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ICES SUMMARY REPORT

Summary:
Key words:

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1 NS - IBTS

In the North Sea, the IBTS started in the 1960s as a survey that was directed at juvenile herring and was at that time called the International Young Herring Survey (IYHS).

As it was gradually realised that the survey also yielded valuable information for other fish species, such as cod and haddock, the objectives were broadened and the survey was renamed into the International Young Fish Survey (IYFS). Besides the IYFS, which was carried out in the first quarter, a number of national surveys developed in the 1970s and 1980s that were mainly carried out in the third quarter.

In 1990, ICES decided to combine the international and the national surveys into the IBTS. The IBTS has been carried out twice per year (1st and 3rd quarter) since 1997, and on a quarterly basis in the period 1991-1996.

The stratification of the survey grid has always been based on ICES statistical rectangles (one degree longitude x 0.5 degree latitude 30 x 30 nautical miles). Each rectangle is usually fished by the ships of two different countries, so that at least two hauls are made per rectangle. The ICES-rectangles are used to evenly distribute the hauls over the whole North Sea (Figure **??**).

Most statistical rectangles contain a number of possible tows that are deemed to be free of obstructions, and vessels are free to choose any of these positions in the rectangles that they are surveying. In some rectangles, sampling may be further stratified due to significant changes in seabed depth which may, in turn, cause variations in the fish population.

In rectangles or strata that are to be sampled more than once by the same vessel, is the IBTS manual recommends that valid hauls are separated by at least one day or by at least 10 miles wherever possible. Tows in adjacent rectangles should also be separated by at least 10 miles.

In practise, all countries except England (Q3) and Norway (Q1 and Q3) select the hauling position randomly from a list of clear haul positions. England and Norway use the same fixed hauls every year.

To obtain the length distribution, the catch is sorted into species or species/sex. Where the numbers of individuals are too large for all to be measured (due to time constraints etc), a representative sub-sample is selected of at least 75 fish (although sampling a very limited length range could be adequately achieved with less). In the event that a truly representative sub-sample cannot be selected, it will be necessary to further sort the species into two or more size grades or categories (Manual for the International Bottom Trawl Surveys, version VII).

Otolith samples are collected within 9 specified Roundfish areas as illustrated in Figure **??**. For all species, the same areas are used. For the target species, the following minimum sampling levels are tried to be obtained for each sampling area:

herring: 8 otoliths per 1/2 cm group

sprat: 16 otoliths per 1/2 cm group 8.0-11.0cm 12 otoliths per 1/2 cm group >11.0cm

mackerel: 8 otoliths per 1 cm group

cod: 8 otoliths per 1 cm group

haddock: 8 otoliths per 1 cm group

whiting: 8 otoliths per 1 cm group Norway pout: 8 otoliths per 1 cm group

saithe: 8 otoliths per 1 cm group

For the smallest size groups, that presumably contain only one age group, the number of otoliths per length class can be reduced. Inversely, more otoliths per length are required for the larger length classes.

2 The Data

2.1 Data type

The International Bottom Trawl Survey (IBTS) is divided into three types and according to ICES documentation:

- C types - Data calculated as catch per unit effort (CPUE) (number per hour);
- R types - data by haul; and
- S types - sub-sampled data

In the HL- records the code that specifies the data is as follows:

- C - category catch weight is adjusted per hour;
- R - weight of the catergory catch in the haul;
- S - weigth of the category catch in the subsample of the total catch.
- If subsampling was performed per species, but the whole catch was not sub-sampled, R should be reported.

2.2 Description of specifics

- CPUE - catch per unit effort

- mCPUE - mean catch per unit effort
- NoMeas - Number of fish, that is, number of measured fish in the given haul or subsample, species, and sex.

- HLNoAtLngt (haul number at length) - number of fish at this category in. For CPUE data should be adjusted with time.

- Count - number at length per haul

- TotalNo - Number of fish, that is Total number of fish in the given haul and species.

- SubFactor - Factor for subsampling. Sub-sampling factor. If 1/6 of the catch was measured, report 6. If DataType is C, it should be reported as 1. If DataType is S, it is always > 1. If DataType is R, the SubFactor is $= 1$ or >1 for different species depending on whether they were subsampled. More details for use of SubFactor can be found in the manual.

- AreaType - is sampling based on ICES statistical rectangles or survey areas? If it's Statrecs, make sure that all CA-records have the relevant HL-records. 0: ICES statistical Rectangles

2.3 Species

(1) Pleuronectes platessa = plaice,
(2) Clupea harengus = herring
(3) Scomber scombrus = atlantic mackerel
(4) Gadus morhua = atlantic cod
(5) Merlangius merlangus = whiting
(6) Trisopterus esmarkii = norway pout

(7) Melanogrammus aeglefinus = haddock

(8) Sprattus sprattus = sprats

(9) Pollachius virens = saithe

(10) Scyliorhinus canicula = morgay

(11) Myxine glutinosa = hagfish

(12) Galeus melastomus = blackmouth catshark

3 Computation of Statistics

3.1 Count

- Data Type R: the Subfactor is: $a = 1$ or $b > 1$. Therefore,

$$Count = \text{HLNoAtLngt} \times \text{Subfactor}$$

or

$$Count = \text{HLNoAtLngt} \times \text{Subfactor a} + \text{HLNoAtLngt} \times \text{Subfactor b} \tag{3.1}$$

- Data Type C: The Subfactor is 1 always

$$Count = \text{HLNoAtLngt} \Big/ [(\text{Subfactor} \times 60)/\text{Haul duration}]$$

- Data Type S: HLNoAtLngt - **not sure of this**

3.2 Total

- Data Type R: the Subfactor is: $a = 1$ or $b > 1$. Therefore,

$$\begin{aligned} Total\ Number &= \text{Sum(HLNoAtLngt)} \times \text{Subfactor} \\ &= \text{NoMeas} \times \text{Subfactor} \end{aligned}$$

or

$$\begin{aligned} Total\ Number &= \text{Sum(HLNoAtLngt)} \times \text{Subfactor a} \ + \ \text{Sum(HLNoAtLngt)} \times \text{Subfactor b} \\ &= \text{NoMeas} \times \text{Subfactor a} \ + \ \text{NoMeas} \times \text{Subfactor b} \end{aligned} \tag{3.2}$$

- Data Type C:

$$Total\ Number = \text{Count} \Big/ (\text{Haul duration} \times 60).$$

4 IBTS Indices

In IBTS North Sea, the indices are calculated per index area, which are specific for each species. The indices are calculated as mean at age per statistical rectangle and then as a mean of the statistical rectangles over the index area. Some statistical rectangles are reduced in size due to land or very shallow water. For herring, sprat and saithe, the mean CPUE at age are weighted with the percent covered with water depths between $10m$ and $200m$ for these statistical rectangles.

4.1 CPUE Per Length Class

4.1.1 Formulas

(1) The CPUE per length class per haul is computed as follows

- Data Type R: the Subfactor is: $a = 1$ or $b > 1$. Therefore,

$$CPUE_{H,l} = (\text{Count } \times \ 60) \Big/ \text{Haul duration}$$

or

$$CPUE_{H,l} = (\text{Count}(\text{Subfactor a} + \text{Subfactor b}) \times 60) \Big/ \text{Haul duration} \tag{4.1}$$

- Data Type C: The Subfactor is 1 always

$$CPUE_{H,l} = \text{HLNoAtLngt} \times \text{Subfactor}$$

- Data Type S:

(2) The mean catch per unit effort at length per statistical rectangle (ST) is defined as the sum of the number per length (l) (1 cm group and 0.5 cm for herring and sprat) per haul (H) by year and quarter divided by the total hauls in the statistical rectangle,

$$\text{mCPUE}_{ST,l} = \frac{\sum_{ST} \text{CPUE}_{H,l}}{\sum_{ST} H} \tag{4.2}$$

(3) The mean number by index area is computed by taking the sum of the mean catch per length (sum of $\text{mCPUE}_{ST,l}$ in equation (4.2)) in all fished rectangles divided by the number of fished rectangles in the index area, i.e.,

$$\text{mCPUE}_{IA,l} = \frac{\sum_{IA} \text{mCPUE}_{ST,l}}{\sum_{IA} ST}. \tag{4.3}$$

4.2 CPUE Per Age Class

Age-Length-Keys (ALK) is an aggregation of individual samples from a haul combined over a larger area. For IBTS, this larger area is the Round Fish area (statistical rectangle): IBTS Area of ALK - Round fish area.

The CPUE per age (a), length and haul (H) is calculated as the fraction of the age distribution:

$$\text{CPUE}_{H,a,l} = \frac{\text{CPUE}_{H,l} \times ALK_{a,l}}{ALK_l} \tag{4.4}$$

(1) If there is no ALK for a length in the CPUE file, age information is obtained as follows:

- If length class (CPUE) $<$ minimum length class (ALK), then age=1 for the first quarter and age=0 for all other quarters (see Annex 1)

- If minimum length class (ALK) $<$ length class (CPUE) $<$ maximum length (ALK) then age is set to the nearest ALK. If the ALK file contains values at equal distance, a mean is taken from both values.

(2) If length class (CPUE) $>$ maximum length (ALK) age is set to the plus group

(3) Merge ALK file with CPUE file by year, quarter, length class (see Annex 4)

[Figure 1 about here.]

4.2.1 ALKRFA and CPUE: This is CPUE at age by length class (CPUEALK)

(1) Merge ALKRFA and CPUE by year, quarter, RFA, length class

(2) Sum numbers at length per age per statistical rectangle

(3) Sum number of hauls per statistical rectangle

(4) Calculate mean CPUE at length per age per by statistical rectangle (=result(2)/recult(3))

4.2.2 ALKRFA and CPUE: Weighted CPUE at age by length class (CPUEALKw)- herring, sprat, saithe

For North Sea IBTS herring, saithe and sprat, data are weighted by depth strata in the statistical rectangle (see Annex 1 and Annex 3). As herring in RFA 8 and 9 are autumn spawners, ages > 1 are set to age=0 for North Sea IBTS herring in quarter 1 in RFA 8 and 9.

(1) Merge ALKRFA and CPUE by year, quarter, RFA, length class

(2) Sum numbers at length per age per statistical rectangle

(3) Sum weights of all valid hauls by statistical rectangle, following Annex 3

(4) Calculate weighted mean CPUE =result(2)/result(3)

[Figure 2 about here.]

[Figure 3 about here.]

4.2.3 CPUEALK: Index

(1) Sum CPUE per age by indexarea

(2) Sum number of fished statistical rectangles in indexarea

(3) Calculate mean CPUE for the index area (=result(1)/result(2))

4.2.4 Formulas

The mean catch per unit effort at age per statistical rectangle (ST) is defined as the sum of the number per length (l) and age (a) (1 cm group and 0.5 cm for herring and sprat) per haul (H) by year and quarter divided by the total hauls in the statistical rectangle,

$$\text{mCPUE}_{ST,a,l} = \frac{\sum_{ST} \text{CPUE}_{H,a,l}}{\sum_{ST} H} \tag{4.5}$$

The mean number by index area is computed by taking the sum of the mean catch per age and length (sum of $\text{mCPUE}_{ST,a,l}$ in equation (4.5)) in all fished rectangles divided by the number of fished rectangles in the index area, i.e.,

$$\text{mCPUE}_{IA,a,l} = \frac{\sum_{IA} \text{CPUE}_{ST,a,l}}{\sum_{IA} ST}. \tag{4.6}$$

The final indices by age are computed by taking the sum of the length classes for a given age within the index area, i.e.,

$$\text{mCPUE}_{IA,a} = \sum_{l} \text{CPUE}_{IA,a,l}, \tag{4.7}$$

5 Spatial plots for countries across year

[Figure 4 about here.]

[Figure 5 about here.]

[Figure 6 about here.]

[Figure 7 about here.]

[Figure 8 about here.]

[Figure 9 about here.]

[Figure 10 about here.]

[Figure 11 about here.]

[Figure 12 about here.]

[Figure 13 about here.]

4.jpg

Annex 4

Filling ALK procedure

MinL		10
MaxL		23

	Age	Age	Age	Age	Age
cm	1	2	3	4	5+
5		0	0	0	0
6		0	0	0	0
7		0	0	0	0
8		0	0	0	0
9		0	0	0	0
10	5	2	1	0	0
11	3	7	2	0	0
12					
13	2	8	1	0	0
14	9	2	7	1	8
15					
16					
17					
18					
19					
20					
21					
22	1	2	4	5	2
23	2	4	5	6	1
24+	0	0	0	0	1

	Age	Age	Age	Age	Age
cm	1	2	3	4	5+
5	1	0	0	0	0
6	1	0	0	0	0
7	1	0	0	0	0
8	1	0	0	0	0
9	1	0	0	0	0
10	5	2	1	0	0
11	3	7	2	0	0
12	2.5	7.5	1.5	0	0
13	2	8	1	0	0
14	9	2	7	1	8
15	9	2	7	1	8
16	9	2	7	1	8
17	9	2	7	1	8
18	5	2	5.5	3	5
19	1	2	4	5	2
20	1	2	4	5	2
21	1	2	4	5	2
22	1	2	4	5	2
23	2	4	5	6	1
24+	0	0	0	0	1

Figure 1: ANNEX 4.

Annex 1

Day-night haul, min-max length and aggregation of ALK and CPUE lookup table for individual index areas

Index area and species	Quarter	Maximum age	Minimum length (mm)	Maximum length (mm)	ALK area level	CPUE area level	Length class aggregation level	Length Class (mm)	Area weighting taken into account	Day/night
NS_Cod	1	6	150	900						
NS_Cod	2	6	70	1100						
NS_Cod	3	6	70	1100		Statistical				
NS_Cod	4	6	70	1100	RFarea	rectangle	1 cm	1500	no	no
NS_CodCat	1	6	150	900		Statistical				
NS_CodCat	3	6	70	1100	RFarea	rectangle	1 cm	1500	no	no
NS_Haddock	1	6	150	600				800	no	no
NS_Haddock	2	6	100	700					no	no
NS_Haddock	3	6	100	700		Statistical				
NS_Haddock	4	6	100	700	RFarea	rectangle	1 cm	1000		
NS_Herring	1	5	150	320						
NS_Herring	2	5	60	340						
NS_Herring	3	5	60	340		Statistical				
NS_Herring	4	5	60	340	RFarea	rectangle	0.5 cm	500	yes	yes
NS_Her1to9	1	5	60	125	RFarea	Statistical rectangle	0.5 cm	500	1	1
NS_Her1to7	1	5	60	125	RFarea	Statistical rectangle	0.5 cm	500	1	1
NS_Mackerel	1	6	200	450						
NS_Mackerel	2	6	50	450						
NS_Mackerel	3	6	50	450		Statistical				
NS_Mackerel	4	6	50	450	RFarea	rectangle	1 cm	600	no	no
NS_Norway Pout	1	6	100	250						
NS_Norway Pout	2	6	50	250						
NS_Norway Pout	3	6	50	250						
NS_Norway Pout	4	6	50	250	RFarea	Statistical rectangle	1 cm	500	no	no
NS_Plaice IIIa	1	10	40	600		Statistical				
NS_Plaice IIIa	3	10	40	600	RFarea	rectangle	1 cm	800	No	no
NS_Saithe	1	6	250	900						
NS_Saithe	2	6	70	1100						
NS_Saithe	3	6	70	1100		Statistical				
NS_Saithe	4	6	70	1100	RFarea	rectangle	1 cm	1200	yes	no
NS_Sprat IIIa	1	6	70	160		Statistical				
NS_Sprat IIIa	3	6	70	160	RFarea	rectangle	0.5 cm	300	yes	yes
NS_Sprat IV	1	6	70	160						
NS_Sprat IV	2	6	45	160						
NS_Sprat IV	3	6	45	160		Statistical				
NS_Sprat IV	4	6	45	160	RFarea	rectangle	0.5 cm	300	yes	yes
NS_Whiting	1	6	150	450				650		
NS_Whiting	2	6	80	500	RFarea					
NS_Whiting	3	6	80	500		Statistical				
NS_Whiting	4	6	80	500		rectangle	1 cm	800	no	no

1.jpg

Figure 2: ANNEX 1.

Annex 3

Weights of the statistical rectangle based on its surface area (10 – 200 meter in the North Sea and 10 -250 meter in the Skagerrak and Kattegat)

StatRec	Weight	StatRec	Weight	StatRec	Weight	StatRec	Weight	StatRec	Weight
31F1	0.6	38F0	1	41F6	1	44F1	1	47G0	0.3
31F2	0.8	38F1	1	41F7	1	44F2	1	47G1	0.02
31F3	0.05	38F2	1	41F8	0.1	44F3	1	48E6	1
32F1	0.8	38F3	1	41G0	0.2	44F4	1	48E7	1
32F2	1	38F4	1	41G1	0.97	44F5	0.9	48E8	0.9
32F3	0.8	38F5	1	41G2	0.53	44F8	0.25	48E9	1
32F4	0.01	38F6	1	42E7	0.4	44F9	0.8	48F0	1
33F1	0.3	38F7	1	42E8	1	44G0	0.94	48F1	1
33F2	1	38F8	0.3	42E9	1	44G1	0.6	48F2	1
33F3	1	39E8	0.5	42F0	1	45E6	0.4	48F3	0.5
33F4	0.4	39E9	1	42F1	1	45E7	1	48G0	0.02
34F1	0.4	39F0	1	42F2	1	45E8	1	49E6	0.8
34F2	1	39F1	1	42F3	1	45E9	1	49E7	1
34F3	1	39F2	1	42F4	1	45F0	1	49E8	0.4
34F4	0.6	39F3	1	42F5	1	45F1	1	49E9	1
35F0	0.8	39F4	1	42F6	1	45F2	1	49F0	1
35F1	1	39F5	1	42F7	1	45F3	1	49F1	1
35F2	1	39F6	1	42F8	0.2	45F4	0.6	49F2	1
35F3	1	39F7	1	42G0	0.32	45F8	0.3	49F3	0.5
35F4	0.9	39F8	0.4	42G1	0.89	45F9	0.02	50E6	0.1
35F5	0.1	40E7	0.04	42G2	0.64	45G0	0.24	50E7	0.6
36F0	0.9	40E8	0.8	43E7	0.03	45G1	0.55	50E8	0.7
36F1	1	40E9	1	43E8	0.9	46E6	0.4	50E9	0.9
36F2	1	40F0	1	43E9	1	46E7	0.9	50F0	1
36F3	1	40F1	1	43F0	1	46E8	1	50F1	1
36F4	1	40F2	1	43F1	1	46E9	1	50F2	1
36F5	1	40F3	1	43F2	1	46F0	1	50F3	0.2
36F6	0.9	40F4	1	43F3	1	46F1	1	51E6	0
36F7	0.4	40F5	1	43F4	1	46F2	1	51E7	0
36F8	0.5	40F6	1	43F5	1	46F3	0.8	51E8	0.5
37E9	0.2	40F7	1	43F6	1	46F9	0.3	51E9	1
37F0	1	40F8	0.1	43F7	1	46G0	0.52	51F0	1
37F1	1	41E6	0.03	43F8	0.94	46G1	0.2	51F1	1
37F2	1	41E7	0.8	43F9	0.41	47E6	0.8	51F2	0.5
37F3	1	41E8	1	43G0	0.21	47E7	0.6	51F3	0
37F4	1	41E9	1	43G1	0.7	47E8	1	52E6	0
37F5	1	41F0	1	43G2	0.3	47E9	1	52E7	0
37F6	1	41F1	1	44E6	0.5	47F0	1	52E8	0
37F7	1	41F2	1	44E7	0.5	47F1	1	52E9	0.1
37F8	0.8	41F3	1	44E8	0.9	47F2	1	52F0	0.2
38E8	0.2	41F4	1	44E9	1	47F3	0.6	52F1	0.5
38E9	0.9	41F5	1	44F0	1	47F9	0.01	52F2	0.1
								52F3	0

3.jpg

Figure 3: ANNEX 1.

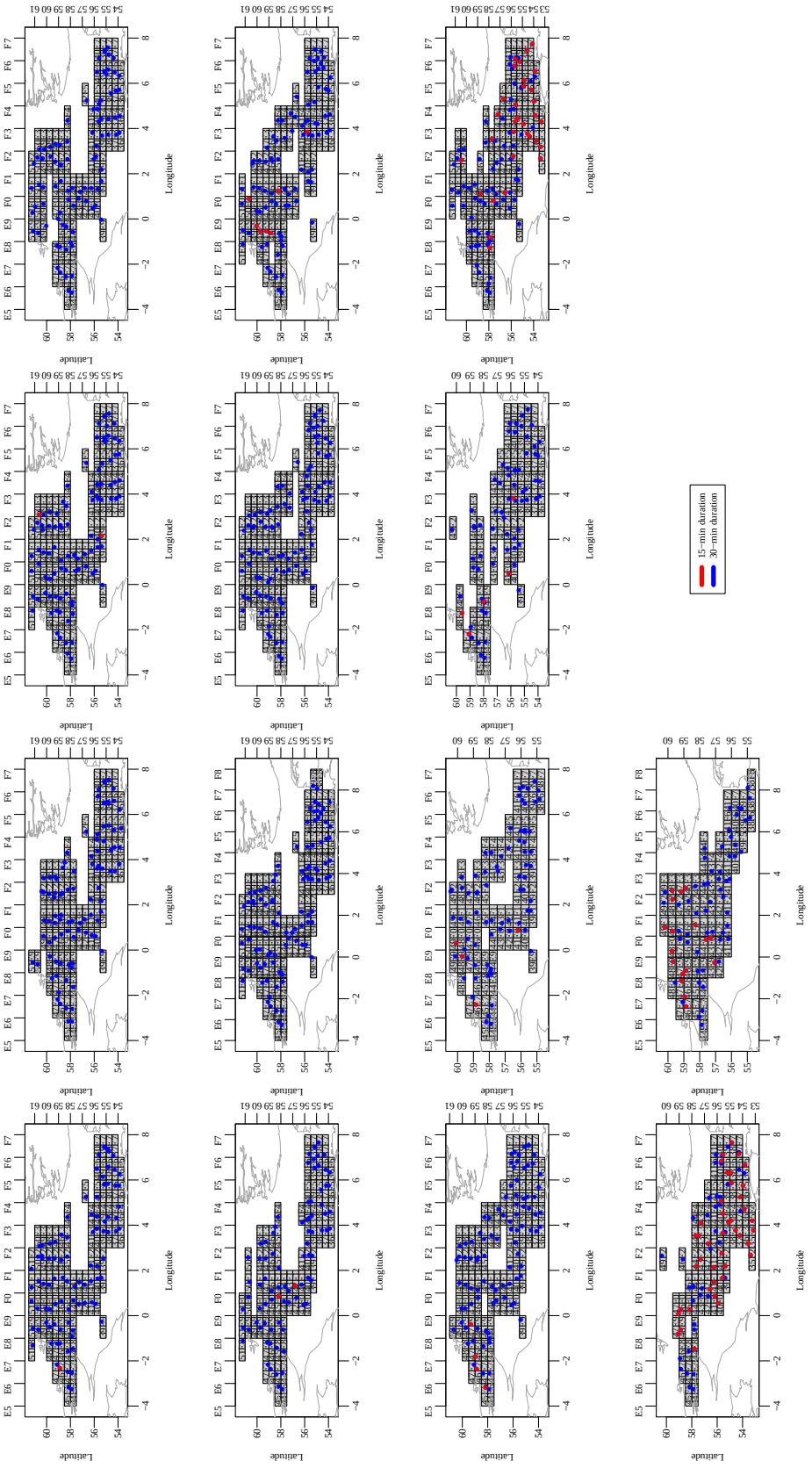

Figure 4: Germany for the period 2004-2017.

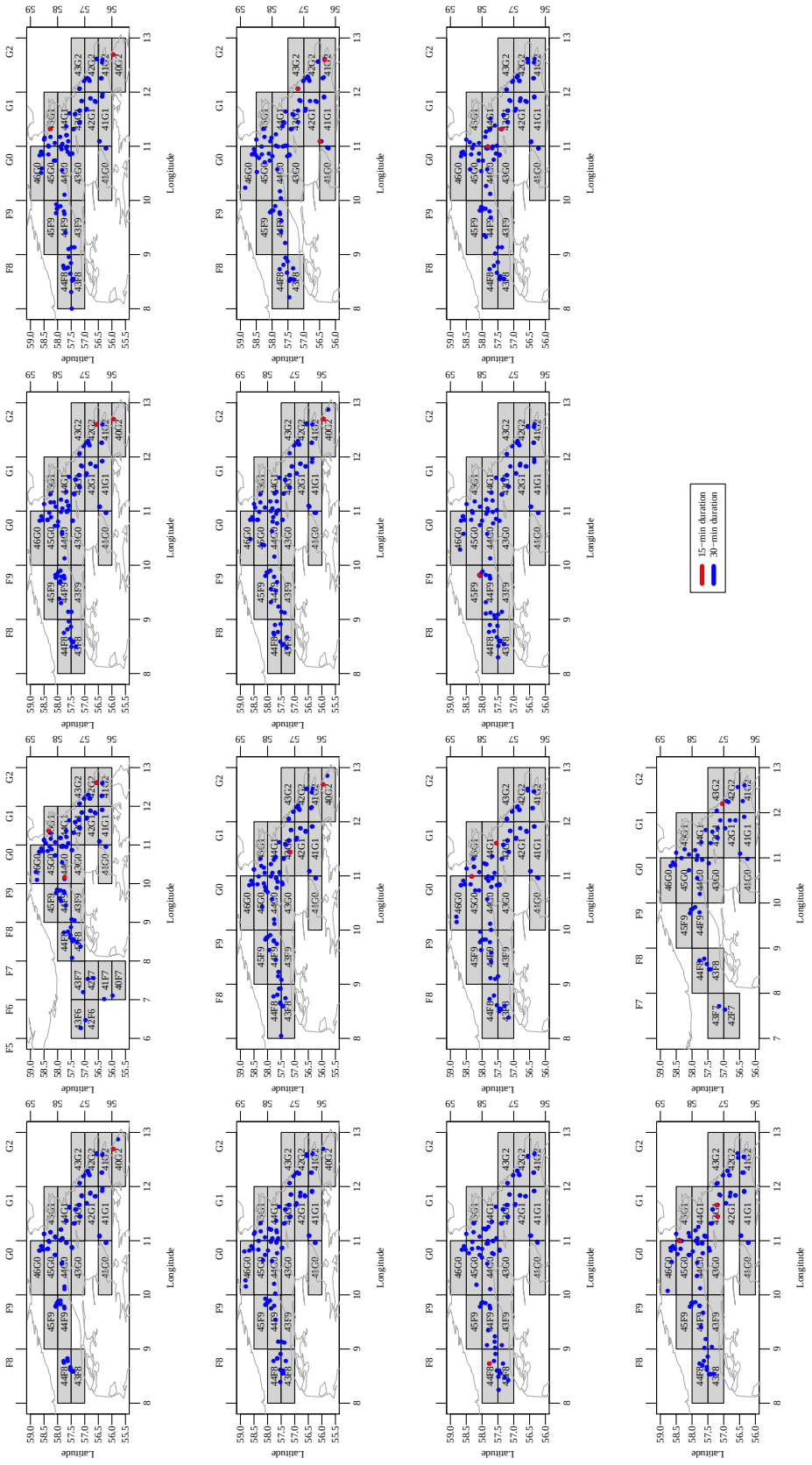

Figure 5: Sweden for the period 2004-2017.

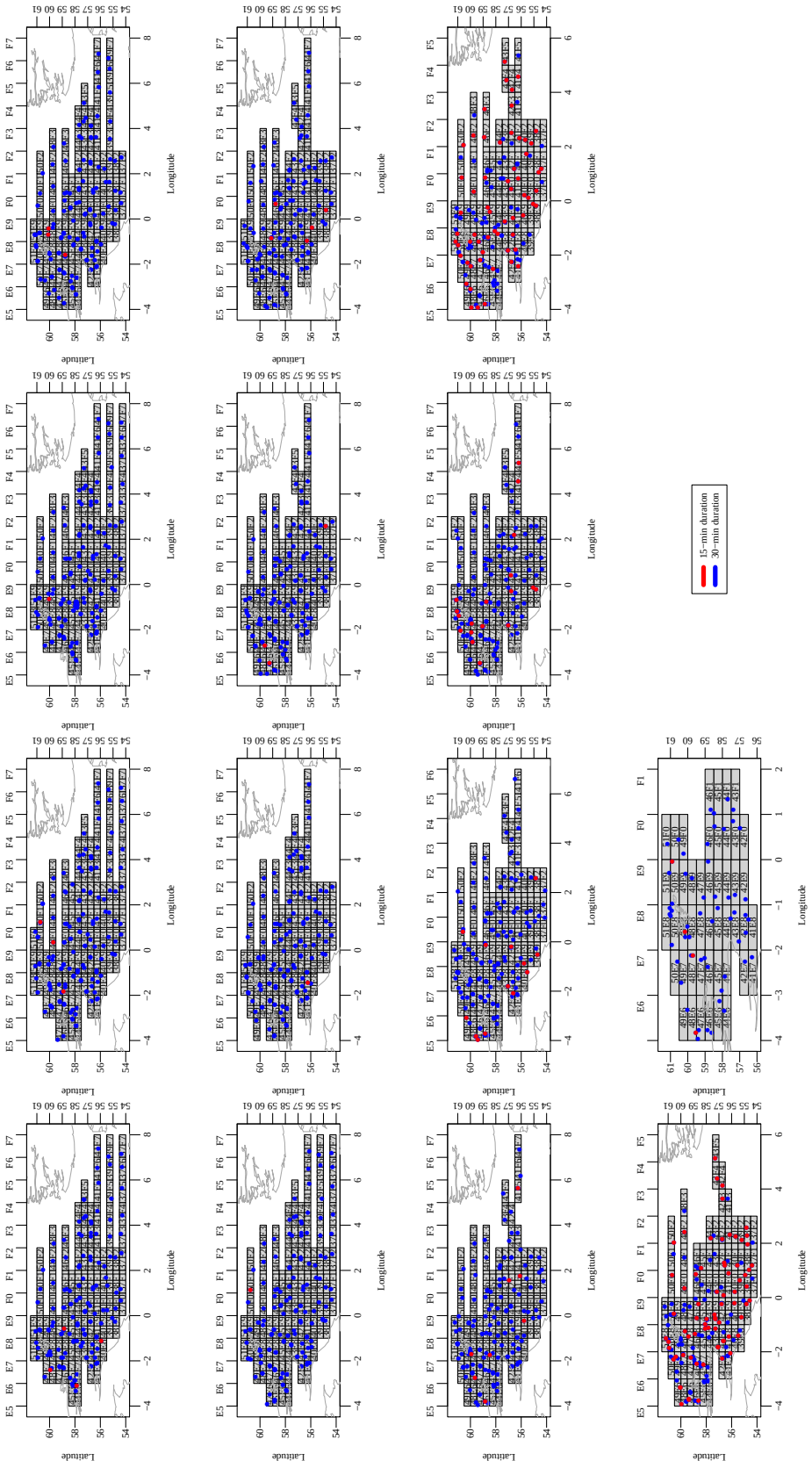

Figure 6: Scotland for the period 2004-2017.

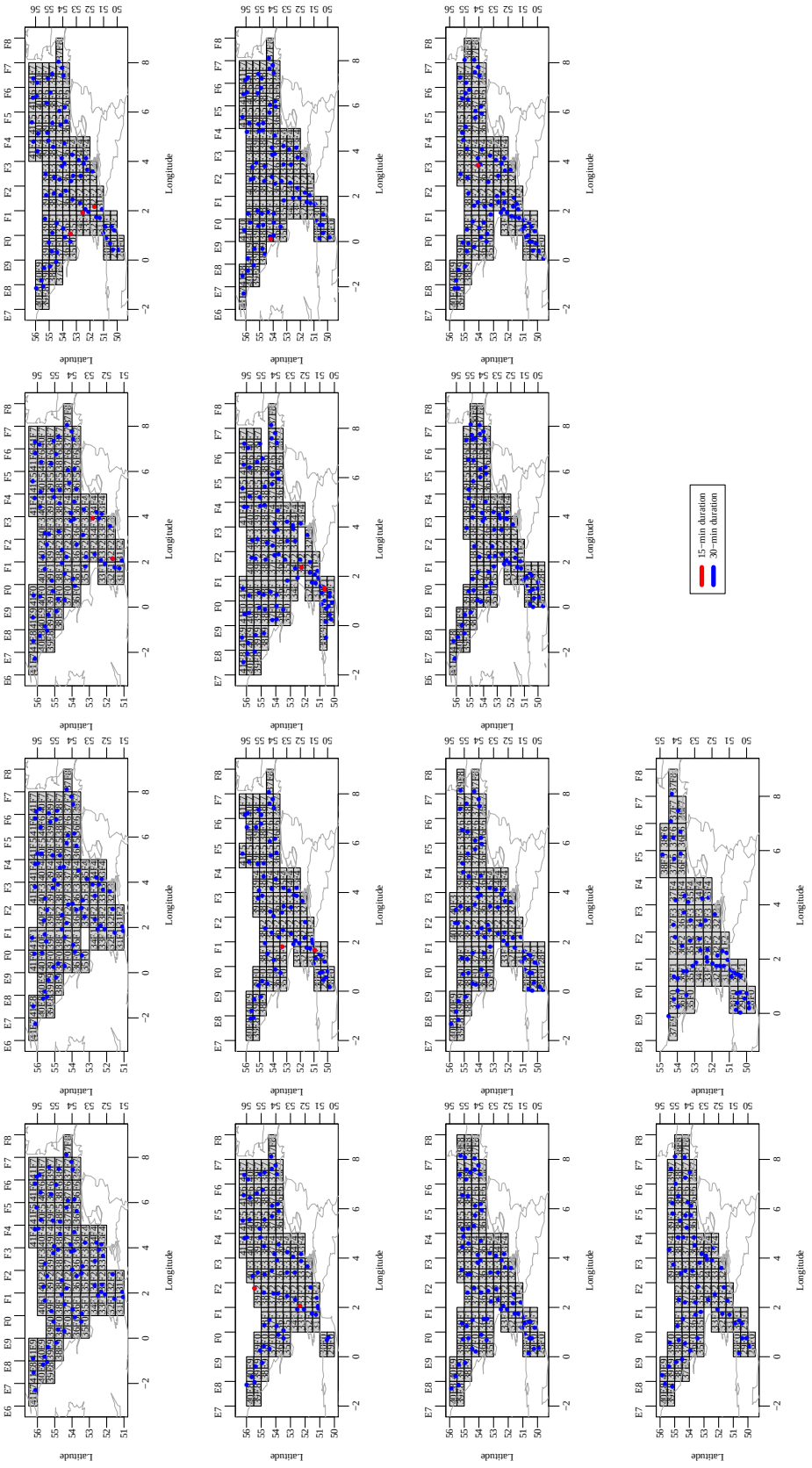

Figure 7: France for the period 2004-2017.

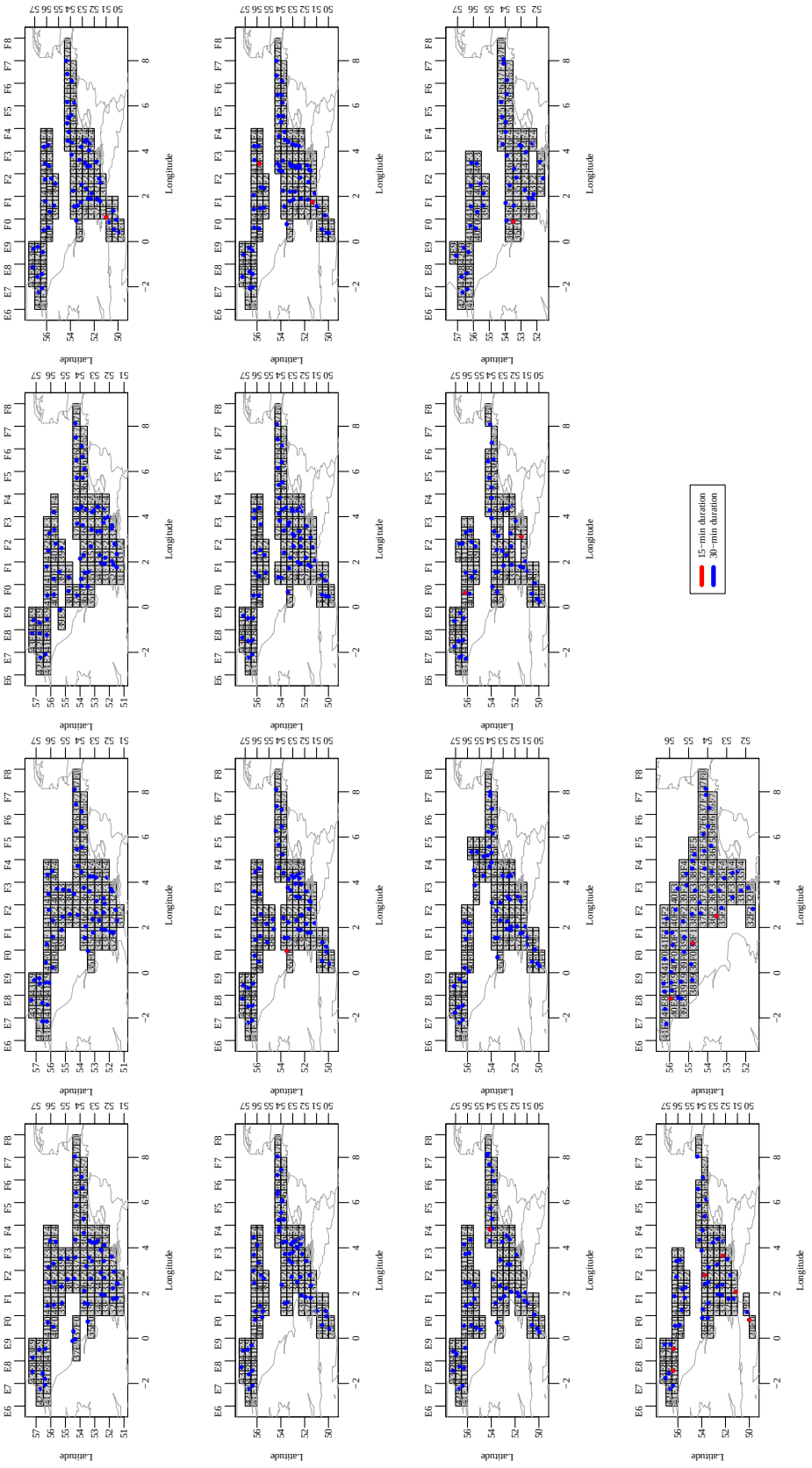

Figure 8: Netherlands for the period 2004-2017.

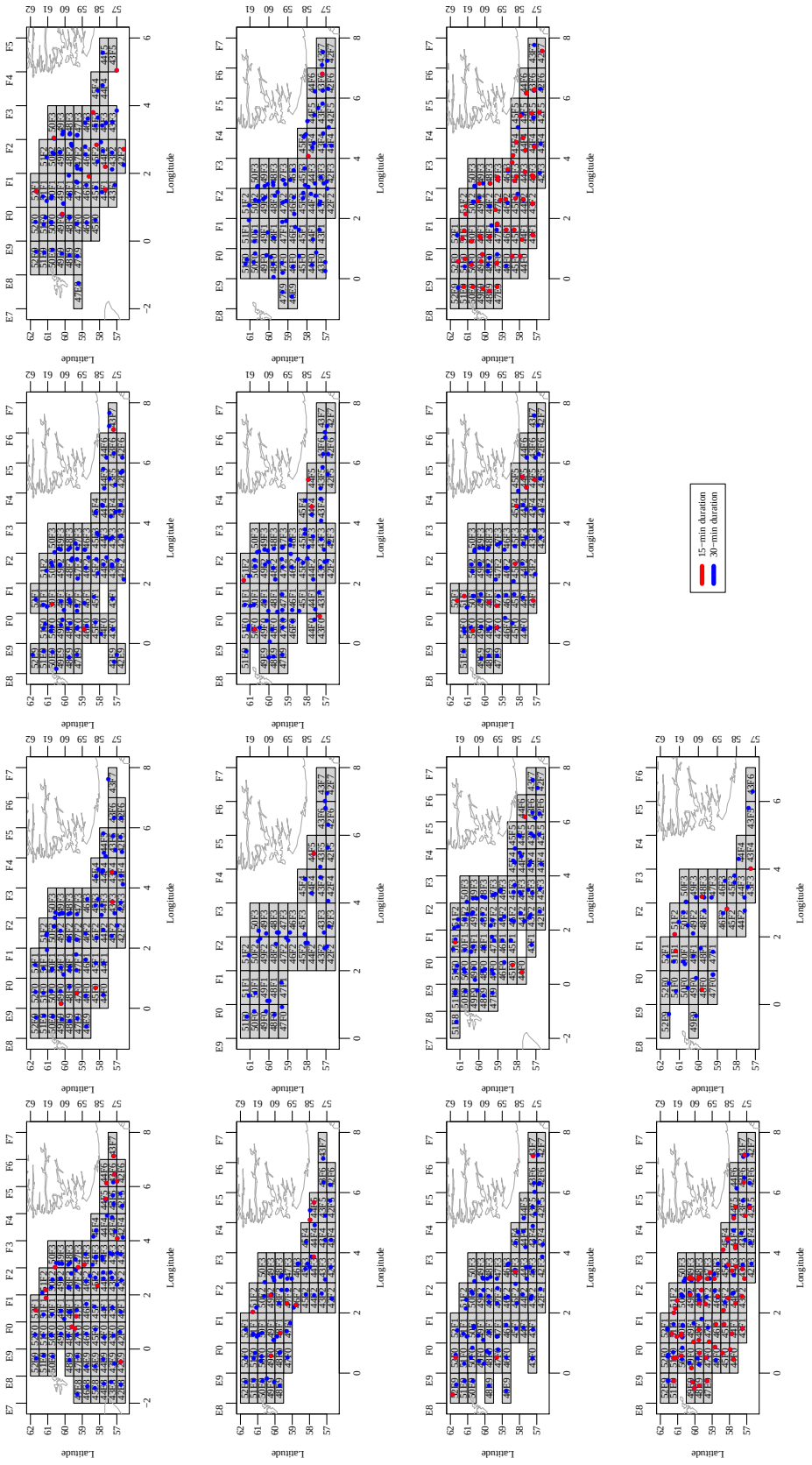

Figure 9: Norway for the period 2004-2017.

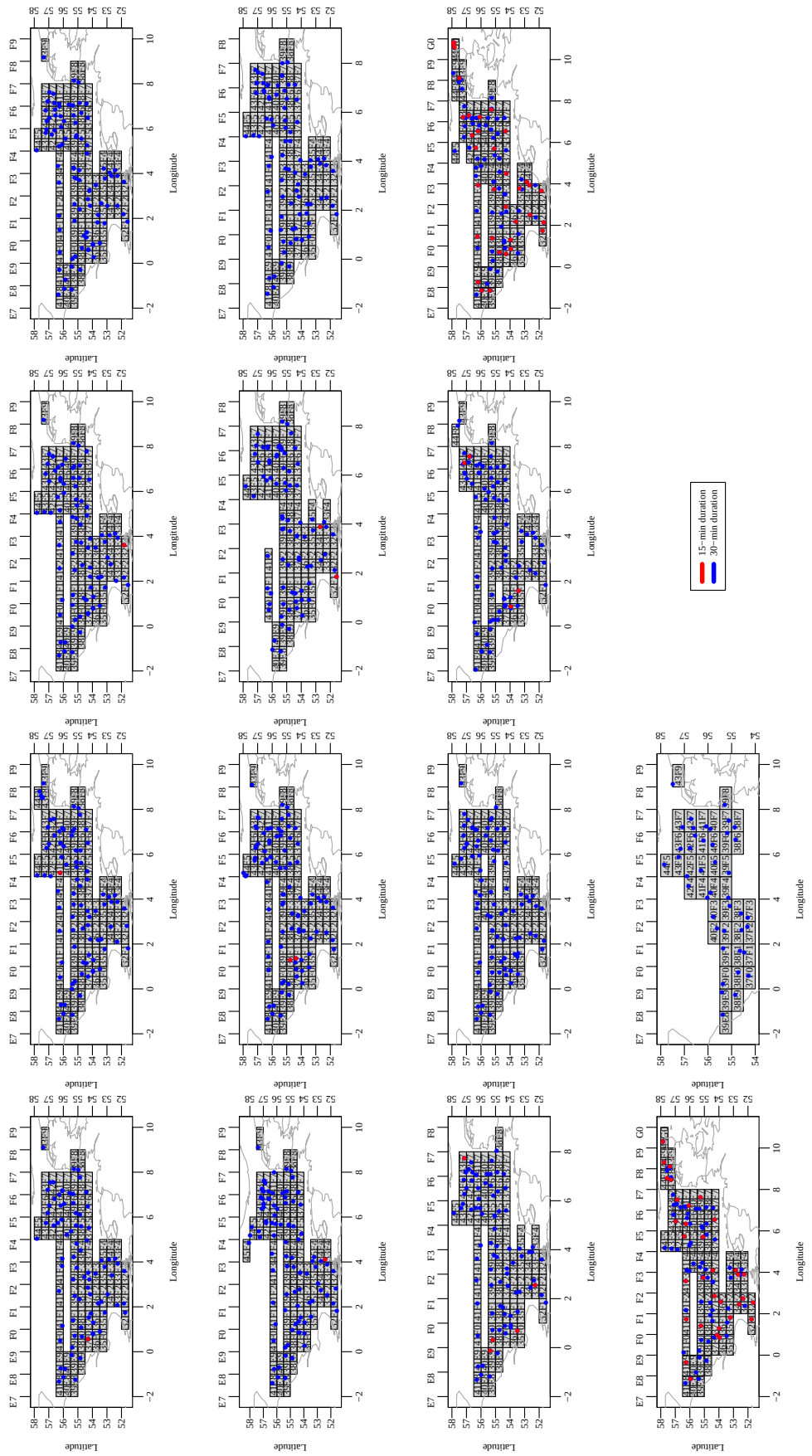

Figure 10: Denmark for the period 2004-2017.

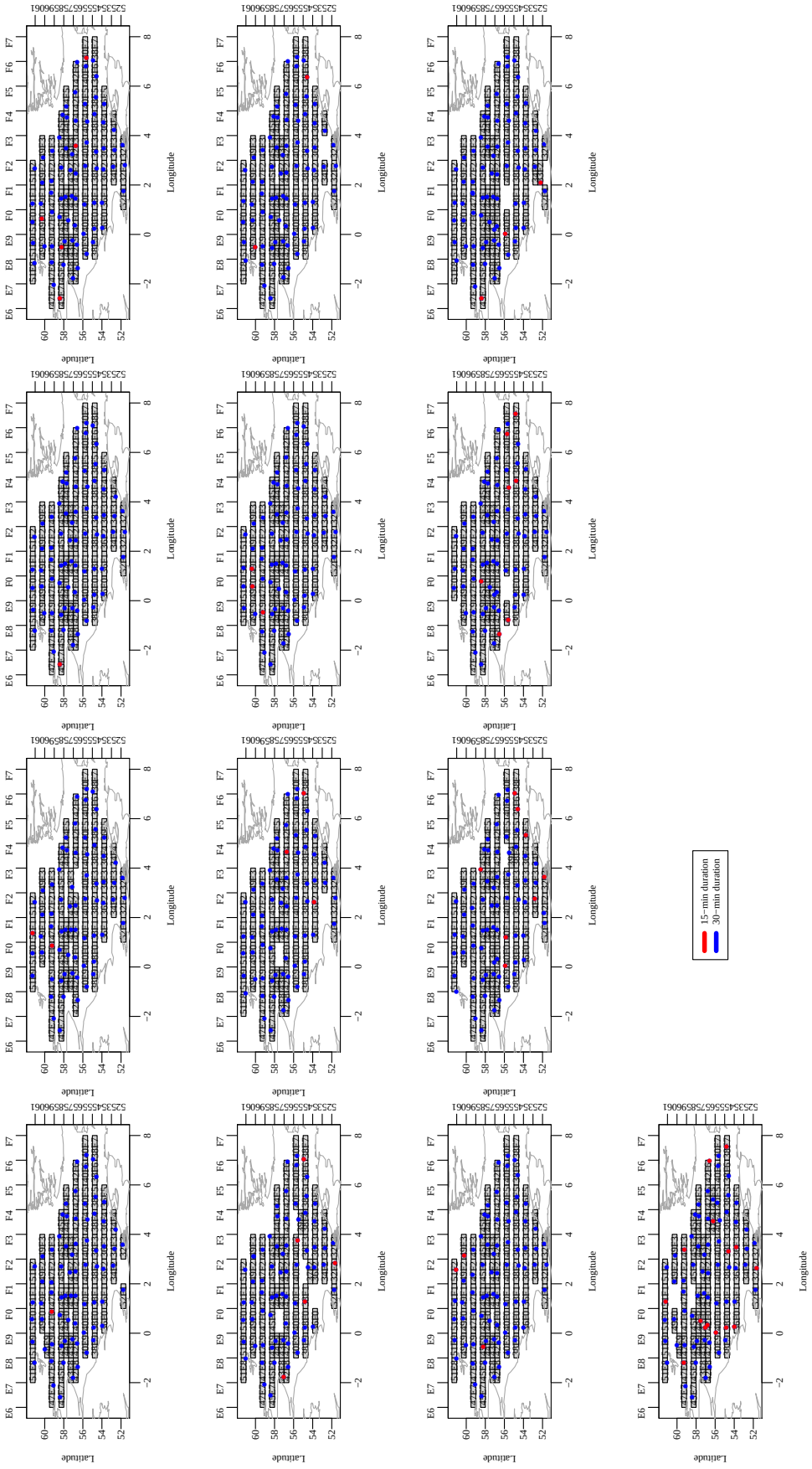

Figure 11: England for the period 2004-2017.

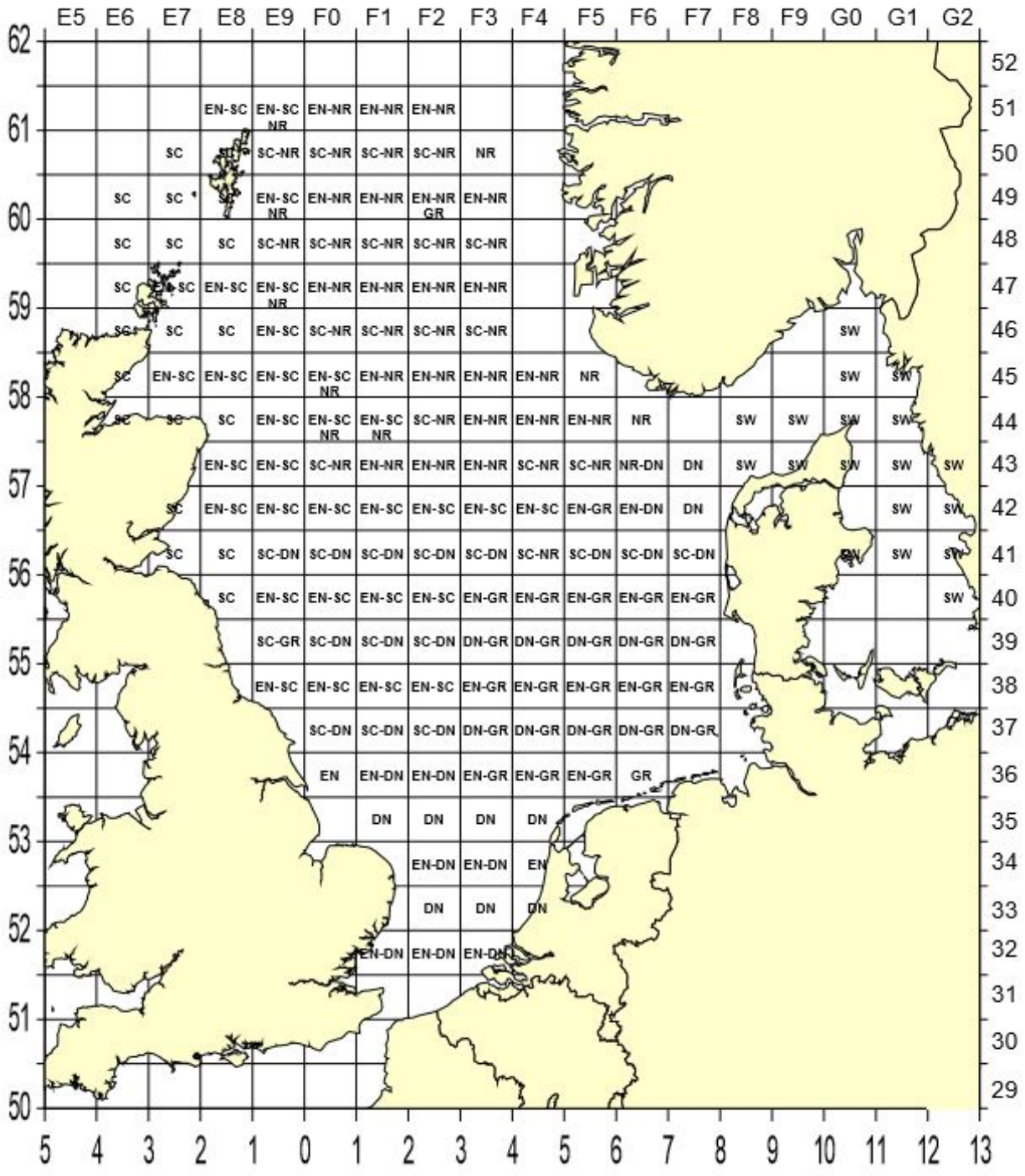

Figure 12: IBTS Quarter 3 Proposed Survey Grid for all participants: D: Denmark, E: England, G: Germany, N: Norway, SC: Scotland, SW: Sweden. The country named first in the rectangle was to take the standard 30-min tow, whereas the second country could take the 15-min tow. England took only 30-min tows, therefore, all countries sharing rectangle with England took the 15-min tow.

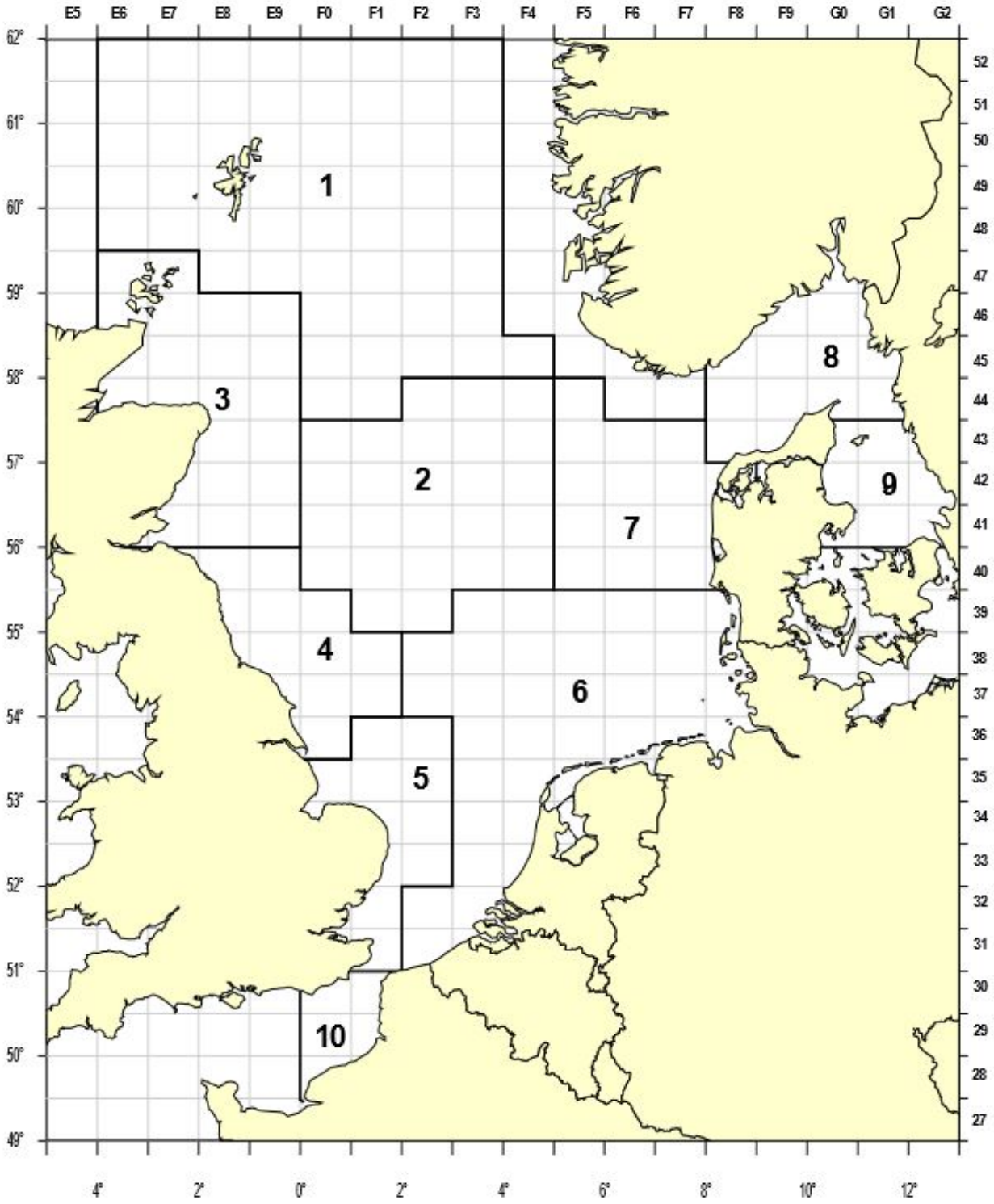

Figure 13: Standard Roundfish Areas: used for roundfish since 1980, for all standard species since 1991. Additional RFA 10 added in 2009. For example, the number 1 indicates ICES Index Area 1, and an ICES Statitical rectangle (ST) in IA 1 is 43F1.