

Fisheries Sensitivity Maps in British Waters



**Fisheries
Research
Services**



CEFAS

*The Centre for Environment,
Fisheries & Aquaculture Science*



**UK OFFSHORE OPERATORS
ASSOCIATION LIMITED**



**National Federation
of Fishermen's
Organisations**



**SCOTTISH
FISHERMEN'S
FEDERATION**

Edition 1

Summer 1998

Fishery Sensitivity Maps in British Waters - Introduction

This booklet has been produced by the Fisheries Agencies with support from the United Kingdom Offshore Operator's Association (UKOOA), the Scottish Fishermen's Federation (SFF) and the National Federation of Fishermen's Organisations (NFFO). It has two primary purposes. Firstly, it seeks to provide information to enable all interested parties better to understand the potential for interaction between the fishing and offshore oil and gas industries. Secondly, it seeks to encourage meaningful dialogue in order that competing concerns can be addressed and, wherever possible, dealt with as early as possible in the planning process. It will also aid the newly introduced environmental impact assessment process, and will inform seismic, exploration, field development and decommissioning activities and the preparation of oil spill response strategies.

The fisheries agencies collect information about the marine environment and the living resources it supports in order to advise on regulation and conservation policy. The staff involved in work connected with the fishing and offshore oil and gas industries are located at centres in Scotland and England. The Aberdeen Marine Laboratory, formerly part of the Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD) is now a division of Fisheries Research Services (FRS), an Executive Agency of The Scottish Office. The Lowestoft and Burnham-on-Crouch Laboratories are now part of the Centre for Environment, Fisheries and Aquaculture Science (CEFAS), an Executive Agency of the Ministry of Agriculture Fisheries and Food (MAFF).

The enclosed maps have been compiled from data collected and collated by FRS and CEFAS. This work forms part of comprehensive study programmes financed, respectively, by The Scottish Office and by MAFF. The data are mapped as reported and describe the sensitivities of the main commercial species. The booklet contains maps under five headings;

[Individual species spawning areas](#)

[Individual species nursery areas](#)

[Monthly seismic restriction areas](#)

[Fishing effort maps](#)

[Relative value maps](#)

The [species spawning](#) and [nursery area maps](#) are constantly revised in the light of the latest information. For some species we have decided not to produce maps. For example, the information on monkfish life history is not yet very comprehensive and other species, such as brown crab, are very locally distributed and exploited. The fishing activity maps are based on the averaged data for the years 1991-1996. The relative value maps describe 1996 values.

Some readers may have local knowledge of species spawning activity, that might improve subsequent editions. This information can be passed on to either R Johnstone of FRS, or Dr S I Rogers of CEFAS, at the addresses indicated below. Requests for further information may be similarly forwarded.

In order to identify sensitivities by quadrant, the map of [oil and gas activity](#) on page 1 should be photocopied on to a transparent sheet. It can then be overlaid on the individual maps. Because commercial landings data are collected on a coarser scale than applies to oil and gas licence blocks (see later), the maps are only indicative of potential sensitivities. They should not be read too literally and an overly detailed interpretation is not advised.

The following additional sources of information may also be of interest.

UKDMAP. Project Manager, Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, Merseyside, L43 7RA.

Knijn, R. J., Boon, T. W., Heessen, H. J. L. & Hislop, J. R. G. 1993 Atlas of North Sea fishes. ICES Cooperative Research Report 194, 268 pp.

Lee, A. J. & Ramster, J. W. 1981 Atlas of the seas around the British Isles. Lowestoft: Ministry of Agriculture, Fisheries and Food, Directorate of Fisheries Research.

The North Sea and Atlantic Marine Oil and Gas Activity and Concession Map. Oilfield Publications Ltd, Po Box 11, Ledbury, Herts, HR8 1BN.

The Energy Report, Published annually with the permission of the Department of Trade and Industry on behalf of the Controller of Her Majesty's Stationery Office, PO Box 276, London SW8 5DT.

Jennings, S, Alsvag, J., Cotter, A.J., Ehrich, S., Greenstreet, S. P. R., Jarre-Teichmann, A., Mergardt, N., Rijnsdorp, A. D. And Smedstad, O. (1998). International fishing effort in the North Sea: an analysis of temporal and spatial trends. Fisheries Research, in press

For citation purposes this booklet can be referenced as:

Coull, K.A., Johnstone, R., and S.I. Rogers. 1998. Fisheries Sensitivity Maps in British Waters. Published and distributed by UKOOA Ltd.

Further copies are obtainable, free of charge, from the addresses below, or from UKOOA, 9 Albyn Terrace, Aberdeen.

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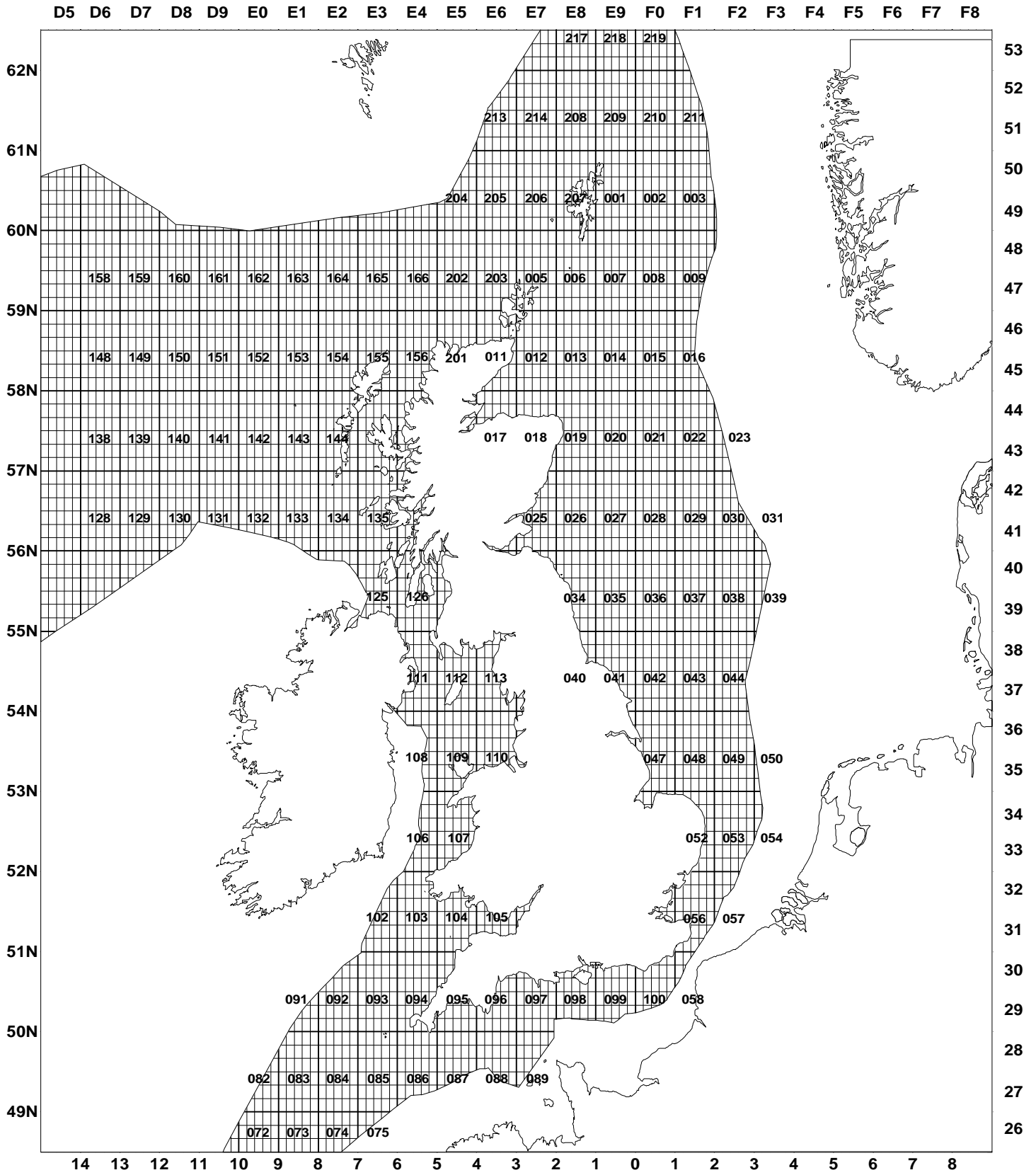
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Oil and Gas Activity

UK Quadrant / Blocks



Individual species spawning maps.

There is an integrated, multinational research effort supporting the management of fish stocks in the North East Atlantic area. Research vessels from the various countries continually collect details of the distribution of eggs, larvae and young and commercially sized fish. Samples of the sea floor sediments are also routinely collected and wider areas are also surveyed using modern acoustic visualisation techniques. From these data, the spawning and nursery areas of the commercially important species of fish and shellfish have been described. They are illustrated in the following pages.

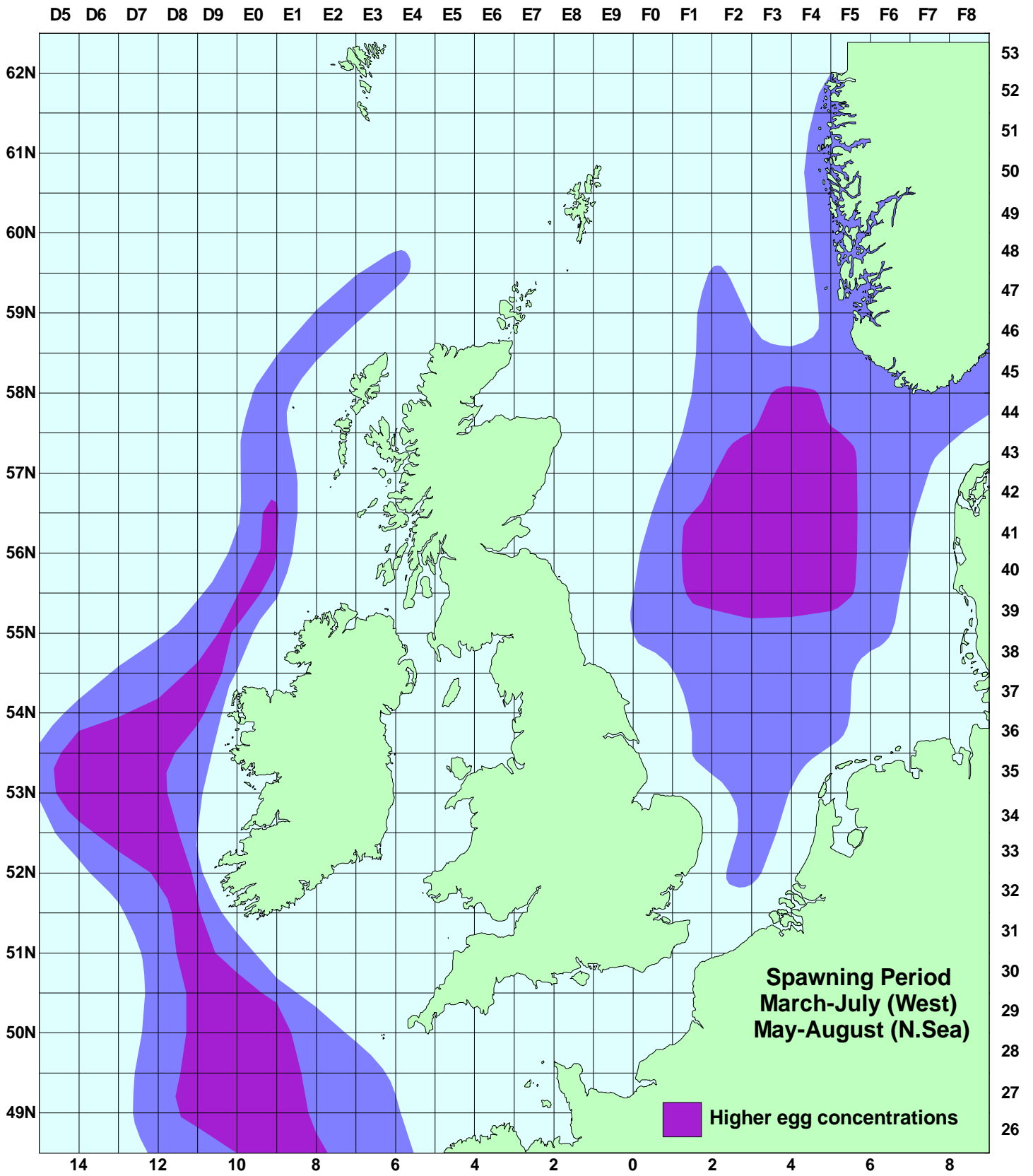
Spawning areas for most species are not rigidly fixed. In addition, fish may spawn earlier or later in the season in response to environmental change ([spawning periods](#) are summarised in a table on page 17). For sediment spawners, not all suitable sediment areas might be used in every year - use will depend on the size of the spawning stock. For these reasons, spawning distributions are under continual revision. It follows that these maps should be seen as representing the widest known distribution given current knowledge and should not be seen as rigid, unchanging descriptions of presence or absence. The table of spawning times likewise shows the generally accepted maximum duration of spawning. Normally, fish spawn earlier to the south of the British Isles than in the north, mainly due to the warmer water conditions in southern waters. This regional pattern must be remembered when interpreting the maps. Together, these facts underline the desirability of consultation with the regulatory authorities and other users of the environment prior to commencing any activity. In any given year the sensitivity of the presence of spawners in a particular area may change sufficiently to allow licence conditions to be redefined.

In relation to oil and gas exploration offshore, spawning distribution information is used to determine seismic exclusion areas ([see page 33](#)). For fish that lay their eggs on the sediment (eg [herring](#) & [sandeels](#)) or which live in intimate contact with sediments (eg [sandeels](#) and most [shellfish](#)), they are also used to advise areas where discharge controls might be needed to minimise impact.

The maps have been sized for convenience to fit sensibly on an A4 page. This has meant that the most northerly UKCS blocks (220, 221) have been excluded. Fishing effort in these areas is very low. The reporting unit of the fisheries database (see later), and the grid on the maps, is the ICES (International Council for the Exploration of the Sea) rectangle, $\frac{1}{2}^{\circ}$ latitude by 1° longitude. At UK latitudes they measure approximately 30 x 30 nautical miles. One ICES rectangle covers one half of one Quadrant, i.e. 15 licence blocks.

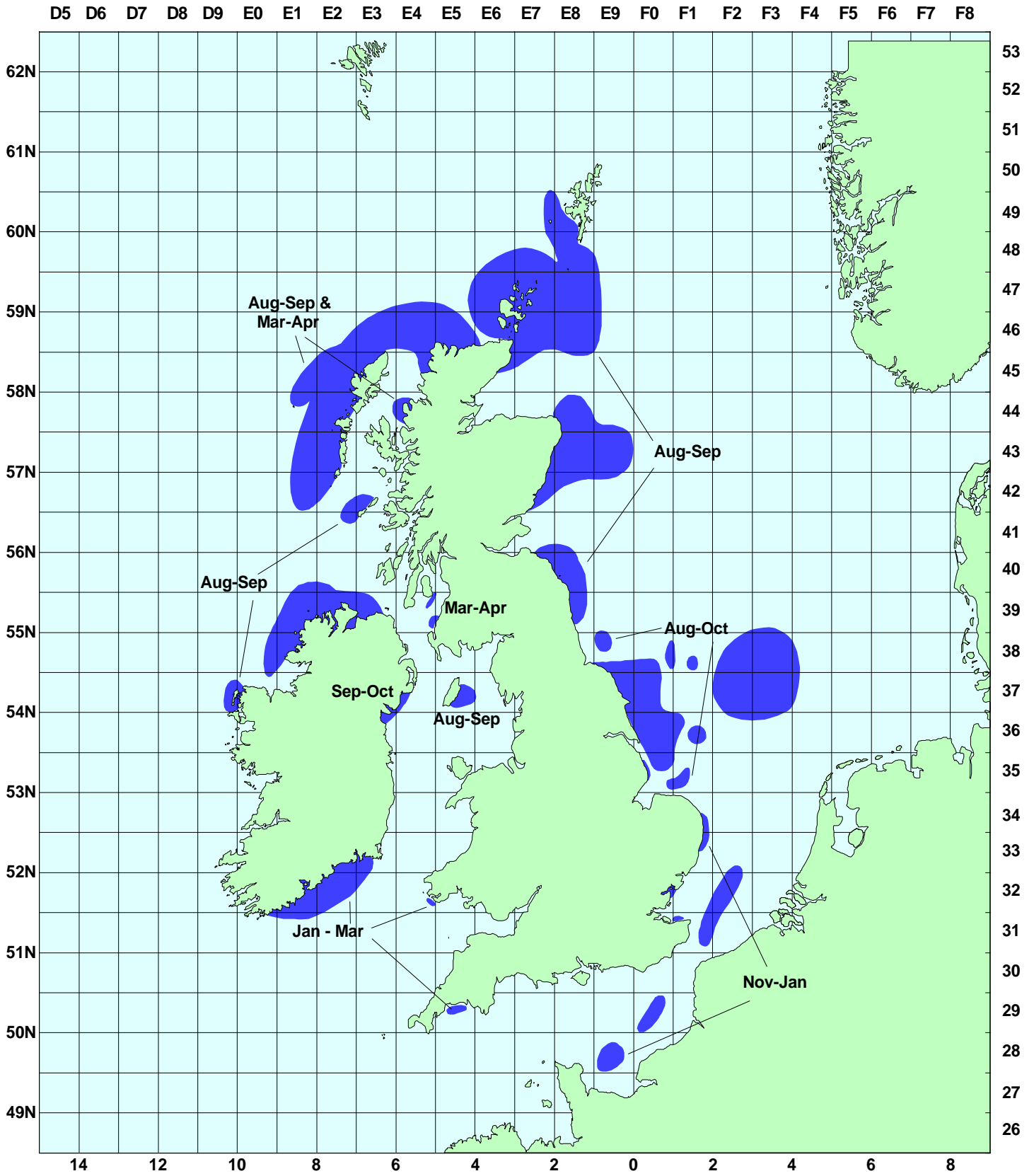
Spawning Areas

Mackerel



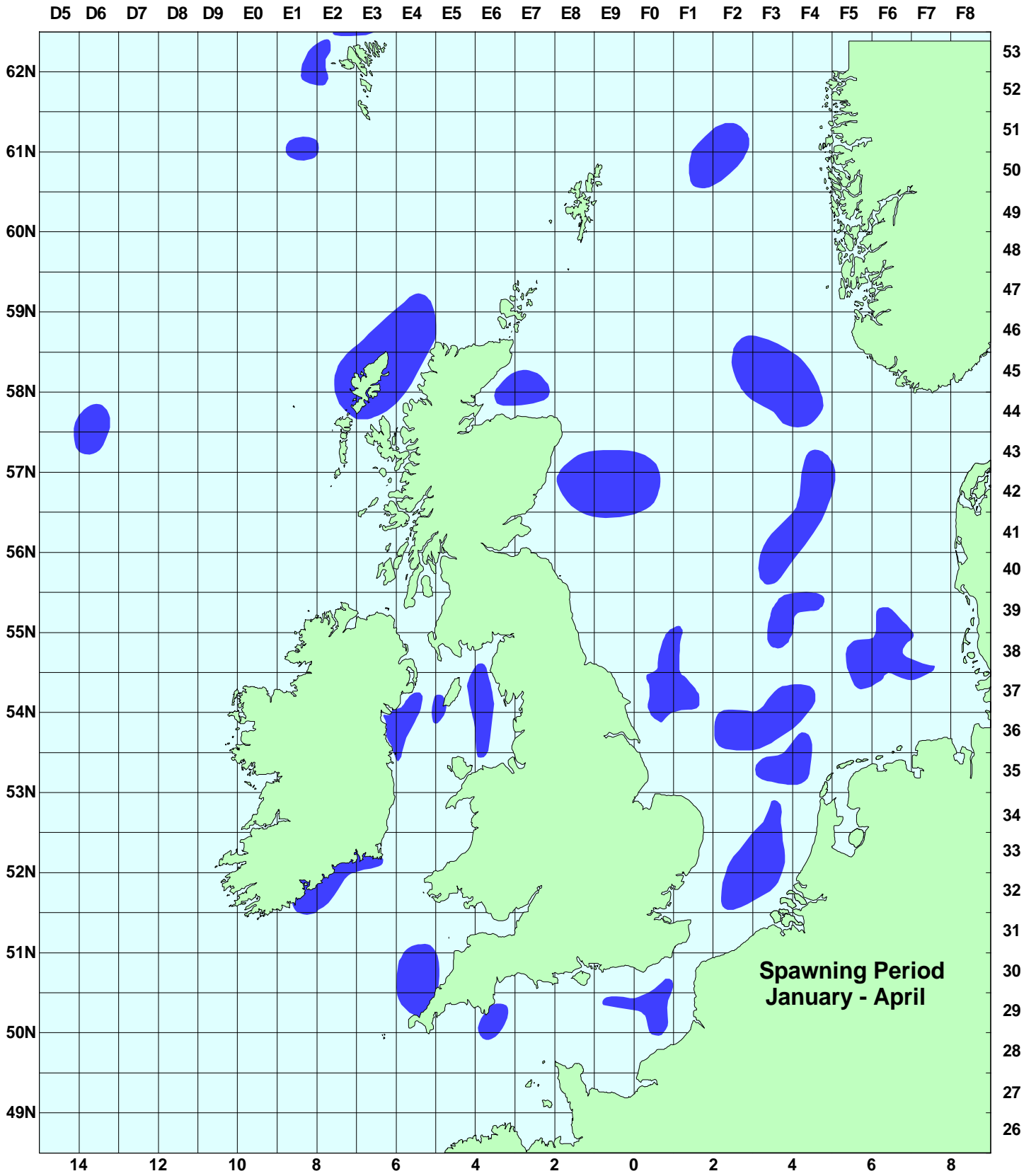
Spawning Areas

Herring



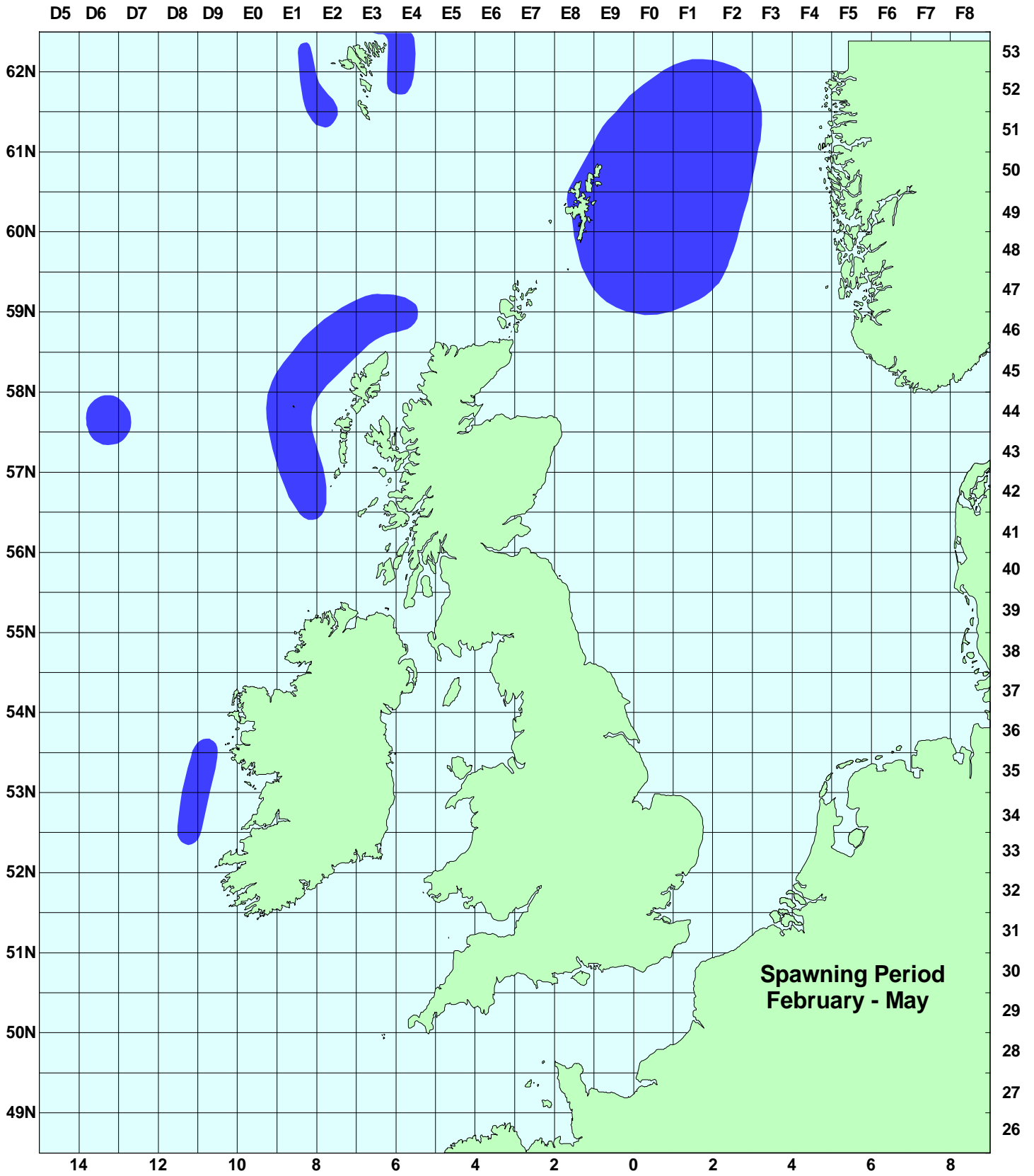
Spawning Areas

Cod



Spawning Areas

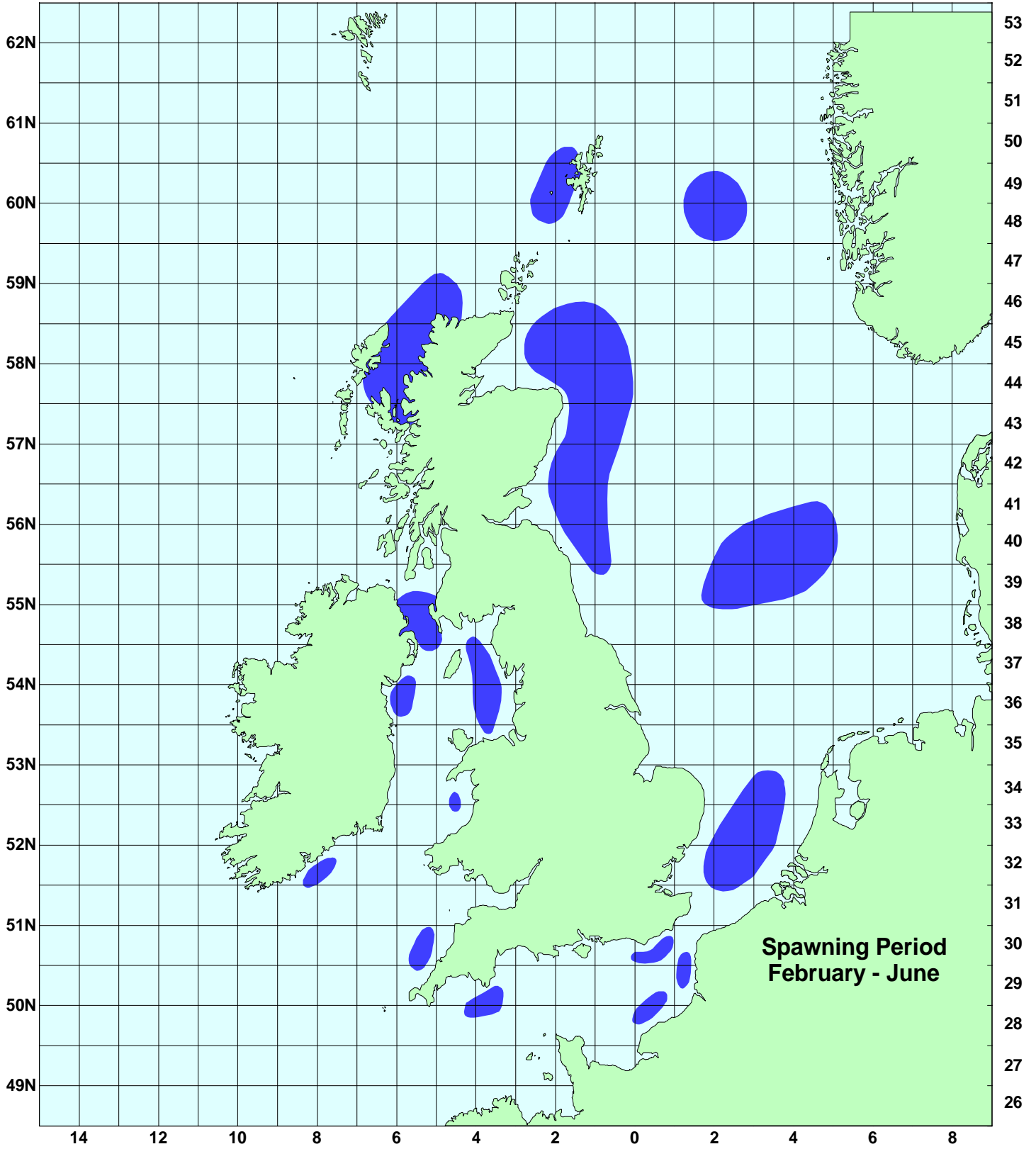
Haddock



Spawning Areas

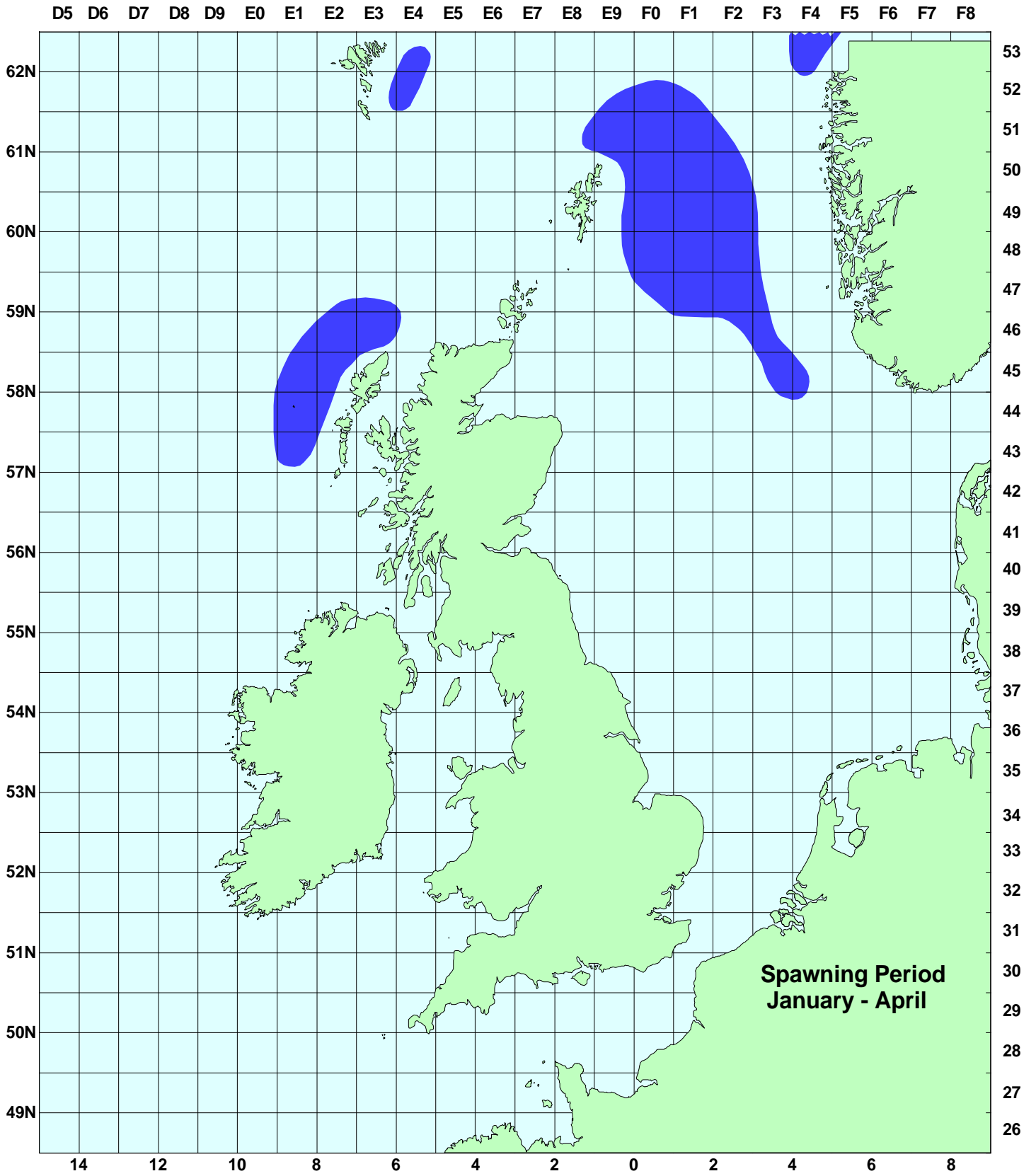
Whiting

D5 D6 D7 D8 D9 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 F0 F1 F2 F3 F4 F5 F6 F7 F8



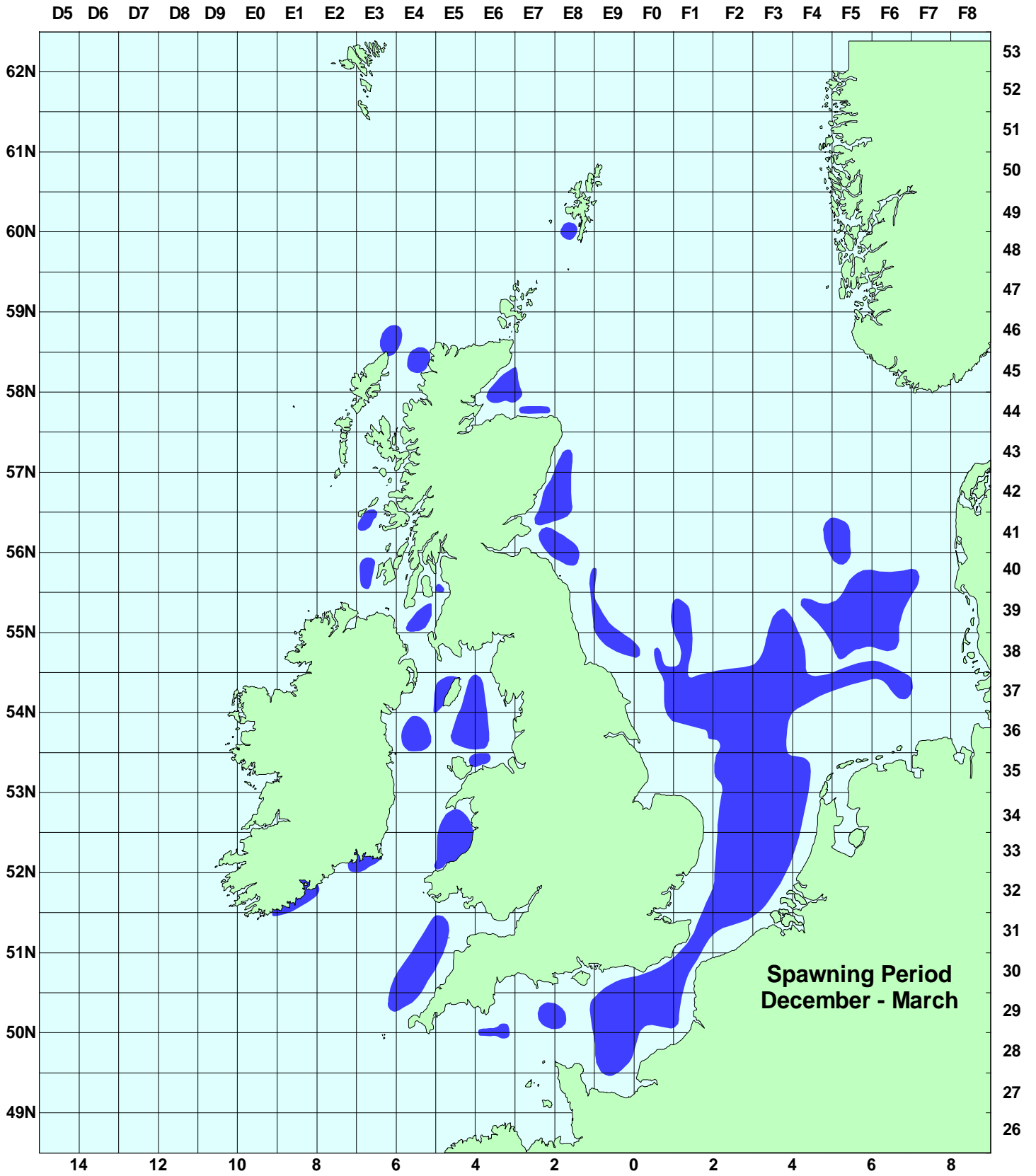
Spawning Areas

Saithe



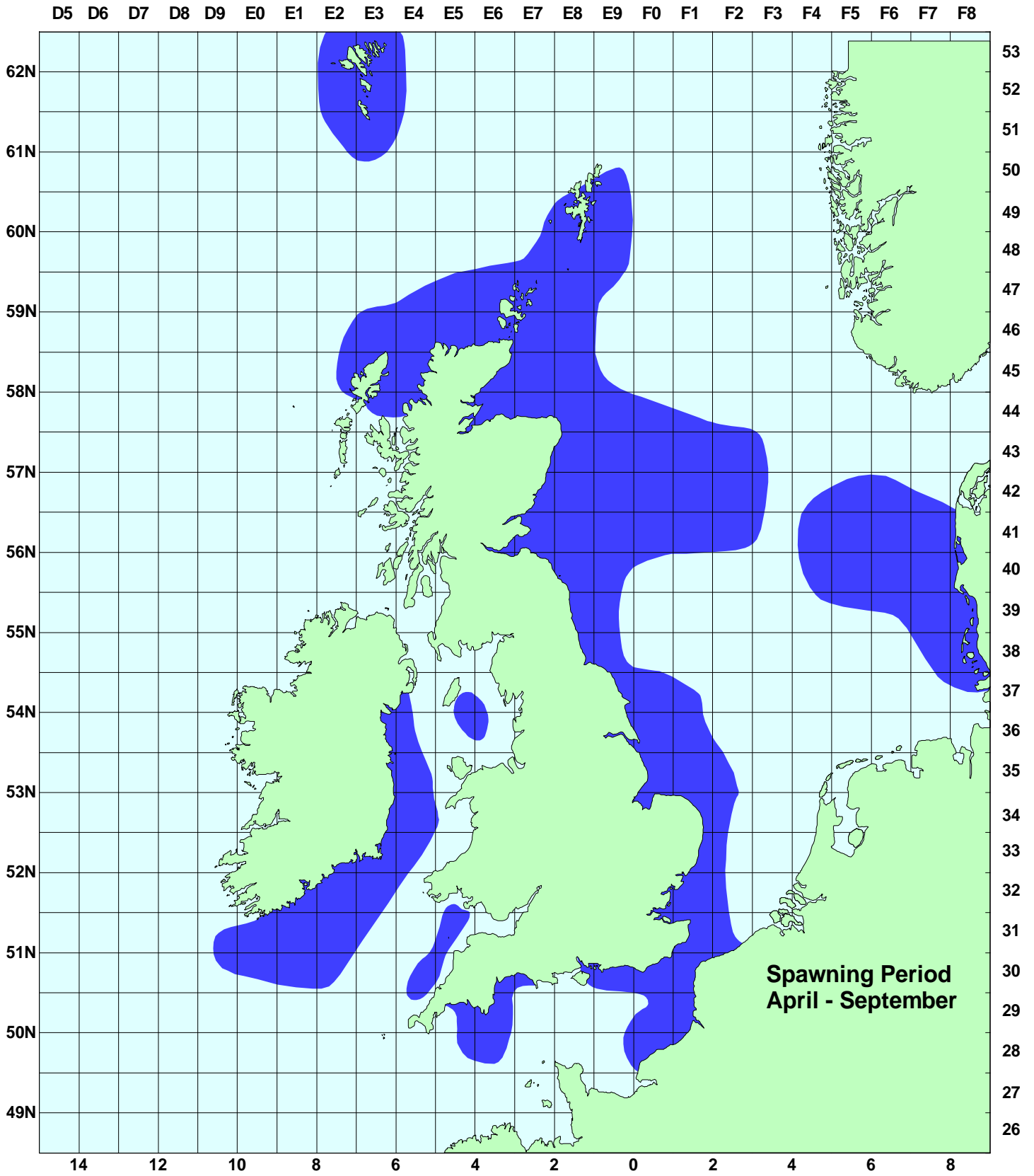
Spawning Areas

Plaice



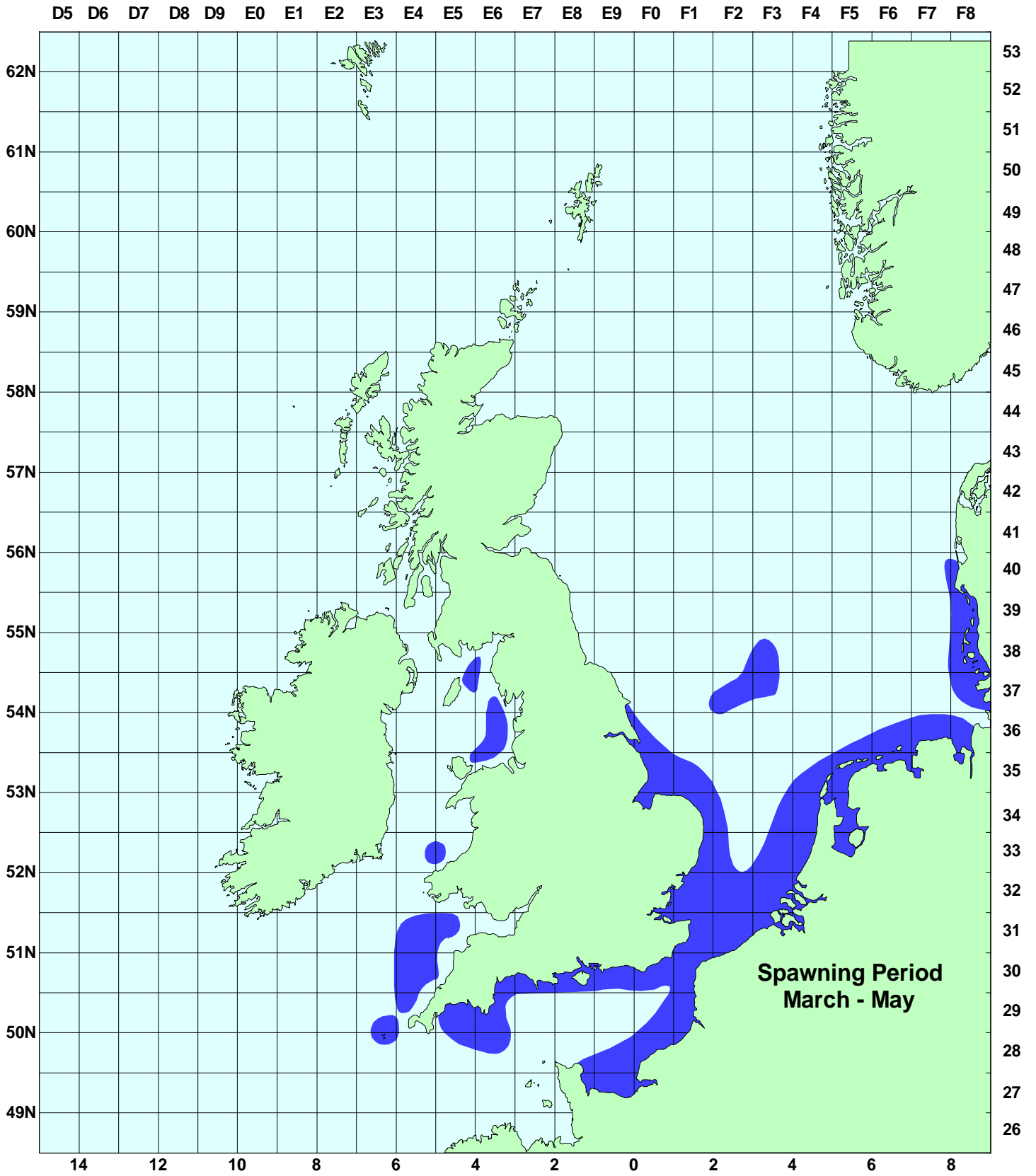
Spawning Areas

Lemon sole



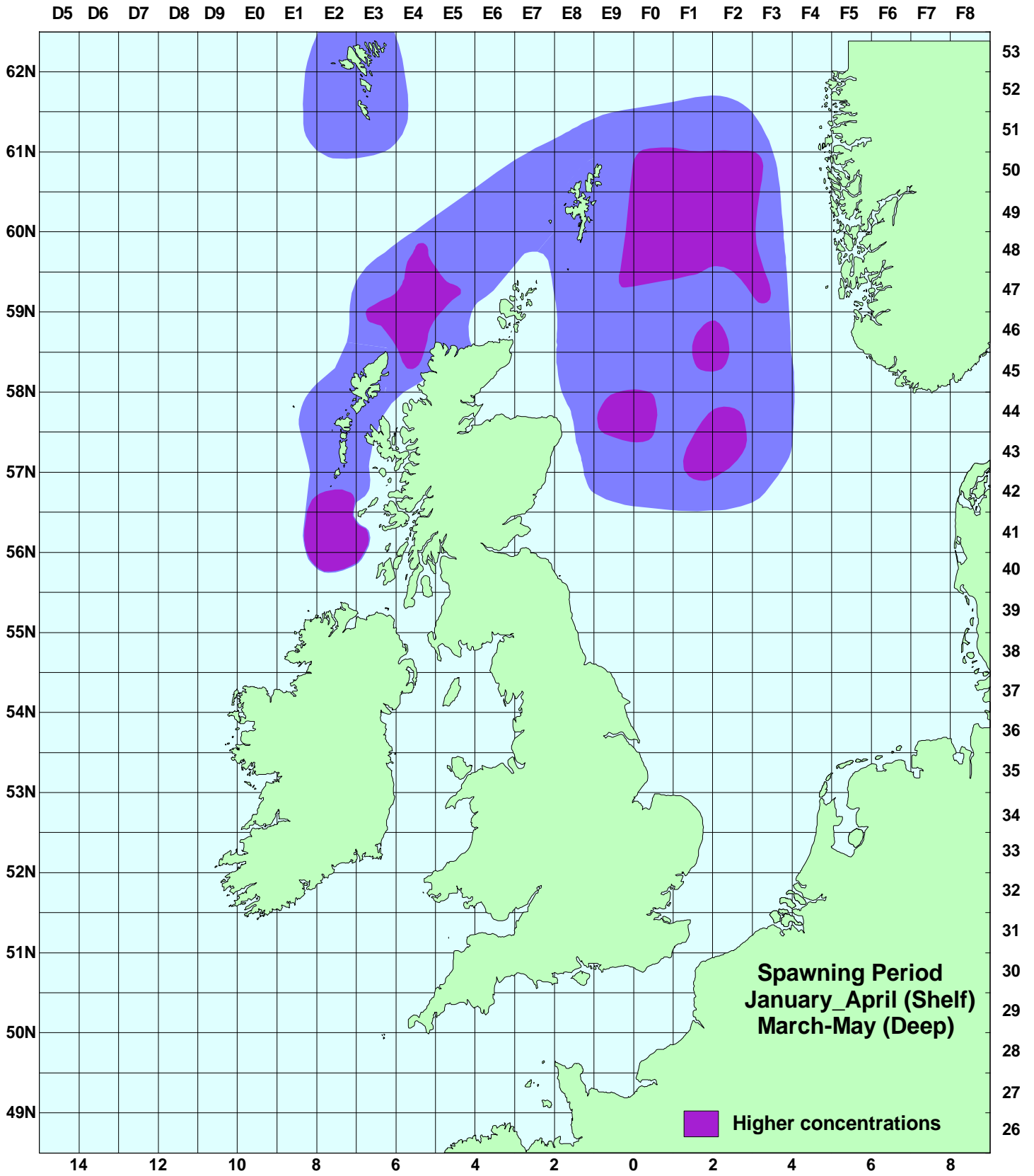
Spawning Areas

Sole (*Solea solea*)



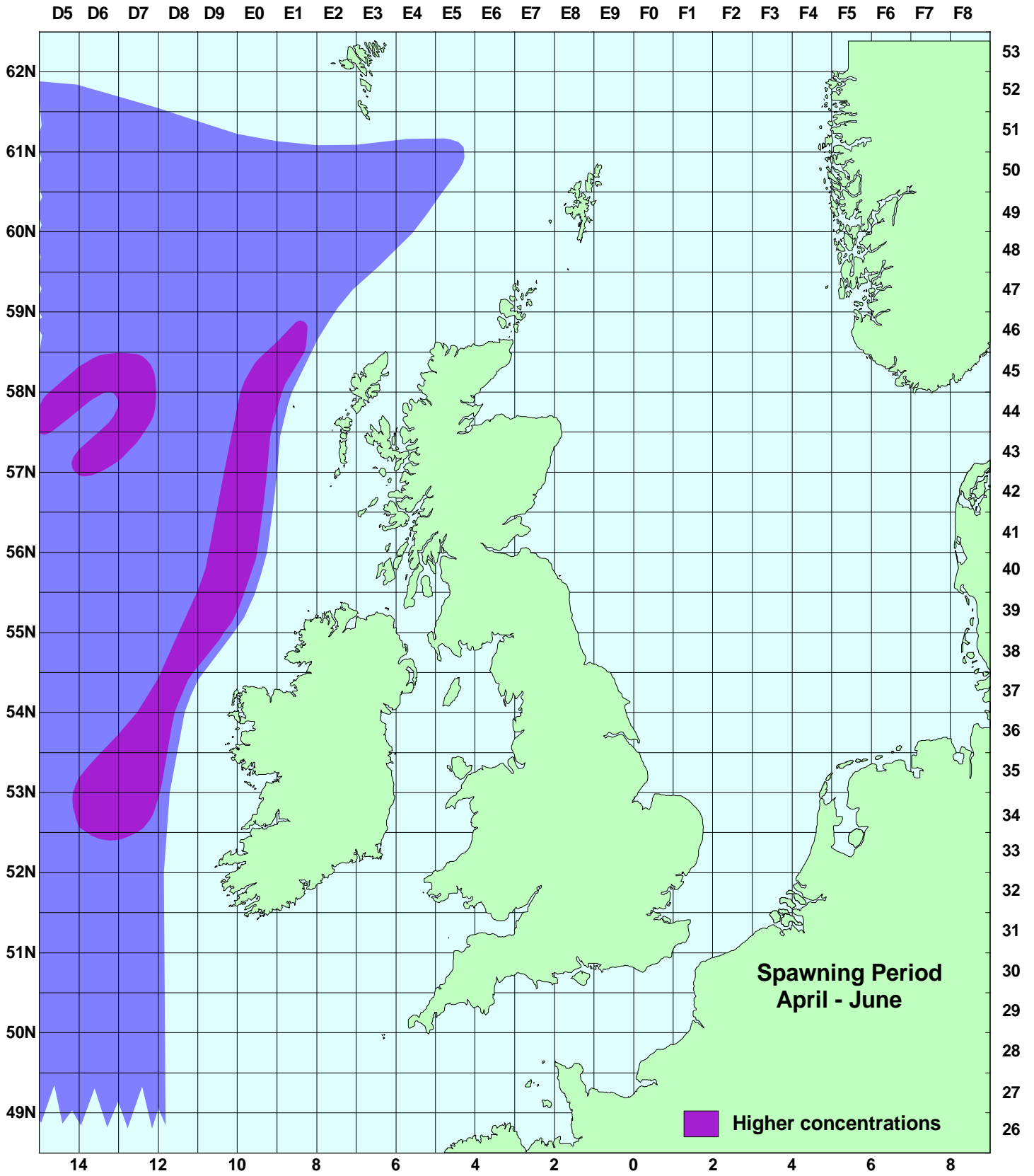
Spawning Areas

Norway pout



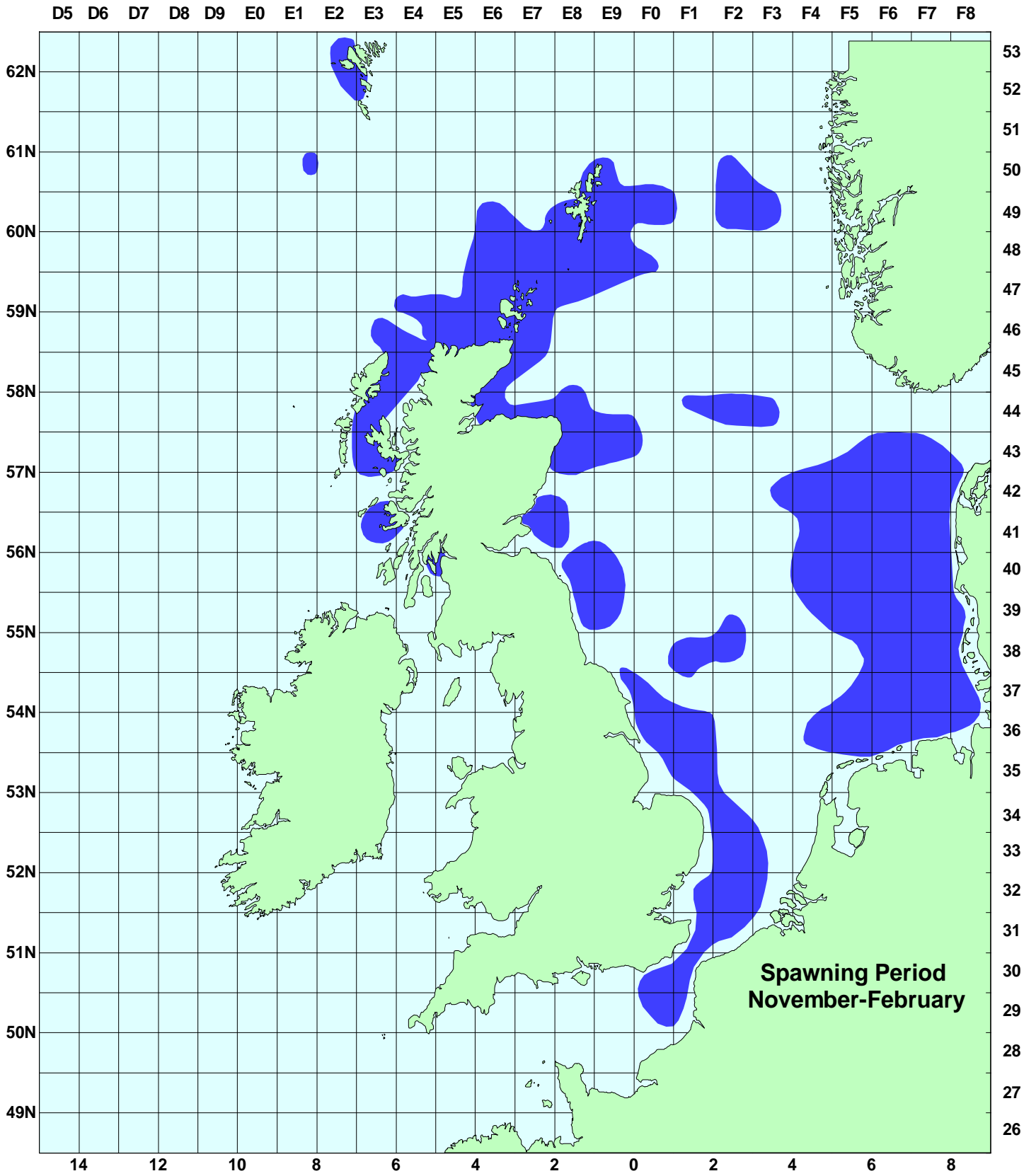
Spawning Areas

Blue whiting



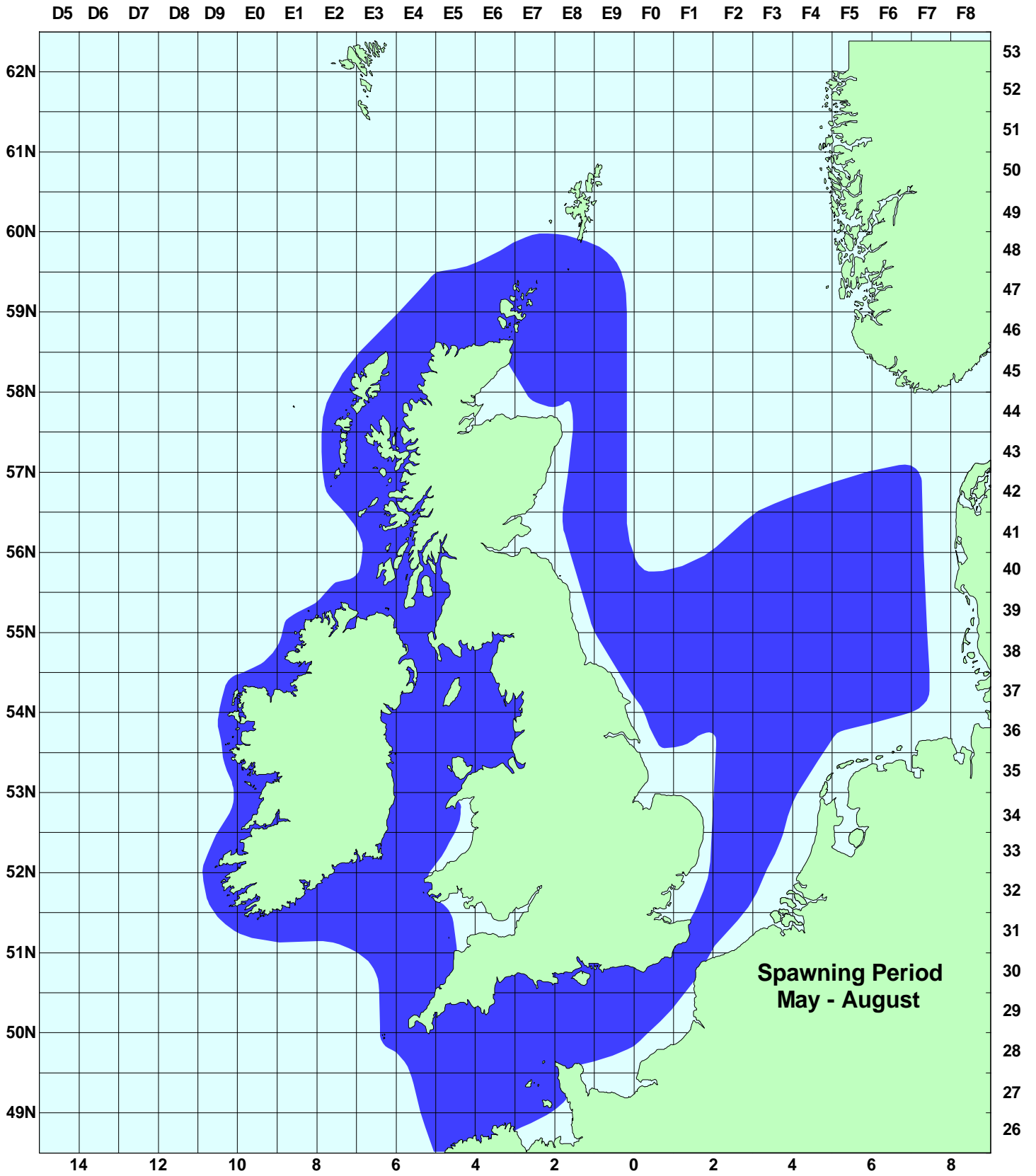
Spawning Areas

Sandeels (*A. marinus*)



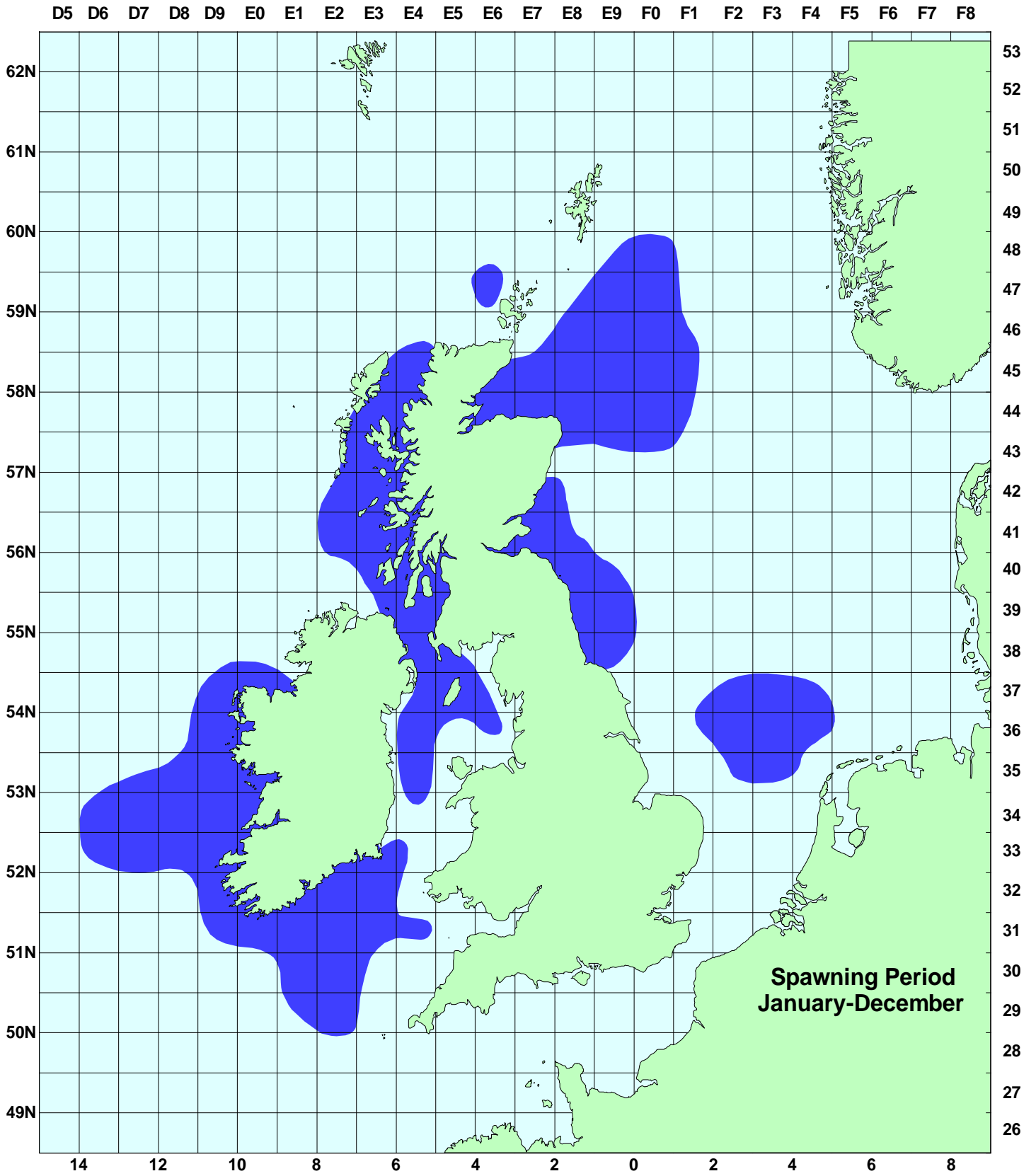
Spawning Areas

Sprat



Spawning Areas

Nephrops



Spawning Periods For Main Commercial Species

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cod		*	*									
Haddock		*	*	*								
Whiting												
Saithe	*	*										
Plaice	*	*										
Norway pout (shelf)		*	*									
Norway pout (deep)												
Blue whiting				*	*							
Sprat					*	*						
Lemon sole												
Sole				*								
Mackerel (N Sea)					*	*	*					
Mackerel (Western)					*	*						
Herring												
(Buchan/Shetland)												
(Banks/Dogger)												
(SE England)												
(SW Ireland)												
(NW Scotland)												
(Clyde)												
(Mourne)												
(NW Ireland/)												
Sandeel												
Nephrops				*	*	*						

Spawning Period	
Peak Spawning	*

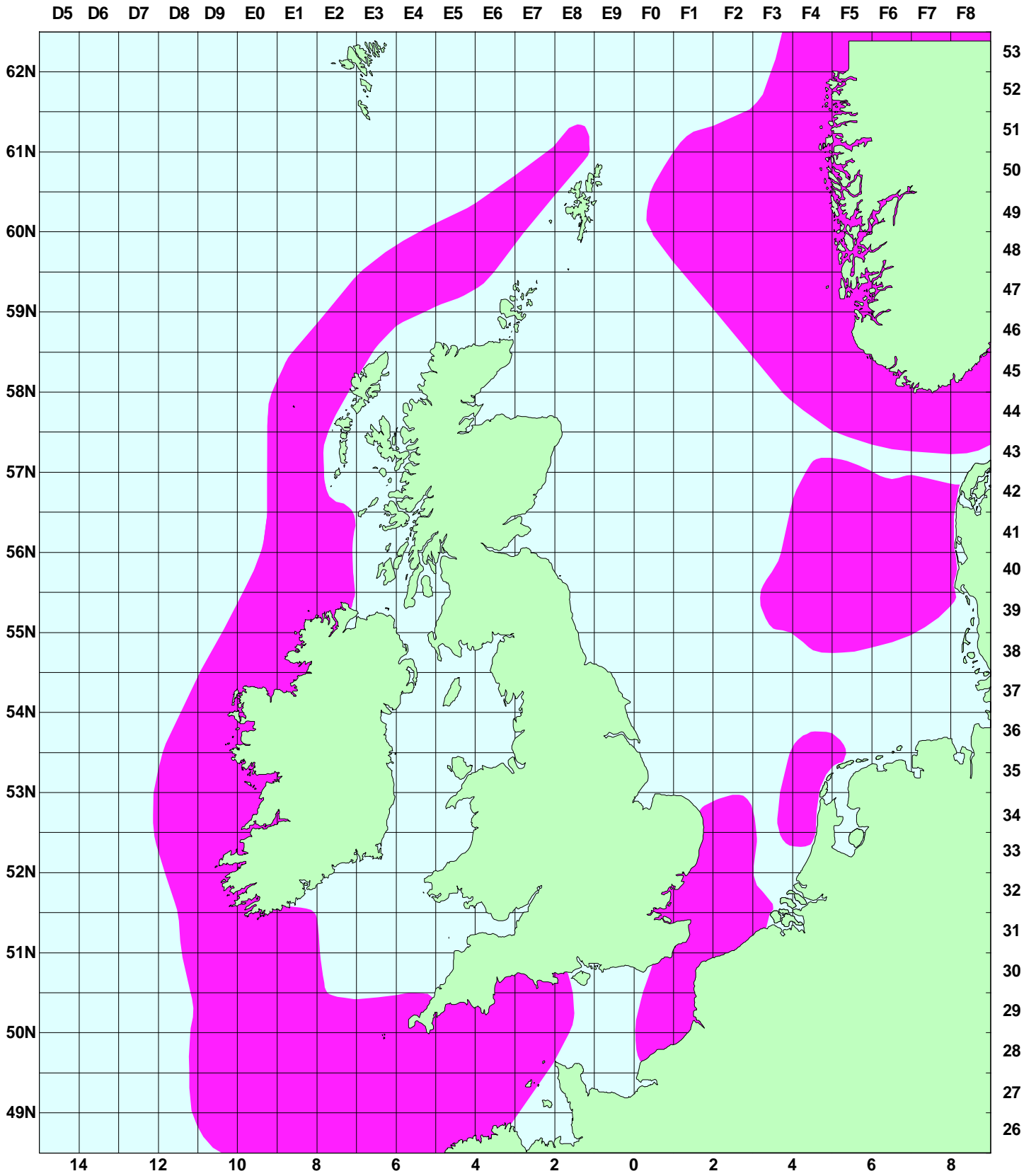
Individual species nursery maps.

Fish hatch quickly from their eggs and many species remain in the water column as larvae, consuming microscopic organisms and gradually developing the body shape and behaviour patterns of adults. At this stage of the life cycle, many species occupy discrete areas, either in the water column or on the seabed, where opportunities for feeding, and for protection from predators are greatest. These are nursery areas. For example, juvenile flatfish will tend to converge on shallow coastal waters and feed on the abundant worms and crustaceans in these productive areas. Other fish, such as [juvenile cod](#), can occupy coastal reef environments as well as deeper offshore regions. Juvenile fish can often be found in nursery areas together with slightly older individuals, and occasionally adults, and the prevailing water temperature and availability of food can also alter the position of these nursery grounds from year to year. As a result of these factors it is difficult precisely to define the limits of nurseries.

The following charts are intended as an indication of the likely positions of juvenile concentrations around the UK coast, rather than a definitive description of the limits of all nursery grounds.

Nursery Areas

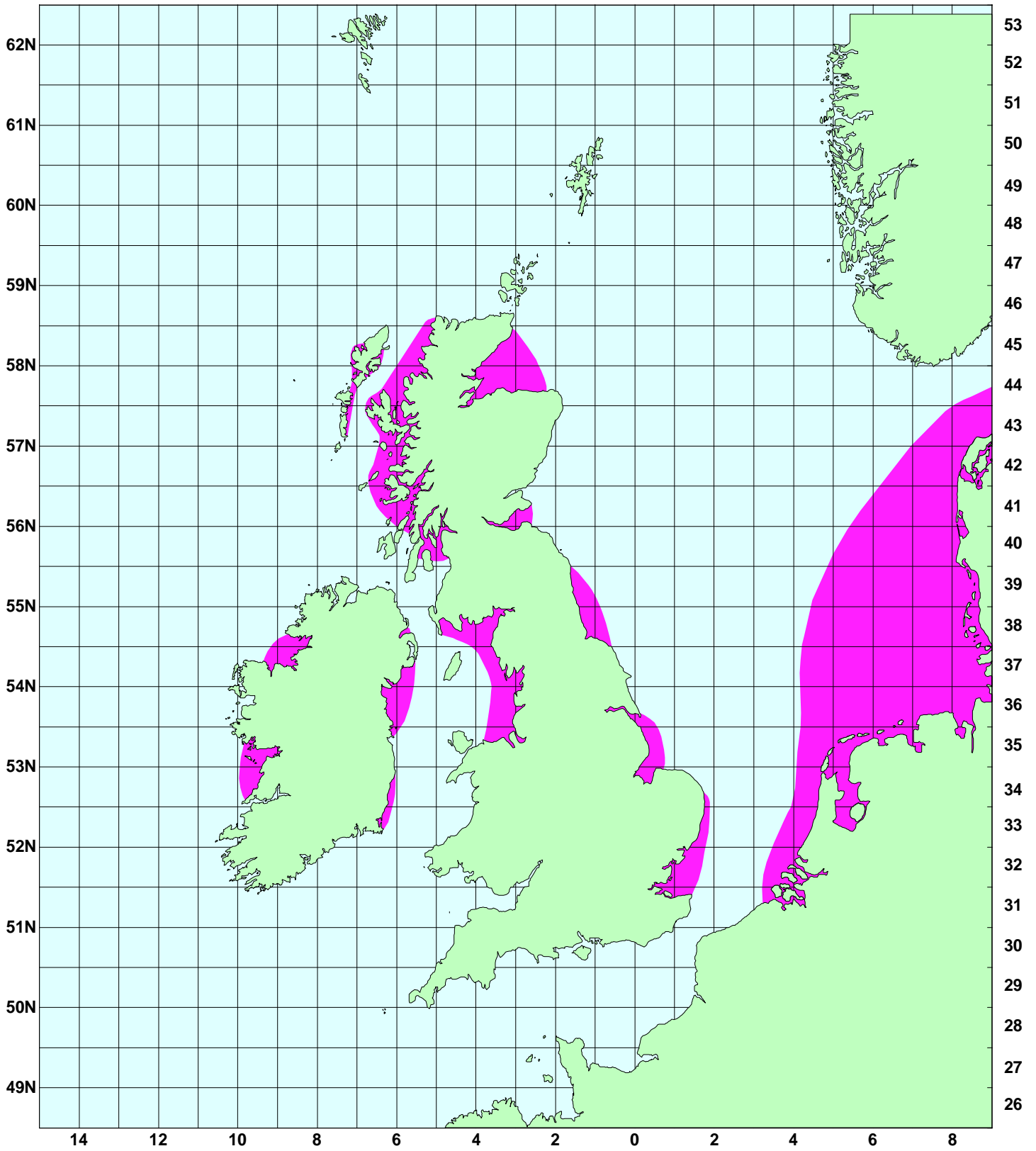
Mackerel



Nursery Areas

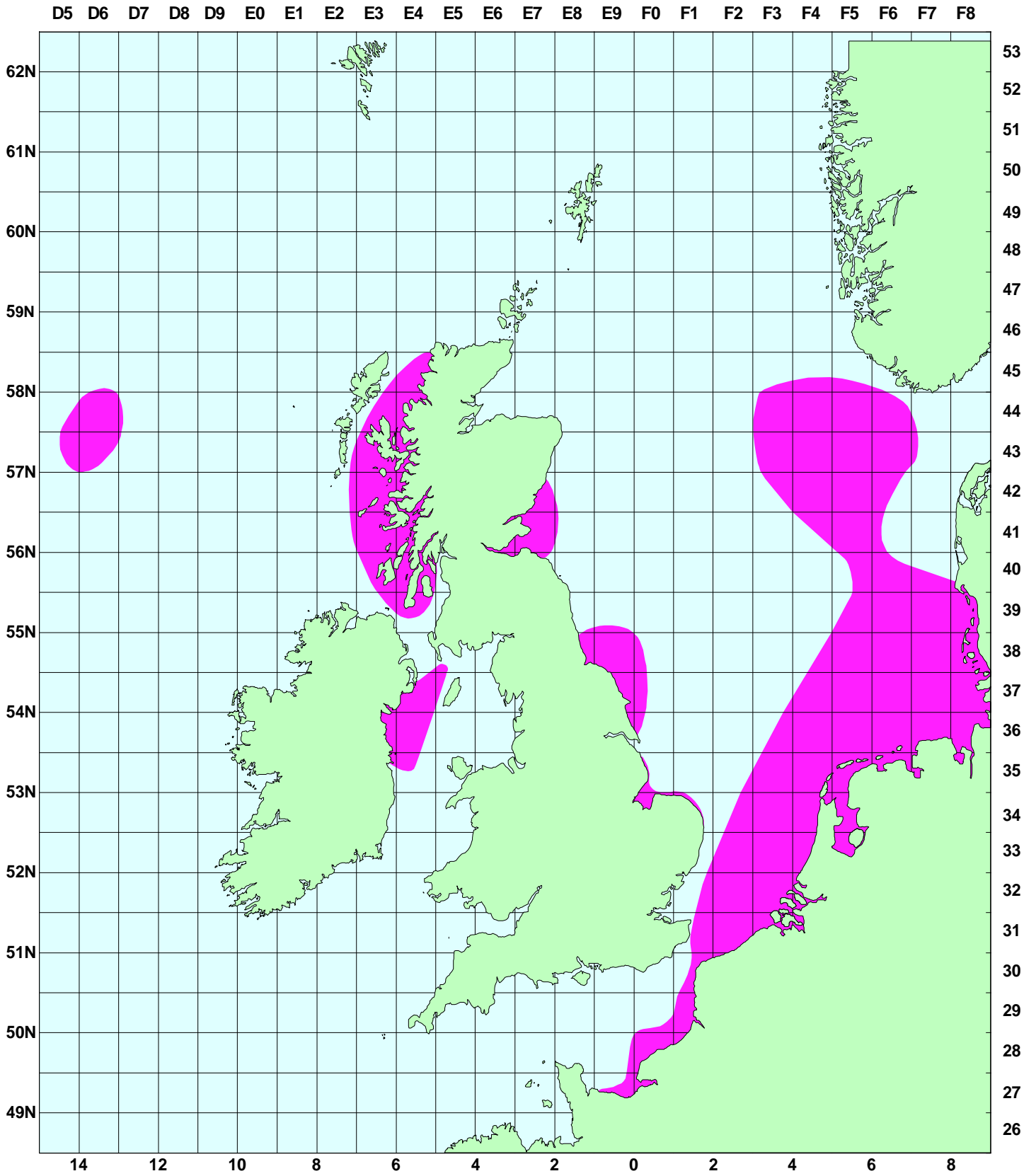
Herring

D5 D6 D7 D8 D9 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 F0 F1 F2 F3 F4 F5 F6 F7 F8



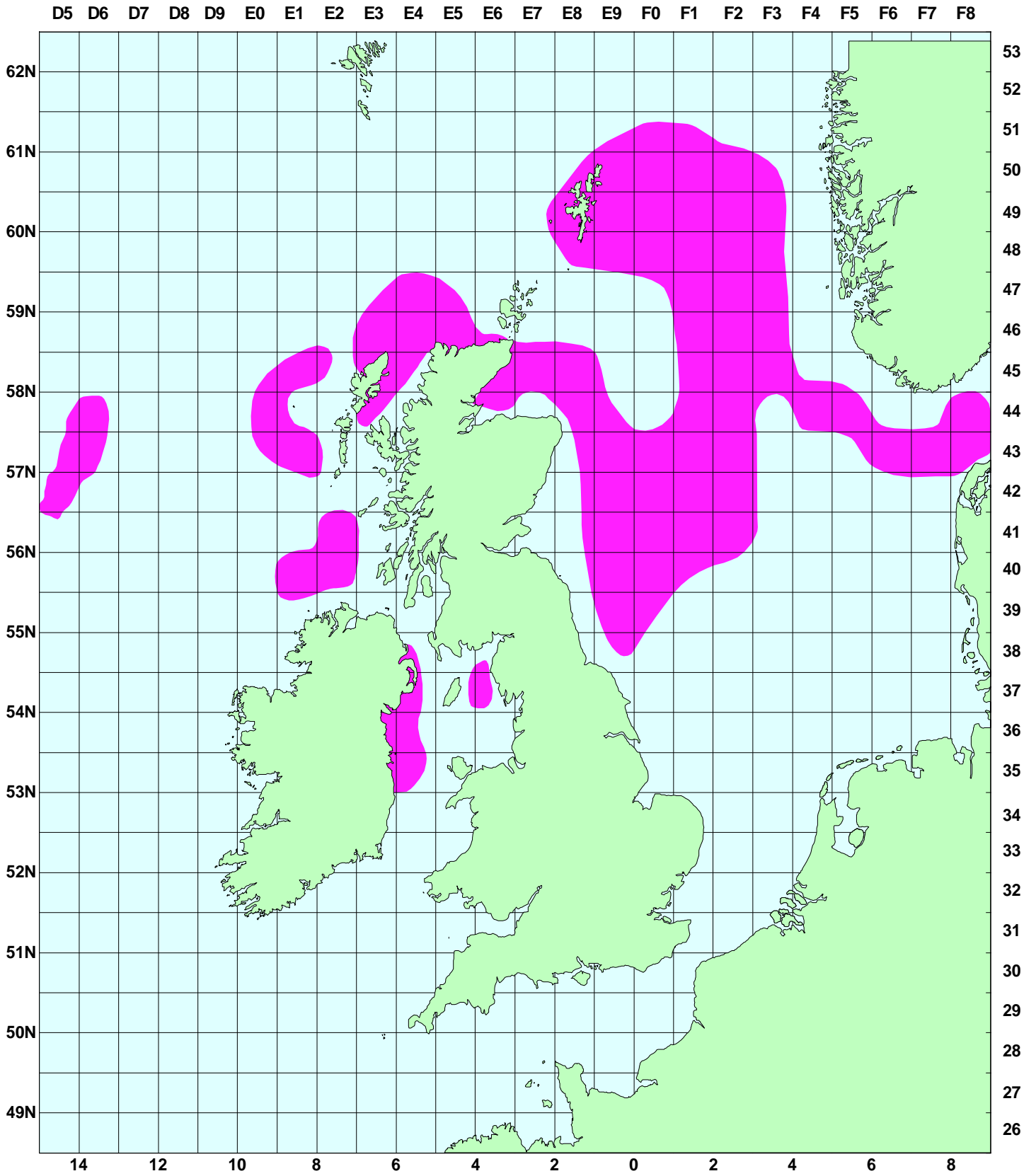
Nursery Areas

Cod



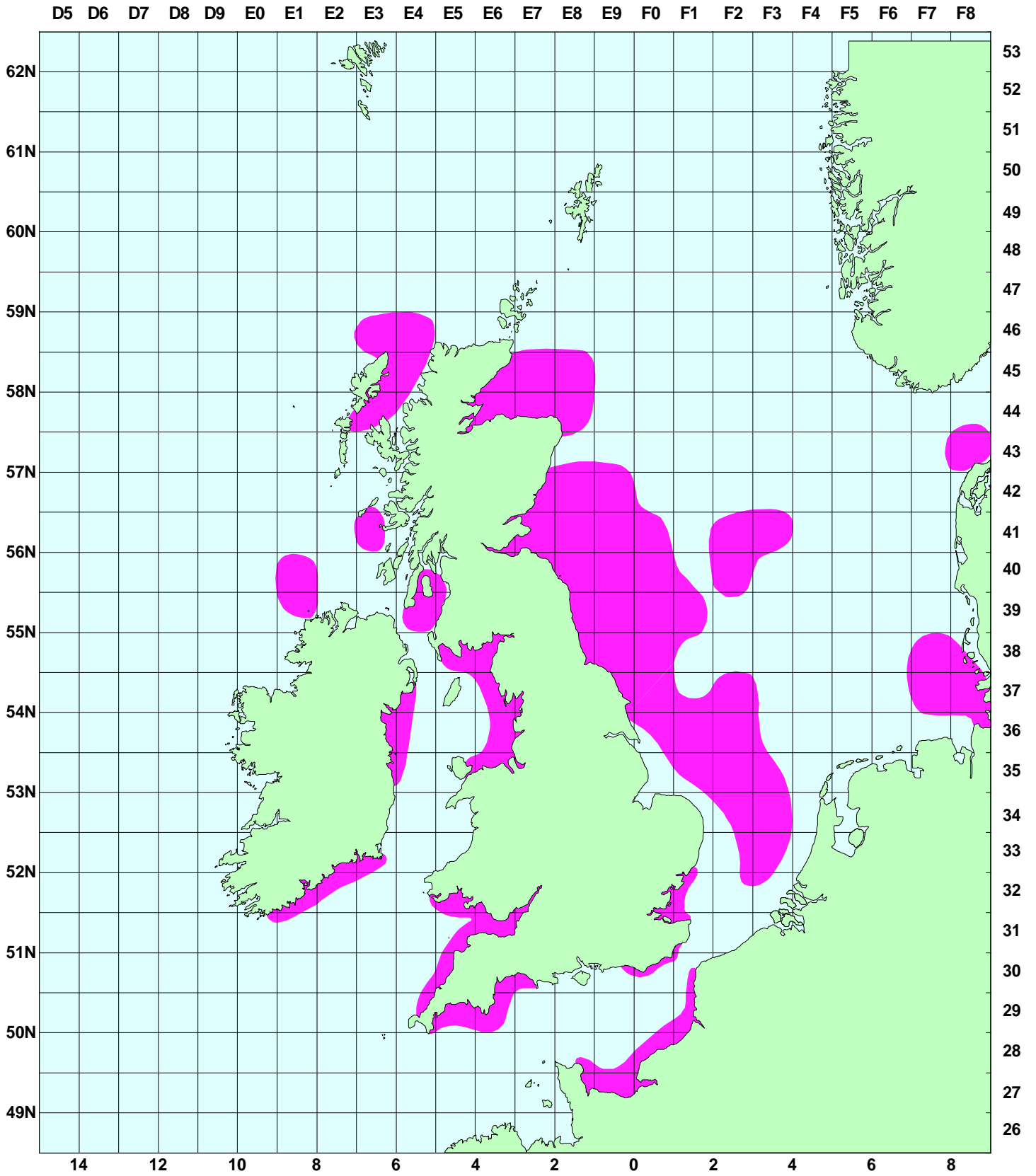
Nursery Areas

Haddock



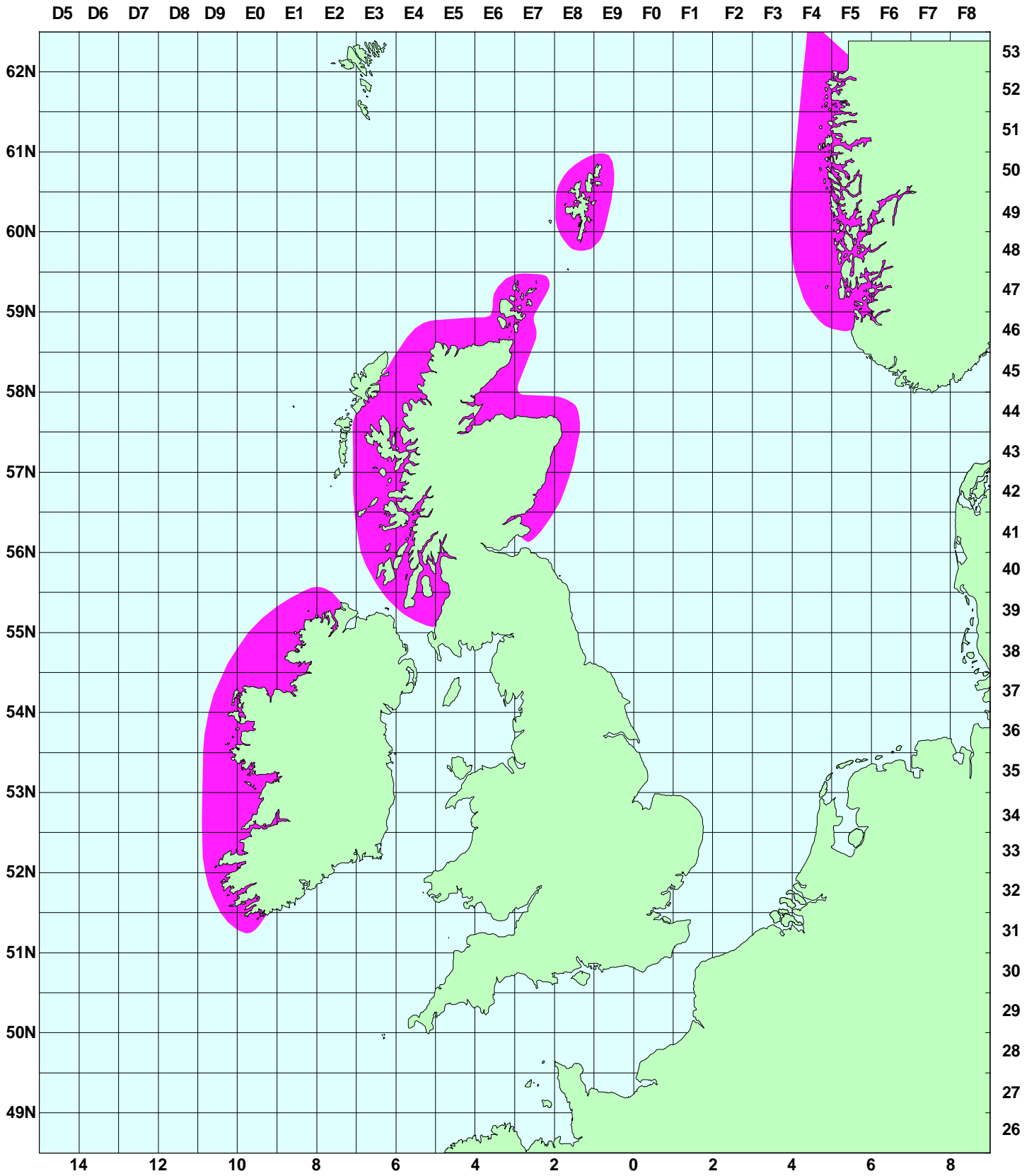
Nursery Areas

Whiting



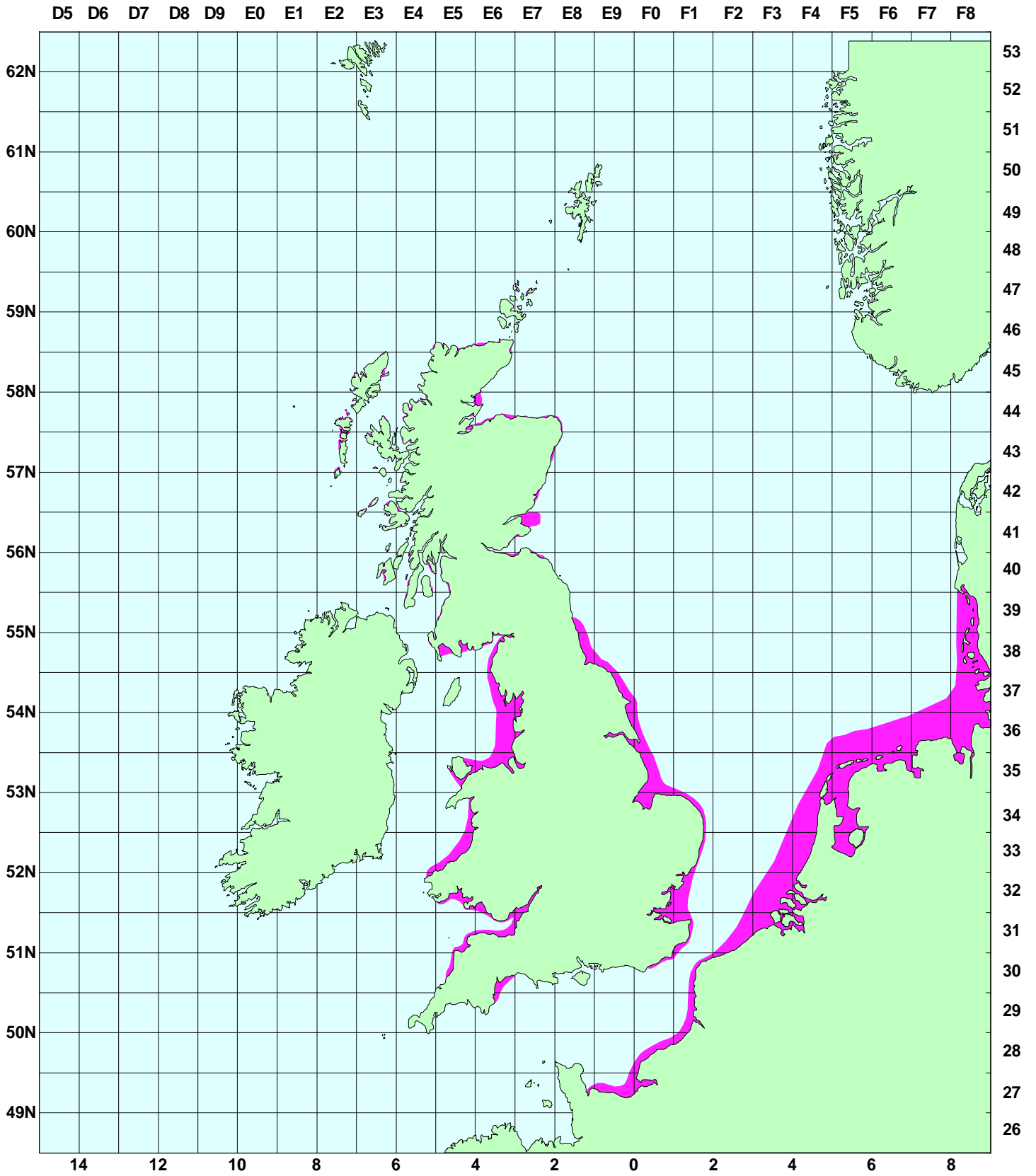
Nursery Areas

Saithe



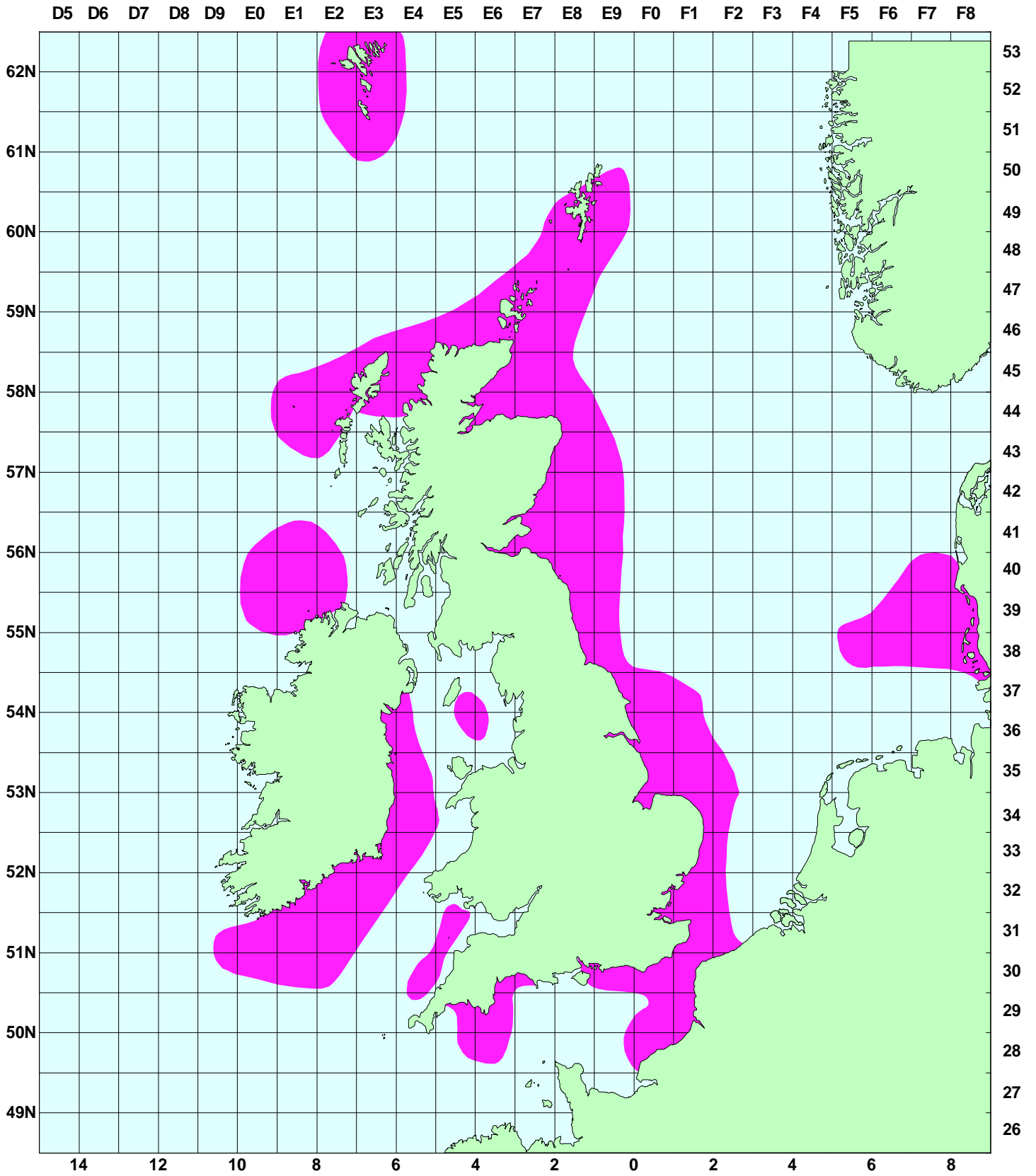
Nursery Areas

Plaice



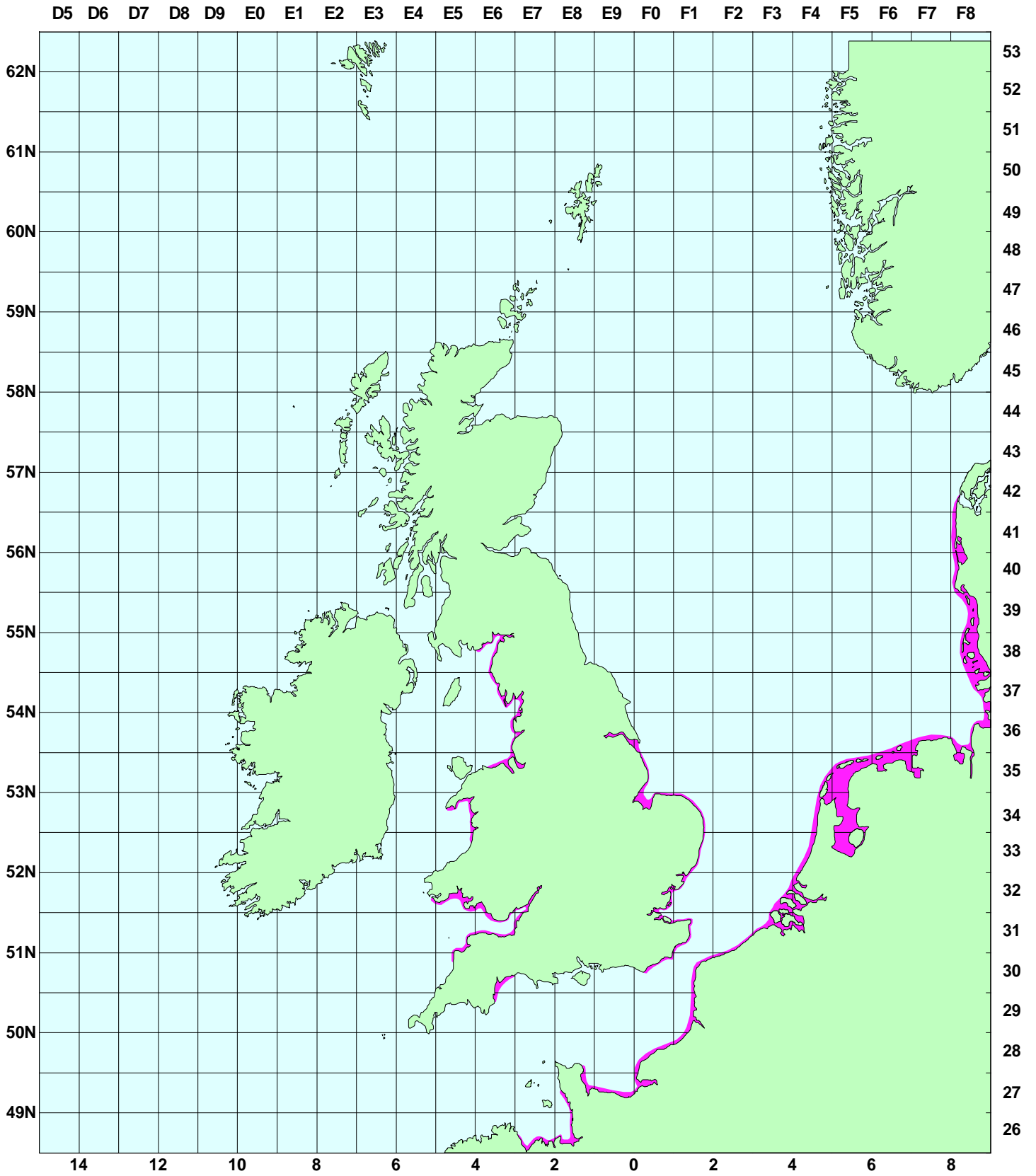
Nursery Areas

Lemon sole



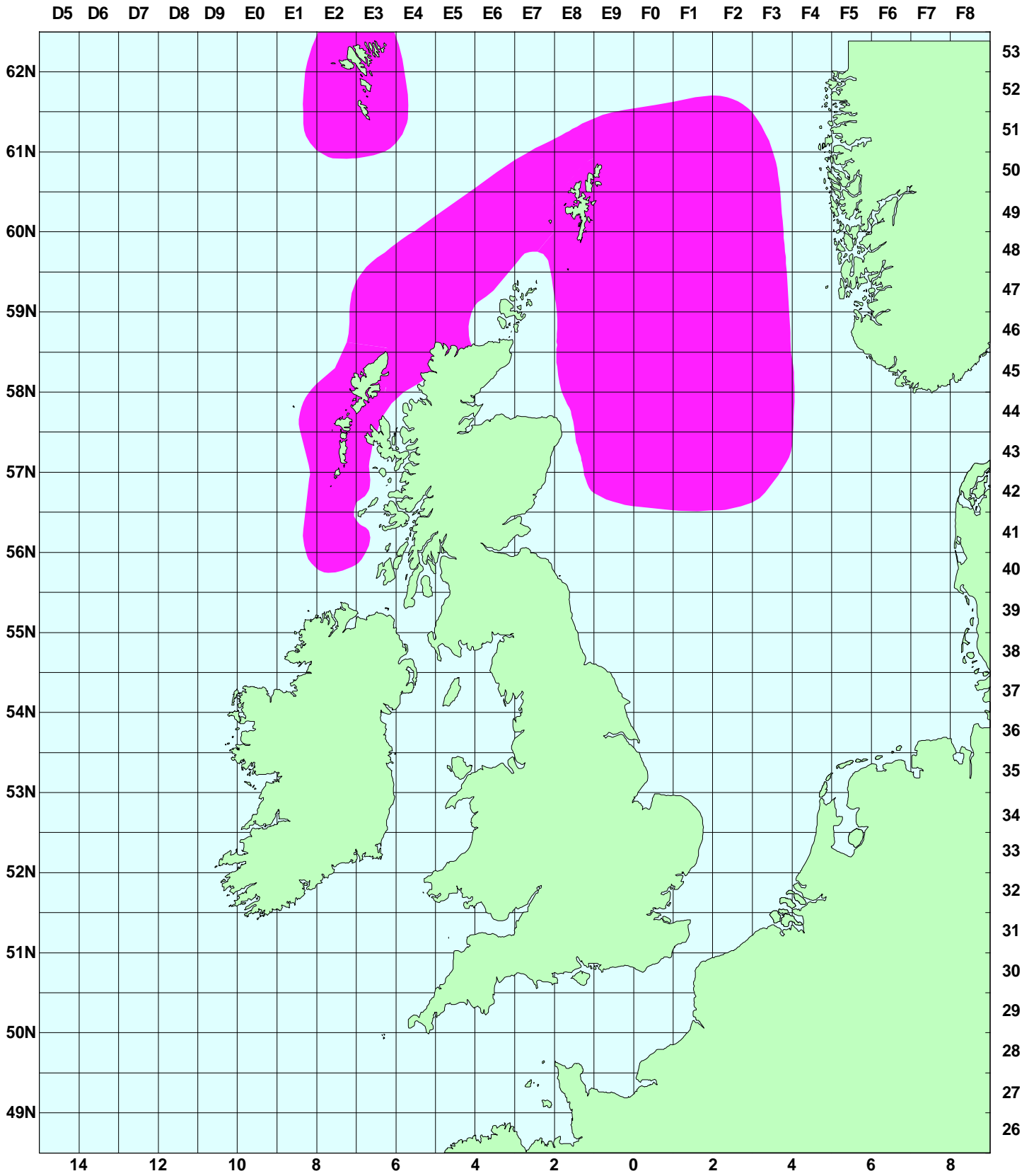
Nursery Areas

Sole (*Solea solea*)



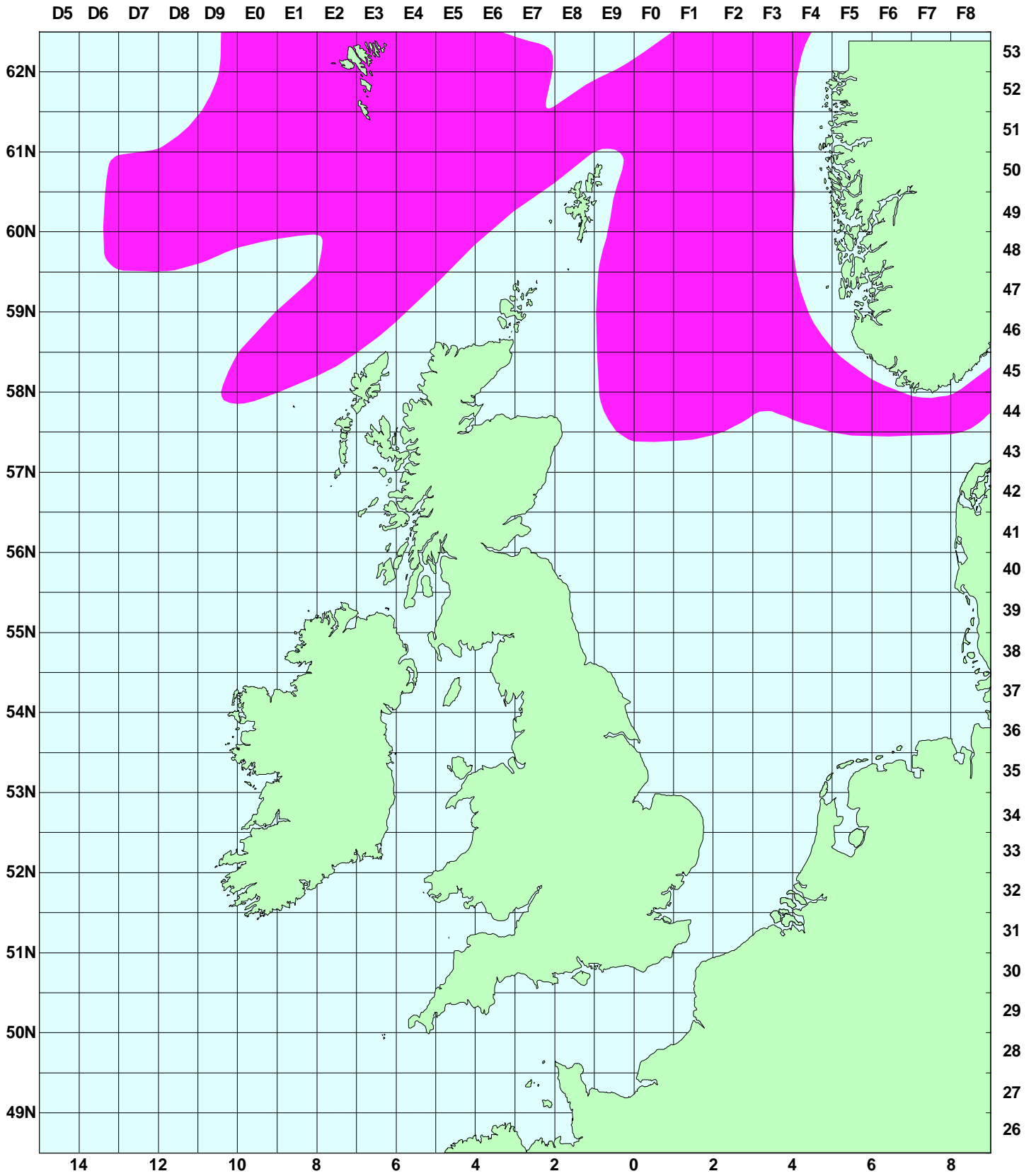
Nursery Areas

Norway pout



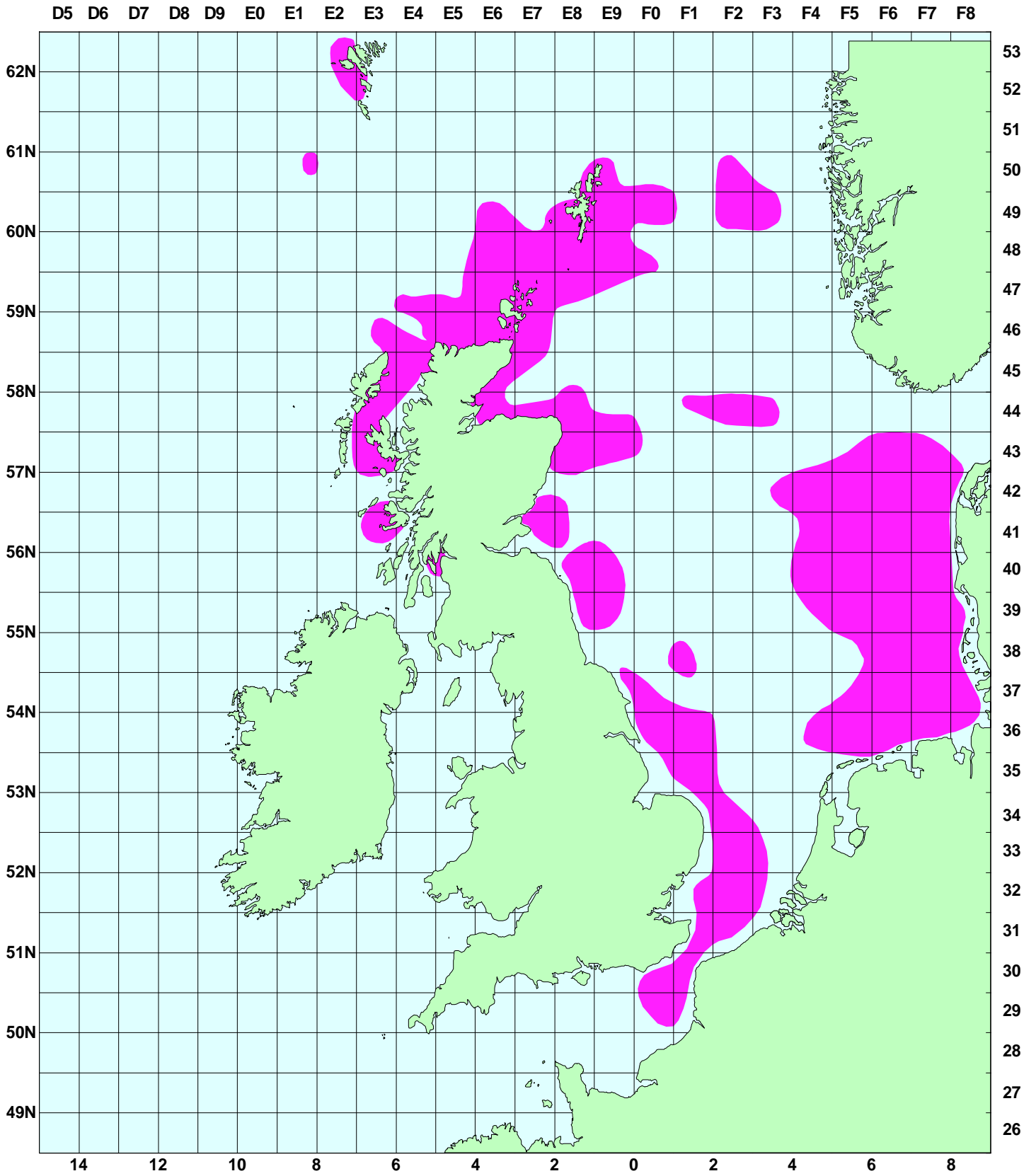
Nursery Areas

Blue whiting



Nursery Areas

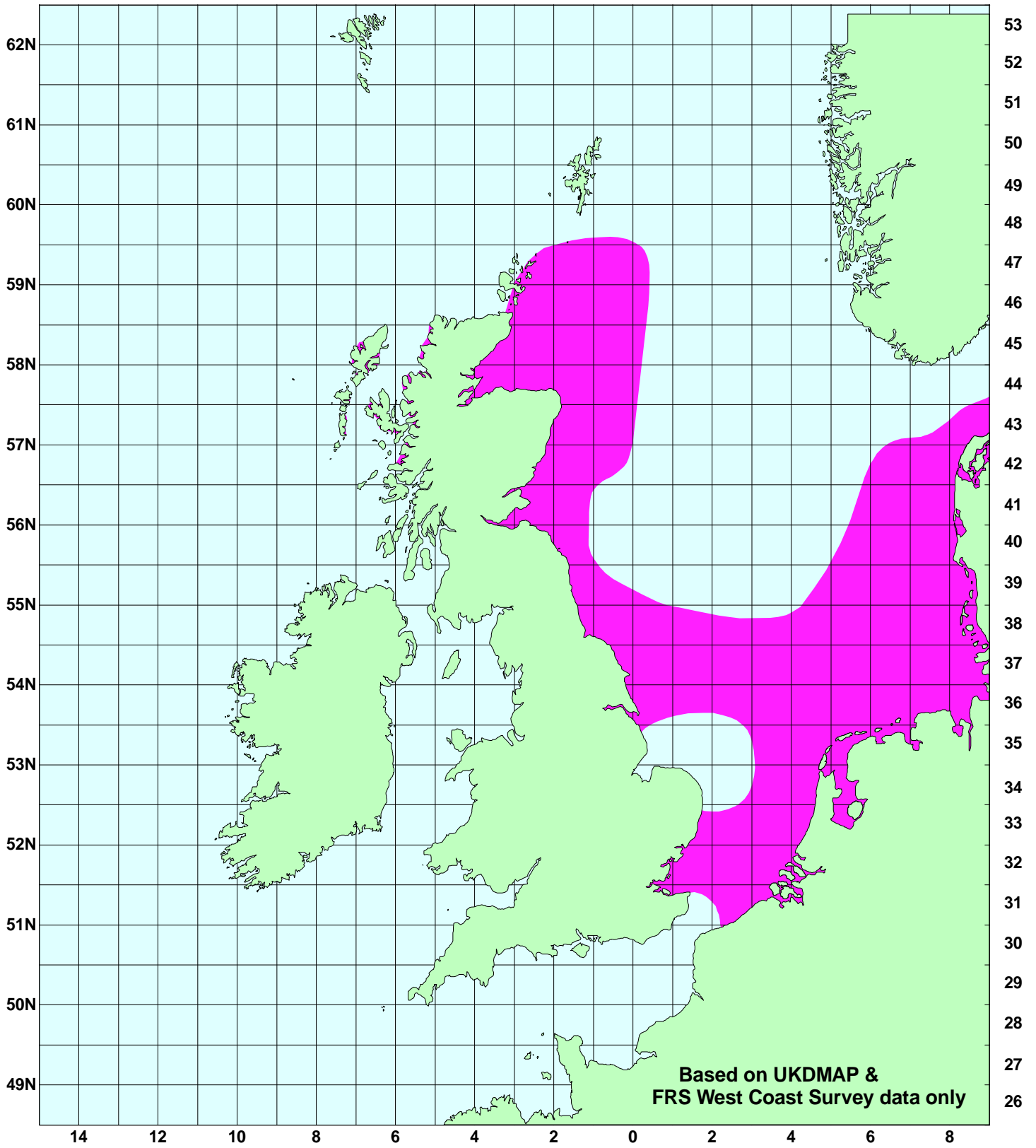
Sandeel (*A. marinus*)



Nursery Areas

Sprat

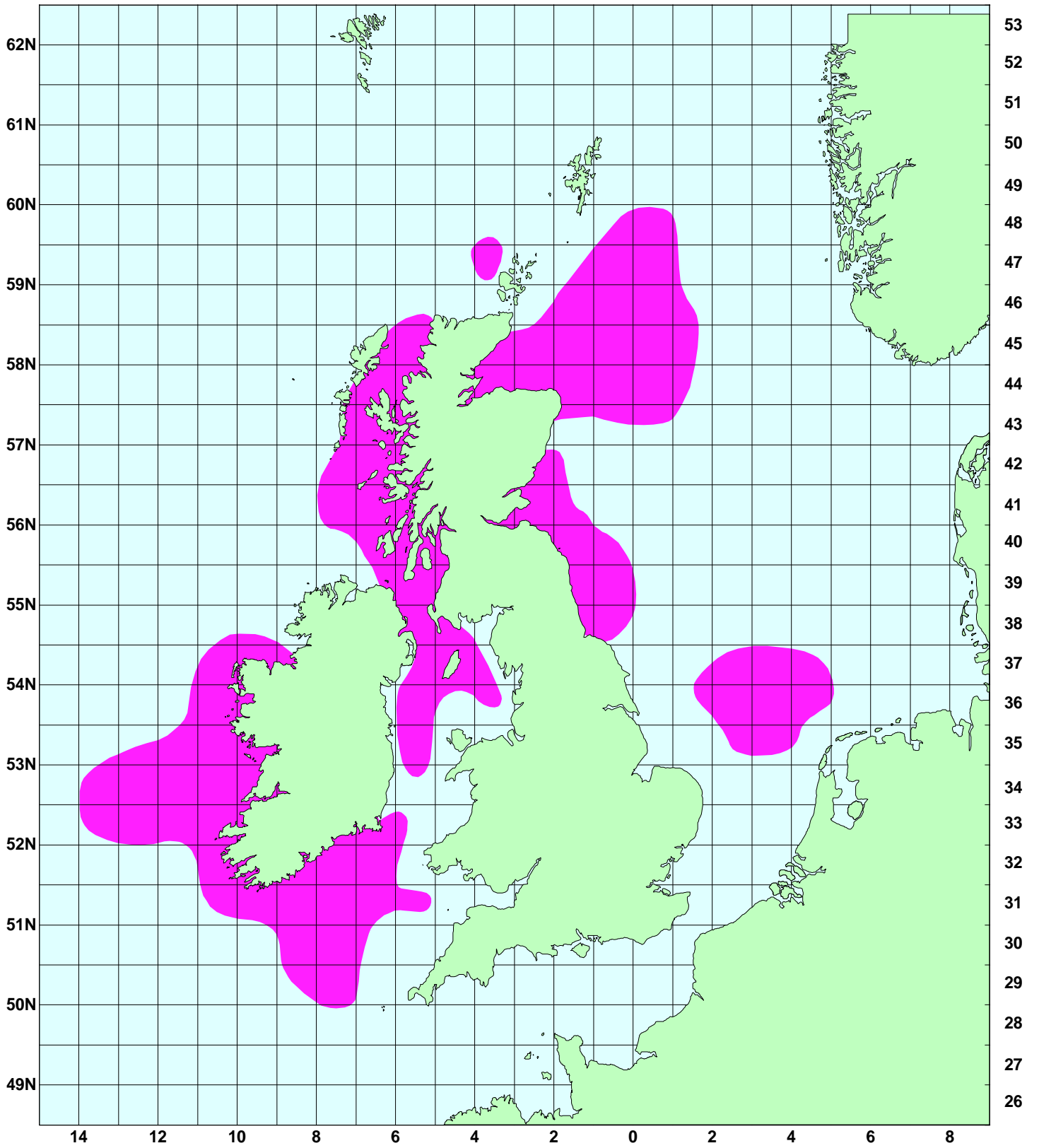
D5 D6 D7 D8 D9 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 F0 F1 F2 F3 F4 F5 F6 F7 F8



Nursery Areas

Nephrops

D5 D6 D7 D8 D9 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 F0 F1 F2 F3 F4 F5 F6 F7 F8



Seismic sensitivity periods.

In the sea, fish hear sounds from ships and towed gears long before they see them but tend only to avoid them at close range. In seismic surveys, exceptionally loud and repeated ‘bangs’ are added to the towing ship's sounds and even at several hundred metres range will create an uncomfortable sound stimulus. In some circumstances seismic surveys have been observed to cause fish to move away from and avoid the survey area. There are two concerns of seismic surveys from a fisheries standpoint.

Firstly, marine fish tend to migrate to particular areas to spawn and these chosen areas may have attributes that contribute to successful spawning. It is therefore considered reasonable to avoid seismic survey disturbance in identified spawning areas at times when it is known that spawning regularly takes place.

Secondly, seismic cables, sometimes comprising many synchronised air guns, are towed just below the sea surface. This is the zone where the eggs and larval stages of many fish species drift while they hatch and grow. Cables are towed at speeds of ca 3 metres per second (6 knots) and guns are fired frequently (10-20 seconds). The smaller larval fish and eggs, unlike adult stages, are unable to move aside from the track of the ship and at each explosion of the guns, those within 2 metres or so of each gun, will be unavoidably damaged. Studies show that at this range the very intense pressure impulse released by the air gun can cause internal rupture of tissues leading to bleeding and death. Each detonation of the multiple gun arrays may therefore kill a fresh sample of eggs and larvae and the accumulated effect where these are more densely concentrated in a breeding area may have stock consequences.

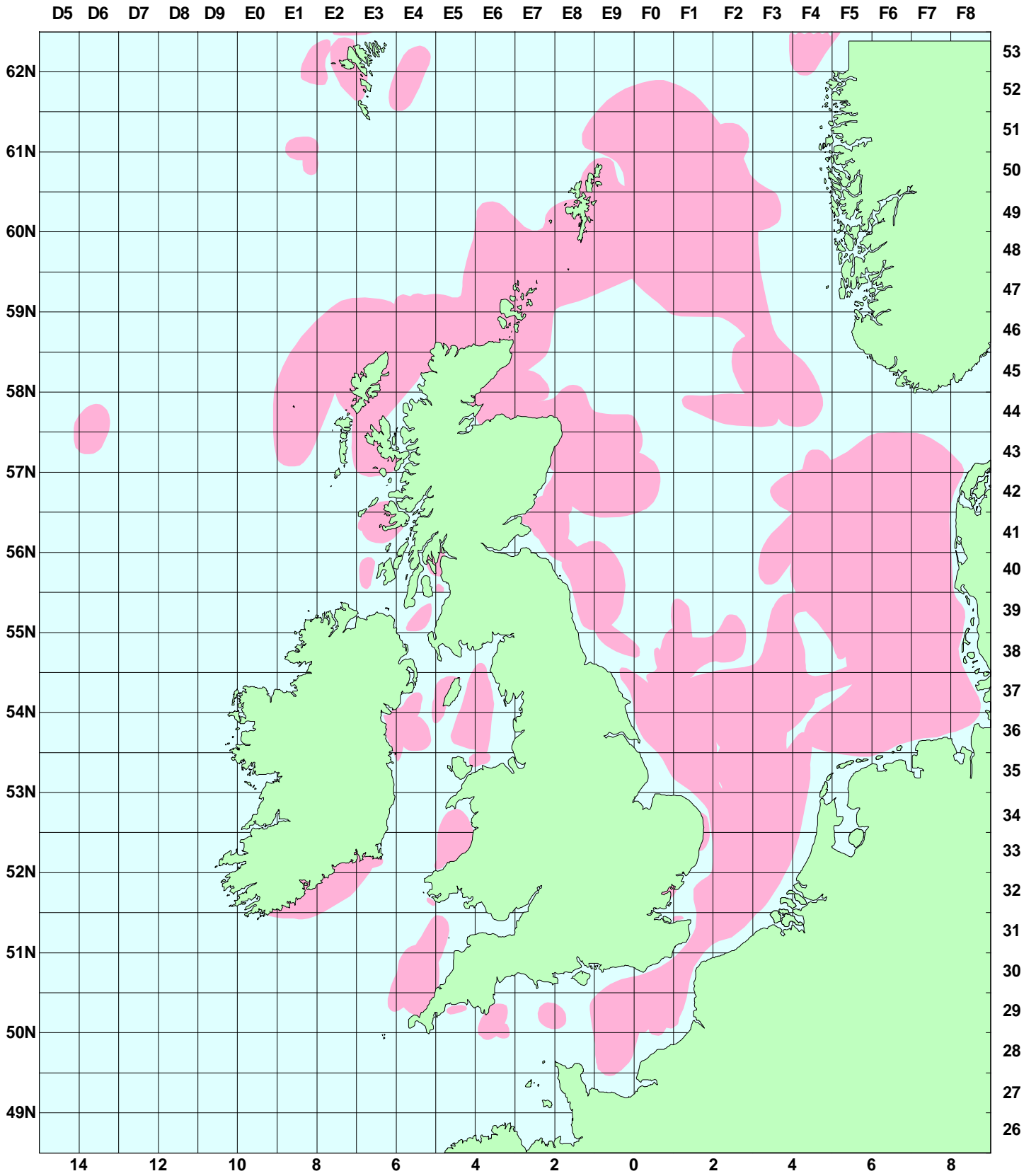
All fish will hear and may choose to avoid seismic sound. Most fish are additionally sensitive because they contain an internal air bladder, the swim bladder, which aids their buoyancy. Mackerel, flatfish, rays and sharks do not contain air bladders and are not thought to be as sensitive as other fishes. Shellfish also do not contain air bladders and commonly live on or in the sea bed. For the most part therefore, they too are not thought to be adversely affected by seismic surveys.

As a precautionary measure, regulators set exclusion windows to minimise seismic disturbance to individual species at or around the peak times and locations of spawning activity. A knowledge of sensitive spawning periods by block and by month will enable operators to plan their activities more efficiently. The accompanying monthly maps have been derived by simple area addition from the individual species maps shown earlier. There is less concern for species with very wide spawning distributions (eg pout, blue whiting, sprat and lemon sole) and they are not included in the restriction maps. Where exclusion windows cause exceptional operational difficulty there may be room for fine tuning and operators in this position should talk to the regulator or to fisheries advisors.

Many fishermen have traditional fishing grounds and local fishermen should always be consulted about seismic survey activity in order to explore possible operational and commercial sensitivities. The possibility of interaction with static gears is likely to be most important (see effort map on page 50). In addition, prior and timely consultation will allow commercial concerns related to the scaring away of nomadic and migratory fish to be properly discussed.

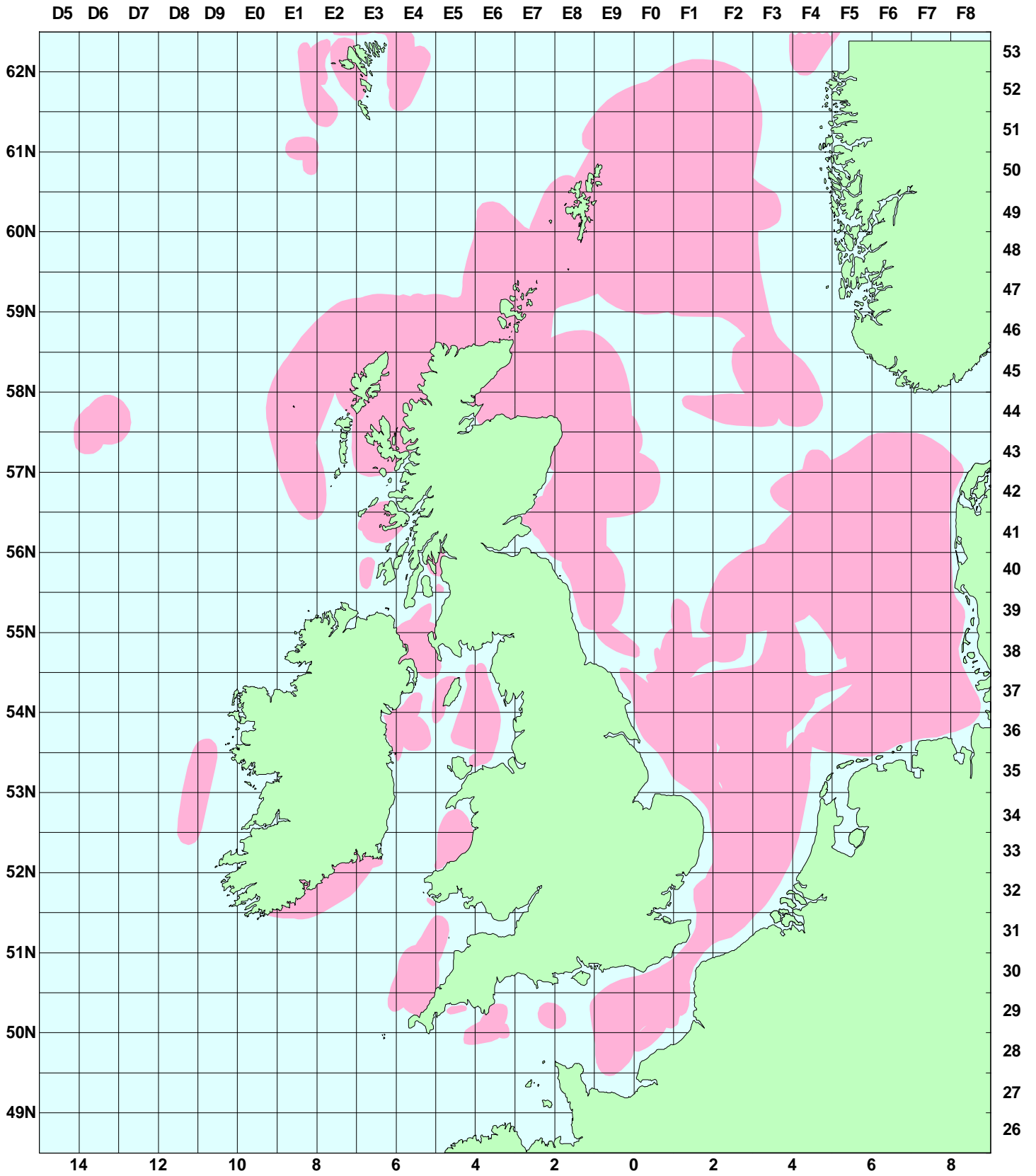
Seismic sensitivity

Month: January



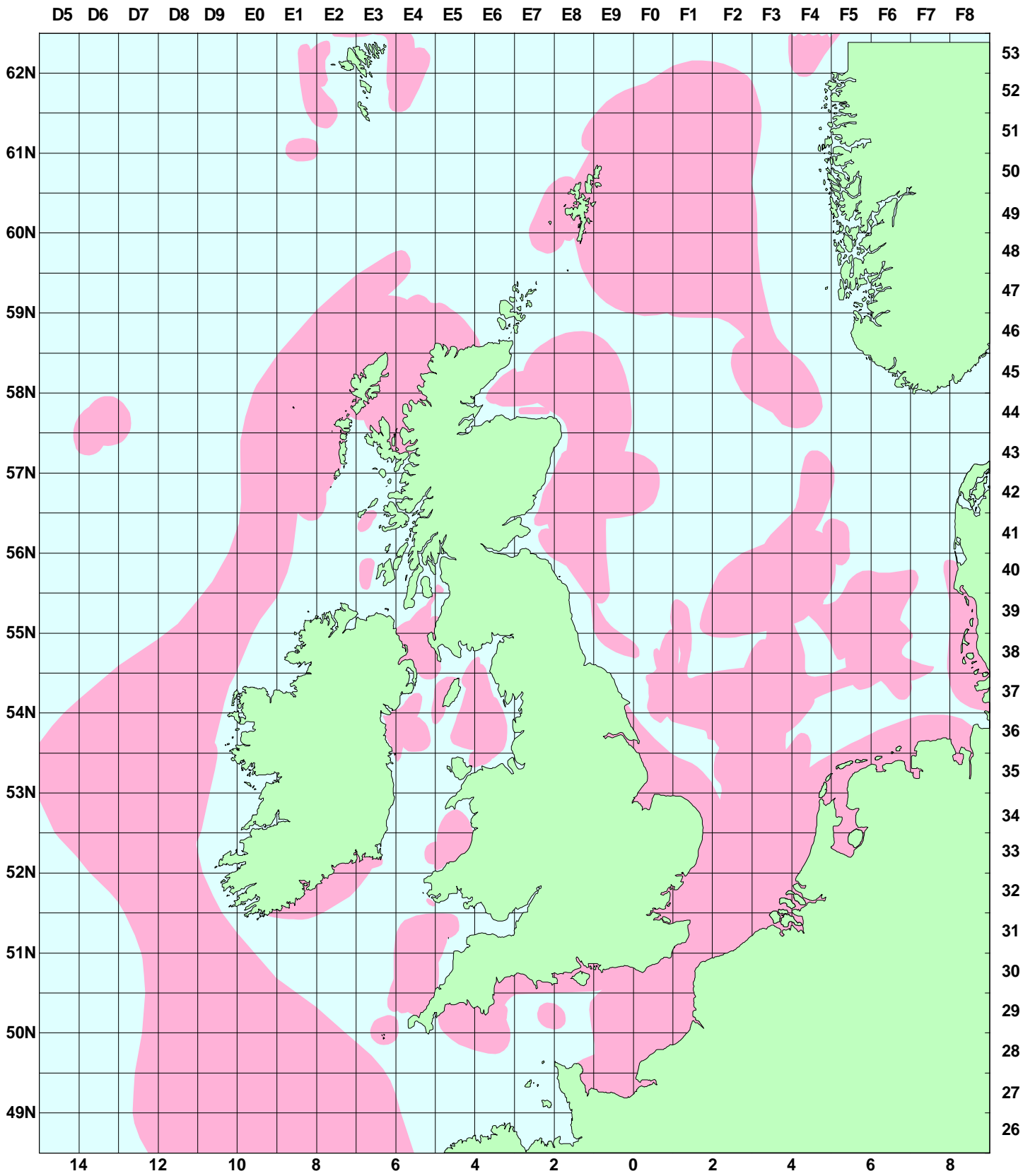
Seismic sensitivity

Month: February



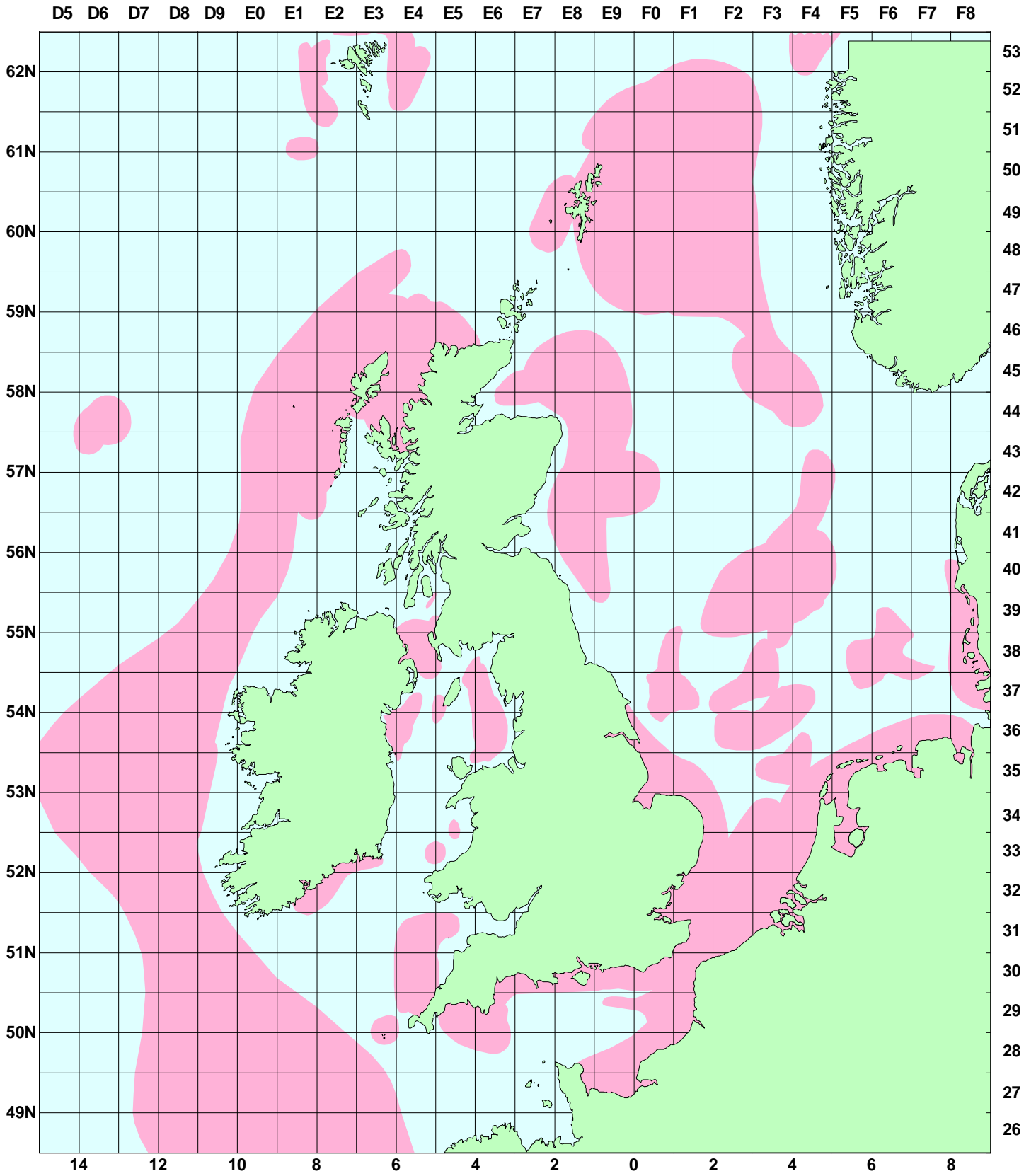
Seismic sensitivity

Month: March



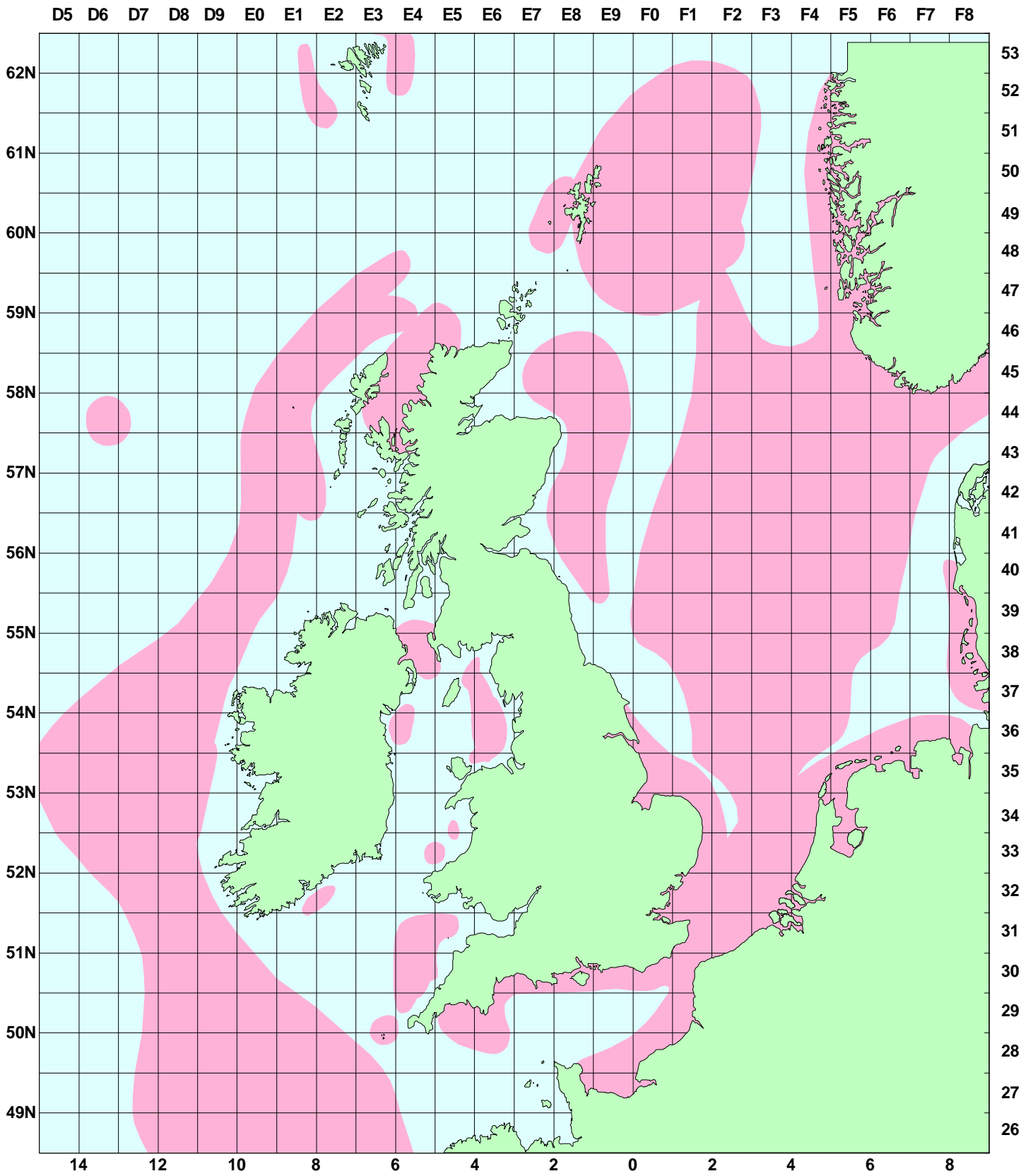
Seismic sensitivity

Month: April



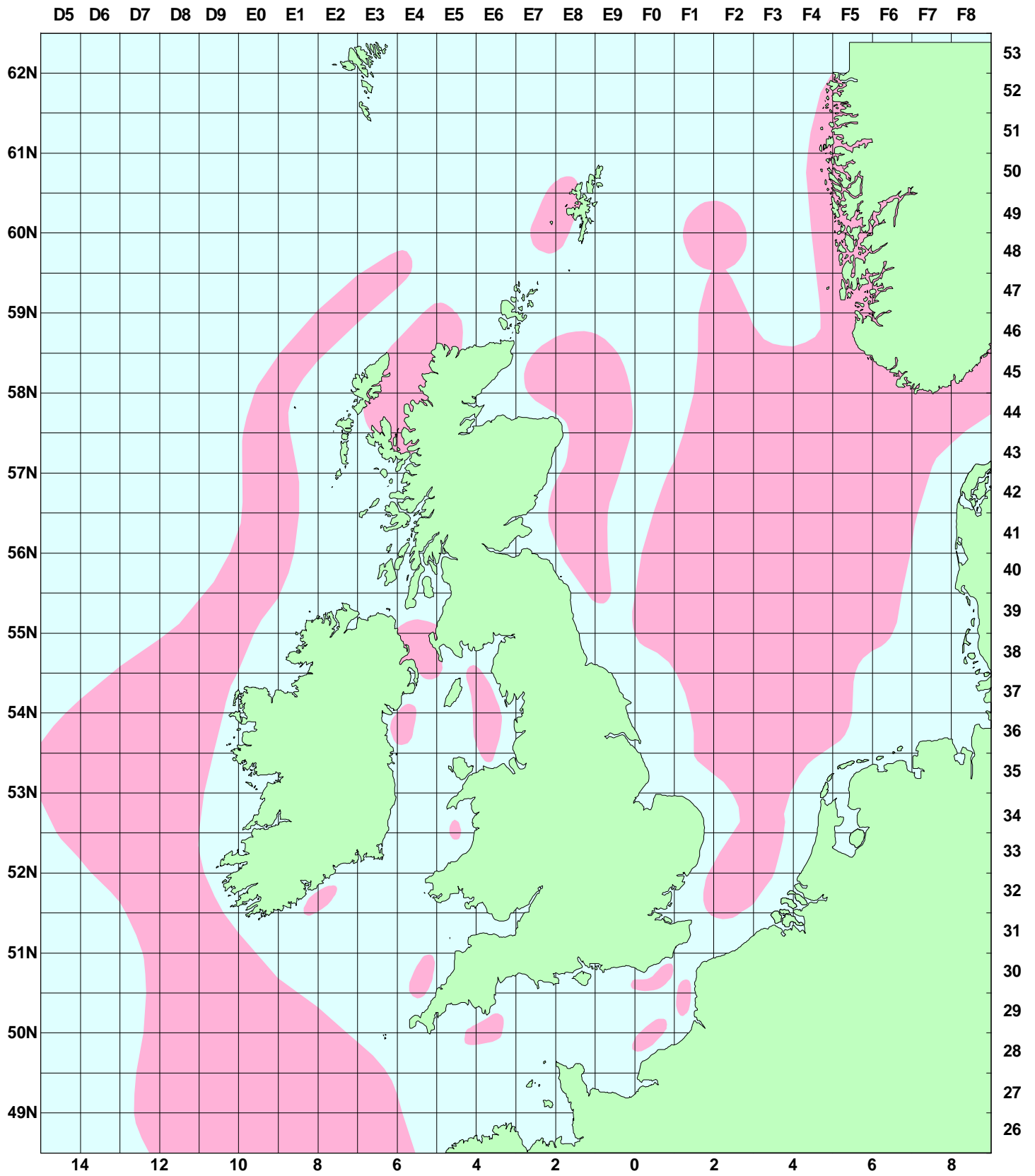
Seismic sensitivity

Month: May



Seismic sensitivity

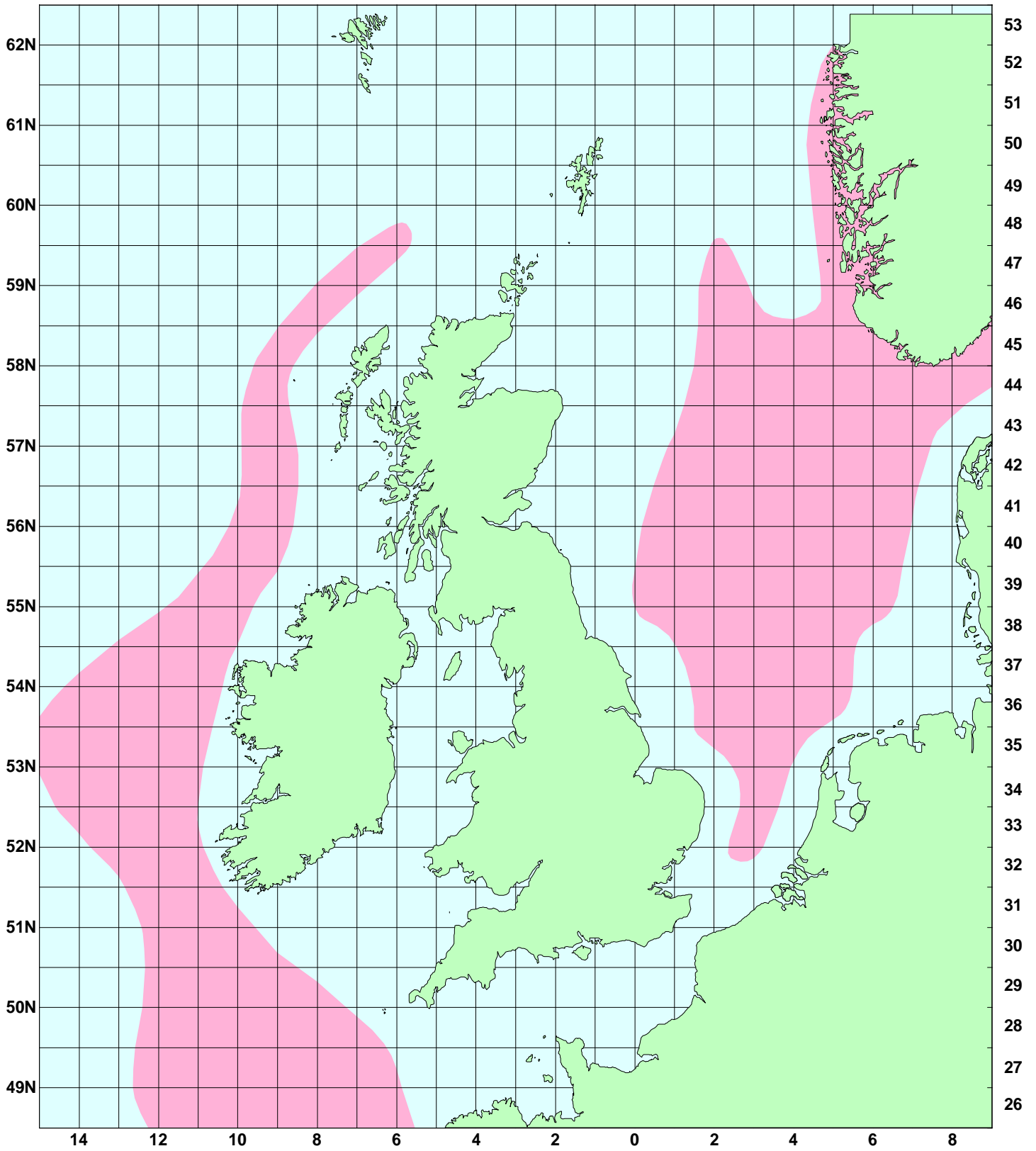
Month: June



Seismic sensitivity

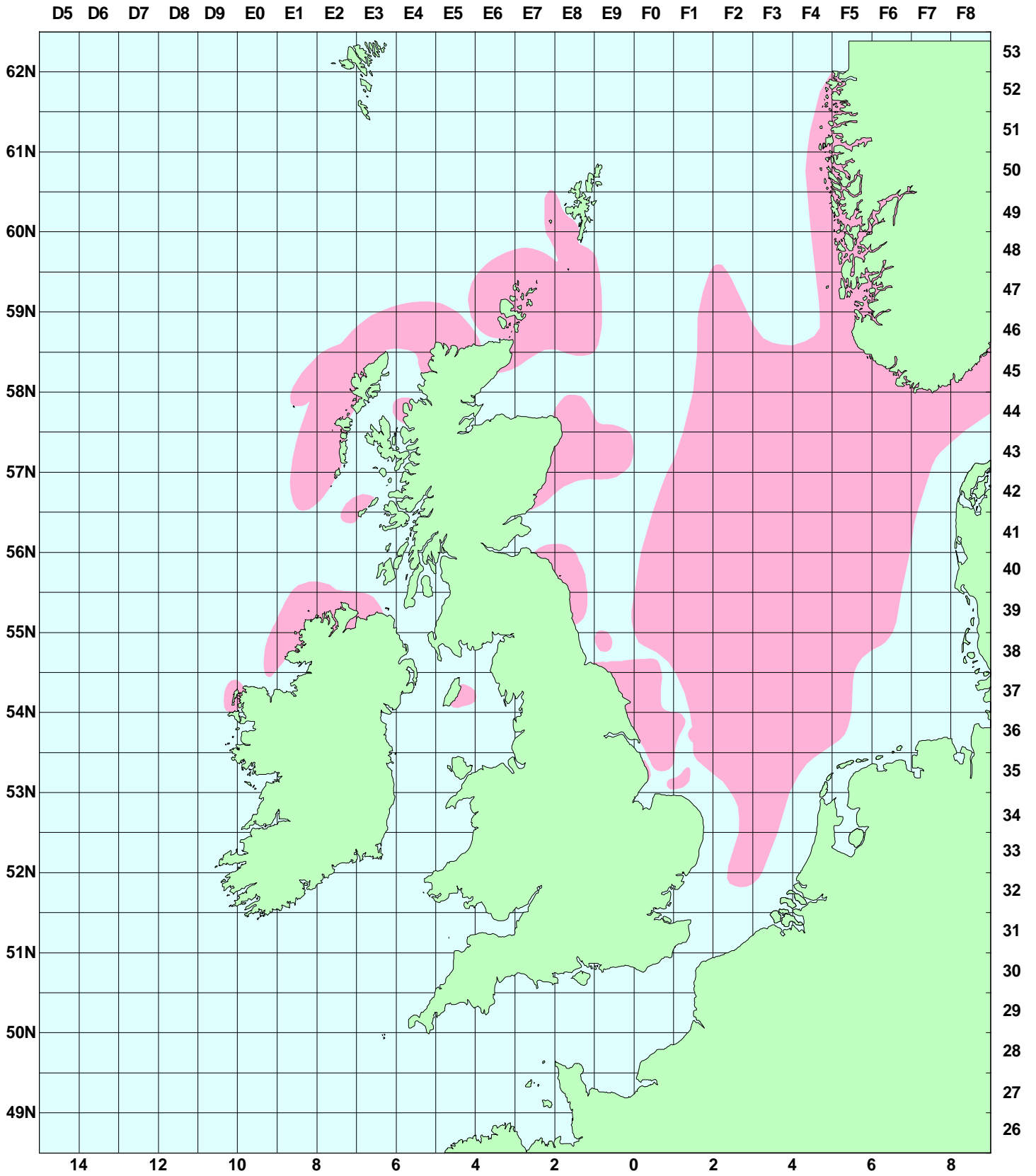
Month: July

D5 D6 D7 D8 D9 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 F0 F1 F2 F3 F4 F5 F6 F7 F8



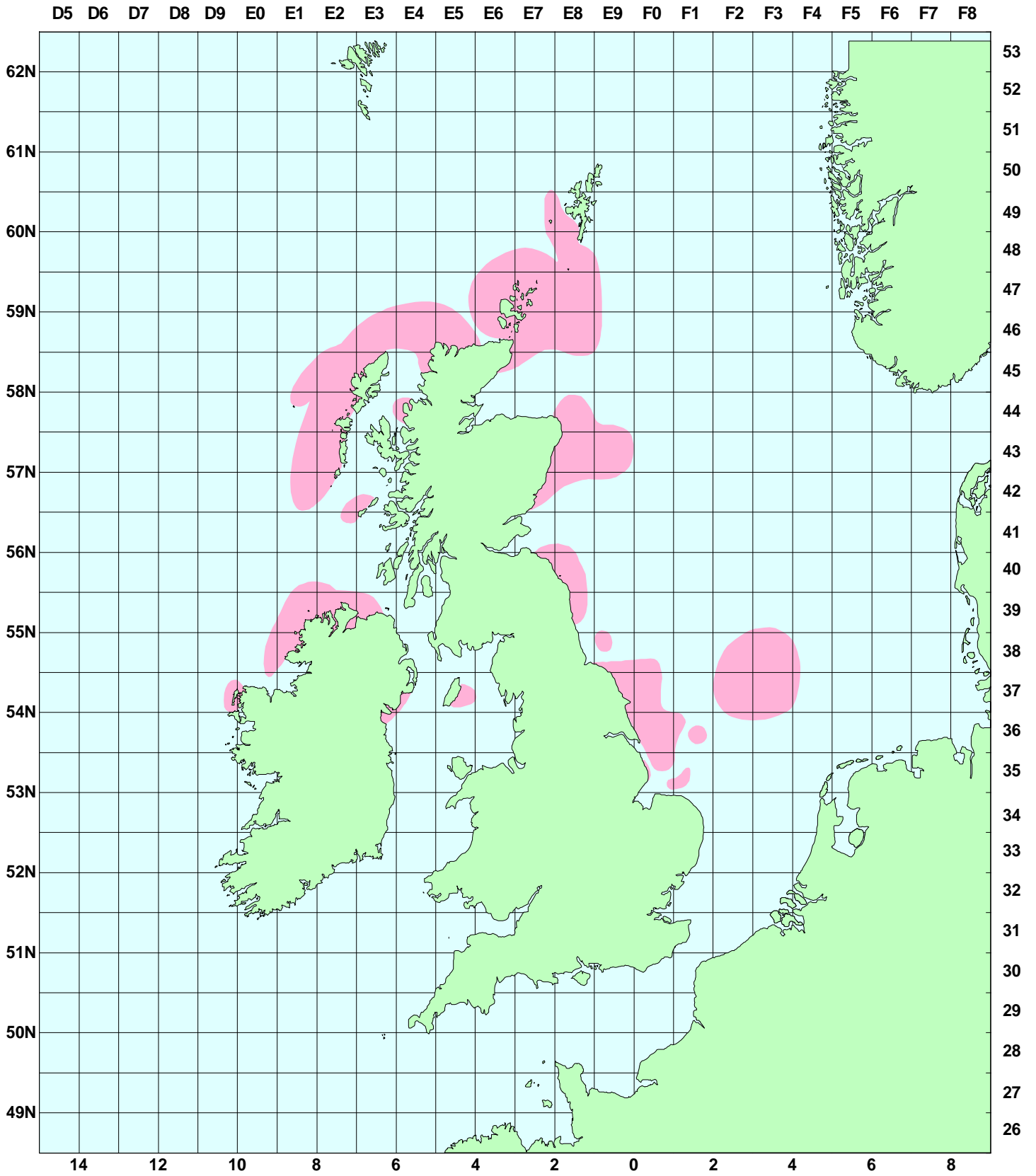
Seismic sensitivity

Month: August



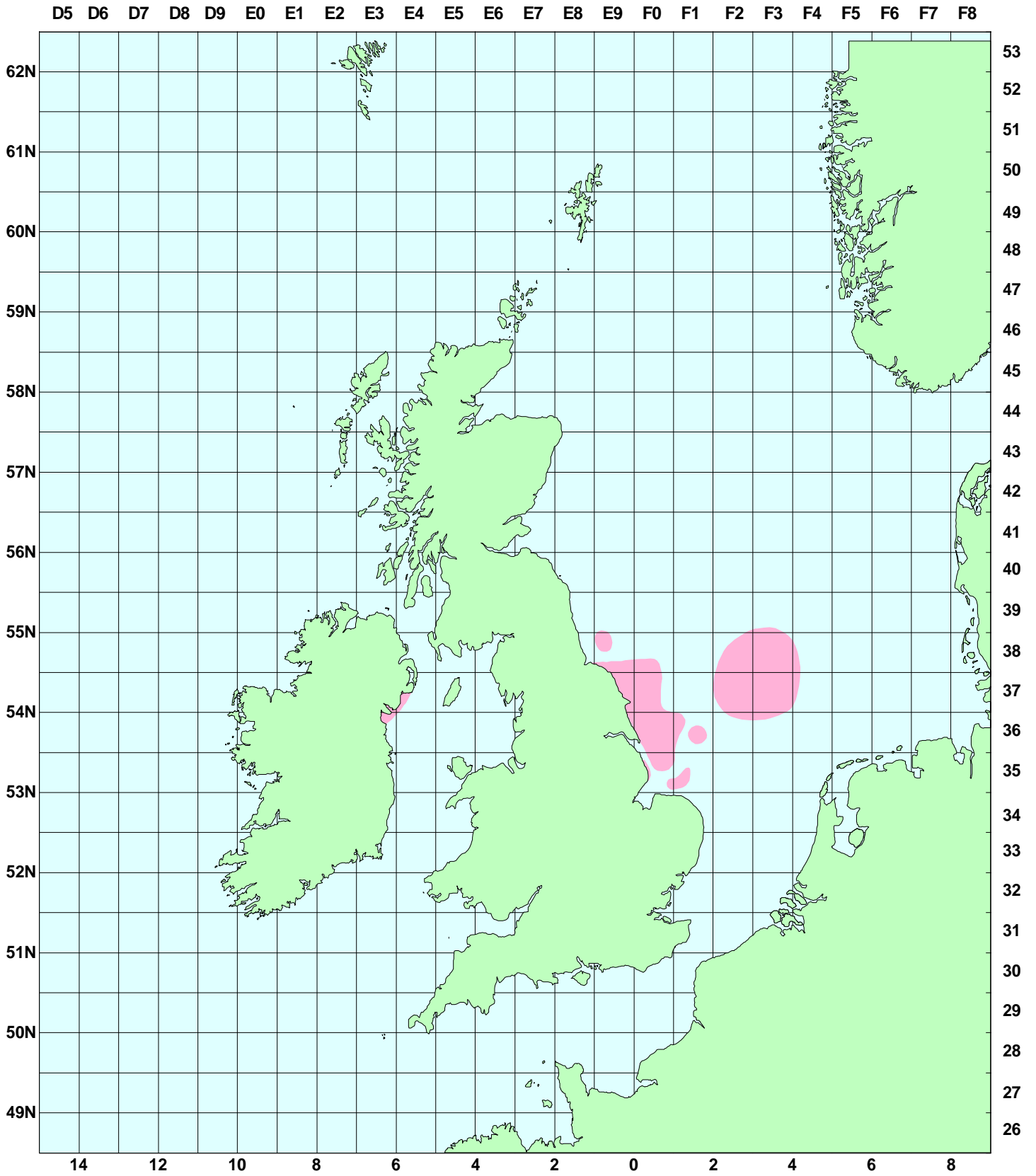
Seismic sensitivity

Month: September



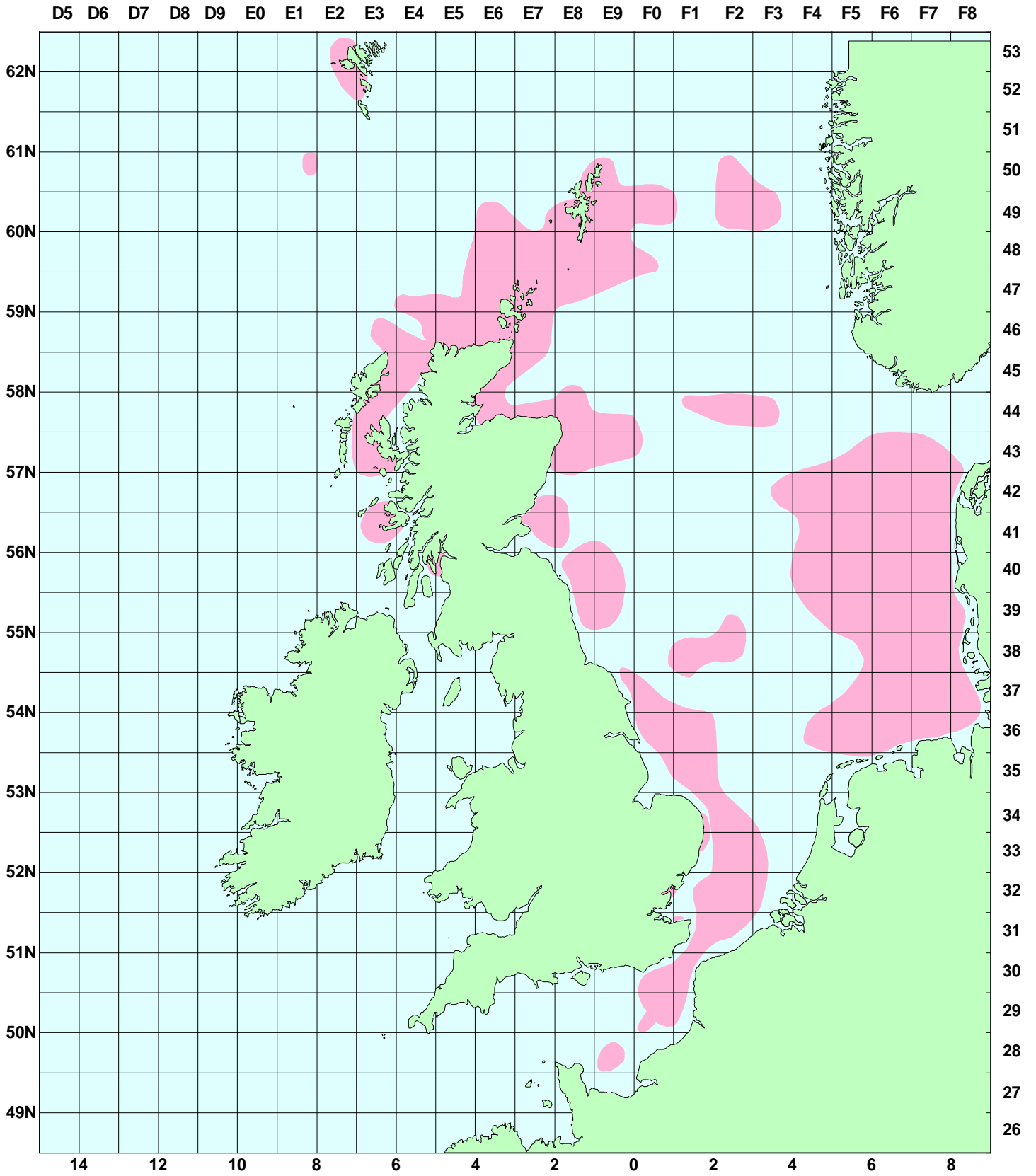
Seismic sensitivity

Month: October



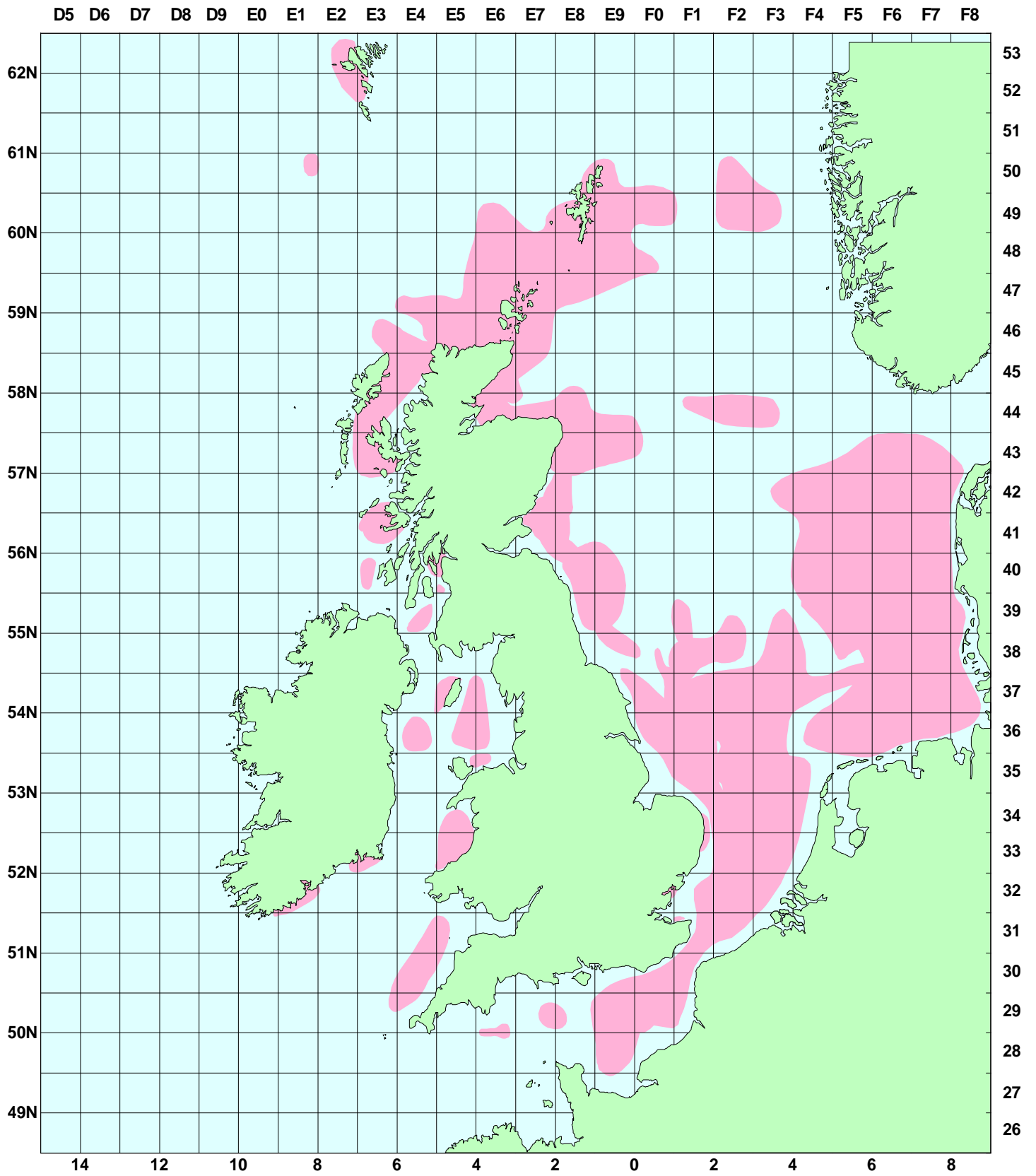
Seismic sensitivity

Month: November



Seismic sensitivity

Month: December



Effort Maps

UK fishermen are obliged when they land their catches to market to report the quantities of species landed, where they were caught, and what method (which gear / duration of fishing) they used to capture them. Data are linked to the first sales value of the catch by Fisheries Officers in each port throughout the UK and are then passed to the Fisheries Agencies and entered into a database.

For the purposes of this booklet effort is considered to be time spent fishing, i.e. what is sometimes defined as nominal fishing effort. Clearly the efficiency (catch per unit of effort) of boats of different sizes varies considerably and this must be borne in mind when viewing the maps. Small boats, i.e. those < 10 m length which commonly operate close to shore, do not need to report their returns. The effort and overall sensitivity in these areas is thus considerably under represented by the present maps.

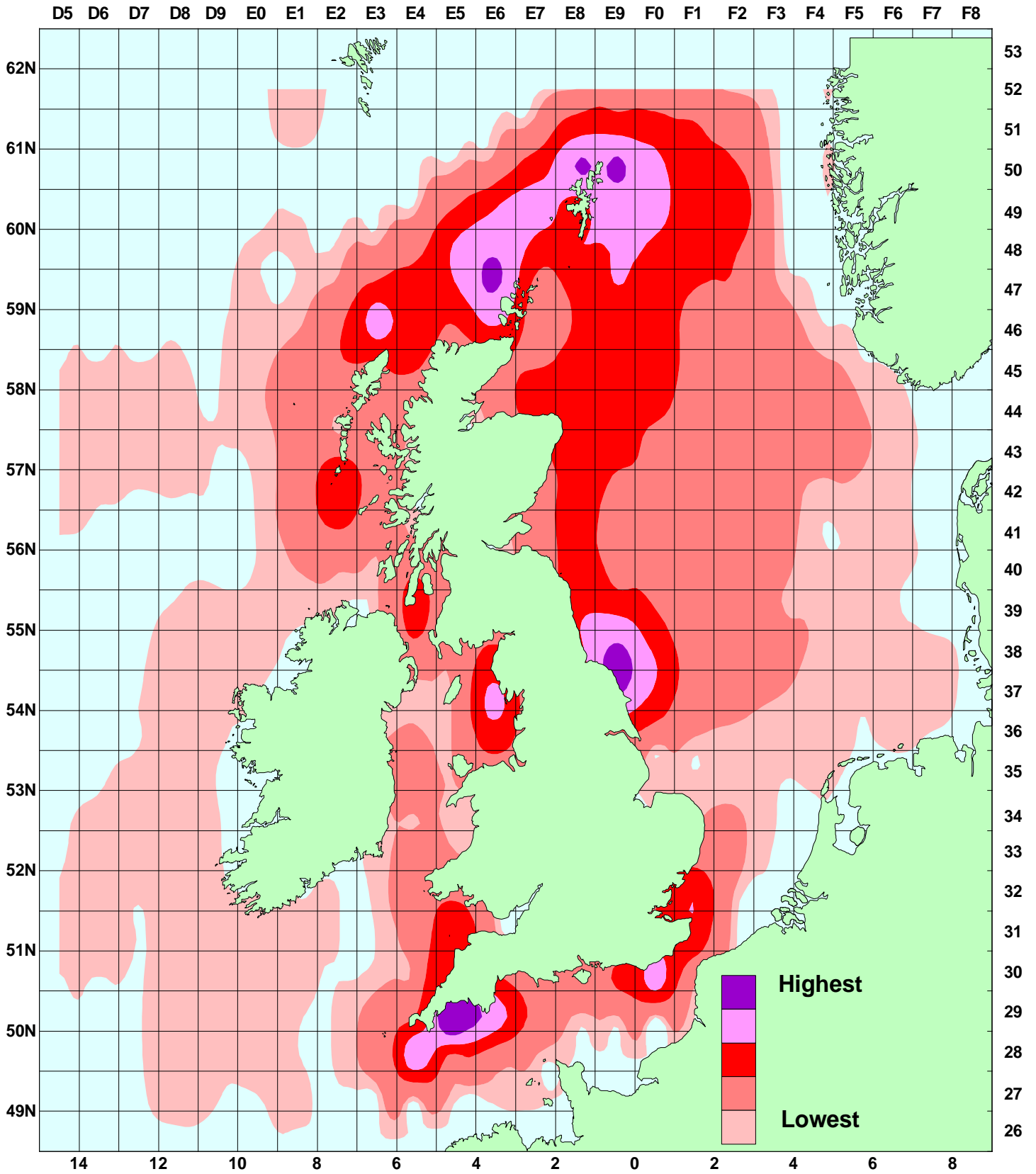
The reporting unit of the fisheries database is the ICES (International Council for the Exploration of the Sea) rectangle and covers 15 licence blocks. It is therefore quite coarse. In the North Sea where most rectangles are actively exploited most of the time, this coarseness matters little in mapping terms. In the maps, the effort in most rectangles is assumed to have been centrally located. One way of plotting the effort would have been to colour individual squares differently according to their effort value. But this would have resulted in areas with hard edges and clearly effort changes gradually between areas. Instead, contoured maps are presented, and a smoothing function has been used to decide, in comparison with adjacent scores, where the boundary line should be drawn. Although this is more realistic it has the consequence in some areas of reducing the area assigned to the highest effort. This illustrates that these maps, like the others in this series, are merely indicative of the real situation - discussion with local groups will be necessary to tease out detailed concerns. In some areas, e.g. west of Shetland where individual ICES rectangles have both very deep and much shallower water, allocation of the effort to the centre of the square would be inappropriate. In these squares the effort has been more accurately located, in most cases to the shallower water area. This allows the deep water effort, which is currently low, to be delineated by block from the shallow water effort. The deep water effort, however, is increasing rapidly as fishermen use bigger boats pulling heavier gears to exploit non-quota, deeper water species. Operators will wish to plan accordingly.

In the maps, UK effort is divided arbitrarily into five categories from the highest to the lowest. It is recognised that this makes little scientific sense since the distribution of effort is actually a continuum between those squares which contain little effort and those which are actively exploited. However, since the primary purpose of the maps is to inform and flag up relative sensitivities in order to encourage dialogue and resolution of potential interaction this is not thought to be an important criticism. Five maps, for **demersal** (excluding beam trawls), **pelagic**, **Nephrops and shrimp**, **beam trawlers** and **static gears** are presented. The value of each category is not consistent between the gears, i.e. high demersal effort does not necessarily correspond with high pelagic effort.

The potential for interaction during **seismic exploration**, field developments, production and decommissioning, is obvious and a knowledge of fishing effort by area will help operators in their planning processes. Some gears carry more potential threat to oilfield equipment than others. Beam trawls carry the most threat and an extra map of **beam trawl effort** by all countries by area is provided (it comes from Jennings *et al*, 1998, for reference see page ii).

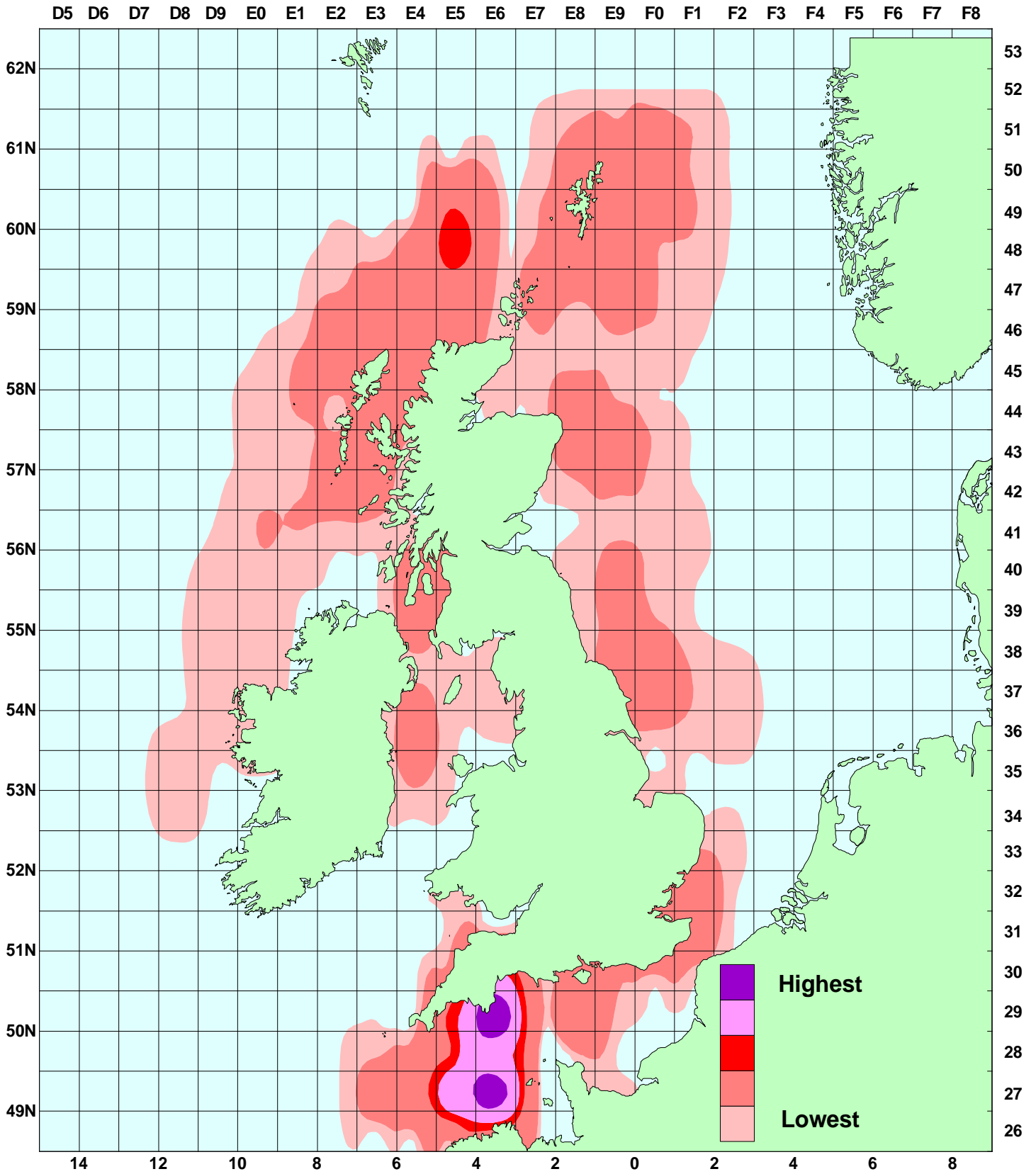
Distribution of Fishing Effort

Demersal species



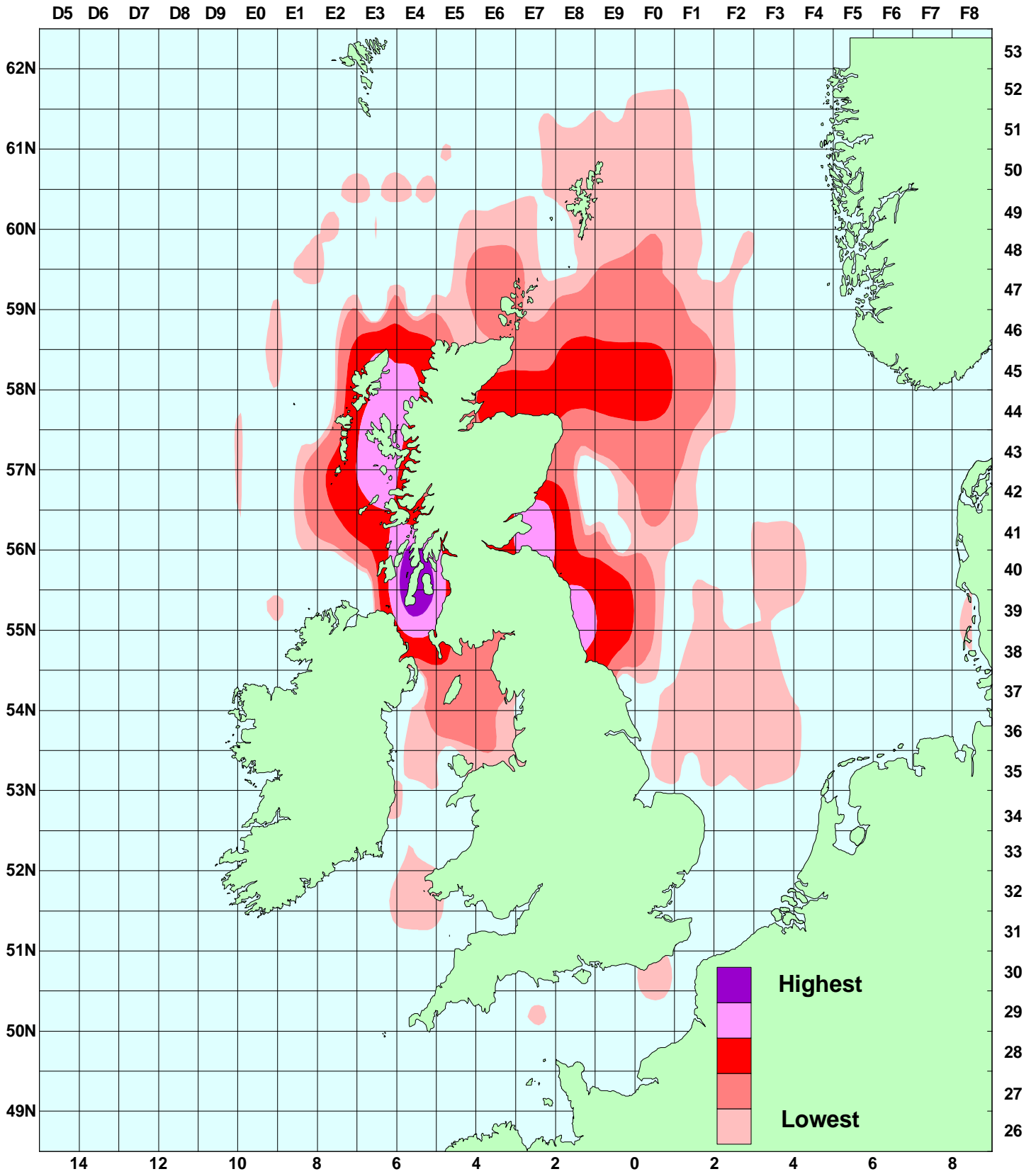
Distribution of Fishing Effort

Pelagic species



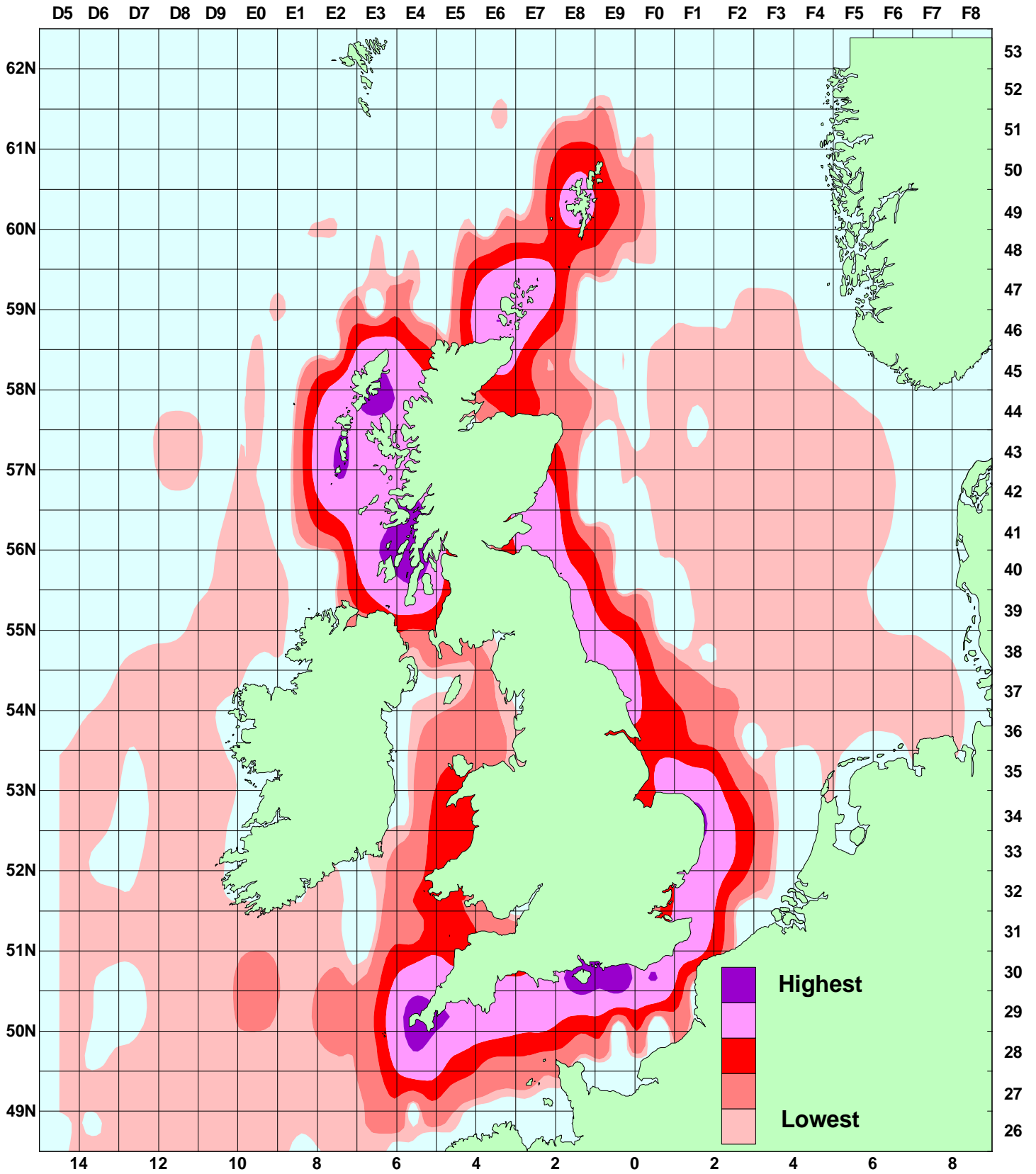
Distribution of Fishing Effort

***Nephrops* / Shrimp Trawlers**



Distribution of Fishing Effort

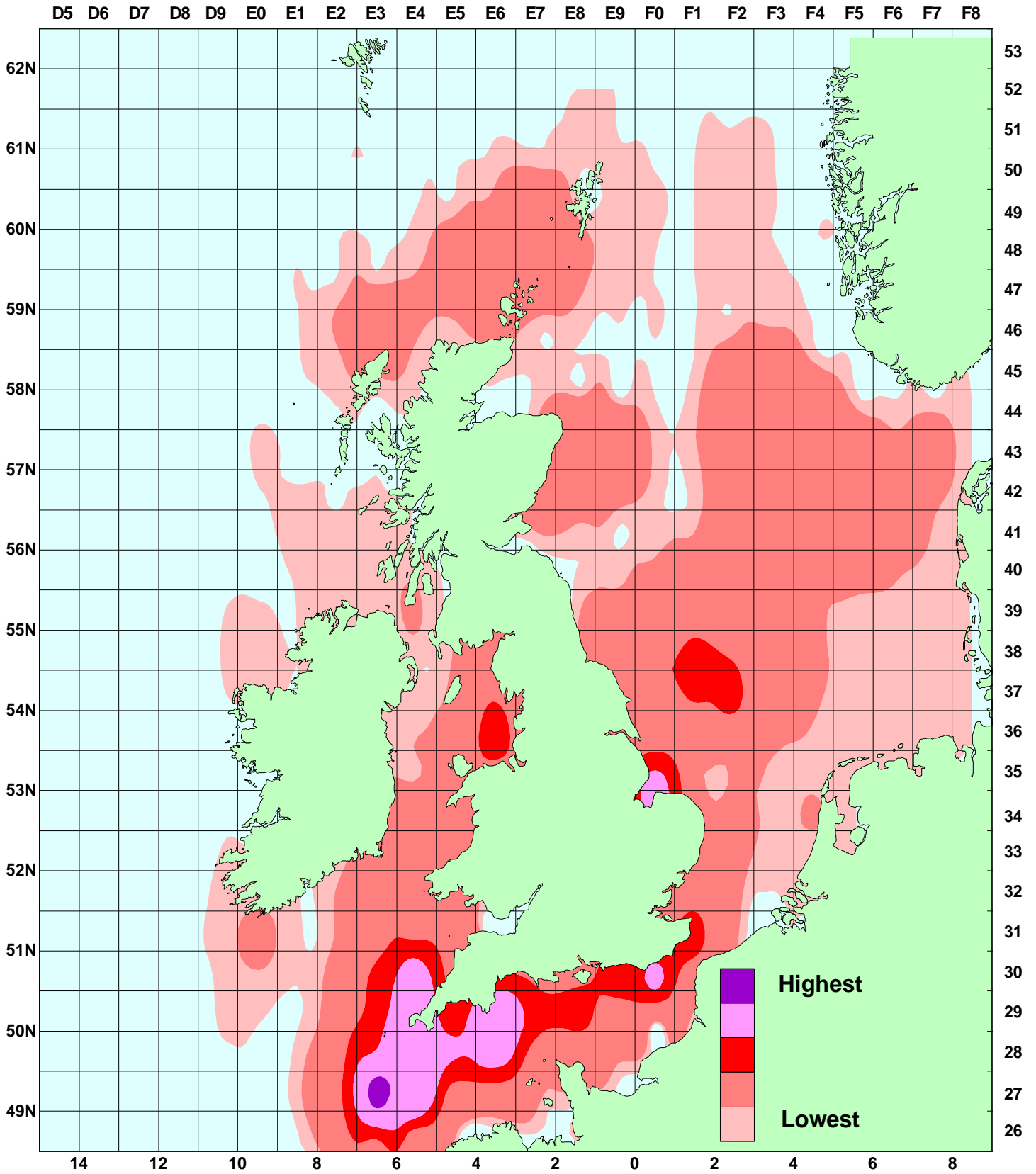
Static Gears



50

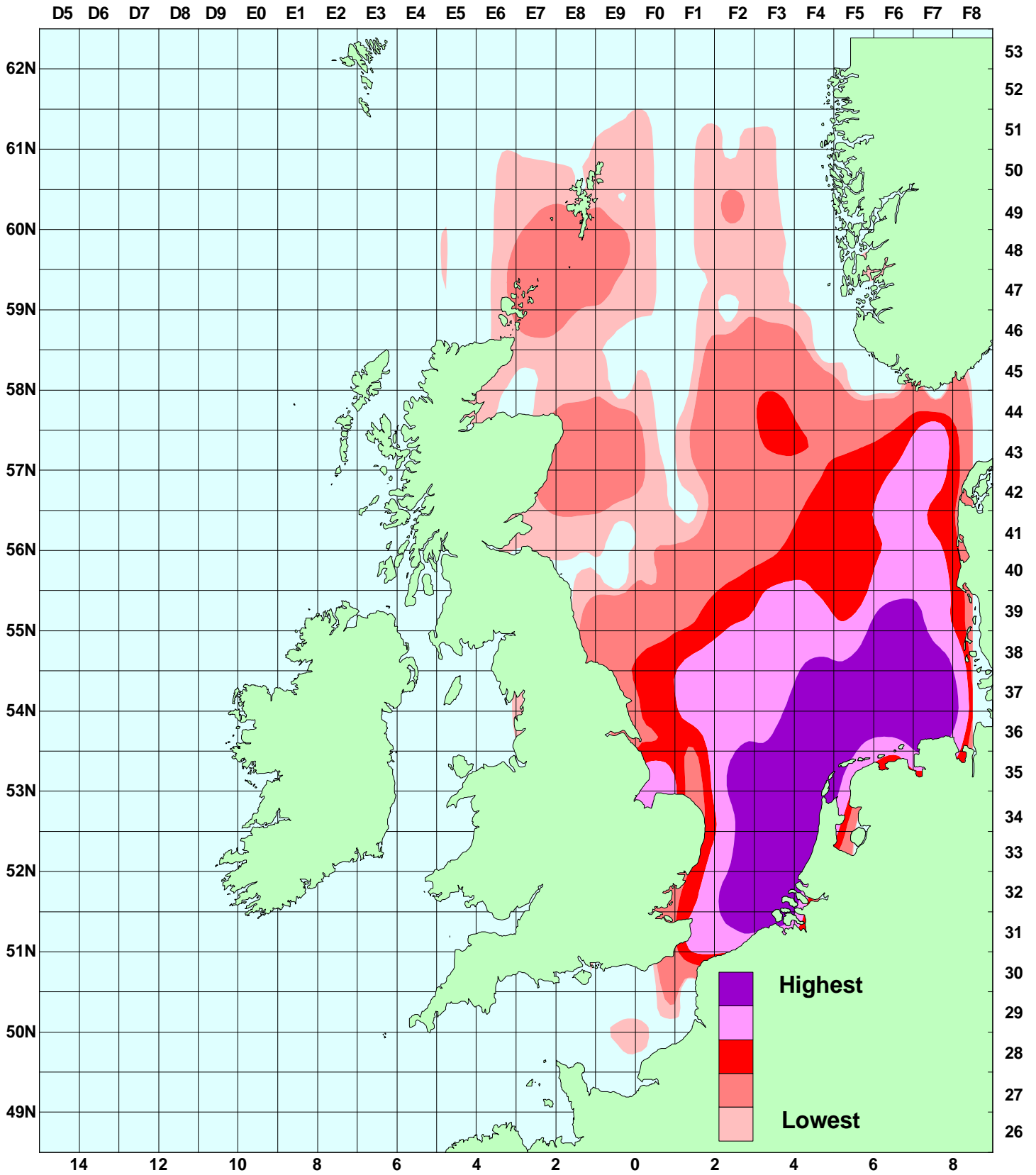
Distribution of Fishing Effort

Beam Trawl



Distribution of International Fishing Effort

N. Sea Beam Trawl (1995)



Relative Value Maps

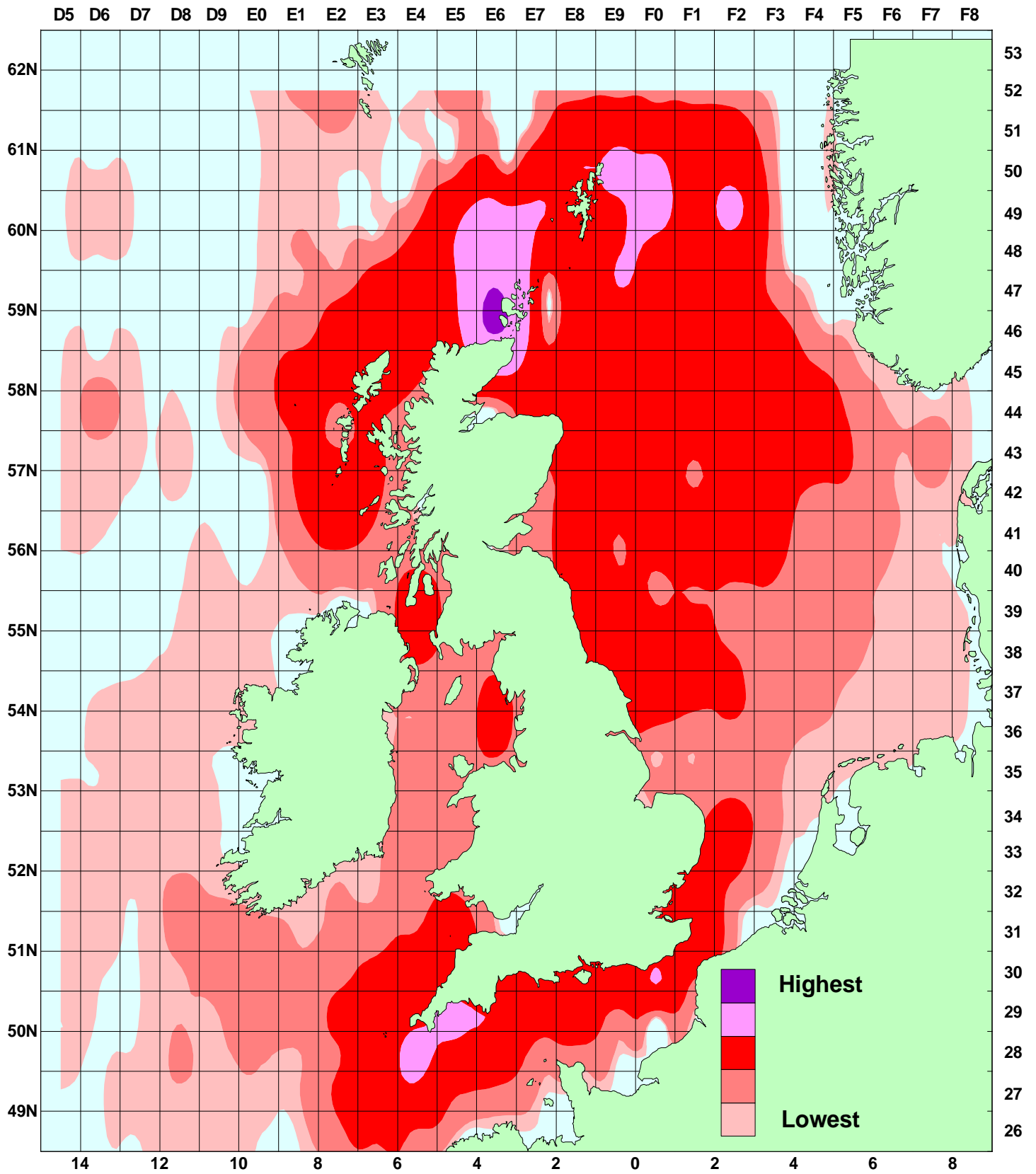
It is not possible to describe all sensitivities by a common metric. Overall value of the different species by area (financial yield per ICES square) is an indication of the differential worth of areas and is merely another way of expressing sensitivity. Damaging events eg an oil spill, in an area of higher fisheries value would be of more concern than a similar spill in less productive waters, not only in strictly financial terms to fishermen but also perhaps to fish eating mammals and piscivorous birds via the food chain.

The following maps show annual value by area. The first three maps show the value of the demersal, pelagic, and the principal shellfish, namely *Nephrops* and shrimp. The fourth map shows the values of other shellfish (scallops, crabs and lobsters) and its more coastal distribution reflects the fact that static gears are often used to collect these resources. These data, like those for effort described in the previous section, are allocated to a rectangle, but have been smoothed to show a continuous change between rectangles. Clearly they should be used only as an indication of the likely sensitivity of an area. Values are arranged in arbitrary categories, from the highest to the lowest and, as with the effort maps, the actual values are different for the different resources.

A final map which sums the values of all resources by area is also included. It is an indication of overall economic productivity of the different marine areas around the UK.

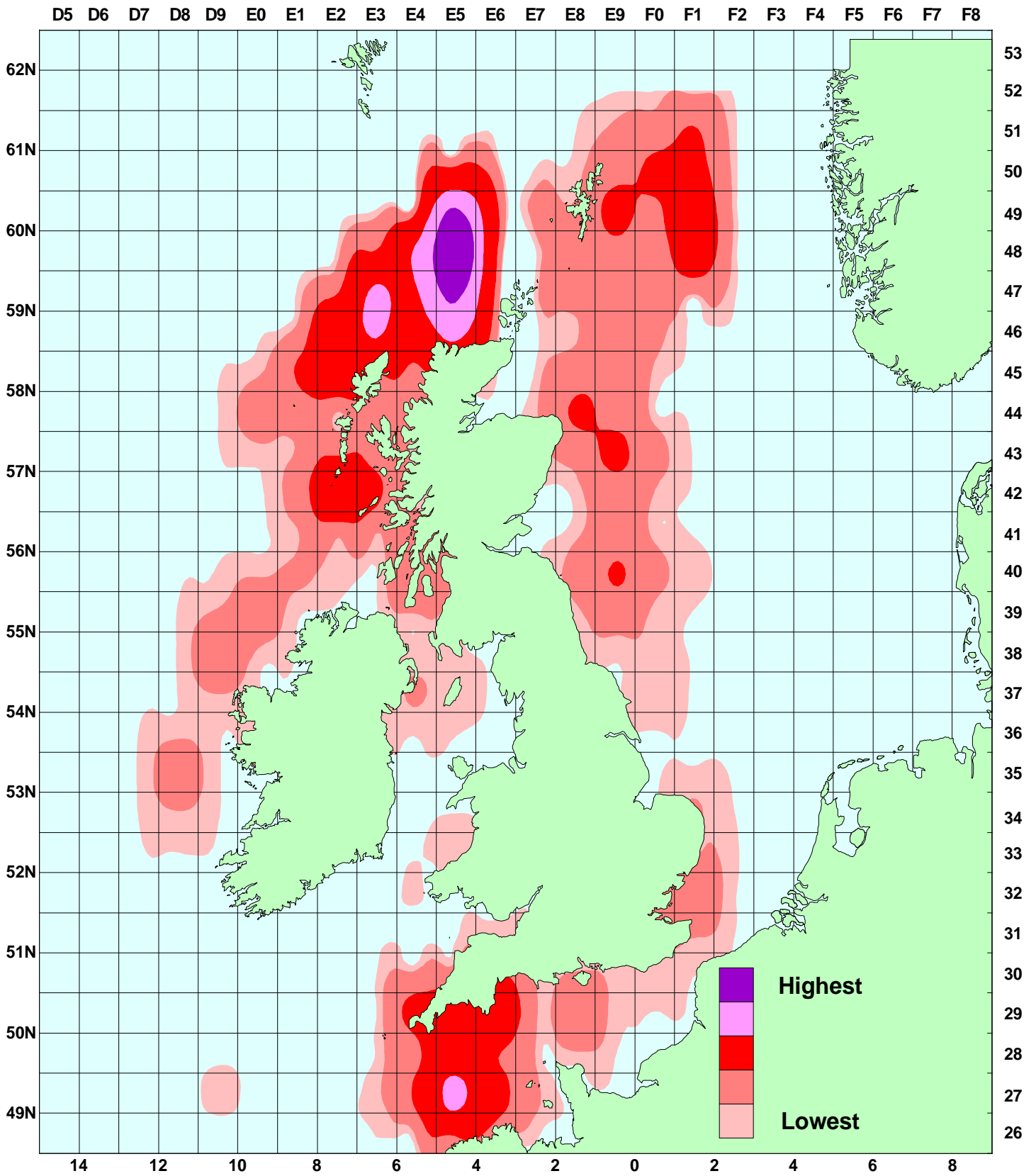
Relative Value 1996

Demersal species



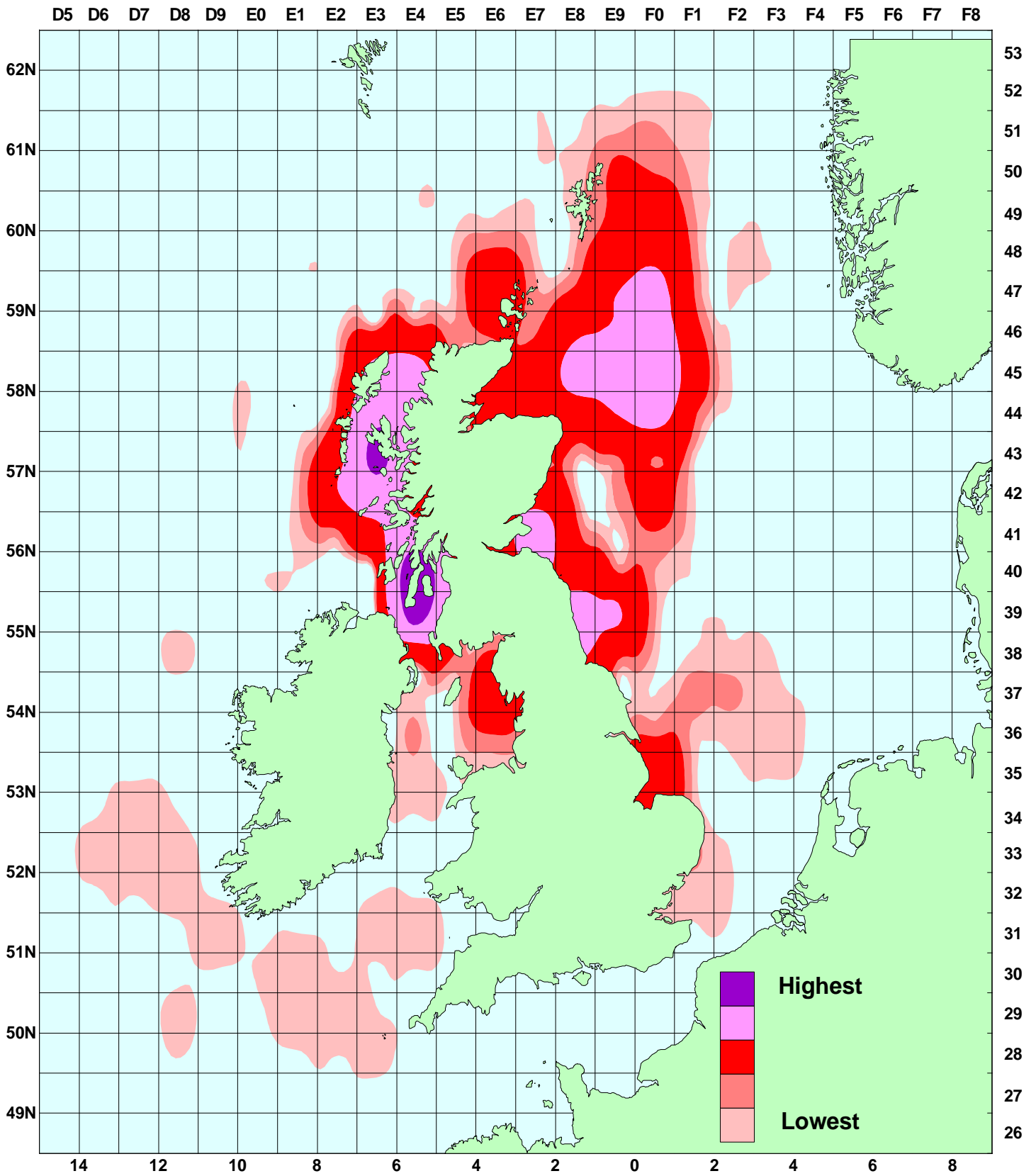
Relative Value 1996

Pelagic species



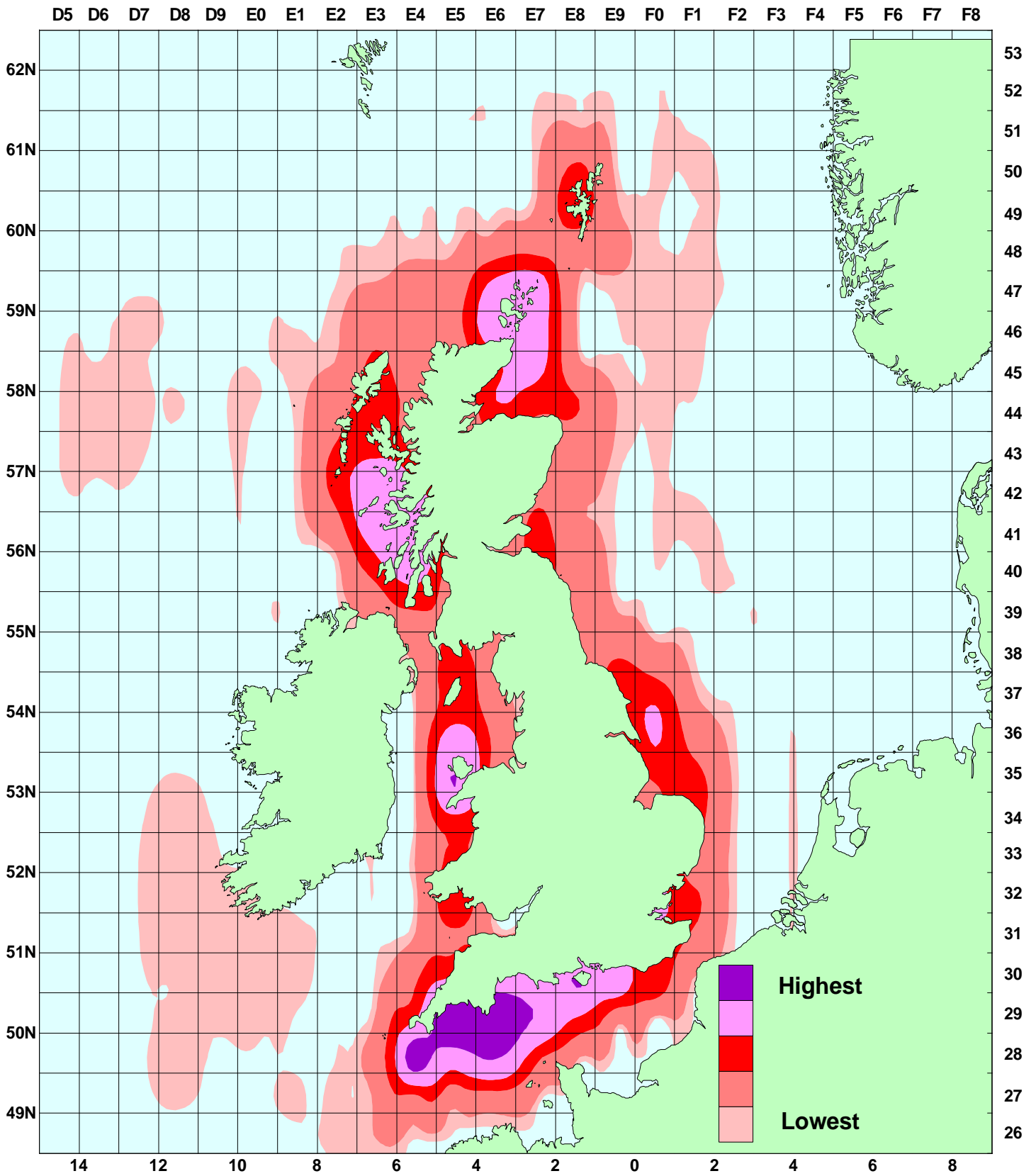
Relative Value 1996

Nephrops & Shrimps



Relative Value 1996

Shellfish (exc *Nephrops*/Shrimp)



Relative Value 1996

Total All Species

