Science Series
Technical Report no.137

Species distributions from English Celtic Sea groundfish surveys, 1992–2003

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Cefas

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1. Introduction

Cefas has carried out a trawl survey of the shelf and the shelf slope to the southwest of the British Isles since 1981. The results (for selected species) of surveys carried out in December and March from December 1984 to December 1988, and in March only from 1989 to 1991, are described by Warnes and Jones (1995). The present report describes the surveys from March 1992 to March 2003, and includes distribution maps for the main species caught by the survey.

2. History of the surveys

The original objectives of this series of surveys were to investigate the distribution and biology of mackerel of the western stock (spring surveys) and the distribution and abundance of pre-recruit mackerel (winter surveys). At this time there had been a big expansion in the fishery for the western stock of mackerel, and there were concerns about overexploitation. Subsequently, with an increasing need for fishery-independent data on the state of western demersal stocks for assessment purposes, the objectives were widened to include the biology, distribution and abundance of all species that were being sampled representatively by bottom trawl and, by 1982, catch numbers, catch weight, and length compositions were recorded routinely for all species caught.

On early cruises, when the main interest was the distribution of mackerel, the surveys covered the continental shelf of all, or part of, an area extending from the northern North Sea, around the west coast of the United Kingdom, south through the Bay of Biscay, to the northern coast of Spain. Later, as the objectives changed, the survey area was reduced to extend from the west of Ireland at 52°N to the northern coast of Spain, over the continental shelf to a maximum depth of 300 m. This area of coverage proved to be too ambitious, however, and only exceptionally did cruise duration and weather conditions permit sufficient stations to be worked for the full area to be sampled adequately.

From the winter cruise of 1987 it was decided to further reduce the survey area to concentrate on stocks in ICES areas VIIe-j and northern VIIIa. The survey area extends from 47°30'N to 52°30'N and from 3°W to 12°W, and includes International Council for the Exploration of the Sea (ICES) Divisions VIIf,g,h,j, the northwestern part of Division VIIe, and the northeastern part of VIIIa, but excludes the Irish Sea (VIIa). Since 1992, coverage of VIIg has been improved, and additional stations have been worked in the deeper water along the shelf edge as time permits since 1998. Figure 2.1(a) shows the boundaries of the ICES Divisions in the survey area and Figure 2.1(b) shows the positions of standard survey stations as at March 2003.

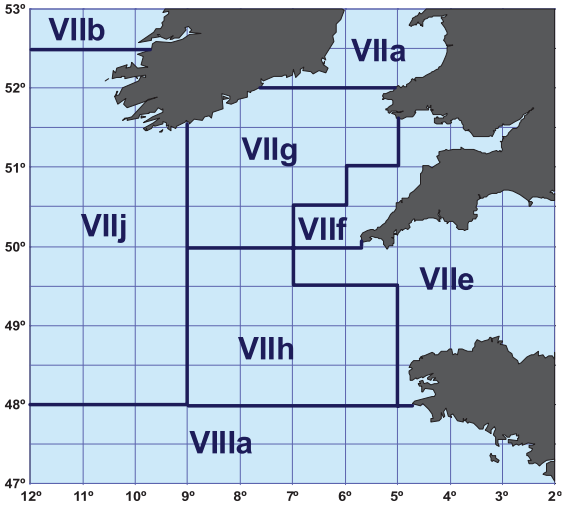

Figure 2.1(a). ICES Divisions in the survey area.

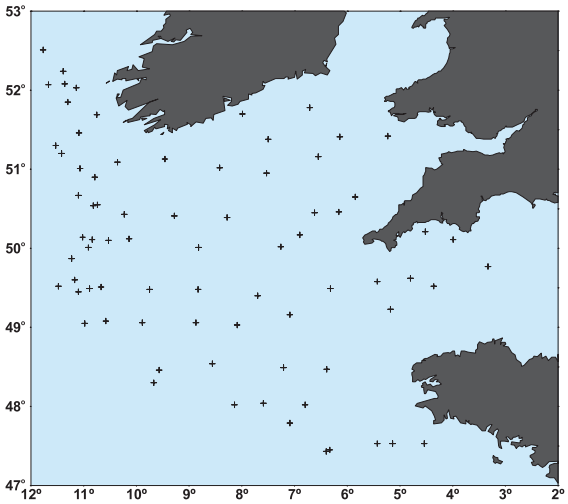

Figure 2.1(b). Positions of standard survey stations as at March 2003.

3. Current survey objectives

The current objectives of the survey are as follows:

1. To monitor changes in the distribution, abundance and size/age structure of fish populations within the survey area.

2. To provide time-series of indices of abundance for inclusion in scientific assessments of the main commercial species.

3. To provide information on the biology and ecology of fish species in the survey area.

4. Survey methods

The standard bottom trawl used on these surveys is a modified Portuguese High-headline Trawl fitted with 14" rubber bobbins on the groundrope and a bunt tickler chain. The codend is fitted with a small-mesh liner (nominal diagonal stretched mesh 20 mm). The ratio of warp length to water depth tends to vary with depth, ratios being smaller at greater depths. For the spring 1992 survey, for example, the overall average ratio was 3.76. In recent years Scanmar equipment has been used to monitor trawl parameters, and headline height and door spread have been recorded at 1 min intervals during the tow. For the survey conducted in spring 1992, average headline height for the cruise was 4.4 m, and the average door spread was 81.7 m. Door spread increases at deeper stations because of the amount of warp shot. There is a tendency for door spread to decrease over the duration of a tow, with an associated increase in headline height when large catches are taken. The reduction in door spread can be as much as 10 m when large catches of pelagic fish are taken.

The standard haul duration is 60 min and trawling is restricted to daylight hours. Fixed station positions are used and for analytical purposes, stations are allocated to depth strata as follows:

Depth Stratum	Depth Range (m)
1	<90
2	90-114
3	115-139
4	140-179
5	>180

Depth strata were further subdivided by latitude at 48°45'N and 50°15'N.

The following data are recorded at each station:

Station log data

For each species caught, the number and the weight of fish in the catch, using subsampling techniques where necessary.

For each species caught, the length composition of the total catch or of a random sample. Some species are sorted by sex before measuring. For selected species, additional samples are analysed to record biological data such as length, weight, age, sex, and stage of maturity of the individual fish.

These data are stored in a survey computer database. Ages are referred to throughout this report as "1-group" and "2-group and older", the former referring to fish caught between their first and second birthdays, the latter to all fish that have passed their second birthday. A nominal birthdate of 1 January is assumed for all species for this purpose.

5. Physical characteristics of the survey area

The survey is restricted to the continental shelf down to a depth of 300 m, although some stations have been worked deeper in later surveys. Figure 5.1 shows isobaths contoured from depths recorded at the standard stations. Figures 5.2 and 5.3 show average temperatures in °C of the water at the surface and the bottom during each month of the year.

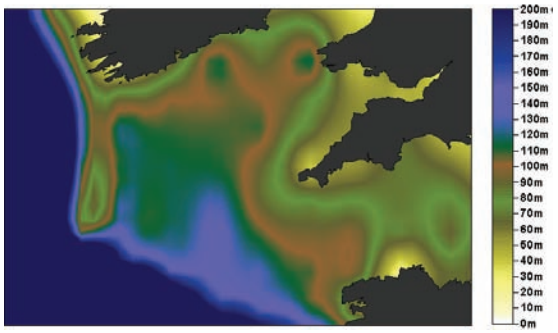

Figure 5.1. Depth isobaths.

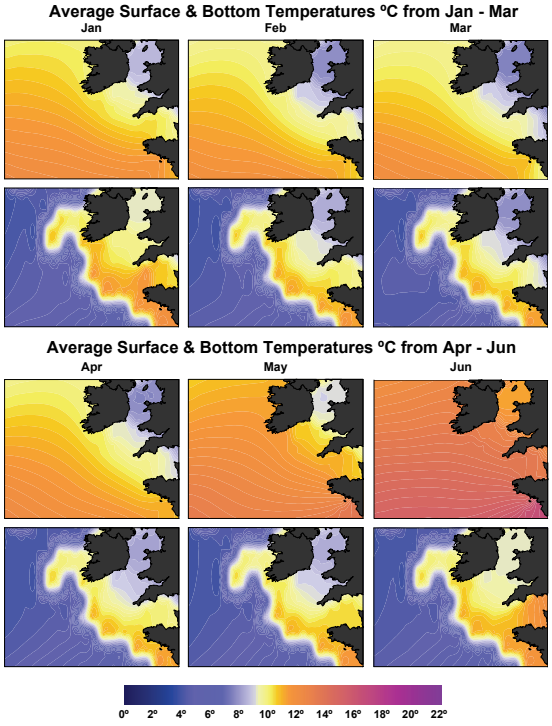

Figure 5.2. Average temperatures (surface, upper set; bottom, lower set)

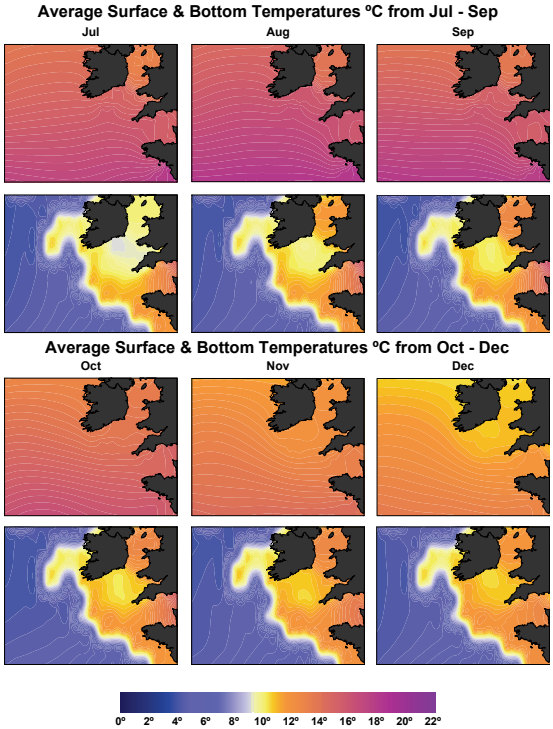

Figure 5.3. Average temperatures (surface, upper set; bottom, lower set)

6. Species recorded by the survey

Table 6.1 is a complete list of scientific and common names of all species caught on surveys from 1992 to 2003, together with an indication of presence or absence for each survey.

It is important to stress that the data collected during the survey reflects both the type of trawl used and the fish communities occurring on the seabed types suitable on which to deploy the gear. The Celtic Sea has extensive areas that cannot be trawled, as well as areas unsuitable for the specific survey gear, and which will have a different fish community structure from that of the trawlable areas. Fishing gear has developed to "target" specific species groups. For example, a beam trawl can be used to exploit flatfish more effectively than the otter trawl used on the present survey, but it would be less effective for catching roundfish such as cod and hake or pelagic fish such as mackerel and horse mackerel (scad).

Table 6.1. List of species taken on the surveys with an indication of presence on each survey.

Latin name	Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Agonus cataphractus	Pogge			*	*			*			*		
Alepocephalidae	Smooth heads						*						
Alosa alosa	Allis shad				*	*	*	*		*	*	*	
Alosa fallax	Twaite shad			*	*								
Ammodytidae	Sandeels	*	*		*	*	*	*	*	*			*
Antonogadus macropthalmus	Bigeye rockling				*								
Aphanopus carbo	Black scabbard fish											*	
Argentinidae	Argentines	*	*	*	*	*	*	*	*	*	*	*	*
Argyropelecus olfersi	Hatchetfish						*		*	*		*	
Arnoglossus imperialis	Imperial scaldfish	*	*	*	*	*	*	*	*	*	*	*	*
Arnoglossus laterna	Scald fish	*	*	*	*	*	*	*			*	*	*
Aspitrigla cuculus	Red gurnard	*	*	*	*	*	*	*	*	*	*	*	*
Belone belone	Garfish					*			*				
Beryx decadactylus							*	*	*	*	*	*	
Beryx splendens	Lowes beryx						*	*	*	*	*	*	
Blennius ocellaris	Butterfly blenny							*				*	
Buglossidium luteum	Solenette				*						*	*	*
Caelorinchus caelorhinchus	Hollownosed rattail						*	*	*	*			
Callionymidae	Dragonets	*	*	*	*	*	*	*					
Callionymus lyra	Common dragonet								*	*	*	*	*
Callionymus maculatus	Spotted dragonet									*	*	*	*
Callionymus reticulatus	Reticulate dragonet												*
Capros aper	Boar fish	*	*	*	*	*	*	*	*	*	*	*	*
Cepola rubescens	Red bandfish		*		*		*	*	*	*			
Chimaera monstrosa	Rabbitfish						*	*	*	*		*	
Clupea harengus	Herring	*	*	*	*	*	*	*	*	*	*	*	*
Conger conger	European conger eel	*	*	*	*	*	*	*	*	*	*	*	*
Coryphaenoides rupestris	Roundnose grenadier									*			
Ctenolabrus rupestris	Goldsinny wrasse		*		*	*	*			*		*	

Table 6.1. continued: List of species taken on the surveys with an indication of presence on each survey.

Latin name	Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Dalatias licha	Kitefin shark								*				
Dasyatis pastinaca	Stingray												*
Dicentrarchus labrax	European seabass		*	*	*	*	*		*	*	*	*	
Dipturus batis	Common skate	*	*	*	*	*	*	*	*			*	*
Dipturus nidarosiensis	Norwegian skate					*							
Dipturus oxyrinchus	Longnose skate												*
Echiichthys vipera	Lesser weever fish	*	*		*	*	*	*	*	*	*	*	*
Echiodon drummondi	Pearlfish					*		*				*	
Enchelyopus cimbrius	Four-bearded rockling	*	*	*	*	*	*	*		*	*	*	
Engraulis encrasicolus	European anchovy	*	*	*	*	*	*	*	*	*	*	*	*
Epigonus telescopus	Bullseye											*	
Etmopterus spinax	Velvet belly						*	*	*	*	*	*	
Eutrigla gurnardus	Grey gurnard	*	*	*	*	*	*	*	*	*	*	*	*
Gadiculus argenteus	Silvery pout	*	*	*	*	*	*	*	*	*	*	*	
Gadus morhua	Cod	*	*	*	*	*	*	*	*	*	*	*	*
Gaidropsarus mediterraneus	Shore rockling				*						*		
Gaidropsarus vulgaris	Three-bearded rockling	*	*	*		*	*	*		*	*	*	
Galeorhinus galeus	Tope	*	*			*	*	*	*	*	*	*	*
Galeus melastomus	Blackmouthed dogfish						*	*				*	
Glyptocephalus cynoglossus	Witch	*	*	*	*	*	*	*	*	*	*	*	*
Gobiidae	Gobies	*	*	*	*	*	*	*	*	*	*	*	*
Halargyreus .johnsonii	Slender codling											*	
Helicolenus dactylopterus	Bluemouth redfish	*	*	*	*	*	*	*	*	*	*	*	*
Hexanchus griseus	Six-gill shark				*					*			
Hippoglossoides platessoides	American plaice (long rough dab)	*	*	*	*	*	*	*	*	*	*	*	*
Labrus mixtus	Cuckoo wrasse						*					*	
Lampanyctus crocodilus	Lanternfish						*		*		*	*	
Lepidopus caudatus	Cutlassfish						*						
Lepidorhombus boscii	Four-spot megrim	*	*	*	*	*	*	*	*	*	*	*	*
Lepidorhombus whiffiagonis	Megrim	*	*	*	*	*	*	*	*	*	*	*	*
Leucoraja circularis	Sandy ray						*						
Leucoraja fullonica	Shagreen ray	*	*	*	*	*	*	*	*	*		*	
Leucoraja naevus	Cuckoo ray	*	*	*	*	*	*	*	*	*	*	*	*
Limanda limanda	Dab	*	*	*	*	*	*	*	*	*	*	*	*
Lophius piscatorius	Anglerfish (monk)	*	*	*	*	*	*	*	*	*	*	*	*
Lophius budegassa	White anglerfish	*	*	*	*	*	*	*	*	*	*	*	*
Lumpenus lampretaeformis	Snake blenny									*			
Macrorhamphosus scolopax	Snipefish	*	*		*	*	*	*	*	*		*	
Macrourus berglax	Rough rattail										*	*	
Malacocephalus laevis	Softheaded rattail				*	*	*	*	*	*	*	*	

Table 6.1. continued: List of species taken on the surveys with an indication of presence on each survey.

Latin name	Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Maurolicus muelleri	Pearlside	*	*	*	*	*	*	*	*	*	*	*	*
Melanogrammus aeglefinus	Haddock	*	*	*	*	*	*	*	*	*	*	*	*
Merlangius merlangus	Whiting	*	*	*	*	*	*	*	*	*	*	*	*
Merluccius merluccius	European hake	*	*	*	*	*	*	*	*	*	*	*	*
Microchirus variegatus	Thickback sole	*	*	*	*	*	*	*	*	*	*	*	*
Micromesistius poutassou	Blue whiting	*	*	*	*	*	*	*	*	*	*	*	*
Microstomus kitt	Lemon sole	*	*	*	*	*	*	*	*	*	*	*	*
Molva dypterygia	Blue ling						*	*	*	*	*	*	
Molva molva	Common ling	*	*	*	*	*	*	*	*	*	*	*	*
Mullus surmuletus	Red mullet	*	*	*	*	*	*	*	*	*	*	*	*
Mustelus asterias	Starry smoothhound	*	*		*	*	*	*	*	*	*	*	*
Mustelus mustelus	Smoothhound		*	*	*			*	*	*	*	*	*
Myctophidae	Lanternfishs							*		*			
Nezumia aequalis	Smooth rattail		*	*									
Pagellus acarne	Auxillary seabream											*	
Pagellus bogaraveo	Red seabream				*							*	*
Pegusa lascaris	Sand sole												*
Petromyzon marinus	Sea lamprey	*	*				*	*			*		*
Phrynorhombus norvegius	Norwegian topknot											*	*
Phrynorhombus regius	Ekstroms topknot				*								
Phycis blennoides	Greater forkbeard	*	*	*	*	*	*	*	*	*	*	*	*
Platichthys flesus	Flounder (European)	*	*			*		*		*		*	
Pleuronectes platessa	European plaice	*	*	*	*	*	*	*	*	*	*	*	*
Pollachius pollachius	Pollack	*	*	*	*	*	*	*	*	*	*	*	*
Pollachius virens	Saithe	*	*	*	*	*	*	*	*	*	*	*	*
Psetta maxima	Turbot		*	*	*		*						
Raja brachyura	Blonde ray					*	*		*			*	
Raja clavata	Thornback ray (roker)	*	*	*	*	*	*	*	*	*	*	*	*
Raja microocellata	Smalleyed ray		*	*		*	*	*				*	*
Raja montagui	Spotted ray	*	*	*	*	*	*		*	*	*	*	*
Raniceps raninus	Lesser forkbeard							*	*	*			
Salmo salar	Atlantic salmon						*						
Sardina pilchardus	Pilchard	*	*	*	*	*	*	*	*	*	*	*	*
Scomber colias (S. japonicus)	Spanish mackerel		*					*					
Scomber scombrus	European mackerel	*	*	*	*	*	*	*	*	*	*	*	*
Scophthalmus rhombus	Brill				*	*	*		*				
Scorpaena scrofa	Largescaled scorpionfish								*	*			
Scyliorhinus canicula	Lesser spotted dogfish	*	*	*	*	*	*	*	*	*	*	*	*
Sebastes marinus	Norway haddock											*	
Sebastes viviparus	Redfish					*							

Table 6.1. continued: List of species taken on the surveys with an indication of presence on each survey.

Latin name	Common name	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Solea solea	Sole	*	*	*	*	*	*	*	*	*	*	*	*
Spondyliosoma cantharus	Black seabream					*	*	*	*	*		*	*
Sprattus sprattus	Sprat	*	*	*	*	*	*	*	*	*	*	*	*
Squalus acanthias	Spurdog	*	*	*	*	*	*	*	*	*	*	*	*
Synaphobranchus kaupii	Kaup's arrowtooth eel						*	*	*	*	*	*	
Syngnathidae	Pipefish		*						*	*	*	*	
Torpedo marmorata	Marbled electric ray		*										
Torpedo nobiliana	Common electric ray		*	*	*		*			*		*	
Trachinus draco	Greater weever fish				*	*	*				*		
Trachurus mediterraneus	Mediterranean scad	*	*		*	*				*			
Trachurus trachurus	Horse mackerel (scad)	*	*	*	*	*	*	*	*	*	*	*	*
Trigla lucerna	Tub gurnard	*	*	*	*	*	*	*	*	*	*	*	*
Trigloporus lastoviza	Streaked gurnard		*	*	*	*	*	*		*		*	*
Trisopterus esmarki	Norway pout	*	*	*	*	*	*	*	*	*	*	*	*
Trisopterus luscus	Bib	*	*	*	*	*	*	*	*	*	*	*	*
Trisopterus minutus	Poor cod	*	*	*	*	*	*	*	*	*	*	*	*
Zeus faber	John dory	*	*	*	*	*	*	*	*	*	*	*	*

7. Species distributions

Figures 7.1–7.17 show abundance distributions, as numbers of fish caught per 60 min tow, of the main species on each survey.

The species thus illustrated are:

- Cod (2-group and older)
- Cod (1-group)
- Haddock (2-group and older)
- Haddock (1-group)
- Hake (2-group and older)
- Hake (1-group)
- Horse mackerel (2-group and older)
- Horse mackerel (1-group)
- Megrim
- Mackerel (2-group and older)
- Mackerel (1-group)
- Four-spot megrim
- Anglerfish (monk)
- White anglerfish
- Whiting (2-group and older)
- Whiting (1-group)
- Boarfish

The distribution maps were plotted using the software package Surfer (Golden Software, Inc.). In all figures, a plus sign (+) represents a station position. At stations where the species was caught, the catch rates, in terms of numbers caught per 60 min tow, are plotted as circles, the diameters of which are proportional to the square root of the numbers caught. A square root relationship has been used to compress what is often a large range in abundance, and hence shows more clearly the differences between stations. The same scale has been used for all charts for a species, and a key to the scale is given in the lower left comer of each chart to aid comparison between species.

7.1 Cod (*Gadus morhua*) 2-group and older (Figure 7.1)

Cod are distributed mainly in water depths <120 m between North Cornwall and SE Ireland, where the spawning sites are located.

7.2 Cod (*Gadus morhua*) 1-group (Figure 7.2)

The highest catch rates of 1-group cod tend to occur off the SE coast of Ireland.

7.3 Haddock (*Melanogrammus aeglefinus*) 2-group and older (Figure 7.3)

Haddock in the survey area are close to the southern limit of their distribution in the northeast Atlantic. Catch rates are usually low unless an abundant year class recruits to the fishery. Strong recruitment since the 1990s has resulted in an increase in the haddock stock in the survey area. The highest catch rates tend to be off the SW coast of Ireland.

7.4 Haddock (*Melanogrammus aeglefinus*) 1-group (Figure 7.4)

1-group haddock also tend to be most abundant off the SW coast of Ireland, but large year classes tend to cover more of the survey area.

7.5 Hake (*Merluccius merluccius*), 2-group and older (Figure 7.5)

Hake are distributed over the whole survey area with catch rates generally <50 fish per hour. Higher catch rates are recorded in the deeper water at the shelf edge, possibly the result of a movement towards the shelf edge to spawn.

7.6 Hake (*Merluccius merluccius*), 1-group (Figure 7.6)

Hake from the surveys have not been aged because of difficulties in interpreting otoliths. 1-group fish have therefore been separated from older fish by identifying the mode of the youngest age group in the length composition of the catch, and splitting the length composition at the trough between the youngest and the older age groups. Normally, this results in fish <~21 cm being classed as the youngest age group.

Hake of the youngest age group are distributed on the continental shelf to the south of Ireland and particularly in the Bay of Biscay. This was shown more clearly in the earlier surveys, which extended farther south beyond the current survey area. NE VIIIa is a known nursery ground for hake, and the young are particularly associated with areas of muddy bottom. The survey results provide an indication of the strength of pre-recruit year classes, that of 2001 being particularly abundant.

7.7 Horse mackerel (*Trachurus trachurus*), 2-group and older (Figure 7.7)

In spring surveys, adult horse mackerel tend to have a distribution in the survey area similar to that of mackerel. Horse mackerel spawn in a similar area to mackerel and at a similar time of year. Catch rates in excess of 1 t per hour are not uncommon.

7.8 Horse mackerel (*Trachurus trachurus*), 1-group (Figure 7.8)

Survey-caught horse mackerel have not been aged, and the youngest age group has been separated on the basis of the length compositions of the catches. Normally, the split between the youngest and the older age groups is at about 15 cm.

As with juvenile mackerel, the young horse mackerel tend to be in dense shoals, but their distribution tends to be less patchy than mackerel, with the highest densities in the western approaches to the English Channel and in the northern part of the Bay of Biscay.

7.9 Megrim (*Lepidorhombus whiffiagonis*) (Figure 7.9)

Megrim are widely distributed over the survey area, with the highest catch rates towards the shelf edge. Very little difference in distribution is apparent between the spring and winter surveys but, as spawning takes place in spring in the vicinity of the shelf edge, it is possible that adult fish migrate offshore from the shallower areas to spawn. During spring, females have a wider depth distribution extending into relatively shallow water, whereas males are more restricted to the shelf edge.

7.10 Mackerel (*Scomber scombrus*), 2-group and older (Figure 7.10)

Mackerel in the survey area belong to the western stock. The adults of this stock have a regular annual pattern of migration. Spawning takes place along the shelf edge west of Ireland and south into the Bay of Biscay in spring and early summer, after which there is a movement north to the waters around Scotland and the northern North Sea. The survey area covers part of the mackerel spawning grounds, and during the spring survey, adults aggregate on the spawning grounds with the highest densities along the shelf edge and in the western approaches to the English Channel. Catch rates in excess of 1 t per hour are not uncommon.

7.11 Mackerel (*Scomber scombrus*), 1-group (Figure 7.11)

Samples of mackerel caught on the surveys are aged on a routine basis. However, for the purposes of these distribution charts the separation into the youngest and older age groups is done on the basis of the length distributions, because there is normally no overlap of the modes. The split is usually at about 23 cm.

Juvenile mackerel are found throughout the survey area, their distribution tending to be very patchy with young fish frequently in dense shoals.

7.12 Four-spot megrim (*Lepidorhombus boscii*) (Figure 7.12)

Four-spot megrim are recorded at lower densities than megrim. Their distribution is restricted to the deeper waters towards the edge of the shelf.

7.13 Anglerfish (monk) (*Lophius piscatorius*) (Figure 7.13)

Anglerfish are distributed over the whole survey area, at relatively low density.

7.14 White anglerfish (*Lophius budegassa*) (Figure 7.14)

White anglerfish have a similar distribution to anglerfish (monk), occurring at relatively low density over the survey area. However, unlike *L. piscatorius*, white anglerfish density increases towards the shelf edge.

7.15 Whiting (*Merlangius merlangus*) 2-group and older (Figure 7.15)

Whiting catch rates are highest in depths <100 m between SE Ireland and North Cornwall. Almost all are mature.

7.16 Whiting (*Merlangius merlangus*) 1-group (Figure 7.16)

1-group whiting have a distribution generally similar to that of older whiting, although catch rates tend to be highest in the region just south of VIIa between Ireland and South Wales.

7.17 Boarfish (*Capros aper*) (Figure 7.17)

Although not a species of commercial interest, boarfish have been included as an example of other species routinely sampled on the survey. Boarfish are frequently encountered in high-density shoals, and catch rates in excess of 1 t per hour are not uncommon. The species is normally restricted to the deeper waters of the shelf edge south of the survey area.

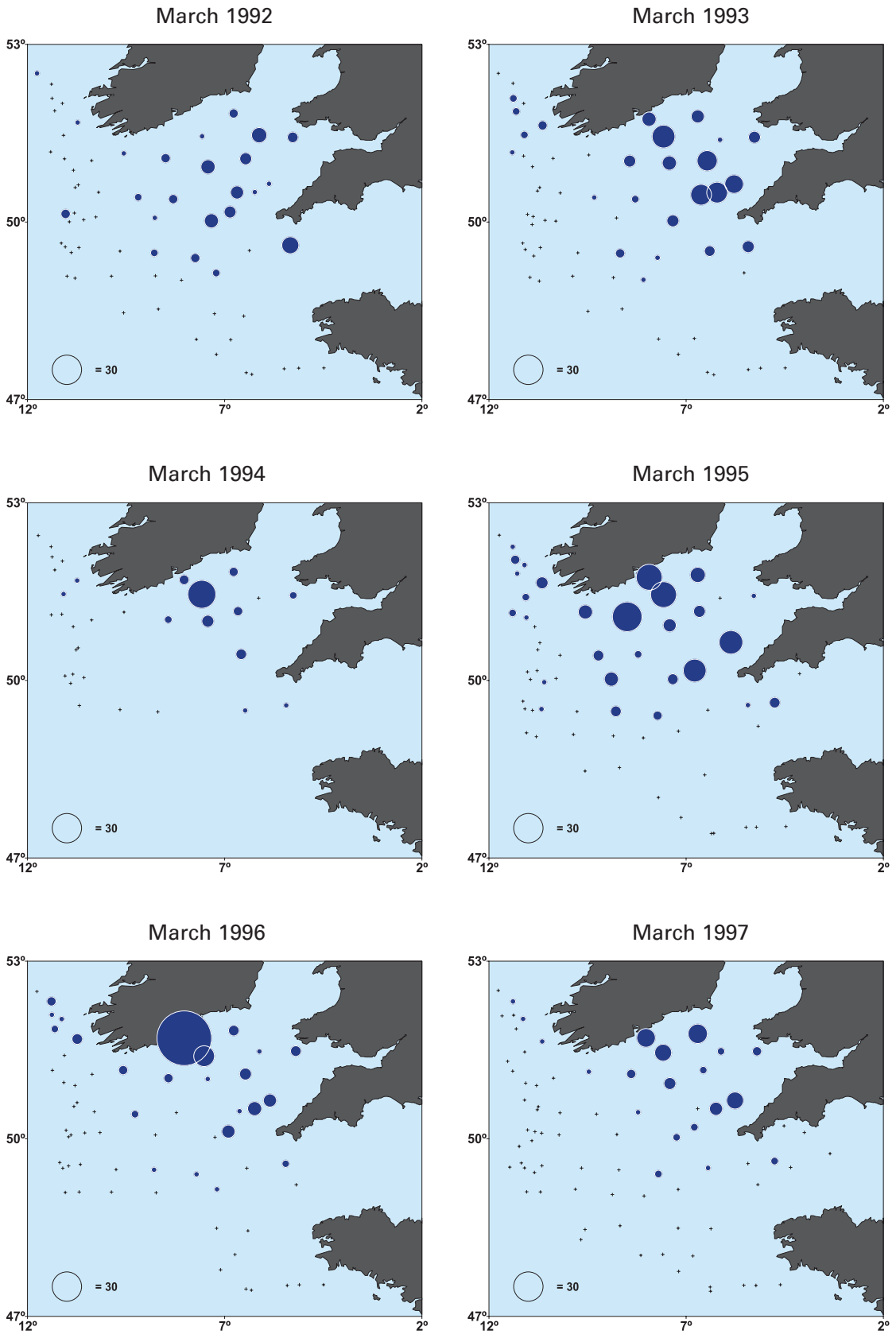

Figure 7.1. Cod, *Gadus morhua* (2-group and older). Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

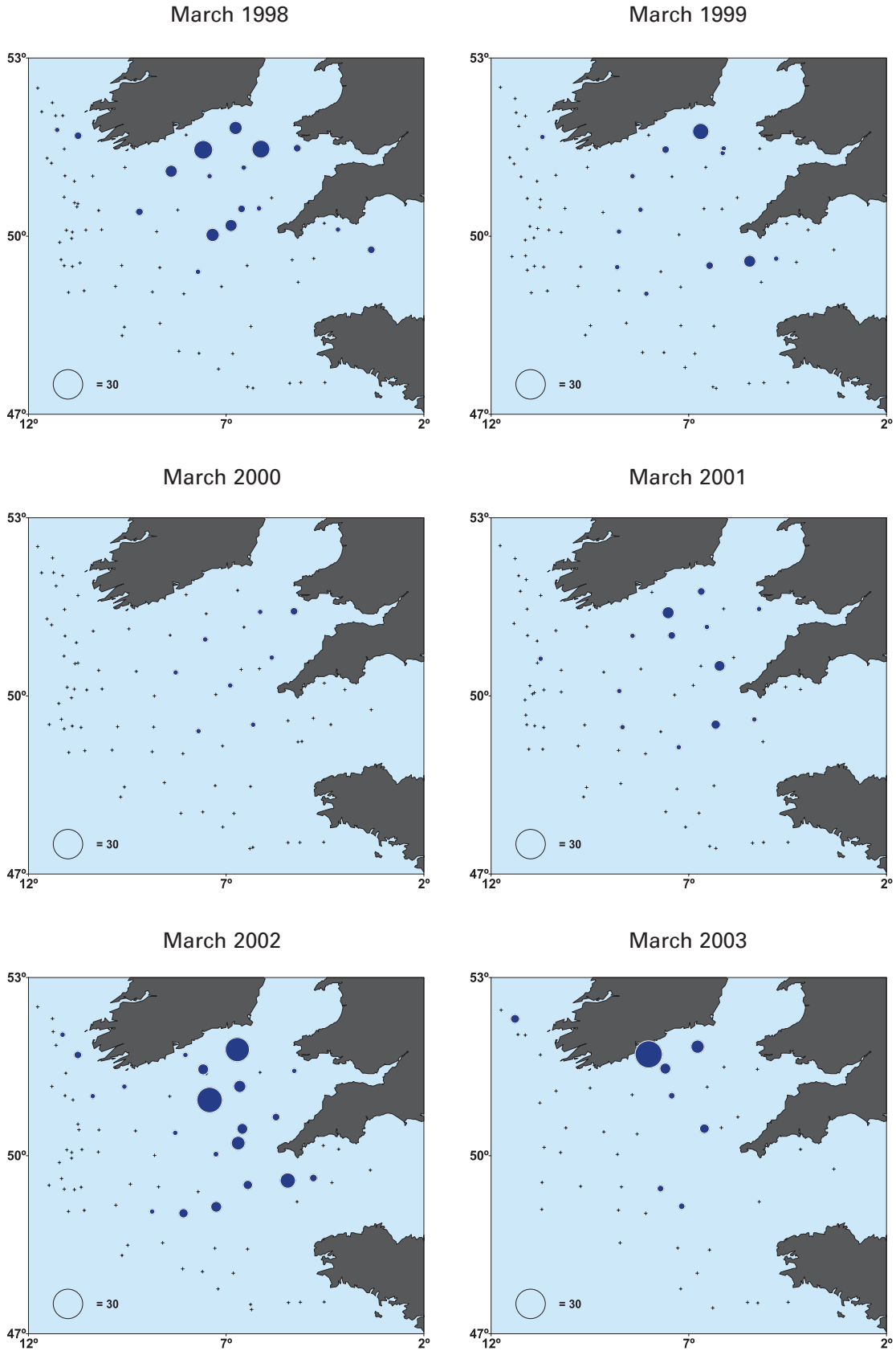

Figure 7.1. continued: Cod, *Gadus morhua* (2-group and older). Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

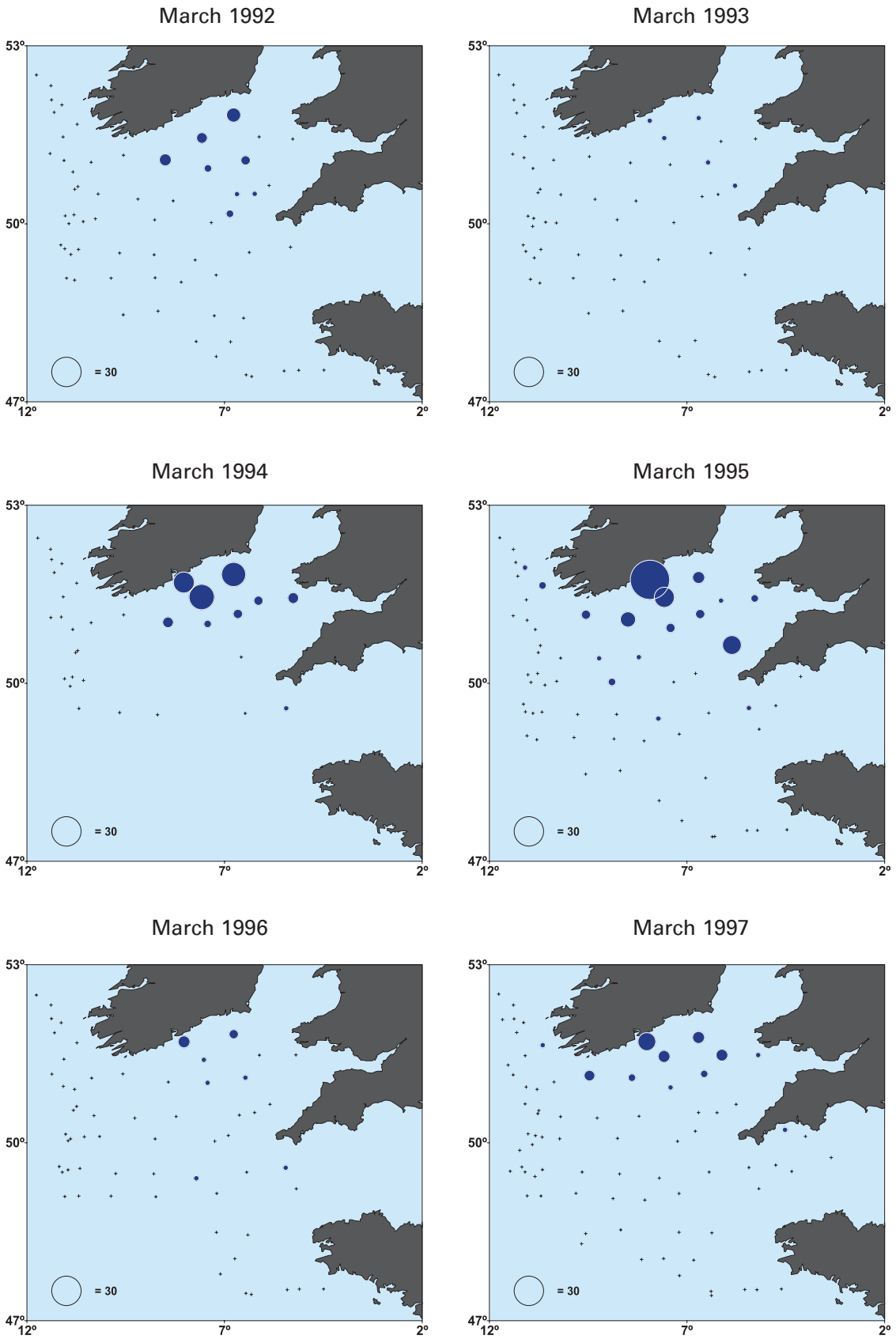

Figure 7.2. 1-group cod, *Gadus morhua*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

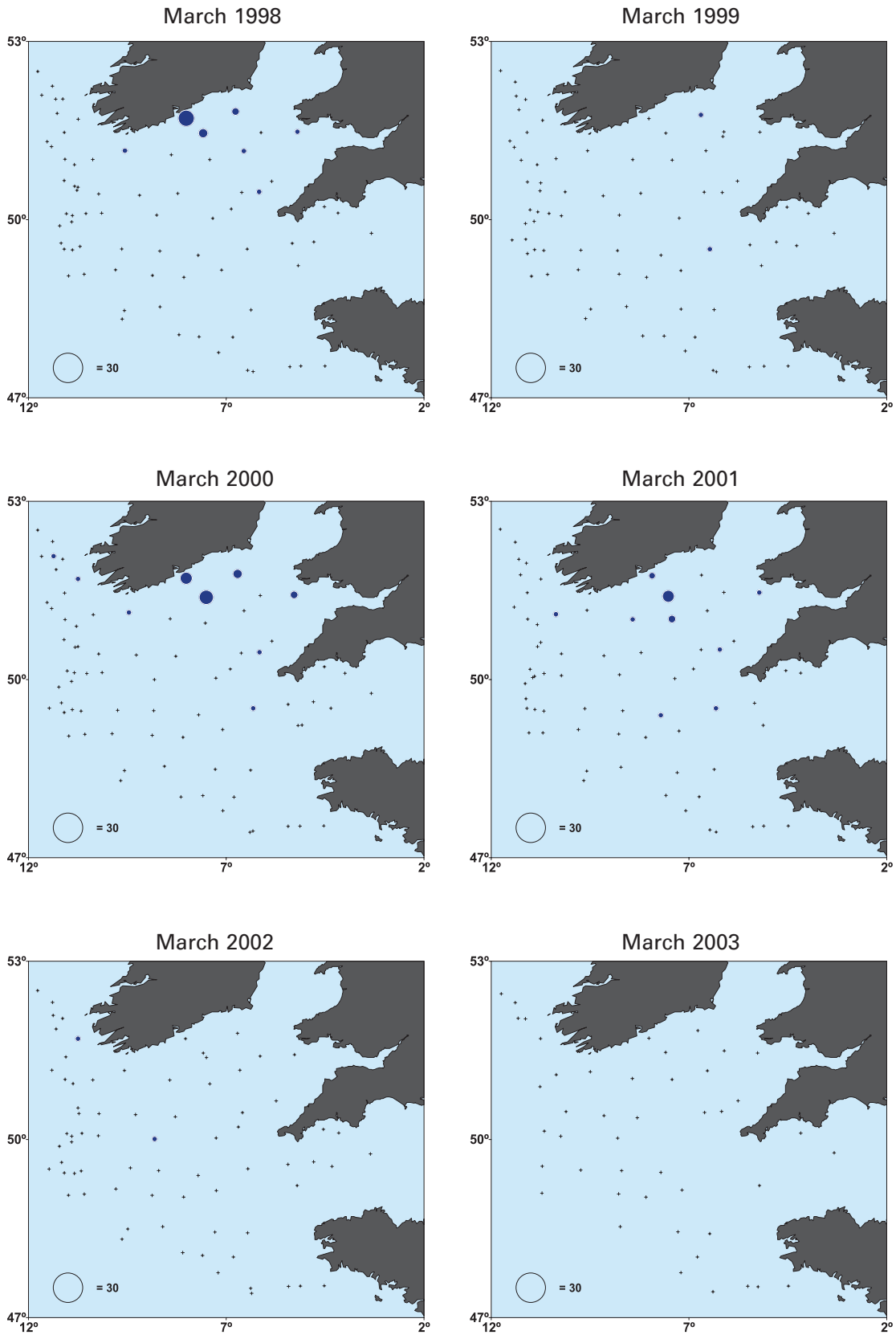

Figure 7.2. continued: 1-group cod, *Gadus morhua*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

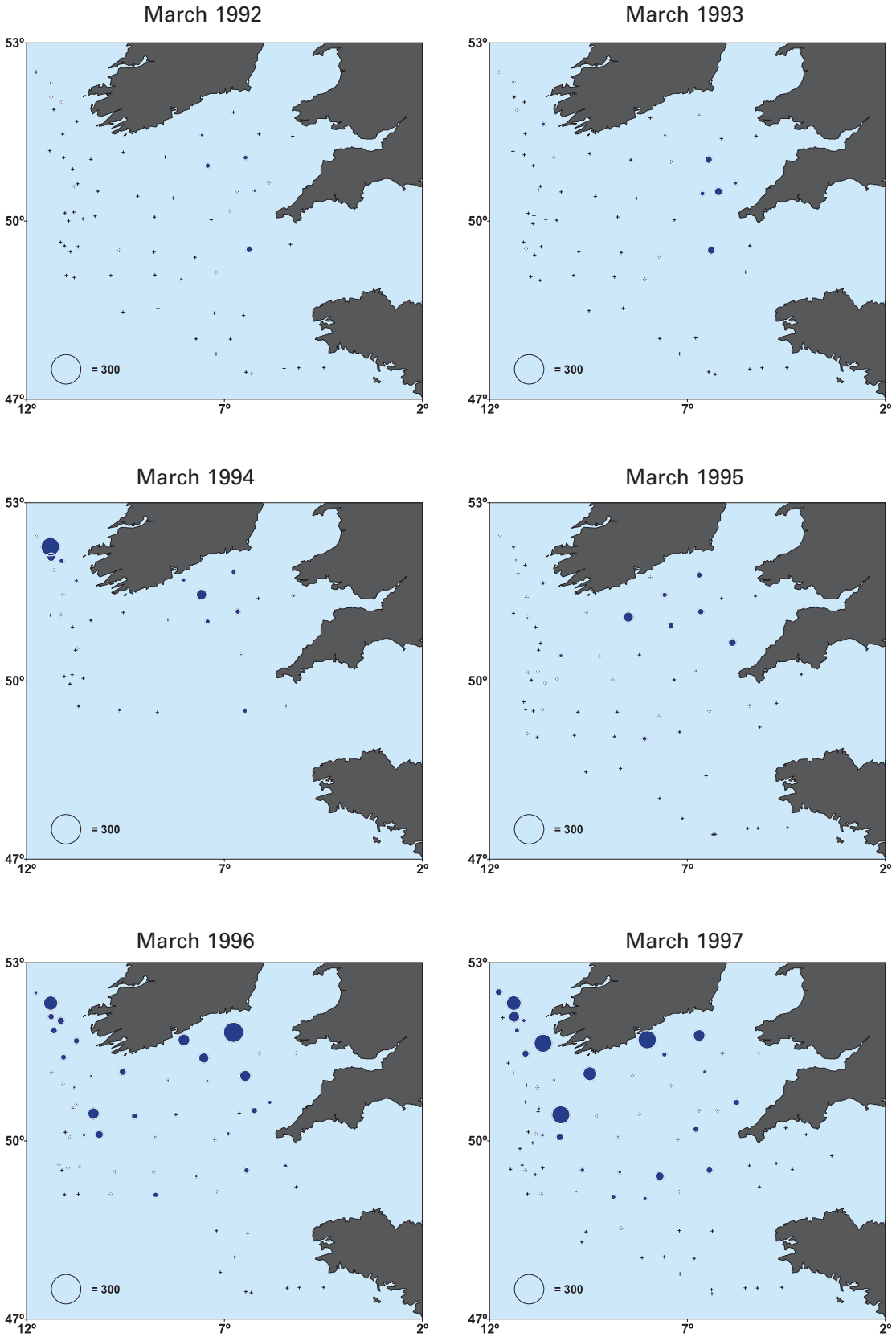

Figure 7.3. Haddock, *Melanogrammus aeglefinus* (2-group and older). Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

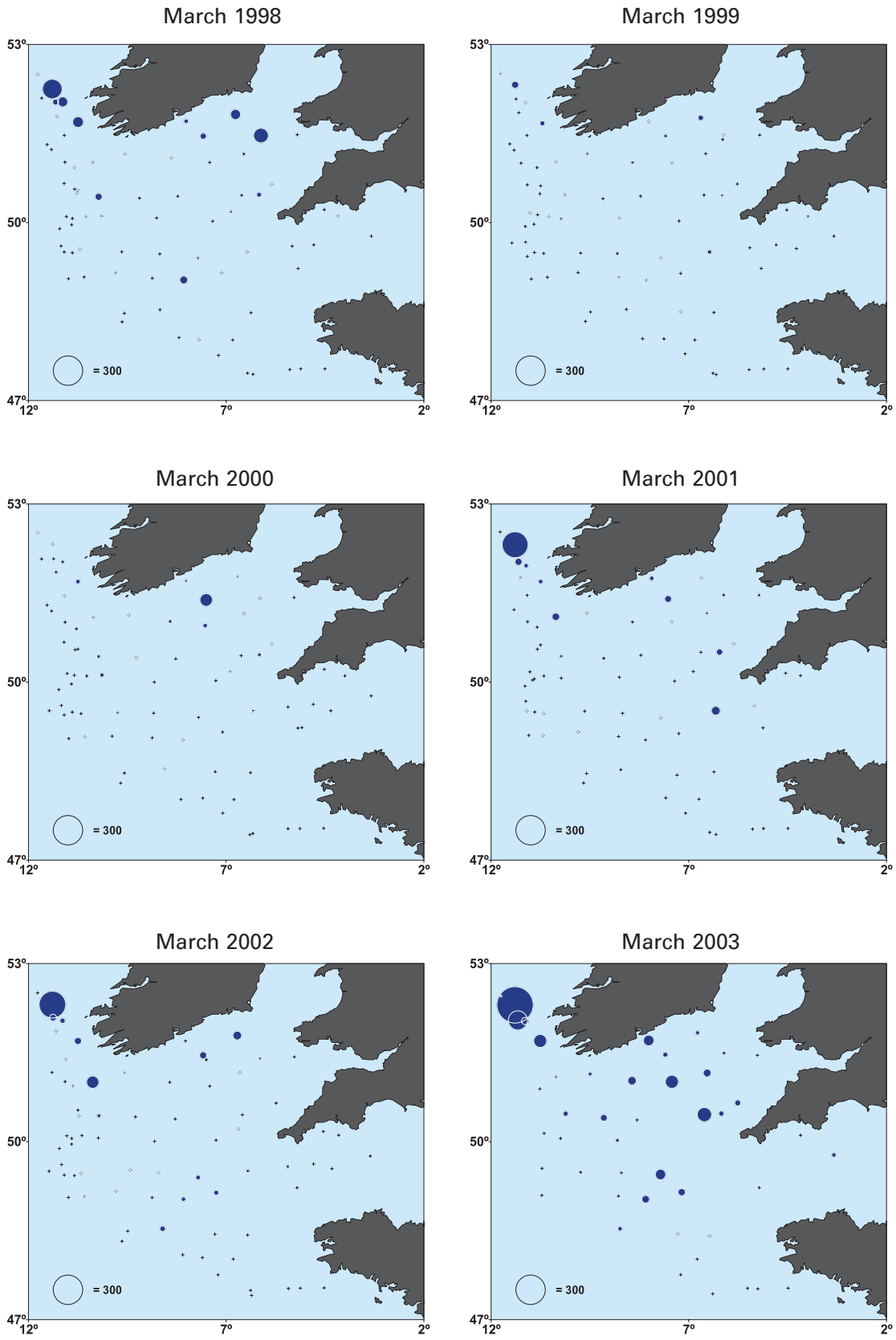

Figure 7.3. continued: Haddock, *Melanogrammus aeglefinus* (2-group and older). Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

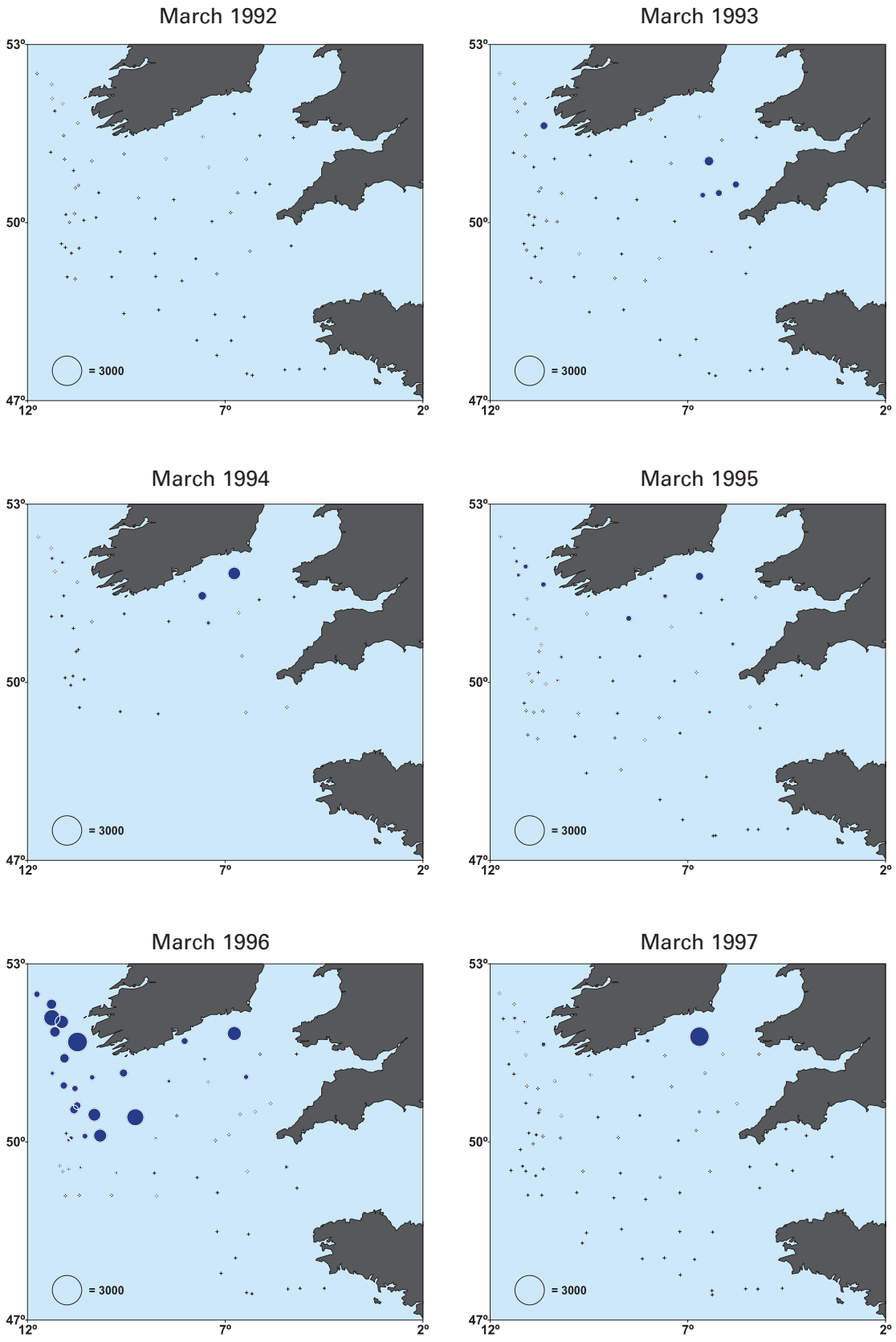

Figure 7.4. 1-group haddock, *Melanogrammus aeglefinus*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

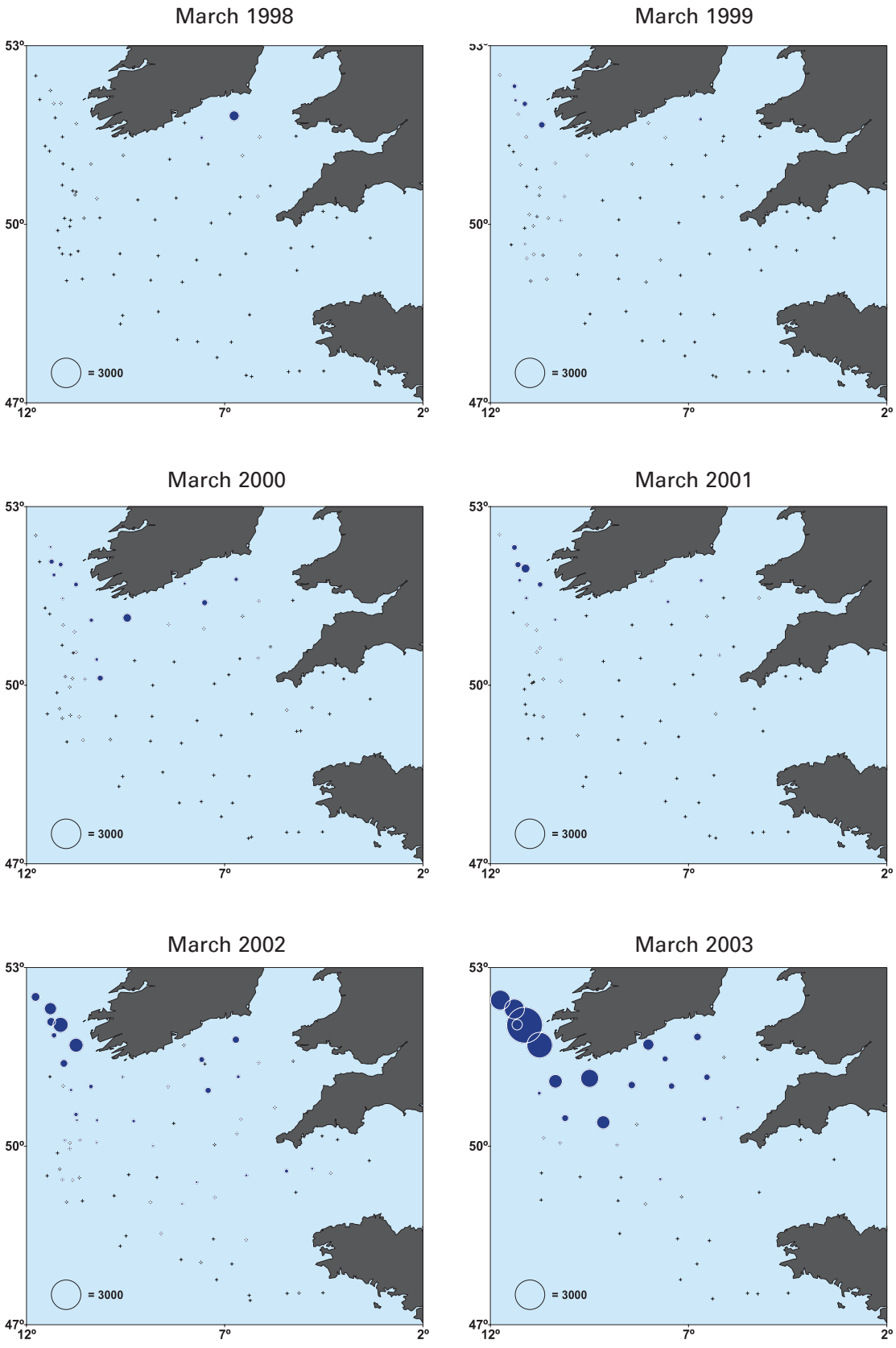

Figure 7.4. continued: 1-group haddock, *Melanogrammus aeglefinus*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

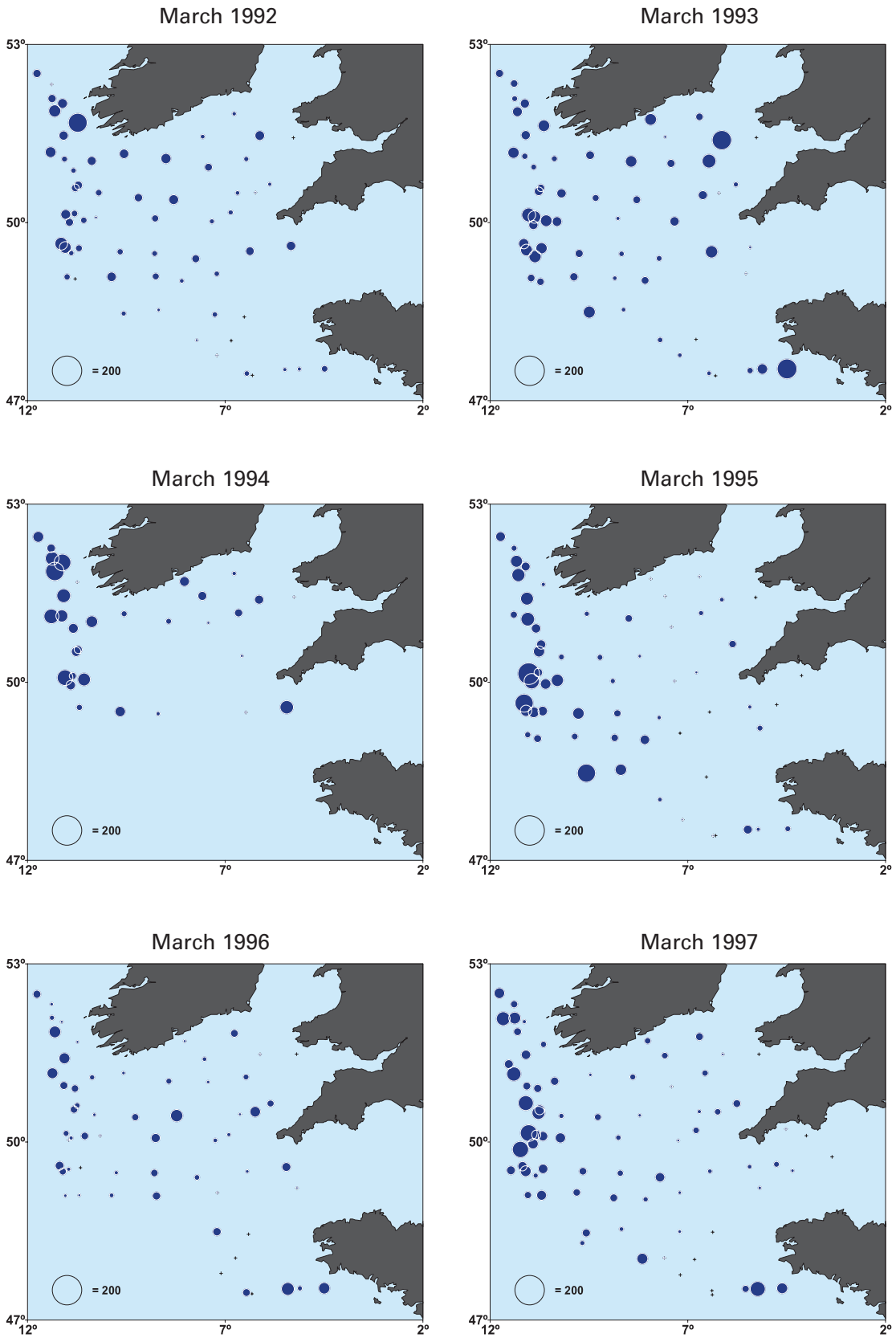

Figure 7.5. Hake, *Merluccius merluccius* (2-group and older). Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

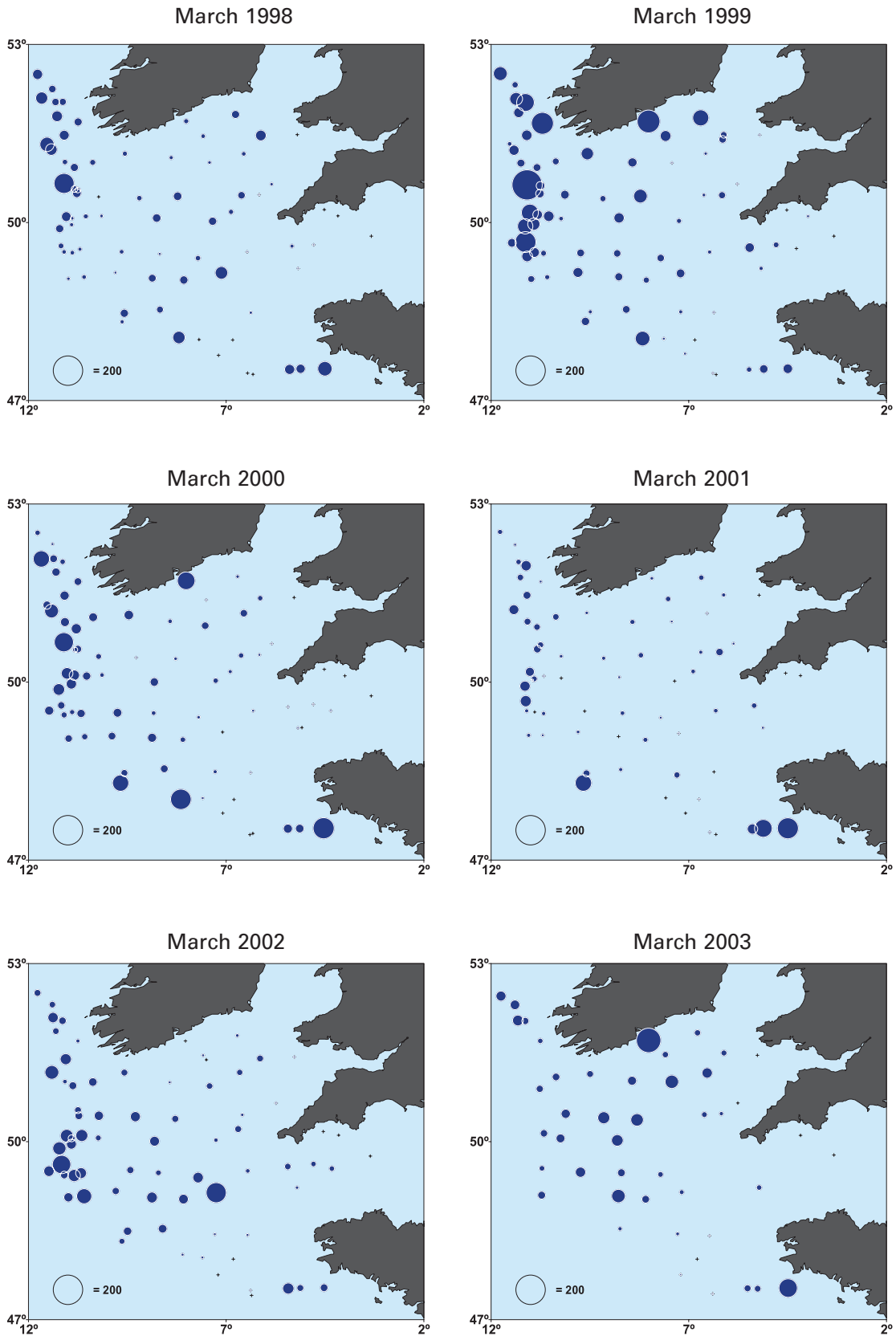

Figure 7.5. continued: Hake, *Merluccius merluccius* (2-group and older). Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

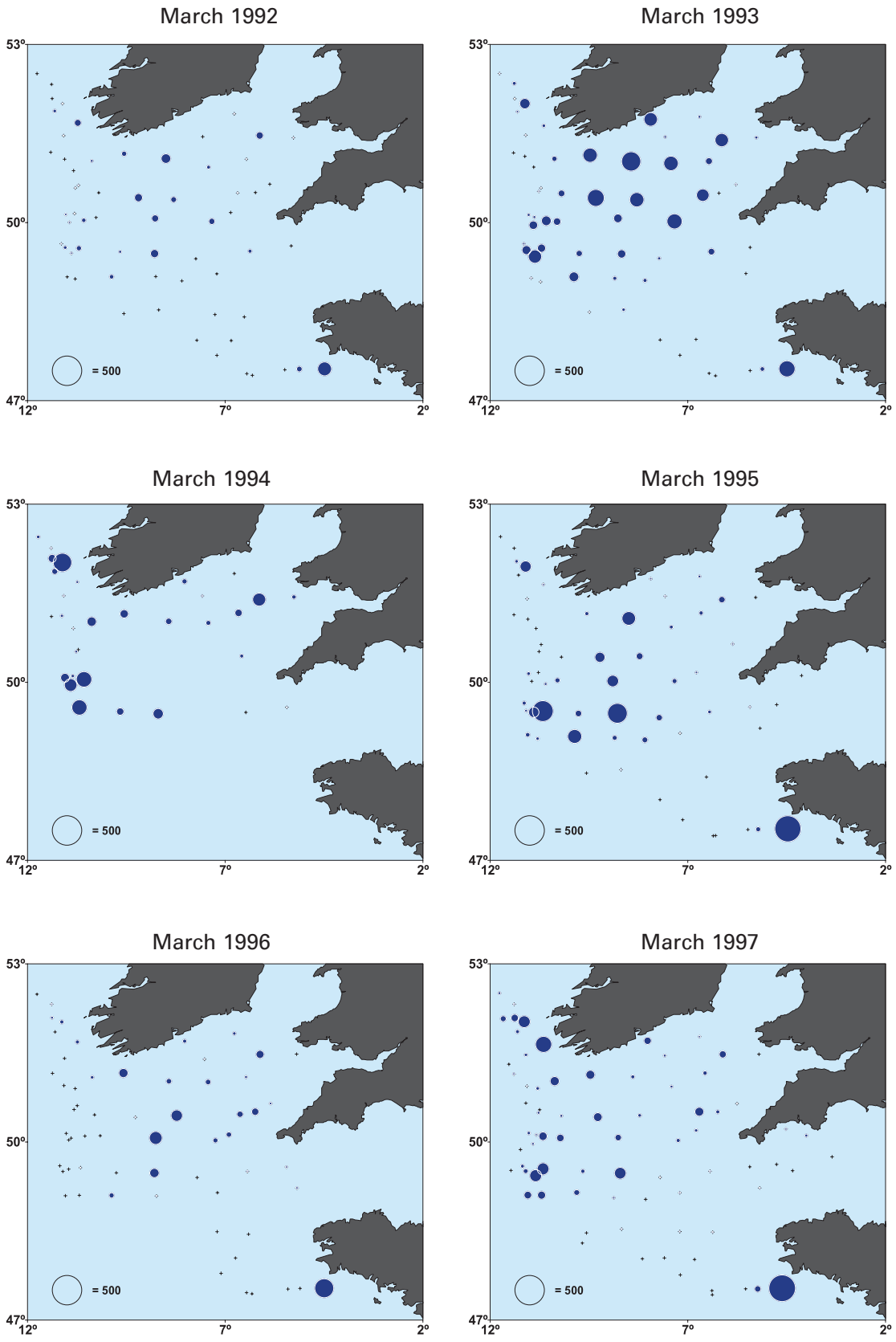

Figure 7.6. 1-group hake, *Merluccius merluccius*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

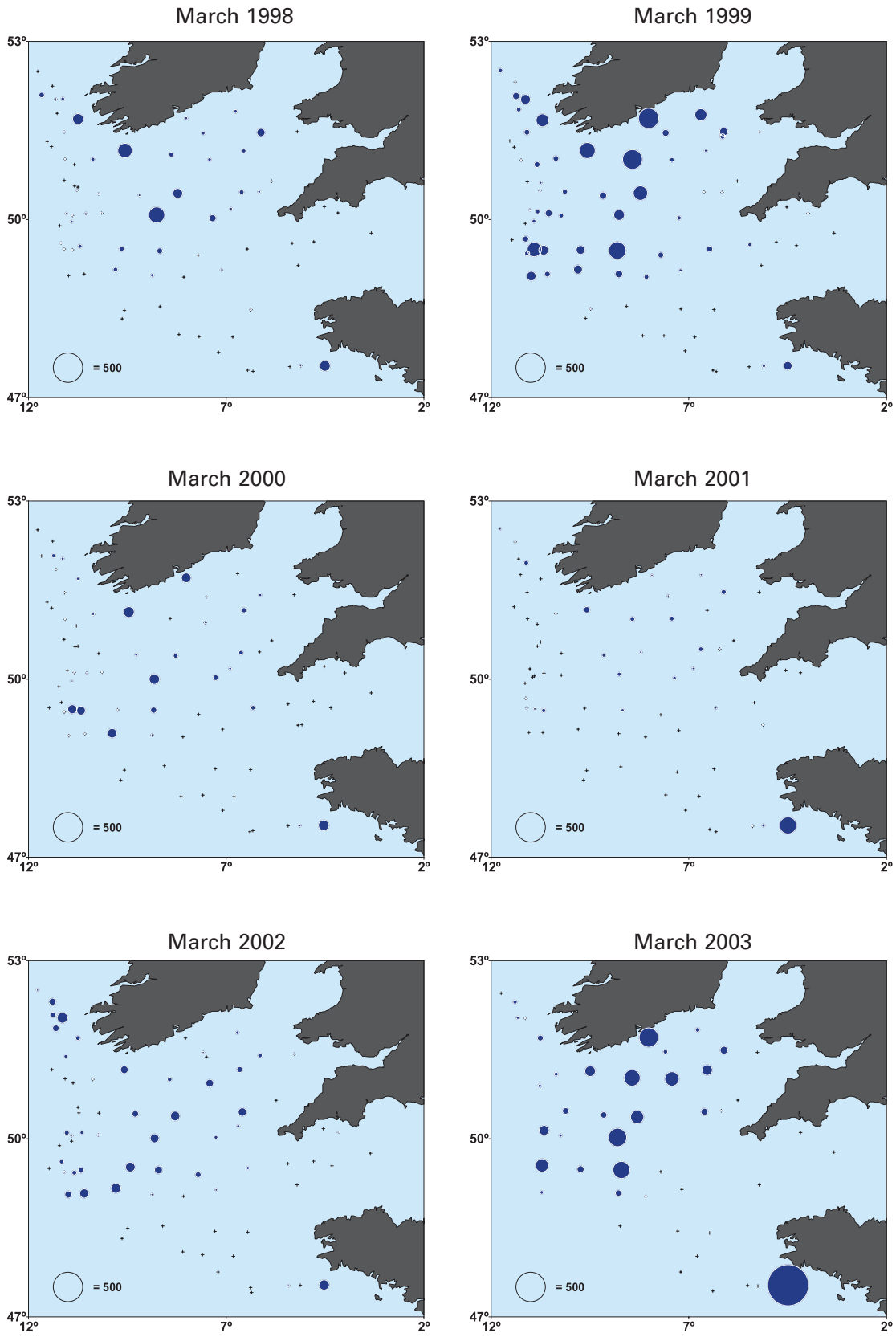

Figure 7.6. continued: 1-group hake, *Merluccius merluccius*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

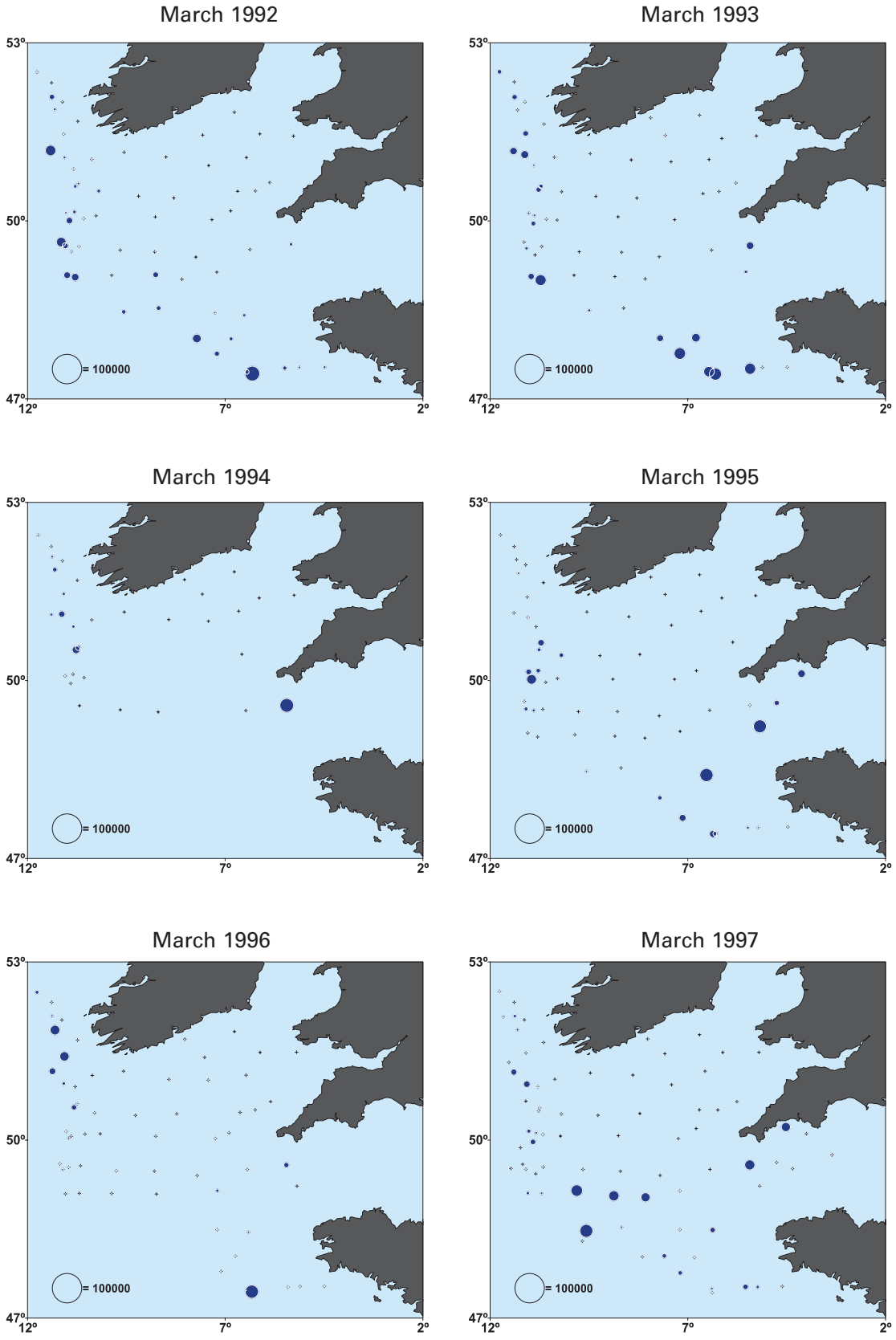

Figure 7.7. Horse mackerel, *Trachurus trachurus* (2-group and older). Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

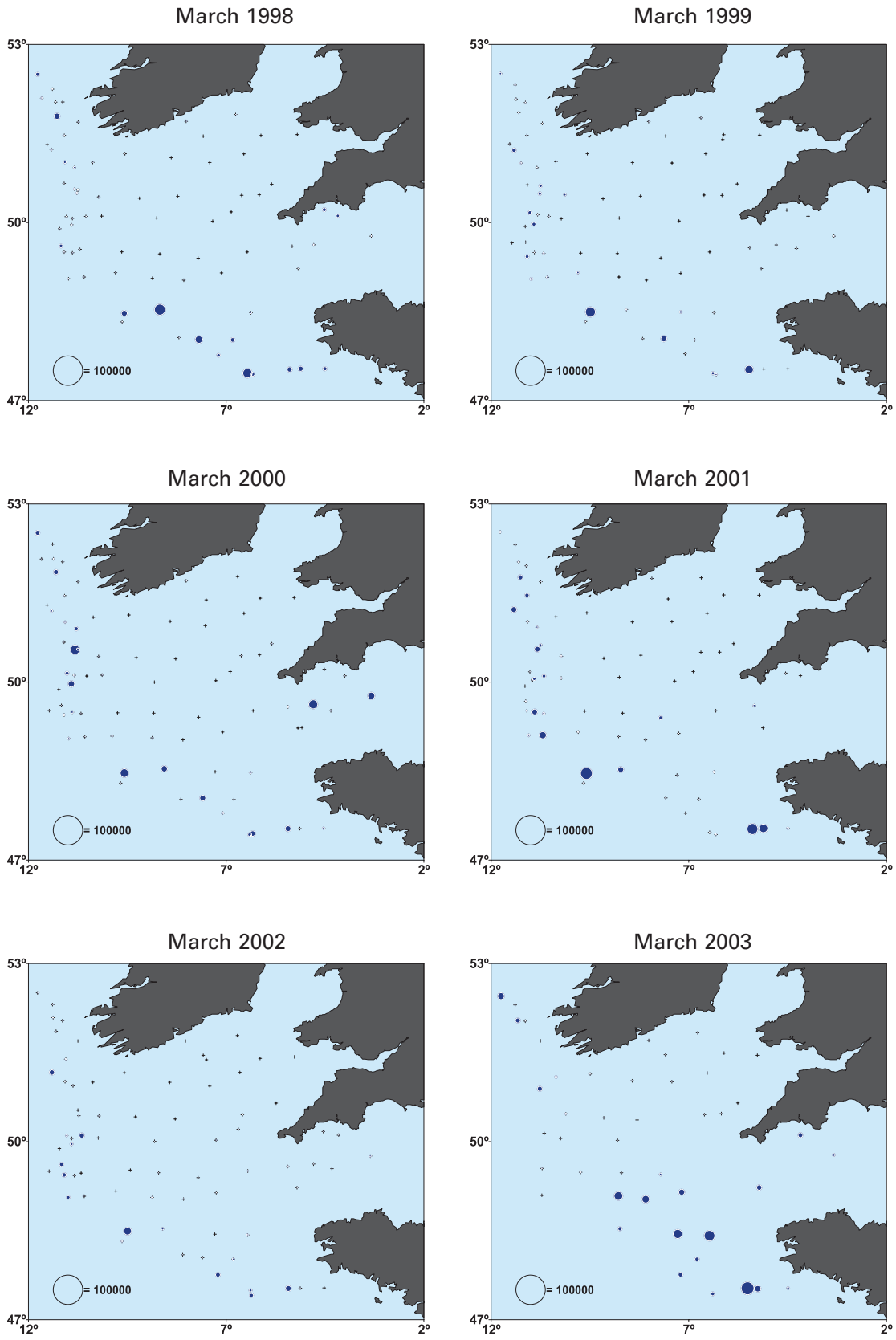

Figure 7.7. continued: Horse mackerel, *Trachurus trachurus* (2-group and older). Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

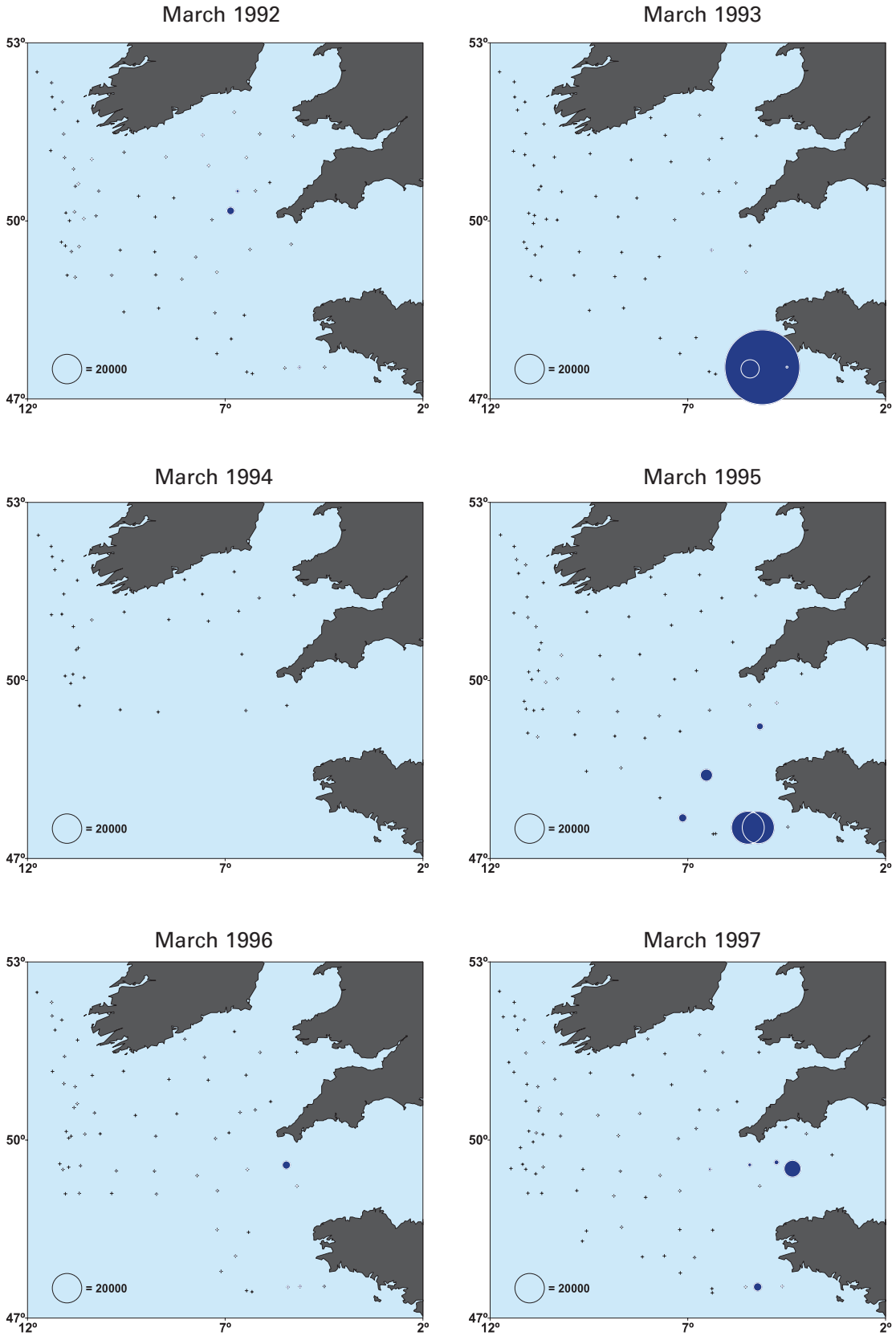

Figure 7.8. 1-group horse mackerel, *Trachurus trachurus*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

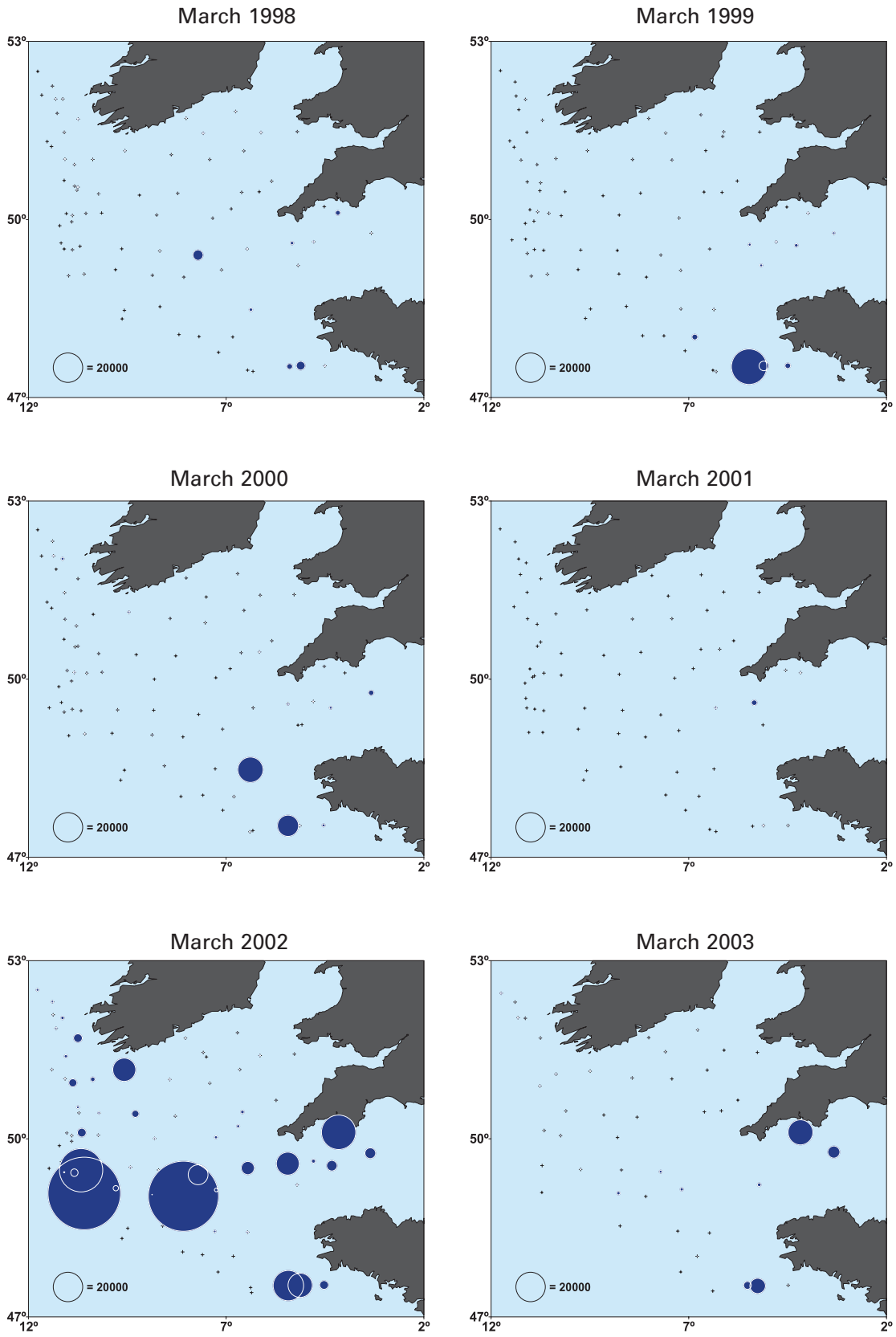

Figure 7.8. continued: 1-group horse mackerel, *Trachurus trachurus*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

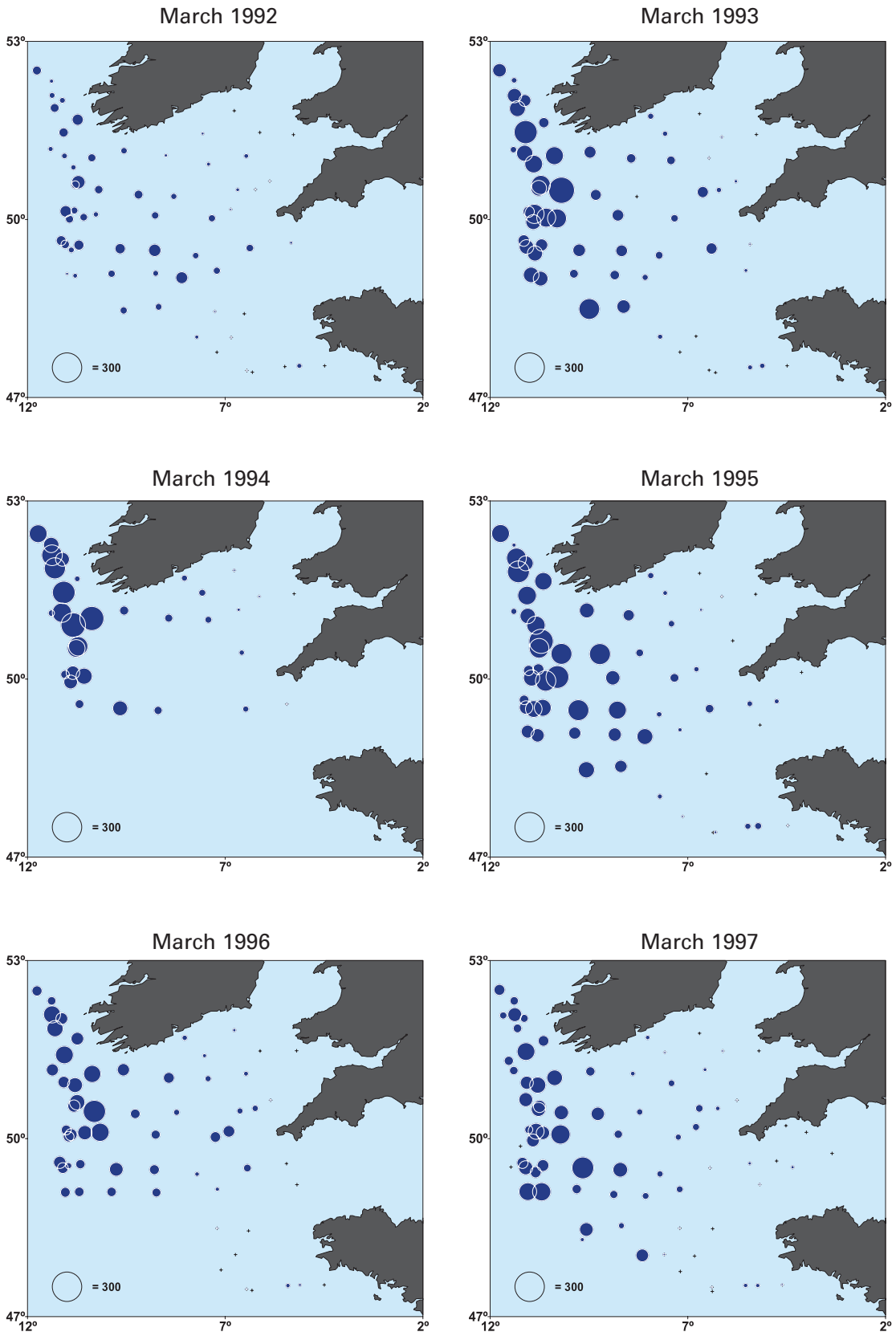

Figure 7.9. Megrim, *Lepidorhombus whiffiagonis*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

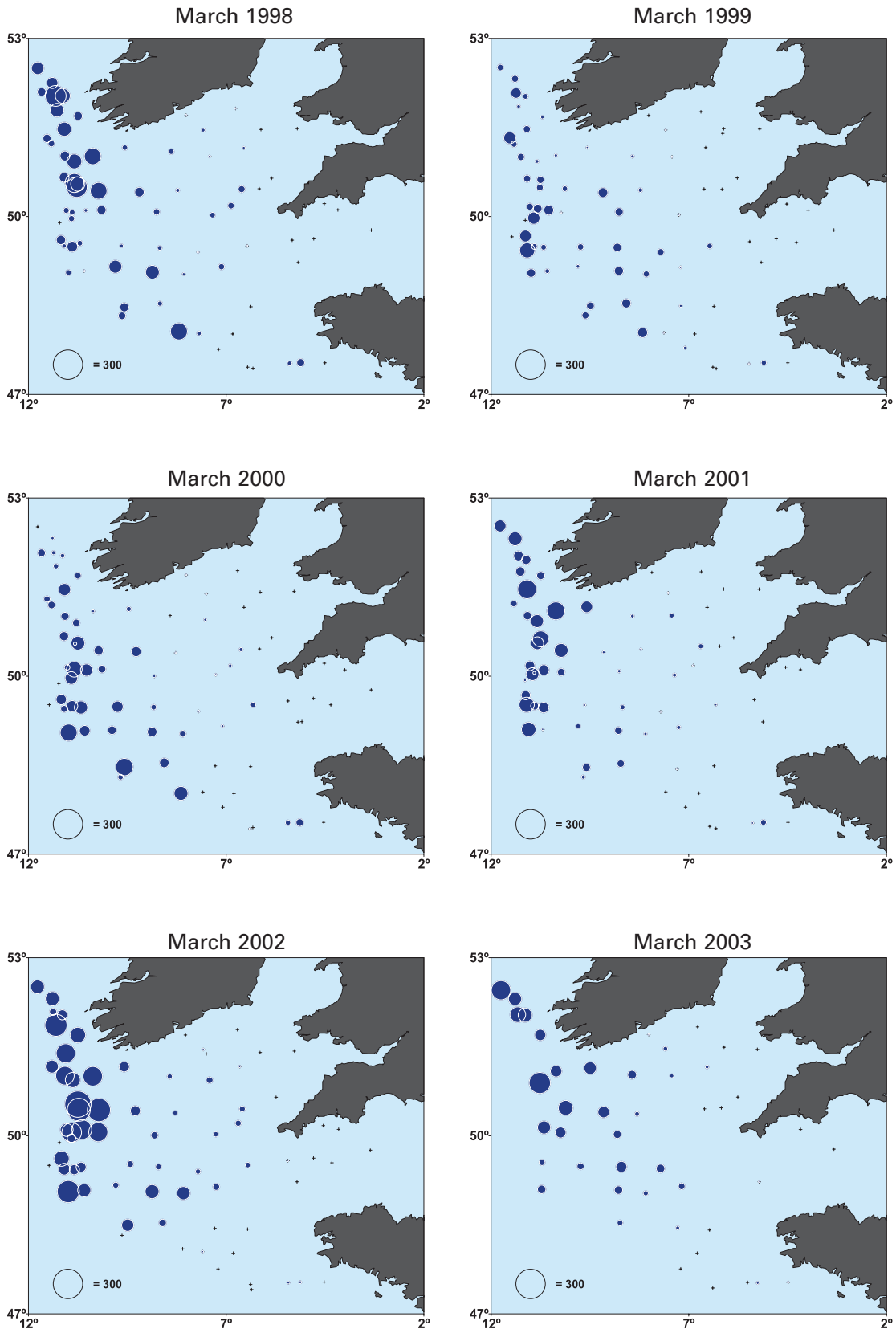

Figure 7.9. continued: Megrim, *Lepidorhombus whiffiagonis*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

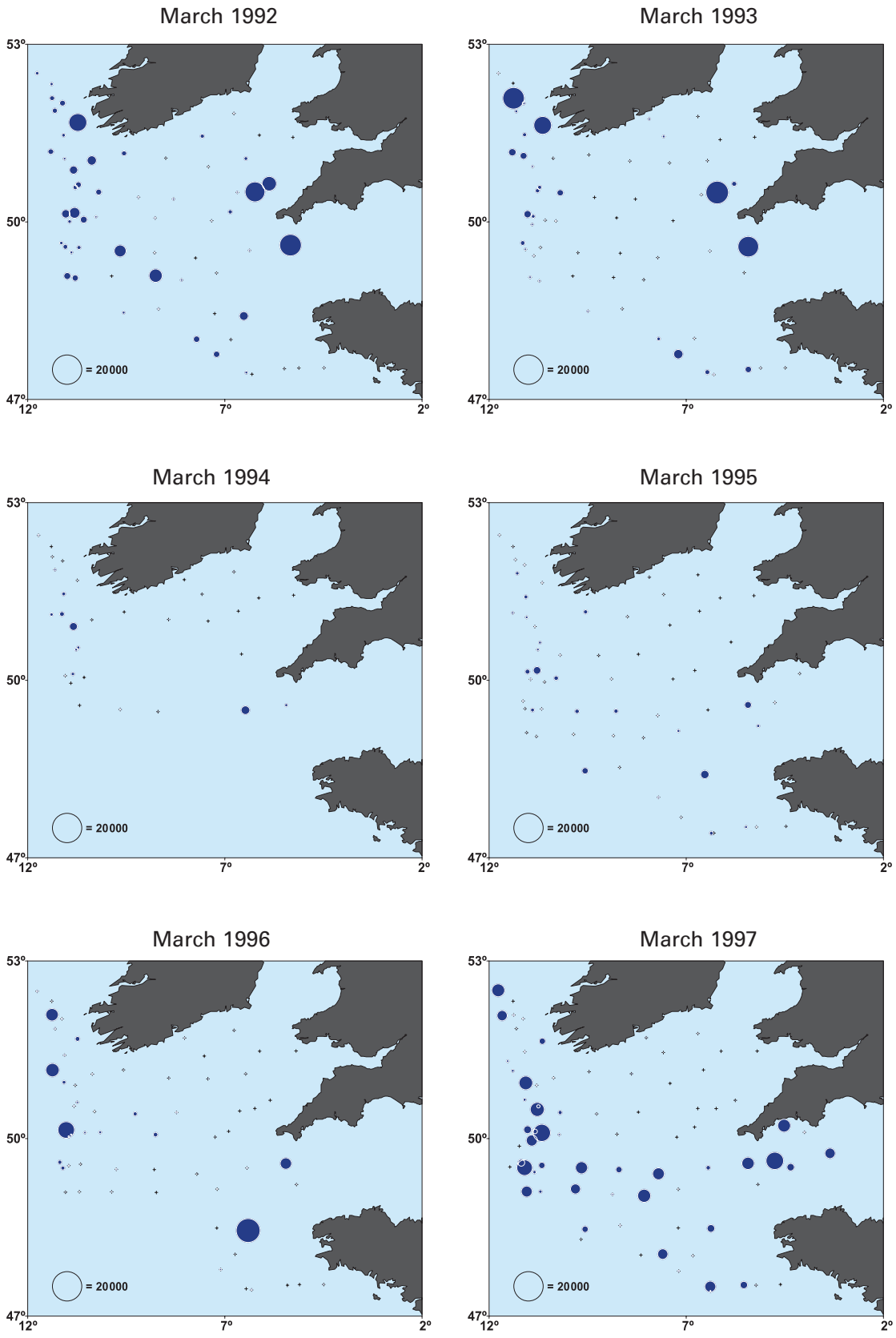

Figure 7.10. Mackerel, *Scomber scombrus* (2-group and older). Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

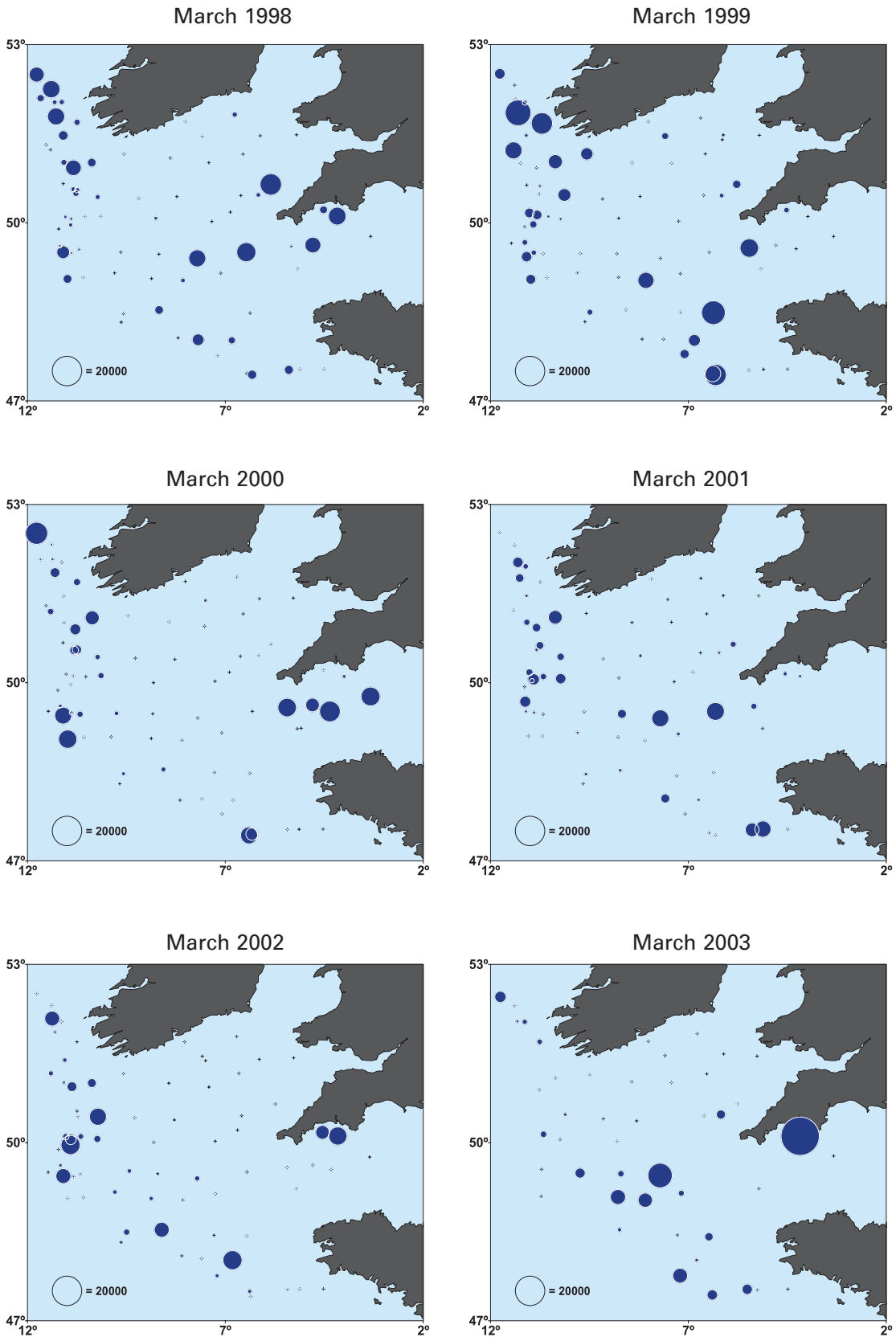

Figure 7.10. continued: Mackerel, *Scomber scombrus* (2-group and older). Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

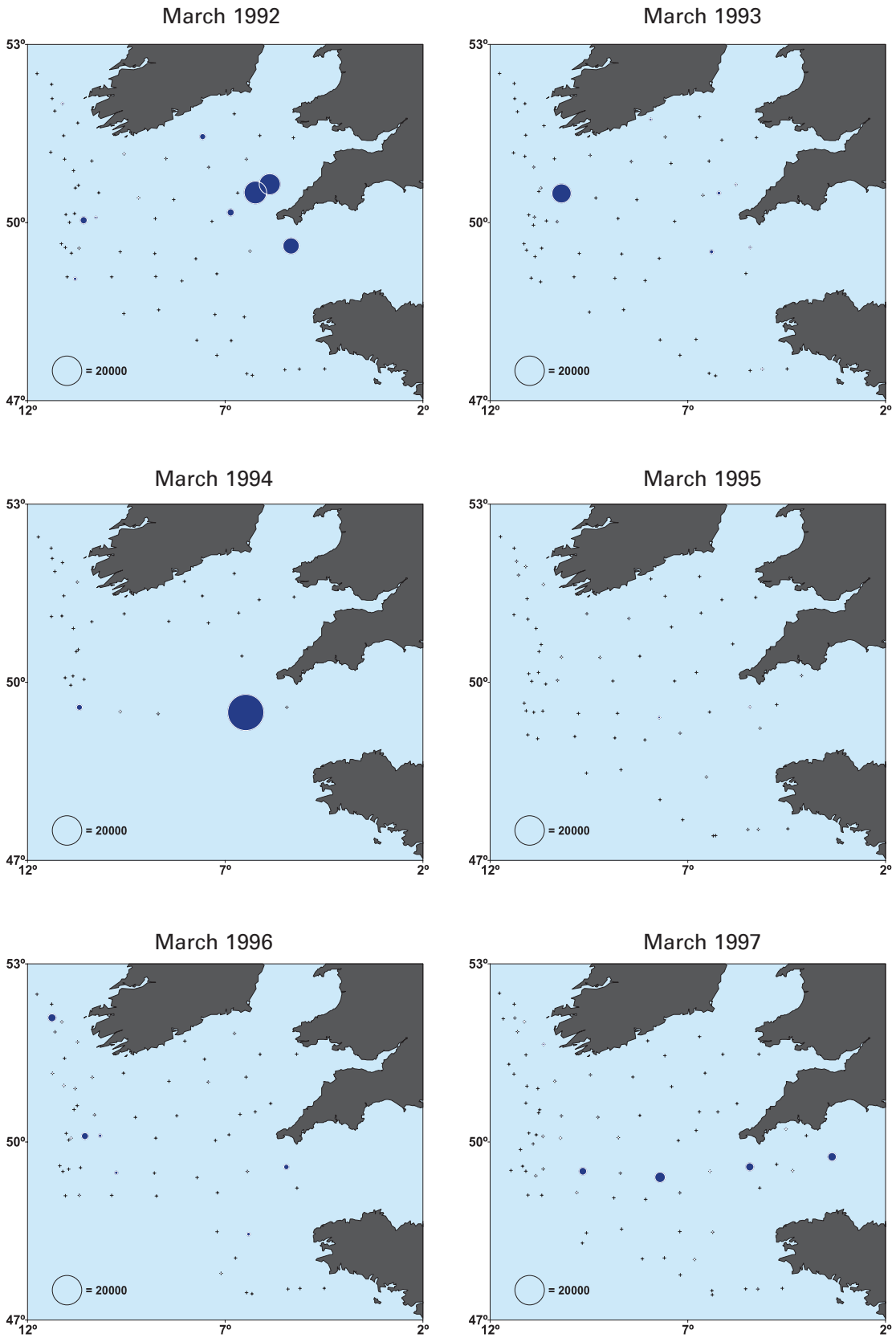

Figure 7.11. 1-group mackerel, *Scomber scombrus*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

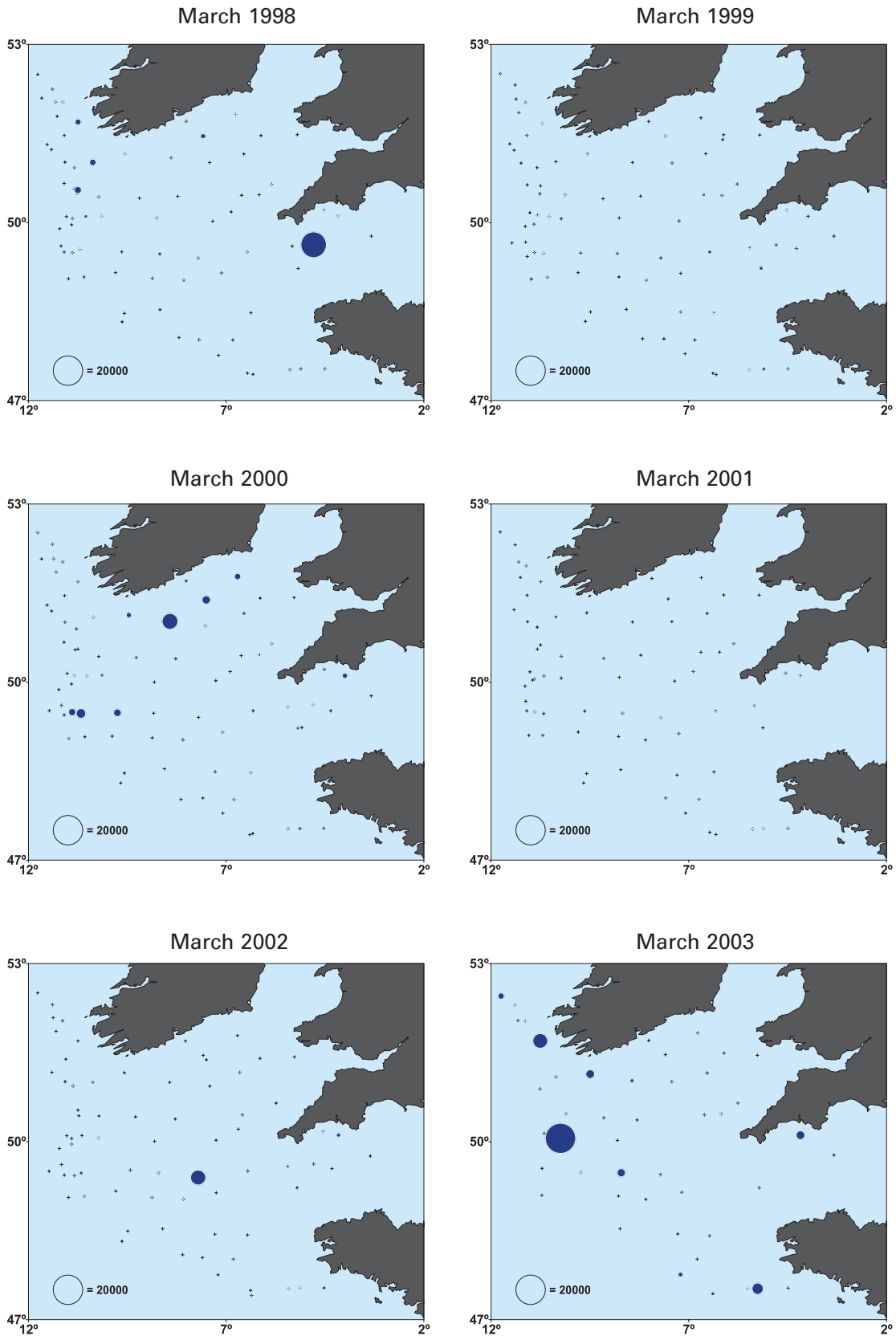

Figure 7.11. continued: 1-group mackerel, *Scomber scombrus*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

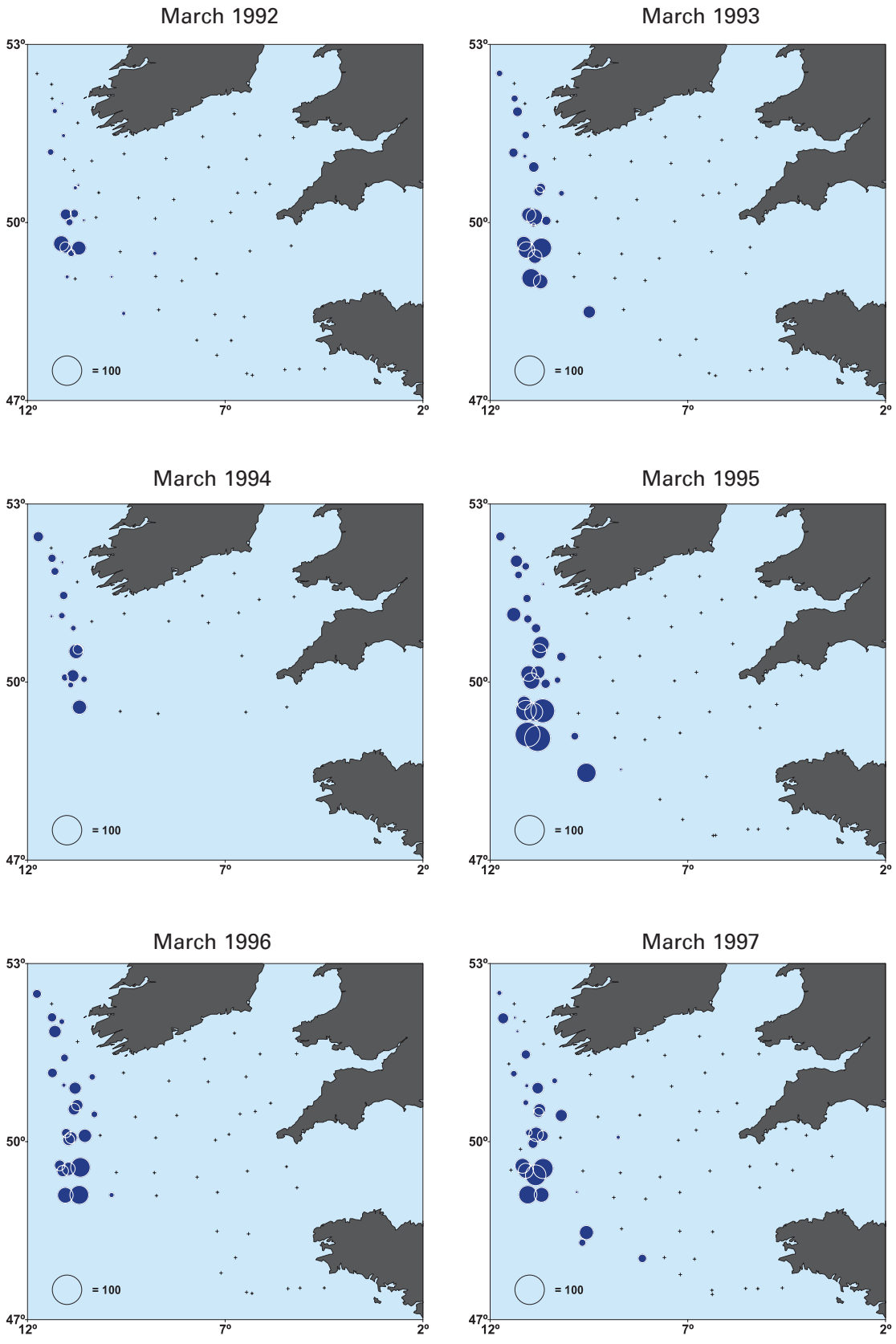

Figure 7.12. Four-spot megrim, *Lepidorhombus boscii*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

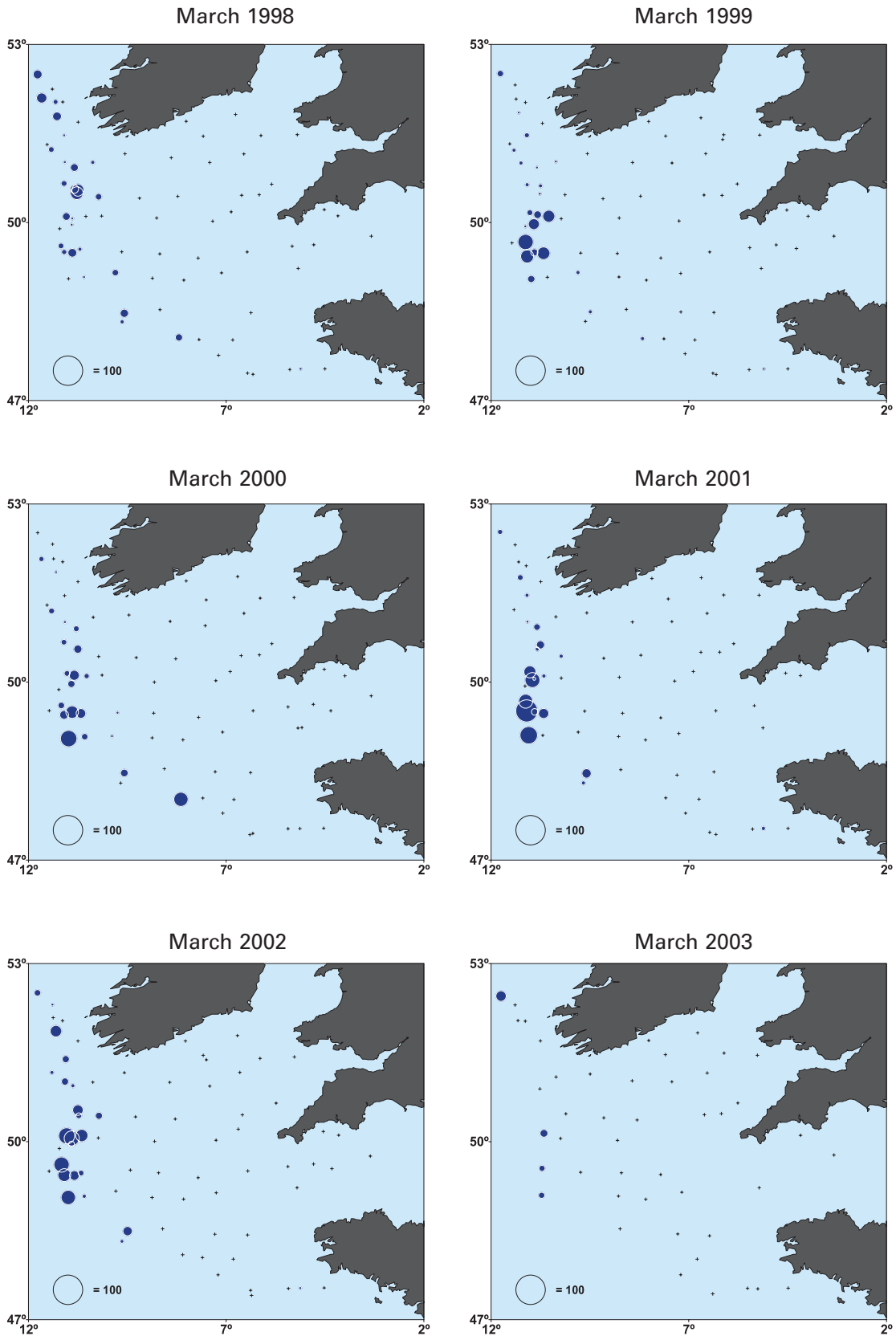

Figure 7.12. continued: Four-spot megrim, *Lepidorhombus boscii*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

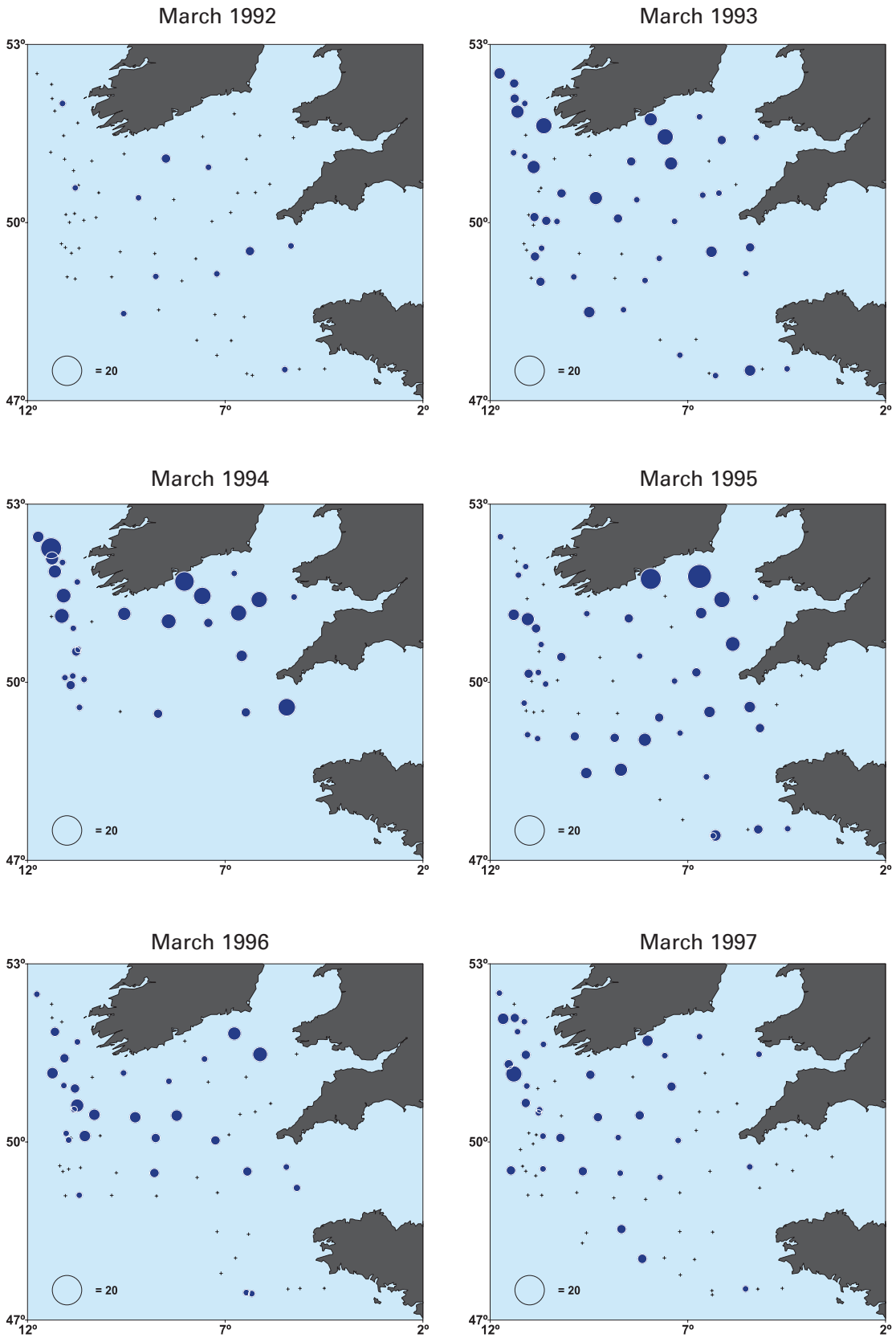

Figure 7.13. Anglerfish (monk), *Lophius piscatorius*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

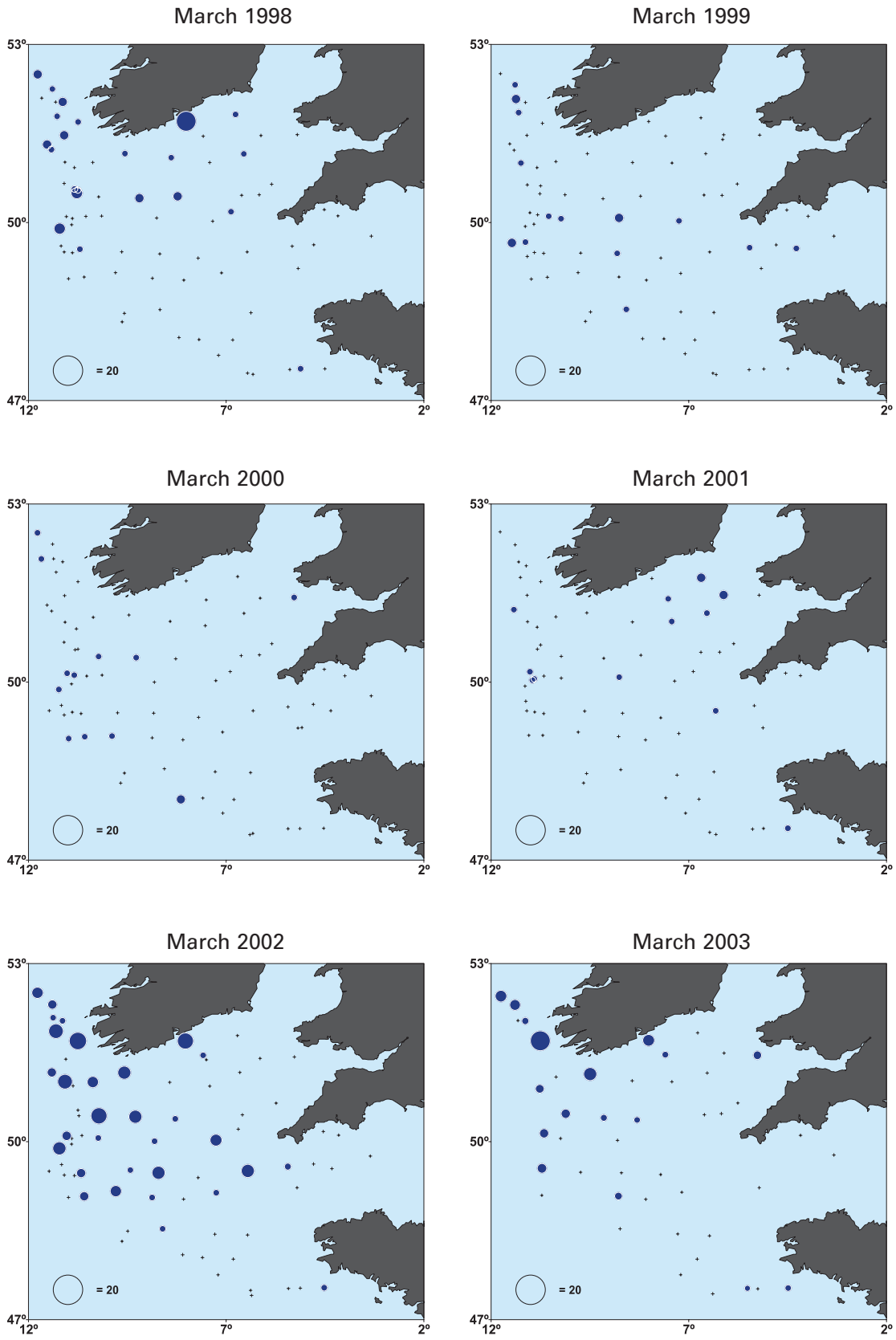

Figure 7.13. continued: Anglerfish (monk), *Lophius piscatorius*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

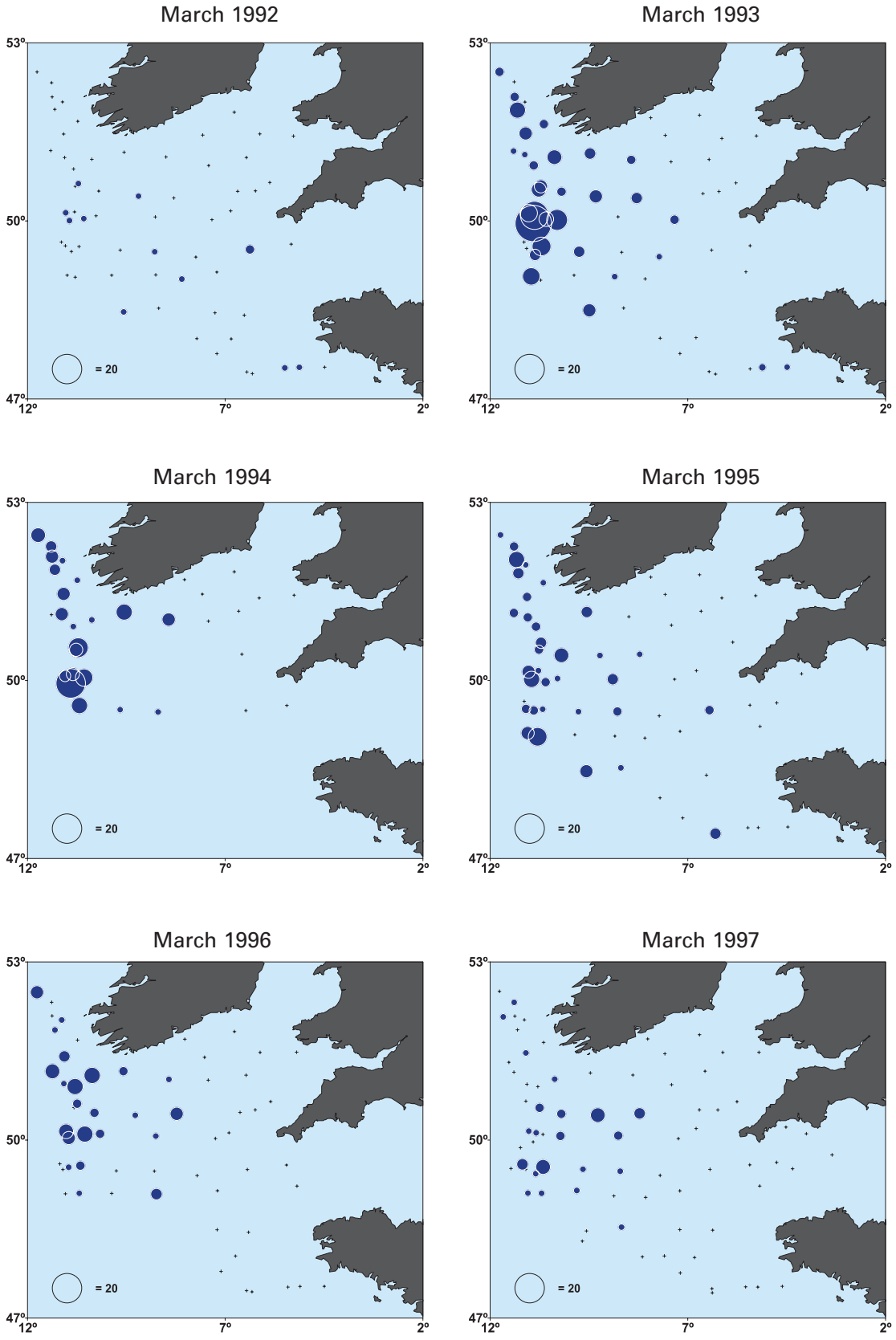

Figure 7.14. White anglerfish, *Lophius budegassa*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

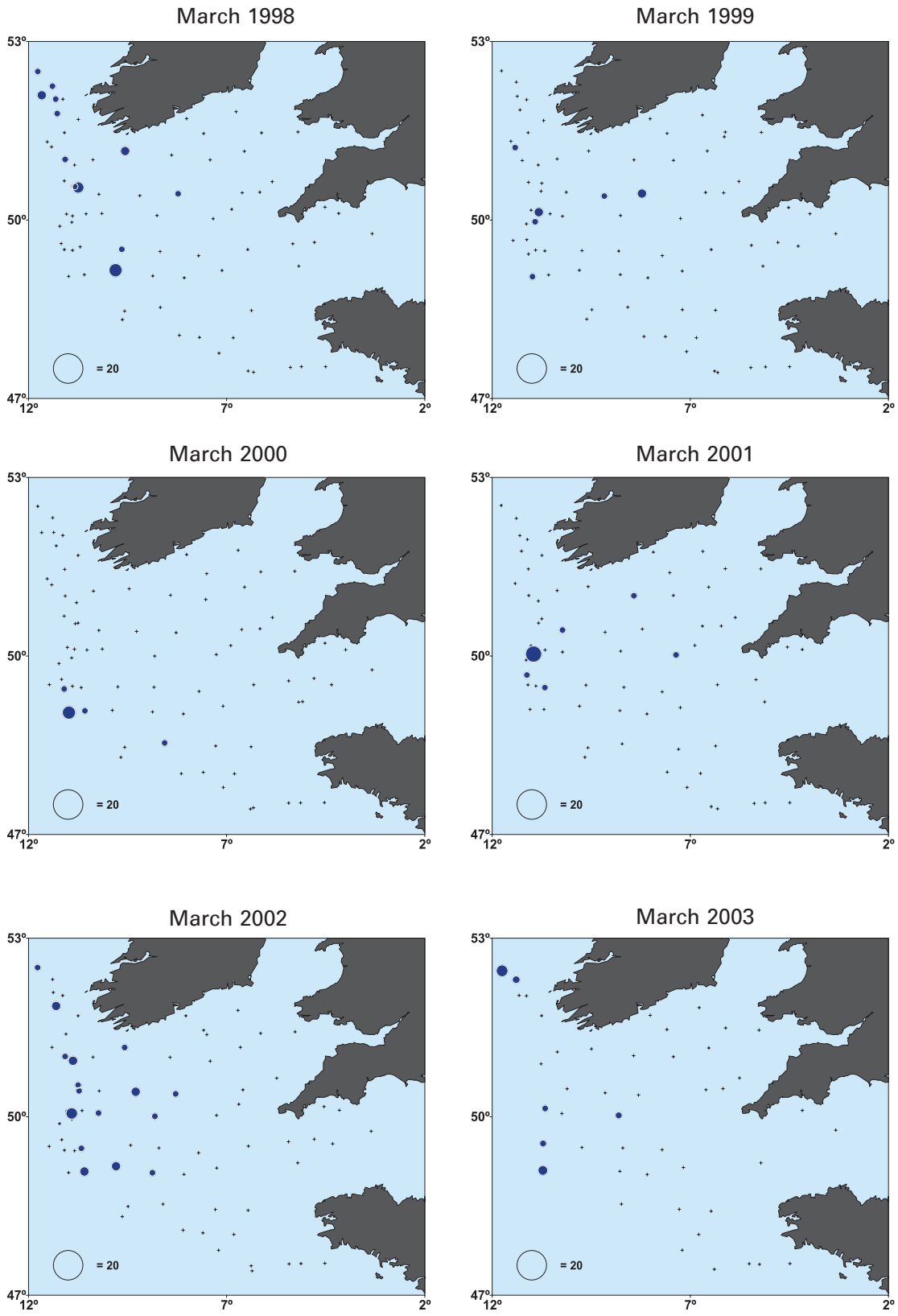

Figure 7.14. continued: White anglerfish, *Lophius budegassa*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

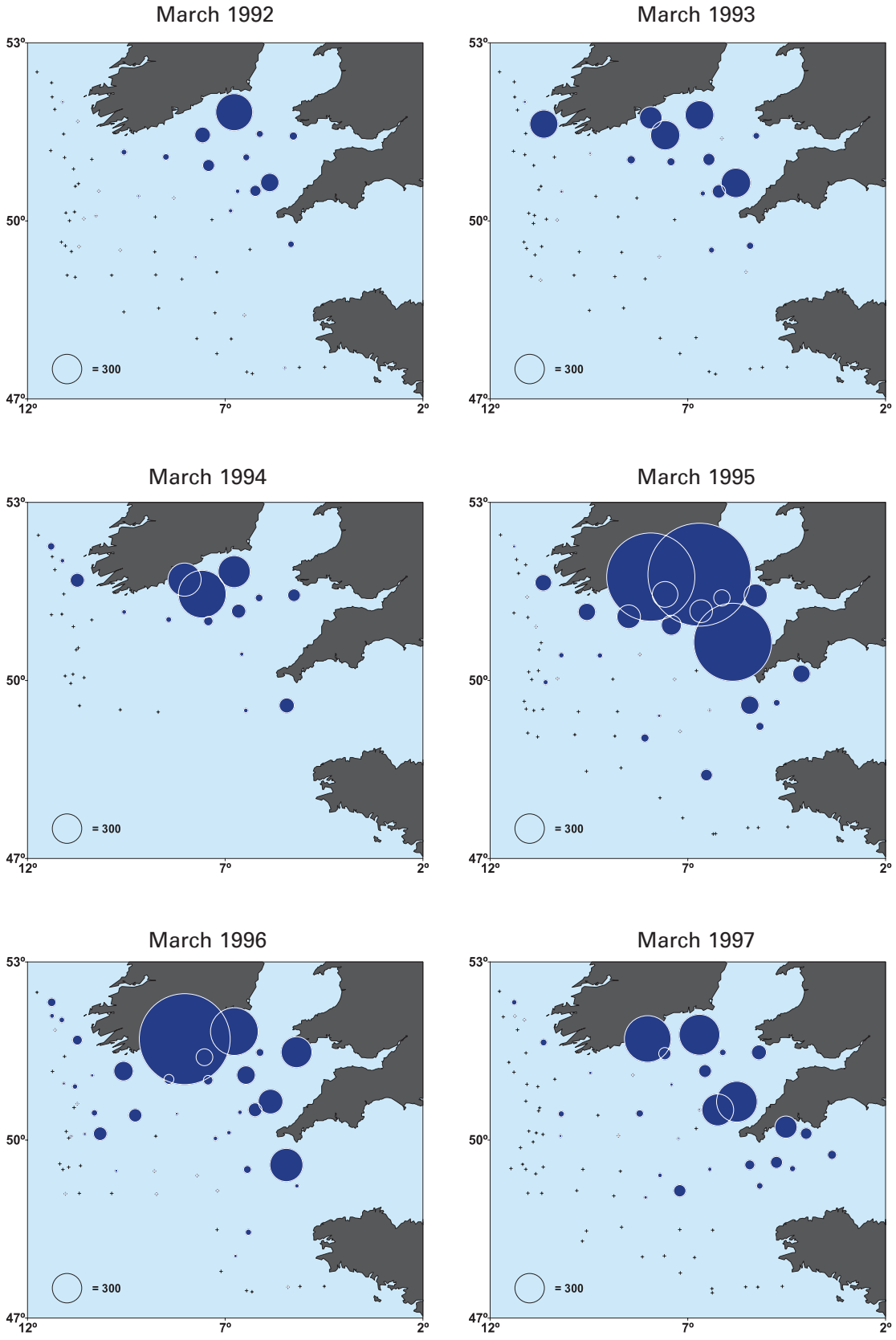

Figure 7.15. Whiting, *Merlangius merlangus* (2-group and older). Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

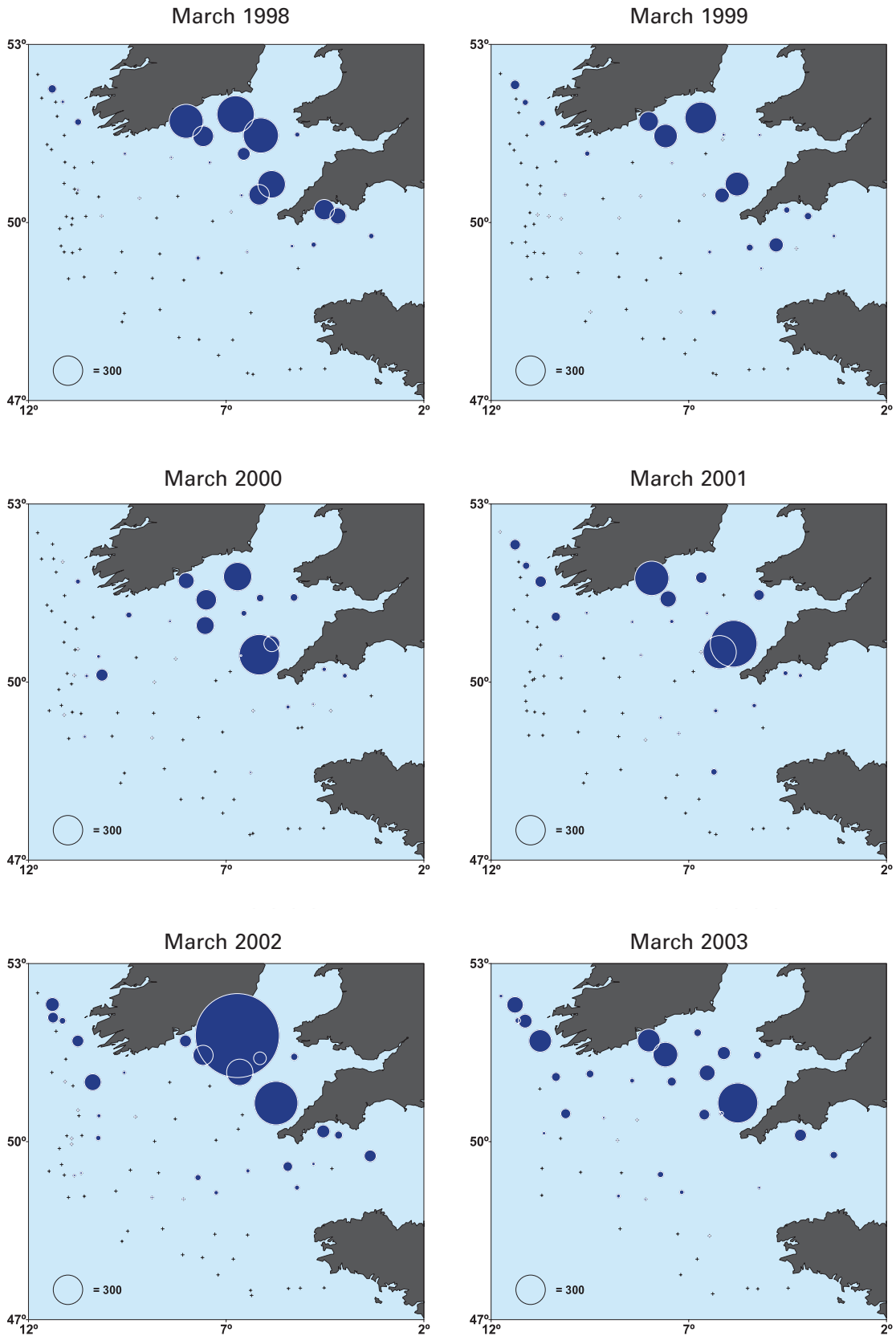

Figure 7.15. continued: Whiting, *Merlangius merlangus* (2-group and older). Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

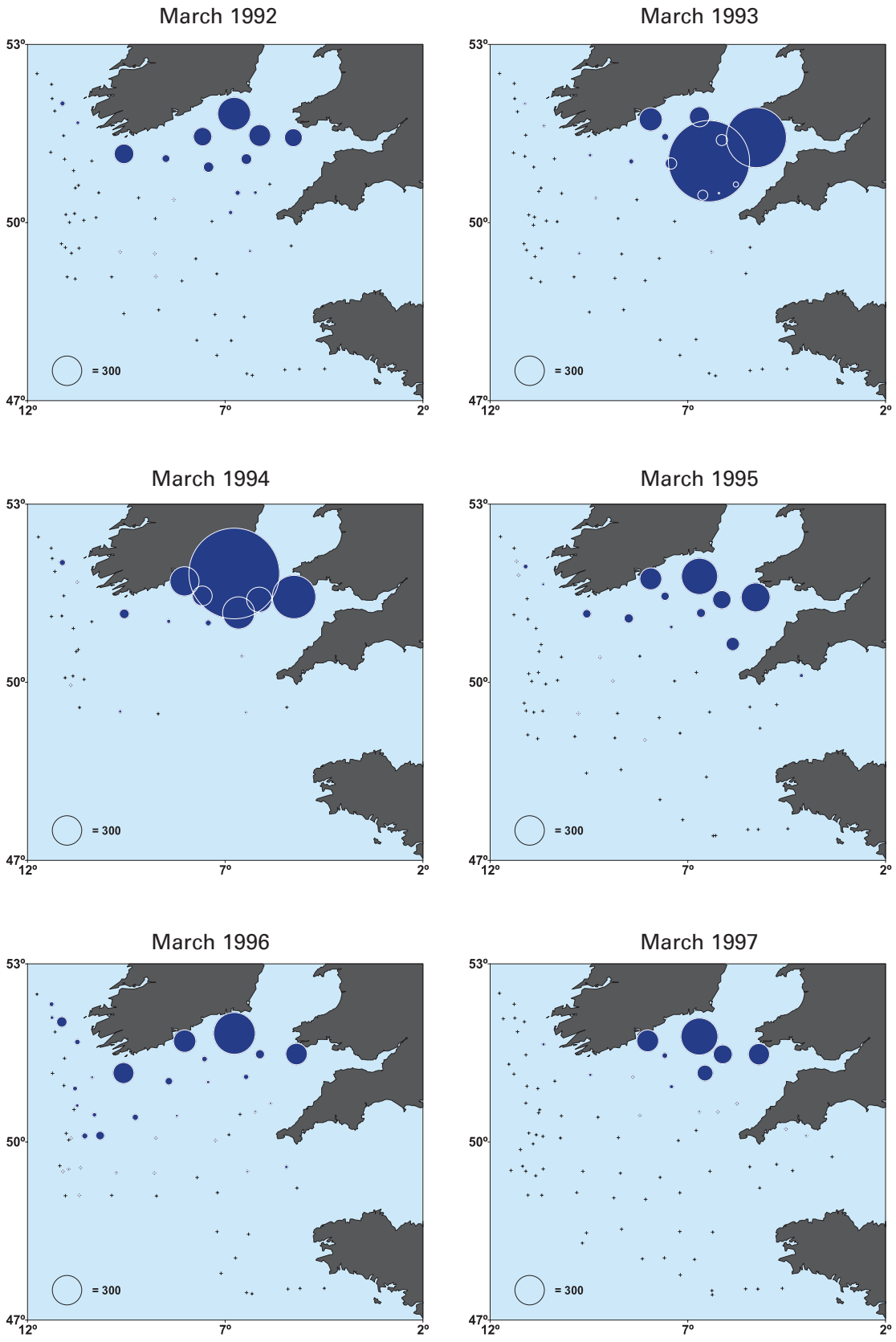

Figure 7.16. 1-group whiting, *Merlangius merlangus*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

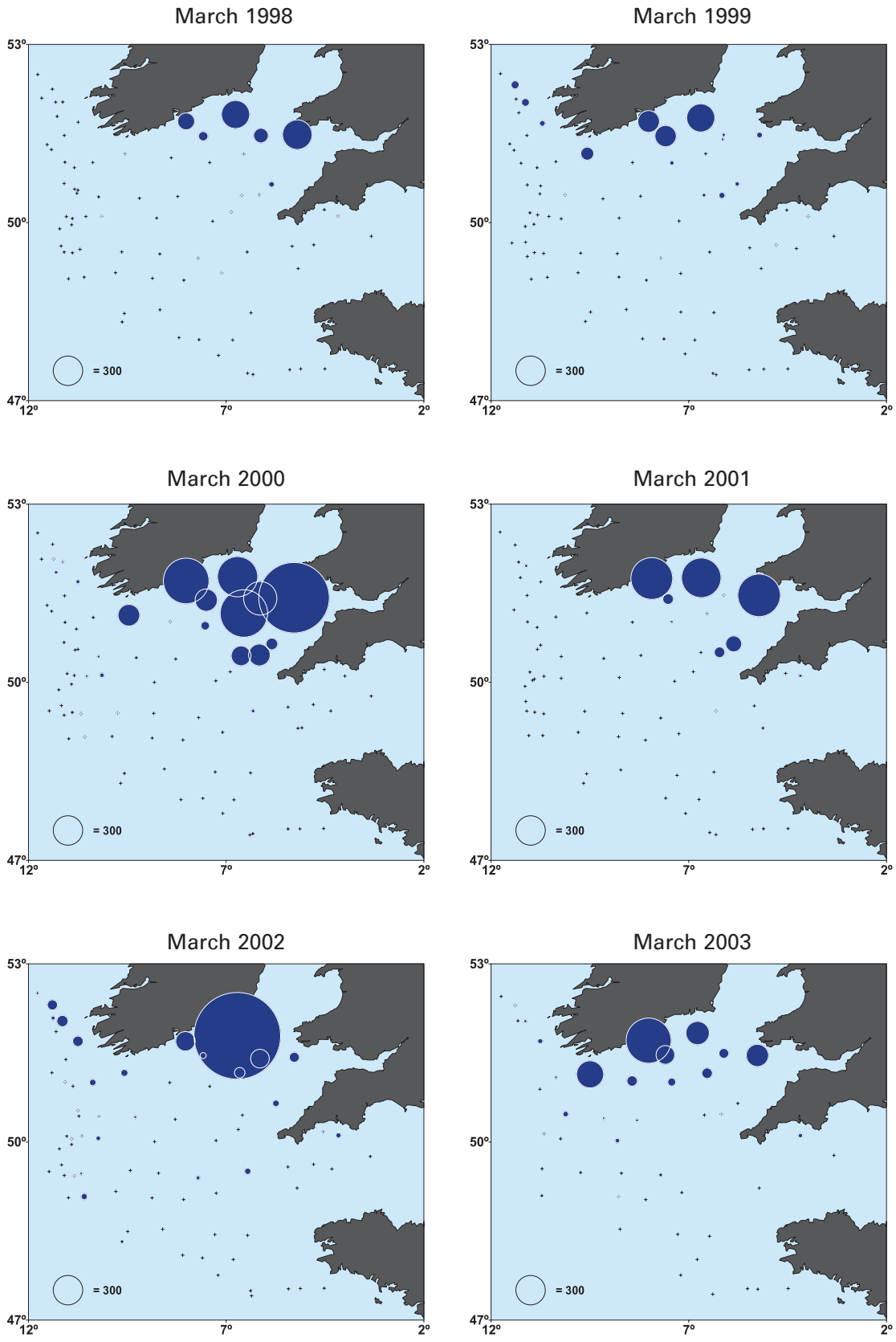

Figure 7.16. continued: 1-group whiting, *Merlangius merlangus*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

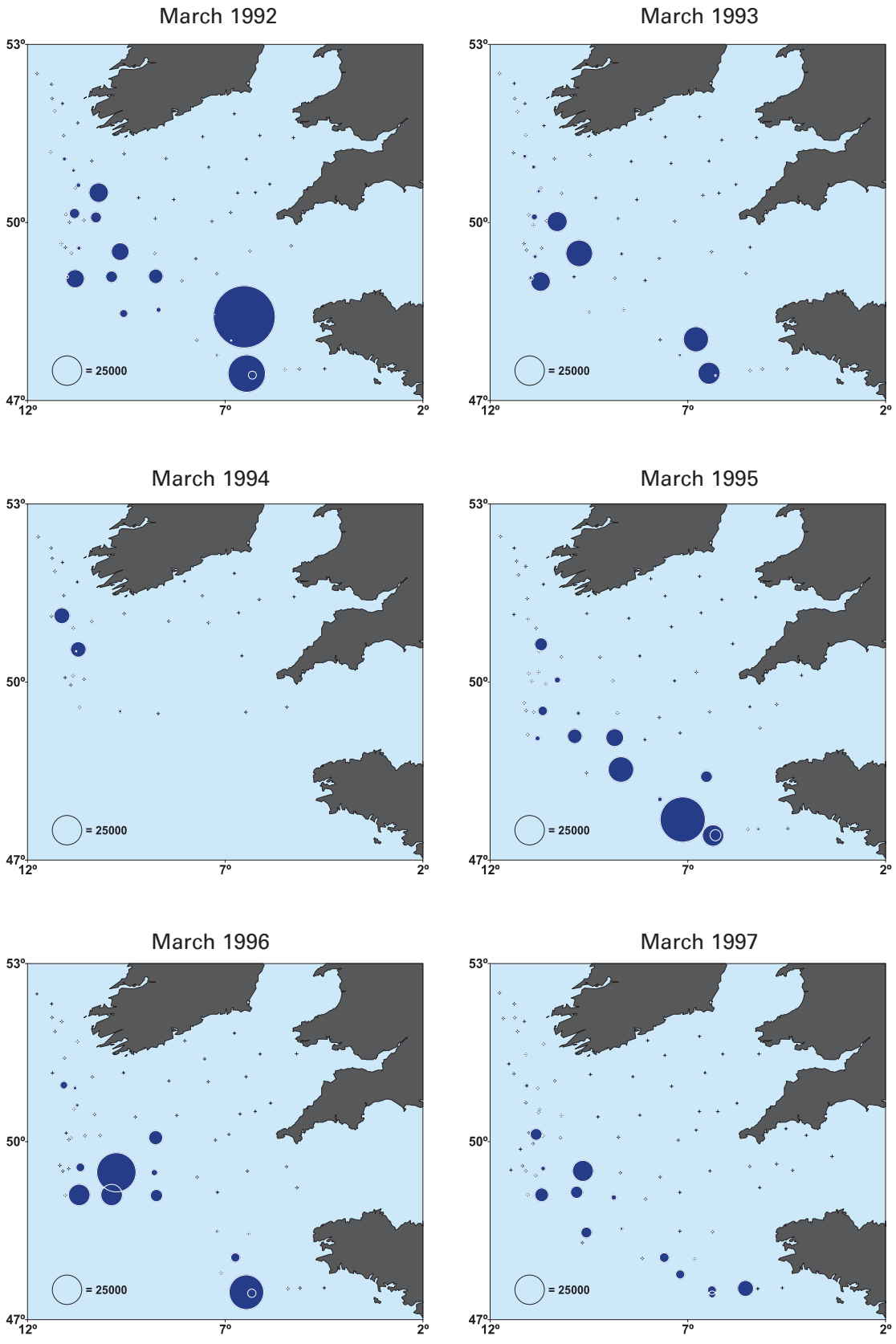

Figure 7.17. Boarfish, *Capros aper*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

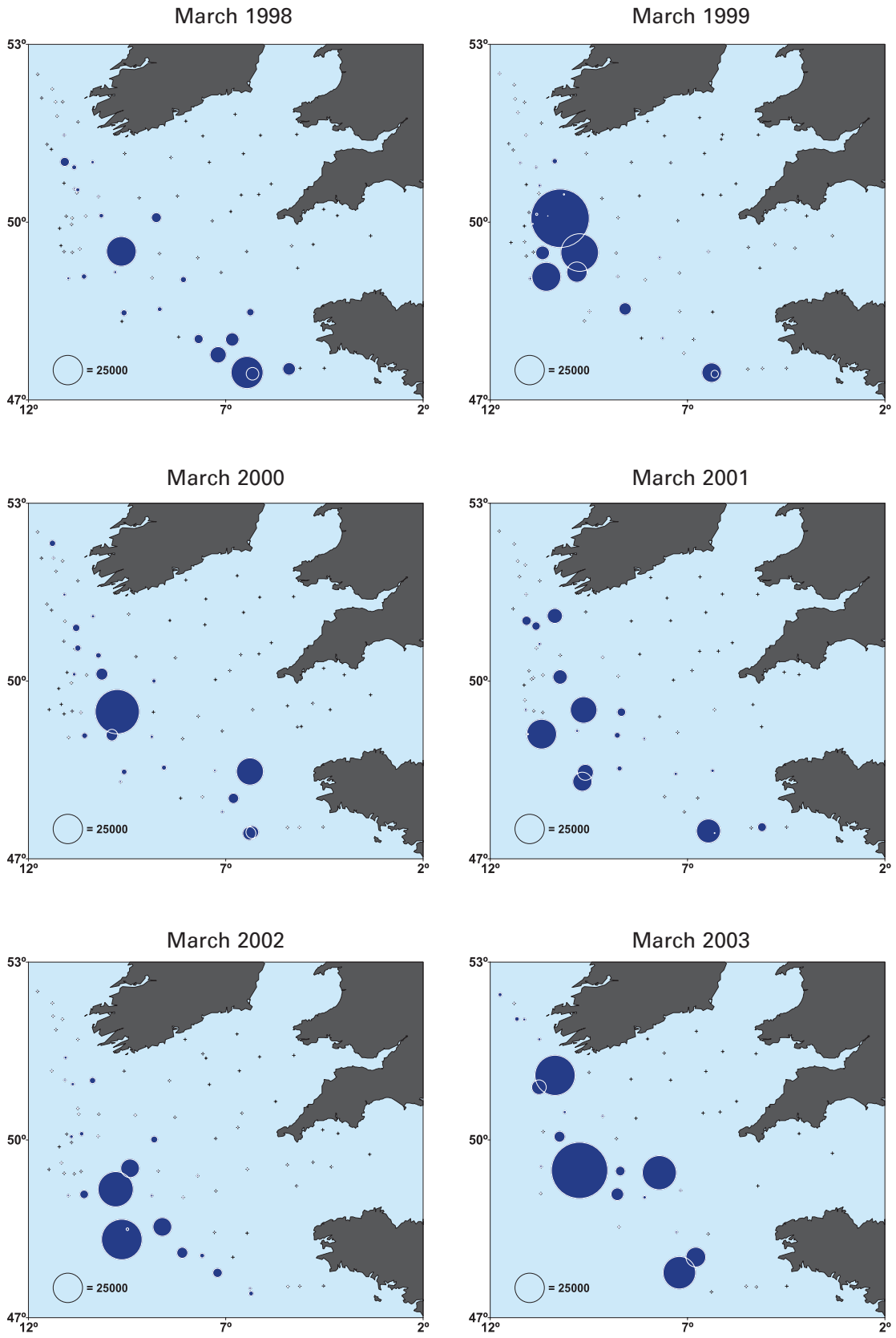

Figure 7.17. continued: Boarfish, *Capros aper*. Abundance (numbers per 60 min trawl) at each station for surveys undertaken between March 1992 and March 2003. Circles are proportional to the square root of the numbers caught. A key to the scale used for each species is given in the lower left corner of each chart.

8. Data collection and usage

This report covers selected data from the Celtic Sea trawl survey series from 1992 to 2003. The complete dataset of catch rates, size compositions, biological parameters and hydrographic data are maintained on the Fishing Surveys System database at Cefas Lowestoft.

Currently, for many stocks, the time-series of abundance indices for both numbers at age and recruitment are provided to the relevant Working Groups for evaluation and inclusion in the assessments where appropriate.

Any data used by the ICES Working Groups covering stocks from area VII are summarized in the reports of those Working Groups, available from ICES (www.ices.dk).

Examples of the other data types collected on the survey series and their uses can be found in the following publications :-

Blanchard, J.L., Dulvy, N.K. , Ellis, J.E. , Jennings, S., Pinnegar, J.K., Tidd, A., and Kell, L.T., 2005. Do climate and fishing influence size-based indicators of Celtic Sea fish community structure? ICES J. mar. Sci, 62: 405-411.

Blanchard , J.L., Dulvy, N.K., Ellis, J.E., Pinnegar, J.K., and Jennings, S., 2003. Ecological and environmental factors influence size-based metrics of Celtic Sea fish community structure. ICES CM2003/N:04. 28pp.

Ellis, J.R., Cruz-Martinez, A., Rackham, B.D., and Rogers, S.I., 2005. The distribution of chondrichthyan fishes around the British Isles and implications for conservation. J. Northw. Atl. Fish. Sci., 35(5).

Ellis, J.R., Lancaster, J.E., Cadman, P.S., and Rogers, S.I., 2002. The marine fauna of the Celtic Sea. pp.45-65. *In*: (Nunn, J.D.(Ed.)). Marine Biodiversity in Ireland and Adjacent Waters. Ulster Museum, Belfast.

Ellis, J.R., Dulvy, N.K., Jennings, S., Parker-Humphreys, M., and Rogers, S.I., 2005. Assessing the status of demersal elasmobranchs in UK waters: a review. J. Mar. Biol. Ass. UK, 85: 1025-1047.

Jennings, S., Pinnegar, J.K., Polunin, N.V.C., and Boon, T.W., 2001. Weak cross-species relationships between body size and trophic level belie powerful size-based trophic structuring in fish communities. J. Anim. Ecol., 70: 934-944.

Pinnegar, J.K., Jennings, S., O'Brien, C.M., and Polunin N.V.C., 2002. Long-term changes in the trophic level of the Celtic Sea fish community and fish market price distribution. Journal of Applied Ecology, 39: 377-390.

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