

**CENTRE FOR ENVIRONMENT, FISHERIES AND AQUACULTURE SCIENCE
LOWESTOFT LABORATORY, LOWESTOFT, SUFFOLK NR33 0HT**

2010 RESEARCH VESSEL PROGRAMME

PROGRAMME: RV CEFAS ENDEAVOUR: SURVEY 13

STAFF:

Part A

Fishing:

S McCully (SIC)

B Harley (2IC)

R Humphreys

L Cox

B Hatton

M Eade

D Peach

Part B

S McCully (SIC)

B Harley (2IC)

R Humphreys

L Cox

B Hatton

M Eade

T Kerby (UEA student)

Plus:

R Forster

K Owen

B Queste

Tim Sykes (JNCC)

D Sivyer (7-8 August only)

Tobias Boehme (7-8 August only)

Hans Ernst (7-8 August only)

V Creach

K Owen

B Queste

Tim Sykes (JNCC)

DURATION: 7 August – 8 September

LOCATION: North Sea

AIMS:

1. To carry out a groundfish survey of the North Sea as part of the ICES coordinated IBTS, using a standard GOV trawl in order to obtain information on:
 - a) Distribution, size composition and abundance of all fish species caught.
 - b) Age – length distribution of selected species.
 - c) Distribution of fish in relation to their environment.
 - d) Distribution of macrobenthos and anthropogenic debris.
 - e) Surface and bottom temperature and salinity data using CTD rosette and Niskin Bottle.
 - f) Length weight & maturity information using individual fish measurements, in support of the EU Data Regulation.
2. Fish selected stations with ‘Poly GOV’ in Northern area of the sampling grid.
3. Carry out water sampling for Caesium/Tritium for an internal Cefas contract (SLA21).
4. Collect samples of sea water from offshore sites for low nutrient water analysis by nutrients lab at Cefas.

5. Collect live specimens of buried edible crab, and lobster for the Cefas aquarium at Lowestoft.
6. Collect and fertilise herring eggs onto plates, and incubate in continuous seawater tanks for Cefas aquarium at Lowestoft.
7. Tag and release specimens of cuckoo ray (*Leucoraja naevus*), common skate (*Dipturus batis* species-complex), spurdog (*Squalus acanthias*) and tope (*Galeorhinus galeus*), in support of Defra projects MB5201 and MB5202.
8. Collect 100 gill samples from Saithe, to examine the DNA-structure of the population in the North Sea in 2010, for the Institute of Marine Research, Norway.
9. Collect herring scales for isotope analysis of stock structures for studies at the University of Southampton and Cefas.
10. Retain by freezing any species which are unusual to the North Sea for ID guide.
11. Retain by freezing whole samples or otoliths of the more unusual species to the North Sea for otolith research.
12. Retain by freezing whole samples of anchovy for studies at the University of Basque Country and AZTI institute.
13. Maturity photos (using protocol) of lemon sole, brill and turbot.
14. Record litter caught in the trawl in support of Defra projects.
15. Record sightings of sea birds and cetaceans for JNCC and Sea Watch Foundation.
16. To determine the diversity of the phytoplankton in relationship with biotic and abiotic conditions.
17. Primary Production and Optics: To calibrate the primary production fluorimeter installed in the Ferrybox setup on Cefas Endeavour. The Turner Phytoflash response will be compared to that of two other commercially-available fluorimeters which will be set to measure continuously in the flowing seawater supply.
18. To determine the variability in key phytoplankton optical and photophysiological parameters from surface and mid-depth waters along the route of the cruise. To perform light and dark acclimation experiments of phytoplankton collected from the flow-through system along the cruise track.
19. To measure profiles of underwater light at all stations on the cruise.
20. Investigate the extent of low oxygen areas that may occur in the southern North Sea and further understand the processes leading to oxygen depletion over the North Sea as a whole. By:

- a) Deploying the ESM2 logger at many stations over night in the stratified area of the North Sea Oyster grounds to quantify the spatial extent of low oxygen issues. If time permits conduct experiments on oxygen consumption beneath the thermocline.
- b) Conduct experiments on oxygen consumption, beneath, above and in the thermocline.

NARRATIVE:

(All times GMT)

RV Cefas ENDEAVOUR sailed from Lowestoft at 0530h on Saturday 7 August with seven Cefas fisheries staff, one Cefas environmental staff member along with two environmental students and a JNCC observer. There were also two Ferrybox engineers and 1 more Cefas environmental staff member onboard for just the first two days in order to service the Ferrybox. Before work on the primary stations commenced, a 'shakedown' tow was carried out to allow for the deployment of the gear, to check that all sensors were working correctly and to allow scientists and crew to familiarise themselves with their particular work areas. A standard station consisted of a cast with the Rosette containing up to ten 10-litre Niskin bottles and the EMS2 logger, followed by a 30-minute tow with the standard IBTS rigged GOV. At the start of the survey, on every station, fisheries acoustic data were continuously collected at three operating frequencies (38kHz, 120kHz and 200kHz), using the Simrad EK60 split beam sounder. The shakedown tow was carried out at prime station 1. The net was shot away successfully, with all rigging in correct order, thus good readings were obtained from all Scanmar units. The accurate fishing of this tow and a good catch of 360kg of mainly sprat allowed us to count this as a valid tow, and thus was our first prime station completed. We then steamed to the southern North Sea and fished eastwards to complete prime stations 2 and 3 before the end of the first day, with minimal catches. The following day (8 August) we moved up the Dutch coast, and fished westwards completing prime stations 6, 5 and 4, catching mainly mackerel, completing them in good time, allowing us to steam back to Lowestoft, to transfer the two Ferrybox engineers and one Cefas environmental staff member as planned by 1700h. We then steamed overnight north-east to fish prime stations 9, 8 and 7 (2.4 tonnes of horse mackerel, whiting and mackerel), avoiding fishing west to east due to the forecast weather conditions, thus allowing us to stay close to land overnight, and fish stations 13, 14 and 15 on Tuesday 10 August. We then made the long steam south to pick up stations 10, 16 and 17 the following day, (catching over 1.5t of herring, sprat and mackerel). Having finished in good time it allowed us to fit in some extra Rosette dips within a box encompassed by 54° 57.00' N and 54° 08.00' N latitude and 003° 39.00' E and 004° 25.20' E longitude, covering ICES rectangles 38F3 and F4 and 37F3 and F4. This is an area of low oxygen, so on the night of 11 August six Rosette casts were made, and water collected from both the surface and bottom and an oxygen profile obtained from each station. The following day stations 11, 12 and 18 were fished (catching mostly sprat), again allowing further overnight work to be undertaken in the low oxygen area. A further five dips in the aforementioned box were made that night. The next two days were spent fishing seven stations along the German and Danish coast, with the primary species caught being sprat, herring and dab. The evening of the 14 August, an additional Rosette cast was made in rectangle 41F5, whilst transiting to prime 28 where fishing began the next day. Steaming west, stations 28, 27, 26 and 25 were completed, and two further CTD dips were made in rectangles 41F2 and 41F1 overnight, again allowing further environmental data to be collected from rectangles which do not comprise part of this English section of the Q3 IBTS. Continuing to work west we fished prime stations 24, 23 and 22 off English north-east coast on 16 August, catching mostly whiting, haddock, herring and grey gurnards. Steaming up the

north-east coast overnight, we then began a busy four days, fishing four stations each day, working west to east, ending up on the southern Norwegian coast. On 17 August large (0.7-2.7 tonnes) pelagic catches of herring and mackerel were made after fishing prime stations 31, 32, 41 and 33. Over the subsequent two days fishing, the catches were a mix of further large pelagic catches of herring at stations 42 and 43, and smaller catches of roundfish and dab in the more southern and eastern stations. On Friday 20 August the stations off southern Norway were fished (small roundfish catches), and staying along the Norwegian coast we moved slightly north to SE Norway and fished prime stations 56, 57 and 65, whilst the weather freshened up the following day. Despite a windy start on Sunday 22 August stations 70, 75 and 69 were fished. Station 75 (our deepest station of the survey at over 200m), was slightly unusual in its catch composition. We caught nearly 300 kg of blue whiting, and 65 kg of very large argentines, and 50kg of saithe and hake. The following day, we moved west to fish prime stations 64, 63, 62 and also an additional station in the North central North Sea. The additional station was fished in 46E9 at the end of the day, as requested by our Norwegian counterparts, as they could not fish a valid tow in this rectangle, and asked us to fish this for them if possible. On Tuesday 24 August stations 54, 55 and 47 were fished and a lot of ground was covered the following day, fishing the last four stations off the North Scottish coast leaving ourselves nicely placed for our Aberdeen mid-cruise break on Thursday 26 August. The species composition was much the same as the previous day, mainly haddock, comprised of smaller fish around 20cm. The morning of Thursday 26 August we started the mid-cruise clean, and docked at the fuel berth at midday, where 3 hours were spent taking on fuel before moving to our berth at 1700h.

We left Aberdeen dock at 0700h on Saturday 28 August. Weather reports were not good for the following few days, but we steamed the 100 miles north to station 51 off Wick, arriving at 1500h, and managed to fish this successfully before the end of the day. Again, the catch mainly comprised of Haddock, and again of mainly a smaller size. The weather then deteriorated overnight as forecast to Northern gale force 8-9, so we headed for shelter in the Orkney Islands that evening, and remained there for Sunday 29 August. The following day, the weather had fined away significantly, and we managed to fish prime stations 59, 60 and 61, catching mostly haddock and herring. On Tuesday we fished prime stations 66, 67 and 68. During the second tow we had significant gear damage with a complete belly out on the net, ripping through five panels, three of which needed replacing, and two were repaired - this took six hours. The final tow was also problematic - after losing door readings from the Scanmar units, these were replaced and the net re-shot just before sunset, this time losing the headline readings. We towed for 20 minutes, making this as a valid tow, yet still recorded our largest cod catch of the survey (55 kg). The final four stations of the survey were fished on Wednesday 1 September: primes 74, 73, 72 and 71. The catches of the first three were composed of blue whiting, hake, and horse mackerel. Of interest on prime station 72, a running male Monkfish was seen – the first seen by this survey, and at just 45cm long, it was worthy of note. There were two male Monkfish, of similar sizes (62 and 56cm) that were also seen and were almost ready to spawn. That evening and the following morning, the gear was changed over from the standard IBTS nylon net, to the polyethylene GOV net. We then selected a variety of prime stations on which to use this change of gear for comparative tows.

On Thursday 2 September, we left the shelter of the Shetlands, and steamed south to fish prime stations 66, 60 and 59 with the poly net. The following day we returned to fish prime station 68 again, as our largest cod catch, this was followed by prime 69, and 63. However on deploying the gear on the final station, a crew member was injured on deck. The tow had to be abandoned, and we left immediately to steam straight back into Lerwick to drop them off

for medical attention. Low nutrient seawater was collected on route. Due to this change of plans, the following day, we arrived at midday to fish prime stations 53 and 52. On the following two days, prime stations 42, 43, 44, 24, 23 and 22 were fished with the poly net. On Tuesday 7 September, the weather deteriorated to south-easterly force 8 hampering fishing and CTD dips, so fishing was terminated for this survey, allowing the day to be spent cleaning. The results from these comparative tows will be analysed on return to the Lowestoft Laboratory and will be reported at a later date, but preliminary observations indicate that the full size range and species composition are being encompassed by the poly net, but it does also appear to catch more benthic material. Cefas Endeavour steamed for Lowestoft overnight, where she docked at 0745h on 8 September.

Results

Aim 1: A valid GOV trawl was successfully completed at all of the 75 primary station positions (Table 1). Also shown in Table 1 is the number of additional stations fished using the polyethylene GOV net. There were two invalid tows, which were all repeated to obtain valid samples. The survey was fished using GOV trawl number 12, and the gear trials were fished using the poly GOV net number 3. A chart indicating the position of each trawl station is attached (Figure 1). SCANMAR equipment was used to monitor headline height, wing width and door spread, as well as tilt sensors monitoring the angle of the doors. At each station, the catch of each species was weighed and all fish, or representative samples, were measured. Table 2 lists the species caught that are sampled for length and Table 3 ranks the top 15 species by weight compared with the last two year's survey. Samples of otoliths for age determination were taken (Table 4) as specified in standard instructions. Benthos and crustacean were identified to the species wherever possible and recorded as present. The resultant data were input to computer database using the Cefas Electronic Data Capture System. This data will be analysed at Cefas Lowestoft and will provide a major input to the ICES assessment of North Sea gadoids and pelagic species. Once checked and validated, all data will also be input to the ICES Datas database.

Surface and bottom salinity samples and a water column CTD profile were taken on all of the primary stations fished. These samples will be forwarded to E&E in order that the CTD profile can be calibrated.

Species of note caught this year during the survey are *Galeus melastomus*, *Anguilla anguilla*, *Belone belone*, *Chimaera monstrosa*, *Hyperoplus immaculatus*, *Sebastes viviparus*, *Gymnamodytes semisquamatus*, *Syngnathus rostellatus*, *Sepietta oweniana*, *Brosme brosme*, *Dipturus batis* species-complex, and *Ommastrephes sagittatus*.

Figures 2-10 show distribution and relative abundance (kg per hour) of cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), whiting (*Melanogobius merlangus*), saithe (*Pollachius virens*), Norway pout (*Trisopterus esmarkii*), herring (*Clupea harengus*), mackerel (*Scomber scombrus*), sprat (*Sprattus sprattus*) and plaice (*Pleuronectes platessa*), respectively, over the last four years. The total weight of cod caught has decreased from last year (395kg in 2010, 442kg in 2009), while the number of stations that cod were caught at remained identical at 44 stations in both 2010 and 2009. The catch of herring has increased by over 2 tonnes from 2009 catch, and is almost three times that seen in 2008. While whiting catches were the lowest seen in the 3 years, and were over 2 tonnes less than in 2009. Norway pout catch has also declined slightly on last year. The mackerel catch was on par with that seen in 2009, and similar levels of catch between years were seen in haddock, saithe, plaice and lemon sole. Of

particular note, is the high catches of blue whiting this year. In 2009, just 2 kg were caught, compared to 499 kg this year – attributable to three large catches made at prime stations 73, 74 and 75 (our most northerly stations). Relatively large increases in catch were also seen in horse mackerel and sprat.

In addition, continuing from last year, further length-weight measurements were taken of non-otolithed species, in order to obtain length-weight curves specific to this survey. These were taken for up to 1000 specimens of each species.

Table 1. Number of trawls and Rosette dips made during the survey

Gear	Valid	Additional	Invalid	Total
GOV (IBTS Standard gear)	75	1	2	78
Niskin Bottle + CTD	75	1	0	76
Poly GOV stations	0	12	0	12

Table 2. List of measured species caught during the survey and number of stations at which they were recorded.

Species	stns.	Species	stns.
<i>Agonus cataphractus</i>	9	<i>Melanogrammus aeglefinus</i>	50
<i>Alloteuthis subulata</i>	16	<i>Merlangius merlangus</i>	71
<i>Alosa fallax</i>	1	<i>Merluccius merluccius</i>	37
<i>Ammodytes marinus</i>	1	<i>Micromesistius poutassou</i>	5
<i>Ammodytes tobianus</i>	3	<i>Microstomus kitt</i>	62
<i>Anarhichas lupus</i>	3	<i>Molva molva</i>	11
<i>Anguilla anguilla</i>	1	<i>Mullus surmuletus</i>	7
Argentinidae	29	<i>Mustelus asterias</i>	3
<i>Arnoglossus laterna</i>	14	<i>Myoxocephalus scorpius</i>	6
<i>Aspitrigla cuculus</i>	1	<i>Myxine glutinosa</i>	4
<i>Belone belone</i>	1	<i>Nephrops norvegicus</i>	13
<i>Brosme brosme</i>	1	<i>Ommastrephes eblanae</i>	13
<i>Buglossidium luteum</i>	18	<i>Ommastrephes saggittatus</i>	2
<i>Callionymus lyra</i>	30	<i>Pecten maximus</i>	1
<i>Callionymus maculatus</i>	17	<i>Platichthys flesus</i>	3
<i>Callionymus reticulatus</i>	1	<i>Pleuronectes platessa</i>	59
<i>Cancer pagurus</i>	18	<i>Pollachius virens</i>	24
<i>Chimaera monstrosa</i>	1	<i>Raja batis</i> skate-complex	2
<i>Clupea harengus</i>	59	<i>Raja clavata</i>	5
<i>Cyclopterus lumpus</i>	2	<i>Raja montagui</i>	2
<i>Dicentrarchus labrax</i>	1	<i>Raja naevus</i>	6
<i>Eledone cirrosa</i>	3	<i>Raja radiata</i>	20
<i>Enchelyopus cimbrius</i>	10	<i>Rossia macrosoma</i>	2
<i>Engraulis encrasicolus</i>	1	<i>Sardina pilchardus</i>	3
<i>Eutrigla gurnardus</i>	66	<i>Scomber scombrus</i>	53

<i>Gadiculus argenteus</i>	6	<i>Scophthalmus maximus</i>	4
<i>Gadus morhua</i>	44	<i>Scophthalmus rhombus</i>	2
<i>Galeus melastomus</i>	1	<i>Scyliorhinus canicula</i>	16
<i>Glyptocephalus cynoglossus</i>	12	<i>Sebastes viviparus</i>	3
<i>Gobius</i> spp.	2	<i>Sepia officinalis</i>	3
<i>Gymnammodytes semisquamatus</i>	2	<i>Sepietta oweniana</i>	1
<i>Hippoglossoides platessoides</i>	55	<i>Sepiola atlantica</i>	4
<i>Homarus gammarus</i>	2	<i>Solea solea</i>	2
<i>Hyperoplus immaculatus</i>	2	<i>Sprattus sprattus</i>	23
<i>Hyperoplus lanceolatus</i>	11	<i>Squalus acanthias</i>	4
<i>Lepidorhombus whiffiagonis</i>	8	<i>Syngnathus rostellatus</i>	1
<i>Limanda limanda</i>	63	<i>Trachinus vipera</i>	15
<i>Lithodes maja</i>	20	<i>Trachurus trachurus</i>	25
<i>Loligo forbesi</i>	18	<i>Trigla lucerna</i>	5
<i>Loligo vulgaris</i>	1	<i>Trisopterus esmarki</i>	33
<i>Lophius budegassa</i>	1	<i>Trisopterus luscus</i>	3
<i>Lophius piscatorius</i>	16	<i>Trisopterus minutus</i>	17
<i>Lumpenus lampretaeformis</i>	2	<i>Zeus faber</i>	4
<i>Maurolicus muelleri</i>	1		

Table 3. Top 15 species by weight compared with the last two years surveys

Species common name	Scientific name	2010 weight (kg)	2009 weight (kg)	2008 weight (kg)
Herring	<i>Clupea harengus</i>	7636.146	5526.396	2668.001
Haddock	<i>Melanogrammus aeglefinus</i>	2826.904	2277.232	2276.911
Norway Pout	<i>Trisopterus esmarkii</i>	2730.316	3383.579	1485.302
Mackerel	<i>Scomber scombrus</i>	2442.406	2800.200	5860.274
Whiting	<i>Merlangius merlangus</i>	2356.443	4507.874	3530.802
Sprat	<i>Sprattus sprattus</i>	2305.760	1204.149	1983.870
Horse Mackerel	<i>Trachurus trachurus</i>	2181.852	1440.914	908.818
Dab	<i>Limanda limanda</i>	1582.011	2052.979	3159.940
Grey Gurnard	<i>Eutrigla gurnardus</i>	625.955	1002.812	742.686
Blue Whiting	<i>Micromesistius poutassou</i>	498.861	2.208	194.855
Hake	<i>Merluccius merluccius</i>	479.937	289.832	297.422
Saithe	<i>Pollachius virens</i>	457.726	416.447	811.436
Cod	<i>Gadus morhua</i>	395.052	441.754	594.468
Plaice	<i>Pleuronectes platessa</i>	361.211	378.922	392.701
Lemon Sole	<i>Microstomus kitt</i>	136.673	173.898	175.790

A total of 6694 biological samples were taken for the primary target species (Table 4). In addition, a total of 112 samples were also taken from elasmobranchs captured during the survey.

Table 4. The number of biological samples taken by species

Species	Number of samples taken
Haddock	1254
Whiting	1121
Plaice	1059
Herring	1040
Dab	425
Mackerel	383
Cod	377
Norway Pout	287
Lemon Sole	238
Saithe	218
Grey Gurnard	185
Ling	23
Red Mullet	22
Monkfish	21
Witch	14
John Dory	9
Tub Gurnard	7
Turbot	5
Red Gurnard	3
Brill	2
Black-bellied Anglerfish	1

Aim 2: 12 stations were fished using the polyethylene GOV net

Aim 3: Water was collected from 37 stations across the North Sea, for Caesium/Tritium analysis.

Aim 4: Low nutrient seawater (13 x 25L carboys) was collected from approximately 59° 20.00' N 001°30.00'E.

Aim 5: 11 edible crabs and 3 lobsters were retained and kept alive onboard for the Cefas aquarium.

Aim 6: Unfortunately this secondary aim could not be met. The herring found in the northern part of the survey grid had predominantly spawned already, yet those encountered in the southern part of the survey had not spawned even by the end of the survey.

Aim 7: 9 cuckoo rays, 2 spurdog and 2 common skate were tagged with Petersen discs.

Aim 8: 100 gill filaments were sampled from 100 Saithe and put into ethanol tubes.

Aim 9: Herring scales were taken and put into packets from 17 herring.

Aims 10 and 11: Samples of *Gymnammodytes semisquamatus*, *Sebastes viviparous*, *Chimaera monstrosa*, *Callionymus reticulatus*, *Belone belone*, and *Hyperoplus immaculatus* were retained and frozen for the ID guide and/or otolith research.

Aim 12: Just 1 anchovy was caught during this survey, and frozen.

Aim 13: Maturity photos were taken for 61 lemon sole, 2 brill and 5 turbot.

	Brill			Lemon Sole			Turbot		
	M	F	Total	M	F	Total	M	F	Total
0-9 cm									
10-19 cm				8	7	15			
20-29 cm				9	21	30		1	1
30-39 cm	1	1	2	2	12	14	1		1
40-49 cm				0	2	2		1	1
50-59 cm								2	2

Aim 14: Litter was recorded for all trawls, and in total 121 individual pieces were recorded and photographed, from the 88 valid and additional nylon and poly trawls.

Aim 15: Seabird and cetacean sightings were made during the survey by a JNCC observer. These were reported to the Sea Watch Foundation.

Aims 16-19: Full CTD and niskin rosette casts were successfully carried out at 74 of the 75 prime stations. Water samples were collected from two depths: surface and either the seafloor or the Deep Chlorophyll Maximum (DCM). At 25 stations, both depths were fully filter fractionated in order to separate out three distinct size based functional groups of phytoplankton: the net (< 200 µm), nano (< 20 µm) and picoplankton (< 3 µm). Each size fraction was then processed, producing filters for later analysis via High Performance Liquid Chromatography (HPLC) for pigments, and Denaturing Gradient Gel Electrophoresis (DGGE) for DNA. Aliquots of each were also analysed onboard for their optical properties using flow cytometry and photosynthetic activity (PAM). A further subsample was preserved in glutaraldehyde and frozen at – 65 °C as a back-up and for later analysis. At each of the remaining 55 stations, one or both depths were only fractionated as far as < 200 µm. These samples were then processed as described above, with the addition of preservation of a subsample in Lugol's Iodine for later analysis by light microscopy. This work assesses phytoplankton community composition, and correlates changes in species and biomass contributions with gradients of biotic and abiotic factors. The overall results will be used to contribute to, and improve, ecosystem modelling, working from the lowest trophic levels upwards.

Aim 20: Bottom and surface water were collected at every prime station of the GOV survey for high precision salinity analysis, determination of nutrients using continuous flow analysis

and fluorometric determination of chlorophyll a and phaeopigments. Additionally, samples for chlorophyll/phaeopigments and nutrient analysis were collected at the additional CTD stations located around the Oyster Grounds (54°41 N / 4°02 E) and in band situated between 56° and 56°30 N where no GOV stations are located. This totalled 182 samples for pigment analysis and nutrients and 150 for salinity analysis.

Alongside, eleven sets of five replicates of water samples were collected at the bottom of each of the Oyster Ground stations for calibration of the Aanderra optode installed on the ESM2 logger. These samples were titrimetrically analysed onboard following a modified Winkler method using CEFAS's SiS dissolved oxygen analyser.

Twelve oxygen uptake experiments were conducted at a select number of stations to attempt to quantify water column respiration rates.

The combination of data obtained from chemical analysis, oxygen uptake experiments and CTD/logger casts will serve to construct a map of oxygen concentrations throughout the water column across the North Sea. This will in turn feed into the GOTM/GETM models in use at CEFAS and will also serve to identify potential areas which could suffer from low oxygen concentrations.

Special thanks are given to the officers and crew of Cefas ENDEAVOUR and the scientists for their enthusiasm, hard work, and positive attitude allowing this cruise to be successfully completed in good time, and thus allowing additional tows with the Poly GOV to be carried out. Best wishes are extended to Robbie Cumming, and we wish him a quick recovery.

S. McCully

8 September 2010

DISTRIBUTION:

Basic List+

S McCully	R Forster
B Harley	V Creach
R Humphreys	K Owen
B Hatton	B Queste
L Cox	T Kerby
M Eade	T Sykes
D Peach	T Bailey
A Reeves	J Ellis
I Huse	K Mackenzie
T Maes	M Nicolaus
S Milligan	N Auchterlonie
S Kupschus	C Darby
M Armstrong	C O'Brien

Figure 1.
Station positions CEFAS Endeavour 13/10.

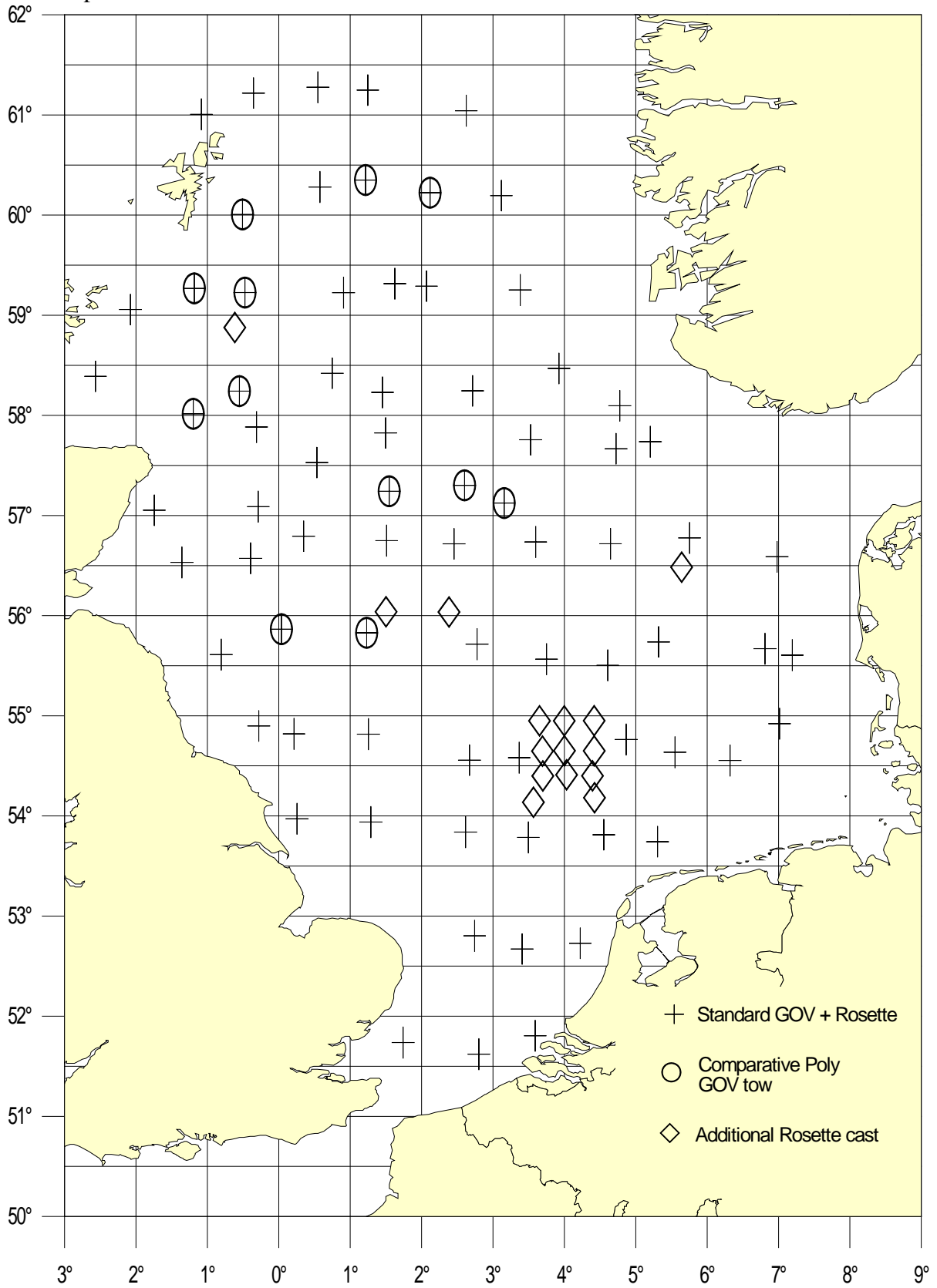


Figure 2.
Distribution and relative abundance (kg) of cod for 2007 to 2010.

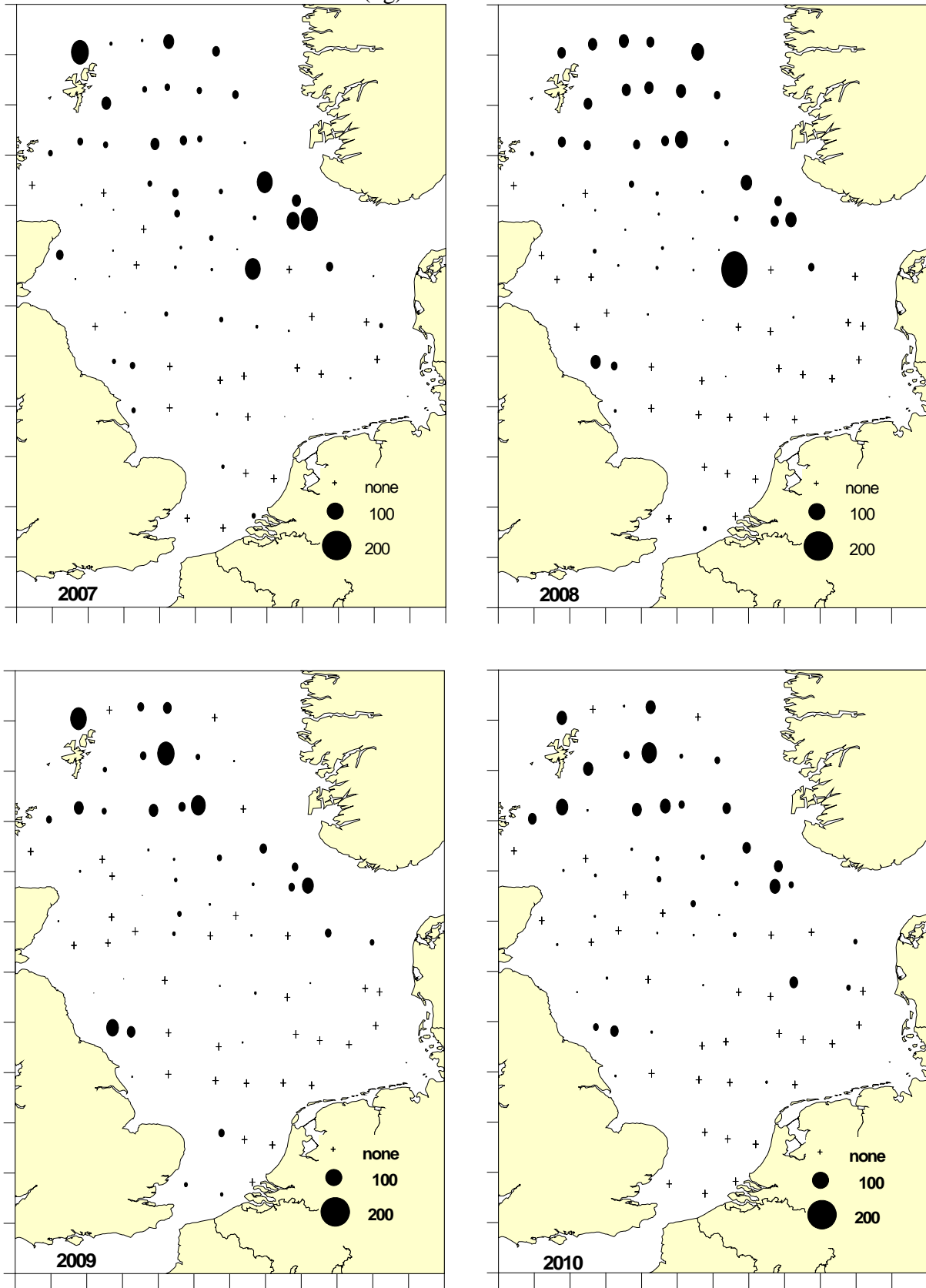


Figure 3.
Distribution and relative abundance (kg) of haddock for 2007 to 2010.

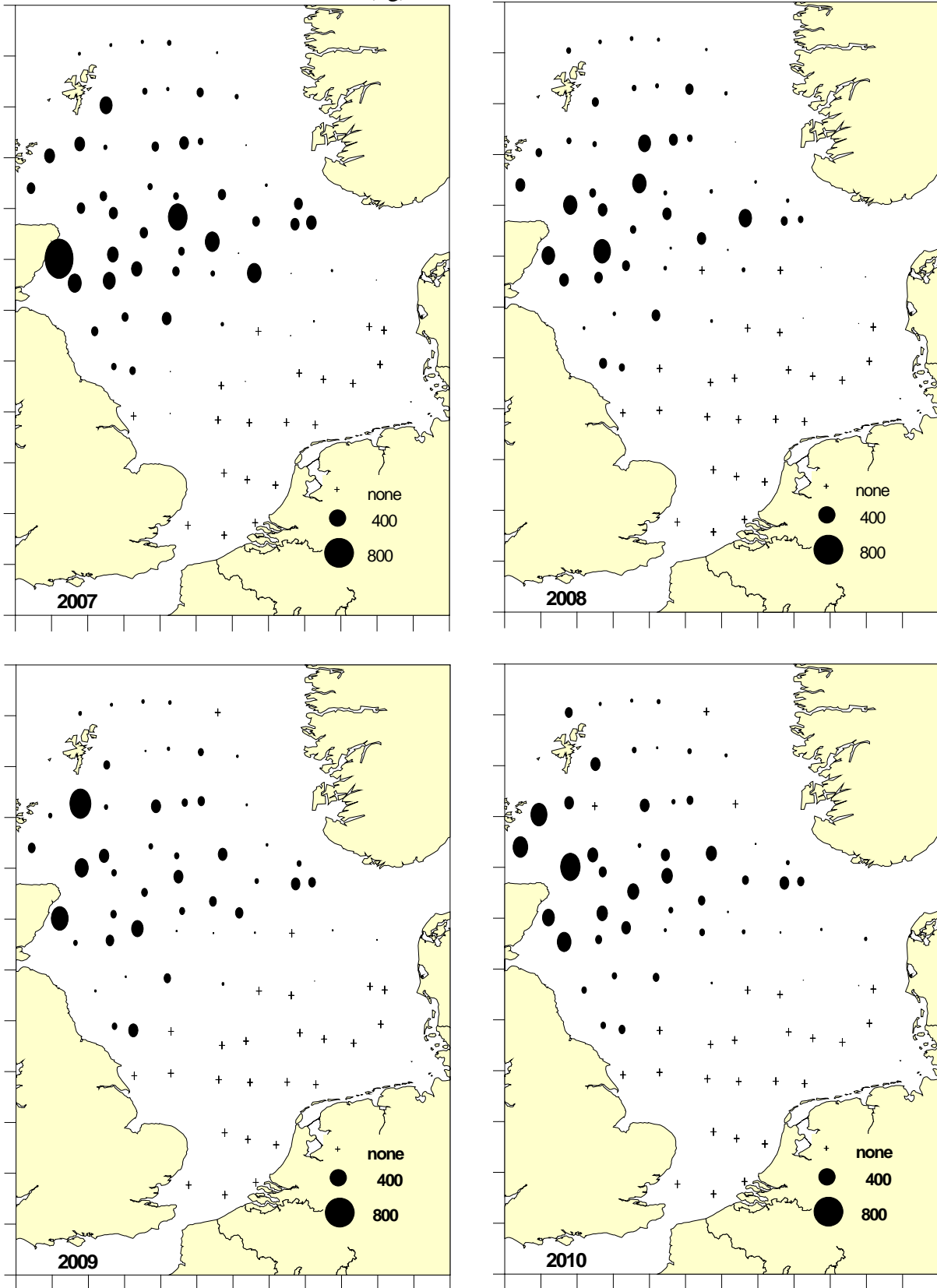


Figure 4.
Distribution and relative abundance (kg) of whiting for 2007 to 2010.

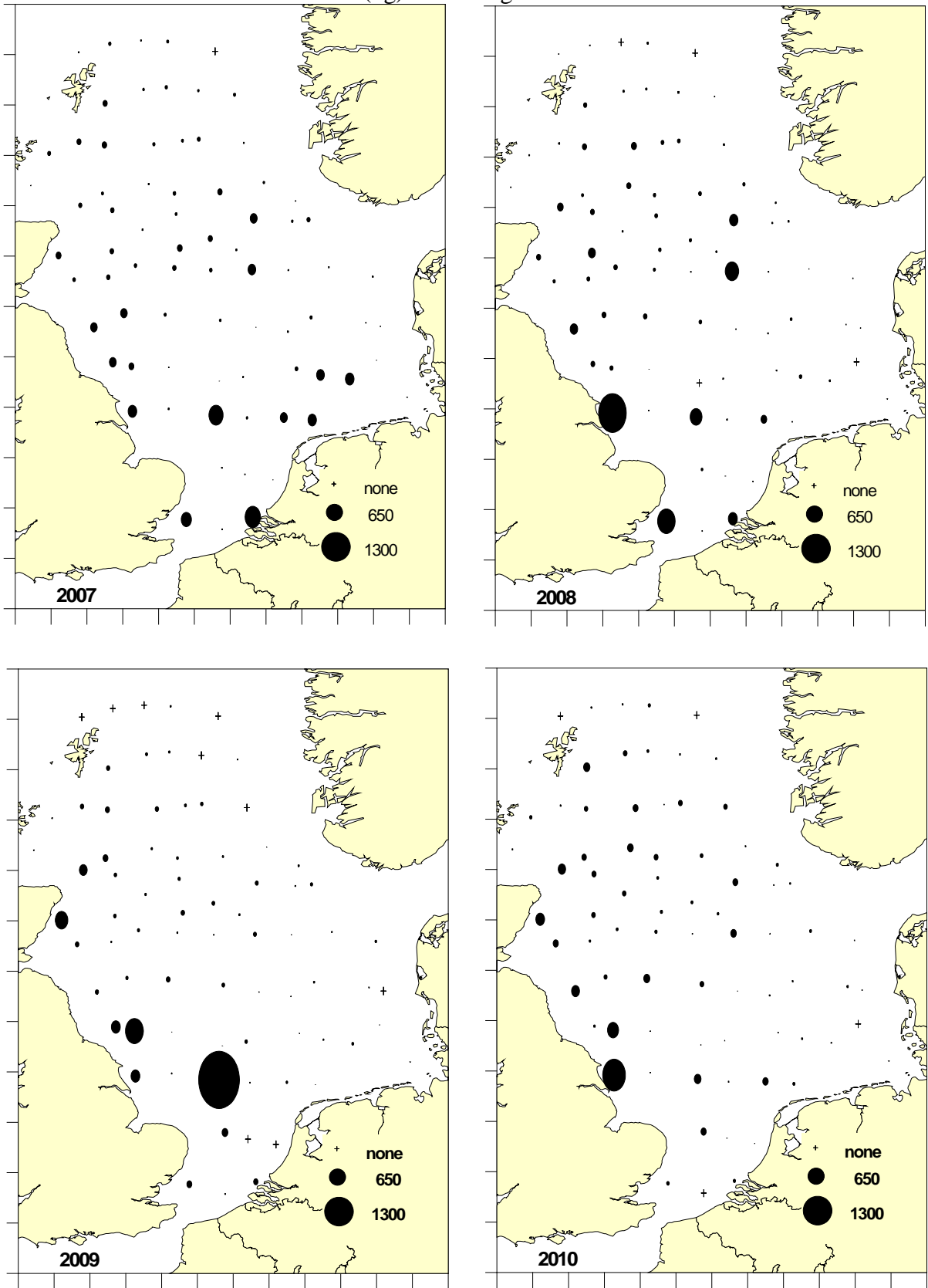


Figure 5.
Distribution and relative abundance (kg) of saithe for 2007 to 2010.

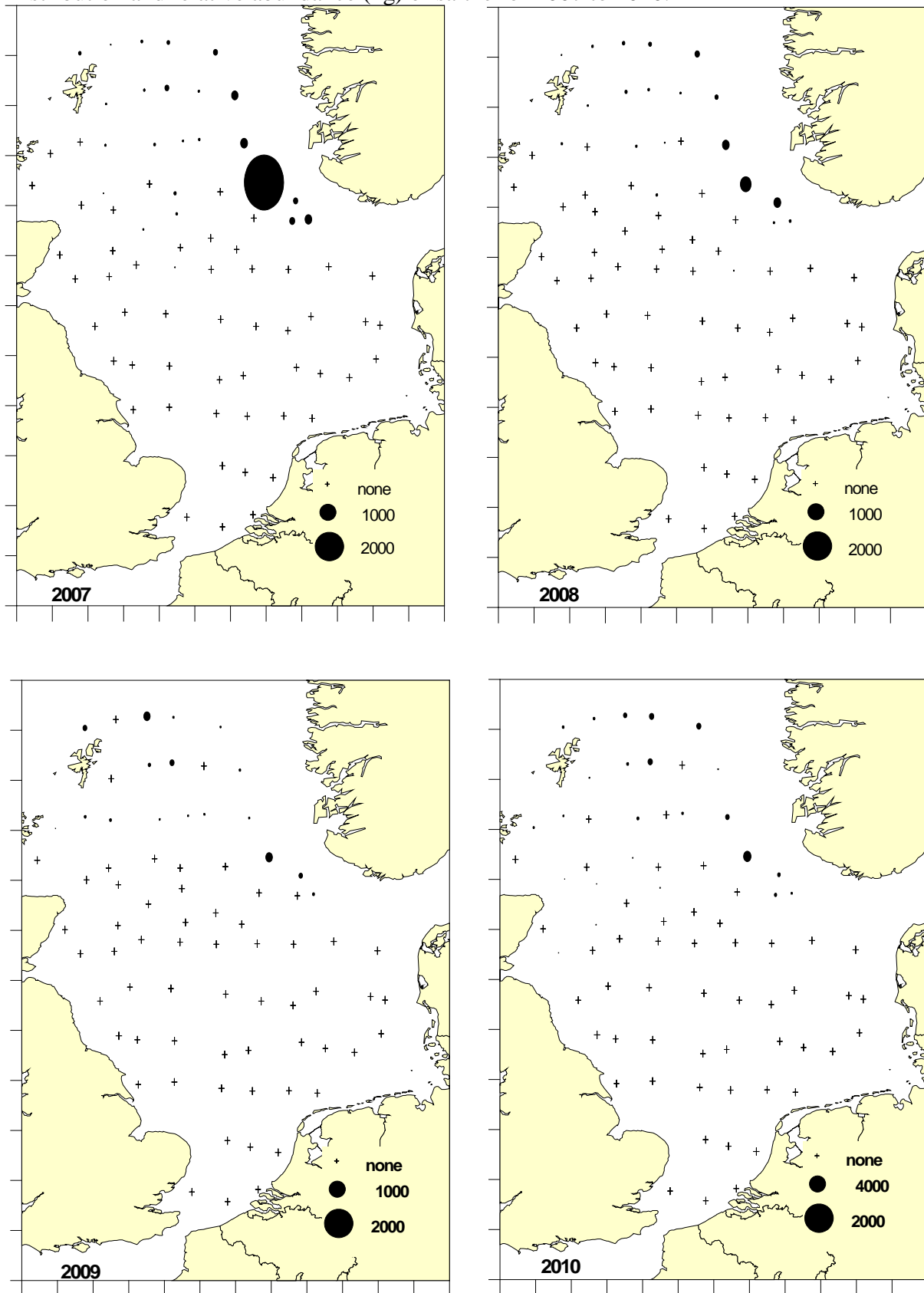


Figure 6.
Distribution and relative abundance (kg) of Norway pout for 2007 to 2010.

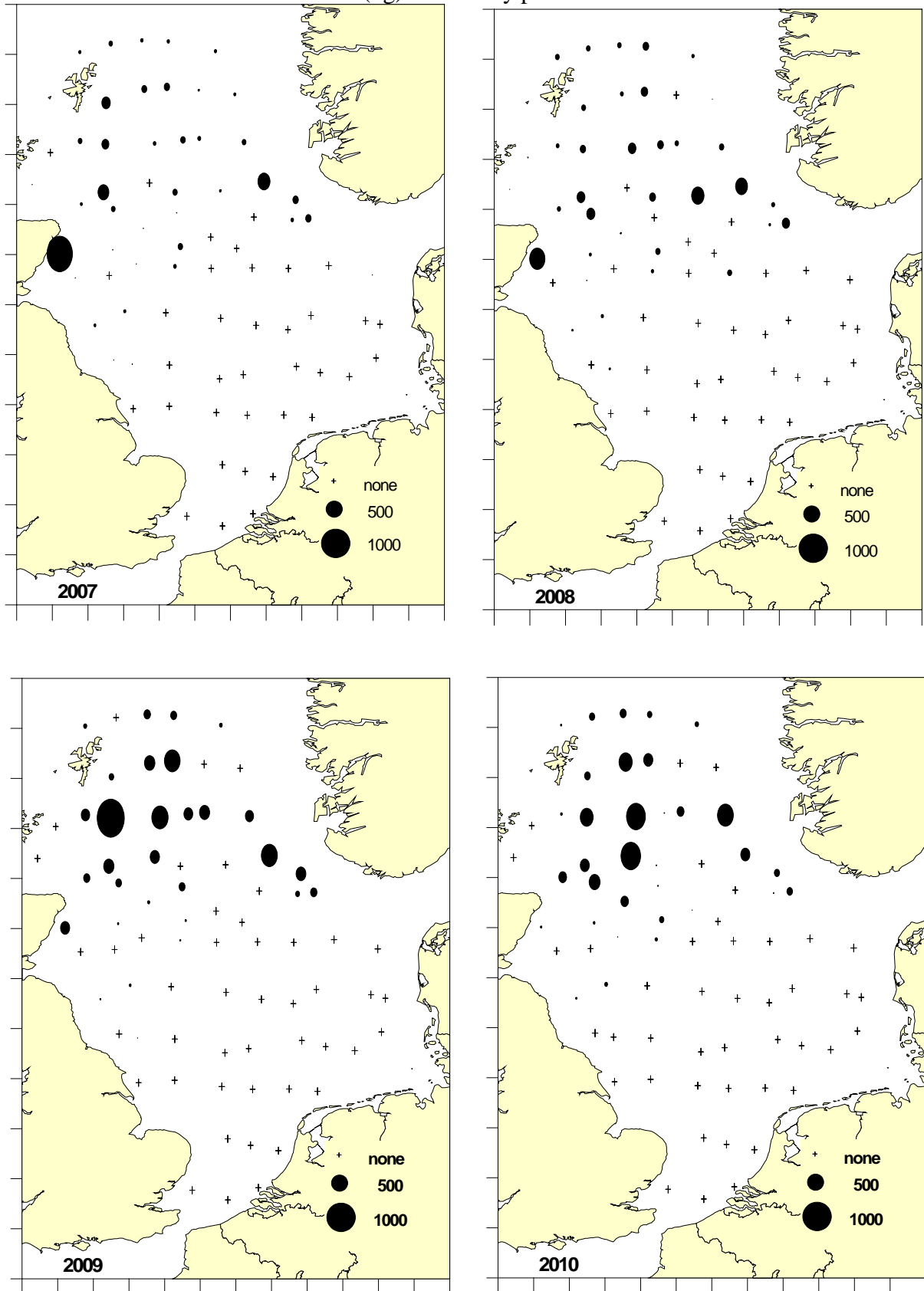


Figure 7.
Distribution and relative abundance (kg) of herring for 2007 to 2010.

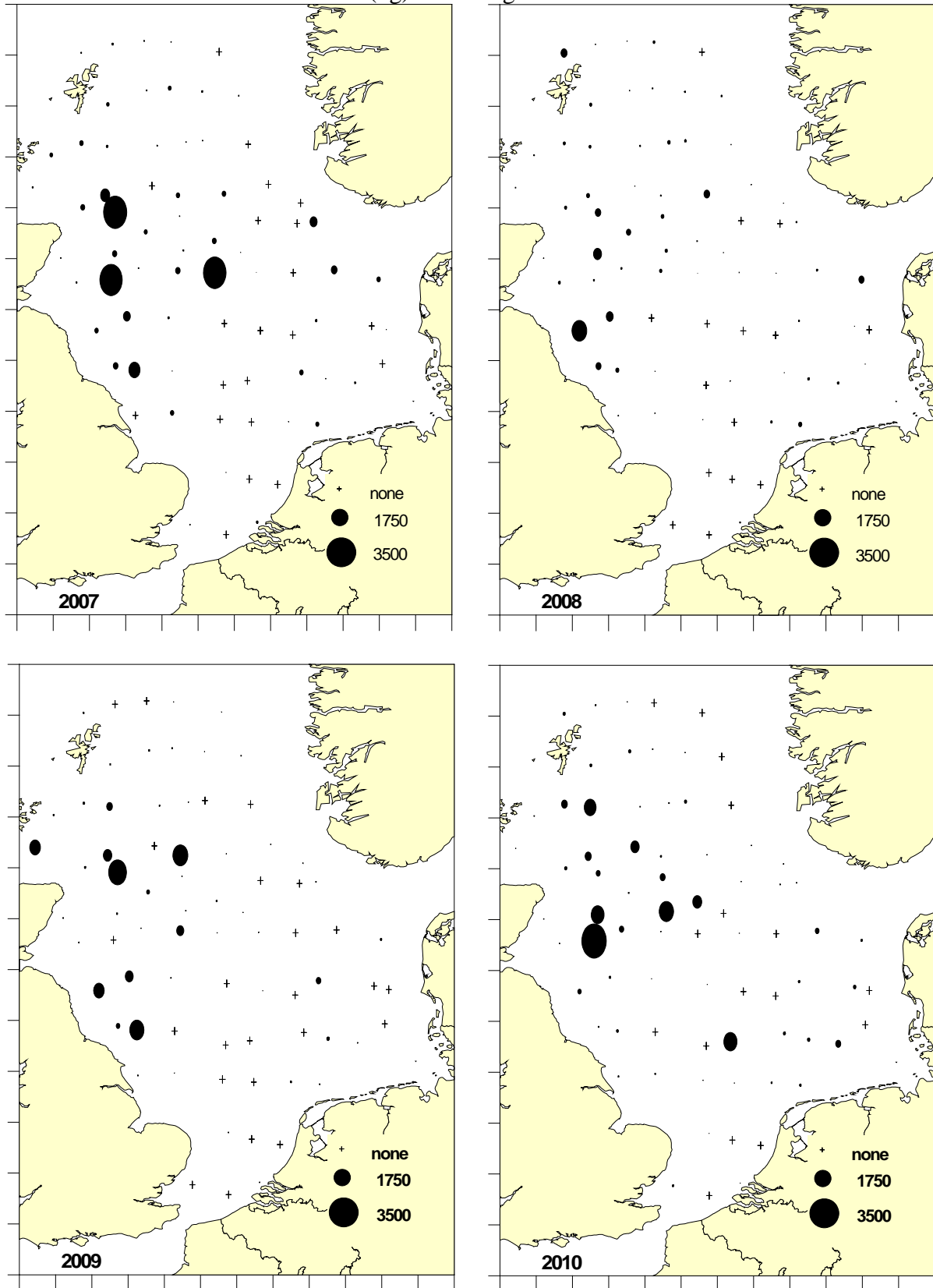


Figure 8.
Distribution and relative abundance (kg) of mackerel for 2007 to 2010.

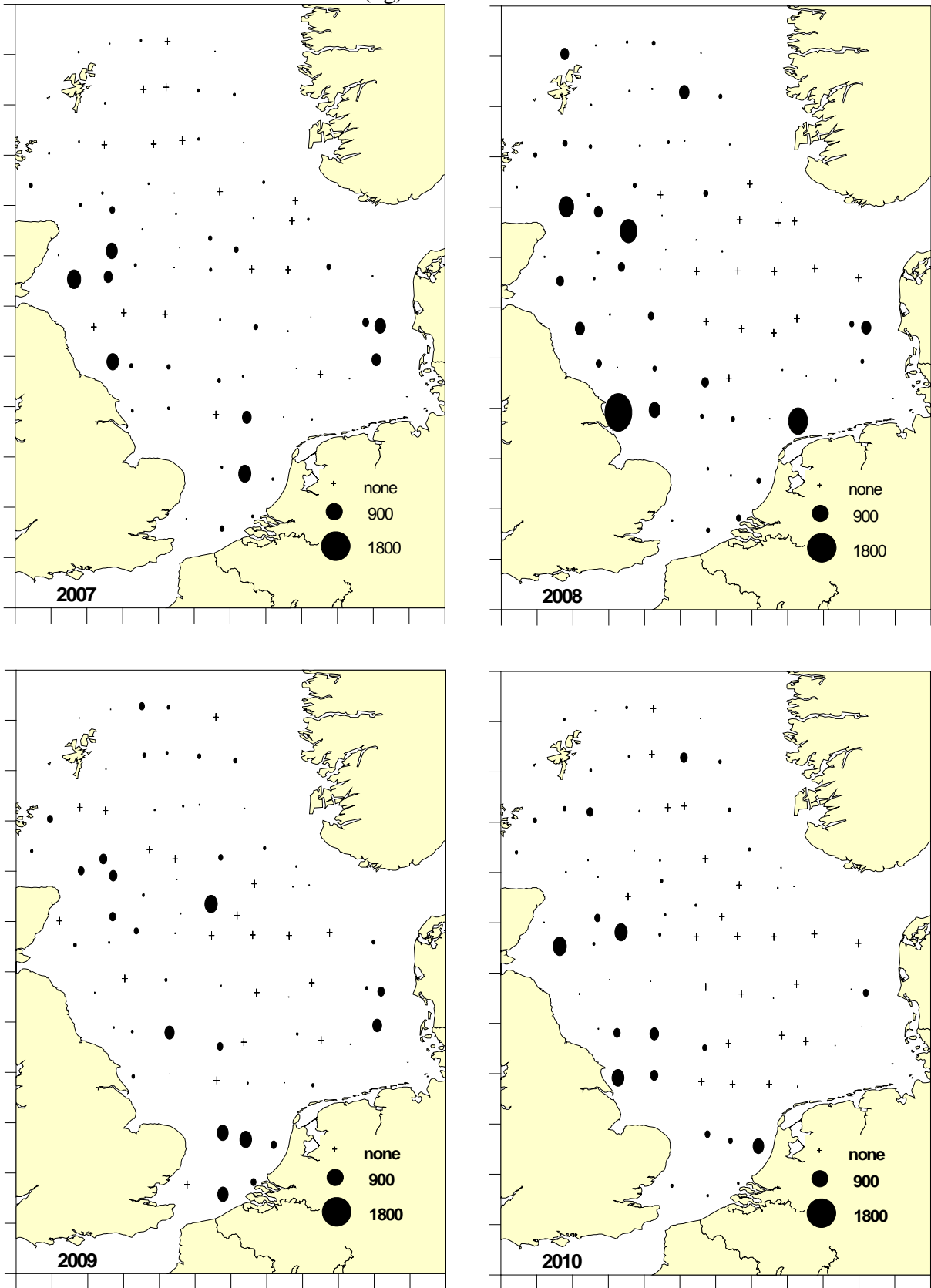


Figure 9.
Distribution and relative abundance (kg) of sprat for 2007 to 2010.

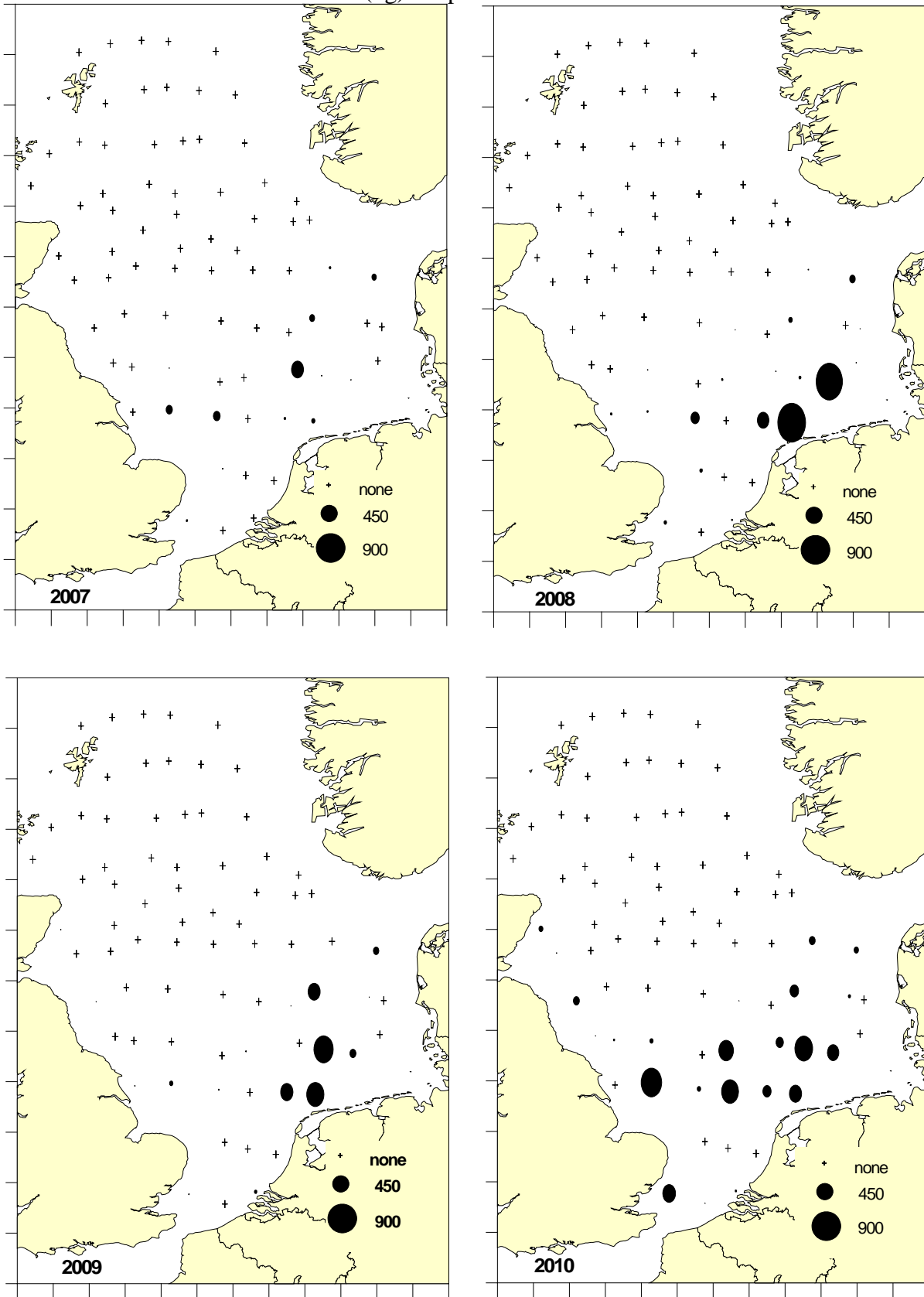


Figure 10.
Distribution and relative abundance (kg) of plaice for 2007 to 2010.

