) in 2000



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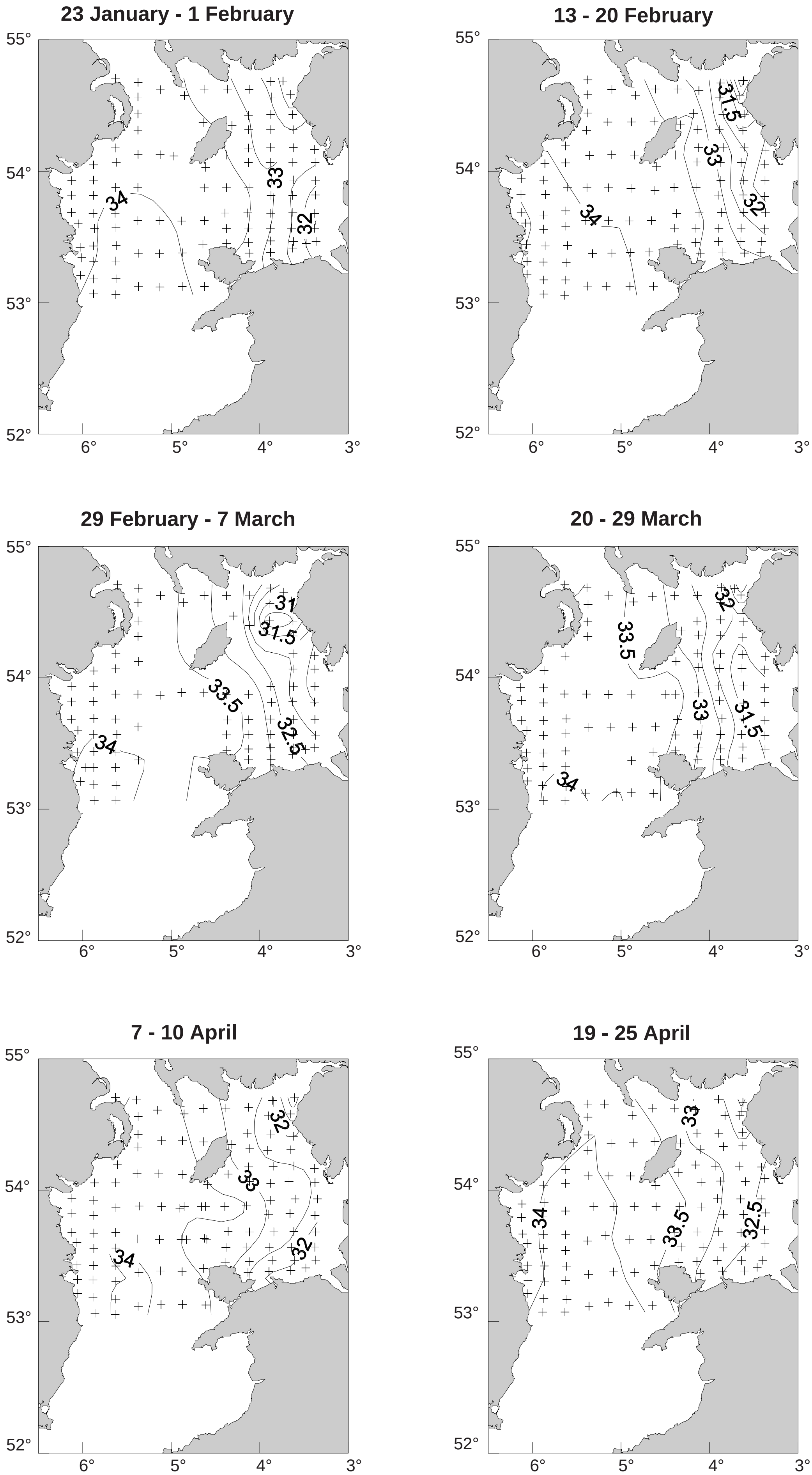


Figure 5. Surface salinities (psu) in 2000

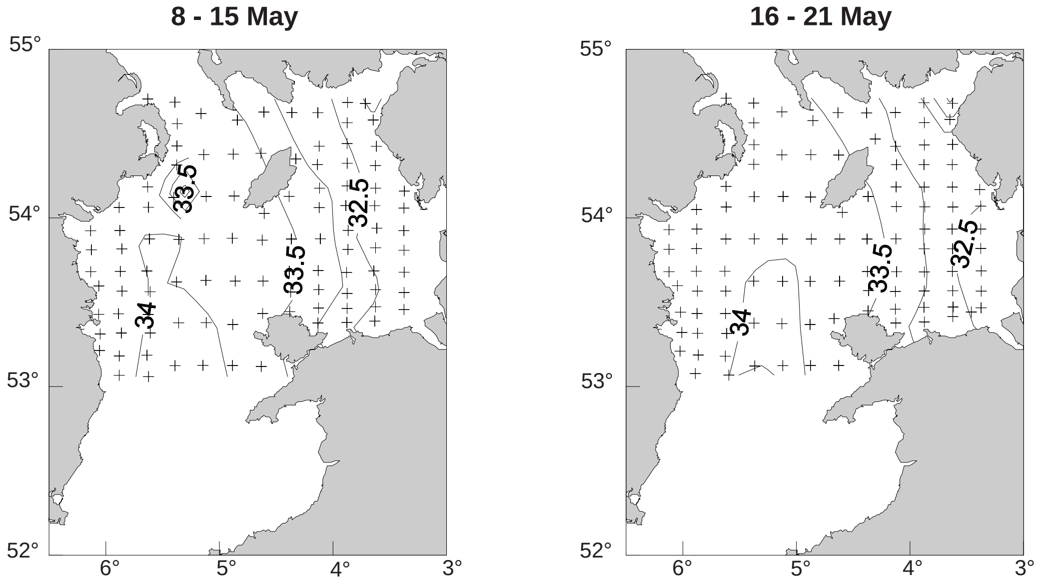


__Figure 5. continued__

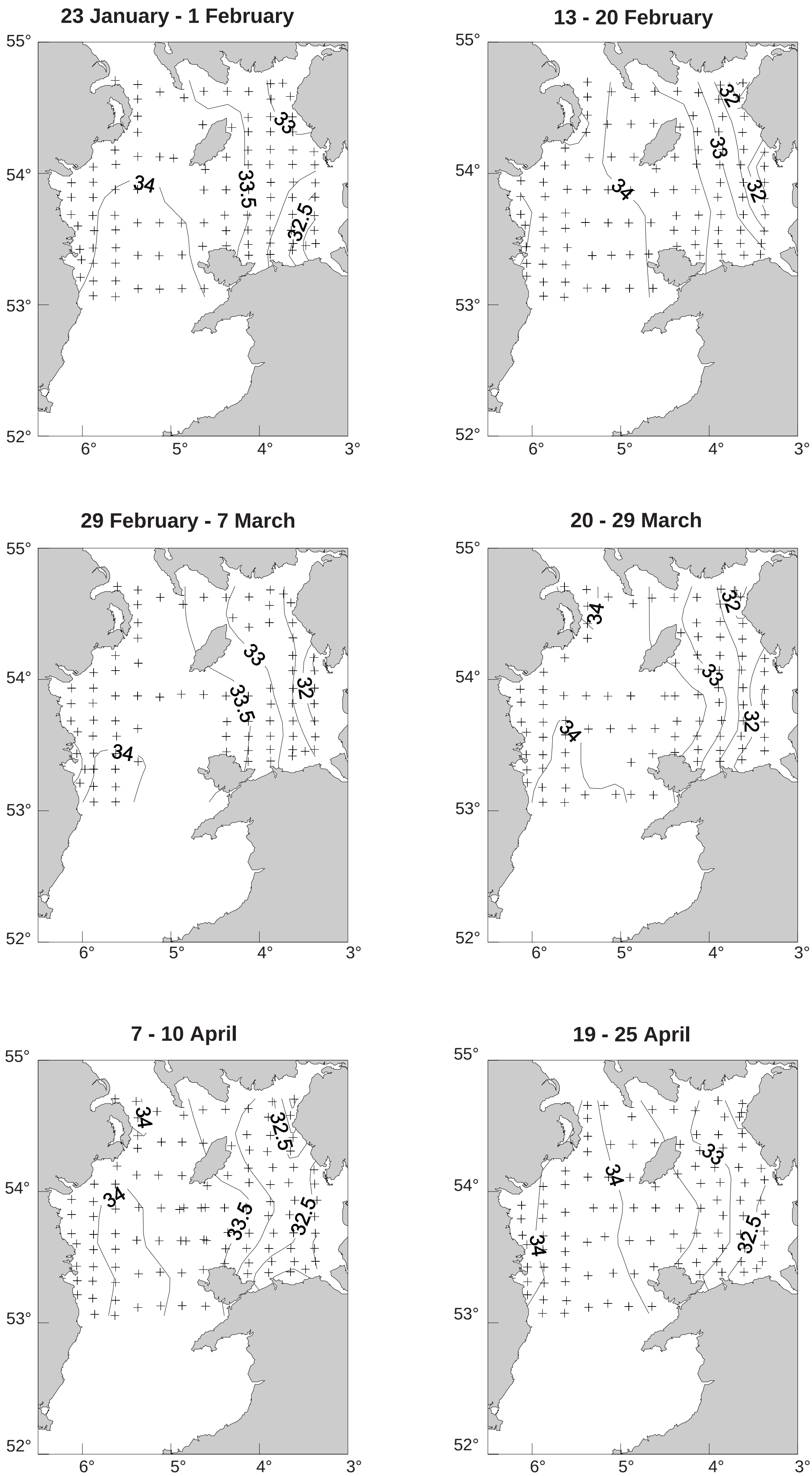


Figure 6. ***Bottom salinities (psu) in 2000***

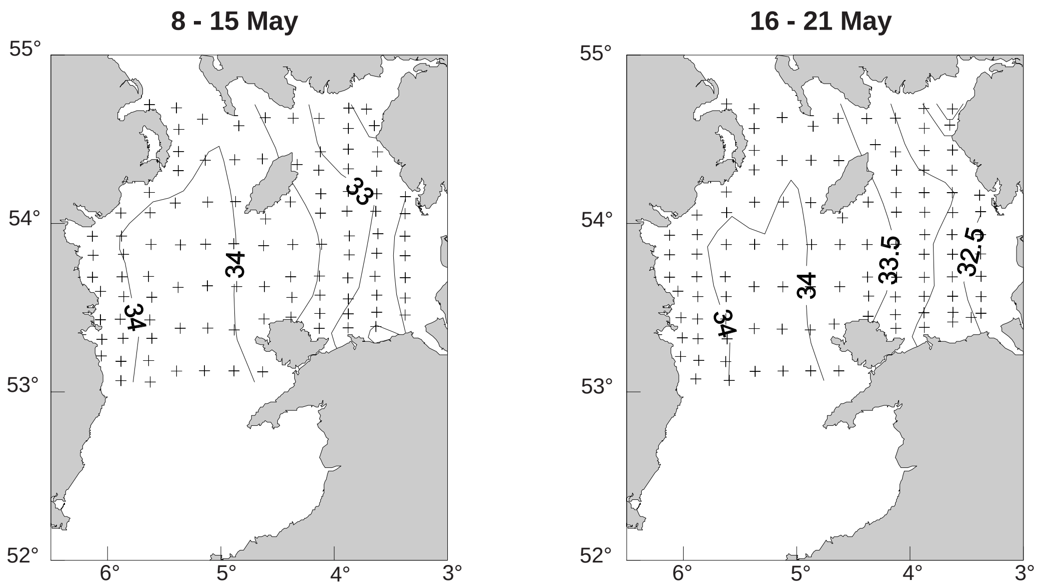


Figure 6. continued

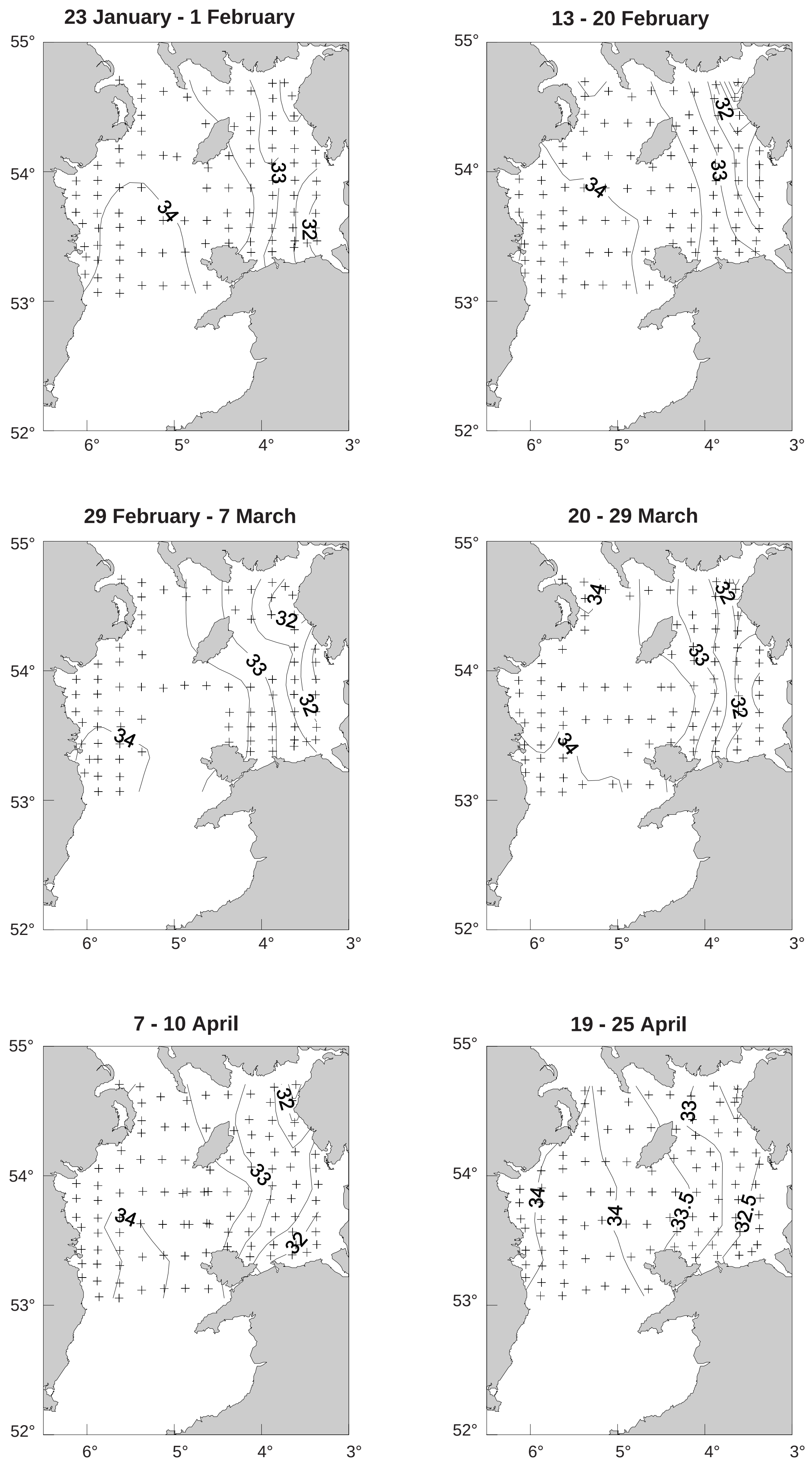


Figure 7. Integrated salinities (psu) in 2000

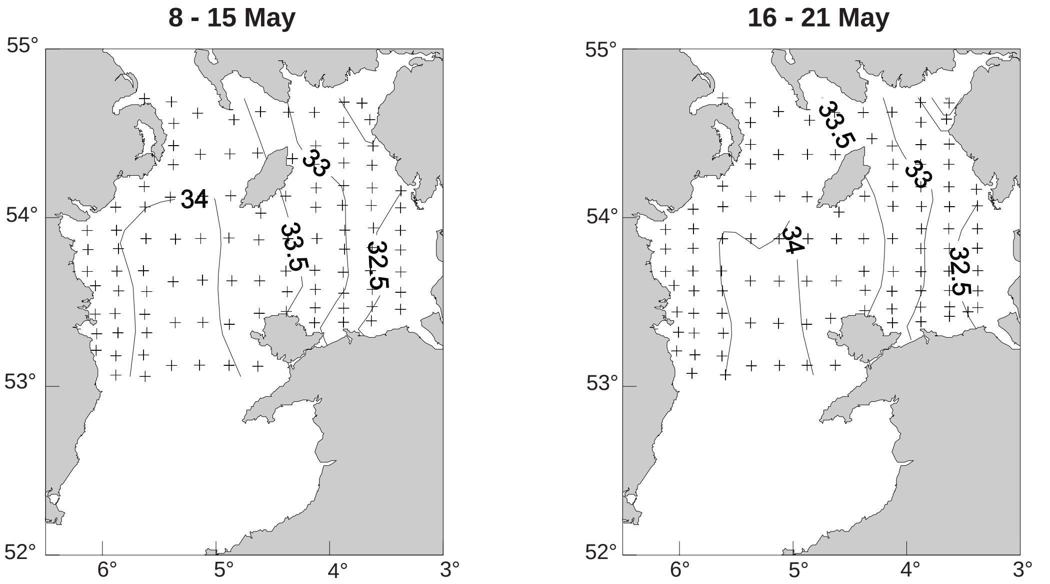


Figure 7.   continued

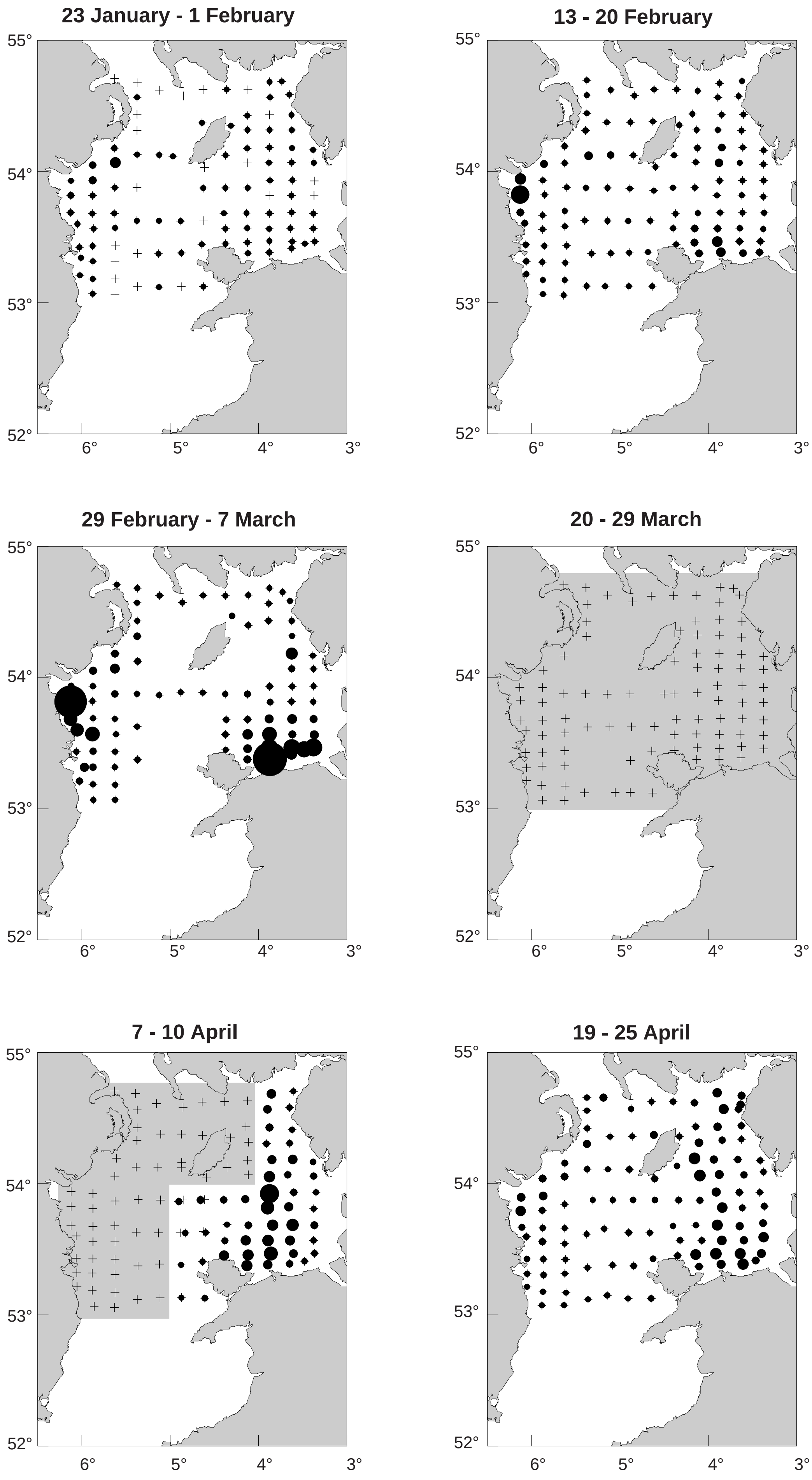


Figure 8. ***Total egg concentrations (nos.m^{-2}) in 2000***

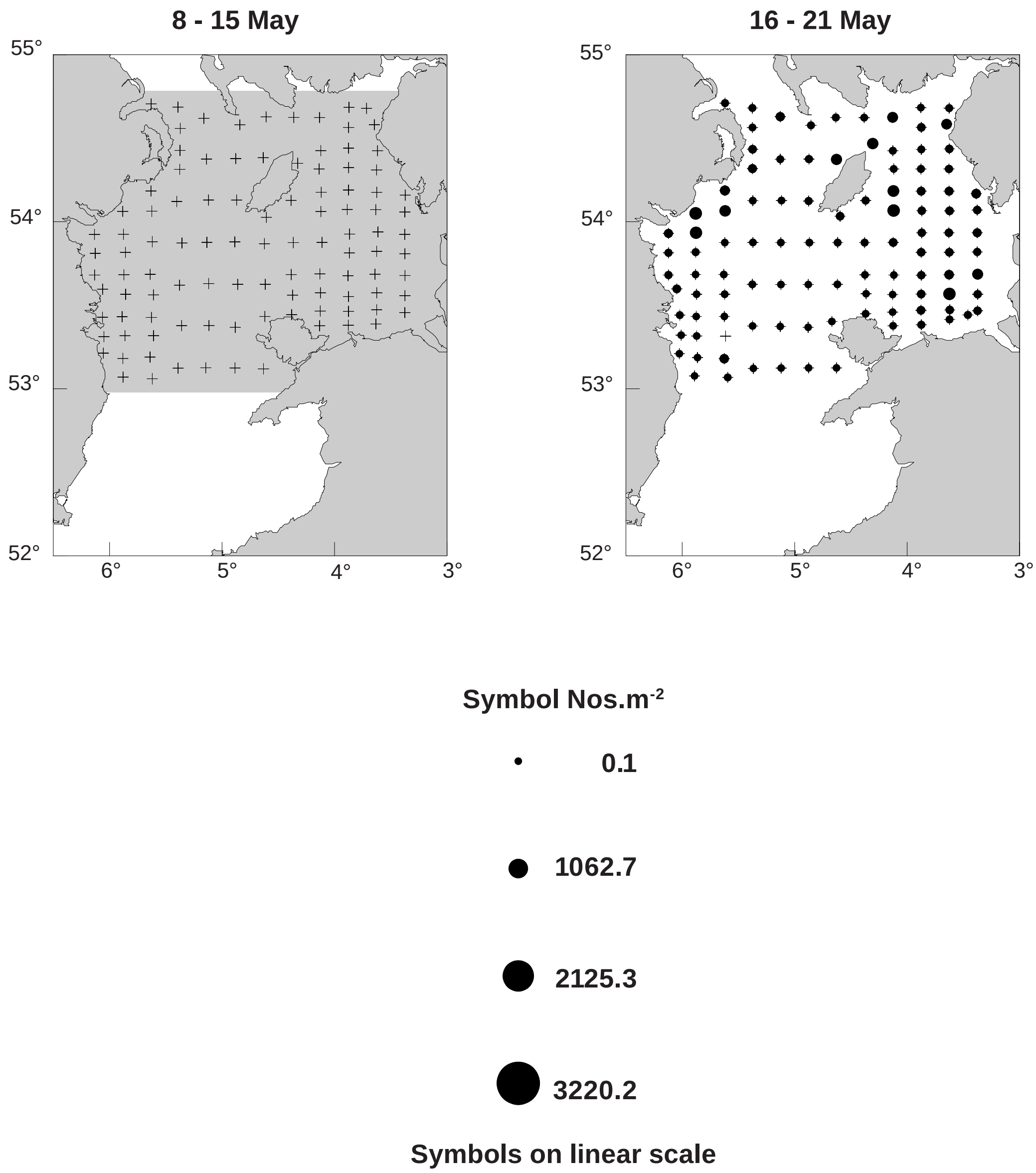


Figure 8. *continued*

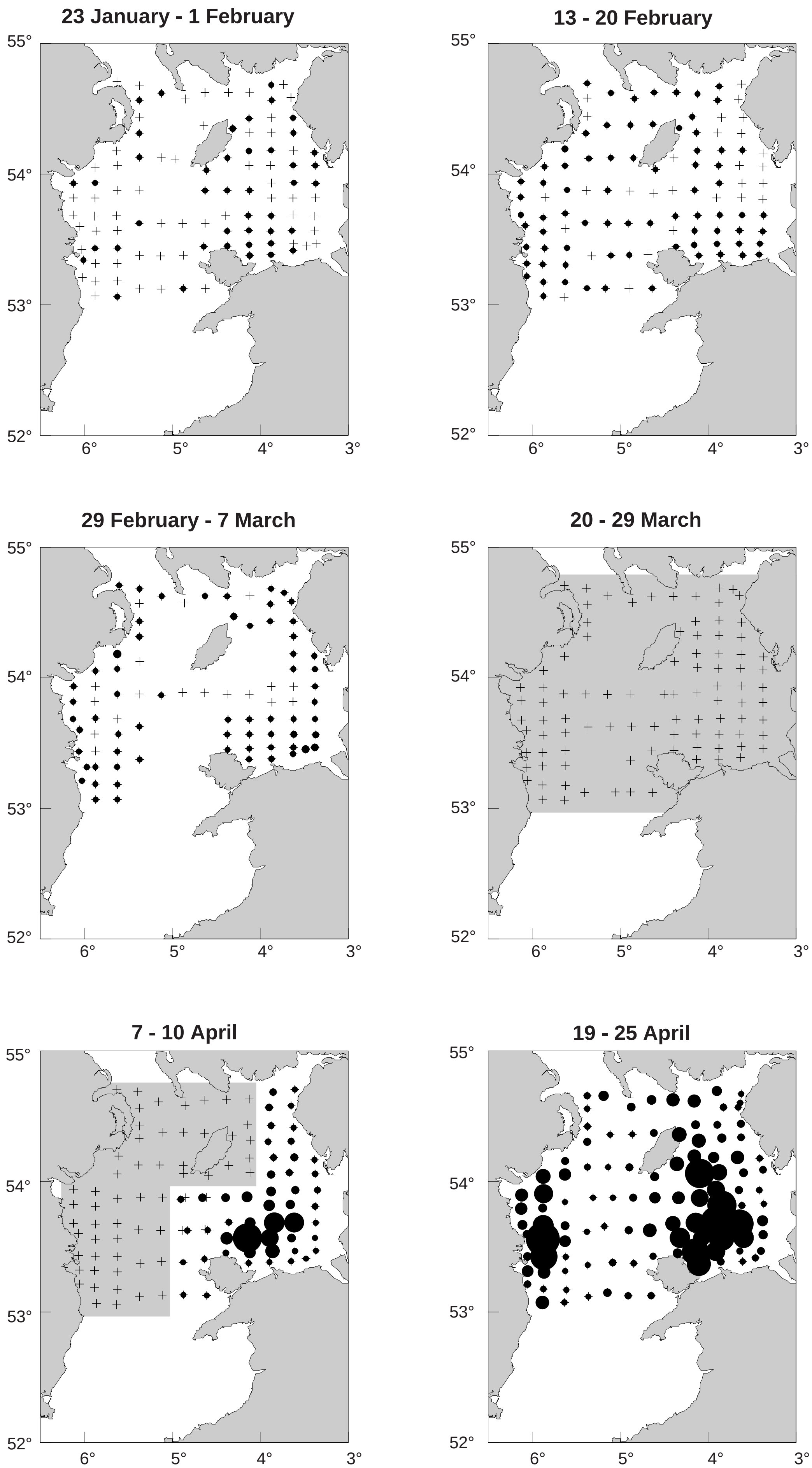
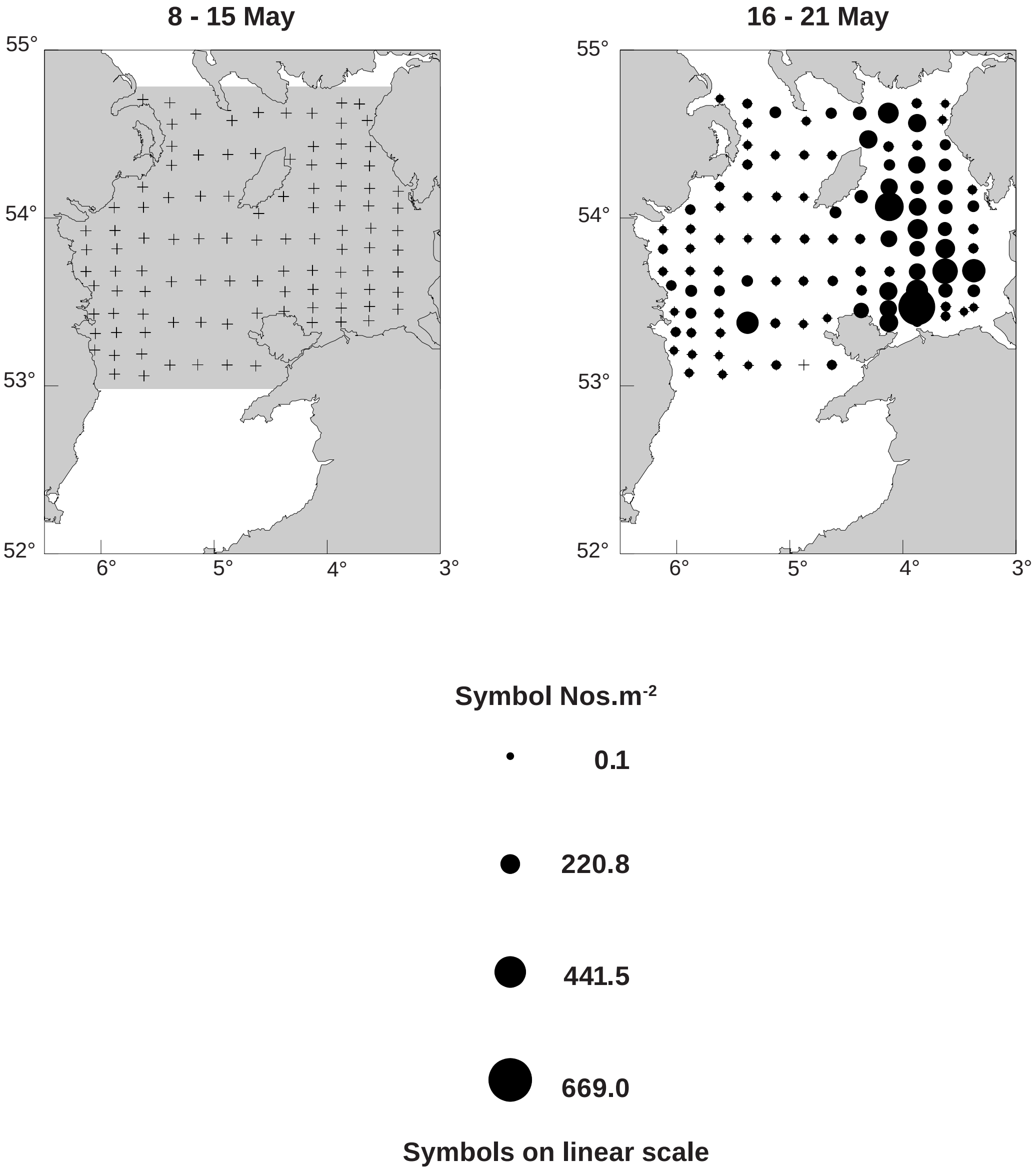


Figure 9. Total larvae concentrations (nos.m^{-2}) in 2000



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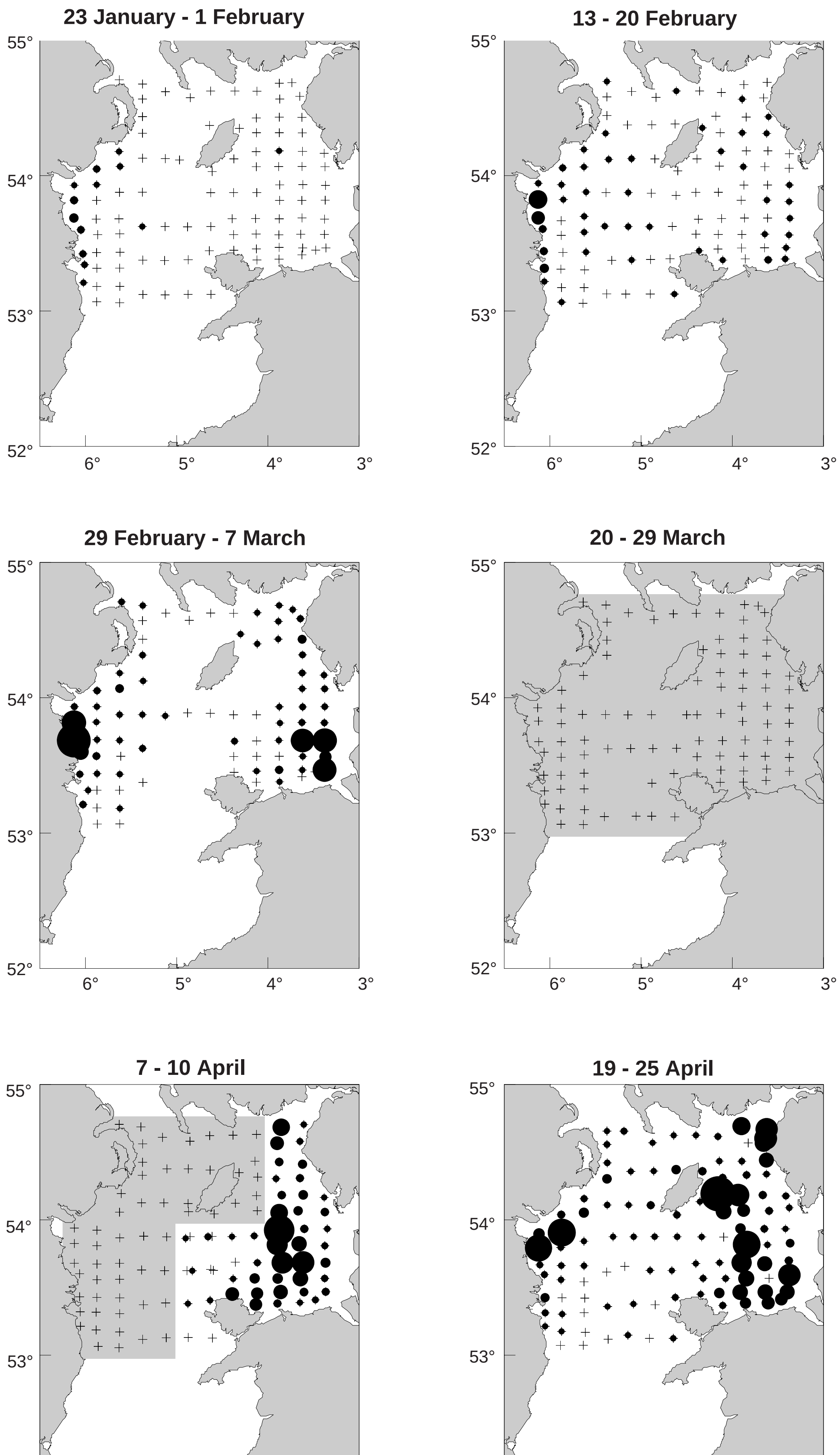
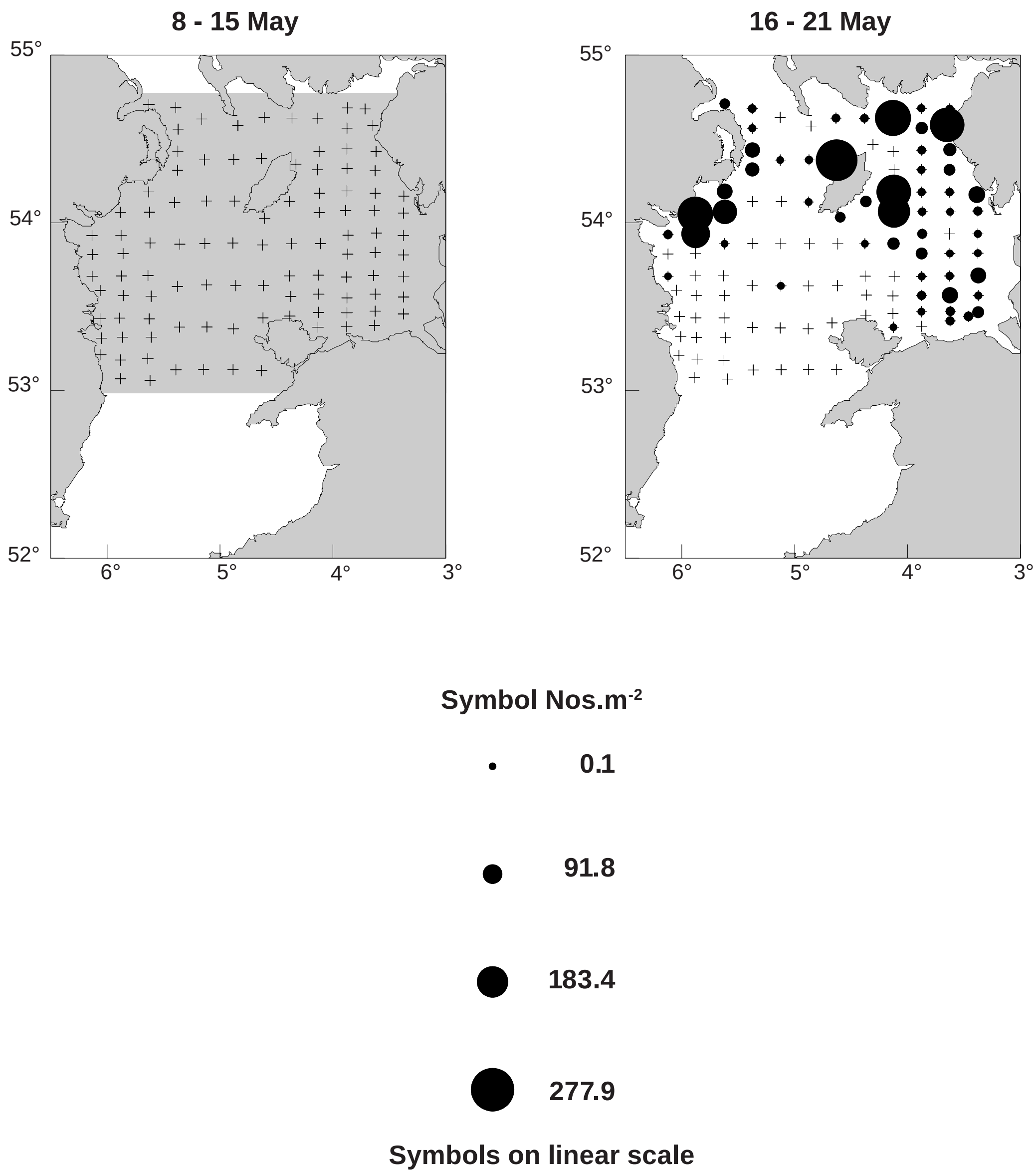


Figure 10. Concentration of sprat (Sprattus sprattus) eggs (nos.m^{-2}) in 2000



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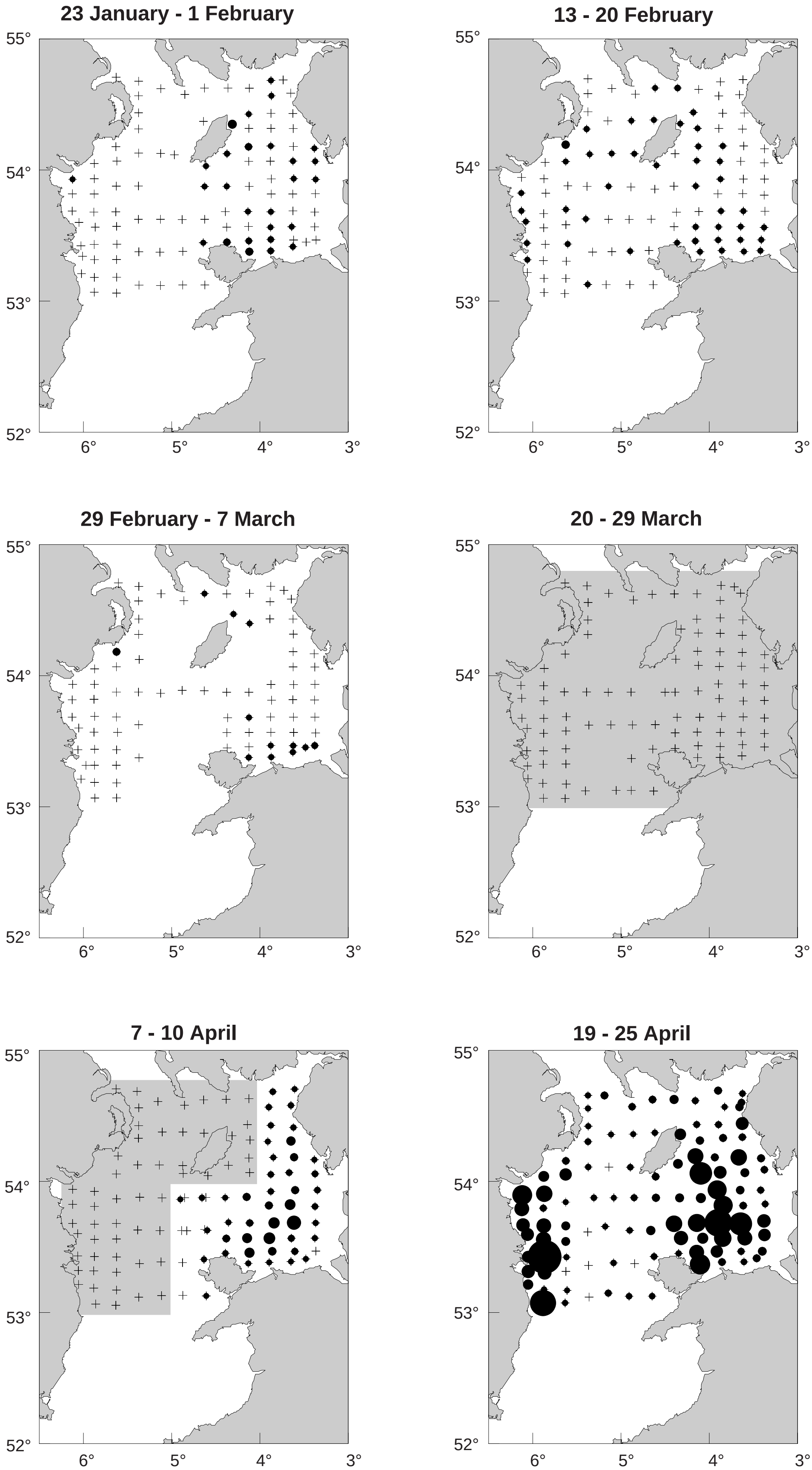
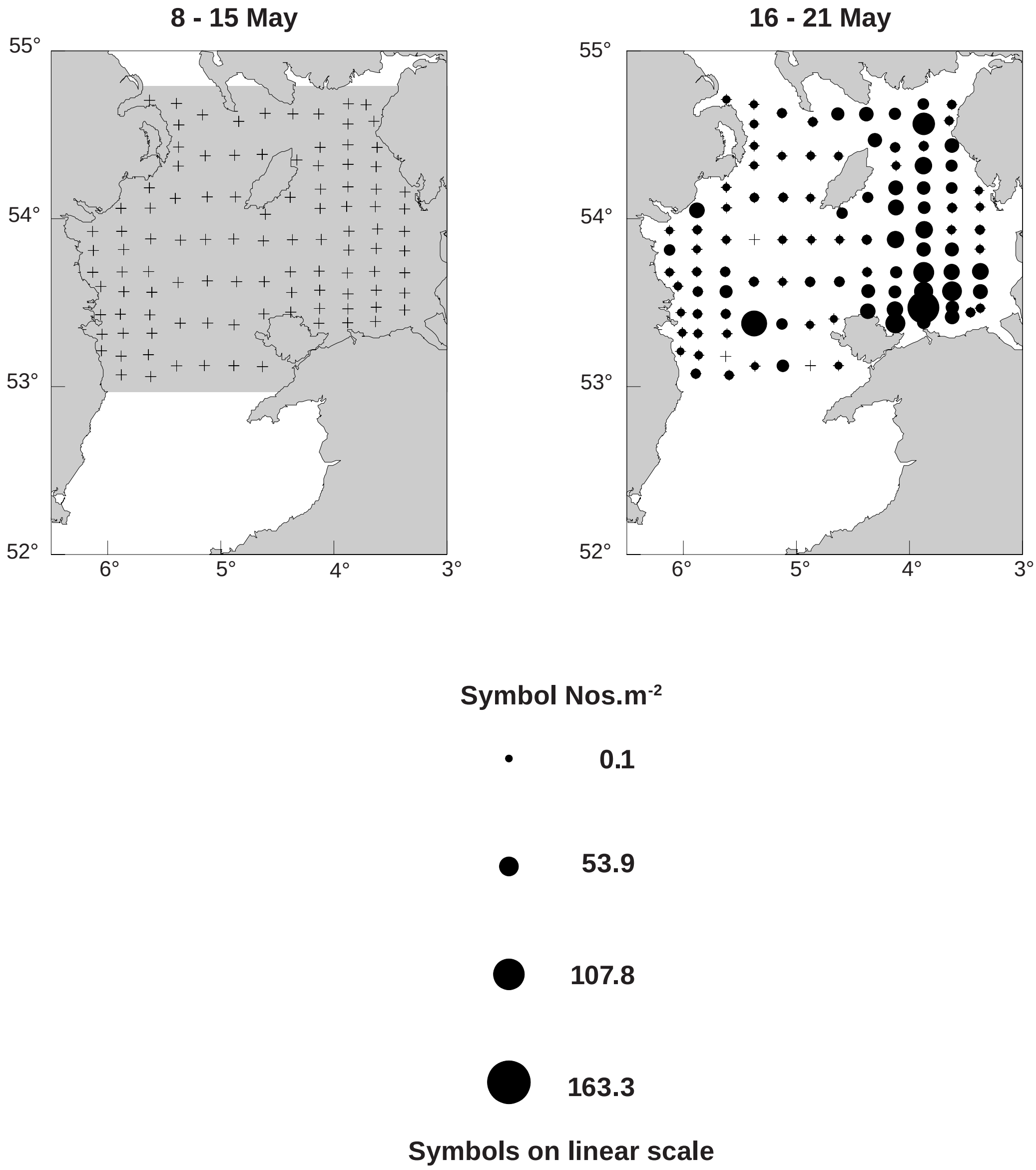


Figure 11. Concentration of sprat and Clupeidae (Sprattus sprattus and Clupeidae) larvae (nos.m^{-2}) in 2000



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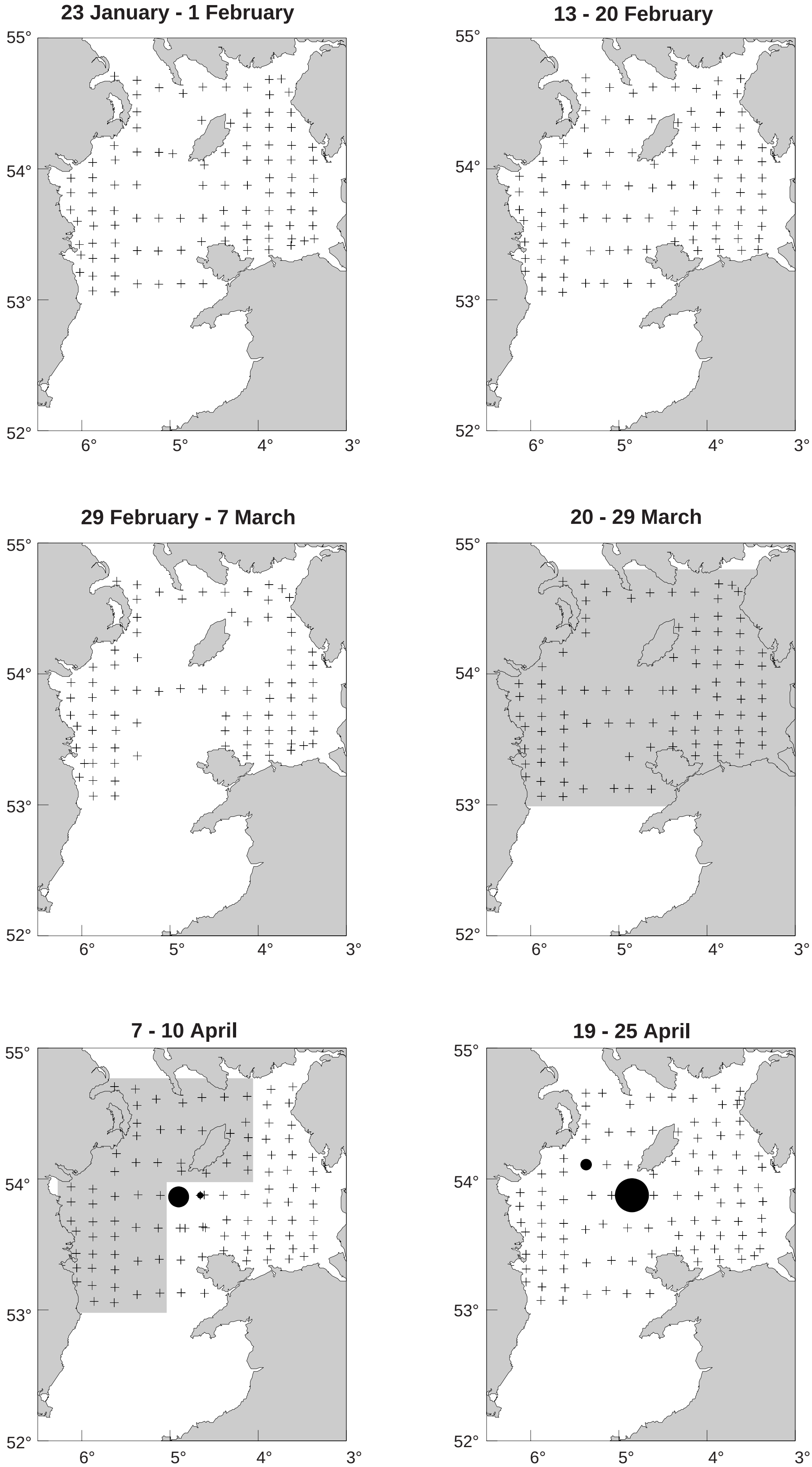
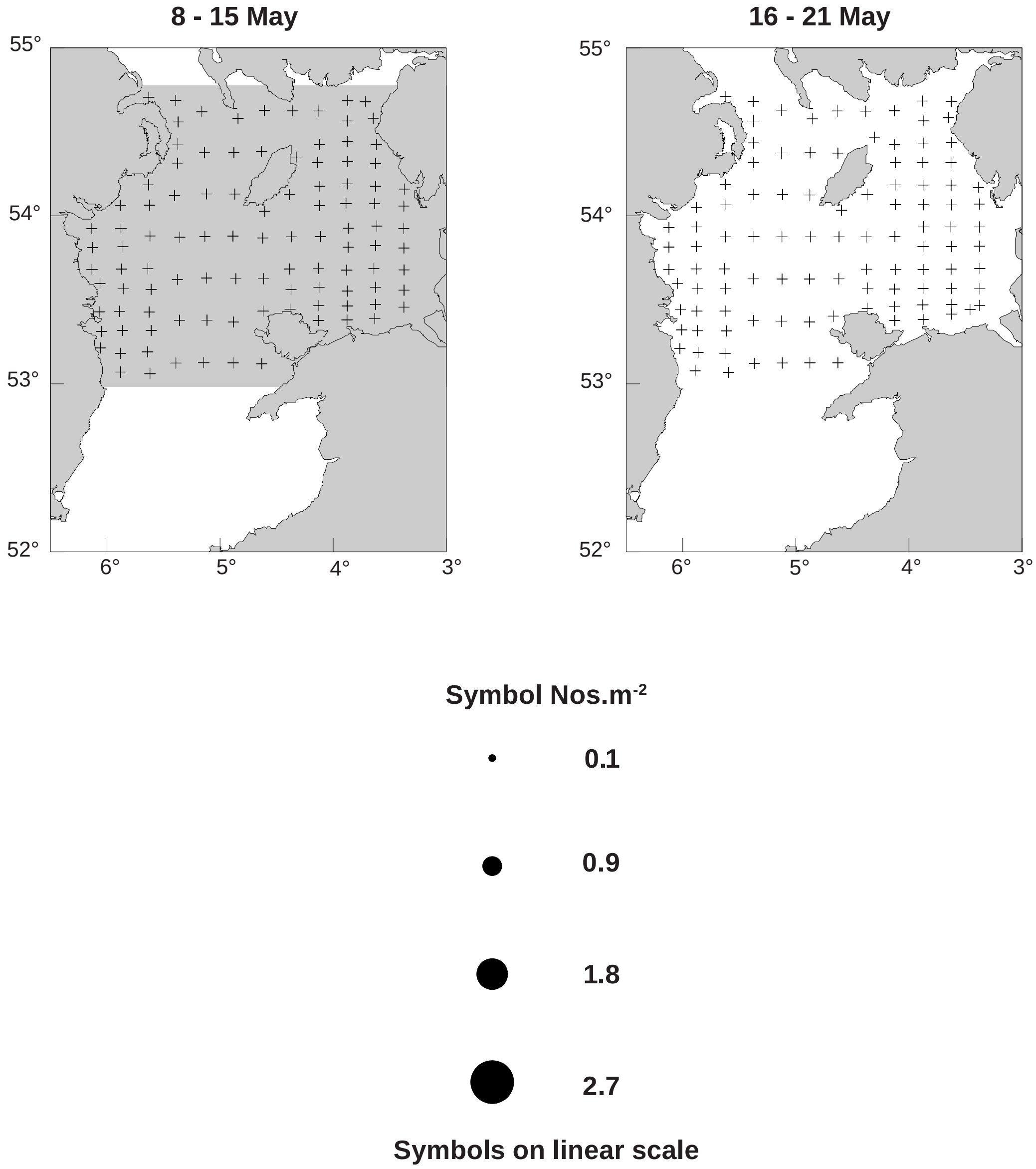


Figure 12. Concentration of Lesser silver smelt (Argentina sphyraena) eggs (nos.m^{-2}) in 2000



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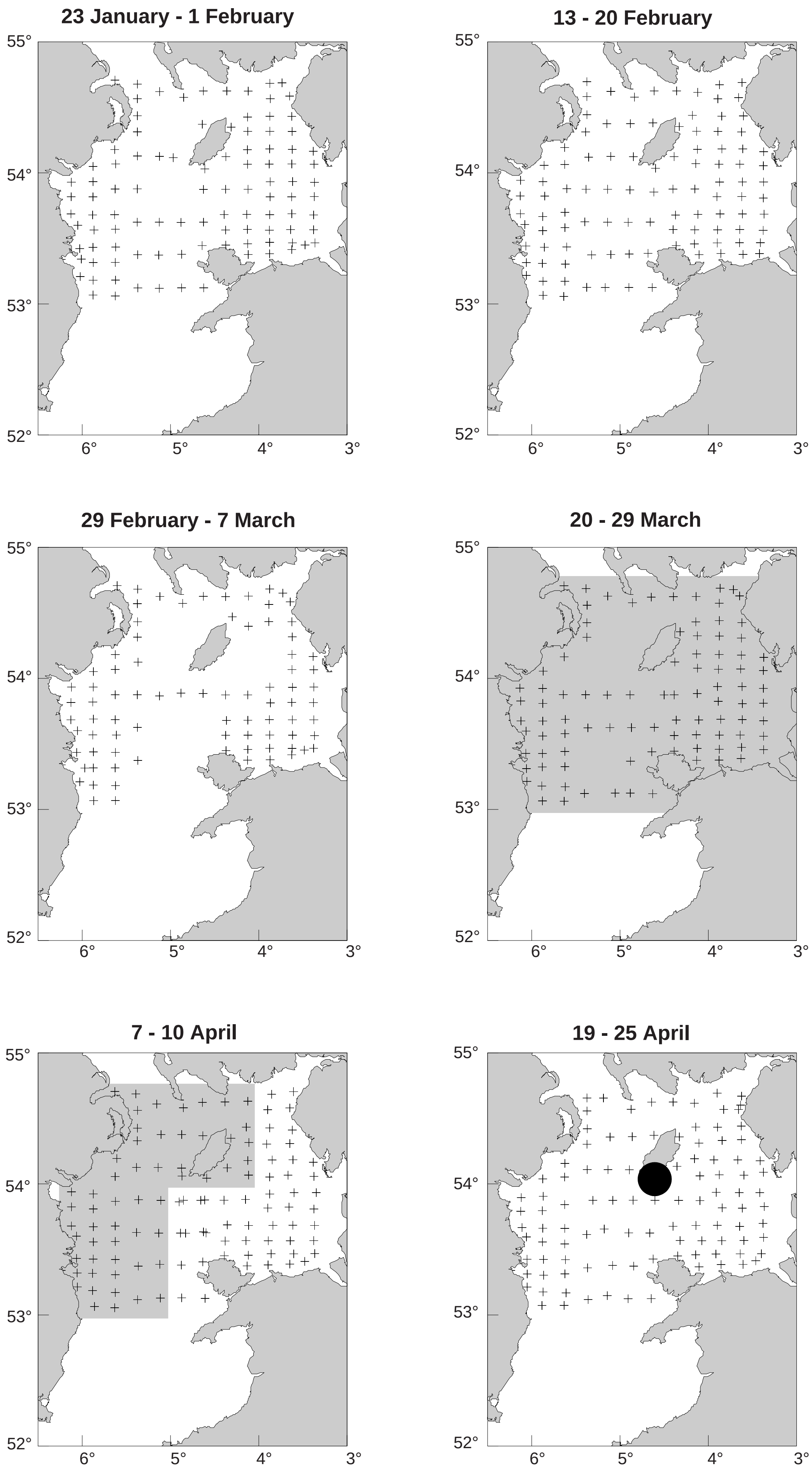
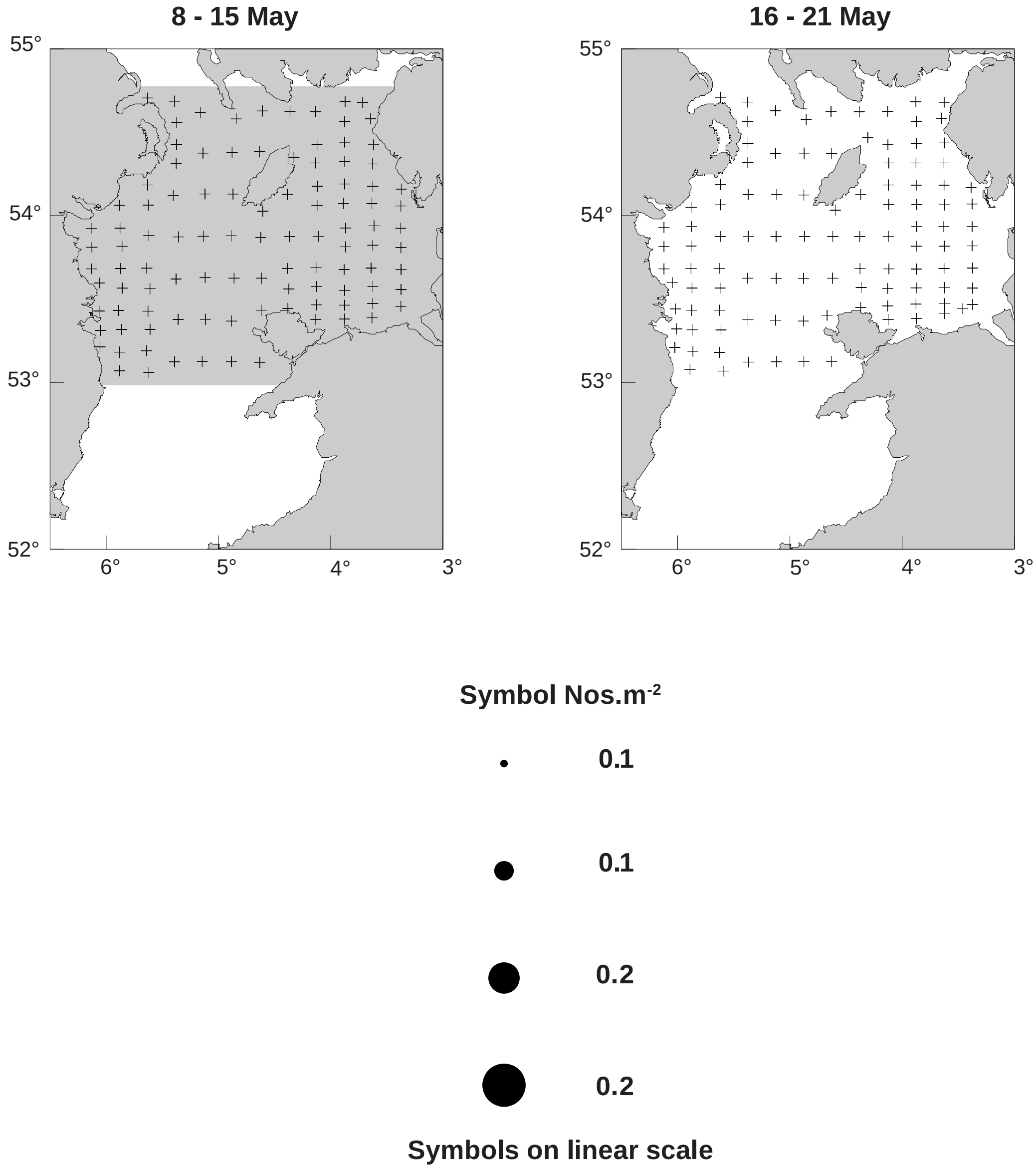


Figure 13. Concentration of Lesser silver smelt (Argentina sphyraena) larvae (nos.m^{-2}) in 2000



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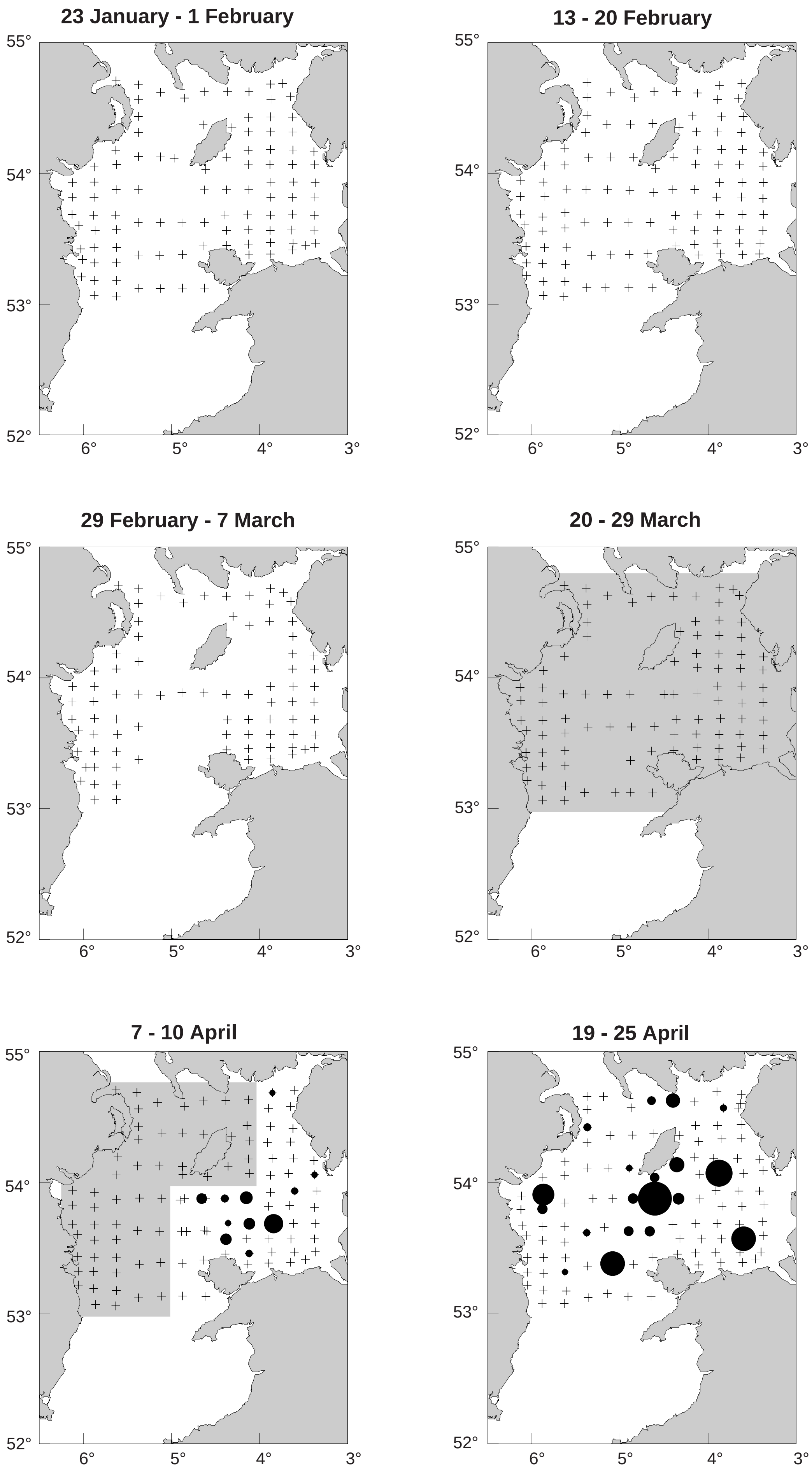
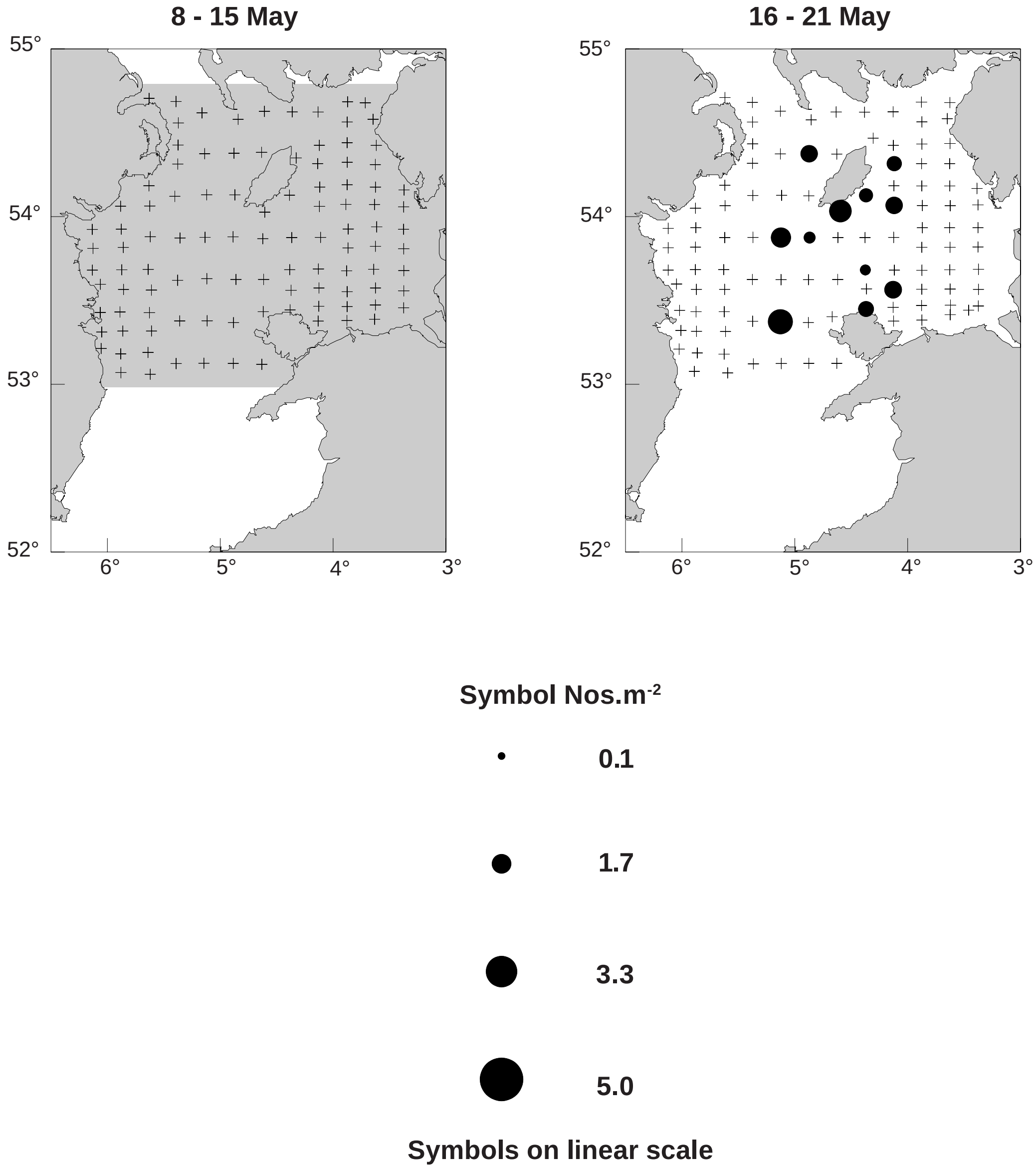


Figure 14. Concentration of Norway pout and poor cod (Gadidae) larvae (nos.m^{-2}) in 2000



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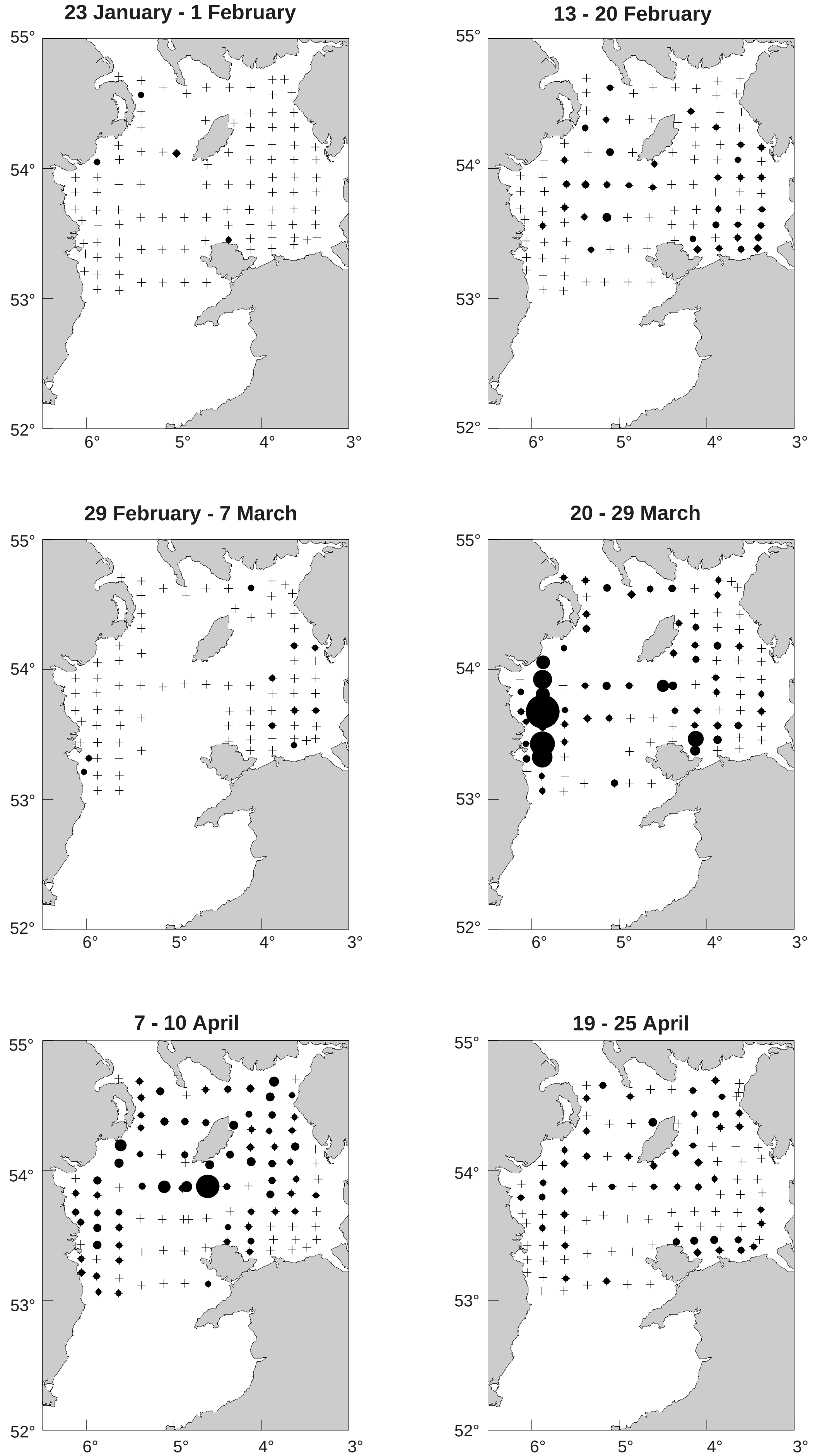
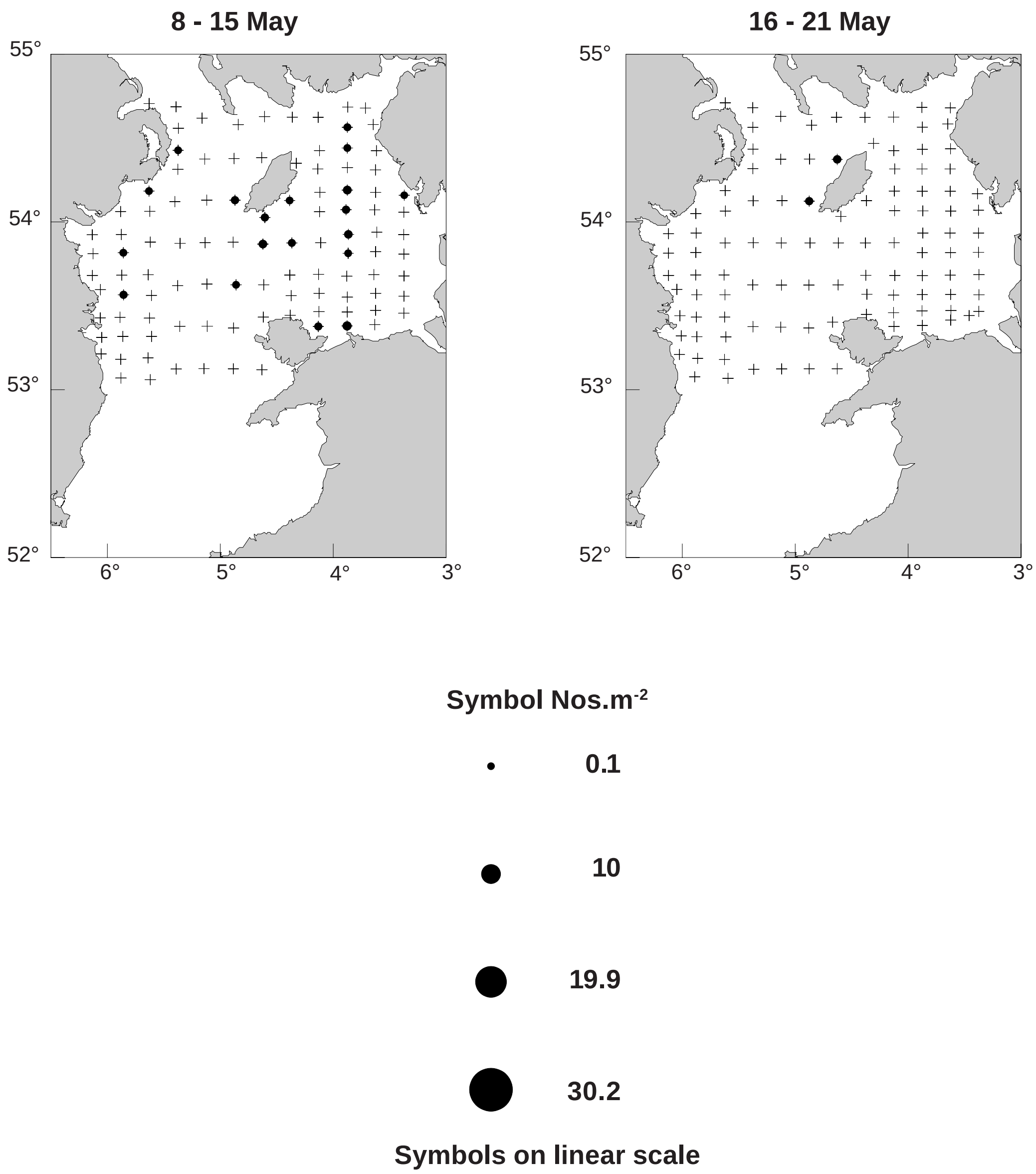


Figure 15. Concentration of late-stage cod (Gadus morhua) eggs (nos.m^{-2}) in 2000



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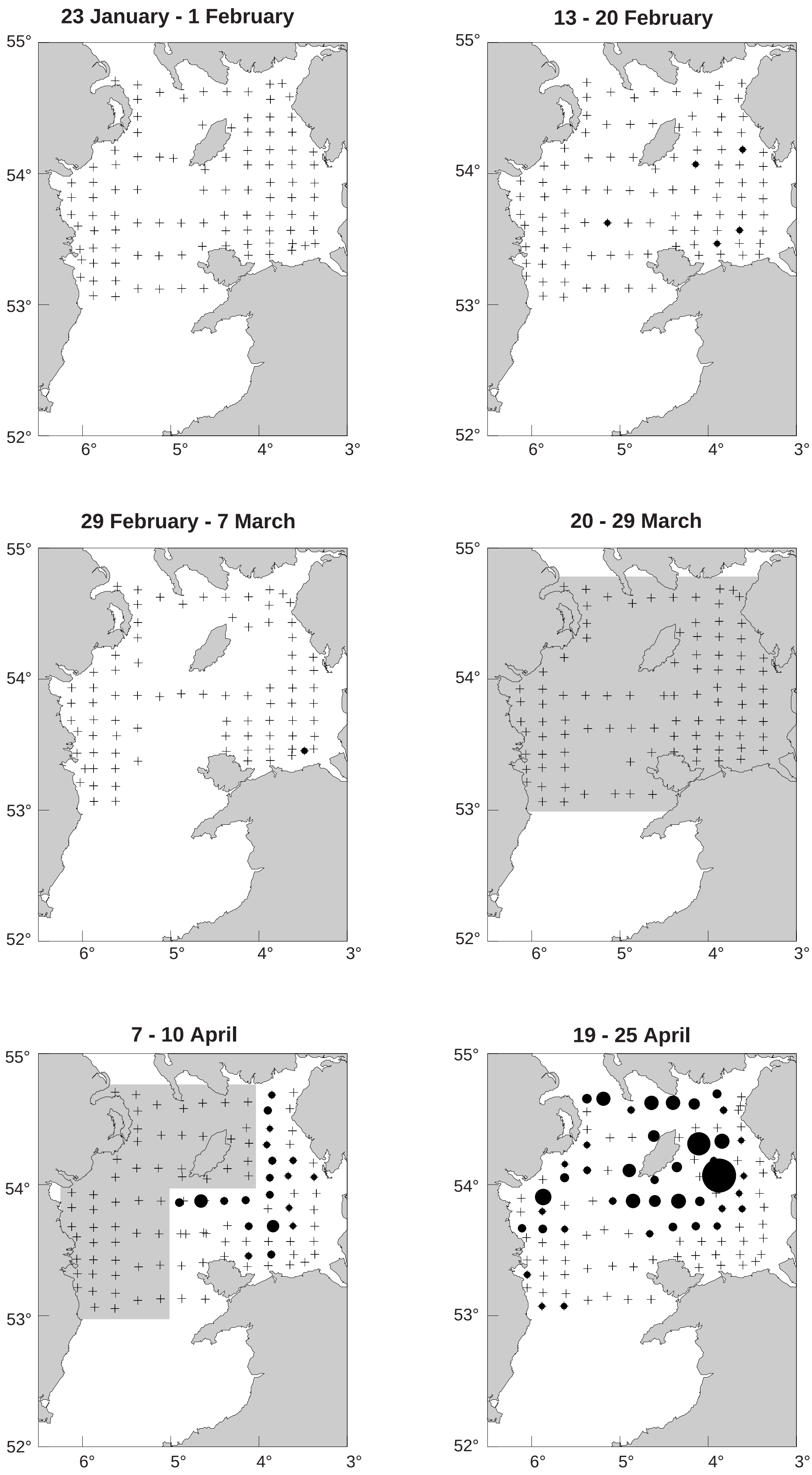
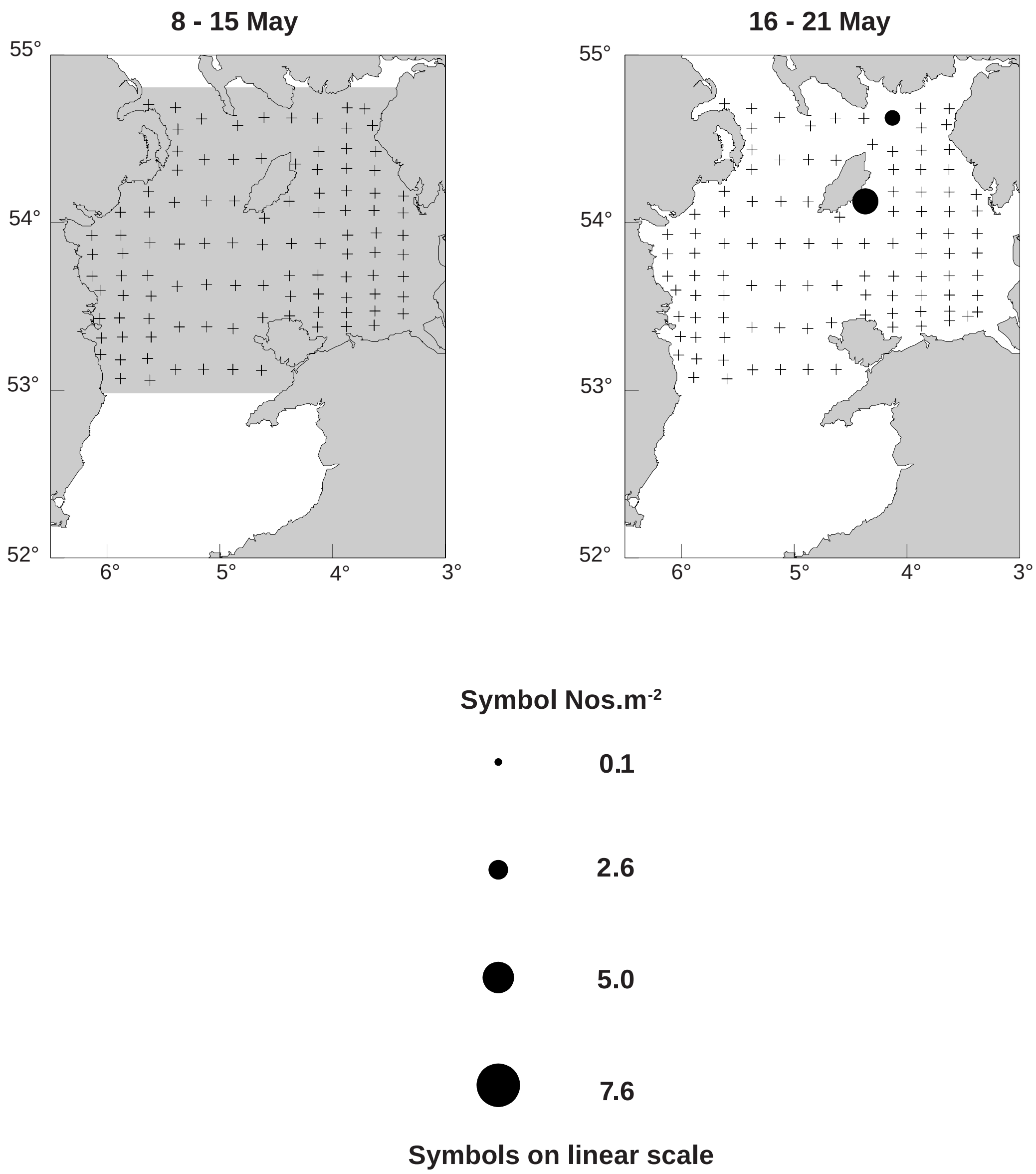


Figure 16. Concentration of cod (Gadus morhua) larvae (nos.m^{-2}) in 2000



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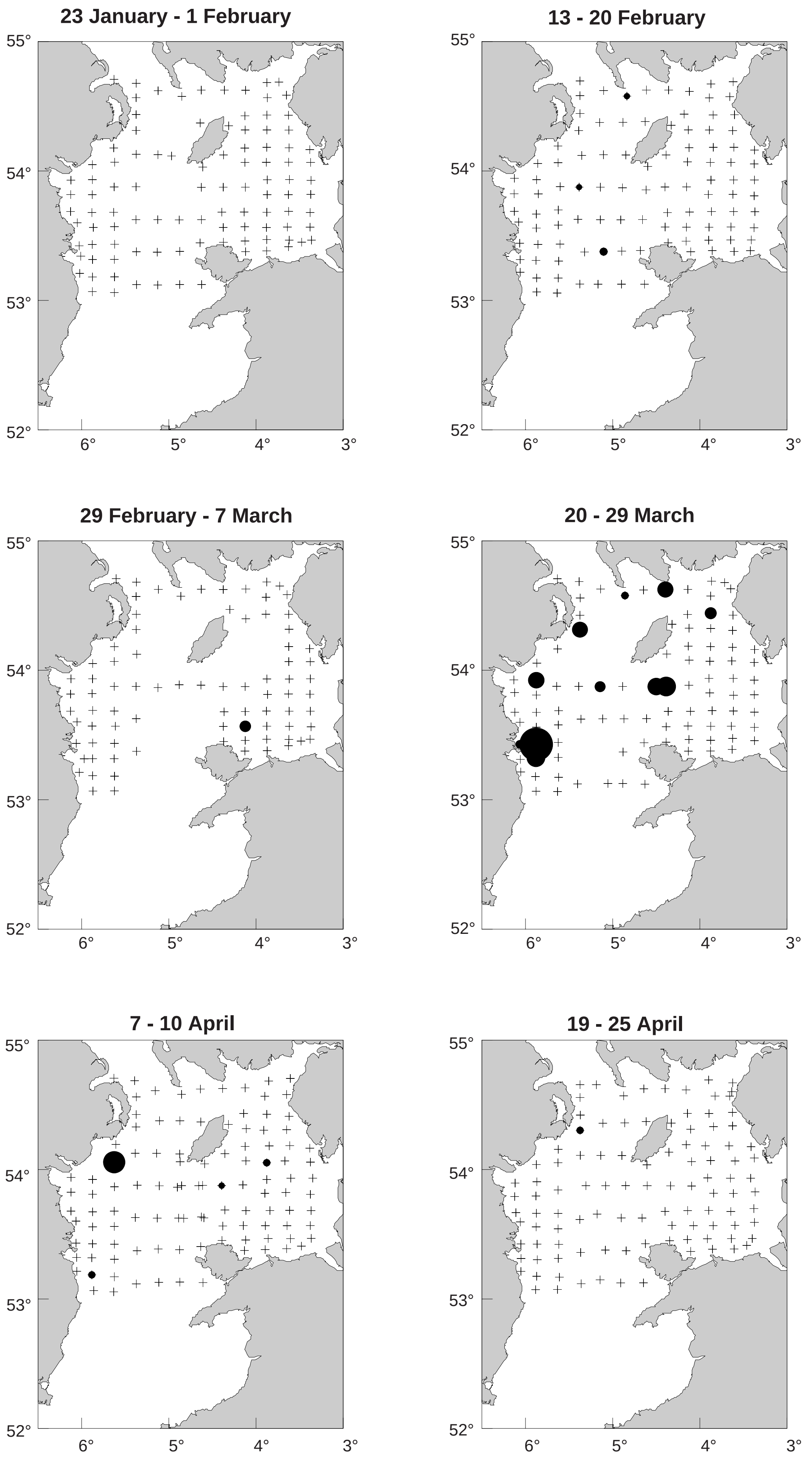
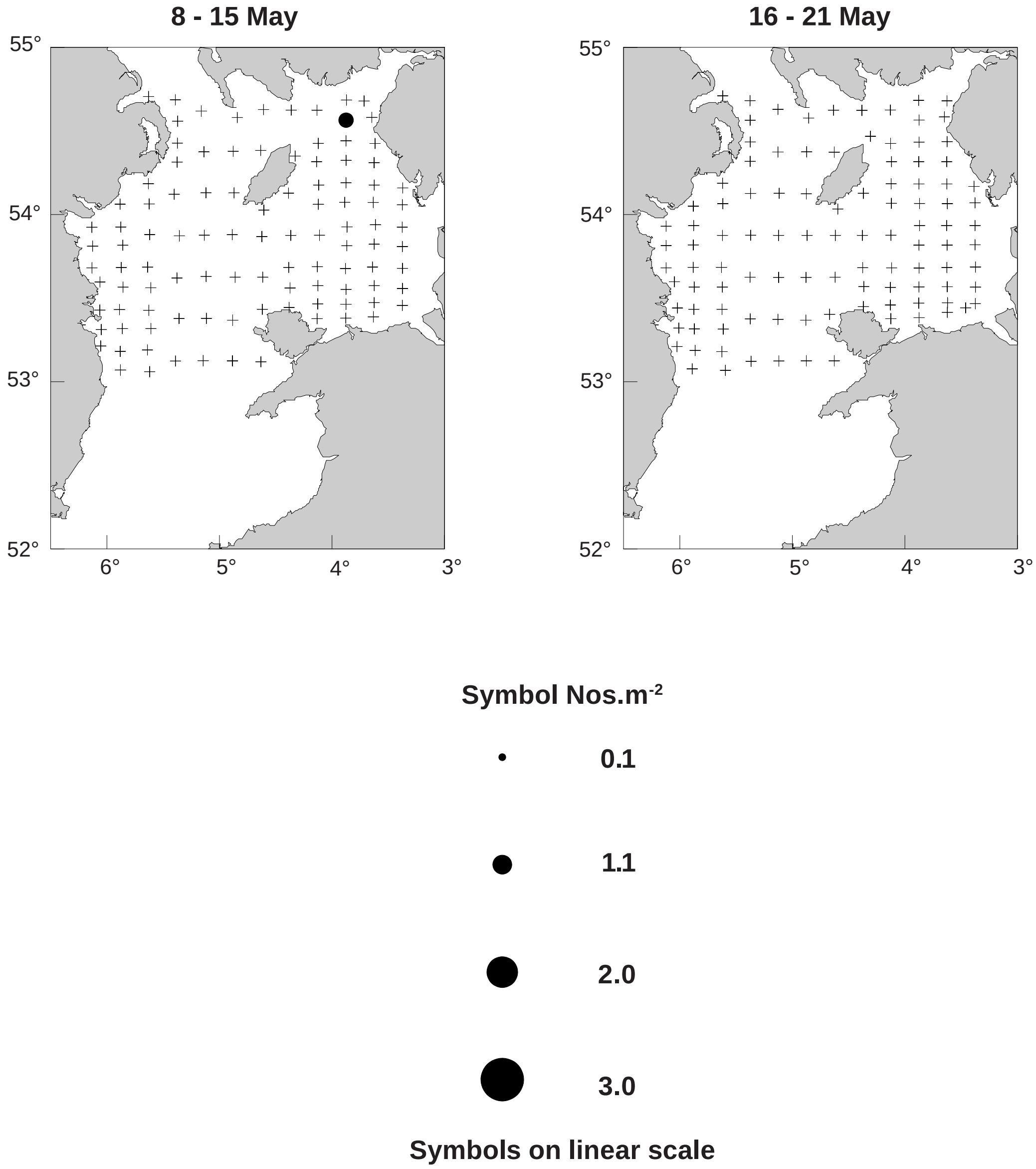


Figure 17. Concentration of late-stage haddock (Melanogrammus aeglefinus) eggs (nos.m^{-2}) in 2000



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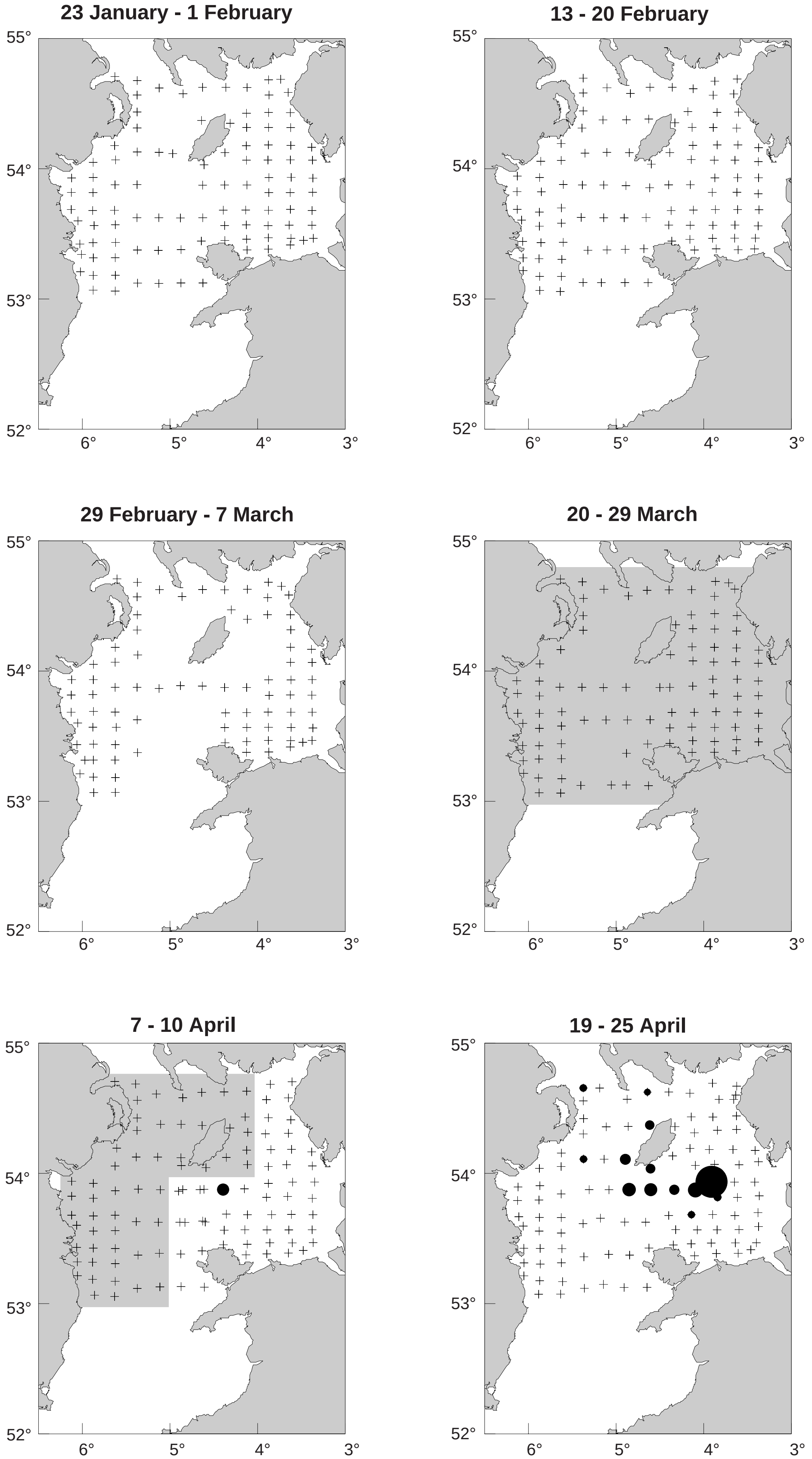
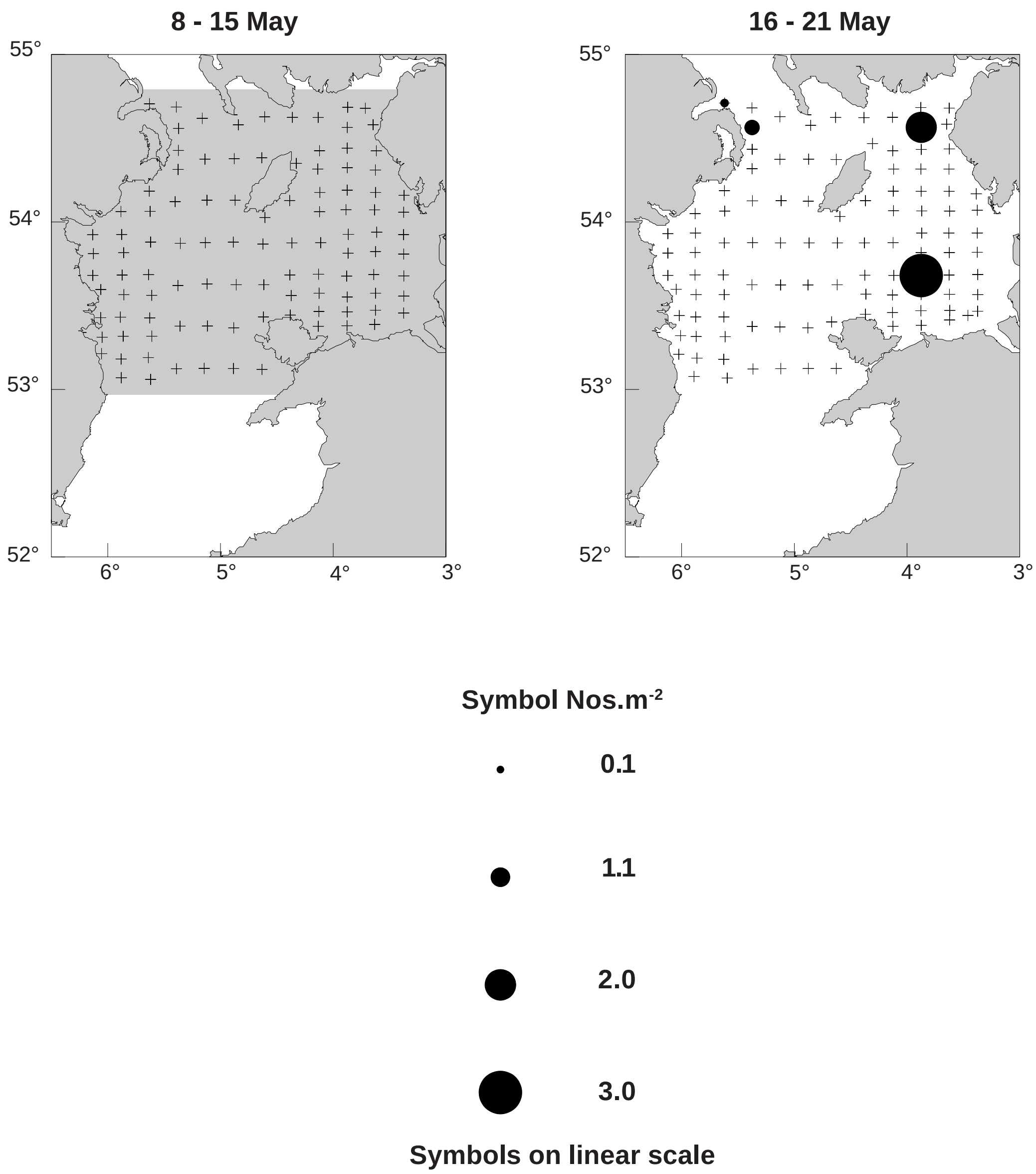


Figure 18. Concentration of haddock (Melanogrammus aeglefinus) larvae (nos.m^{-2}) in 2000



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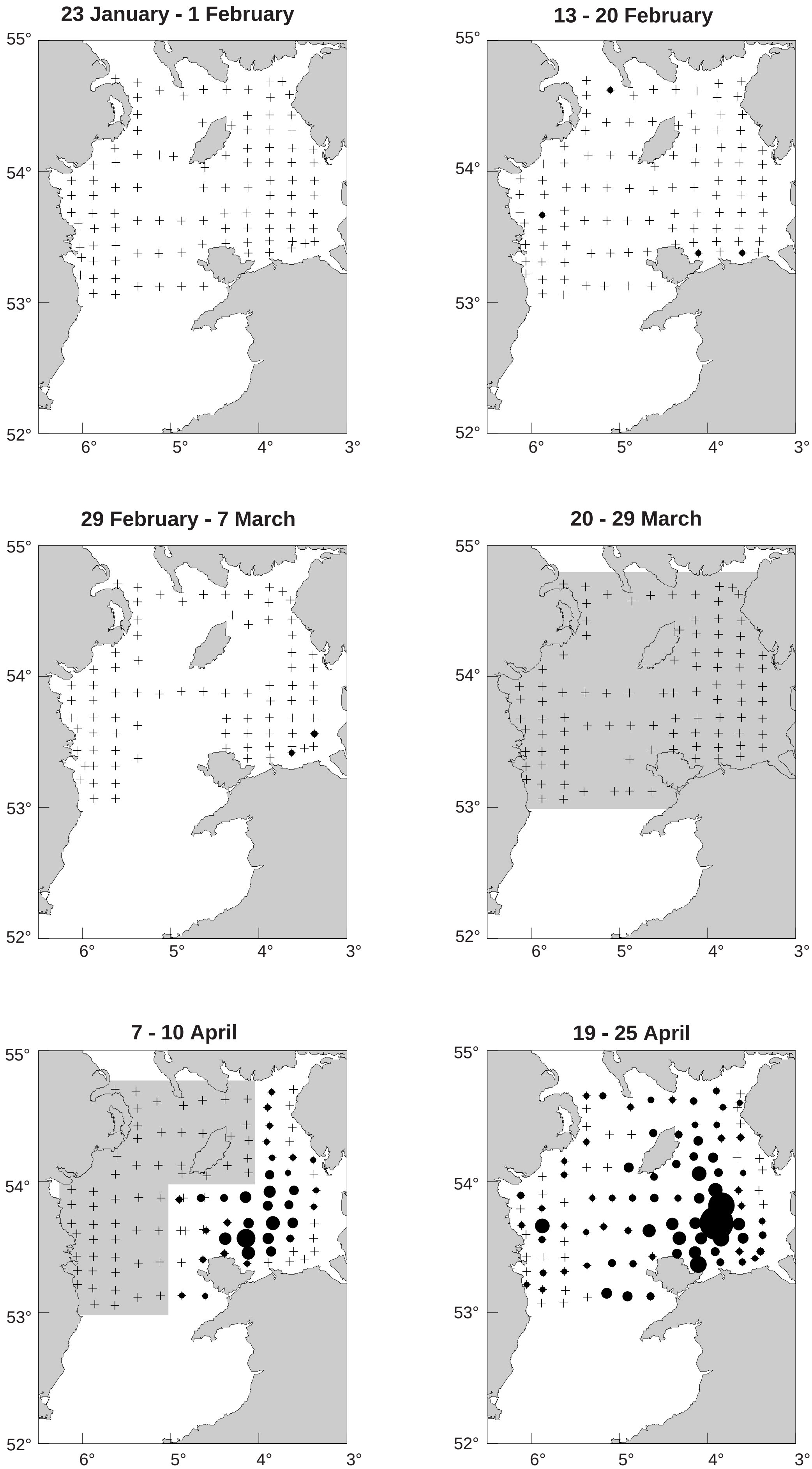
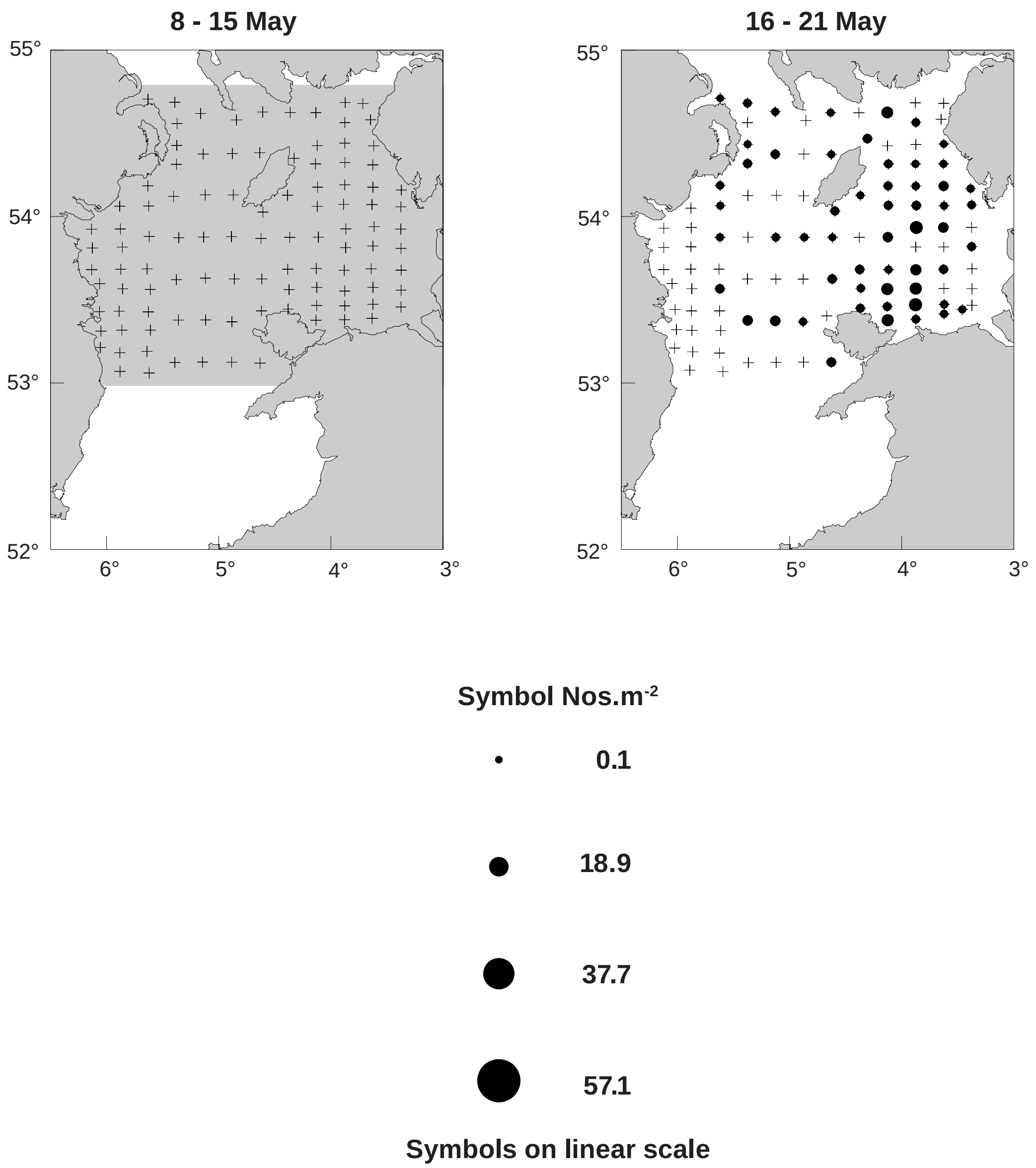


Figure 19. Concentration of whiting (Melangius merlangus) larvae (nos.m^{-2}) in 2000



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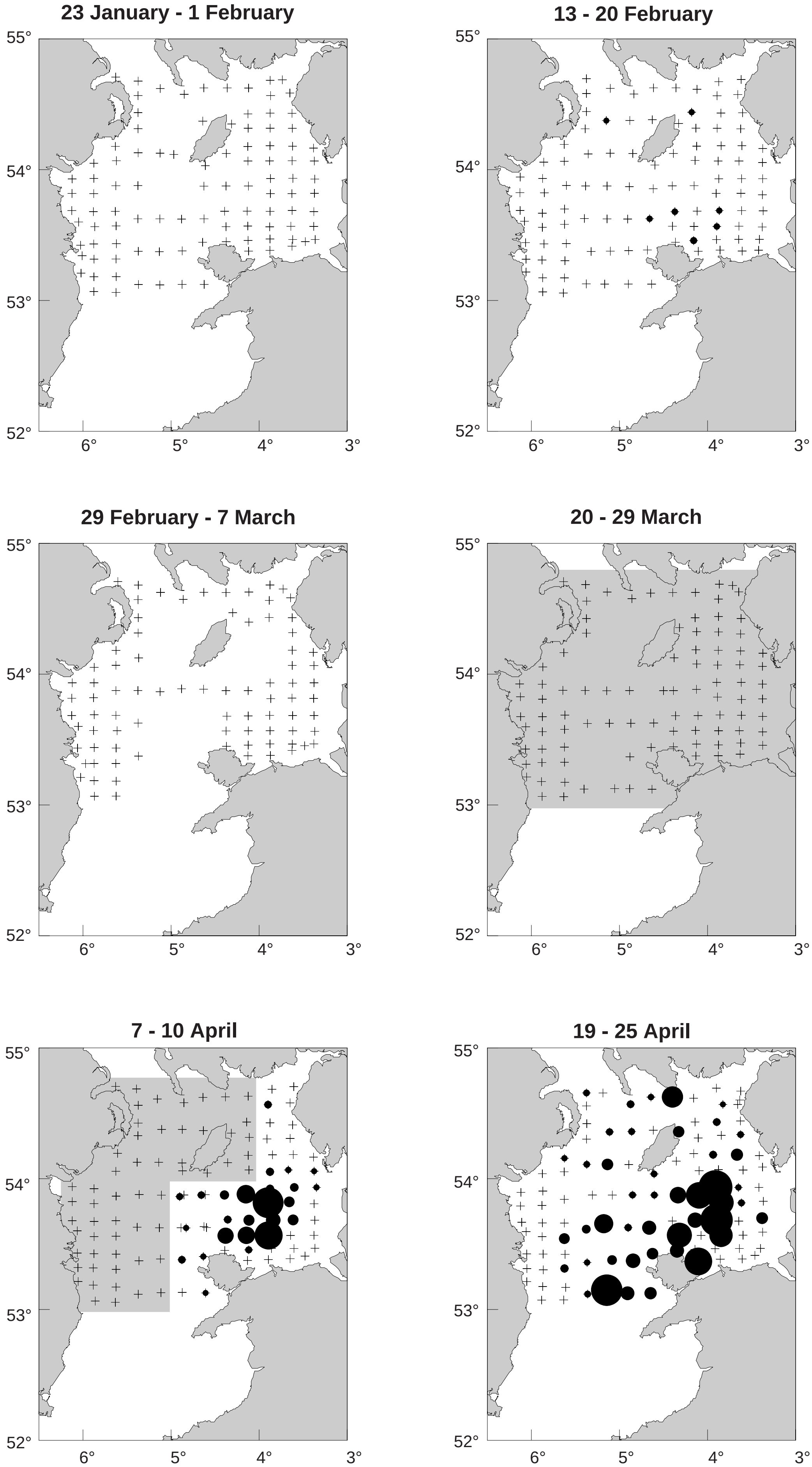
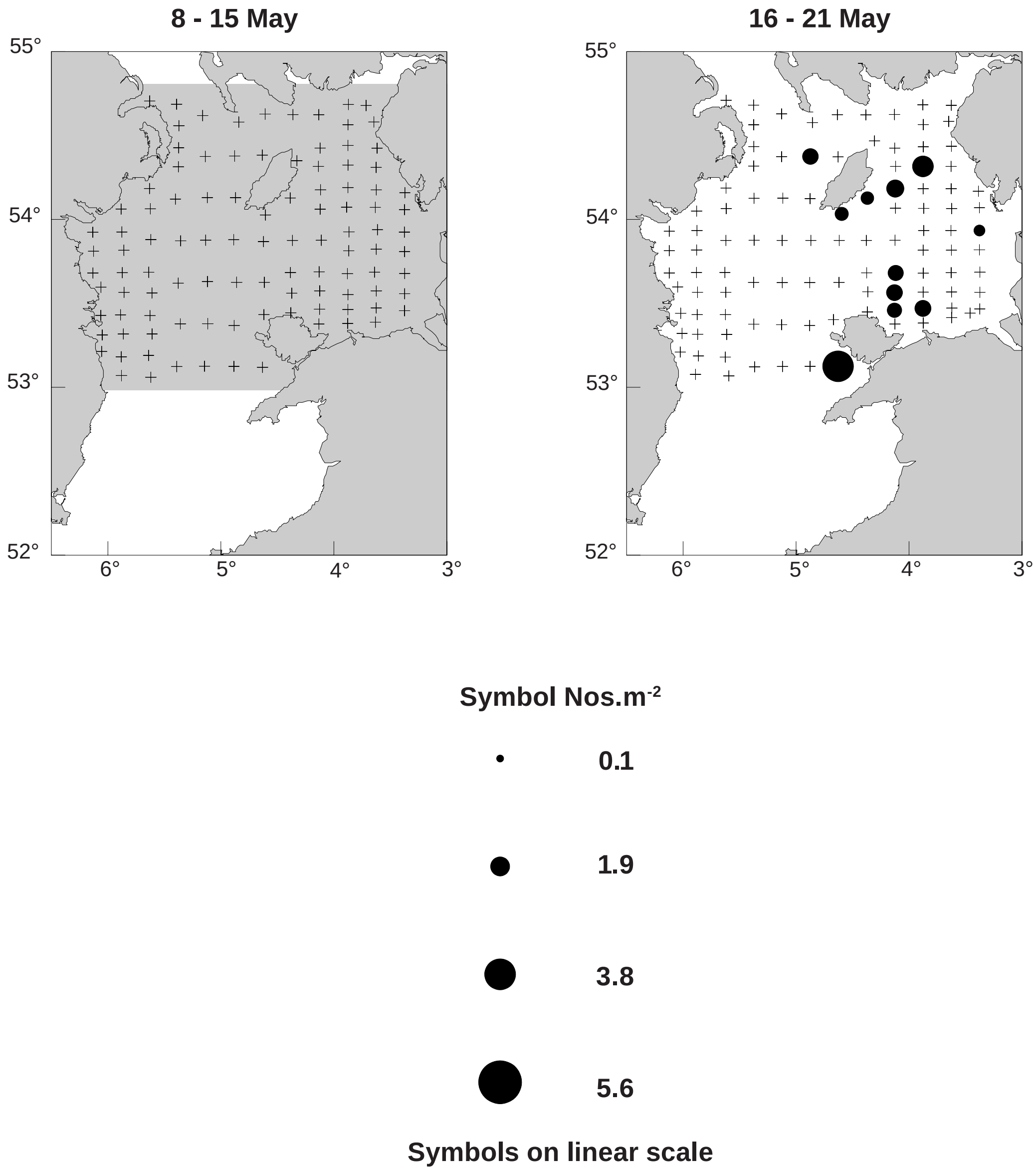


Figure 20. Concentration of bib (Trisopterus luscus) larvae (nos.m^{-2}) in 2000



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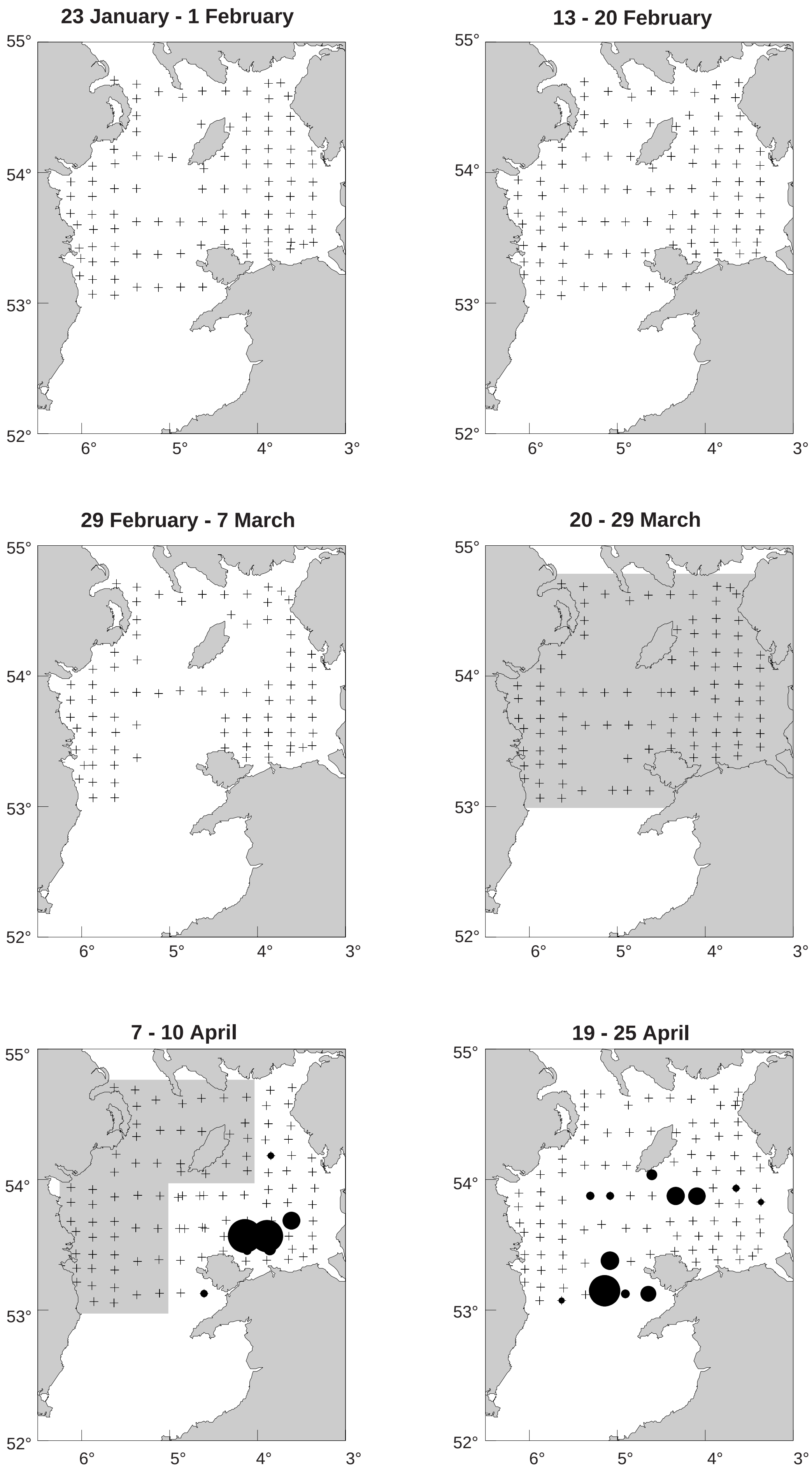
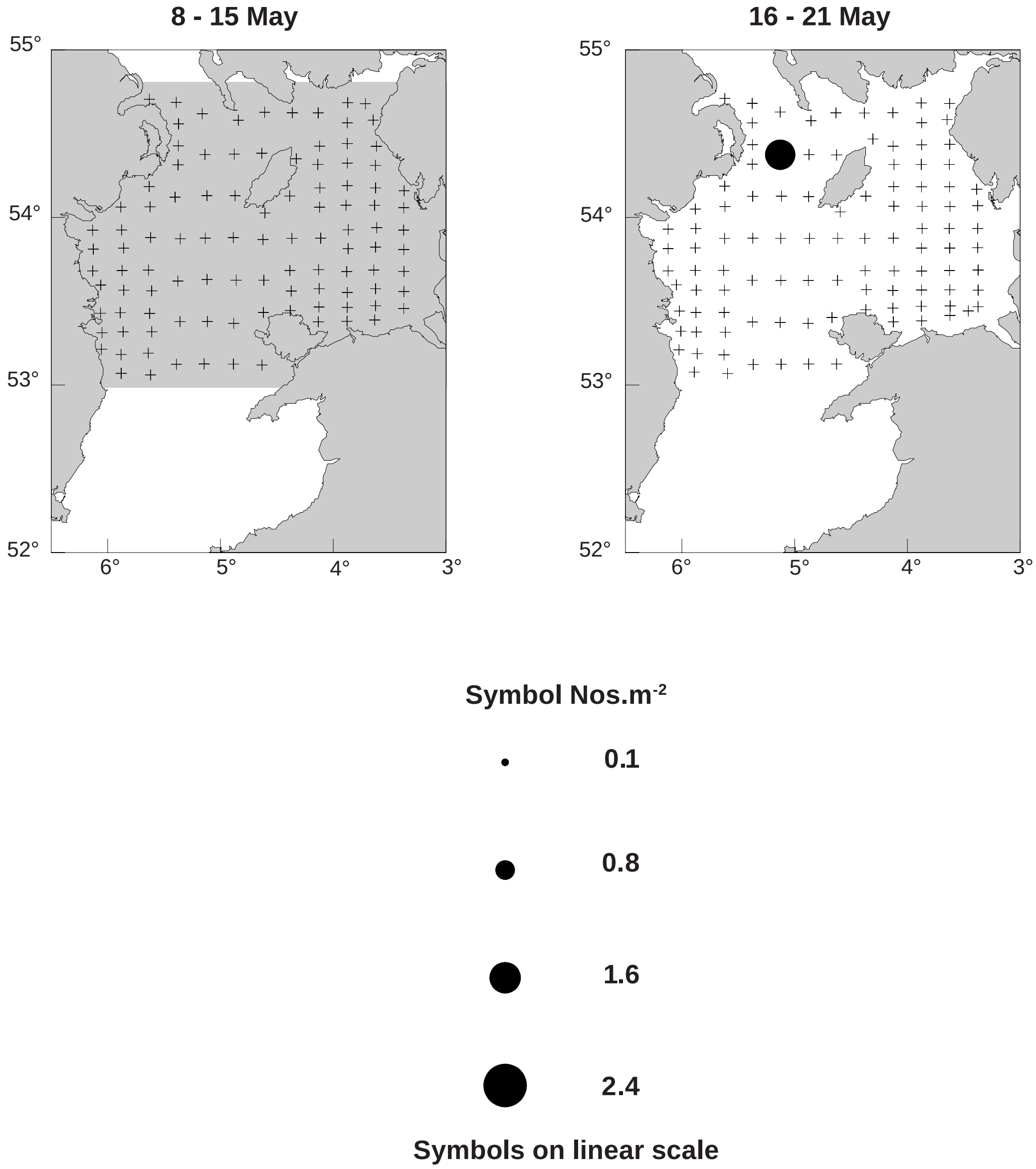


Figure 21. Concentration of pollack (Pollachius pollachius) larvae (nos.m^{-2}) in 2000



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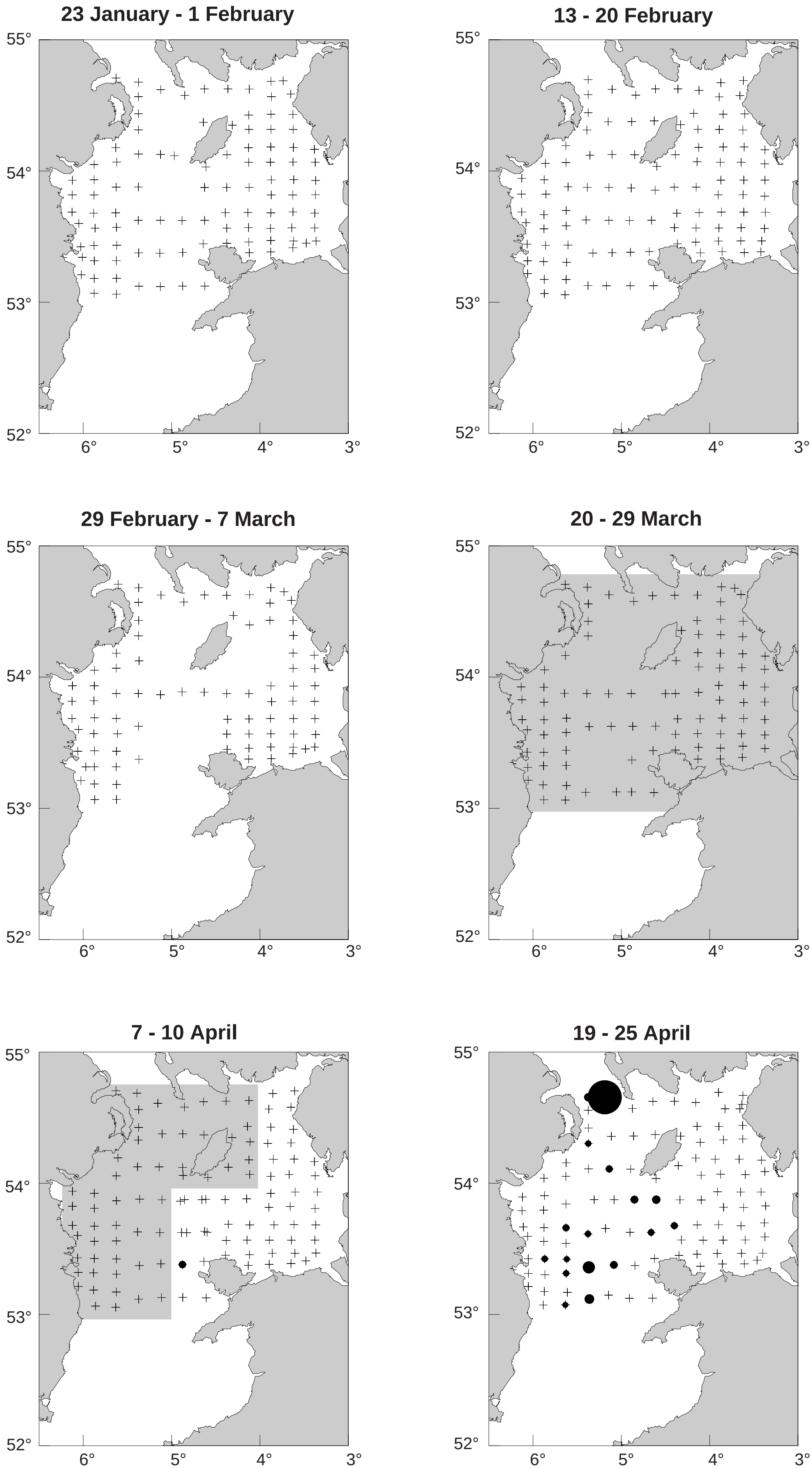
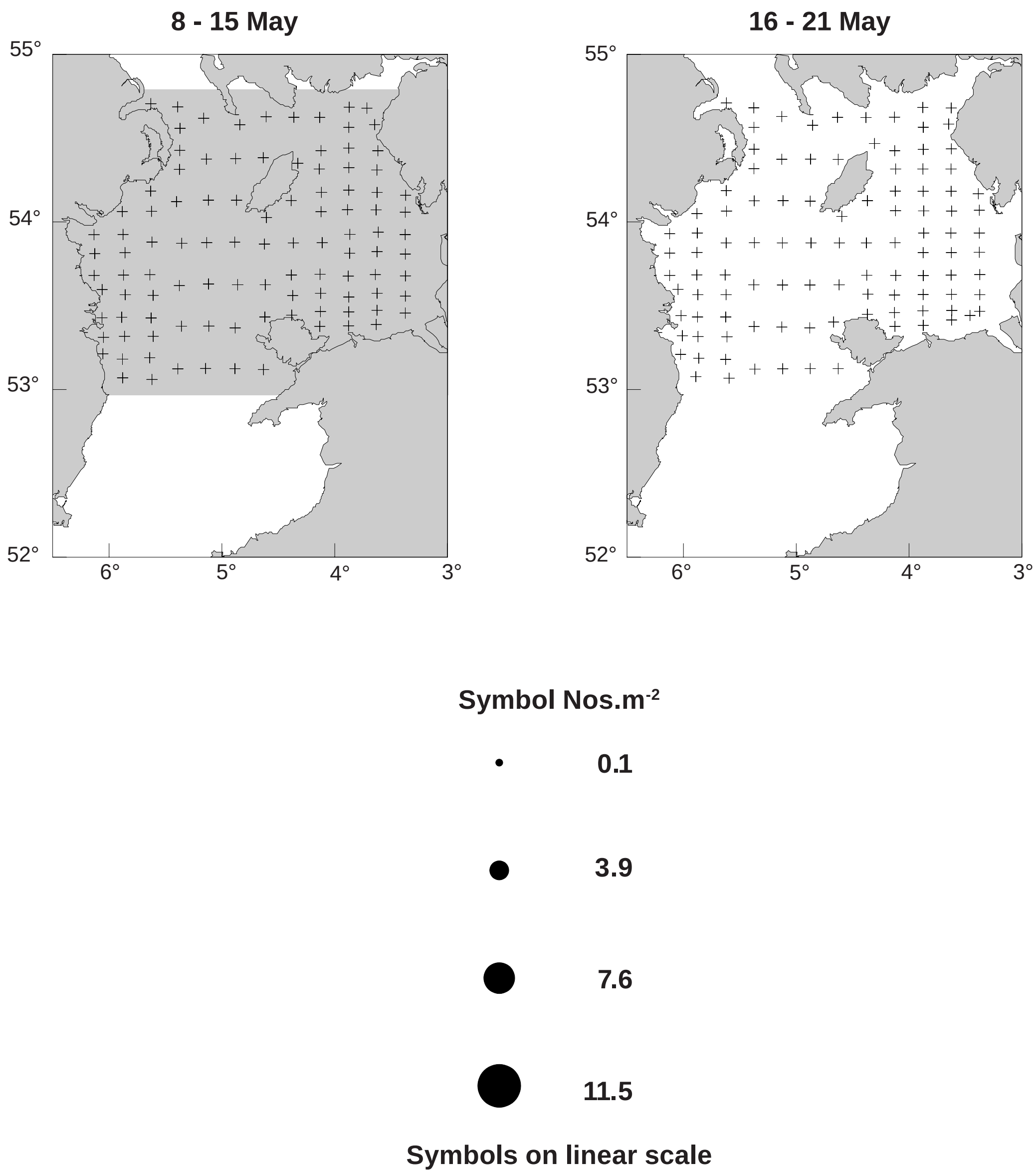


Figure 22. Concentration of ling (Molva molva) eggs (nos.m⁻²) in 2000



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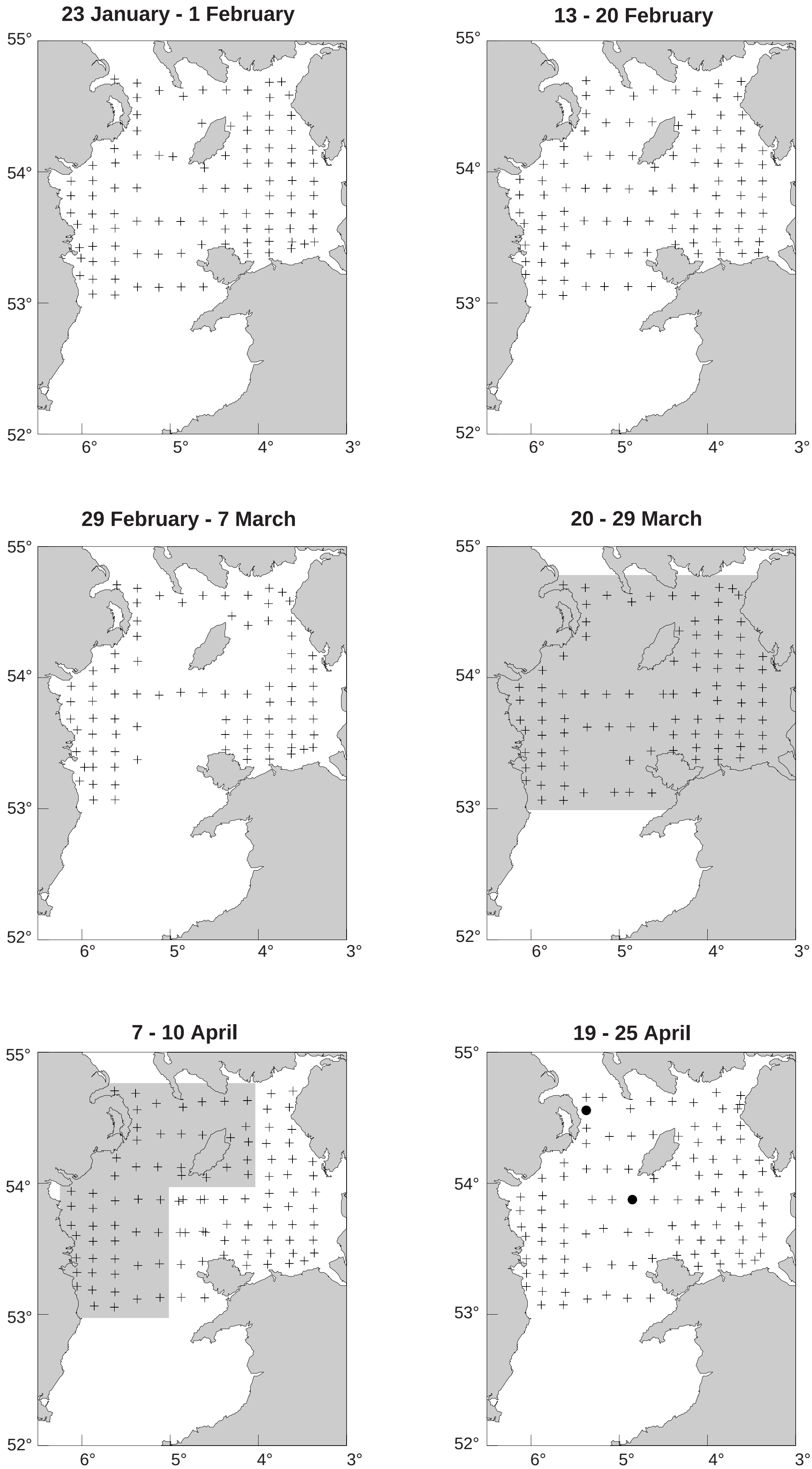
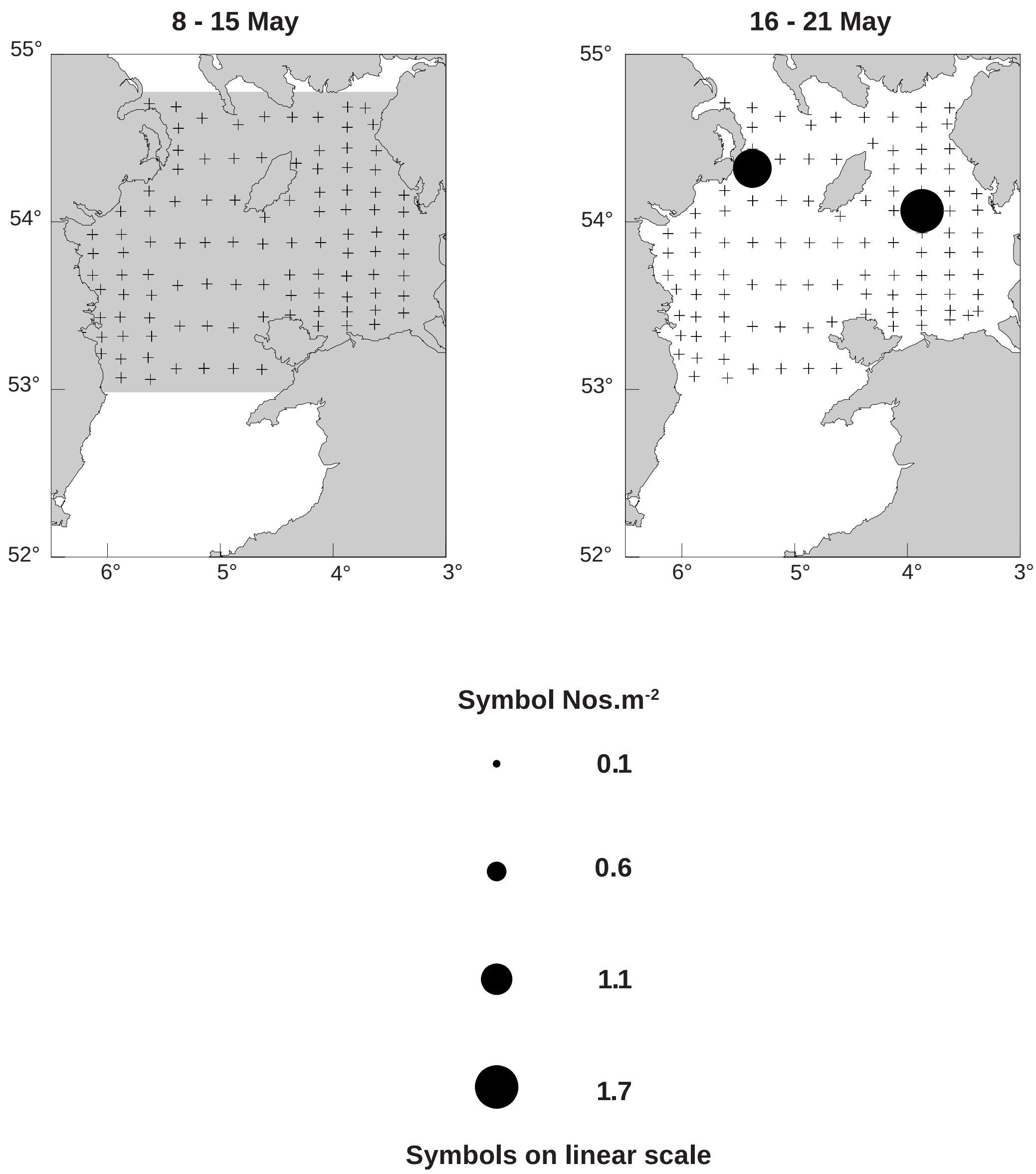


Figure 23. Concentration of ling (Molva molva) larvae (nos.m^{-2}) in 2000



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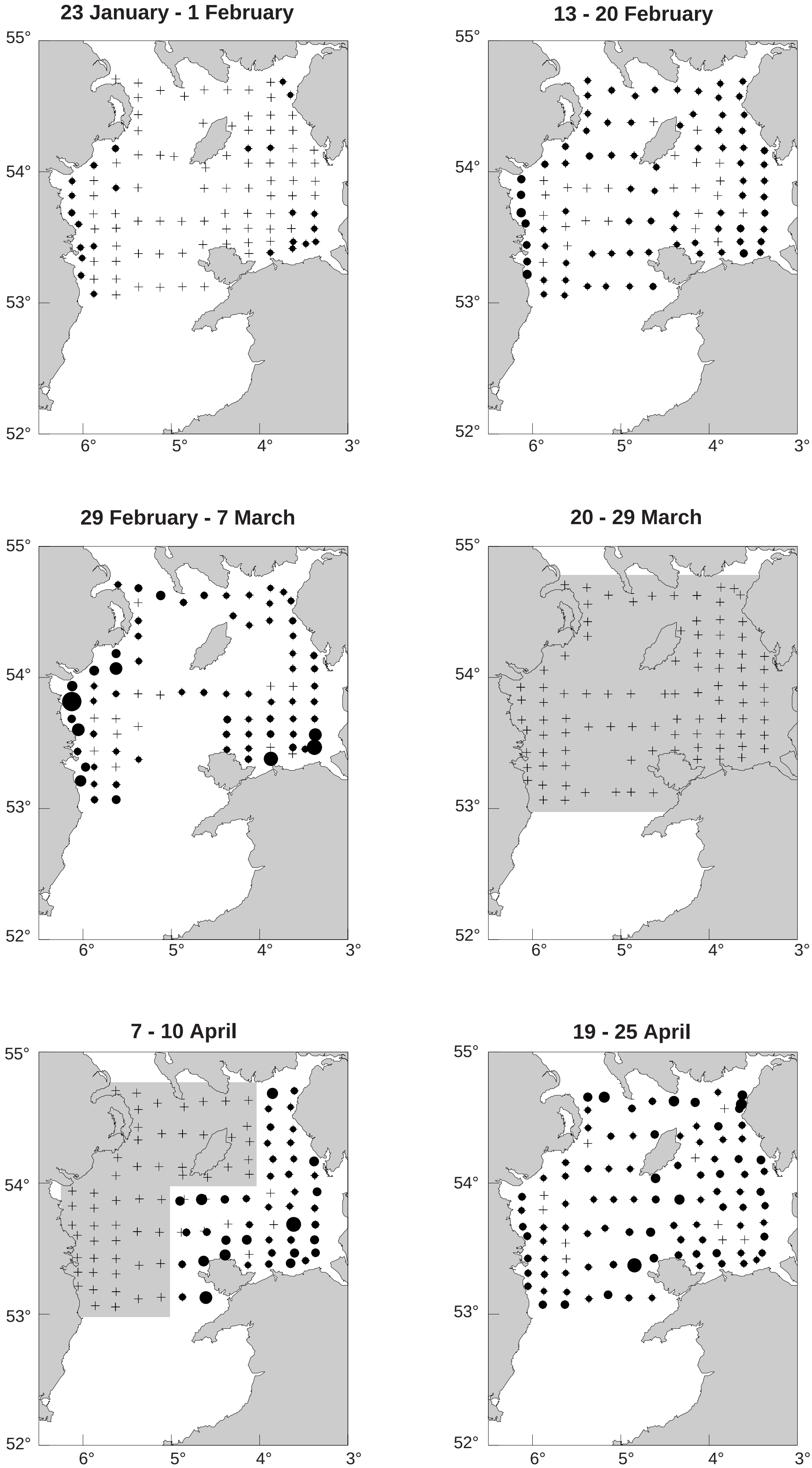
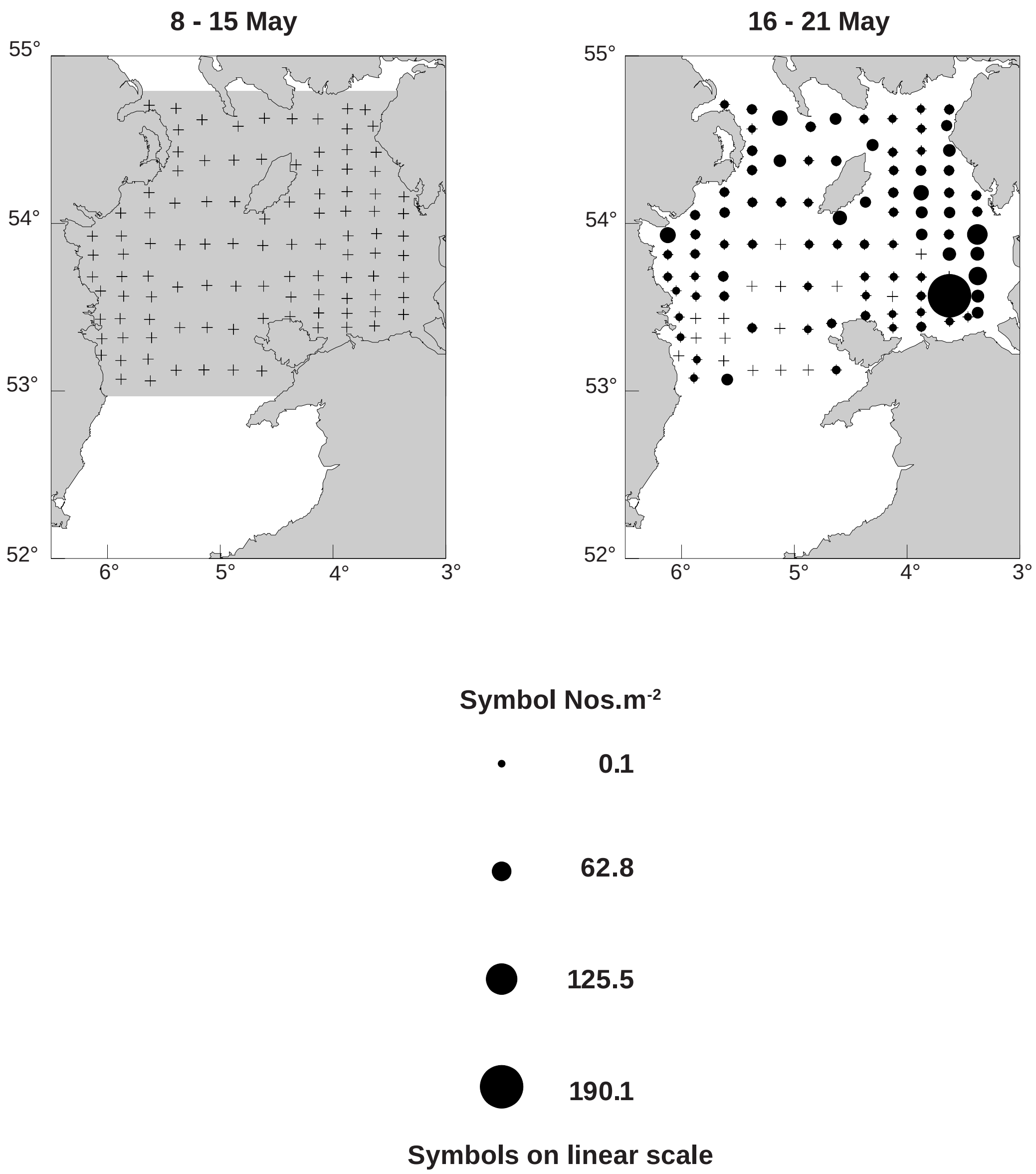


Figure 24. Concentration of rockling (Gadidae) eggs (nos.m^{-2}) in 2000



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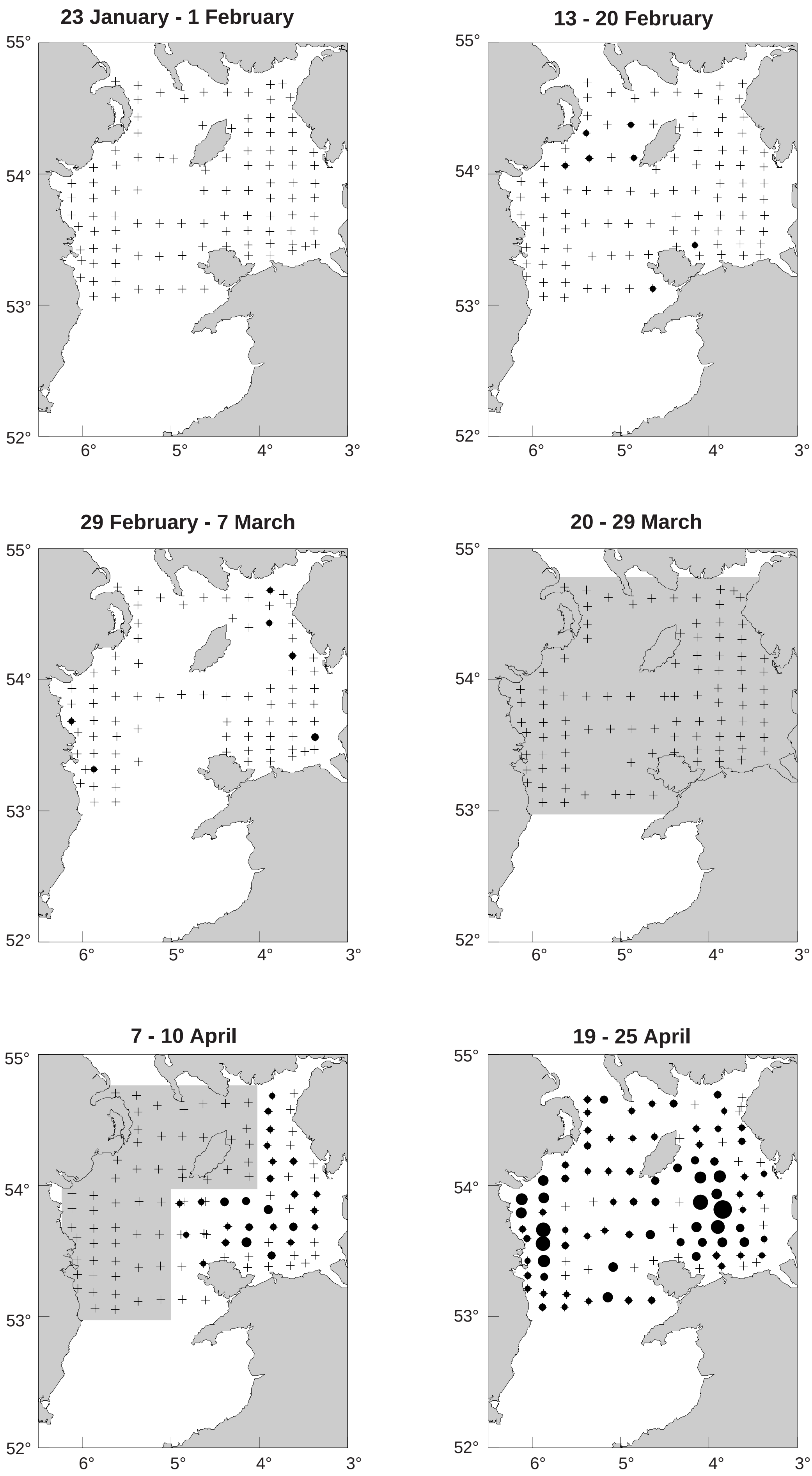
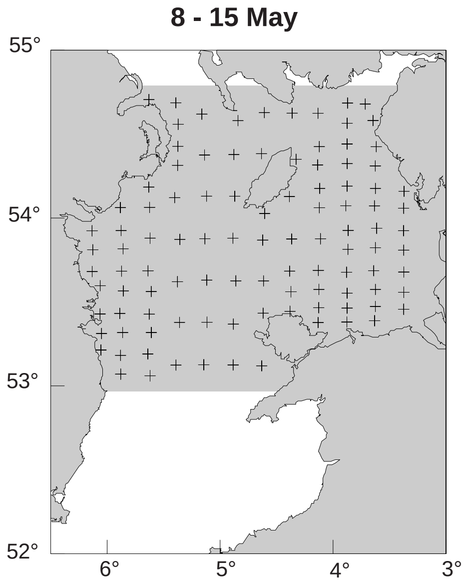
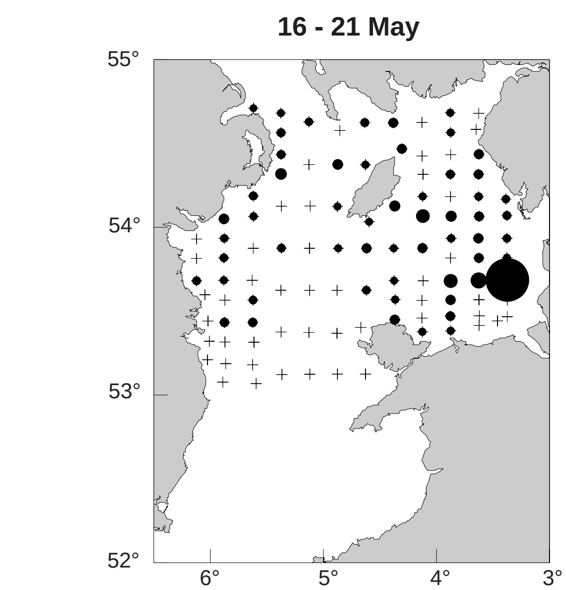


Figure 25. Concentration of rockling (Gadidae) larvae (nos.m^{-2}) in 2000





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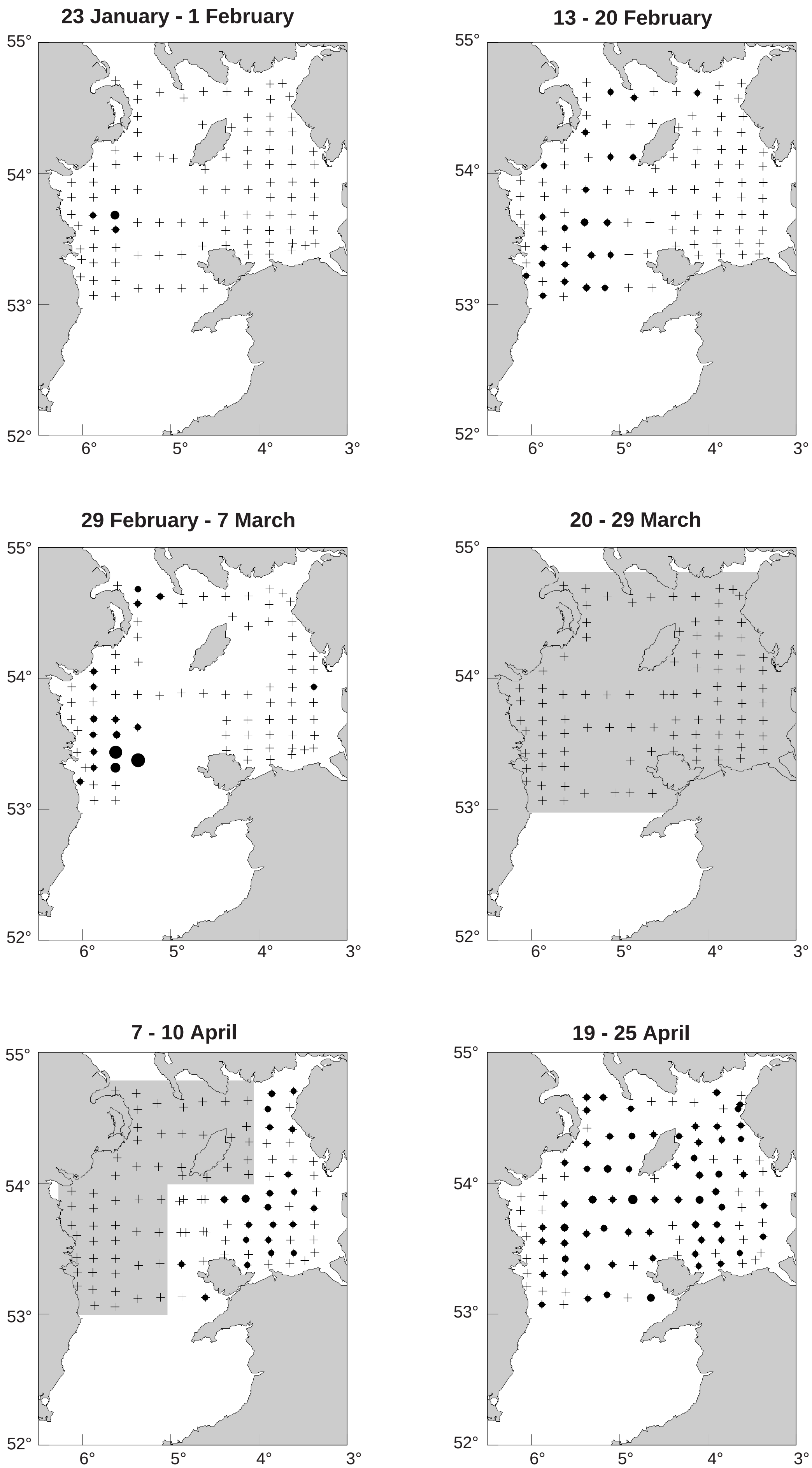
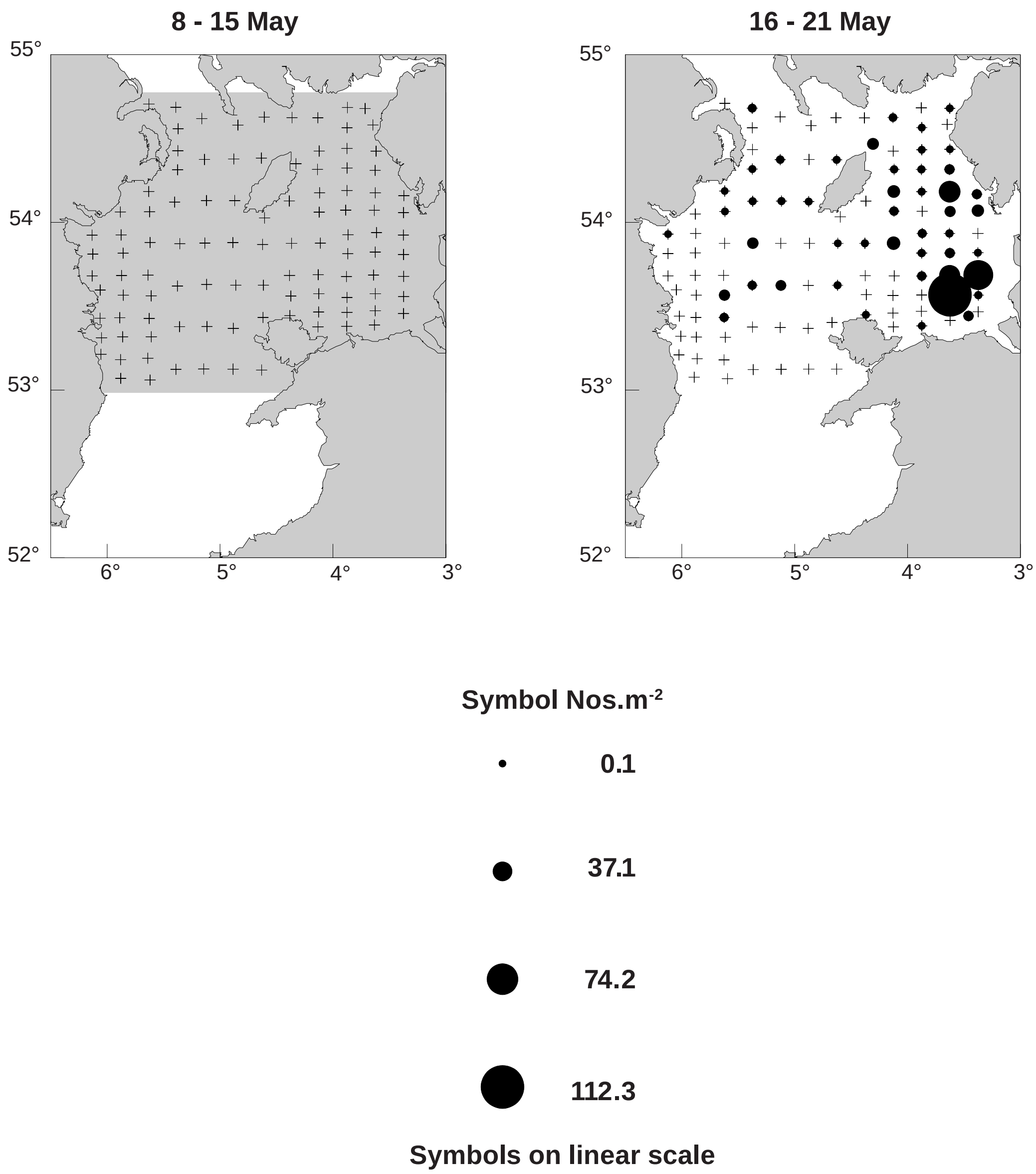


Figure 26. Concentration of gurnard (Triglidae) eggs (nos.m^{-2}) in 2000



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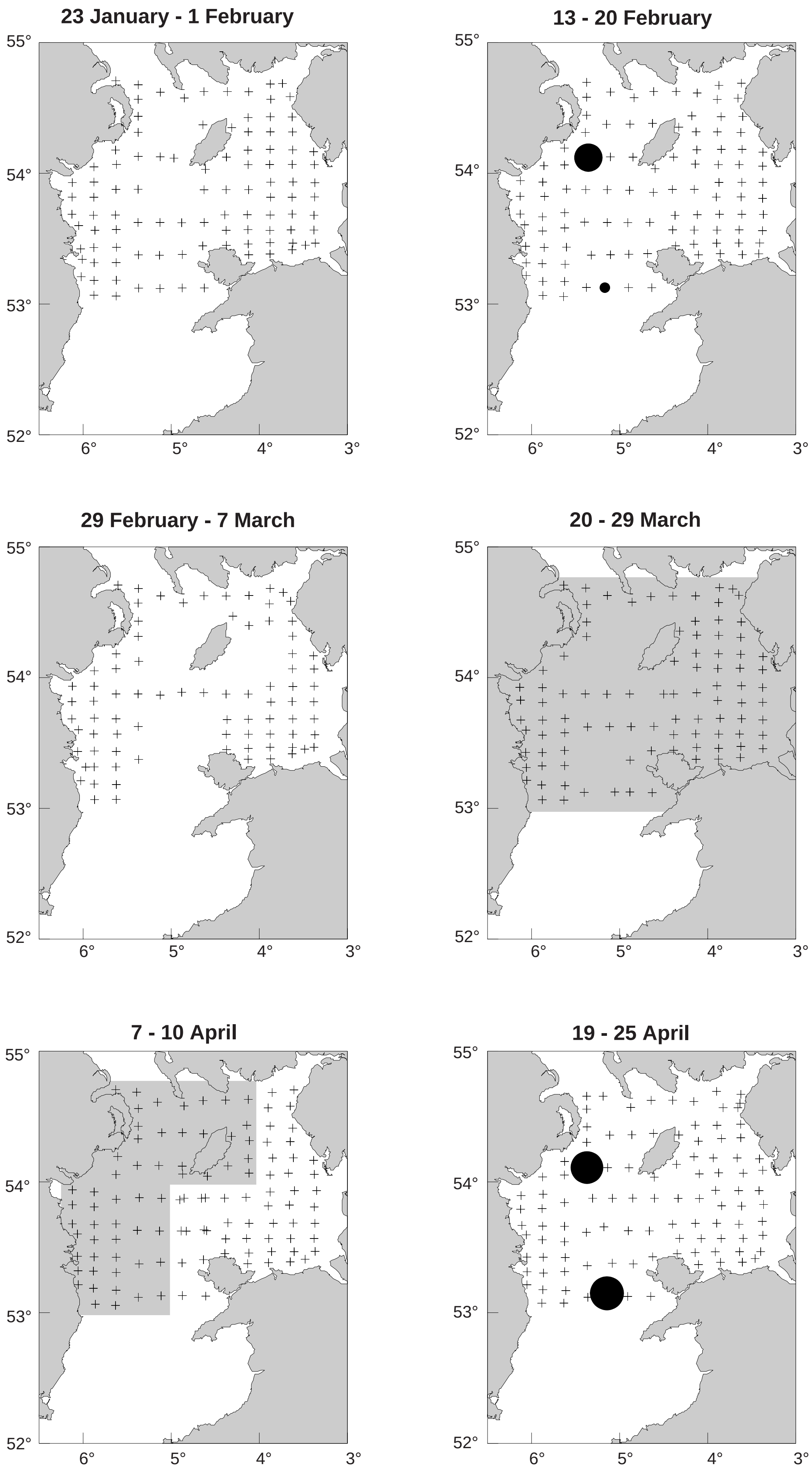
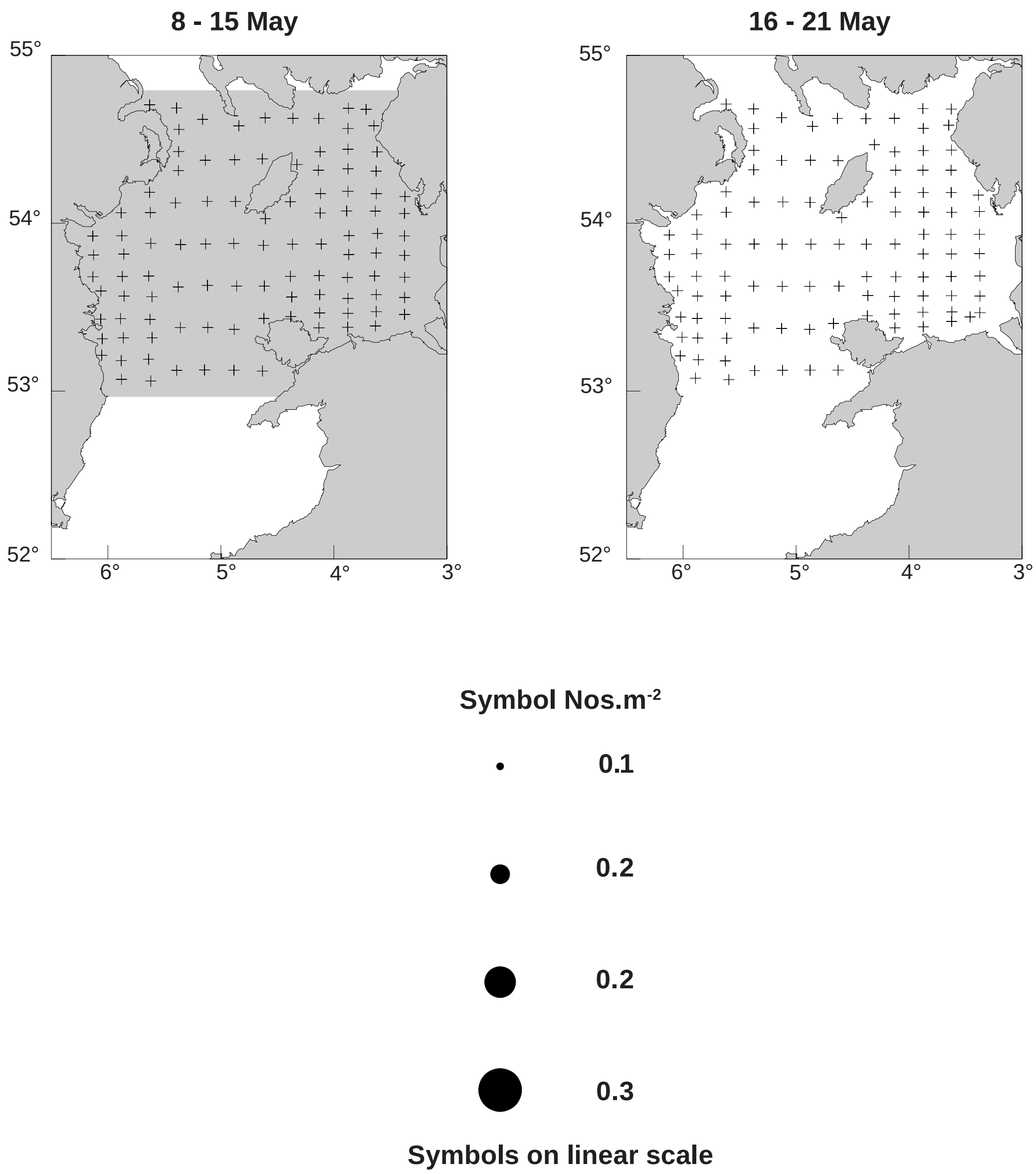


Figure 27. Concentration of gurnard (Triglidae) larvae (nos.m^{-2}) in 2000



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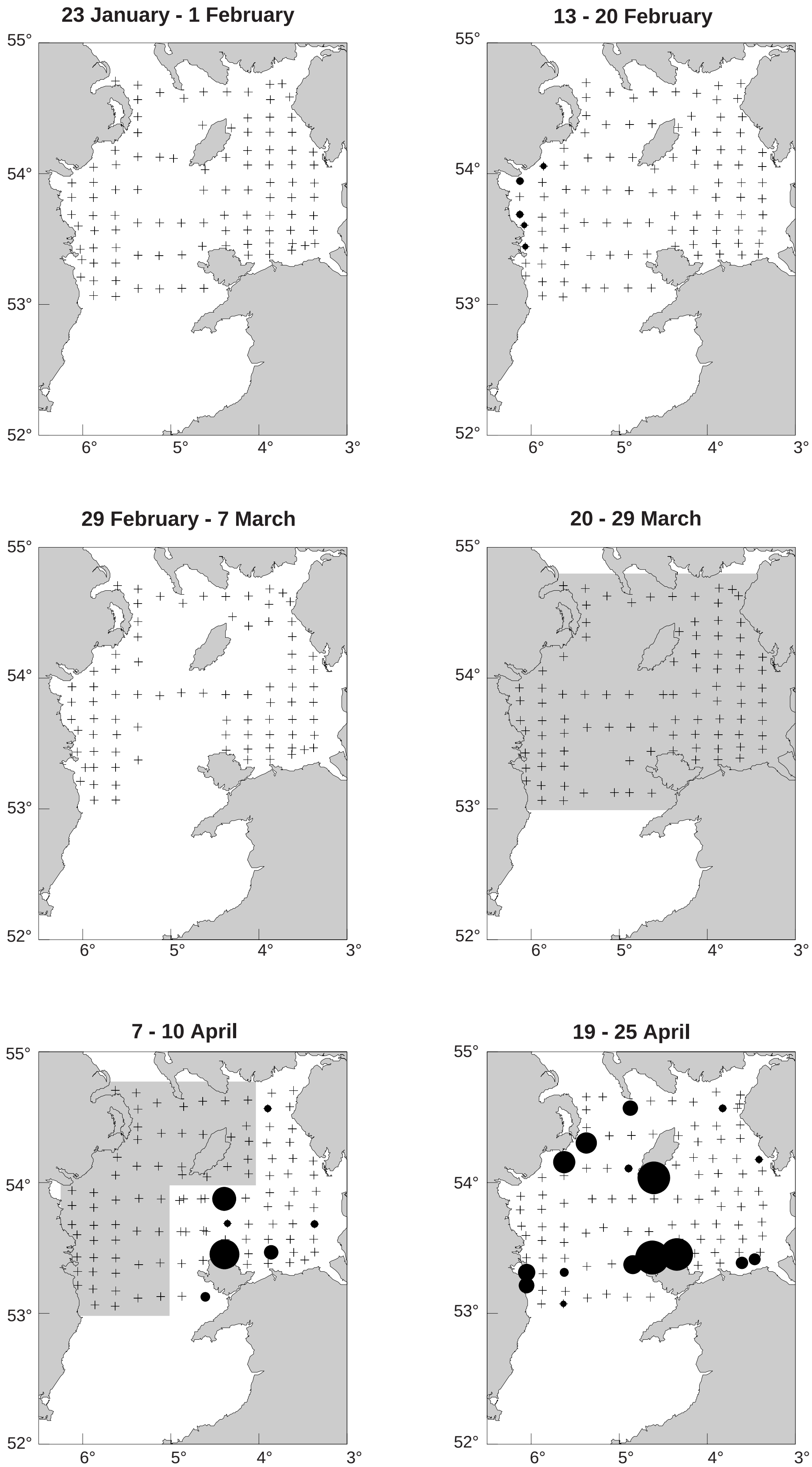
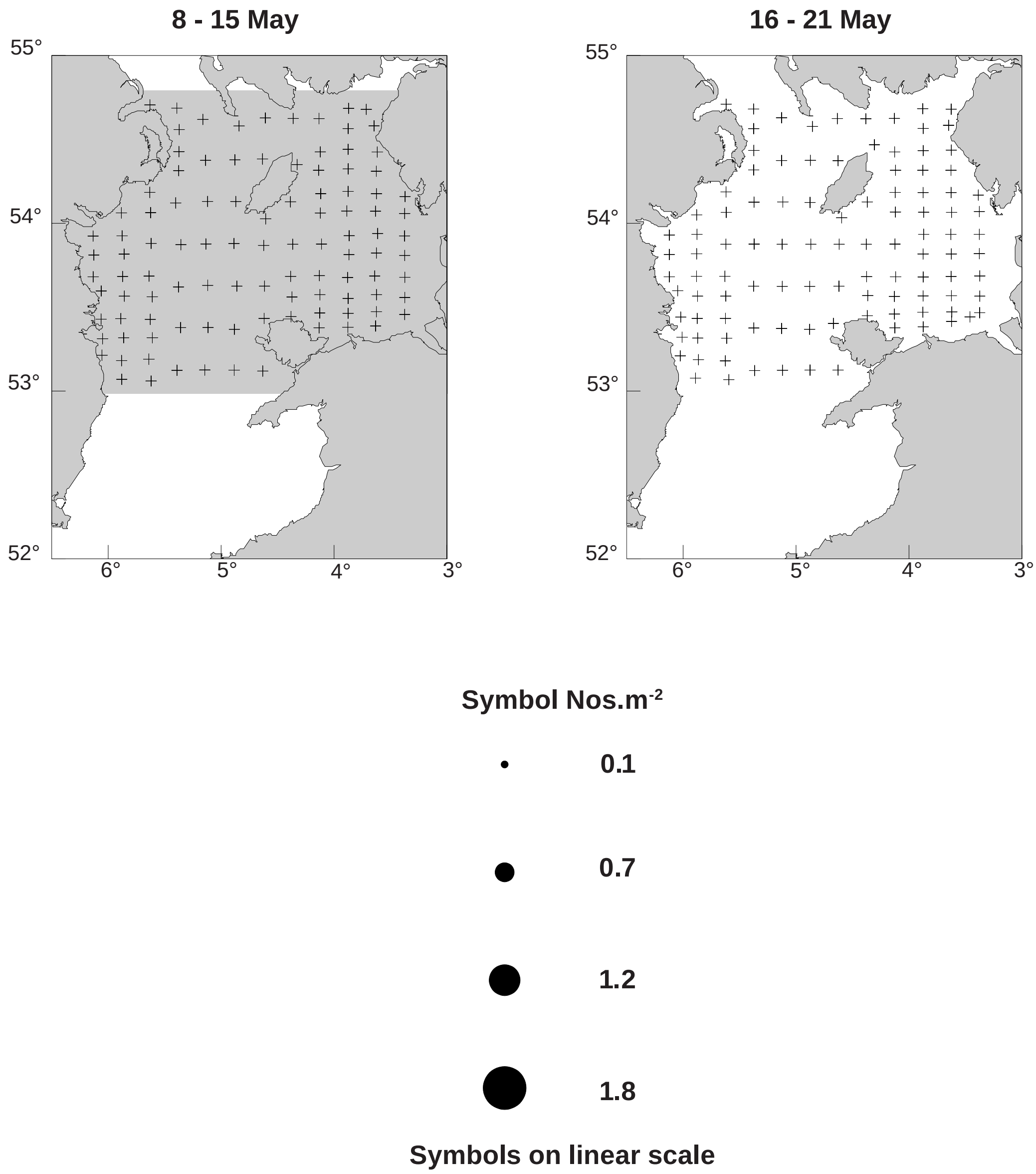


Figure 28. Concentration of Cottidae larvae (nos.m^{-2}) in 2000



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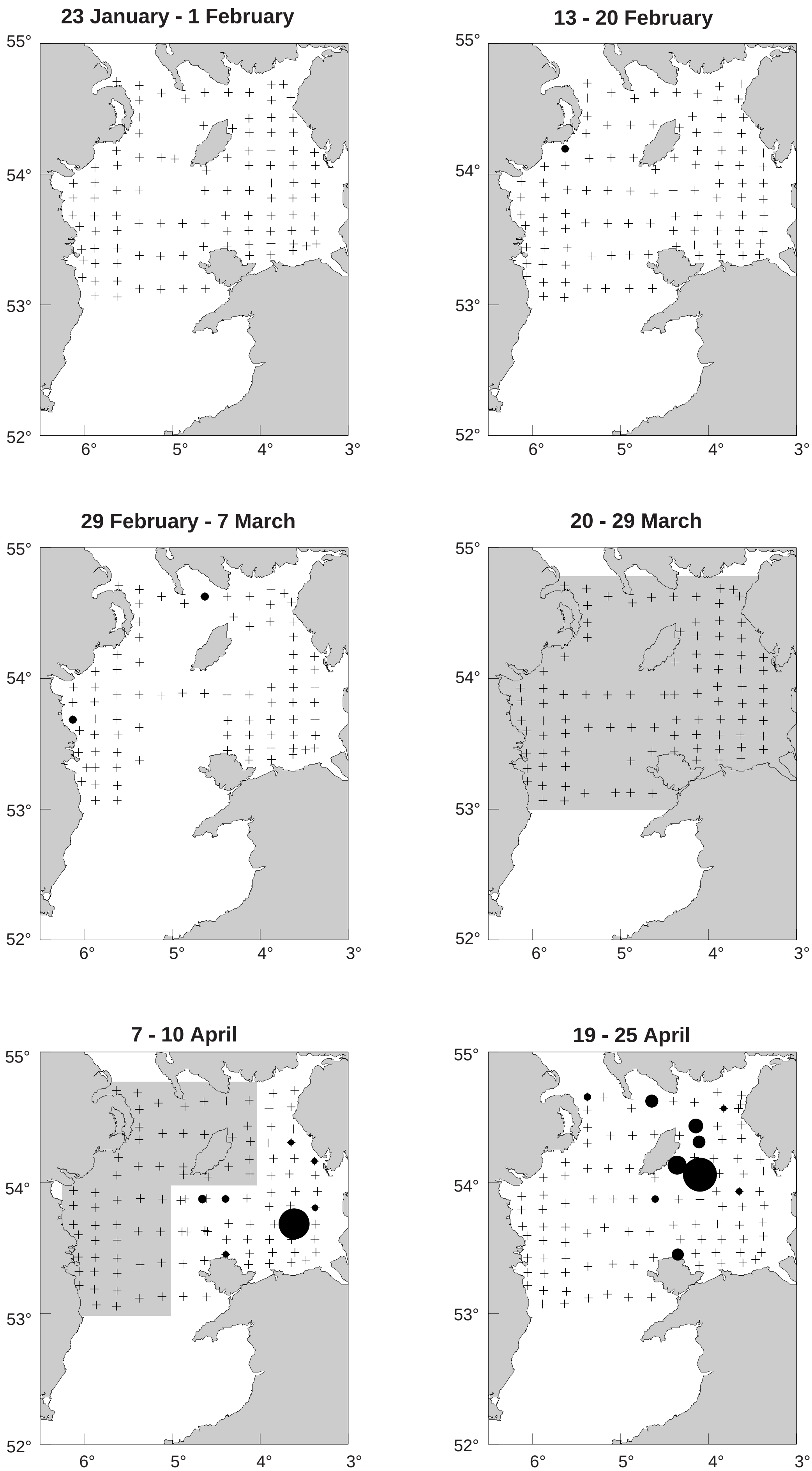
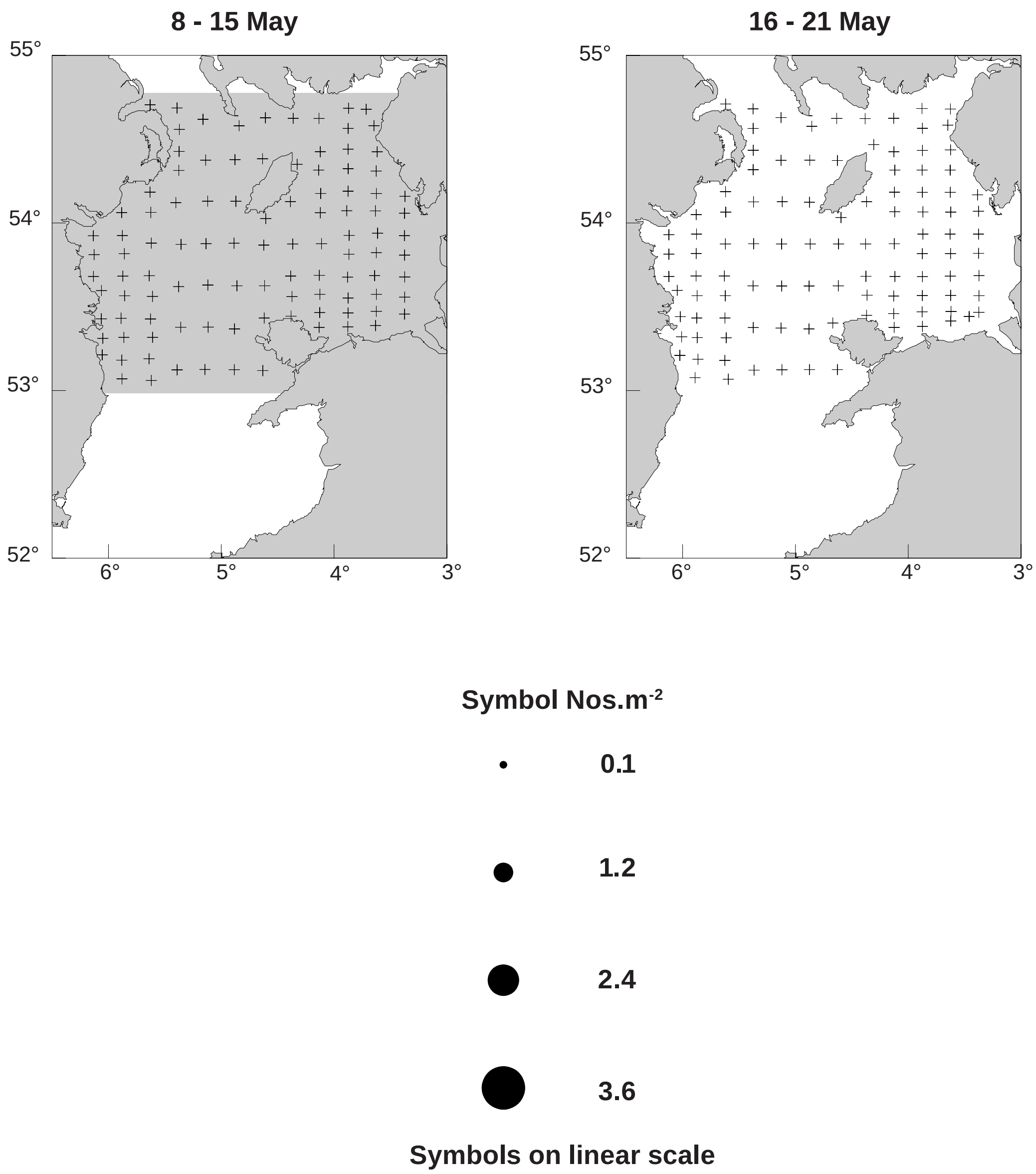


Figure 29. Concentration of pogge (Agonus cataphractus) larvae (nos.m⁻²) in 2000



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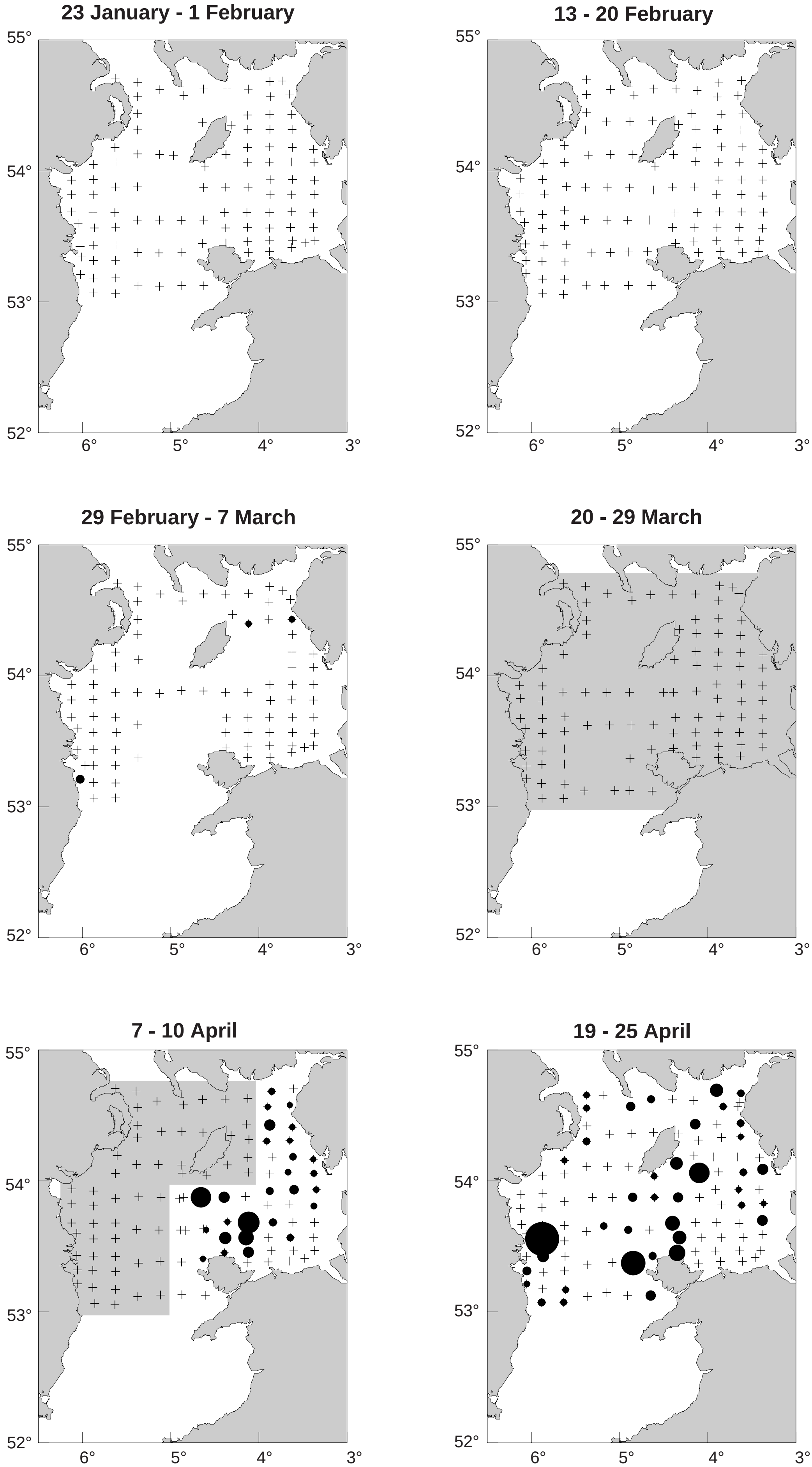
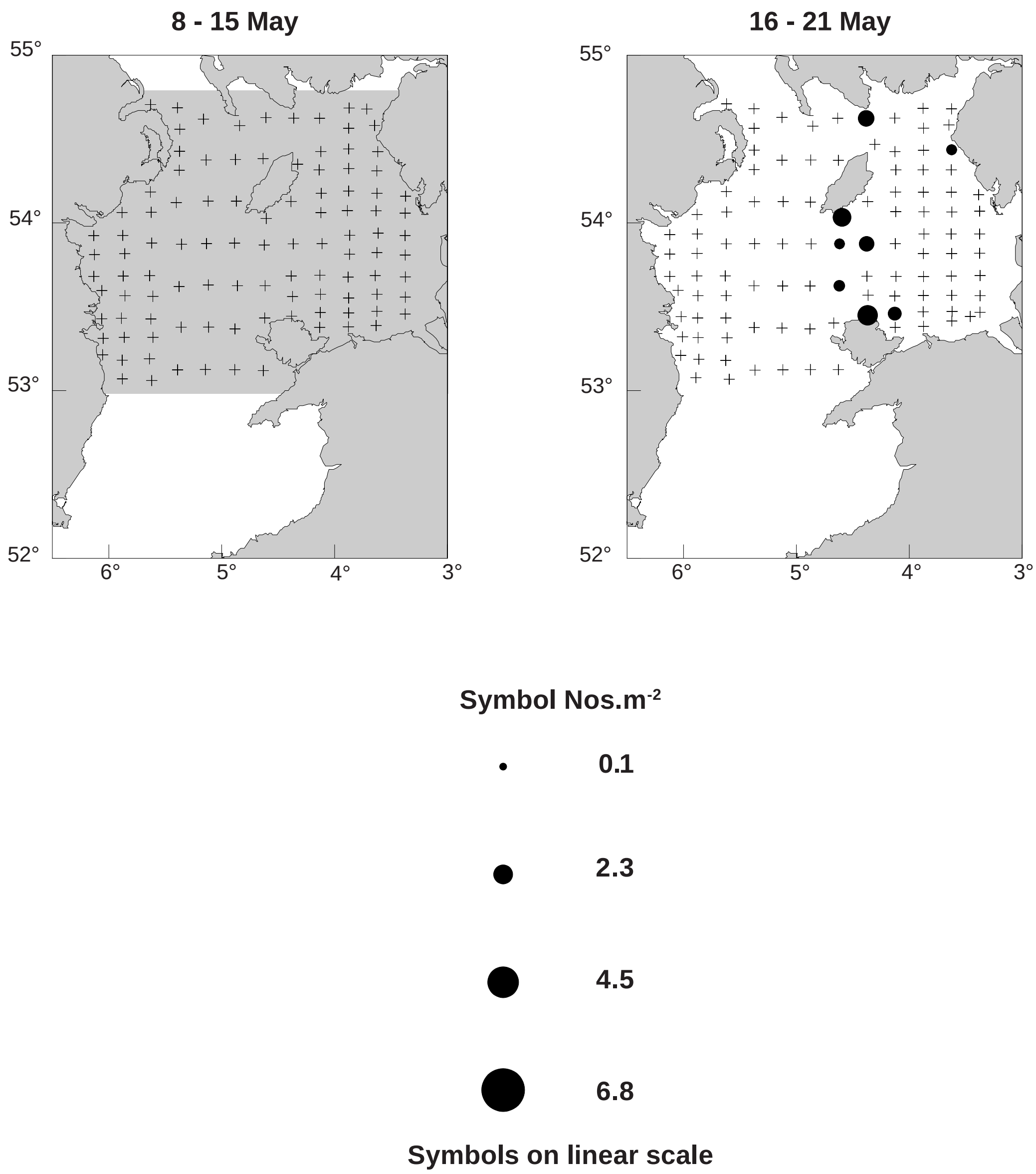


Figure 30. Concentration of sea snail (Liparis spp.) larvae (nos.m^{-2}) in 2000



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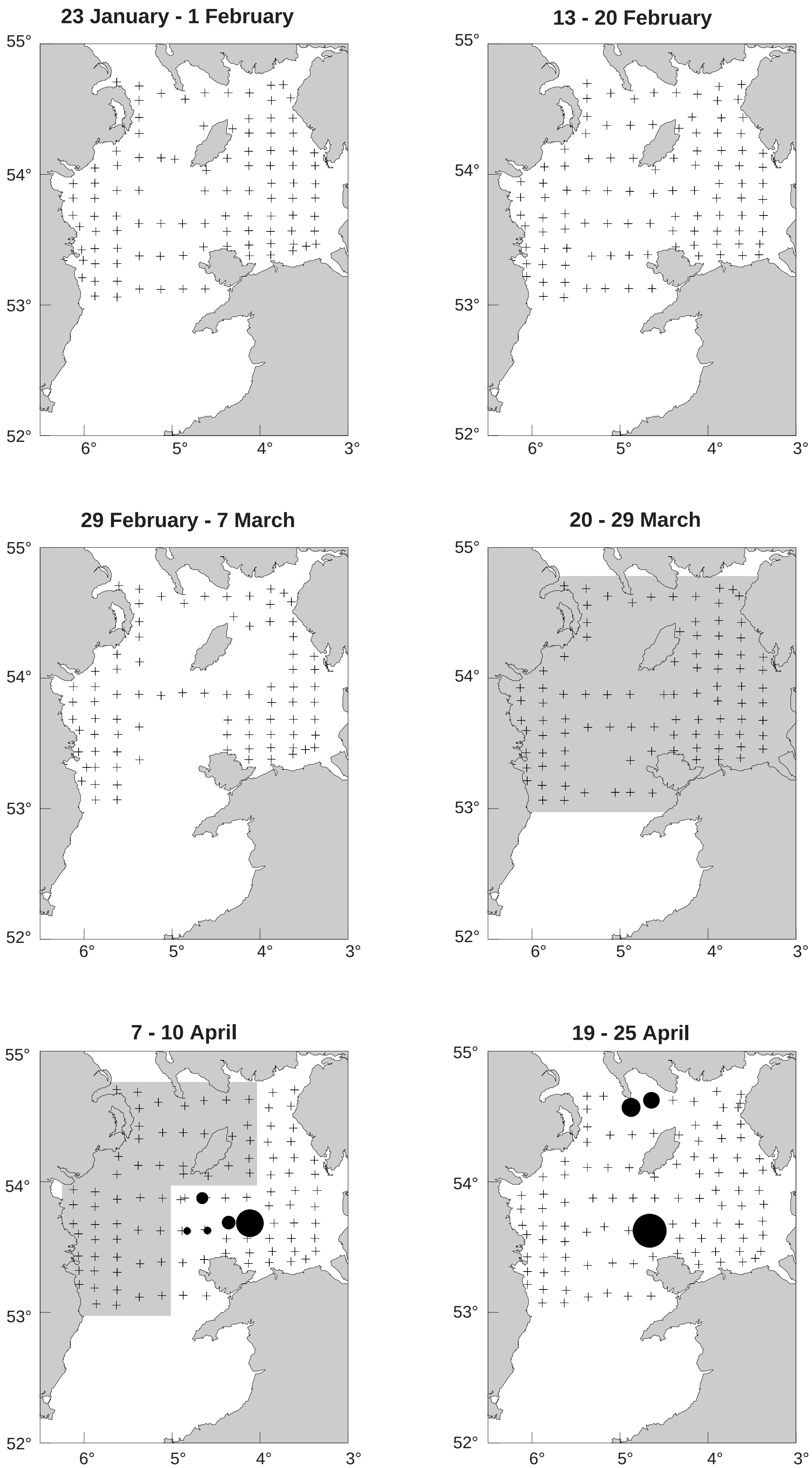
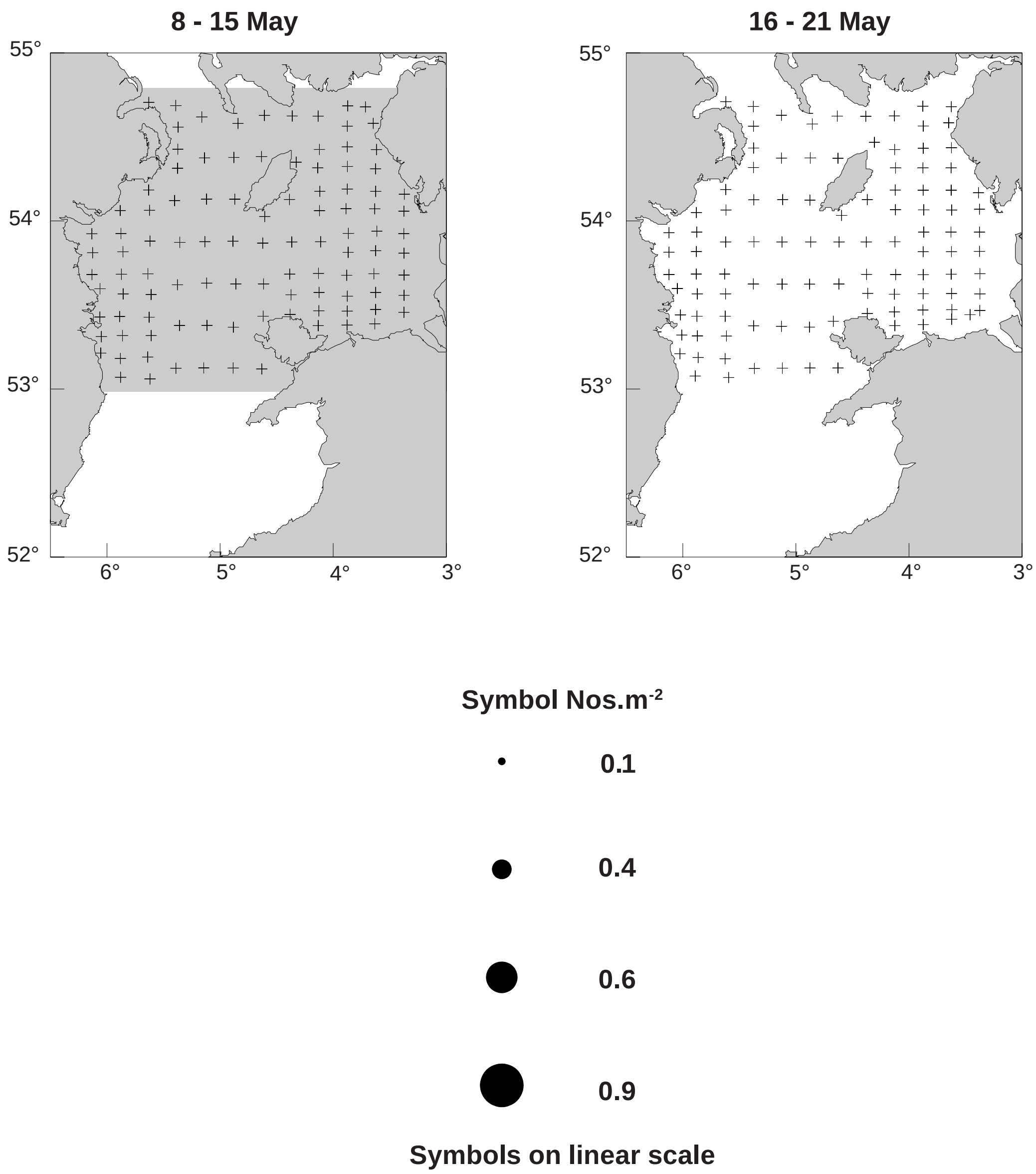


Figure 31. Concentration of Yarrell's blenny (Chirolophis ascanii) larvae (nos.m^{-2}) in 2000



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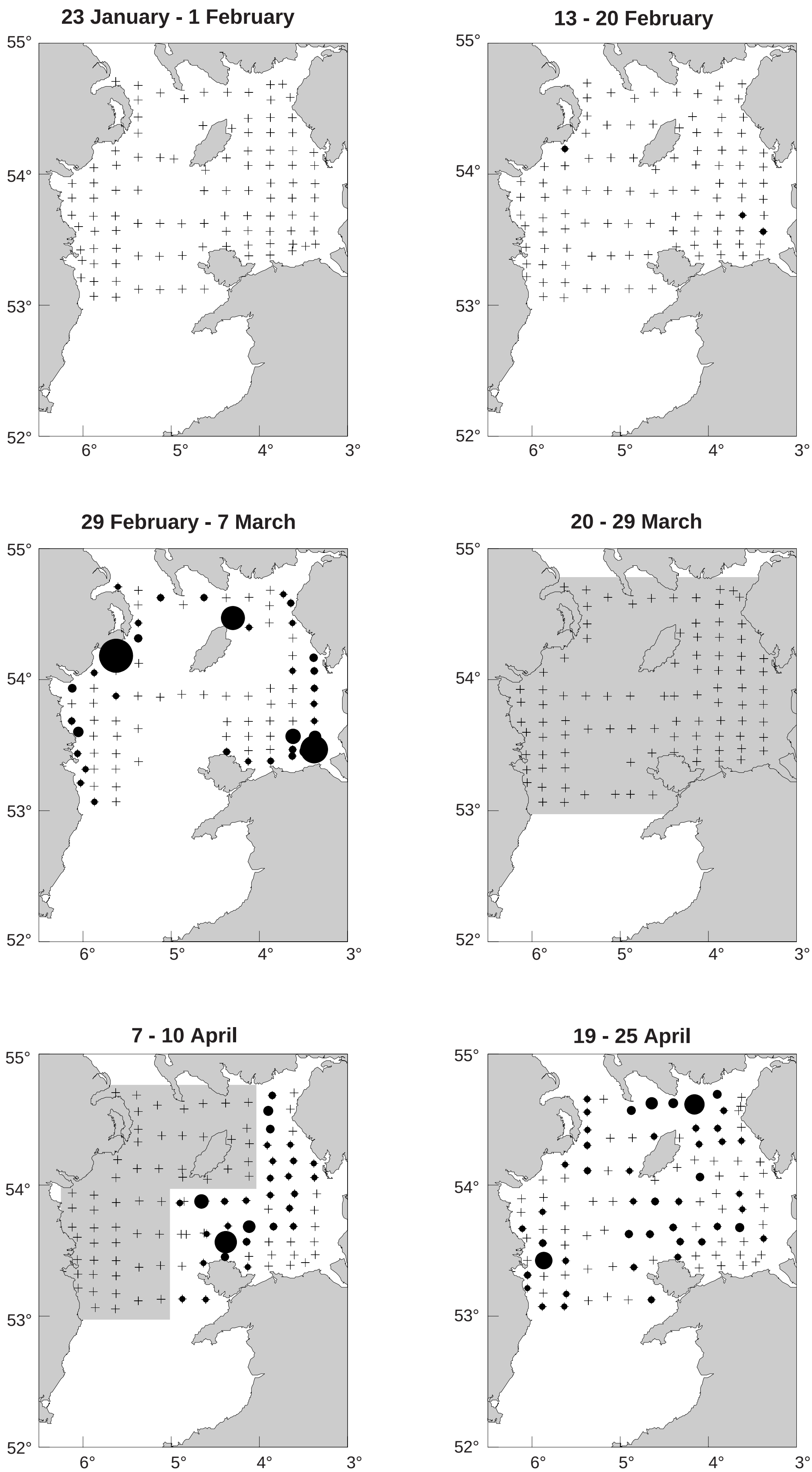


Figure 32. Concentration of butterfish (Pholis gunnellus) larvae (nos.m^{-2}) in 2000

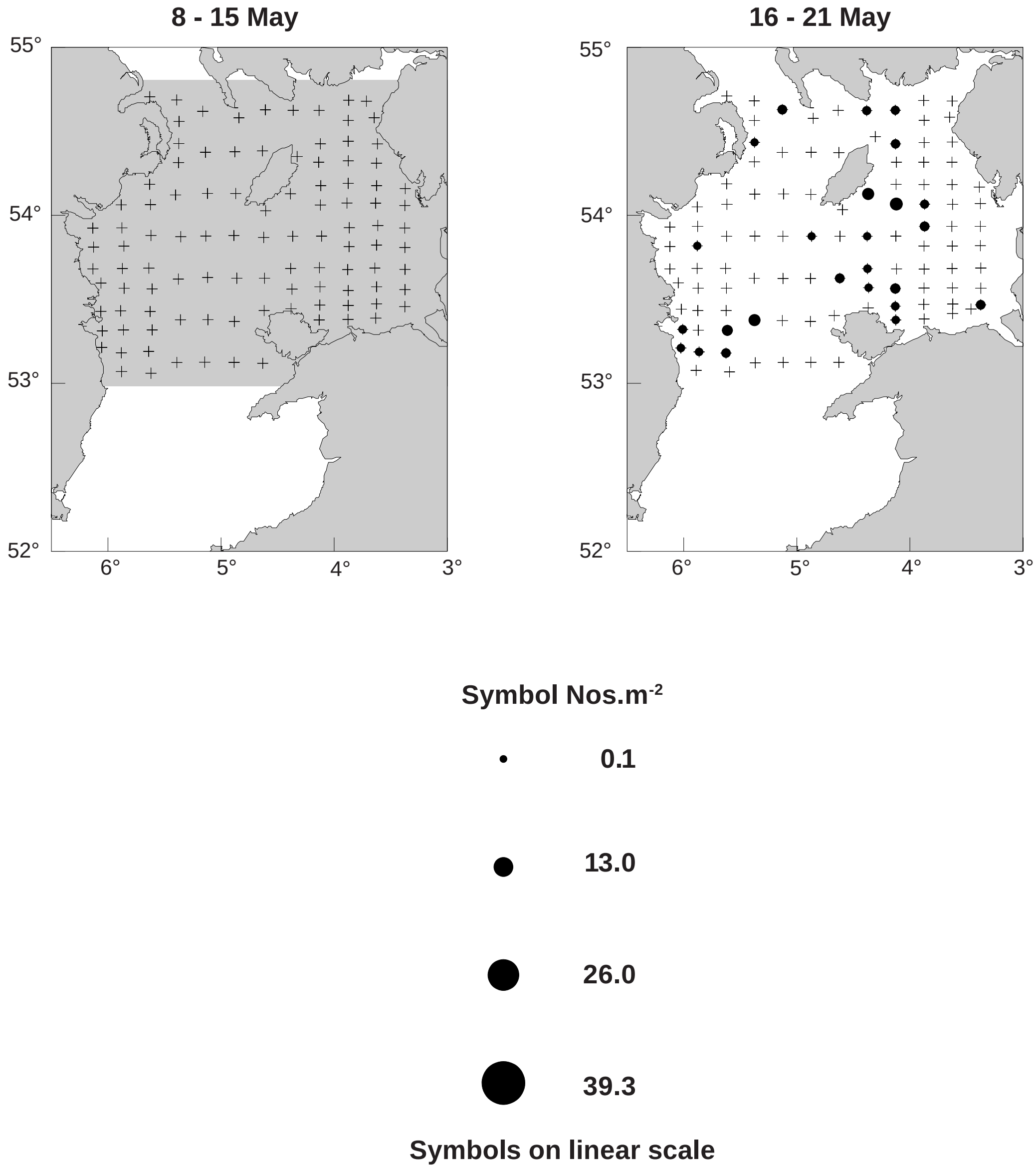


Figure 32. continued

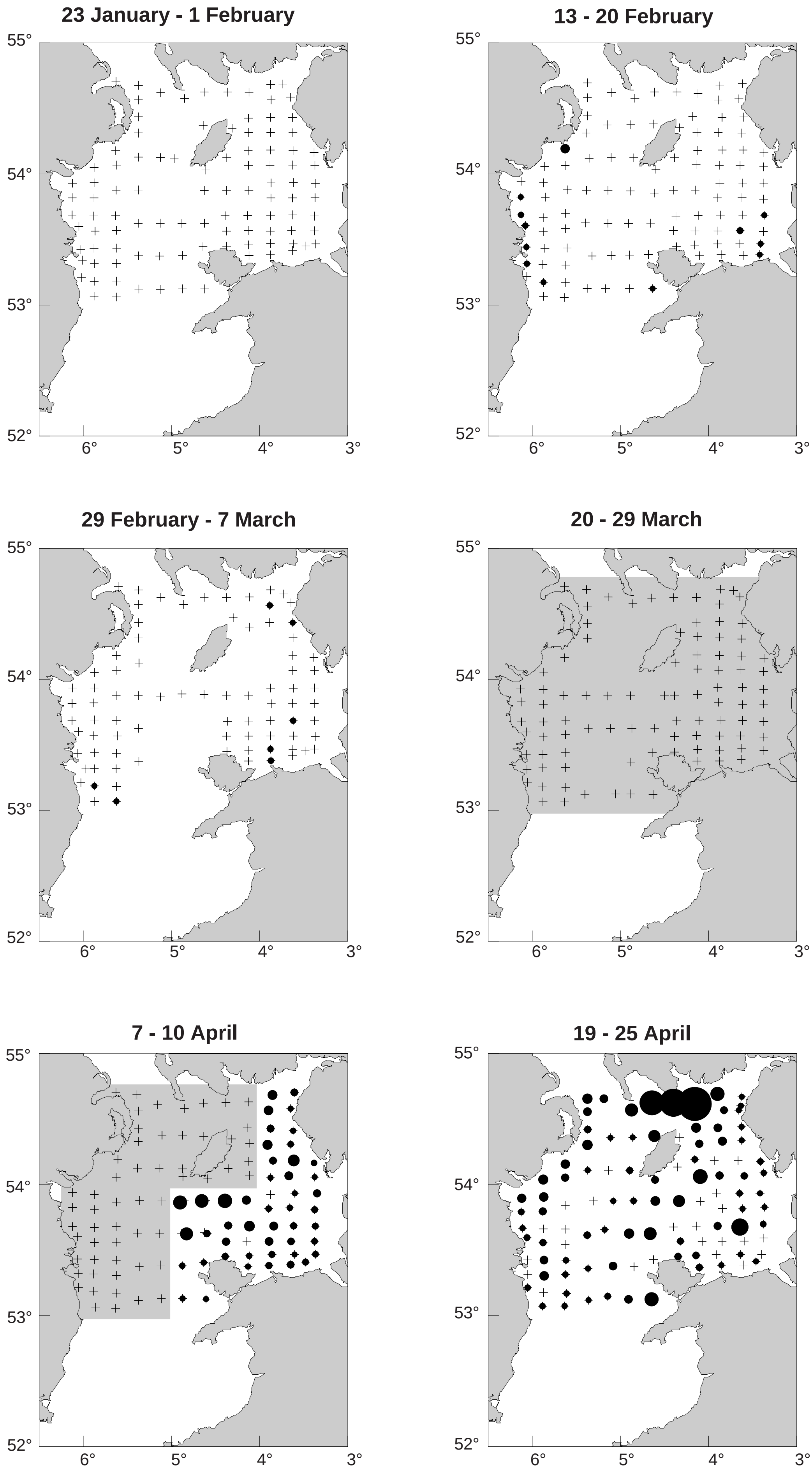


Figure 33. Concentration of sandeel (Ammodytidae) larvae (nos.m^{-2}) in 2000

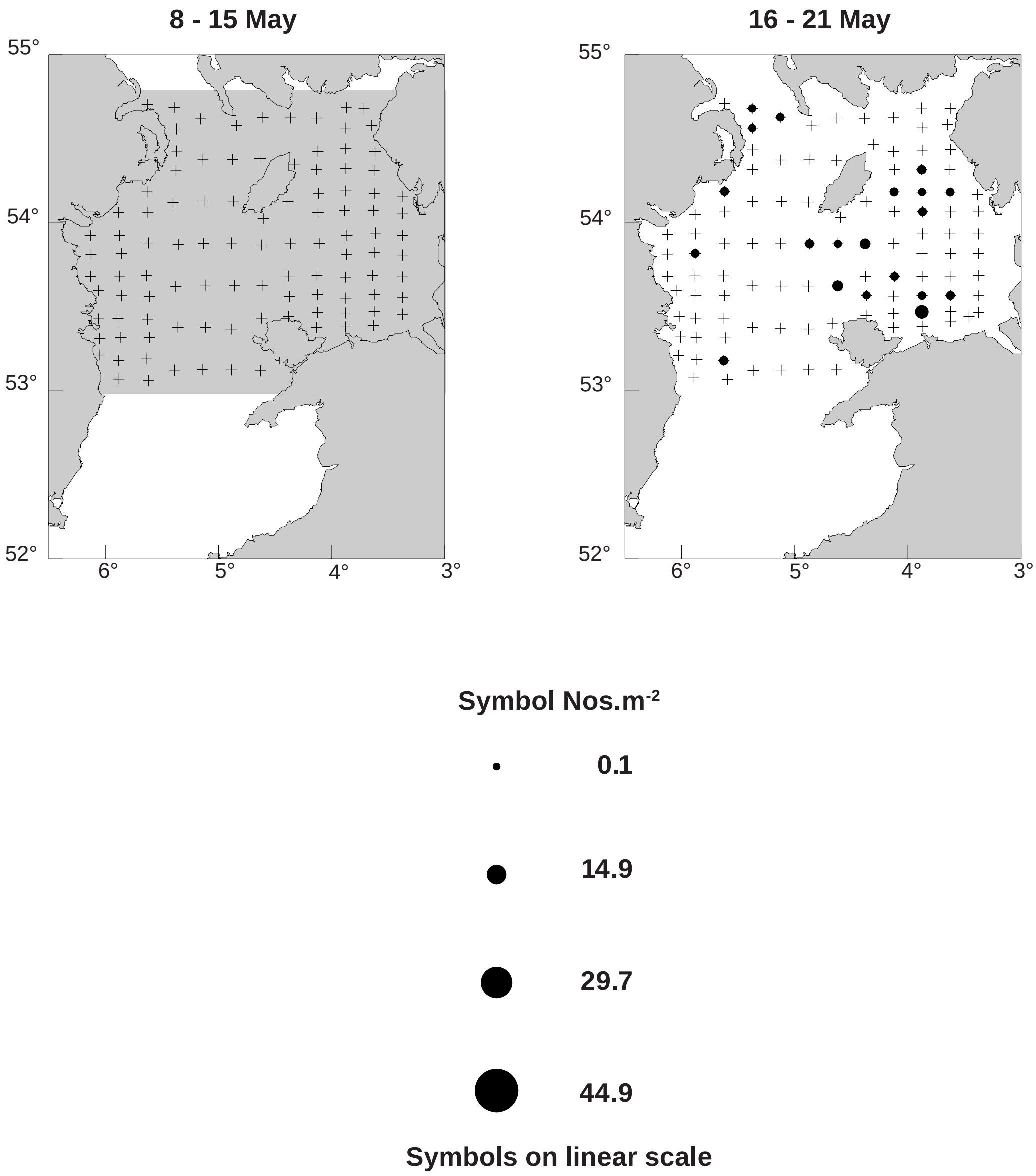


Figure 33. continued

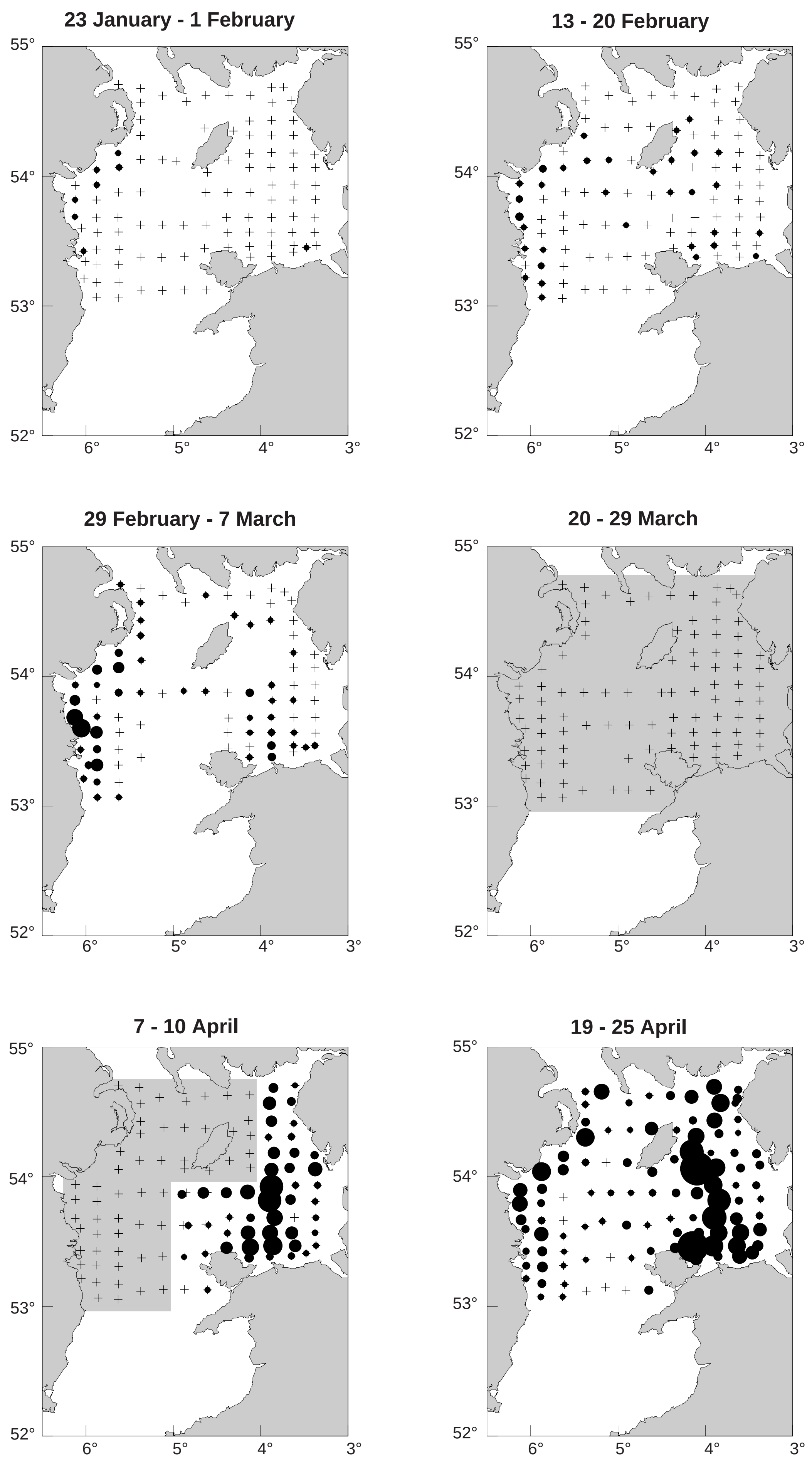


Figure 34. Concentration of dragonet (Callionymidae) eggs (nos.m⁻²) in 2000

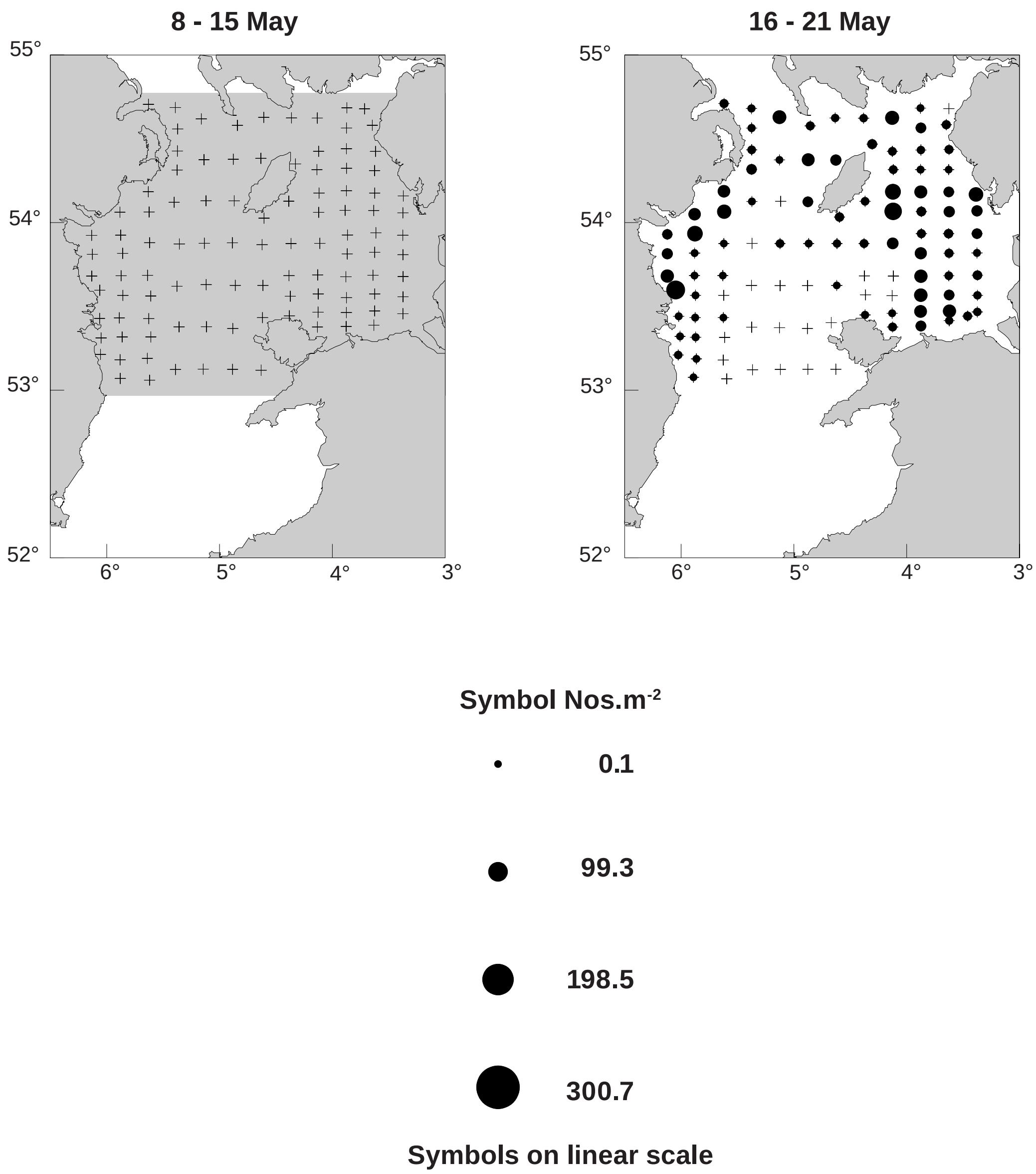


Figure 34. continued

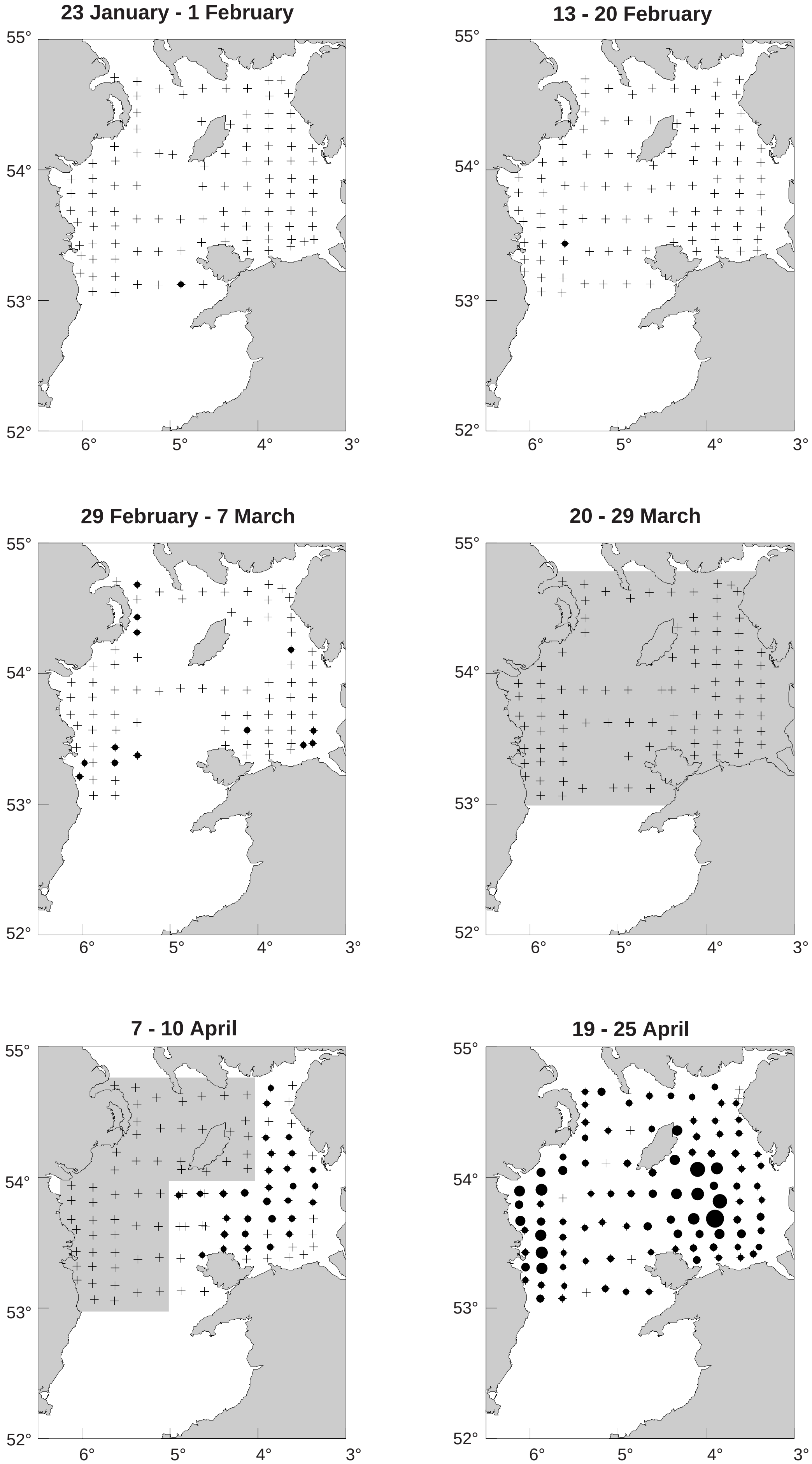


Figure 35. Concentration of dragonet (Callionymidae) larvae (nos.m⁻²) in 2000

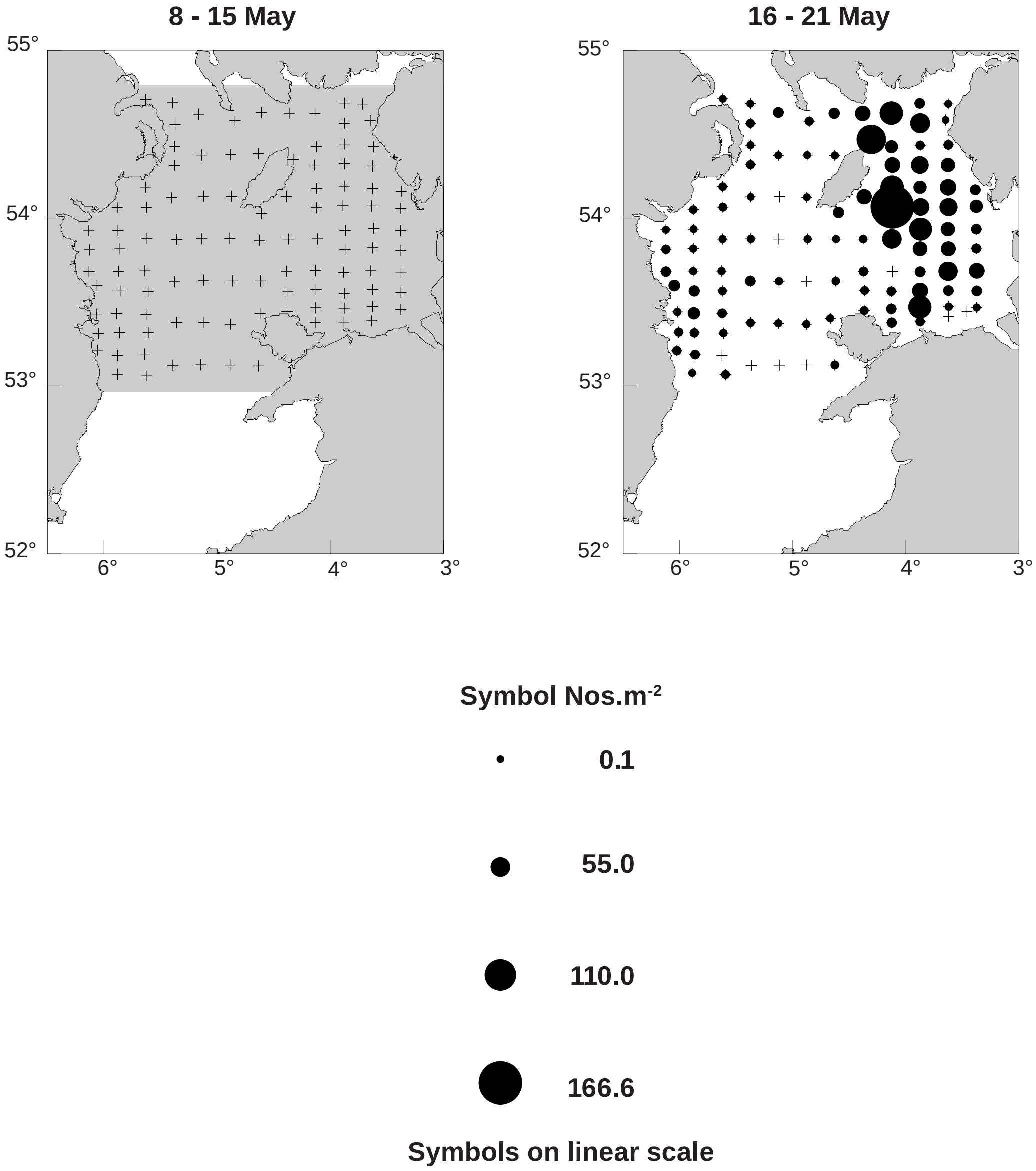


Figure 35. continued

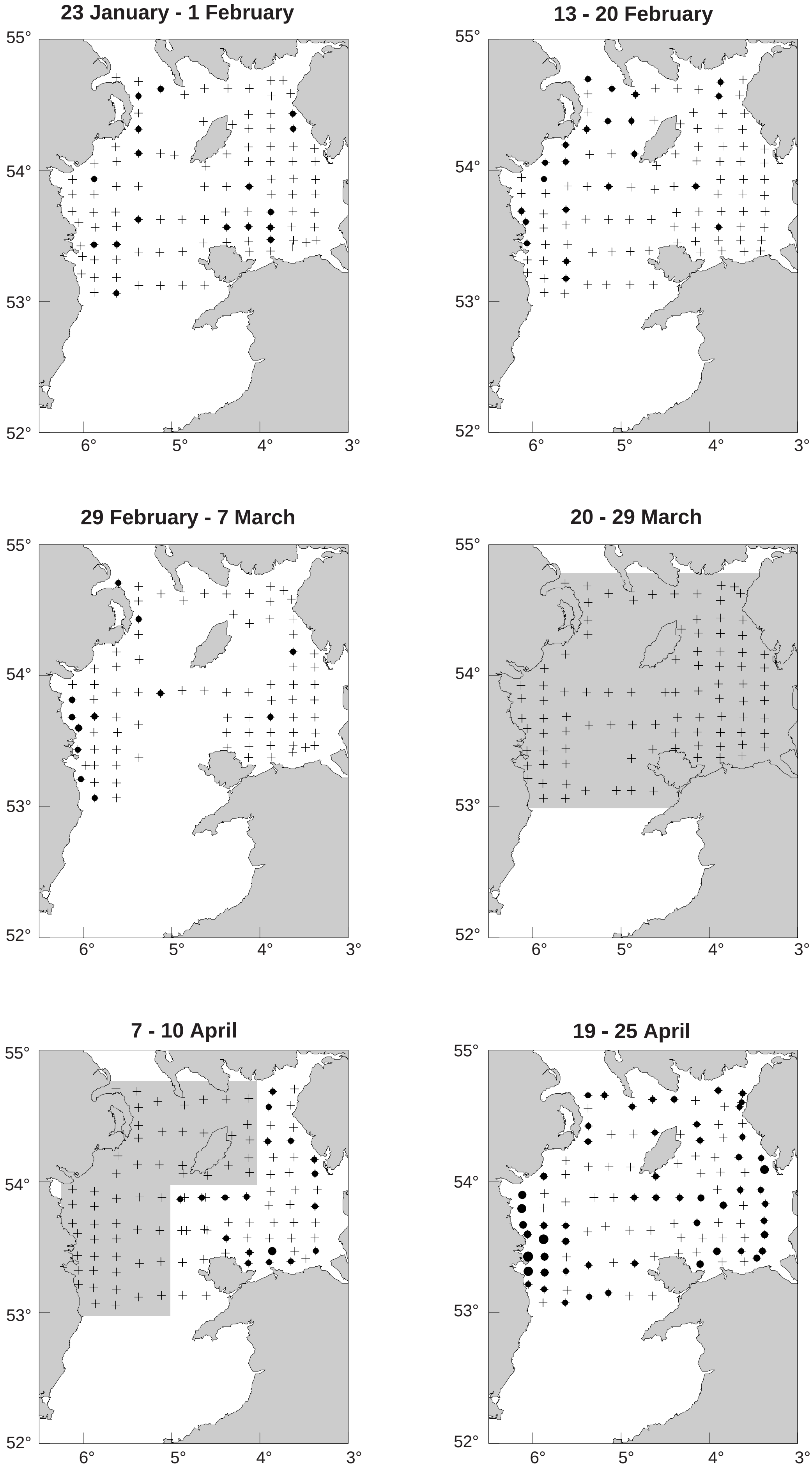


Figure 36. Concentration of Gobiidae spp. larvae (nos.m^{-2}) in 2000

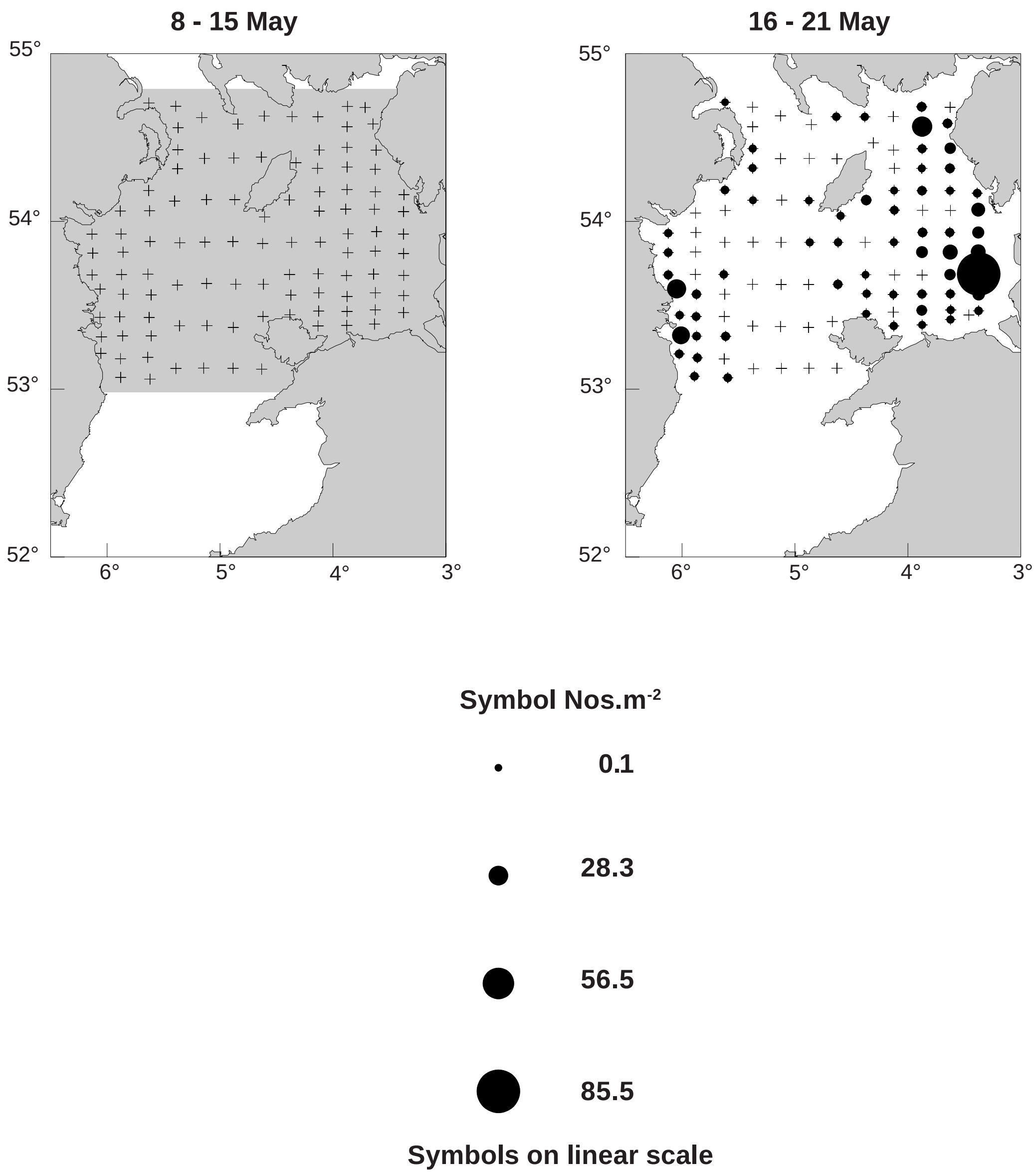


Figure 36. continued

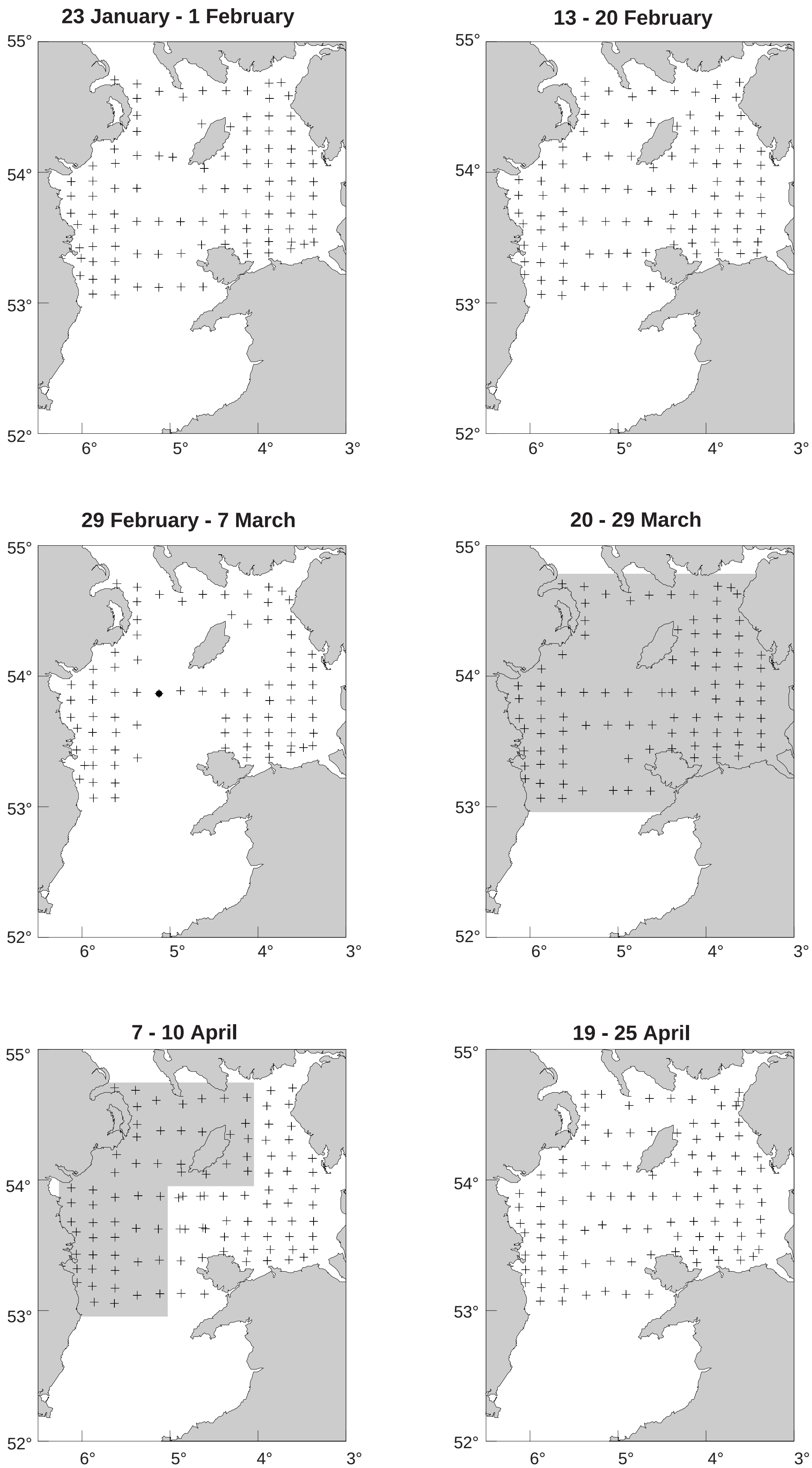


Figure 37. Concentration of mackerel (Scomber scombrus) eggs (nos.m^{-2}) in 2000

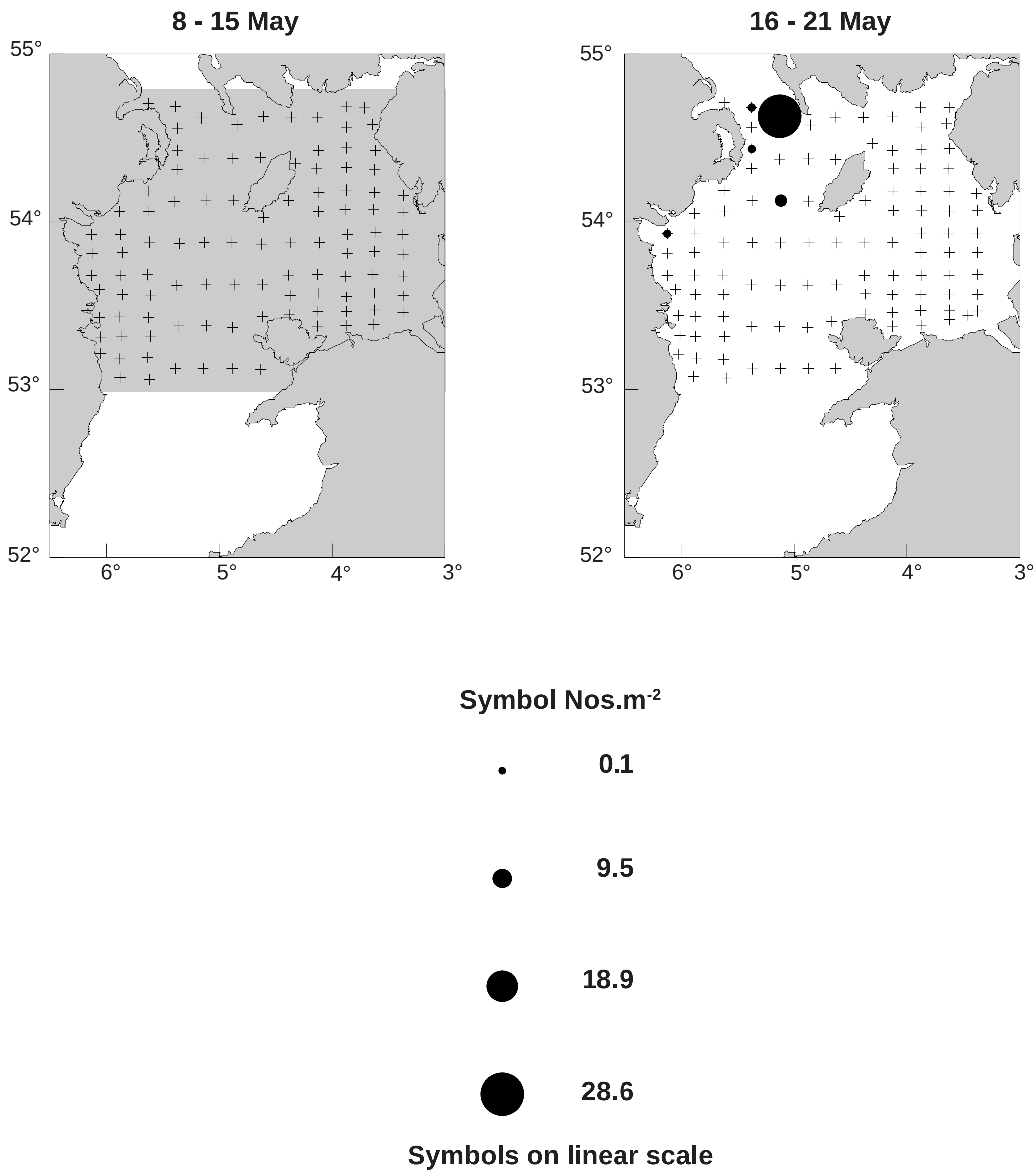


Figure 37. continued

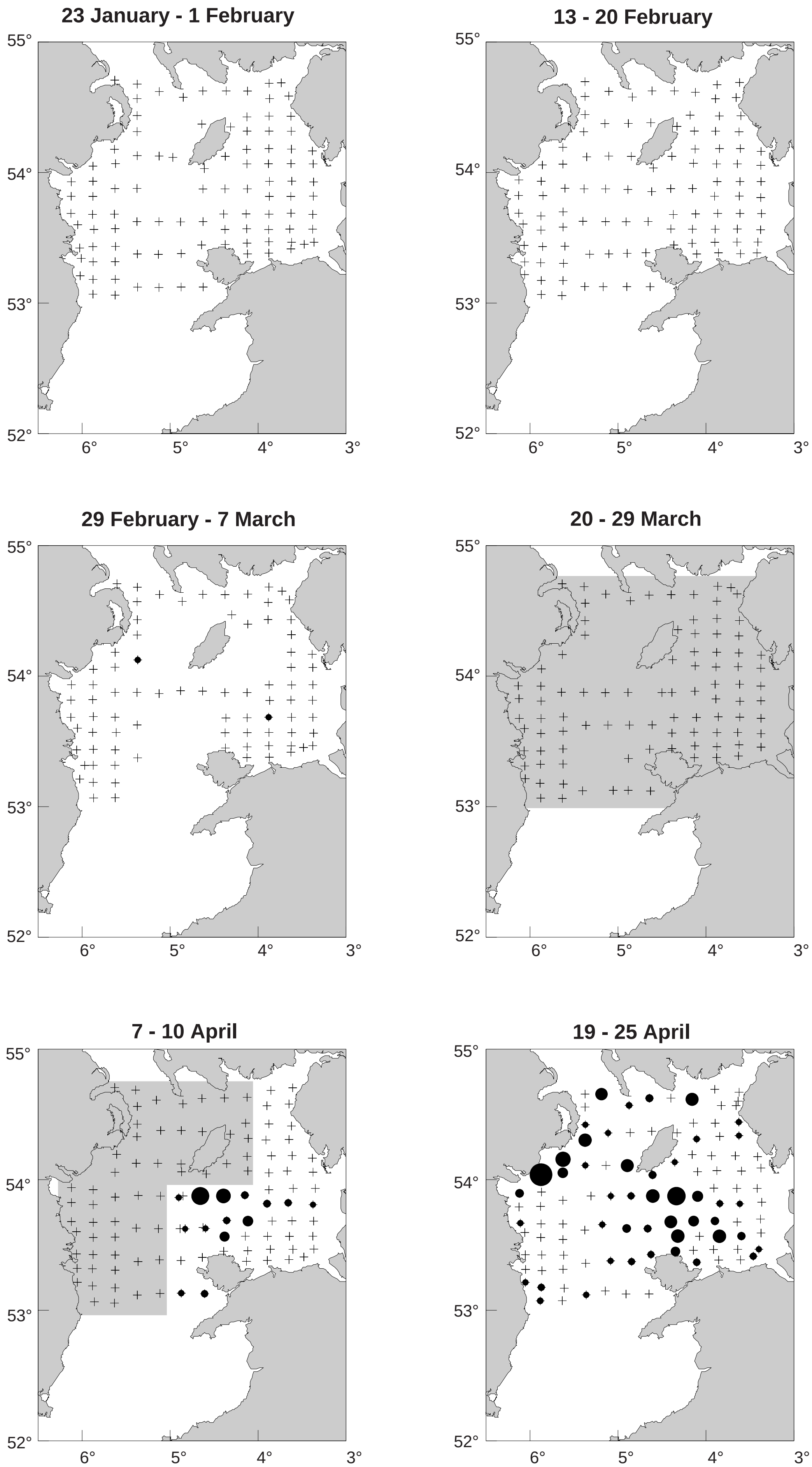


Figure 38. Concentration of Norwegian topknot (Phrynorhombus norvegicus) eggs (nos.m^{-2}) in 2000

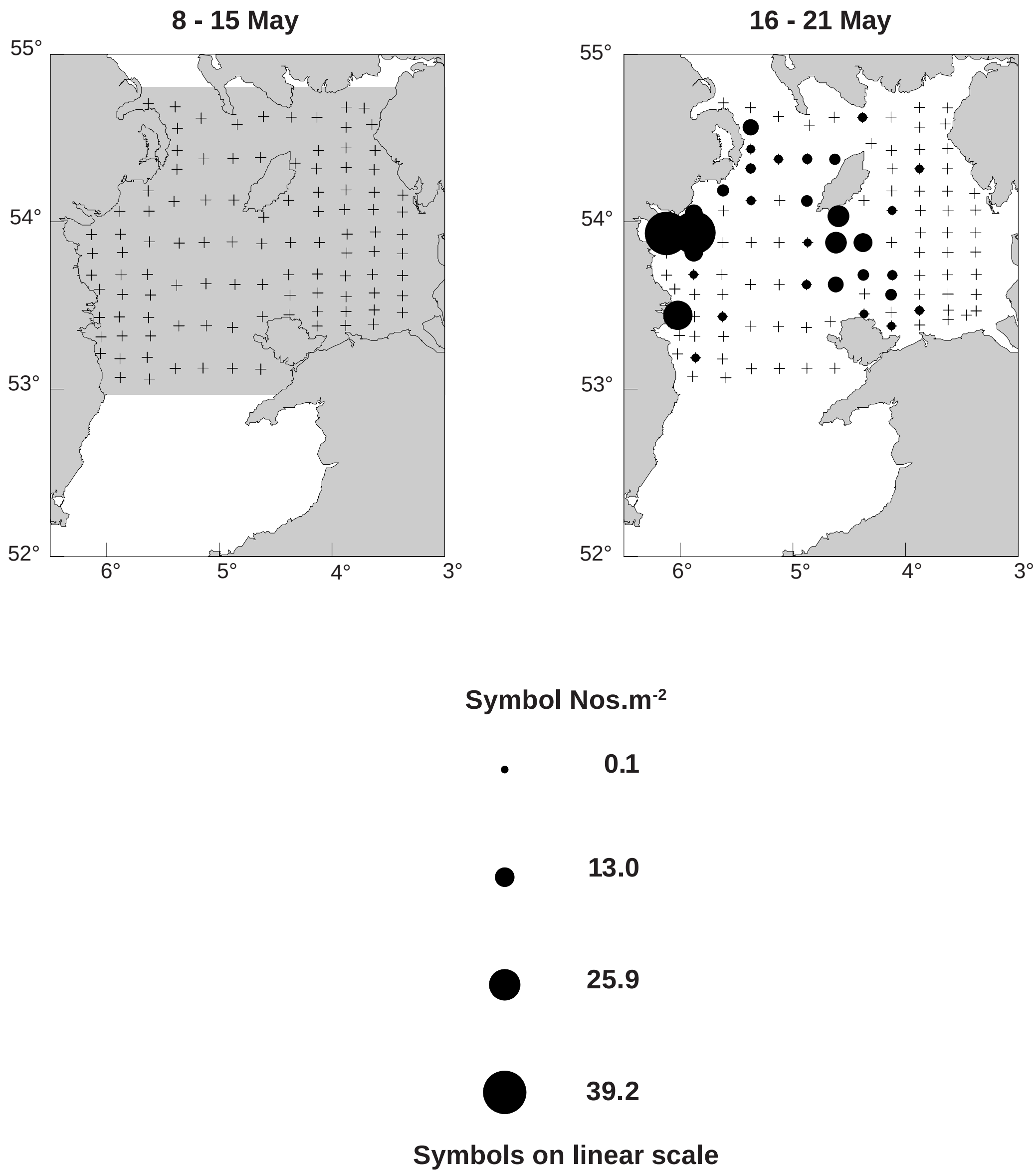


Figure 38. continued

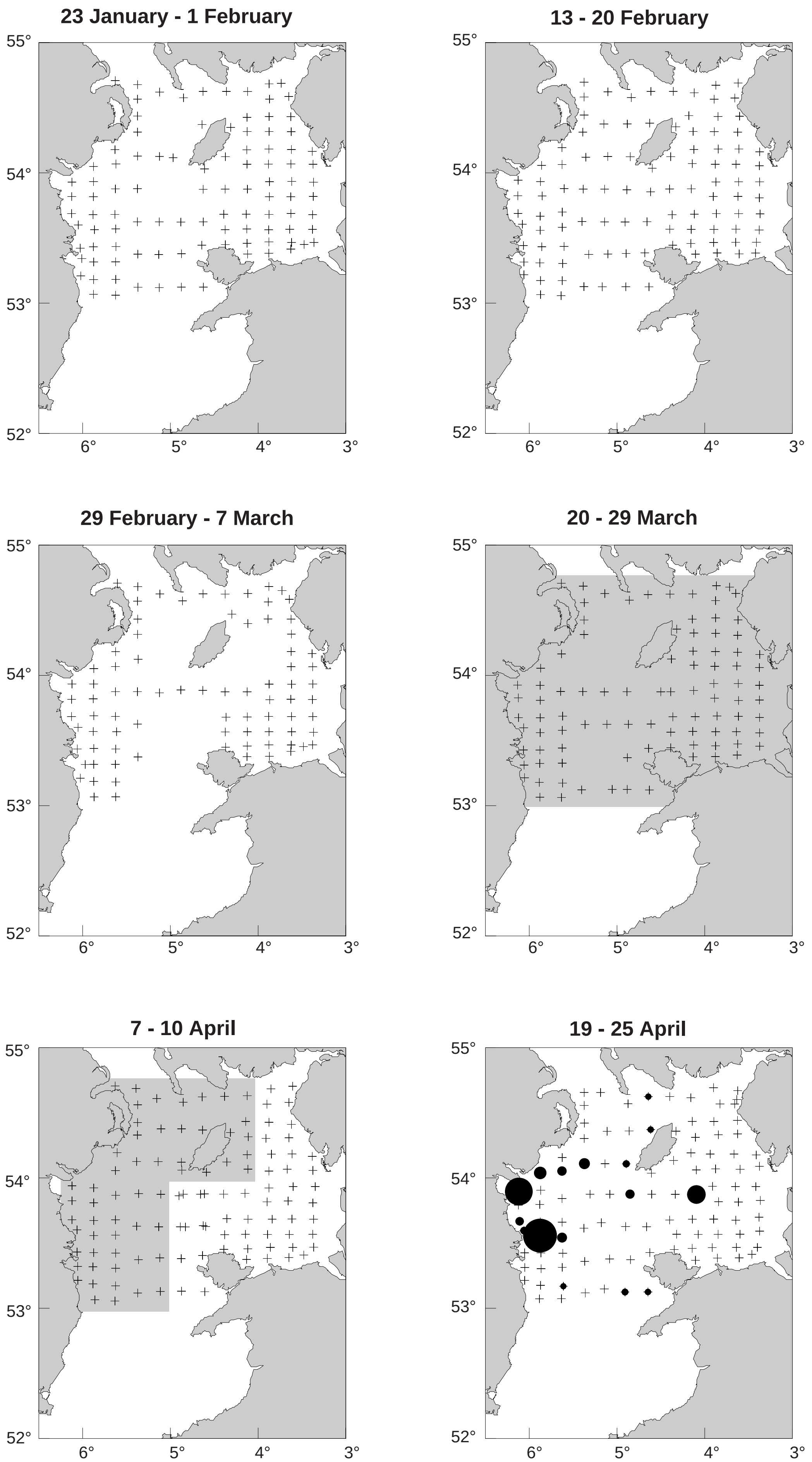


Figure 39. Concentration of Norwegian topknot (Phrynorhombus norvegicus) larvae (nos.m^{-2}) in 2000

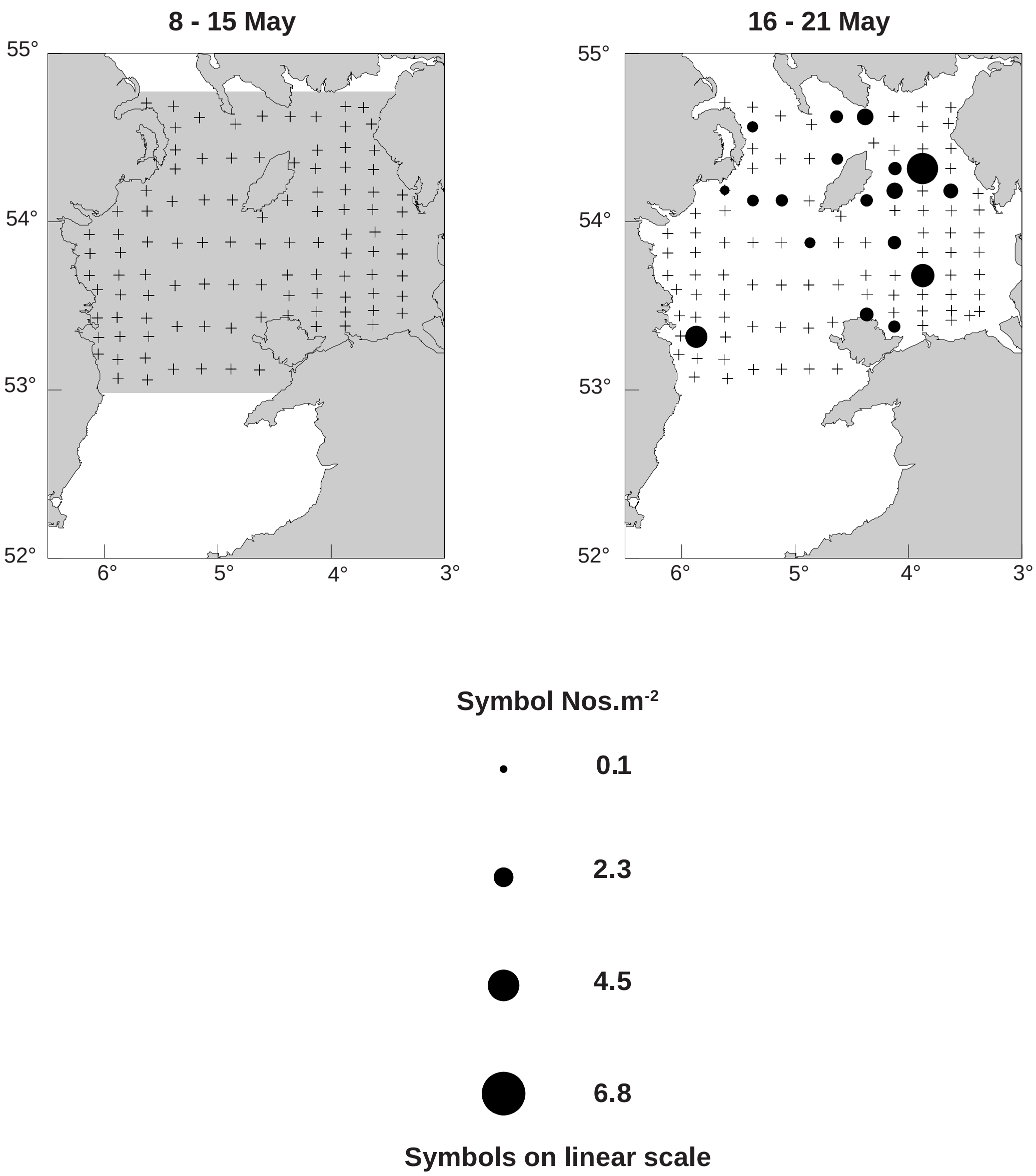


Figure 39. continued

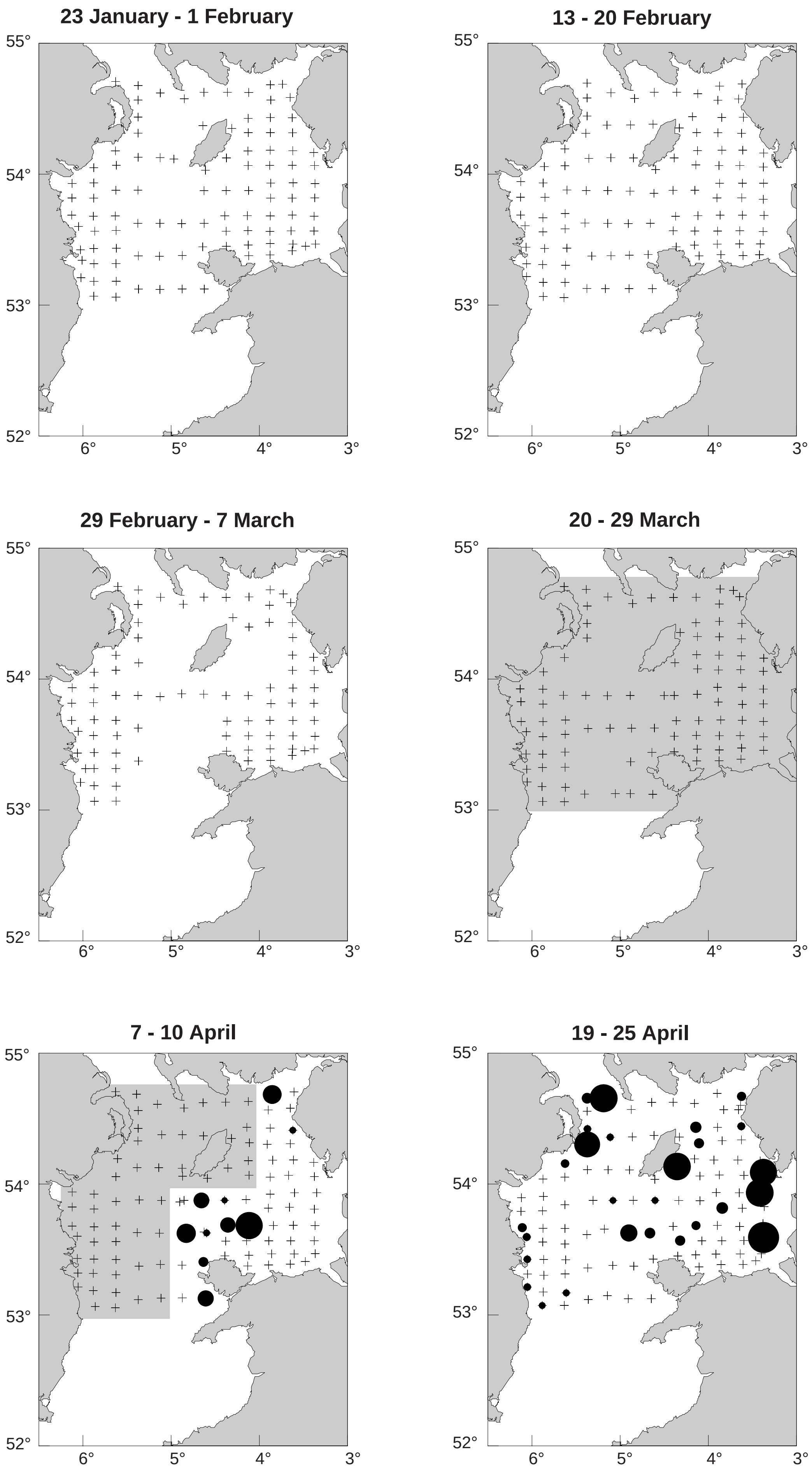


Figure 40. Concentration of topknot (Zeugopterus punctatus) eggs (nos.m^{-2}) in 2000

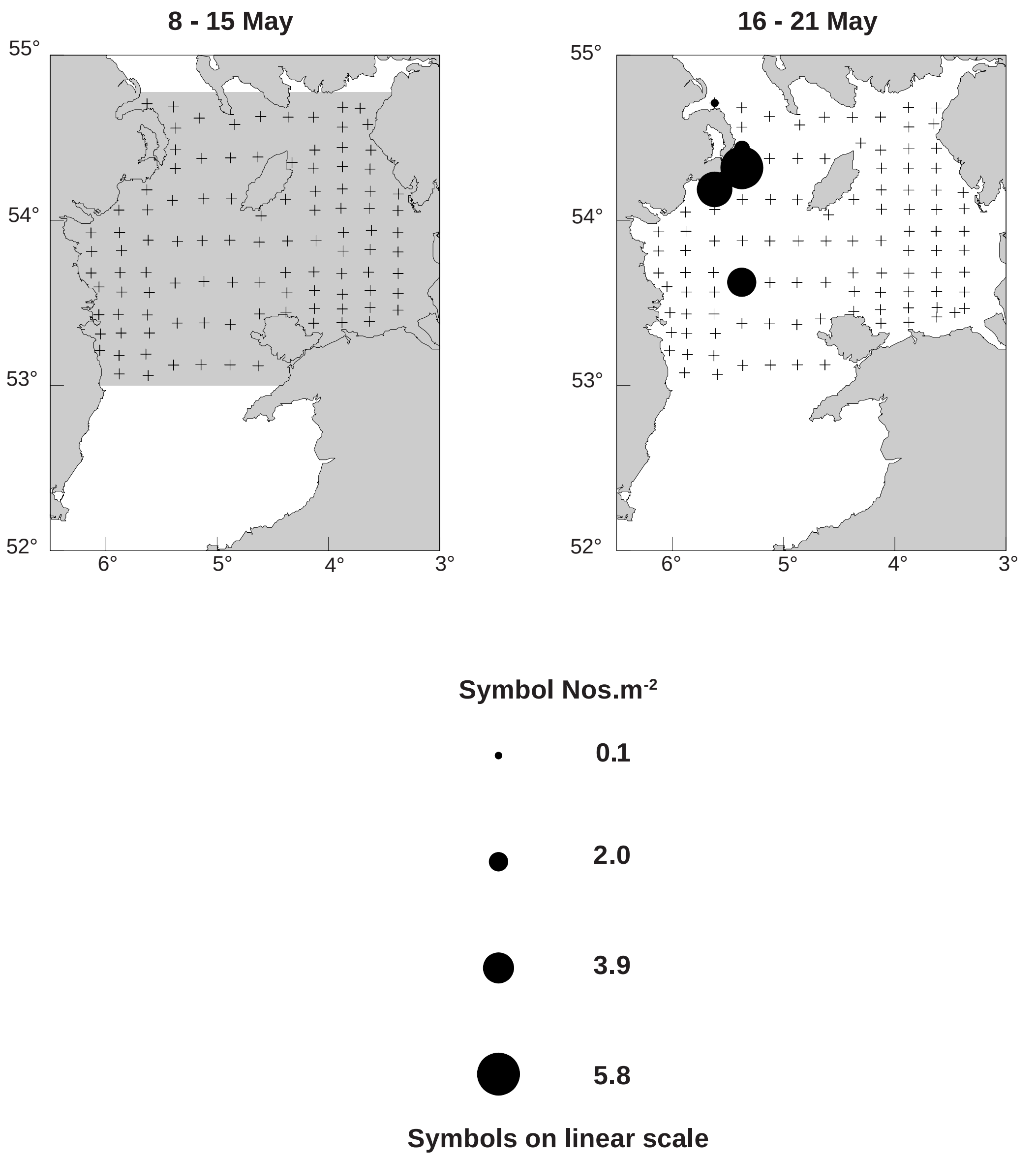


Figure 40. continued

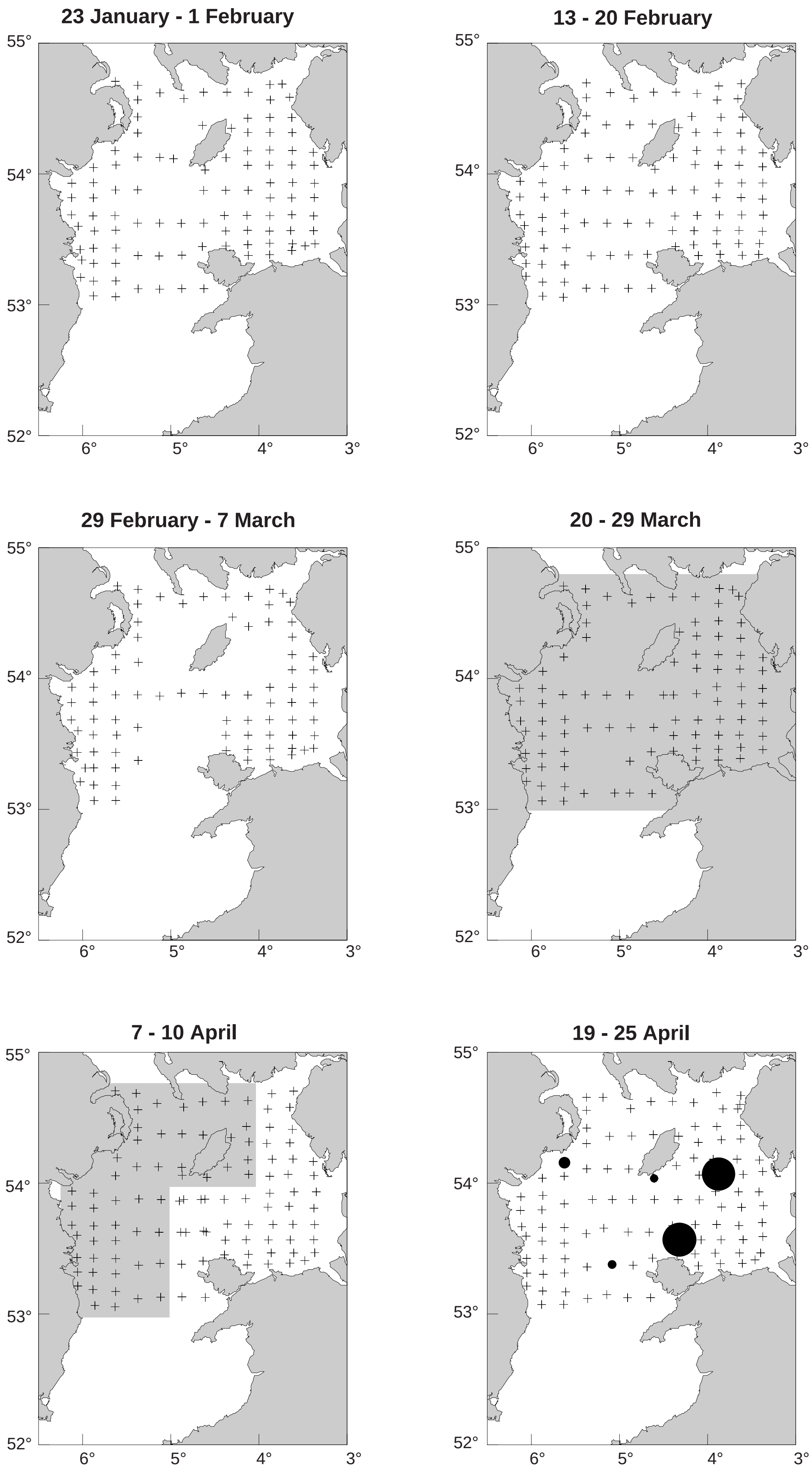


Figure 41. Concentration of topknot (Zeugopterus punctatus) larvae (nos.m⁻²) in 2000

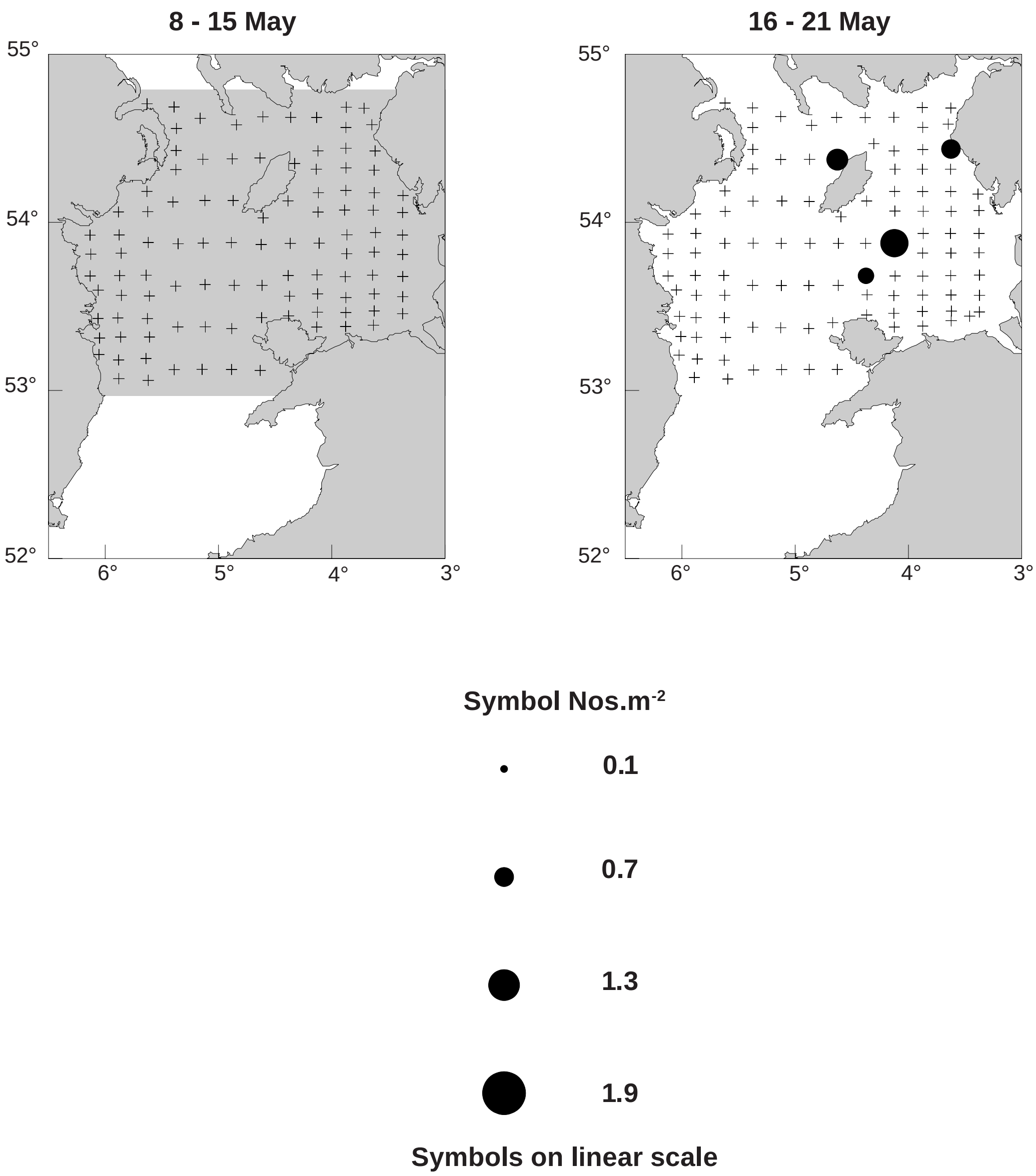


Figure 41. continued

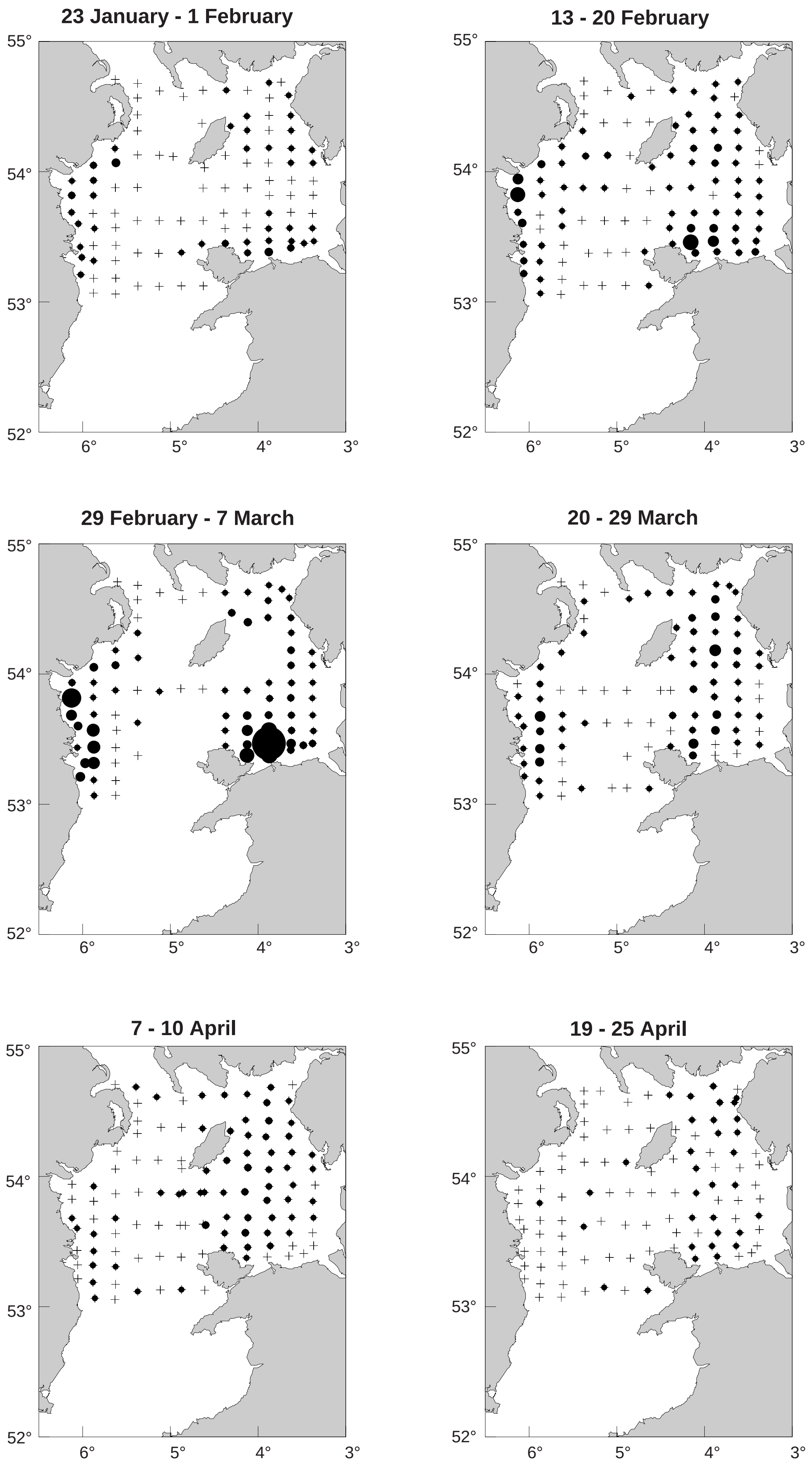


Figure 42. Concentration of plaice (Pleuronectes platessa) eggs (nos.m^{-2}) in 2000

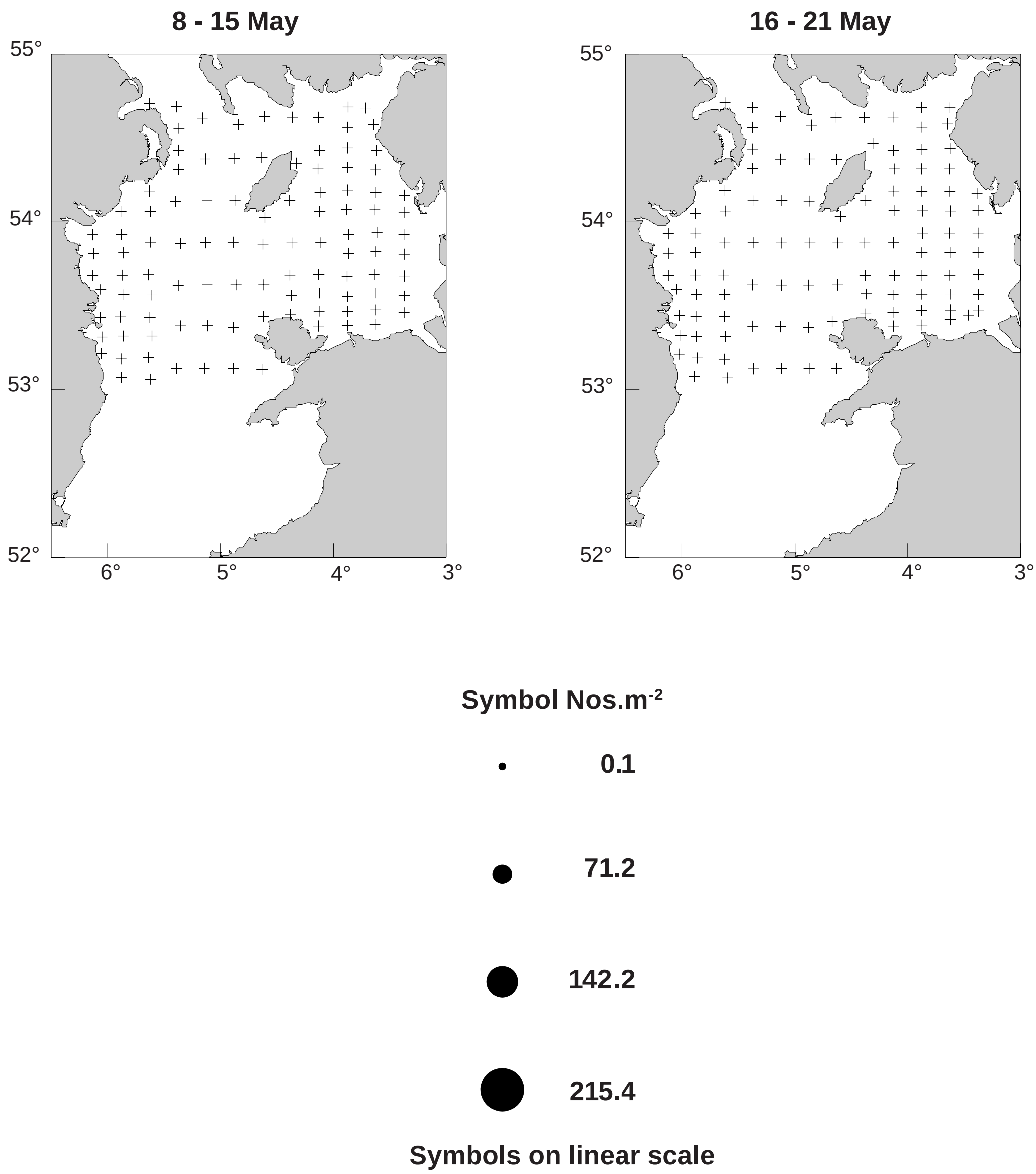


Figure 42. continued

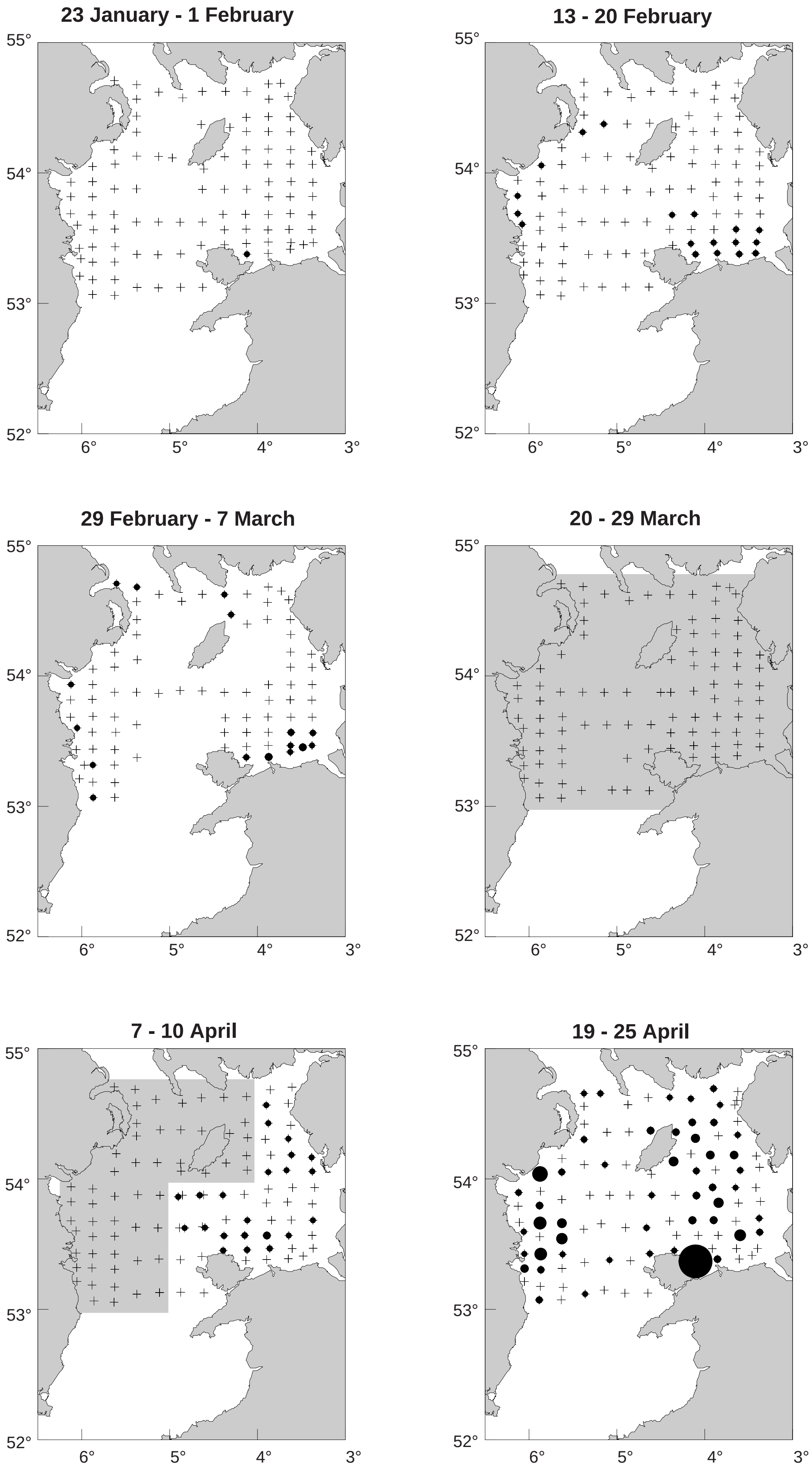


Figure 43. Concentration of plaice (Pleuronectes platessa) larvae (nos.m^{-2}) in 2000

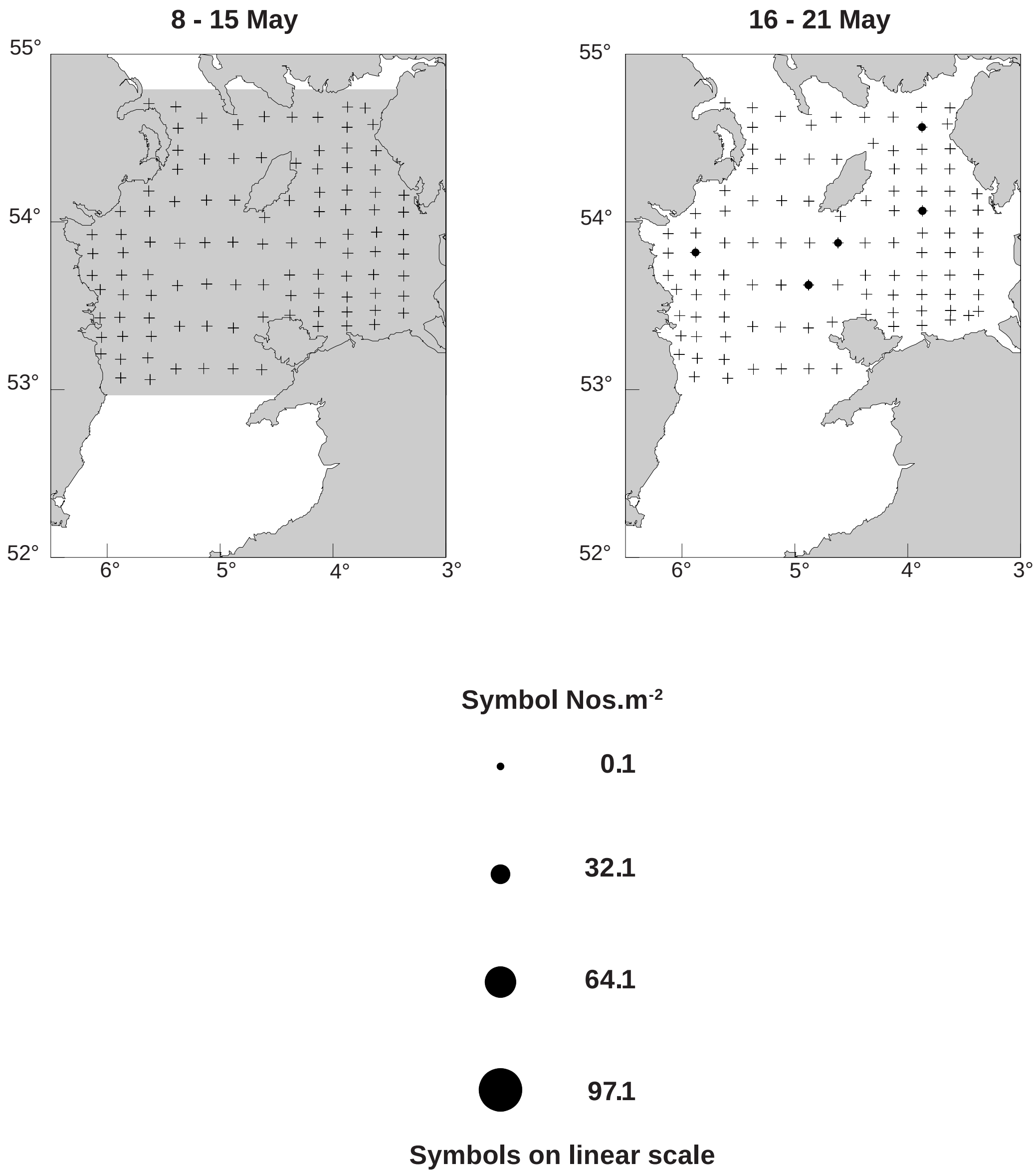


Figure 43. continued

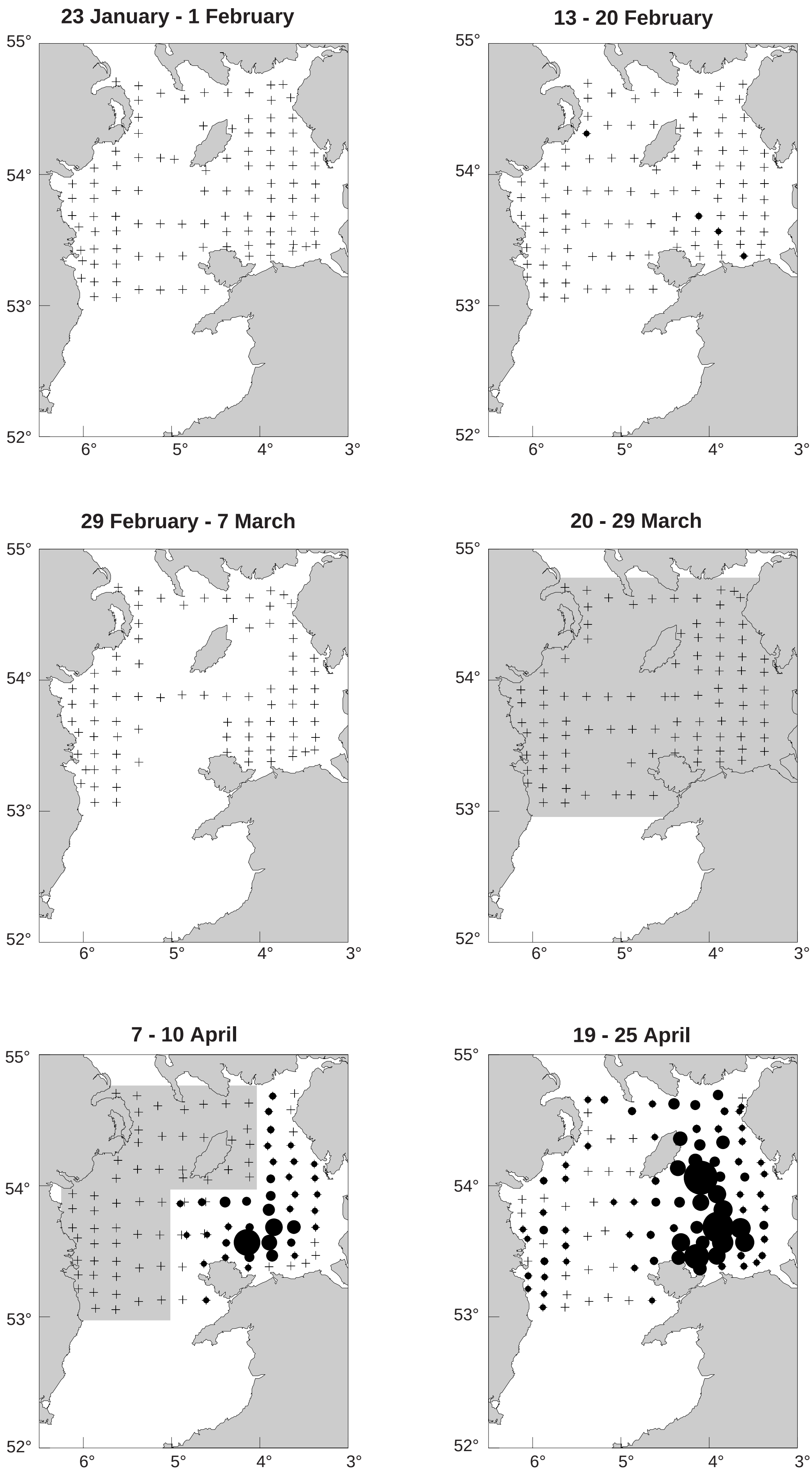


Figure 44. Concentration of flounder (Platichthys flesus) larvae (nos.m^{-2}) in 2000

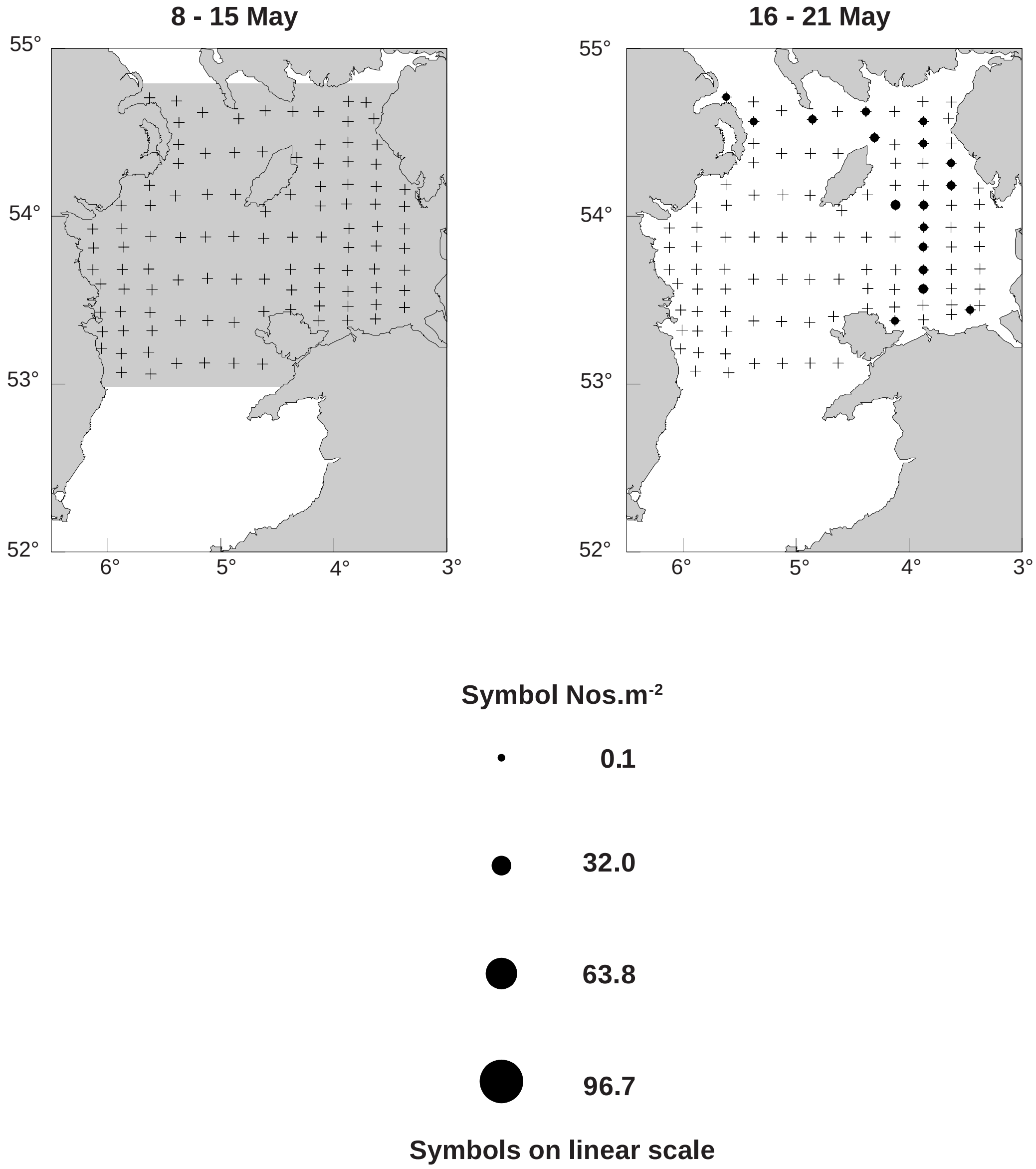


Figure 44. continued

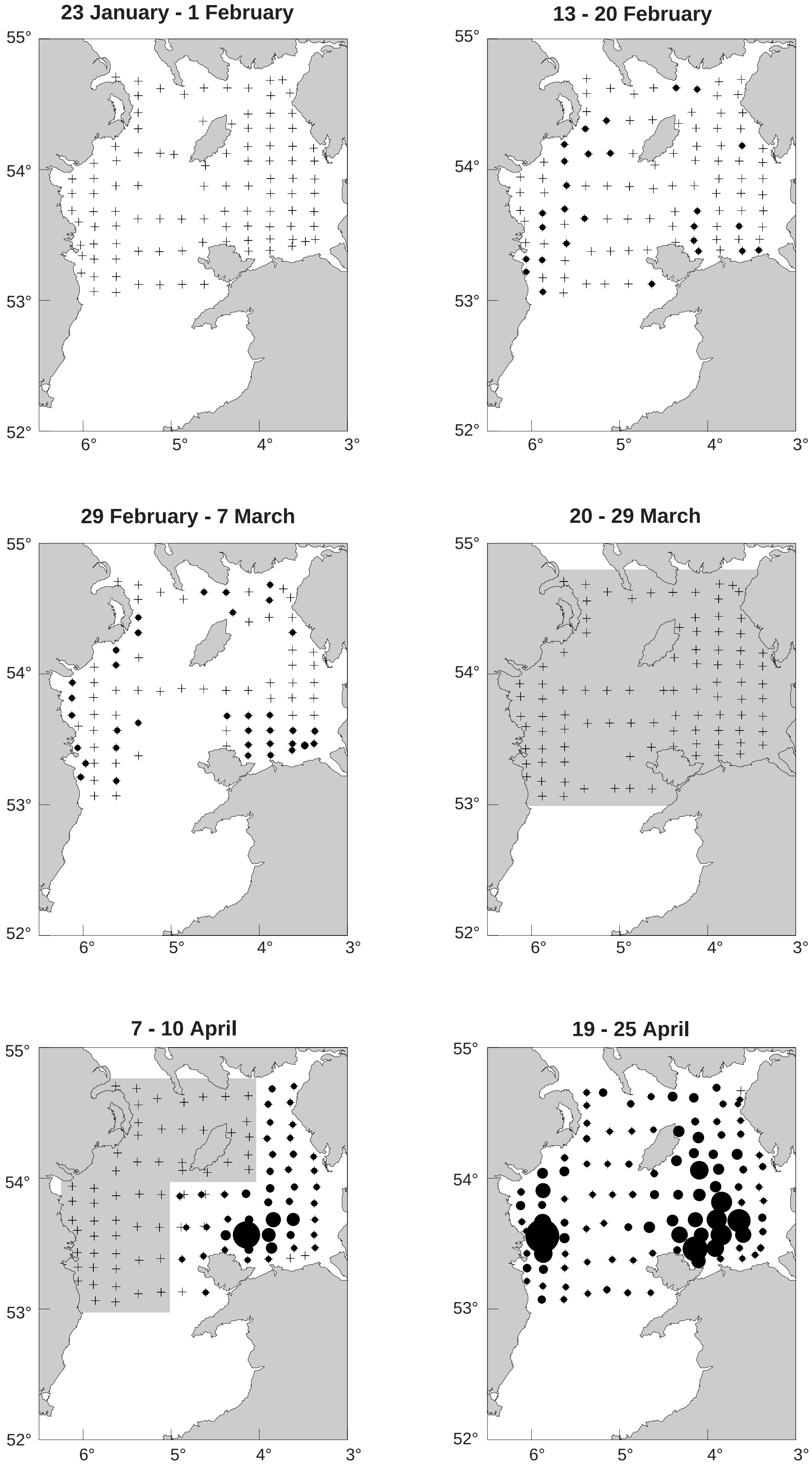


Figure 45. Concentration of dab (Limanda limanda) larvae (nos.m^{-2}) in 2000

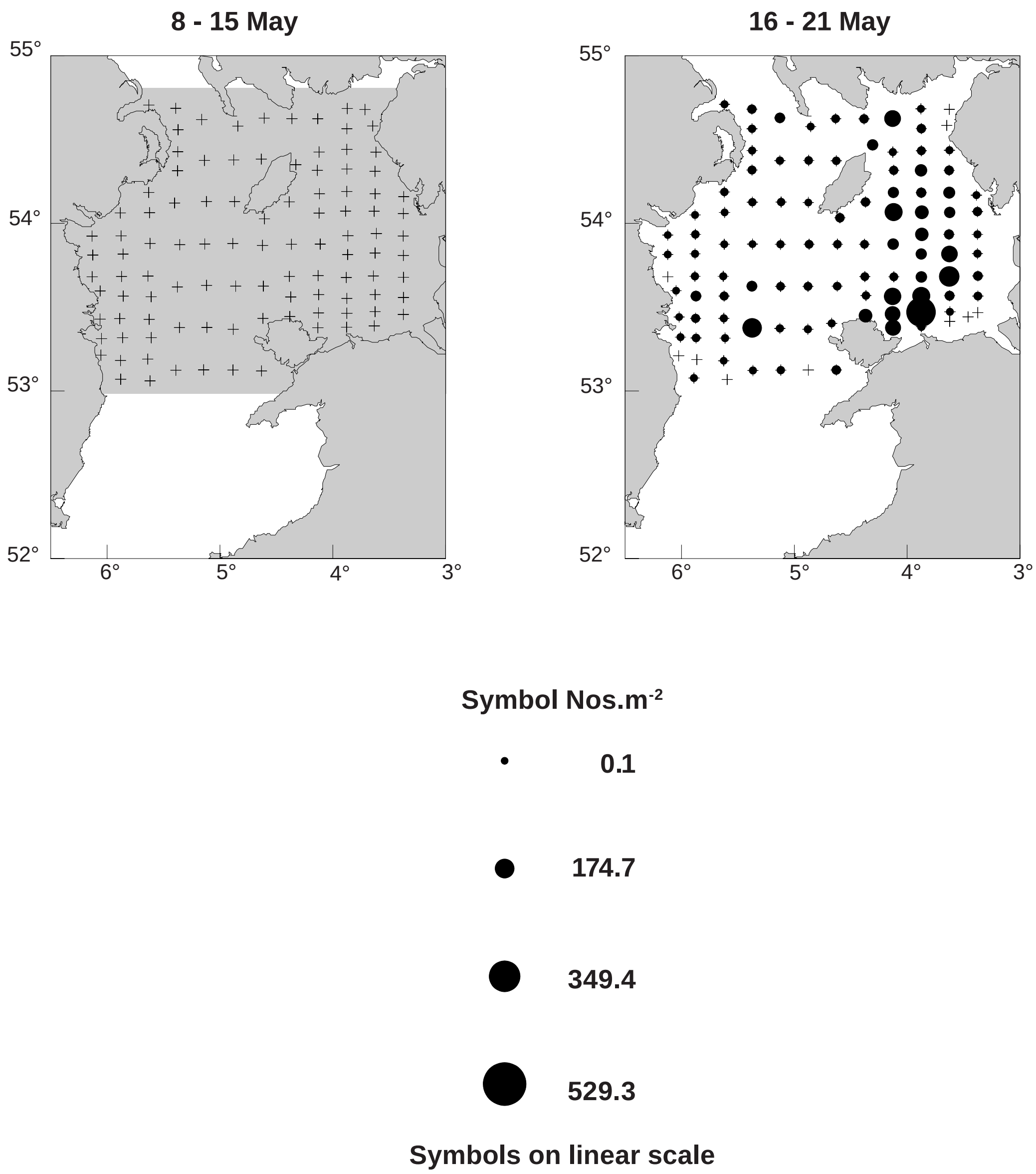


Figure 45. continued

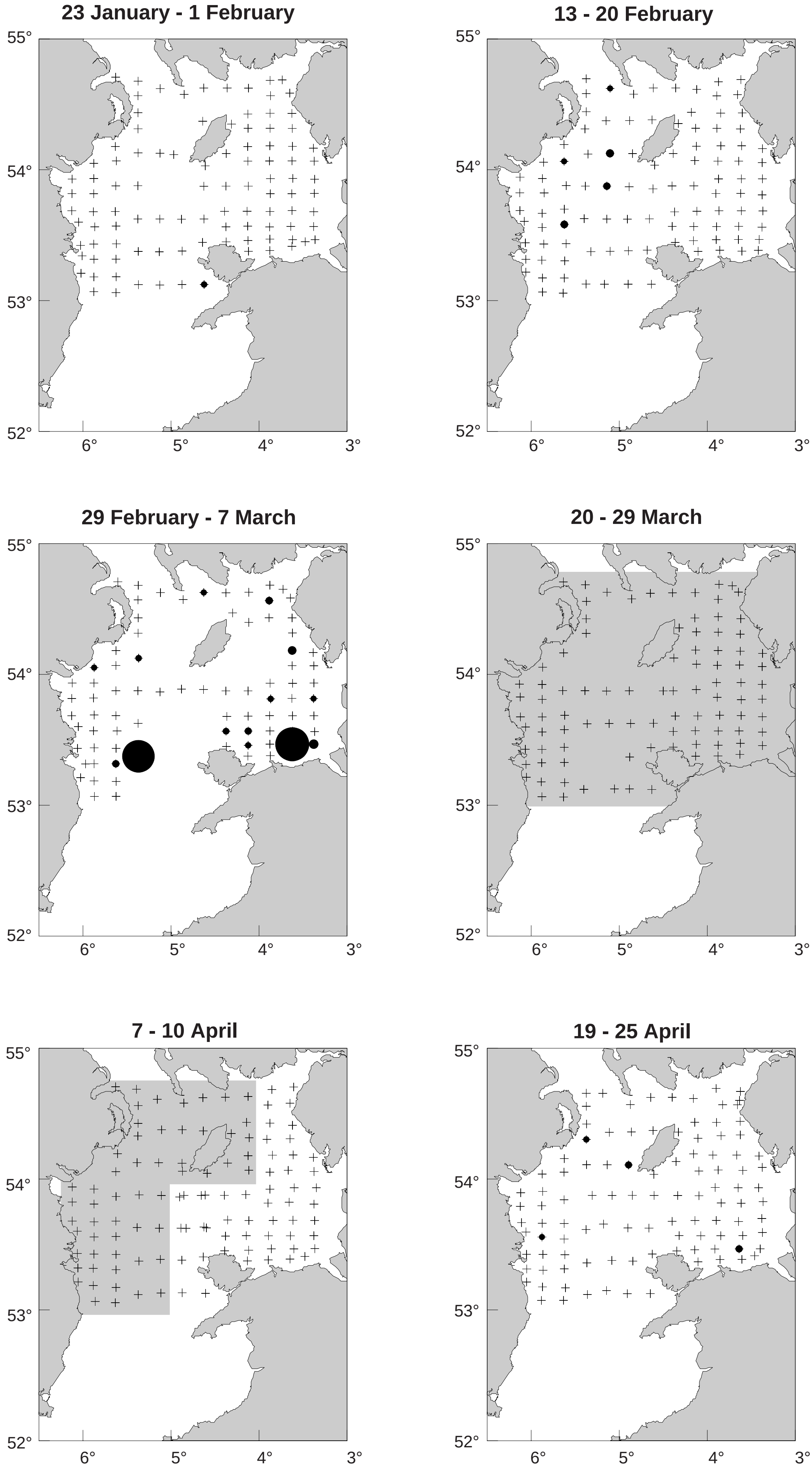


Figure 46. Concentration of late-stage lemon sole (Microstomus kitt) eggs (nos.m⁻²) in 2000

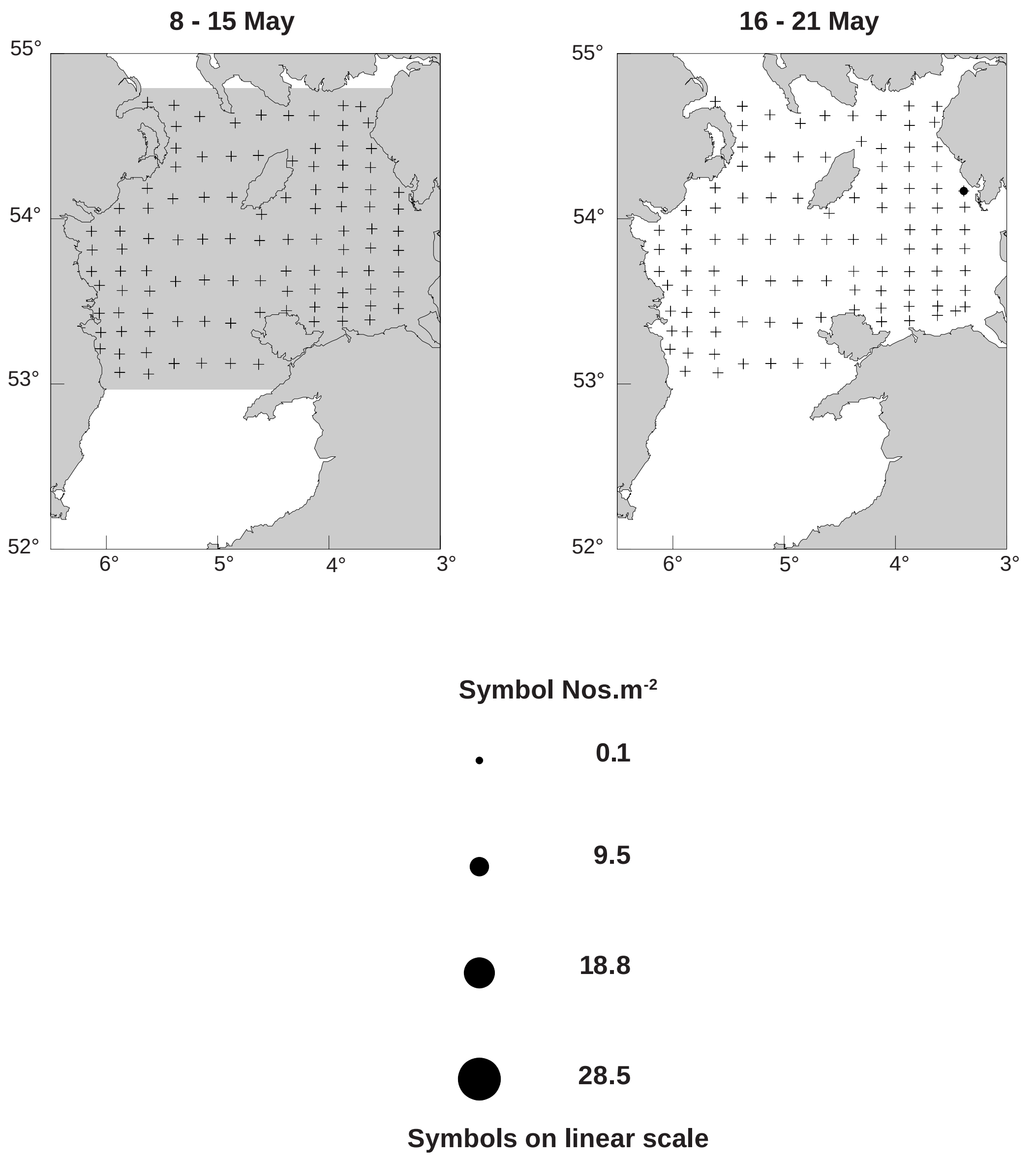


Figure 46. continued

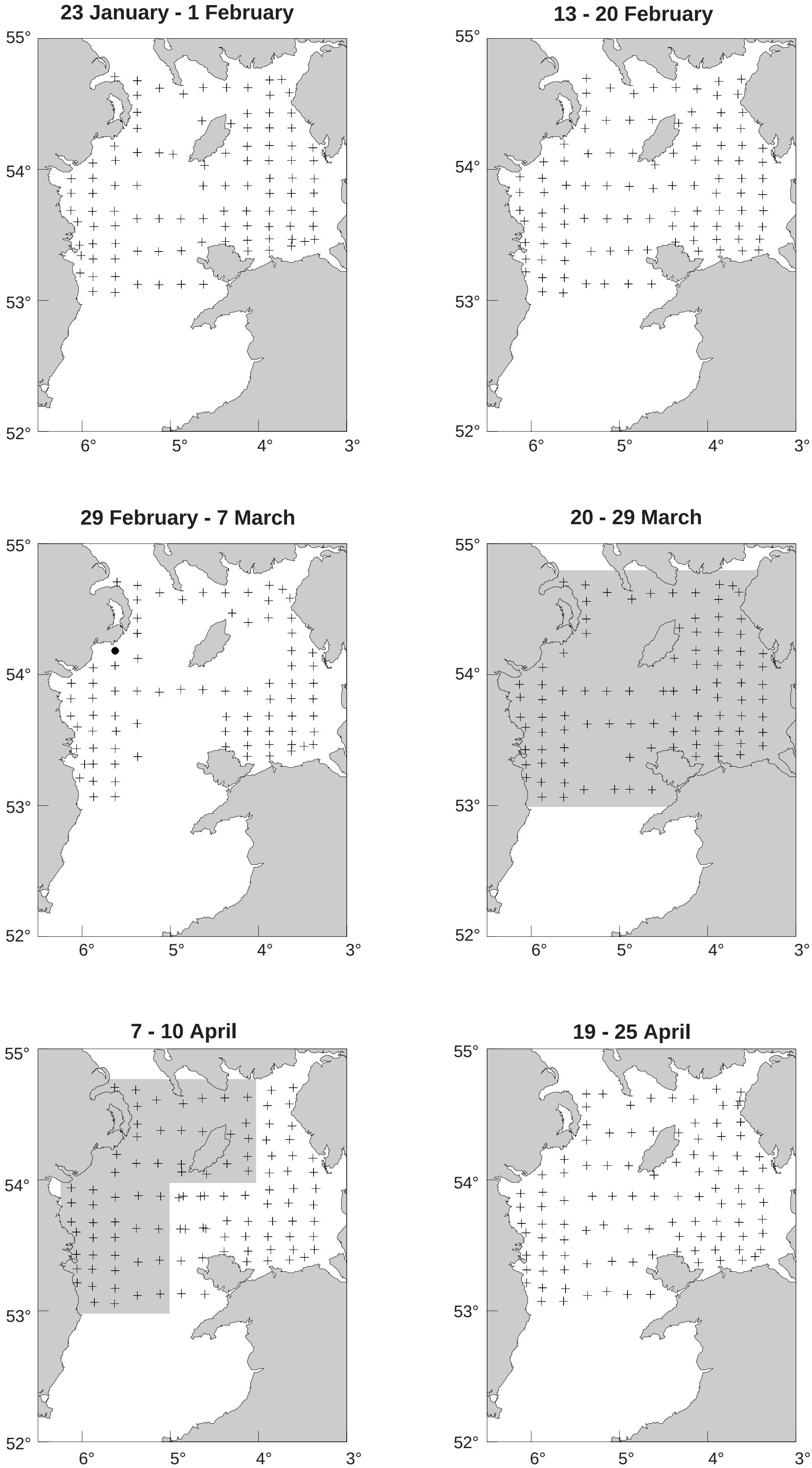


Figure 47. Concentration of lemon sole (Microstomus kitt) larvae (nos.m^{-2}) in 2000

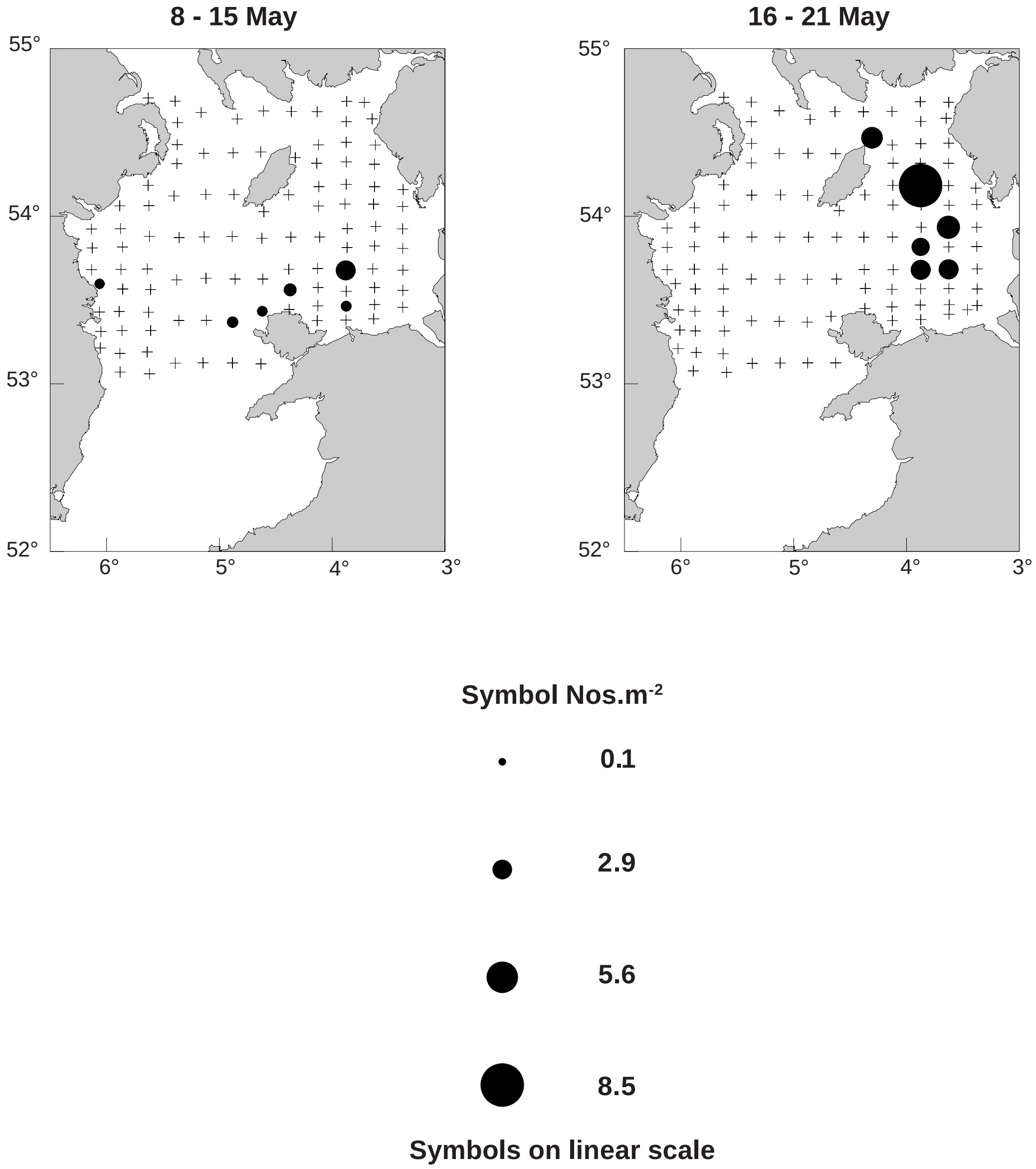


Figure 47. continued

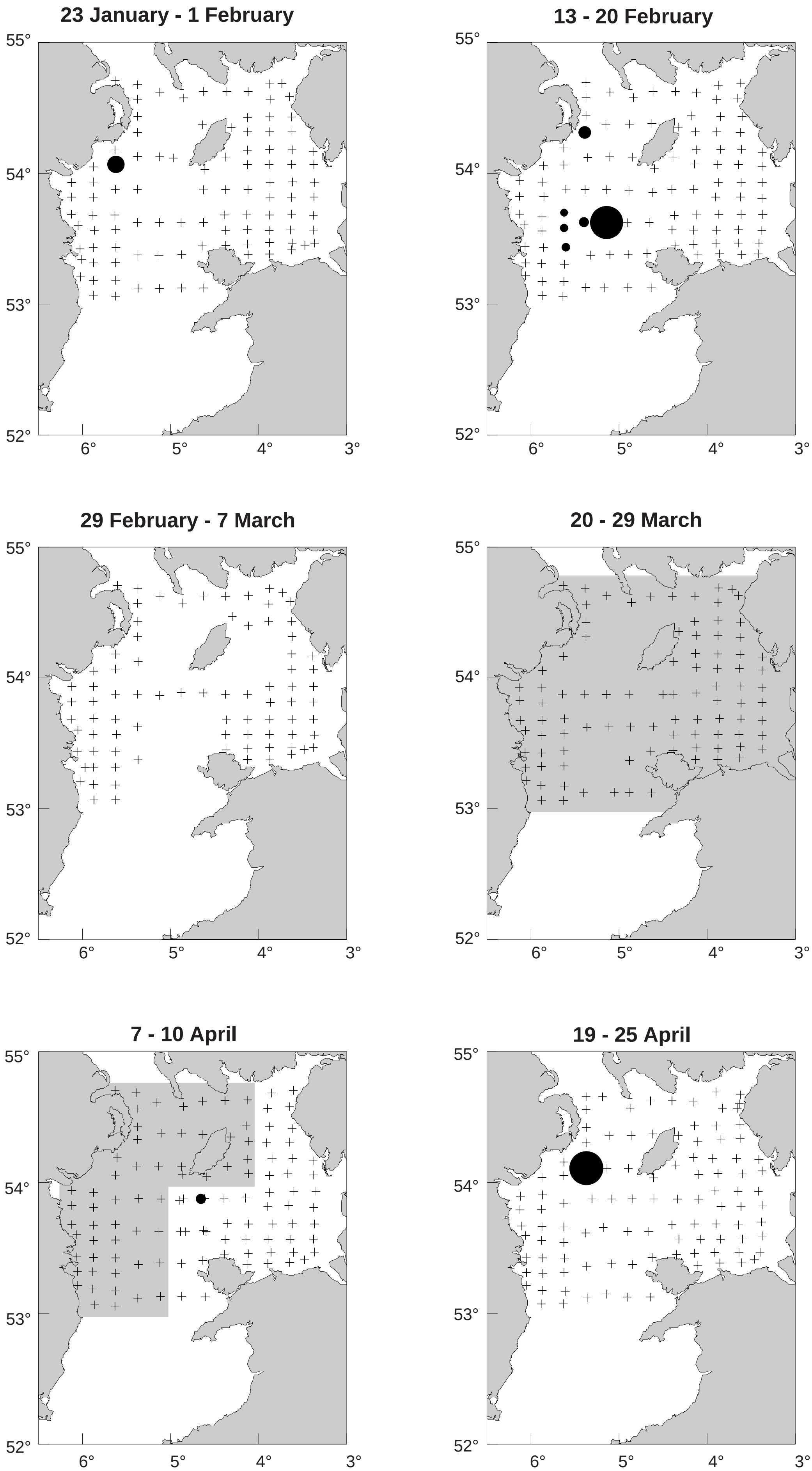


Figure 48. Concentration of late-stage witch (Glyptocephalus cynoglossus) eggs (nos.m^{-2}) in 2000

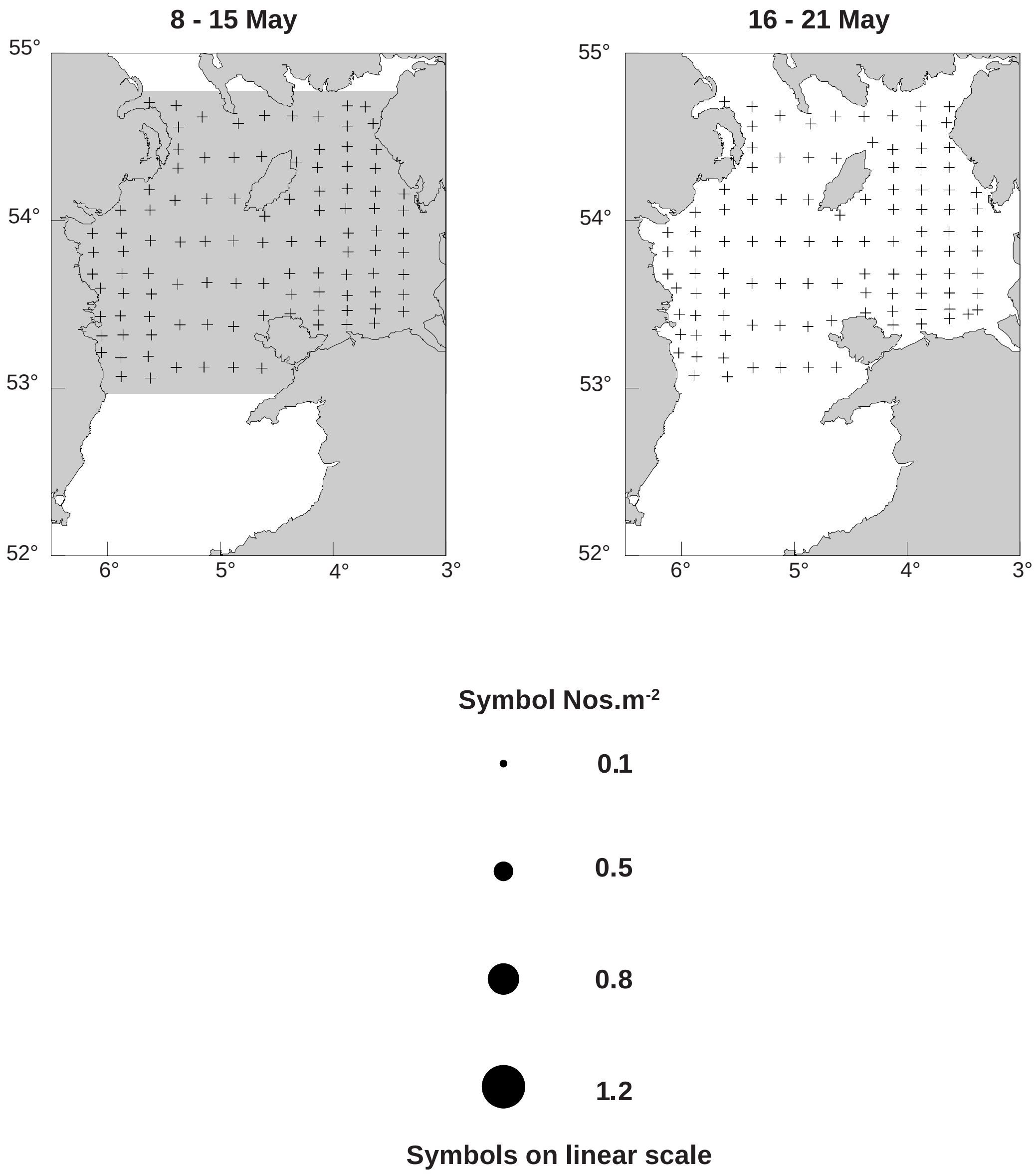


Figure 48. continued

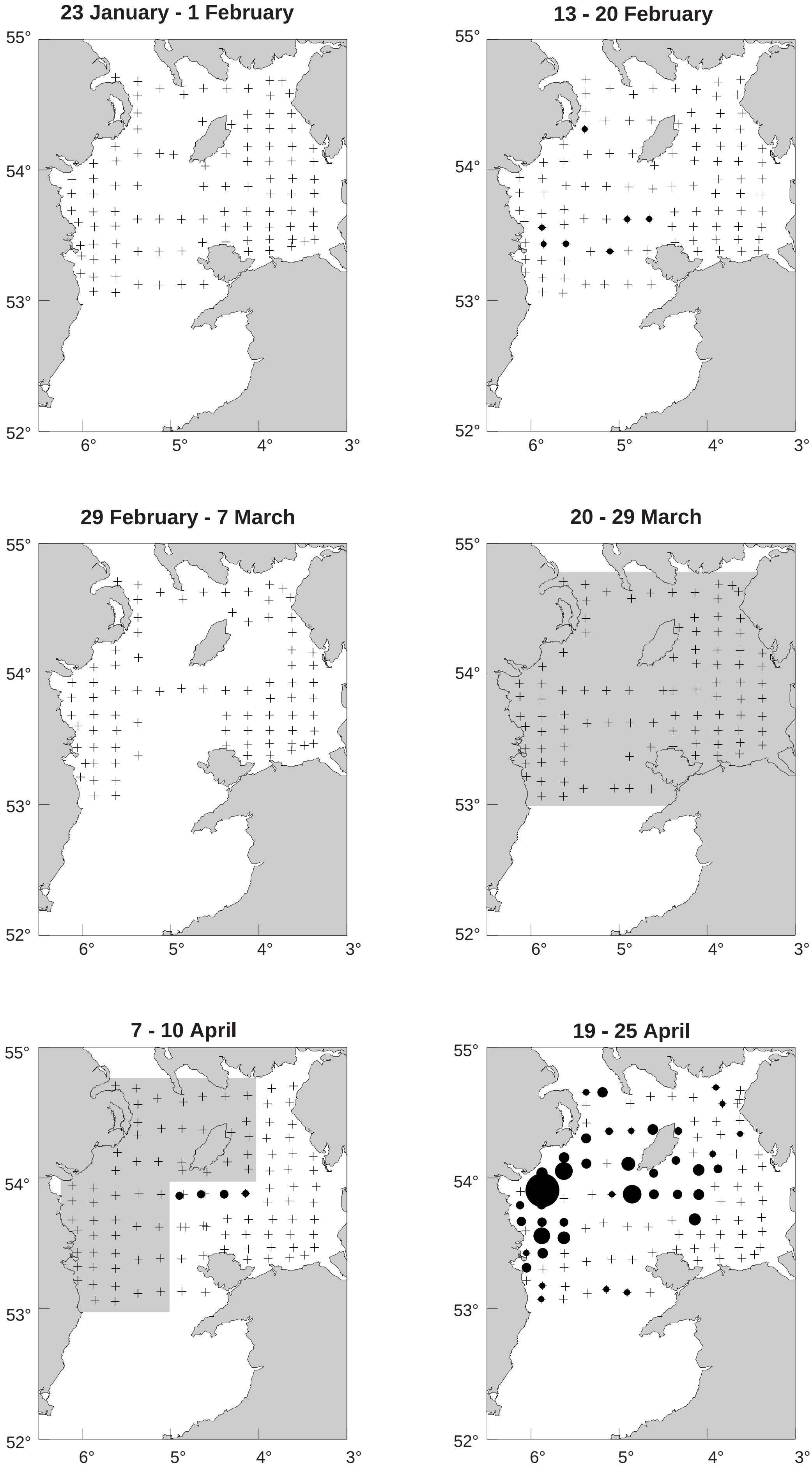


Figure 49. Concentration of witch (Glyptocephalus cynoglossus) larvae (nos.m^{-2}) in 2000

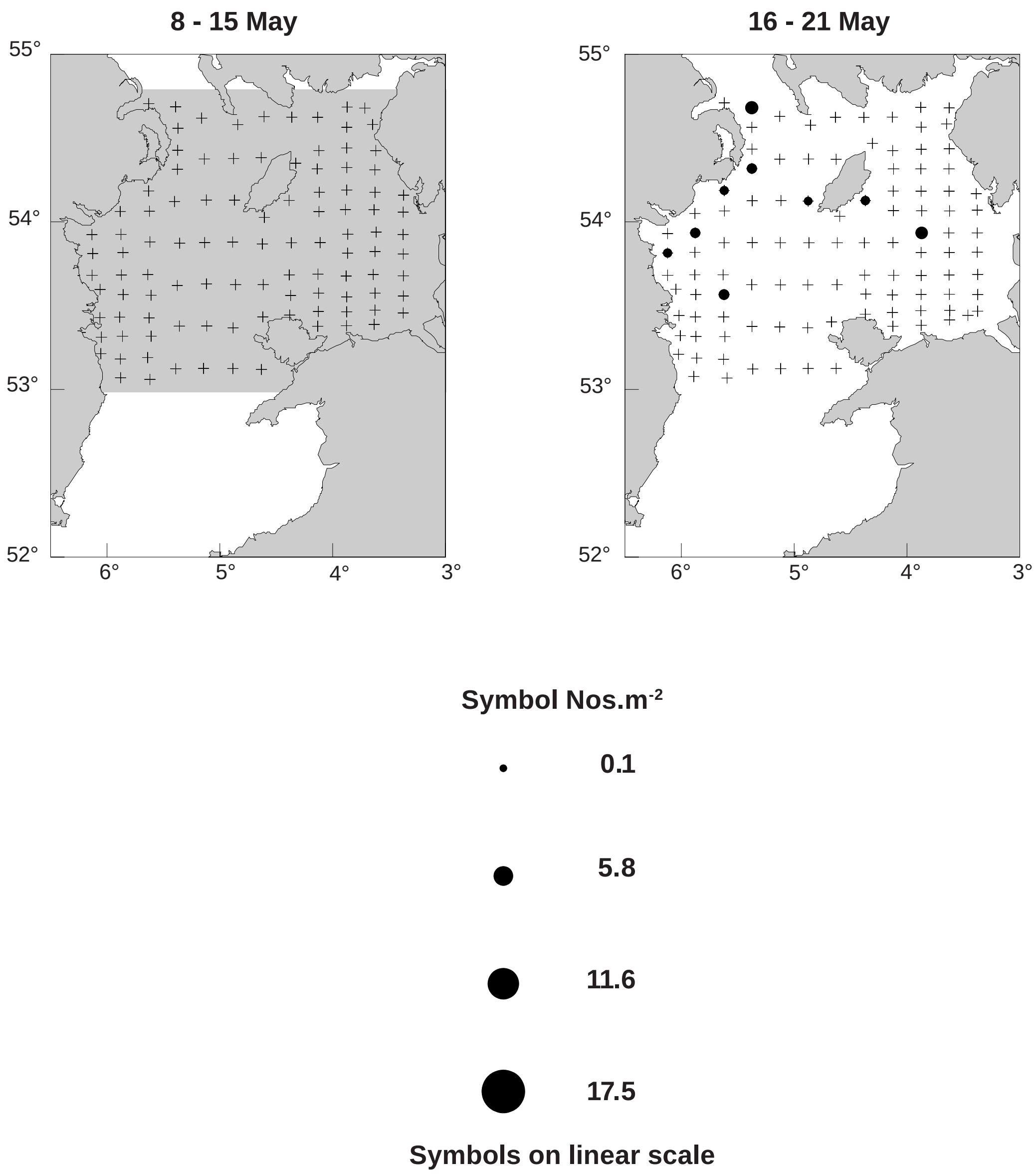


Figure 49. continued

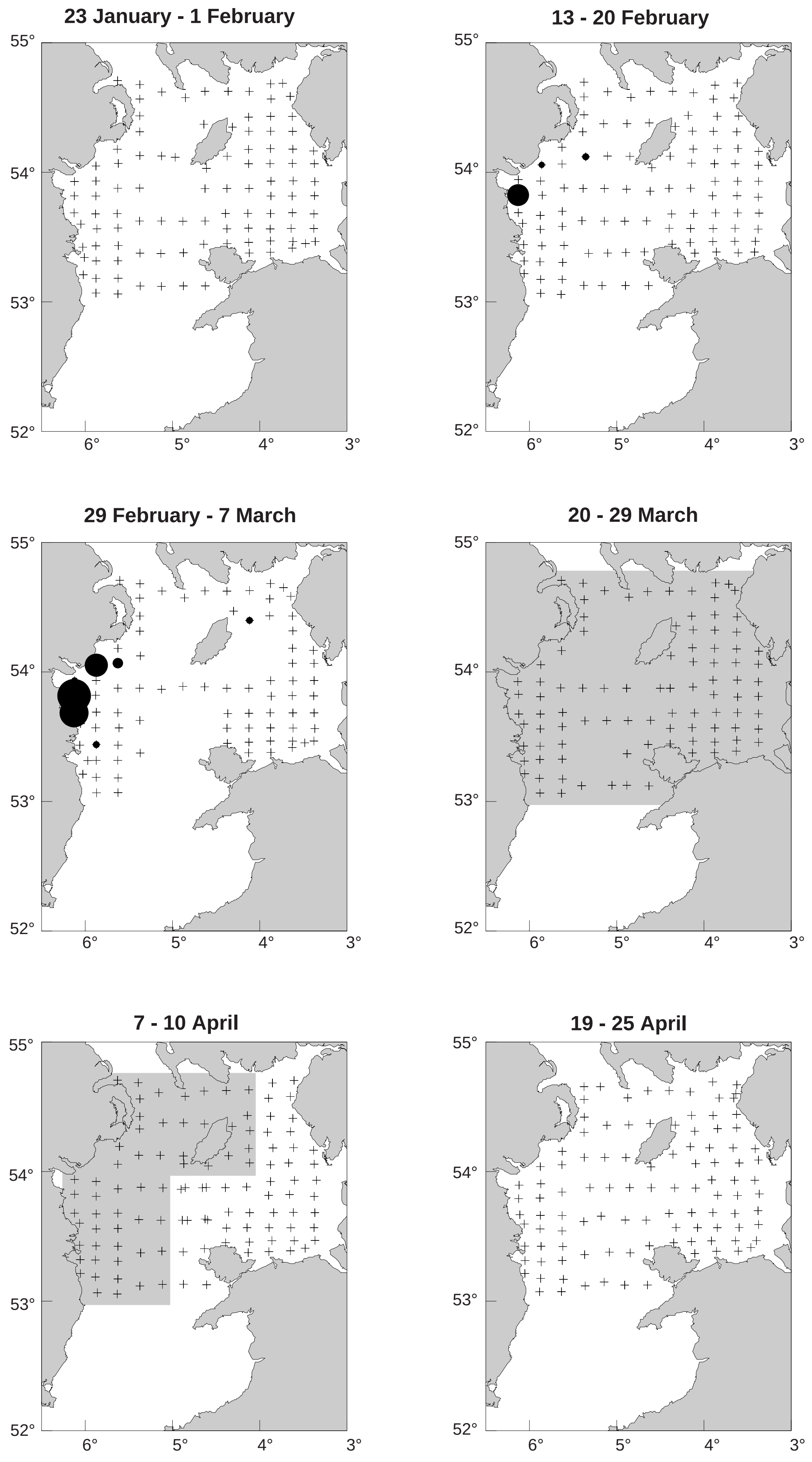


Figure 50. Concentration of long rough dab (Hippoglossoides platessoides) eggs (nos.m^{-2}) in 2000

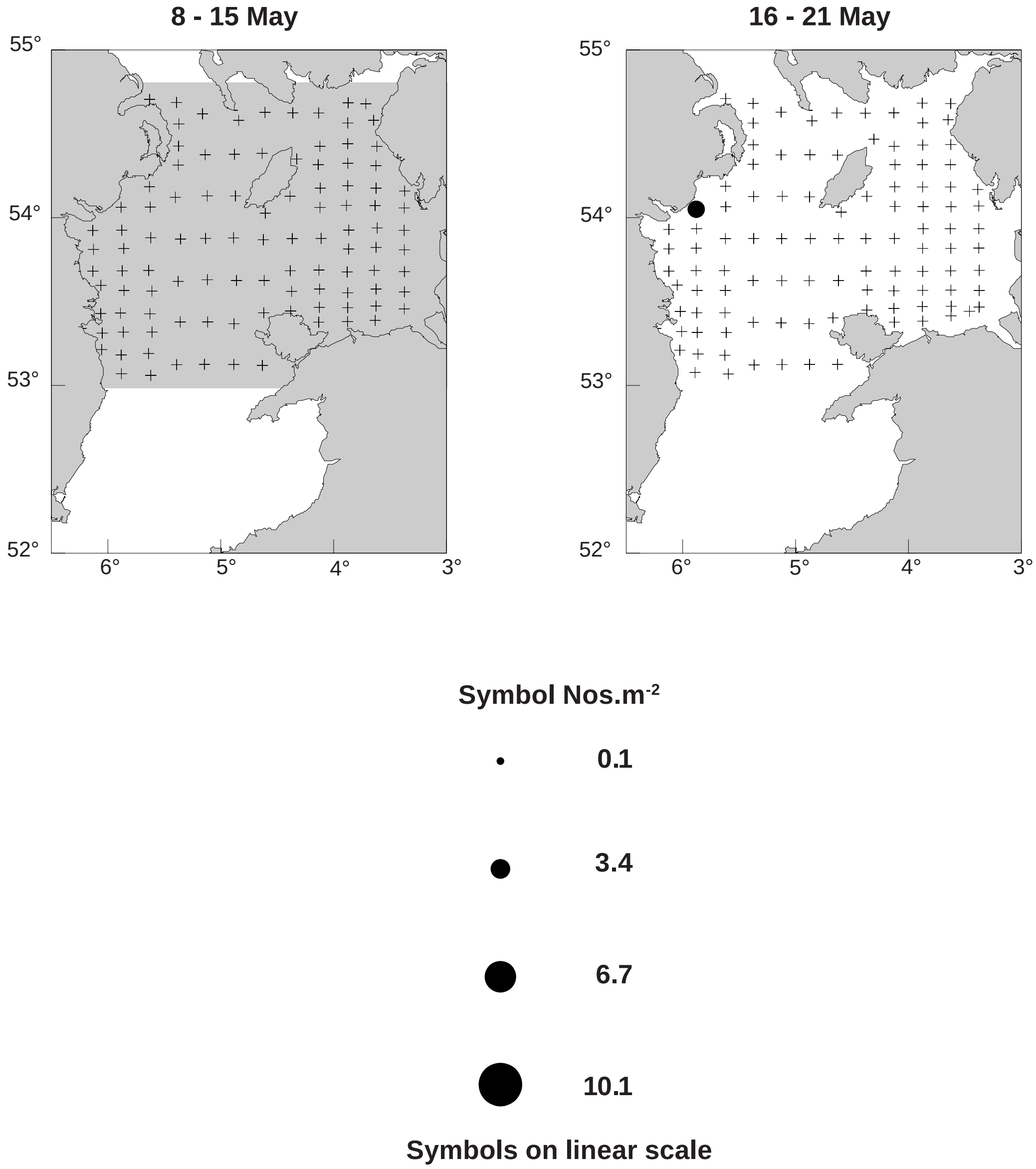


Figure 50. continued

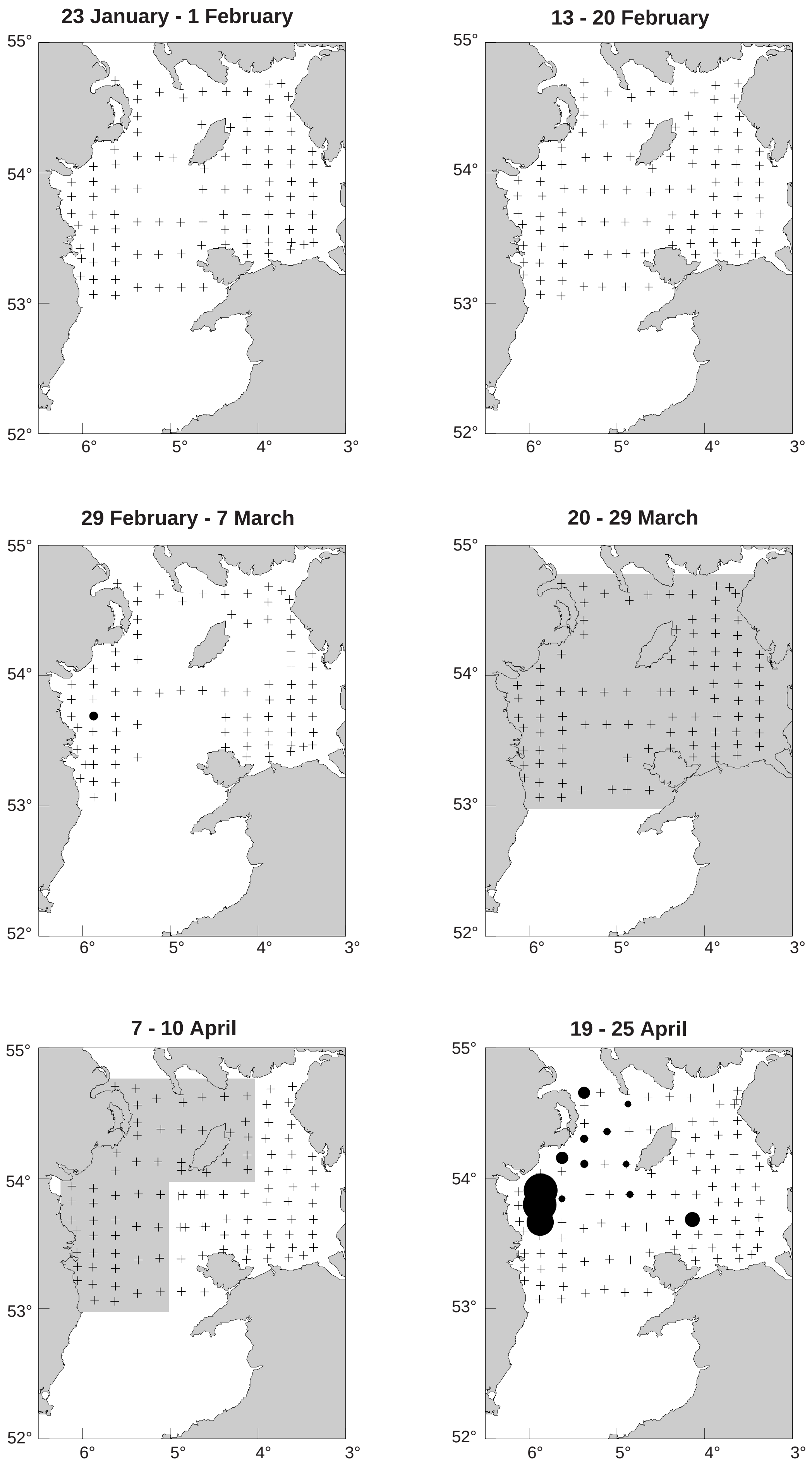


Figure 51. Concentration of long rough dab (Hippoglossoides platessoides) larvae (nos.m-2) in 2000

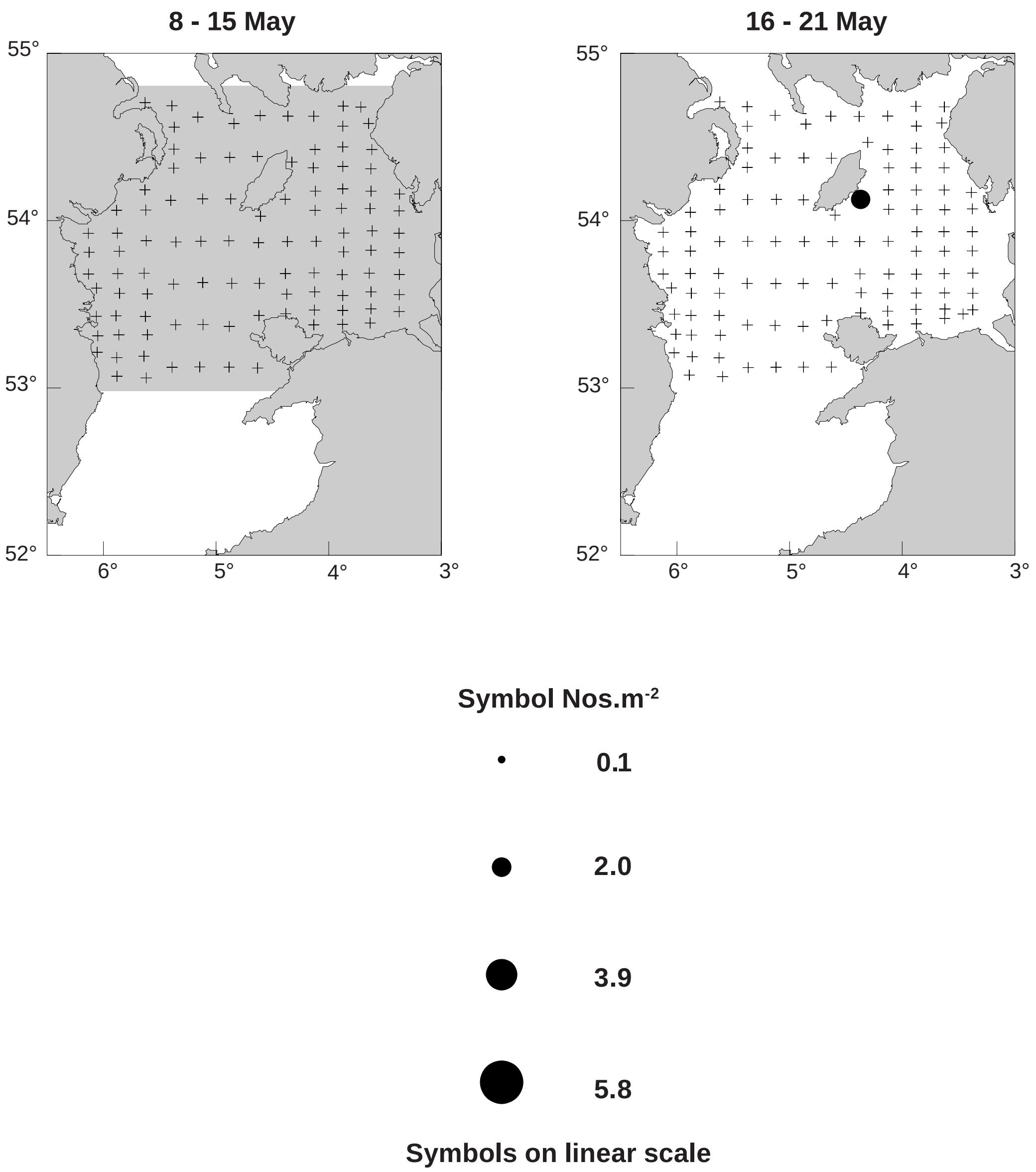


Figure 51. continued

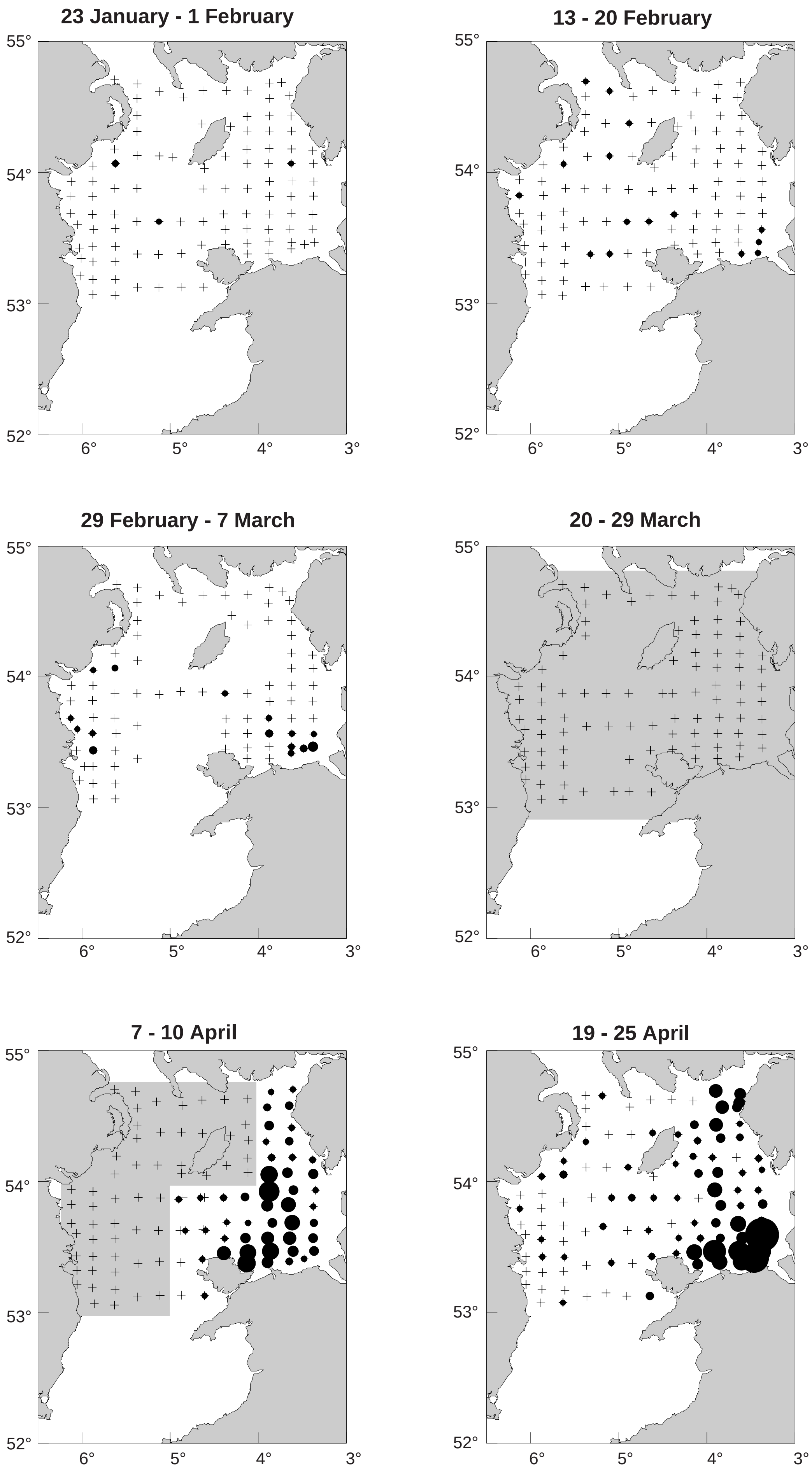


Figure 52. Concentration of sole (Solea solea) eggs (nos.m^{-2}) in 2000

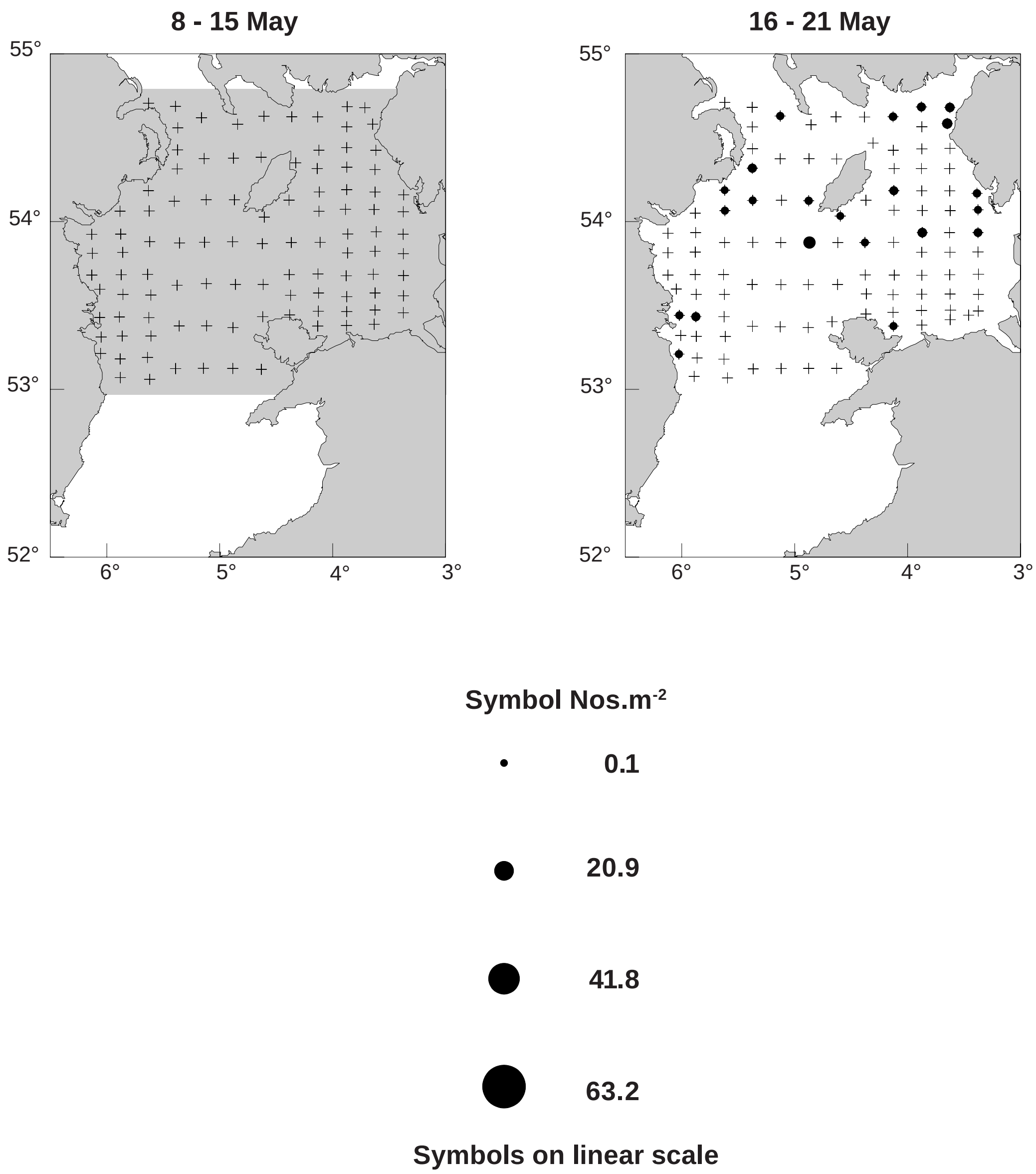


Figure 52. continued

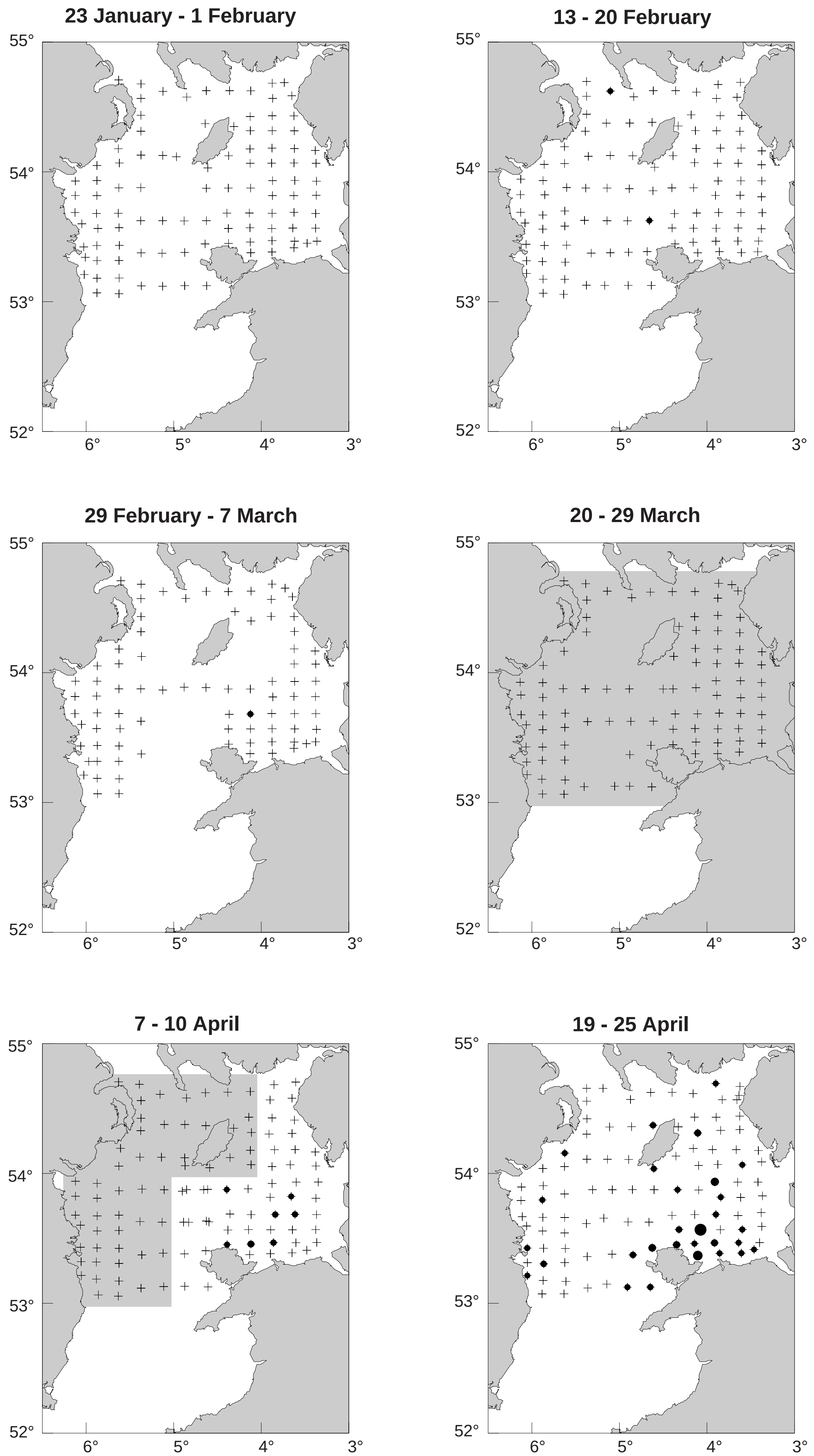


Figure 53. Concentration of sole (Solea solea) larvae (nos.m^{-2}) in 2000

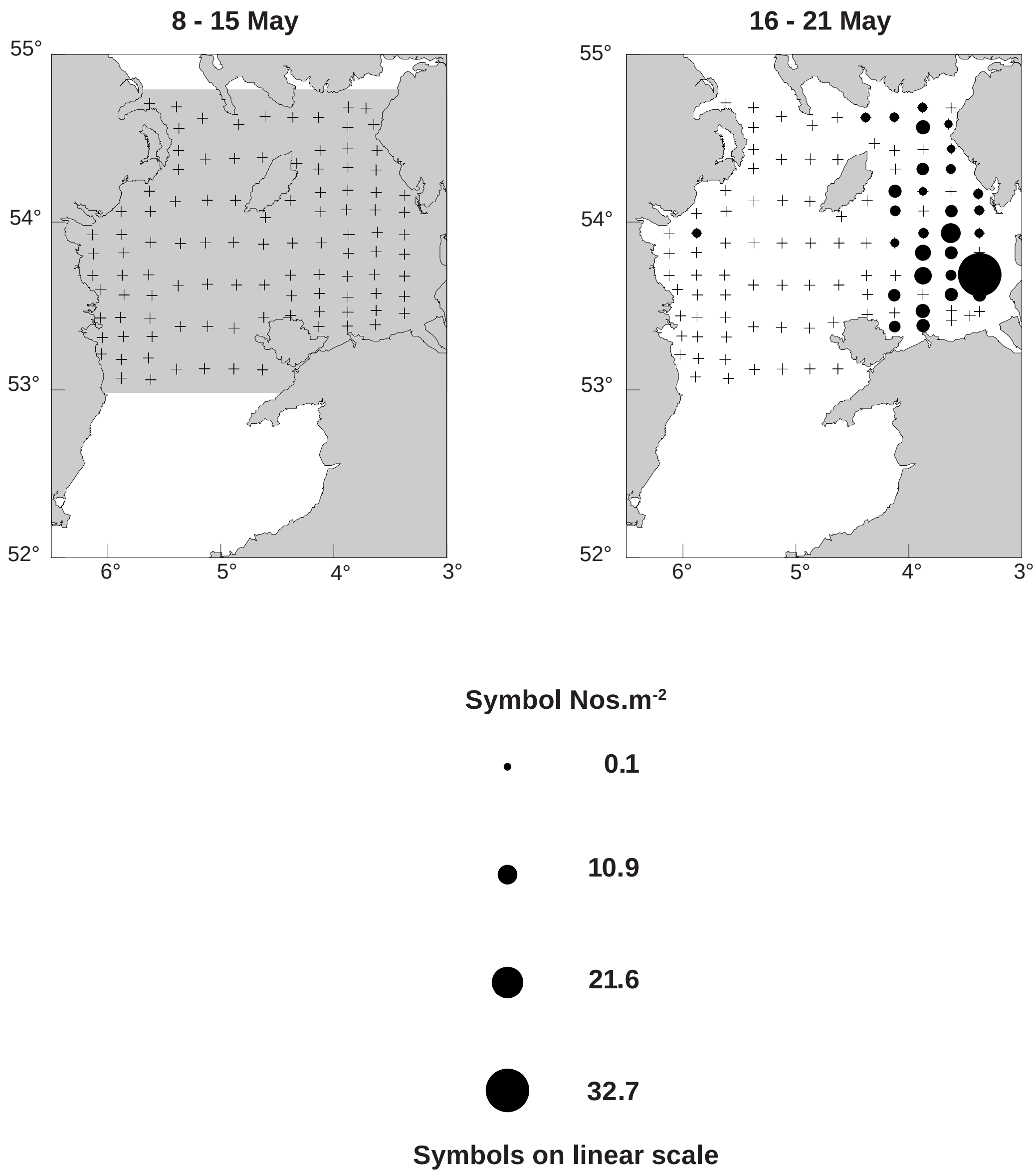


Figure 53. continued

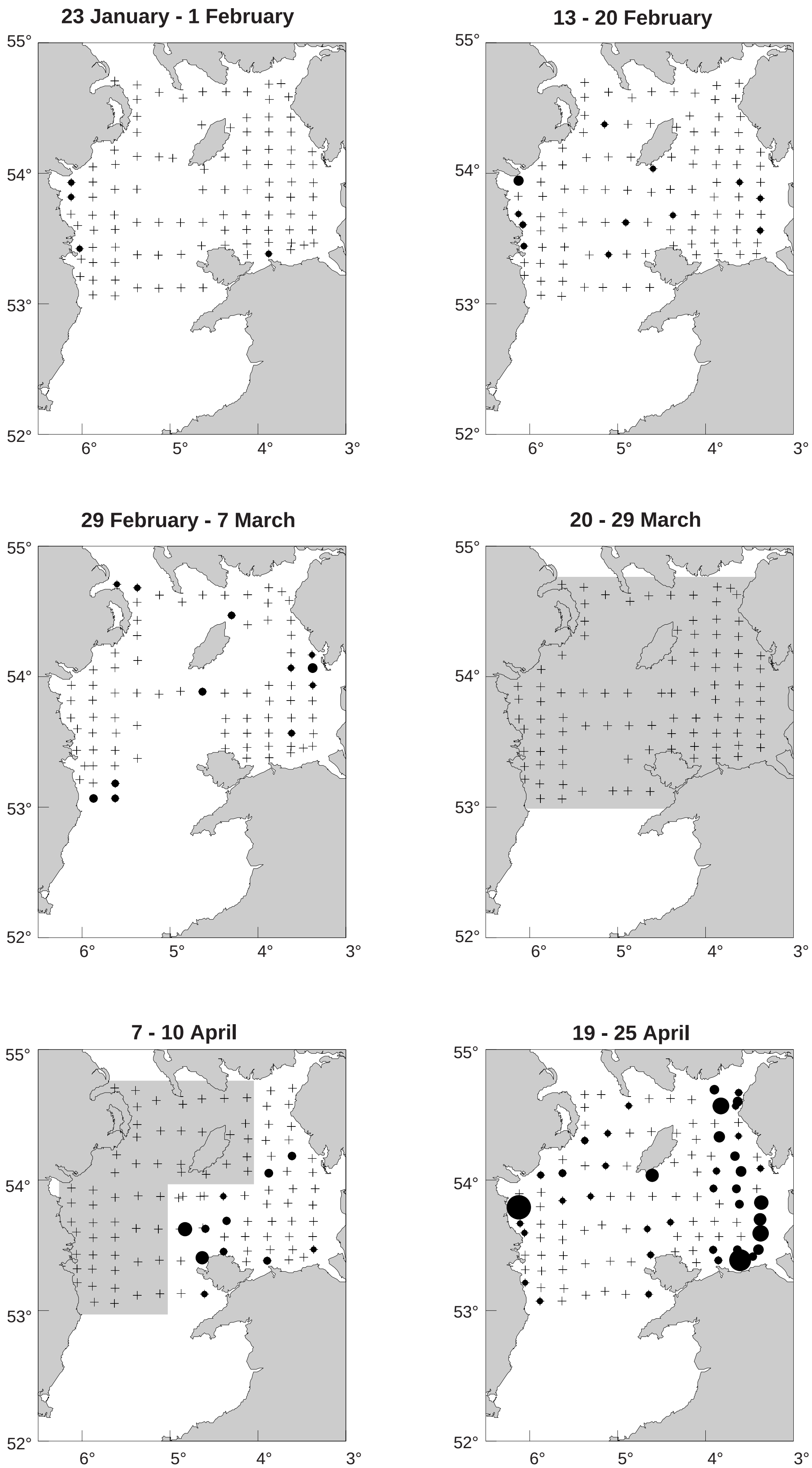
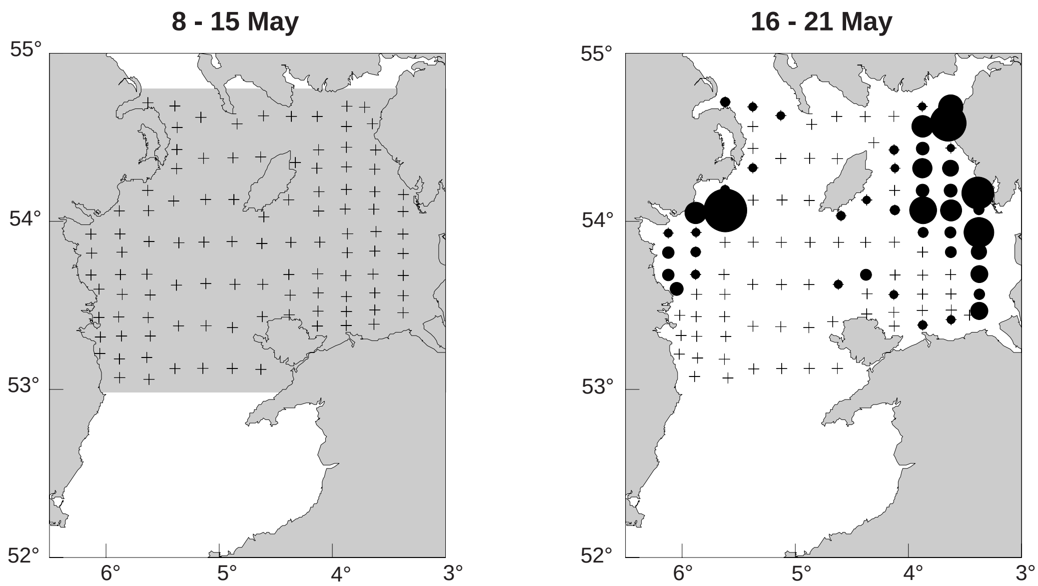


Figure 54. Concentration of solenette (Buglossidium luteum) eggs (nos.m^{-2}) in 2000



Symbol Nos.m^{-2}

0.1

13.8

27.4

41.5

Symbols on linear scale

Figure 54. continued

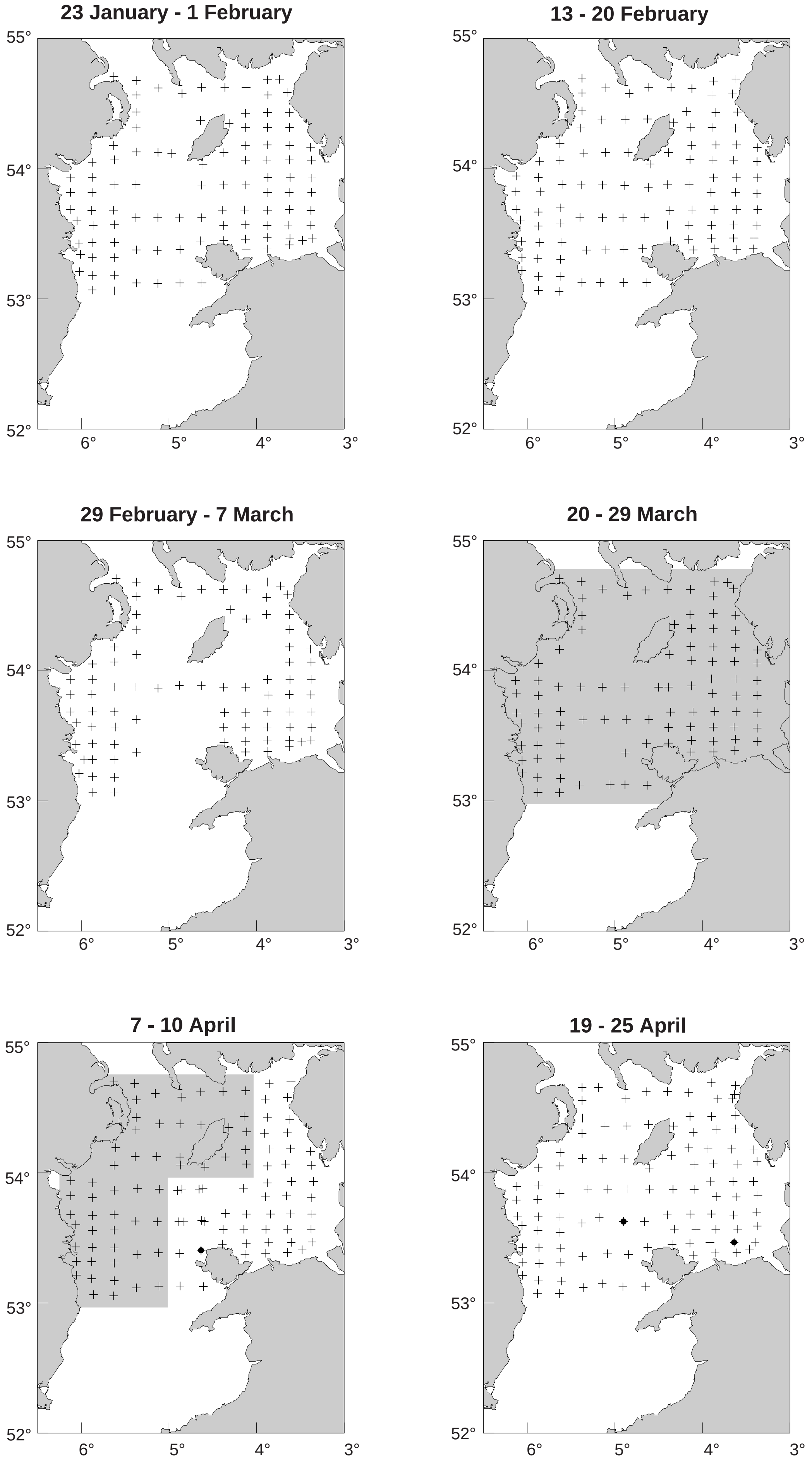


Figure 55. Concentration of solenette (Buglossidium luteum) larvae (nos.m^{-2}) in 2000

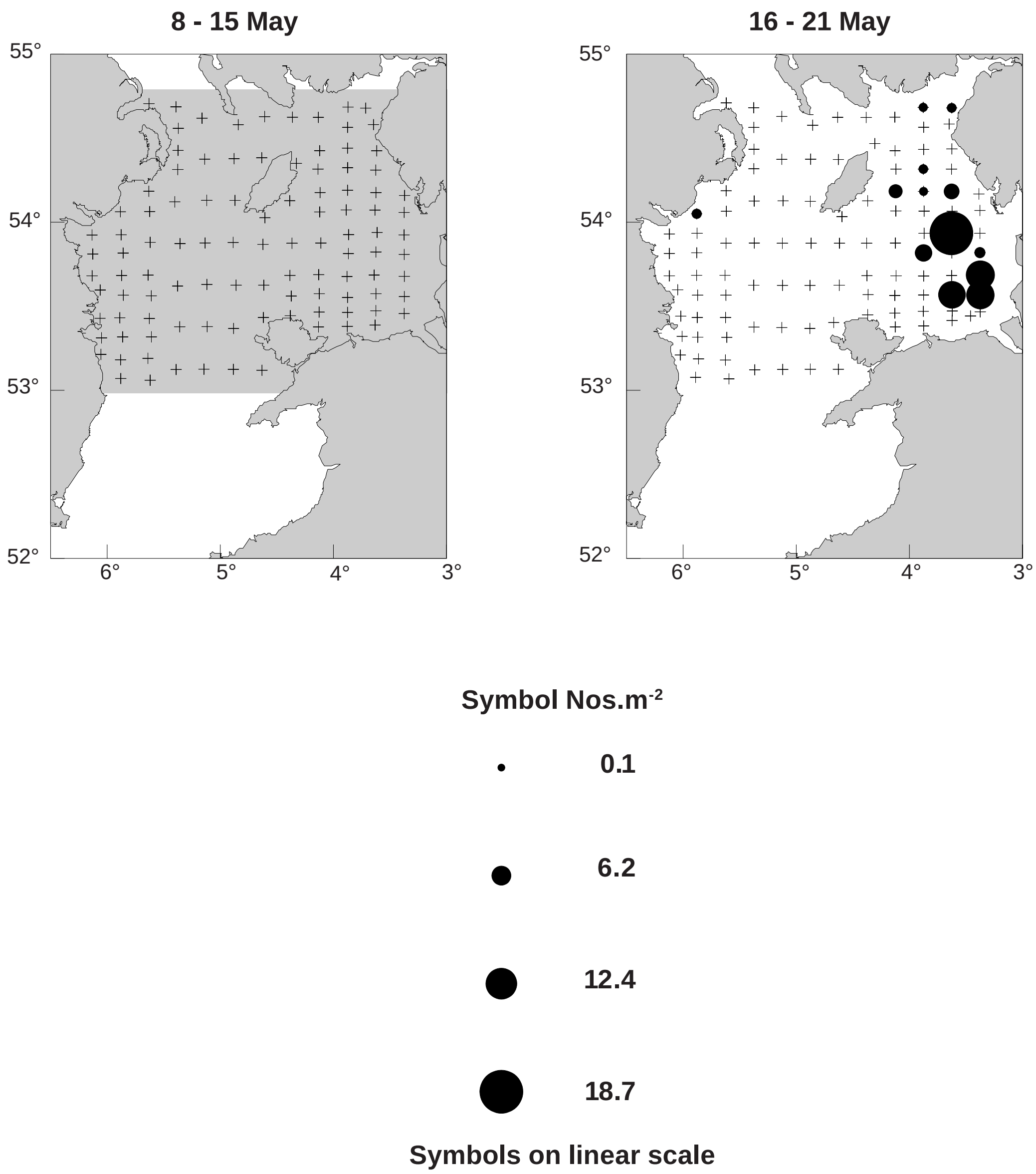


Figure 55. continued

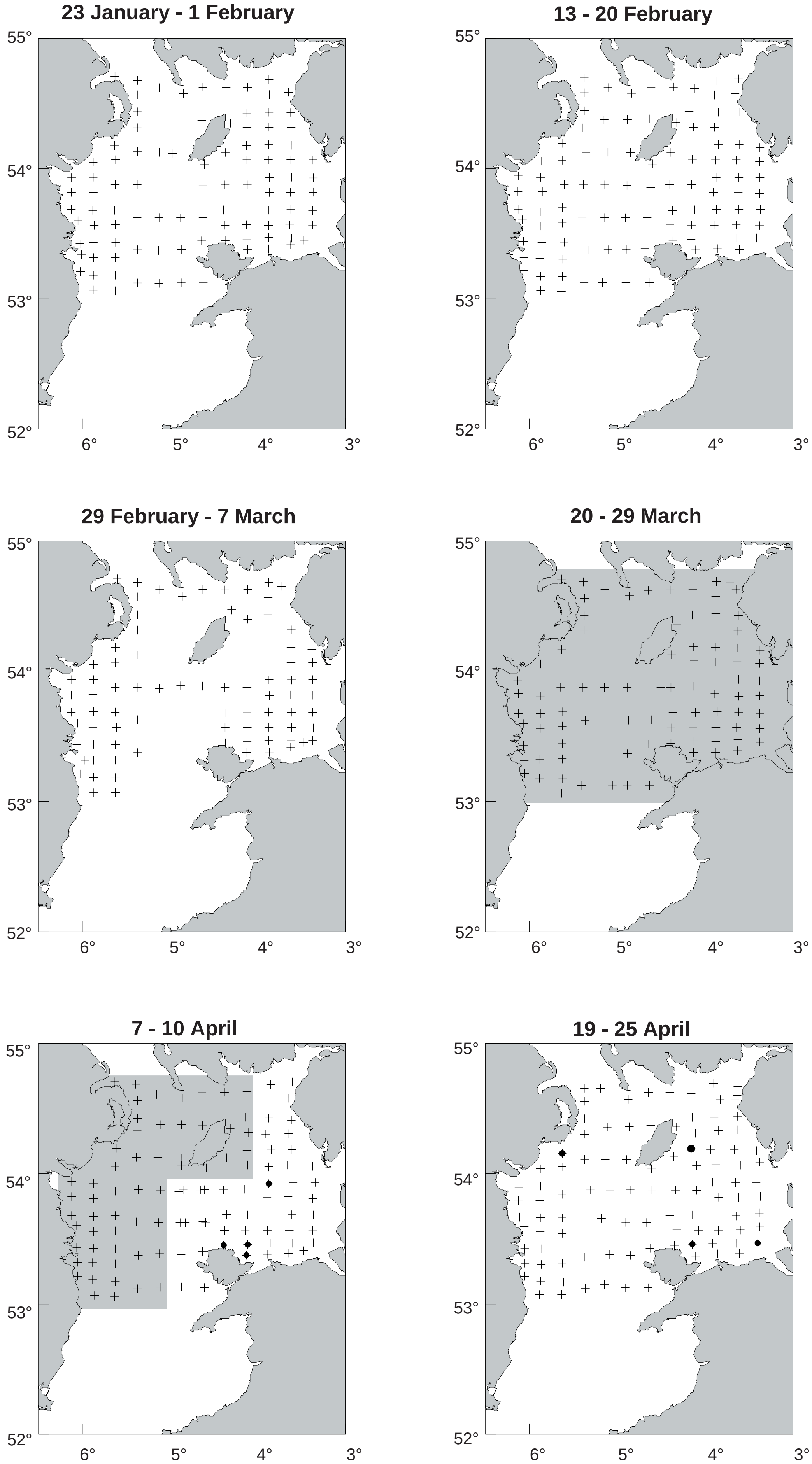


Figure 56. Concentration of thick-back sole (Microchirus variegatus) eggs (nos.m^{-2}) in 2000

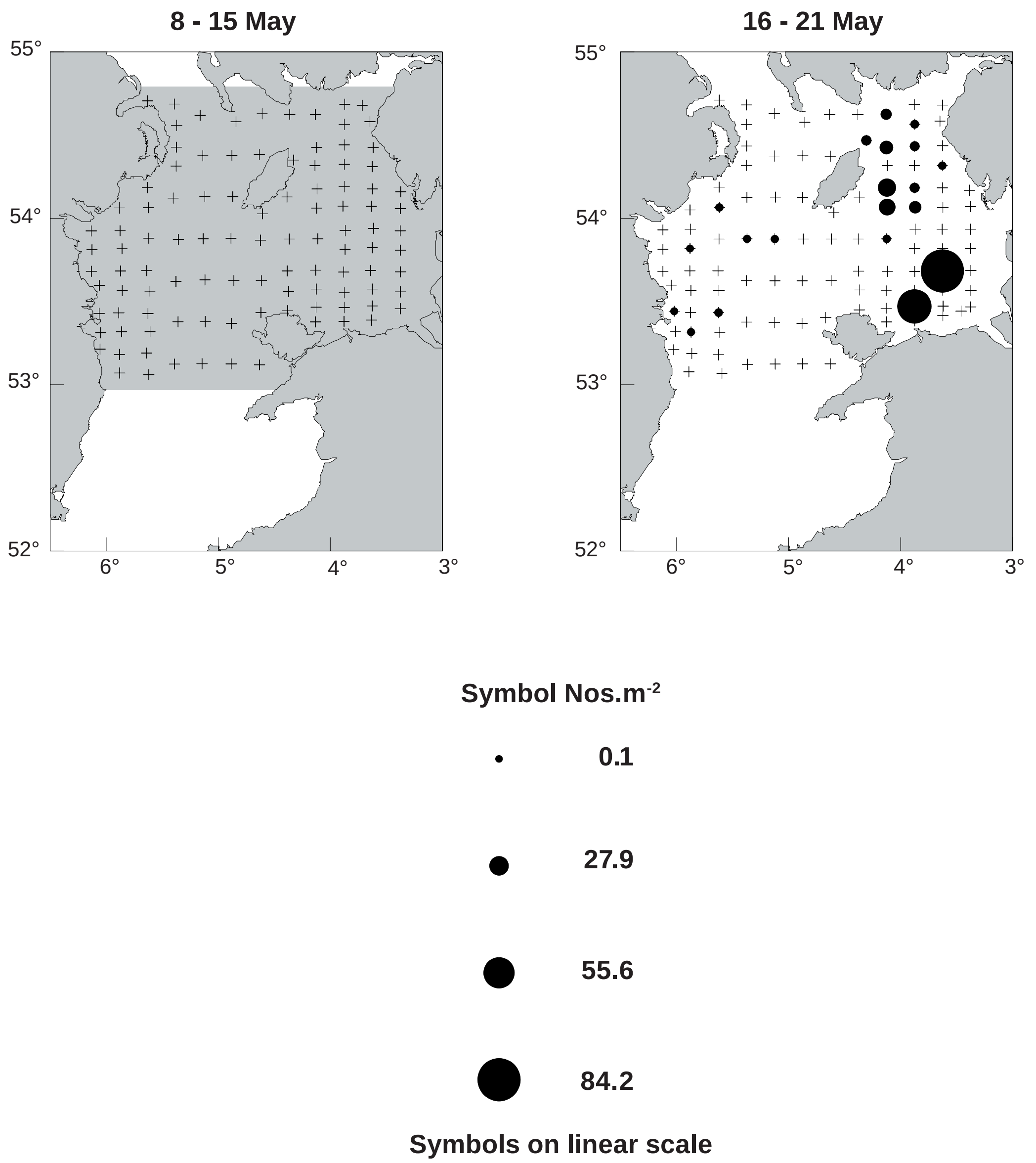


Figure 56. continued

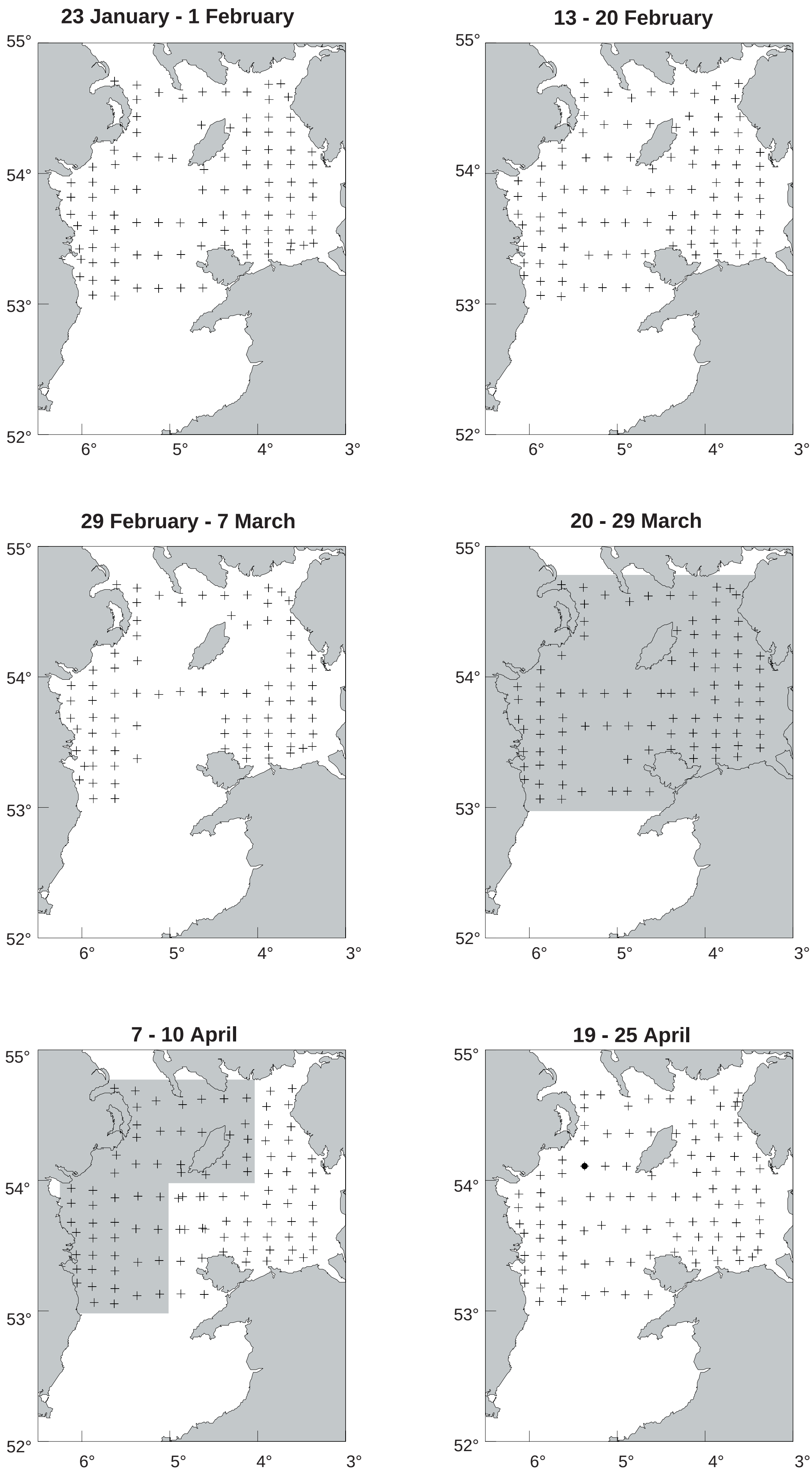


Figure 57. Concentration of thick-back sole (Microchirus variegatus) larvae (nos.m^{-2}) in 2000

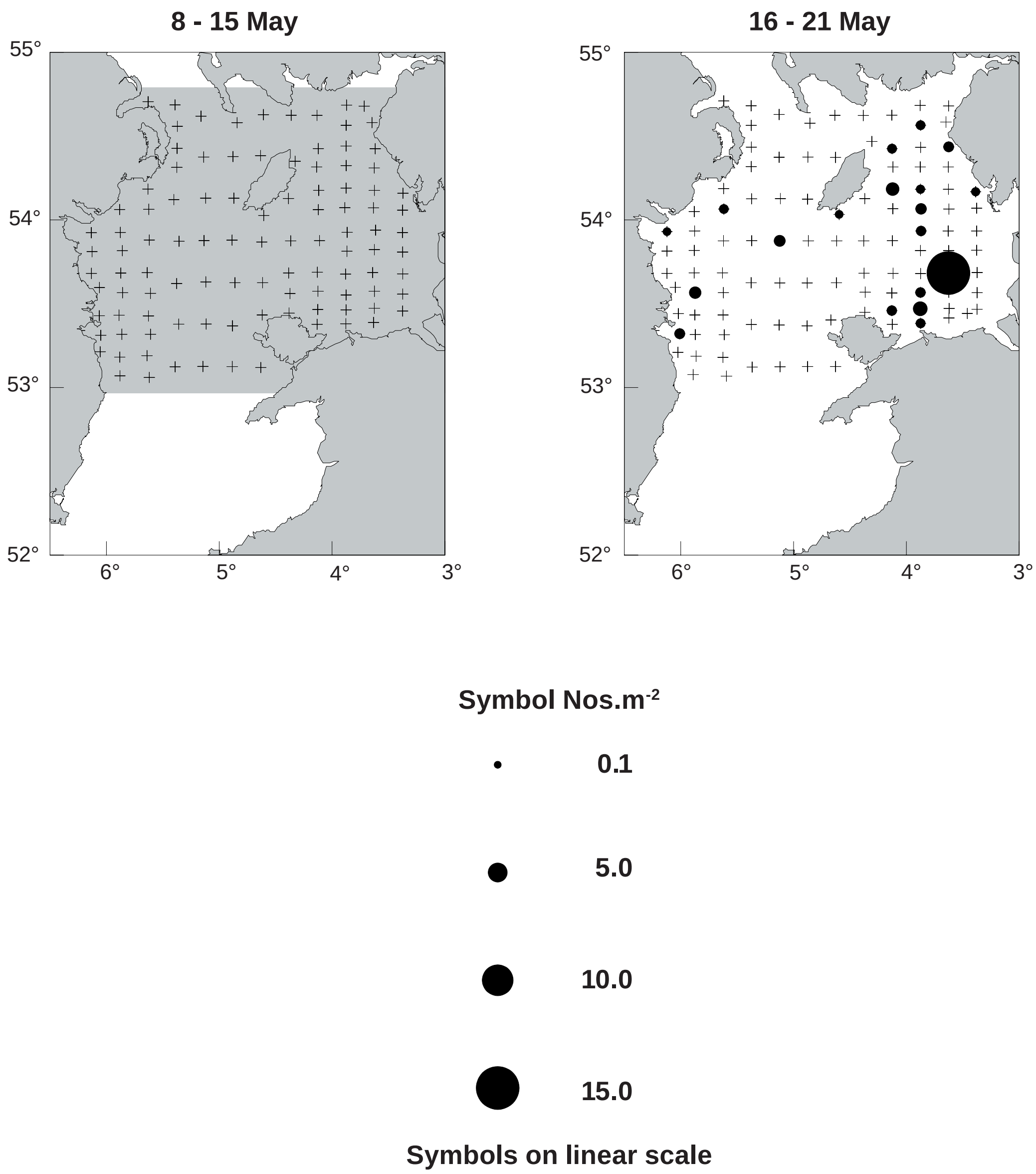


Figure 57. continued

Table 2a. List of identified species occurring as eggs and the maximum concentration on each of the eight surveys in the Irish Sea in 2000. Species marked * have been plotted

Species	Maximum concentrations (nos.m^{-2})							
	23 Jan-1 Feb	13-20 Feb	29 Feb-7 Mar	20-29 Mar	7-10 Apr	19-25 Apr	8-15 May	16-21 May
*Sprattus sprattus**	31.1	120.0	265.2	na	233.8	277.9	na	264.0
Sardina pilchardus	-	0.2	-	na	-	-	na	-
*Argentina sphyraena**	-	-	-	na	1.5	2.7	na	-
*Gadus morhua**+	1.1	3.2	0.6	30.2	19.1	3.1	1.4	0.8
*Melanogrammus aeglefinus**+	-	0.3	0.7	3.0	1.8	0.3	0.7	-
Gaidropsarus spp.*	6.4	23.4	90.6	na	59.9	55.9	na	190.1
*Molva molva**	-	-	-	na	0.7	11.5	na	-
Trigla spp.*	11.3	5.9	31.6	na	7.8	13.6	na	112.3
Trachurus trachurus	-	0.1	-	na	0.2	-	na	0.7
*Trachinus vipera**	-	-	1.0	na	-	10.6	na	37.3
Trachinus draco	-	-	-	na	-	-	na	3.0
Callionymiidae*	7.2	27.1	137.1	na	192.5	300.7	na	93.9
Scomber scombrus	-	-	0.6	na	-	-	na	28.6
*Scophthalmus maximus**	-	-	-	na	-	0.4	na	3.2
*Arnoglossus laterna**	-	-	-	na	0.2	-	na	-
*Phrynorhombus norvegicus**	-	-	0.7	na	16.8	23.5	na	39.2
*Zeugopterus punctatus**	-	-	-	na	4.4	5.2	na	5.8
*Pleuronectes platessa**	22.0	75.6	215.4	45.0	13.6	3.4	-	-
*Microstomus kitt**+	0.5	2.3	28.5	na	1.3	1.4	na	0.7
*Glyptocephalus cynoglossus**+	0.6	1.2	-	na	0.3	1.2	na	-
*Hippoglossoides platessoides**	-	5.9	10.1	na	0.4	-	na	2.8
*Solea solea**	2.2	0.8	9.8	na	33.5	63.2	na	8.3
*Buglossidium luteum**	0.9	6.4	5.7	na	12.3	27.5	na	41.5
*Microchirus variegatus**	-	-	-	na	0.6	6.0	na	84.2
Unidentified spp.	17.1	1199.6	3007.9	na	1028.6	386.6	na	282.8
Total number of stations worked	101	104	82	94	49	105	104	105

+ late-stage eggs only (stages IV and V)

Table 2b. List of identified species occurring as larvae and the maximum concentration on each of the eight surveys in the Irish Sea in 2000. Species marked * have been plotted

Species	Maximum concentrations (nos.m⁻²)							
	23 Jan-1 Feb	13-20 Feb	29 Feb-7 Mar	20-29 Mar	7-10 Apr	19-25 Apr	8-15 May	16-21 May
Clupeidae	-	1.0	11.1	na	2.5	-	na	13.6
*Sprattus sprattus**	-	14.3	-	na	48.2	163.3	na	110.0
Clupea harengus	18.1	3.8	5.3	na	0.5	8.5	na	22.2
*Argentina sphyraena**	-	-	-	na	-	0.2	na	-
Gadidae*†	-	-	-	na	2.4	5.0	na	???
Trisopterus minutus†	-	-	-	na	-	-	na	2.5
Trisopterus esmarkii†	-	-	-	na	-	-	na	1.8
*Gadus morhua**	-	0.2	0.3	na	2.1	7.6	na	4.0
*Melanogrammus aeglefinus**	-	-	-	na	0.8	2.8	na	3.0
*Merlangius merlangus**	-	0.3	1.5	na	26.1	57.1	na	9.0
*Trisopterus luscus**	-	0.3	-	na	5.0	5.6	na	3.8
*Pollachius pollachius**	-	-	-	na	2.4	2.2	na	1.5
Gaidropsarus spp.*	-	0.5	2.9	na	7.1	22.7	na	50.8
*Molva molva**	-	-	-	na	-	0.3	na	1.7
Trigla spp.*	-	0.2	-	na	-	0.3	na	-
Cottidae*‡	-	0.2	-	na	1.6	1.8	na	-
Myoxocephalus scorpius‡	-	-	0.4	na	0.6	4.5	na	0.8
Taurulus bubalis‡	-	0.1	2.1	na	0.5	5.5	na	4.8
Taurulus lillgeborji‡	-	-	1.1	na	-	-	na	1.4
*Agonus cataphractus**	-	0.3	0.3	na	3.2	3.6	na	-
Liparis spp.*	-	0.1	0.8	na	6.3	11.3	na	2.5
Labrus mixtus	-	-	-	na	-	-	na	1.4
Ctenolabrus rupestris	-	-	-	na	-	-	na	1.8
*Chirolophis ascanii**	-	-	-	na	0.7	0.9	na	-
Lumpenus lampretaeformis	0.4	-	-	na	-	0.3	na	-
*Pholis gunnellus**	-	0.8	39.3	na	23.0	20.1	na	5.8
Ammodytidae*	-	5.6	1.1	na	13.7	44.9	na	7.5
Callionymiidae*	0.8	0.4	3.1	na	9.7	71.3	na	166.6
Gobiiidae*	1.4	0.9	3.2	na	6.9	12.3	na	85.5
Crystallogobius linearis	-	-	-	na	-	-	na	0.2
Scophthalmus maximus	-	-	-	na	-	1.5	na	1.7
*Phrynorhombus norvegicus**	-	-	-	na	-	6.8	na	4.5
*Zeugopterus punctatus**	-	-	-	na	-	1.9	na	1.2
Pleuronectidae spp.	-	-	-	na	0.1	-	na	-
*Pleuronectes platessa**	0.6	1.9	6.8	na	6.7	97.1	na	1.8
*Platichthys flesus**	-	1.7	-	na	71.1	96.7	na	5.8
*Limanda limanda**	-	2.1	27.2	na	403.2	529.3	na	322.5
*Microstomus kitt**	-	-	0.5	na	-	-	na	8.5
*Glyptocephalus cynoglossus**	-	0.4	-	na	1.8	17.5	na	2.8
*Hippoglossoides platessoides**	-	-	0.7	na	-	5.8	na	-
*Solea solea**	-	0.2	0.4	na	1.3	7.1	na	32.7
*Buglossidium luteum**	-	-	-	na	0.2	0.2	na	18.7
*Microchirus variegatus**	-	-	-	na	-	0.3	na	15.0
Unidentified spp.	0.3	3.1	0.9	na	130.9	26.6	na	6.8
Total number of stations worked	101	104	82	94	49	105	104	105

† plotted together as Gadidae

‡ plotted together as Cottidae

Table 2c. List of identified species occurring as eggs and the frequency of their occurrence on each of the eight surveys in the Irish Sea in 2000

Species	% Positive stations							
	23 Jan- 1 Feb	13-20 Feb	29 Feb- 7 Mar	20-29 Mar	7-10 Apr	19-25 Apr	8-15 May	16-21 May
Sprattus sprattus	12.9	46.2	69.5	na	48.6	85.7	na	54.3
Sardina pilchardus	-	1.0	-	na	-	-	na	-
Argentina sphyraena	-	-	-	na	1.8	1.9	na	-
Gadus morhua+	4.0	37.5	12.2	59.6	67.9	44.8	18.3	1.9
Melanogrammus aeglefinus+	-	2.9	1.2	11.7	3.7	1.0	1.0	-
Gaidropsarus spp.	23.8	77.9	84.1	na	41.3	90.5	na	83.8
Molva molva	-	-	-	na	0.9	16.2	na	-
Trigla spp.	3.0	23.1	20.7	na	24.8	61.9	na	46.7
Trachurus trachurus	-	1.0	-	na	0.9	-	na	1.0
Trachinus vipera	-	-	2.4	na	-	3.8	na	41.0
Trachinus draco	-	-	-	na	-	-	na	1.9
Callionymiidae	7.9	33.7	57.3	na	43.1	93.3	na	79.0
Scomber scombrus	-	-	1.2	na	-	-	na	4.8
Scophthalmus maximus	-	-	-	na	-	1.0	na	5.7
Arnoglossus laterna	-	-	-	na	0.9	-	na	-
Phrynorhombus norvegicus	-	-	2.4	na	12.8	43.8	na	30.5
Zeugopterus punctatus	-	-	-	na	10.1	25.7	na	4.8
Pleuronectes platessa	42.6	74.0	79.3	73.4	61.5	32.4	-	-
Microstomus kitt+	1.0	4.8	17.1	na	2.8	4.8	na	1.0
Glyptocephalus cynoglossus+	1.0	5.8	-	na	0.9	1.0	na	-
Hippoglossoides platessoides	-	2.9	8.5	na	0.9	-	na	1.0
Solea solea	3.0	19.2	18.3	na	43.1	62.9	na	21.0
Buglossidium luteum	4.0	12.5	14.6	na	11.9	39.0	na	43.8
Microchirus variegatus	-	-	-	na	3.7	3.8	na	19.0
Unidentified spp.	66.3	91.3	98.8	na	99.1	100.0	na	86.7
Total number of stations worked	101	104	82	94	49	105	104	105

+ late-stage eggs only (stages IV and V)

Table 2d. List of identified species occurring as larvae and the frequency of their occurrence on each of the eight surveys in the Irish Sea in 2000

Species	% Positive stations							
	23 Jan- 1 Feb	13-20 Feb	29 Feb- 7 Mar	20-29 Mar	7-10 Apr	19-25 Apr	8-15 May	16-21 May
Clupeidae	-	3.8	7.3	na	2.8	-	na	1.0
Sprattus sprattus	-	11.5	-	na	38.5	94.3	na	97.1
Clupea harengus	26.7	32.7	12.2	na	6.4	3.8	na	1.0
Argentina sphyraena	-	-	-	na	-	1.0	na	-
Gadidae	-	-	-	na	10.1	18.1	na	-
Trisopterus minutus	-	-	-	na	-	-	na	6.7
Trisopterus esmarkii	-	-	-	na	-	-	na	4.8
Gadus morhua	-	6.7	1.2	na	20.2	41.0	1.0	1.9
Melanogrammus aeglefinus	-	-	-	na	0.9	12.4	-	3.8
Merlangius merlangus	-	3.8	2.4	na	35.8	74.3	na	53.3
Trisopterus luscus	-	6.7	-	na	22.9	43.8	na	10.5
Pollachius pollachius	-	-	-	na	6.4	11.4	na	1.0
Gaidropsarus spp.	-	10.6	7.3	na	27.5	79.0	na	54.3
Molva molva	-	-	-	na	-	1.9	na	1.9
Trigla spp.	-	1.9	-	na	-	1.9	na	-
Cottidae	-	8.7	-	na	8.3	17.1	na	-
Myoxocephalus scorpius	-	-	2.4	na	5.5	15.2	na	1.0
Taurulus bubalis	-	1.0	24.4	na	2.8	6.7	na	9.5
Taurulus lillgeborji	-	-	4.9	na	-	-	na	4.8
Agonus cataphractus	-	1.9	2.4	na	7.3	10.5	na	-
Liparis spp.	-	1.0	3.7	na	28.4	39.0	na	7.6
Labrus mixtus	-	-	-	na	-	-	na	1.0
Ctenolabrus rupestris	-	-	-	na	-	-	na	1.0
Chirolophis ascanii	-	-	-	na	6.4	2.9	na	-
Lumpenus lampretaeformis	1.0	-	-	na	-	1.0	na	-
Pholis gunnellus	-	2.9	42.7	na	29.4	43.8	na	23.8
Ammodytidae	-	11.5	8.5	na	43.1	74.3	na	19.0
Callionymiidae	1.0	1.9	15.9	na	29.4	93.3	na	90.5
Gobiiidae	16.8	26.0	14.6	na	21.1	53.3	na	60.0
Crystallogobius linearis	-	-	-	na	-	-	na	1.0
Scophthalmus maximus	-	-	-	na	-	1.0	na	1.0
Phrynorhombus norvegicus	-	-	-	na	-	15.2	na	17.1
Zeugopterus punctatus	-	-	-	na	-	4.8	na	3.8
Pleuronectidae spp.	-	-	-	na	0.9	-	na	-
Pleuronectes platessa	1.0	18.3	19.5	na	22.0	48.6	na	4.8
Platichthys flesus	-	4.8	-	na	39.4	77.1	na	16.2
Limanda limanda	-	29.8	42.7	na	42.2	100.0	na	90.5
Microstomus kitt	-	-	1.2	na	-	-	na	5.7
Glyptocephalus cynoglossus	-	6.7	-	na	4.6	39.0	na	8.6
Hippoglossoides platessoides	-	-	1.2	na	-	12.4	na	1.0
Solea solea	-	1.9	1.2	na	7.3	27.6	na	28.6
Buglossidium luteum	-	-	-	na	0.9	1.9	na	12.4
Microchirus variegatus	-	-	-	na	-	1.0	na	18.1
Unidentified spp.	4.0	23.1	8.5	na	43.1	73.3	na	25.7
Total number of stations worked	101	104	82	94	49	105	104	105

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