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REPORT ON THE INTERNATIONAL BOTTOM TRAWL SURVEY IN THE NORTH SEA, SKAGERRAK AND KATTEGAT IN 1994 QUARTER 1

by

The International Bottom Trawl Survey Working Group

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*General Secretary
ICES
Palægade 2-4
DK-1261 Copenhagen K
DENMARK

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1 INTRODUCTION

This report presents the final results for the International Bottom Trawl Survey (IBTS) in the first quarter of 1994. The survey was formerly named the International Young Fish Survey (IYFS).

In 1990 it was decided to combine the effort of the International Young Fish Survey with a number of national surveys such as the English and Scottish Groundfish Surveys into a quarterly coordinated bottom trawl survey, to be held for a period of 5 years (ICES C. Res. 1990/4:3). These quarterly surveys started in 1991. See the report of the International Bottom Trawl Survey Working Group (Anonymous, 1994) for more details on the quarterly surveys conducted so far.

The data in this report comprise the bottom trawl catches of the seven standard species (herring *Clupea harengus*, sprat *Sprattus sprattus*, mackerel *Scomber scombrus*, cod *Gadus morhua*, haddock *Melanogrammus aeglefinus*, whiting *Merlangius merlangus* and Norway pout *Trisopterus esmarki*), as well as the catches of herring larvae. Also summarized results of temperature and salinity sampling are presented.

2 SURVEY METHODS AND PARTICIPATION

For all matters on survey methodology, the reader is referred to the Manual (Addendum to ICES Doc. C.M. 1992/H:3). Details on the participation in the 1994 survey are given below.

The work at sea was hampered by bad weather and technical problems with some of the participating research vessels. Except for four rectangles in the north-western part of the survey area the overall coverage has been good.

Country	Vessel	Period[1]	GOV	MK/IKMT
Denmark	"Dana"	02.02/20.02	48	90
France	"Thalassa"	05.02/20.02	54	-
Germany	"W.Herwig III"	19.02/21.03	94	-
Netherlands	"Tridens"	31.01/24.02	46	51
Norway	"G.O. Sars"	06.01/26.01	27	7
Sweden	"Argos"	31.01/17.02	48	41
U.K (Scotland)	"Scotia"	12.02/04.03	56	43

[1]Date of First and last haul.

3 DATA AVAILABLE

In Table 3.1 is shown for which first quarter surveys data presently are available in the ICES IBTS Data Base.

At the time of the analysis of the 1994 survey presented in this report all final data were available in the data base except for Norway pout, where problems with age determination in Division IIIa were observed. Time did not allow a re-reading of the otolith before the deadlines of this report.

4 STANDARD OUTPUT FROM THE ICES IBTS DATA BASE

For details on the standard analysis of the data the reader is referred to a description by Pedersen (1989). At request copies of this paper are available at the ICES Secretariat.

5 RESULTS GOV-TRAWL FOR 1992

5.1 North Sea

Preliminary indices based on certain size classes (herring < 20cm, sprat < 10cm, mackerel < 20cm, cod < 25cm, haddock < 20cm, whiting < 20cm and Norway pout < 15cm) are compared with the final indices in Table 5.1. The preliminary indices are very close to the final ones. Final indices of 1- and 2- group fish of the seven standard species are given in Table 5.2. Table 5.3 gives the mean age composition of the standard species within the relevant standard areas.

The number of hauls used in the analysis of the herring data and the hauls used for the other species are shown in Figure 5.1 and 5.2. The total number of valid hauls was 361 of which 308 were daylight hauls which were used for the analysis of the herring data.

Per species a set of figures gives the distributions of the 1-, 2-, and 3+ group and the mean length of 1-group fish per rectangle. In the analysis of the herring data daylight hauls from the whole survey area have been included, for the other species a specific standard area is used to calculate the index of year class strength. This area is indicated in the figures.

HERRING

Indices for 1- and 2-ringed herring are presented in Table 5.2 and mean numbers per rectangle are given in Figures 5.3 to 5.5. It should be noted that the term "age group" in herring refers to number of winter rings and not to years. All juvenile herring in the North Sea are assumed to be autumn spawners, and this means that for instance age group 1 herring in February 1994 represent year class 1992.

The Herring Assessment Working Group for the Area South of 62°N has adopted a new index for 1-ringer abundance. This index is based on the mean catch per rectangle for the entire survey area, including Skagerrak and Kattegat. The former index based on the standard area of 57 squares in the North Sea has now become obsolete.

The new index for 1-ringers in 1994 was 2416. Year class 1992 is smaller than the preceding year class 1991, but larger than year classes 1988-1990. As in 1993, a large proportion of the year class was found in the Kattegat.

SPRAT

Sprat indices of 1- and 2-group are given in Table 5.2. The distributions of the same age groups and the 3+ group, as well as the mean length of 1-group per rectangle, are shown in Figures 5.7-5.10.

The Herring Assessment Working Group has also for sprat adopted a new index series (Anonymous, 1993) in which only hauls between 10 and 150 m depth are included. The standard area has remained the same: Division IVb only. The indices for age groups 1-3 have increased steadily over recent years, and the 1-group index in 1994 is the highest but one on record. The abundance of all age groups combined was the highest on record, and more than twice as high as the index for the 1993 survey.

MACKEREL

Indices for mackerel are given in Table 5.2 and the distributions of 1-, 2- and 3+ group is shown in Figures 5.11-5.13. The mean length of the 1-group per rectangle is presented in Figure 5.14.

COD

Abundance indices are given in Table 5.2, the distributions of 1-, 2-, and 3+ group, and the mean length of 1-group fish are given in Figures 5.15-5.18.

The index value for the 1993 year class of cod caught in the 1994 survey, at 12% below the long term average, was slightly higher than those of the two preceding year classes and the fourth highest of the last seventeen years. As appears to be typical of the more recent better year classes, the distribution was generally confined to a band stretching from the English northeast coast to the Skagerrak. On a cautionary note the removal of a single high abundance rectangle (44F9) would reduce the index from 14.8 to 11.2.

The 1992 year class as two-year-old fish was dispersed thinly throughout the area with a small patch of higher density off the English northeast coast and a few other, randomly scattered, higher catch rectangles - only two rectangles exceeded 50 fish per hour. This combined to produce an index well below the long term average and as the third lowest in the last seventeen years failed to support the strength indicated for this year class when it was sampled as one-year-old fish during the 1993 survey.

HADDOCK

Abundance indices are given in Table 5.2, the distributions of 1-, 2-, and 3+ group, and the mean length of 1-group fish are given in Figures 5.19-5.22.

The index value for the 1993 year class of haddock was less than half of the long term average and one of the lowest of the whole 24 year series. This value will have been affected by the four unfished rectangles in the vicinity of the Shetland Islands but, historically, these rectangles have tended to produce an average catch lower than the index value.

Good catches of two-year-old haddock (1992 year class) were made in the northwest of the standard area and, as the unfished rectangles are also in this area, it is possible that the index value is an underestimate. The index value, at 504, is 40% above the long term average but only seventh highest in the series. When sampled as one-year-olds, during the 1993 survey, it was indicated as the strongest year class in the series.

WHITING

Abundance indices are given in Table 5.2, the distributions of 1-, 2- and 3+ group and the mean length of 1-group fish are given in Figures 5.23-5.26.

After a run of strong year classes, the 1993 year class of whiting, sampled as one-year-olds during the 1994 survey, gave an index value only 20% above the long term average. As is usual there were few one-year-olds in the northern North Sea and the better catches were made off the English northeast coast. Two coastal rectangles produced in excess of 10,000 fish per hour.

As with the 1993 survey, catches of two-year-old whiting were poor in most of the south and southeastern parts of the standard area. In addition, during the 1994 survey, poor catches were also made in the central part of the index area. However, good catches off the English northeast coast, the Moray Firth and the Orkney Islands combined to produce an index for the 1992 year class some 50% above the long term average. This generally supported the strength of this year class as indicated by the one-year-old estimate during the 1993 survey.

NORWAY POUT

Abundance indices are given in Table 5.2, the distributions of 1-, 2- and 3+ group and the mean length of 1-group fish are given in Figures 5.27-5.30. As mentioned in Section 3, the catch rate by age for Division IIIa will be revised at a later stage.

One-year-old Norway pout (1993 year class), although distributed throughout the standard area, produced good catches (>10,000 fish per hour) in only three rectangles, all of which were in the northeast sector. This compares with 15 such rectangle catches for the record 1991 year class when they were sampled as one-year-olds during the 1992 survey. The index value, at 1868, is some 36% below the long term average and the fourth weakest in the whole 20 year series.

The index value for two-year-old fish is less than half the long term average and the fourth weakest in the 20 year series. It does not support the strength of the 1992 year class as indicated by the one-year-old estimate during the 1993 survey which gave an index value 8% below the long term average. The better catches of two-year-olds were made in a similar area to those of the one-year-olds.

5.2 Skagerrak-Kattegat (Division IIIa)

The number of hauls per rectangle for herring and gadoids is shown in Figure 5.1 and 5.2.

The final indices for 1- and 2-group herring and 1- and 2+ group sprat are given in Table 5.4. The herring indices are calculated as the mean catches in four depth strata, covering the depth range of 10Å150 m, and weighted by the surface area of each stratum.

Age/length keys for cod are available from the 1981 IBTS and onwards. The stocks of cod in Skagerrak and Kattegat are assessed separately and indices are given for each area. Final and preliminary indices for cod and preliminary indices for whiting and haddock are given in Table 5.5.

The distribution of herring, sprat and cod is included in the figures in Section 5.1.

HERRING

The indices are given in Table 5.4 and the distribution is shown in Figures 5.3-5.5. The mean length of 1-group is shown in Figure 5.6.

SPRAT

The index of 1- and 2+ group sprat is given in Table 5.4 and the distribution of 1-, 2- and 3+ group is shown in Figures 5.7-5.9. The mean length of 1-group sprat per rectangle is presented in Figure 5.10.

COD

Preliminary and final indices are given in Table 5.5.

The index value for one-year-old cod in the Skagerrak, at almost twice the long term average, indicates a good 1993 year class. However, a single rectangle (44F9) produced exceptionally high catches without which the index value would drop to almost 20% below the long term average. The strong 1992 year class as indicated by a record index value for one-year-old fish during the 1993 survey was not abundant during the 1994 survey. The index value generated was only 20% of the long term average.

In the Kattegat one-year-old (1993 year class) and two-year-old (1992 year class) cod have produced index values at 30% and 12% respectively of their long term averages. This indicates a very weak 1993 year class and, as in the Skagerrak, the two-year-old estimate greatly reduces the 1993 survey estimate of the strength of the 1992 year class.

HADDOCK

The preliminary index value for haddock <20cm (1993 year class) was 50% above the long term average and the fourth highest recorded in the fifteen year series. This was created by good catches in the Skagerrak. Small haddock in the Kattegat were generally scarce.

WHITING

The preliminary index value for whiting of <20cm (1993 year class), at a little less than half of the long

term average, is similar to that provided by the 1988 year class. These are the only two year classes of the most recent nine that fall below the long term average. The other seven of the nine were the seven highest in the 20 year series.

6 RESULTS OF SAMPLING OF LARVAE IN 1994

Sampling of fish larvae during the first quarter IBTS is carried out by use of a small-meshed ring net (MIK) with an opening of 3.14m^2. Catches are used to estimate larval density and abundance, assuming an 100% efficiency of the MIK in catching larvae at night (P.Munk unpubl. results).

Larval density is estimated from:

Density (no m^{-2}) = (no caught / [distance towed (m) * netopening (m^2)]) * water depth (m).

The number of larvae within a given statistical rectangle is estimated by multiplying the density found by the approximate surface area of a rectangle (309*10^7 m^2). The total number of larvae in the sampled area (the MIK-index) is the sum of estimates for all statistical rectangles.

Based on a series of comparative hauls a conversion factor between catchability of the IKMT, used in earlier years, and the MIK is estimated. This is used to convert earlier catches to total numbers.

HERRING

In all 232 hauls were made. A number of rectangles were left unsampled in the central-eastern part of the survey area.

The abundance of herring larvae during this years survey was relatively low (Figure 6.1). Only in the Skagerrak and off the eastern coast of Scotland significant densities were registered. Except for these two concentrations, no pattern in distribution could be deduced. Larval mean length was in the order of 20 mm.

Consequently this years index value is below average (Table 6.1). The value of 101.7 * 10^9 is about half the magnitude of the estimates for the preceding two years.

SPRAT

Sprat larvae were caught in the southeastern part of the survey area. Catches were limited and no interpretation of total abundance is given.

7 HYDROGRAPHIC DATA

7.1 Hydro-chemistry Survey

Seven ships contributed hydrographic data to the 1994 data set. This consists of 357 stations worked between 6 January and 21 March. Nutrient data were supplied for 147 stations, contributions being received from three ships. Data quality was excellent, and no stations were rejected by the data centre.

Charts of the distribution of bottom temperature and salinity are given in Figures 7.1 and 7.2. An updated table giving the time series of temperature and salinity at 10 locations in the North Sea during IYFS/IBTS (1) surveys from 1972 to 1993 is provided as Table 7.1. The Figures and Table show that mild temperatures that had prevailed since 1988 had given way to somewhat cooler conditions, with temperatures exceeding 7°C only in the extreme North, and adjacent to the Straits of Dover. The relative high salinity water (>35.3) that had also been present in the northern North Sea since 1989 gave way to levels barely exceeding 35.2 in salinity.

Particularly exceptional conditions were present in the central eastern Northern North Sea in the vicinity of 57°30'N; 4°E. Here temperature was lowest since 1979; salinity was the lowest since 1980. At that time low temperature and salinity were attributed to persistent and strong south-easterly winds, pushing southern North Sea water to the north. A similar explanation is likely to be valid on this occasion. Conditions here contrasted very much with those prevailing in 1993 when temperature and salinity were the highest ever observed. The absolute change in the last year was 2.2°C in temperature, and 0.5 in salinity at this location.

8 REFERENCES

Anonymous. 1992. Manual for the International Bottom Trawl Survey. Addendum to ICES Doc. C.M. 1992/H:3.

Anonymous. 1992. Report of the International Bottom Trawl Survey in the North Sea, Skagerrak and Kattegat in 1992: Quarter 1. ICES Doc. C.M. 1992/H:20.

Anonymous. 1993. Report of the Herring Assessment Working Group for the Area South of 62°N. ICES Doc. C.M. 1993/Assess:15.

Anonymous. 1994. Report of the International Bottom Trawl Survey Working Group, Copenhagen, 12-14 January 1994. ICES Doc. C.M. 1994/H:6.

Pedersen, L., 1989. International Young Fish Survey, computation of aggregated standard tables and charts. ICES Secretariat, section computer management.

Table 3.1 Data available in the ICES IBTS data base as at 11 August 1994. First Quarter.

\+ = Data available

\- = No data available

x = No survey made

Country	1972	1973	1974	1975	1976	1977	1978	1979	1980
Denmark	+	+	+	+	+	+	+	+	x
France	x	x	x	x	+	x	x	+	+
Germany	-	-	-	-	-	-	-	-	-
Netherlands	+	+	+	+	+	+	+	+	+
Norway	-	-	-	-	-	-	-	-	-
Sweden	-	-	-	-	-	-	-	-	-
UK England	-	-	-	-	-	-	-	-	-
UK Scotland	x	x	+	+	+	+	+	+	+
USSR	x	x	+	+	+	+	x	+	x

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Denmark	x	+	+	+	+	+	+	+	+
France	x	+	+	+	+	+	+	+	+
Germany	-	-	+	+	+	+	+	+	+
Netherlands	+	+	+	+	+	+	+	+	+
Norway	-	-	+	+	+	+	+	+	+[1]
Sweden	-	-	+	+	+	+	+	+	+
UK England	+	+	+	+	+	+	+	+	+
UK Scotland	+	+	+	+	+	+	+	+	+
USSR	+	+	x	x	x	x	x	x	x

Country	1990	1991	1992	1993	1994
Denmark	+	+	+	+	+
France	+	+	+	+	+
Germany	+	+	+	+	+
Netherlands	+	+	+	+	+
Norway	+	+	+	+	+
Sweden	+	+	+	+	+
UK England	+	x	x	x	x
UK Scotland	+	+	+	+	+
USSR	x	x	x	x	x

[1]No Smalk records for Herring.

Table 5.1 Preliminary indices for 1-group fish based on a split of the length distribution, and final indices for the North Sea from the first quarter IBTS in 1994.

	Preliminary	Final
Herring	2,367	2,416
Sprat	4,135	4,003
Mackerel	2.8	2.3
Cod	16.0	14.8
Haddock	230	229
Whiting	823	726
Norway pout	1,838	1,868

Table 5.2 IBTS indices for 1- and 2-year-old fish of various species. Indices in mean number per hour within the relevant standard area in the North Sea.

year class	HERRING 1-ring*	HERRING 2-ring*	SPRAT age 1	SPRAT age 2	MACKEREL age 1	MACKEREL age 2	COD age 1	COD age 2	HADDOCK age1	HADDOCK age 2	WHITING age 1	WHITING age 2	NORWAY POUT age 1	NORWAY POUT age 2
1969	-	-	-	-	-	-	-	25.9	-	32	-	31	-	-
1970	-	-	-	-	-	-	98.3	34.5	855	299	274	190	-	-
1971	-	-	90	-	-	-	4.1	10.6	740	971	332	763	-	-
1972	-	-	123	-	-	-	38.0	9.5	187	110	1,156	496	-	-
1973	-	-	481	-	-	0.1	14.7	6.2	1,092	385	322	153	-	2,412
1974	-	-	-	-	16.5	0.2	40.3	19.9	1,168	670	893	535	4,242	385
1975	-	-	1,186	-	0.4	+	7.9	3.2	177	84	679	219	4,599	334
1976	-	-	136	-	1.4	+	36.7	29.3	162	108	418	293	4,813	1,215
1977	261	-	1,474	-	2.3	+	12.9	9.3	385	240	513	183	1,913	240
1978	456	-	248	-	0.2	+	9.9	14.8	480	402	457	391	2,690	611
1979	571	-	1,402	1,380	+	+	16.9	25.5	896	675	692	485	4,081	557
1980	1,142	106	941	502	0.1	0.1	2.9	6.7	268	252	227	232	1,375	403
1981	1,771	149	296	754	0.1	5.2	9.2	16.6	526	400	161	126	4,315	663
1982	2,156	712	210	387	1.9	0.4	3.9	8.0	307	219	128	179	2,331	802
1983	3,109	648	382	298	0.1	0.0	15.2	17.6	1,057	828	436	359	3,925	1,423
1984	3,908	853	660	103	0.7	2.1	0.9	3.6	229	244	341	261	2,109	384
1985	5,307	3857	71	74	0.5	+	17.0	28.8	579	326	456	544	2,043	469
1986	6,796	816	803	1,437	8.9	0.1	8.8	6.1	885	688	669	862	3,023	760
1987	3,187	470	148	442	1.2	1.8	3.6	6.3	92	97	394	542	127	260
1988	1,585	913	4,246	557	1.1	1.2	13.1	15.2	210	114	1,465	887	2,079	773
1989	1,784	505	177	116	35.0	0.2	3.4	4.1	219	131	509	675	1,320	677
1990	1,664	877	1,121	340	6.9	0.4	2.4	4.5	679	371	1,014	748	2,497	902
1991	3,268	758	1,561	422	16.0	0.8	13.0	19.9	1,115	543	916	524	5,121	2,644
1992	2,416		1,755	1,368	1.0	00.1	12.7	4.4	1,242	504	1,087	637	2,681	375
1993			4,003		2.2		14.8		229		721		1,868	

* Total survey area

Table 5.3 Age composition of the standard species in 1994 for herring in the total survey area, for the other species for the relevant standard areas in the North Sea.

Age group	1	2	3	4	5	6+
Herring	1,857.4	758.0	182.4	71.2	38.9[1]	-
Sprat	4,002.9	1,368.0	127.0	2.7	0.6[1]	-
Mackerel	2.2	0.1	0.1	0.0	0.0	0.0
Cod	14.8	4.4	3.0	0.8	0.5	0.5
Haddock	228.7	503.9	98.3	23.3	1.6	0.8
Whiting	721.0	637.0	179.8	66.6	11.6	8.9
Norway pout	1,867.8	375.4	67.0	2.9	0.2	0.0

[1]Plus-group.

Table 5.4 IBTS indices for herring and sprat in Skagerrak-Kattegat. The herring indices are weighted by the area of four depth strata and the sprat indices are the mean by hour within the total area.

Year	Herring						Sprat		
	Total		Spring-spawners		Autumn-spawners				
	1-ring	2-ring	1-ring	2-ring	1-ring	2-ring	1-group	2+group	Total
1974							1,325		
1975							5,339		
1976							2,069		
1977							5,713	984	6,697
1978							5,119	2,117	7,236
1979							3,338	1,482	4,820
1980	2,311	387	1,607	307	704	80	4,960	3,592	8,558
1981	3,246	1,393	966	1,318	2,250	75	2,809	3,068	5,877
1982	2,560	549	1,408	445	1,152	104	1,577	4,695	6,272
1983	5,419	1,063	1,522	946	3,897	117	1,173	1,685	2,858
1984	6,035	1,947	2,793	1,419	3,242	528	5,818**	861	7,034
1985	7,994	2,473	- *	1,867	- *	606	2,404	2,426	5,388
1986	21,489	2,738	- *	1,562	- *	1,176	670	1,934	4,545
1987	11,733	3,671	- *	2,921	- *	949	2,234	2,219	8,048
1988	67,753	10,095	- *	7,834	- *	2,161	950	5,527	10,634
1989	17,451	4,976	- *	0	- *	4,976	435	1,012	3,310
1990	3,544	3,876	0	3,192	3,544	684	510	243	944
1991	3,588	3,749	- *	480	- *	3,269	659	468	1,945
1992	5,057	1,934	0	771	5,057	1,163	5,897	634	7,122
1993	26,738	3,165	0	203	26,738	2,962	1,593	4,237	7,186
1994	8,777	2,333	0	0	8,777	2,333	1,494	586	3,361

* Separation not valid
** From 1984 onwards only hauls taken in depths between 10 and 150m are included in the estimates

Table 5.5 Indices of 1- and 2-group cod and 1-group whiting and haddock in Skagerrak-Kattegat. The preliminary indices are the mean number per hour for cod < 25 cm, whiting and haddock < 20cm.

Year Class	Cod 1-group Skagerrak		Cod 1-group Kattegat		Cod 2-group		Whiting 1-group	Haddock 1-group
	Prel.	Final	Prel.	Final	Skagerrak	Kattegat	Prel.	Prel.
1974							499	
1975							236	
1976							99	
1977							392	
1978							561	
1979	79		386		93	171	722	40
1980	18	15	42	26	31	63	968	4
1981	36	36	126	104	30	258	690	48
1982	32	28	113	96	19	143	262	34
1983	24	23	49	39	52	106	500	72
1984	18	14	18	9	10	72	940	161
1985	82	78	229	213	113	372	1379	57
1986	15	5	48	11	18	28	2178	251
1987	81	77	76	68	24	48	2978	125
1988	62	56	6	3	8	16	478	20
1989	25	31	131	153	25	112	2255	8
1990	42	9	39	19	5	20	1636	74
1991	119	96	64	64	16	38	1796	288
1992	171	110	40	31	7	13	1359	405
1993	77	82	22	19			525	180

Table 6.1 Density and abundance of herring larvae caught in February during the IBTS. Valuesfor year classes by areas are density estimates in number per square metre. Total abundance (MIK-index) is found by multiplying density by surface area and adding up (see also text).

Area	North west	North east	Central west	Central east	South west	South east	Division IIIa	Southern Bight	O-ringers abundance
Area $m^2 \times 10^9$	83	34	86	102	37	93	31	31	N in billion
Year Class									
1976	0.054	0.014	0.122	0.005	0.008	0.002	0.002	0.016	17.1
1977	0.024	0.024	0.050	0.015	0.056	0.013	0.006	0.034	13.1
1978	0.176	0.031	0.061	0.020	0.010	0.005	0.074	0.000	52.1
1979	0.061	0.195	0.262	0.408	0.226	0.143	0.099	0.053	101.1
1980	0.052	0.001	0.145	0.115	0.089	0.339	0.248	0.187	76.7
1981	0.197	0.000	0.289	0.199	0.215	0.645	0.109	0.036	133.9
1982	0.025	0.011	0.068	0.248	0.290	0.309	0.470	0.140	91.8
1983	0.019	0.007	0.114	0.268	0.271	0.473	0.339	0.377	115.0
1984	0.083	0.019	0.303	0.259	0.996	0.718	0.277	0.298	181.3
1985	0.116	0.057	0.421	0.344	0.464	0.777	0.085	0.084	177.4
1986	0.317	0.029	0.730	0.557	0.830	0.933	0.048	0.244	270.9
1987	0.078	0.031	0.417	0.314	0.159	0.618	0.483	0.495	168.9
1988	0.036	0.020	0.095	0.096	0.151	0.411	0.181	0.016	71.4
1989	0.083	0.030	0.040	0.094	0.013	0.035	0.041	0.000	25.9
1990	0.075	0.053	0.202	0.158	0.121	0.198	0.086	0.196	69.9
1991	0.255	0.390	0.431	0.539	0.500	0.369	0.298	0.395	200.7
1992	0.168	0.039	0.672	0.444	0.734	0.268	0.345	0.285	190.1
1993	0.358	0.212	0.260	0.187	0.120	0.119	0.223	0.028	101.7

TABLE 7.1 Time series data of bottom temperature and salinity during IYFS/IBTS(1) 1972-1994 .

Location	1		2		3		4		5		6		7		8		9		10	
Position	60° 0'N 2°E		57° 30'N 0°E		57° 30'N 2°E		57° 30'N 4°E		55° 0'N 0°E		55° 0'N 2°E		55° 0'N 4°E		55° 0'N 8°E		54° 0'N 3°E		52° 30'N 3°E	
Year	t°C	S-30	t°C	S-30	t°C	S-30	t°C	S-30	t°C	S-30	t°C	S-30	t°C	S-30	t°C	S-30	t°C	S-30	t°C	S-30
1972	5.8	5.22	6.9	5.08	5.9	5.20	4.5	4.78	6.5	4.91	4.8	4.86	5.2	4.80	2.5	3.80	5.2	4.70	6.9	5.10
1973			7.4	5.02	7.2	5.20	6.7	5.10	7.0	5.05	6.1	5.00	6.0	4.86	5.0	3.00	6.4	4.80	6.5	5.05
1974	6.9	5.28	6.5	5.11	6.5	5.08	6.3	5.04	6.5	4.90	6.0	4.90	5.6	4.90	4.7	3.00	6.1	4.78	8.0	5.20
1975	7.3	5.20	6.6	5.05	6.6	5.15	6.4	5.13	6.6	4.95	6.4	4.90	6.1	4.85	5.2	3.50	5.9	4.62	6.9	4.62
1976	6.7	5.20	6.5	5.00	6.5	5.15	5.6	5.12	6.1	4.81	4.9	4.95	4.9	4.85	2.2	1.00	5.1	4.78	5.1	4.80
1977	6.0	5.18	6.2	5.02	5.1	5.00	4.8	4.92	6.0	4.98	4.9	4.85	5.0	4.80	3.1	3.60	5.6	4.78	7.1	5.22
1978	6.4	4.88	6.6	5.00	6.0	4.90	4.7	4.88	5.6	4.78	4.9	4.88	4.2	4.80	2.2	2.50	4.6	4.68	5.5	4.90
1979	6.4	5.15	6.0	4.80	4.1	4.88	4.0	4.98	4.5	4.64	2.8	4.62	2.8	4.62	-1.5	2.00	3.0	4.62	4.2	4.95
1980	5.9	5.12	6.6	5.00	5.5	5.00	4.5	4.70	6.1	4.60	3.8	4.65	4.5	4.50	3.1	3.50	5.1	4.70	6.1	5.11
1981	6.9	5.22	6.6	4.90	6.2	5.05	5.8	5.15	6.5	4.80	5.8	4.82	5.1	4.82	3.4	2.50				
1982	6.6	5.28	6.1	5.02	5.9	5.05	5.5	5.10	5.5	4.72	4.8	4.82	4.5	4.62	2.8	2.50	4.7	4.30	6.0	4.65
1983	6.9	5.22	6.5	5.00	6.4	5.10	6.2	5.15	5.6	4.62	6.1	4.95	5.2	4.90	3.0	3.00	5.2	4.80	6.4	4.70
1984	6.3	5.18	6.4	5.10	6.4	5.10	5.2	5.12	5.9	4.80	5.0	4.84	4.9	4.90	3.5	3.00	4.9	4.65	7.4	4.95
1985	6.9	5.17	6.8	5.10	6.5	5.18	5.9	5.05	6.5	4.70	4.7	4.91	5.0	4.90	1.0	2.50	4.0	4.70	6.0	4.80
1986	6.6	5.25	5.8	5.05	5.4	5.08	5.2	5.05	5.2	4.65	3.9	4.72	3.6	4.60	0.0	2.50	4.0	4.60	4.0	4.65
1987	6.5	5.28	6.1	4.90	5.9	5.08	4.9	5.00	5.0	4.75	4.2	4.80	4.3	4.60	0.8	0.00	4.9	4.60	4.8	4.90
1988	7.6	5.18	7.6	4.95	7.4	5.03	7.0	4.96	7.1	4.70	6.6	4.80	6.5	4.50	5.9	3.50	6.9	4.60	7.7	4.90
1989	8.5	5.29	8.0	4.85	7.8	4.89	7.6	5.05	7.5	4.76	7.1	4.81	6.8	4.80	6.0	4.10	6.5	4.68	7.5	4.62
1990	8.5	5.29	7.6	5.00	7.6	5.12	7.6	5.15	7.5	4.70	7.5	4.85	7.5	4.80	6.5	4.10	7.4	4.70	7.4	4.60
1991	7.9	5.30	6.7	5.10	7.1	5.22	6.1	4.97	6.6	4.65	5.8	4.85	5.5	4.80	3.0	4.00	5.8	4.60	6.1	5.30
1992	8.1	5.29	7.6	5.10	7.1	5.16	7.1	5.19	7.4	4.80	6.6	4.80	6.5	4.80	6.6	2.00	4.5	4.80	6.0	5.20
1993	7.4	5.31	6.5	4.92	6.4	5.18	6.5	5.30	6.5	5.05	6.2	5.00	5.4	4.95	4.3	3.50	5.6	4.80	6.0	5.00
1994	6.2	5.20	6.5	5.05	5.5	4.93	4.3	4.80	6.3	4.90	5.4	4.90	5.2	4.80	4.0	2.00	5.5	4.70	7.0	5.00

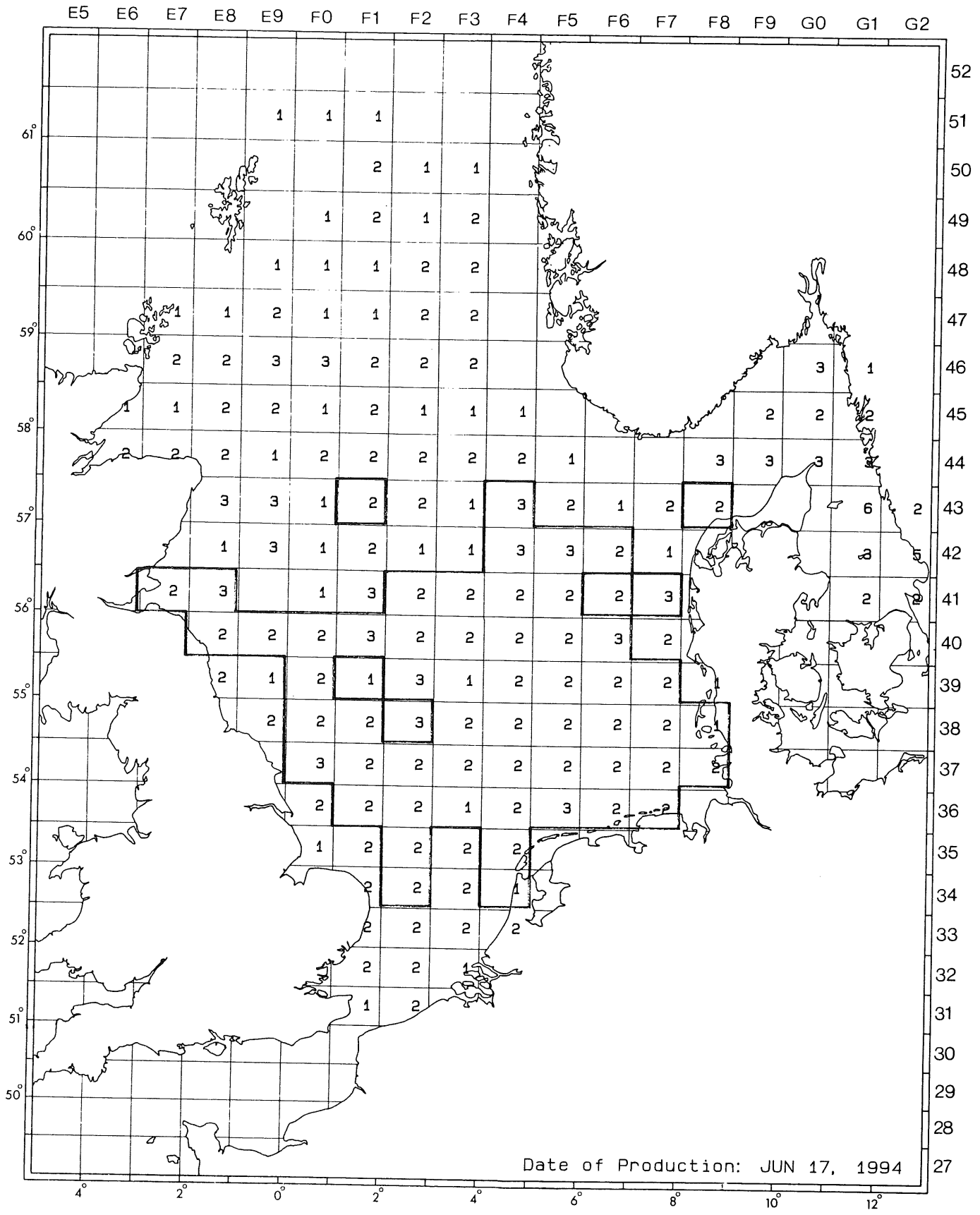

Figure 5.1 Number of hauls used in the analysis of herring 1994 data.

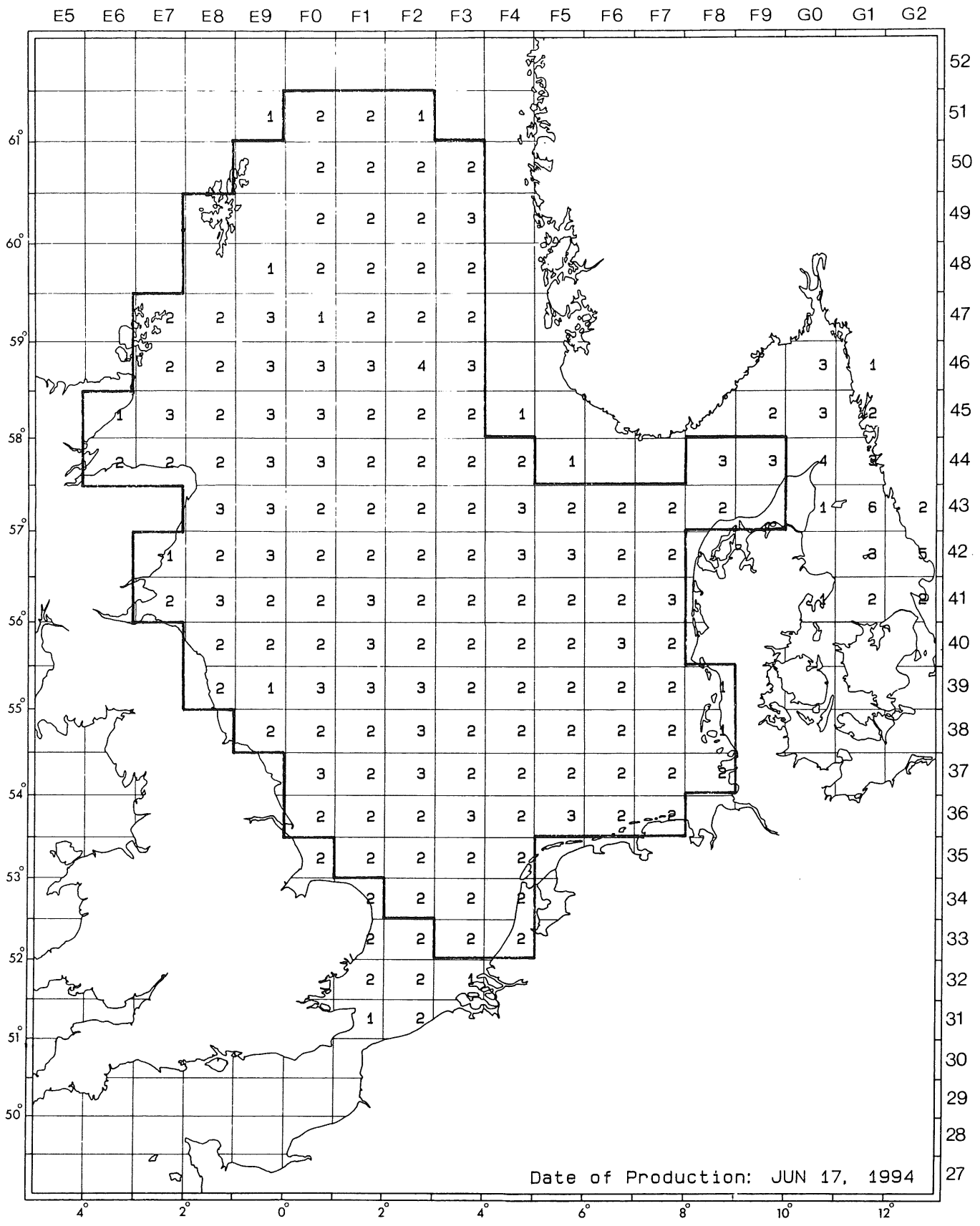

Figure 5.2 Number of hauls used in the analysis of 1994 data on sprat, mackerel, cod, haddock, whiting and Norway pout.

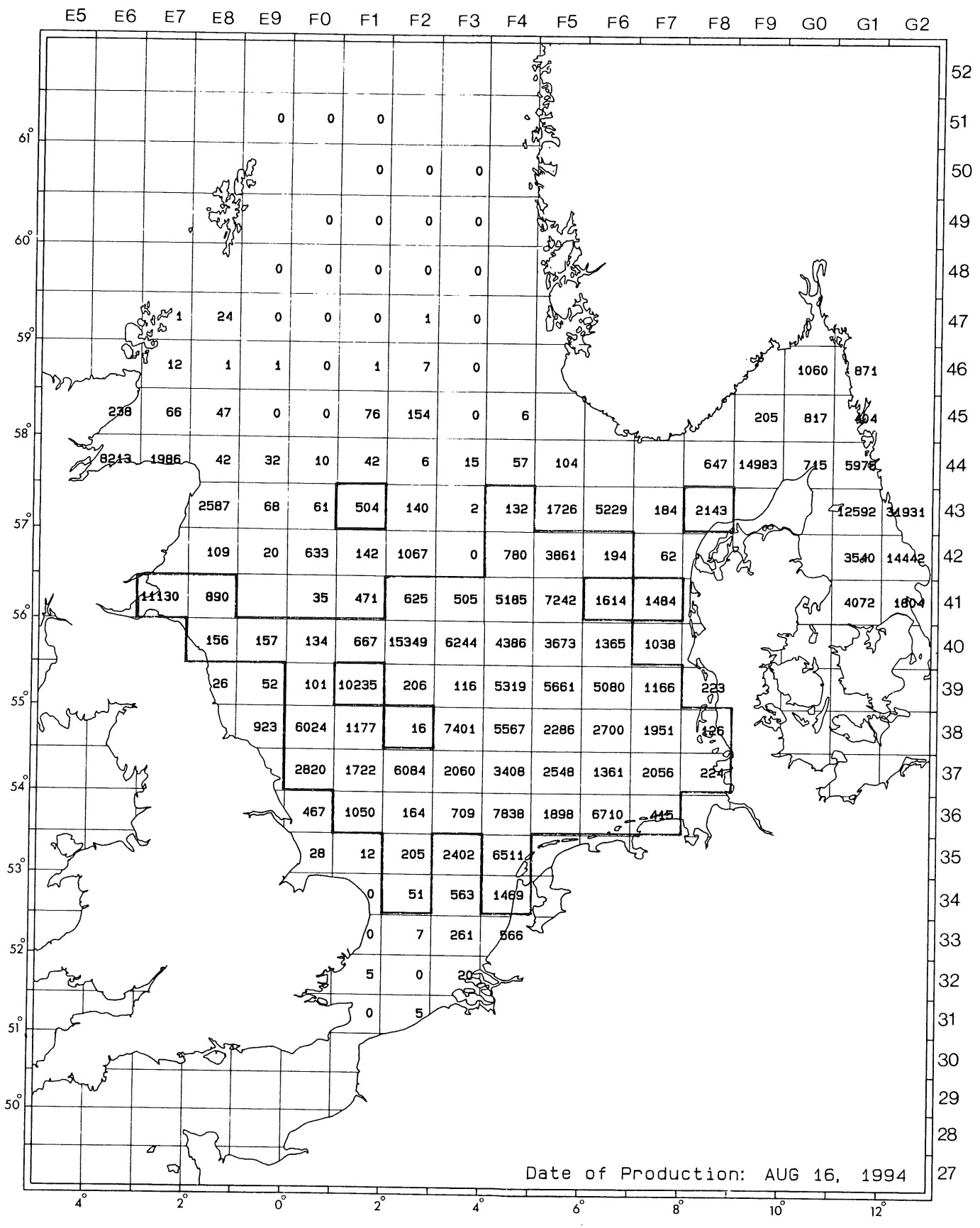

Figure 5.3 Herring: number per hour, 1-ringers.

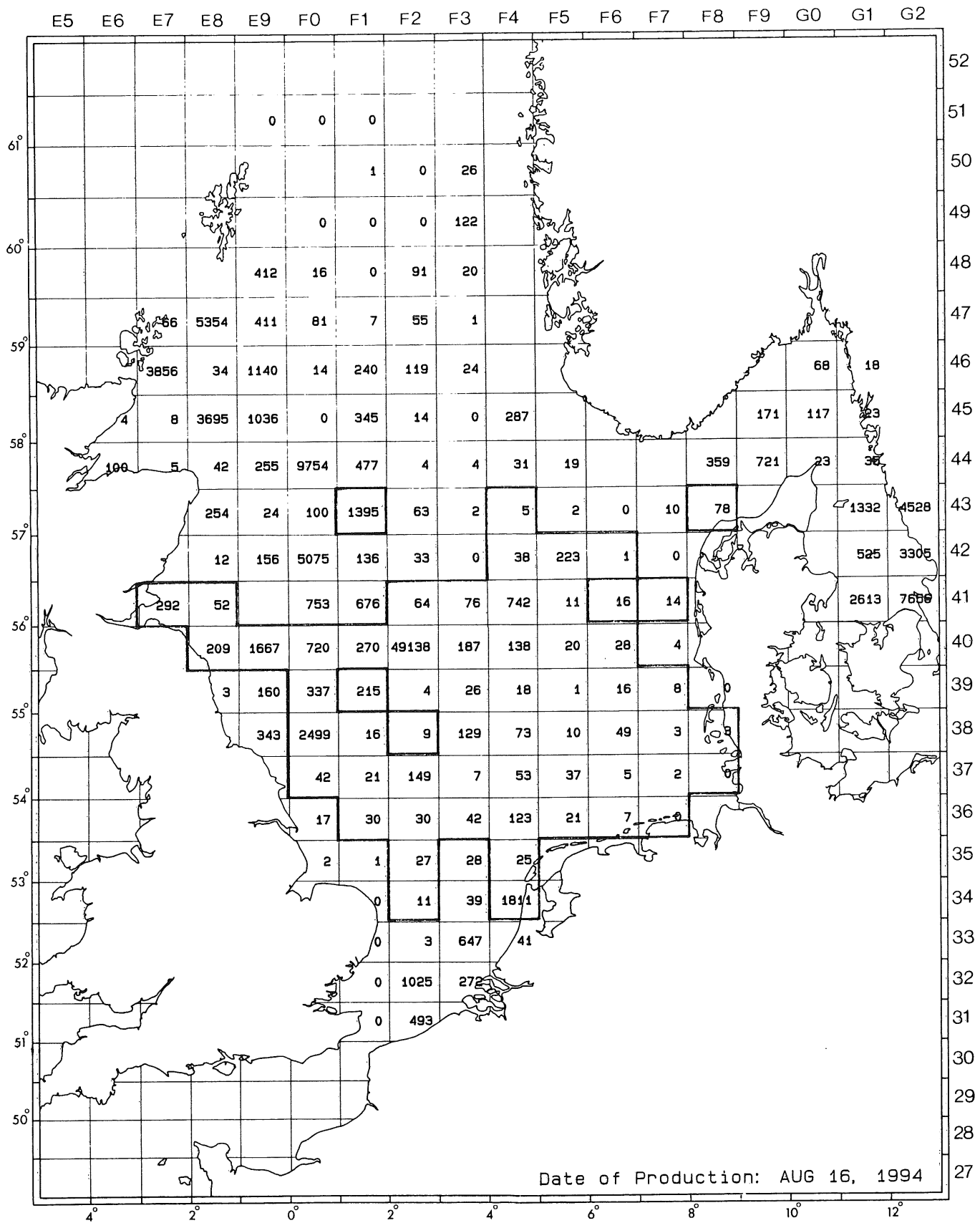

Figure 5.4 Herring: number per hour, 2-ringers.

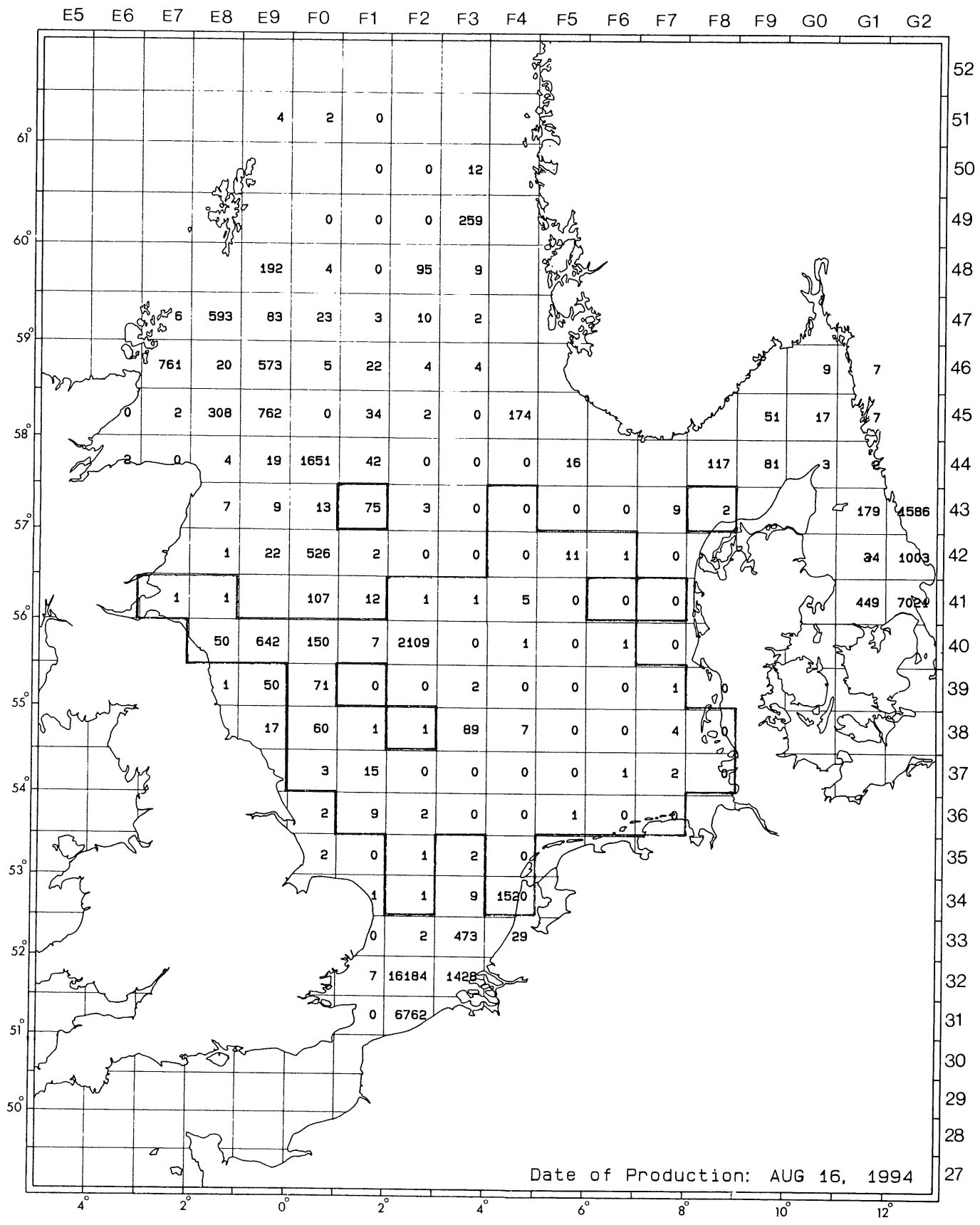

Figure 5.5 Herring: number per hour, 3+ ringers.

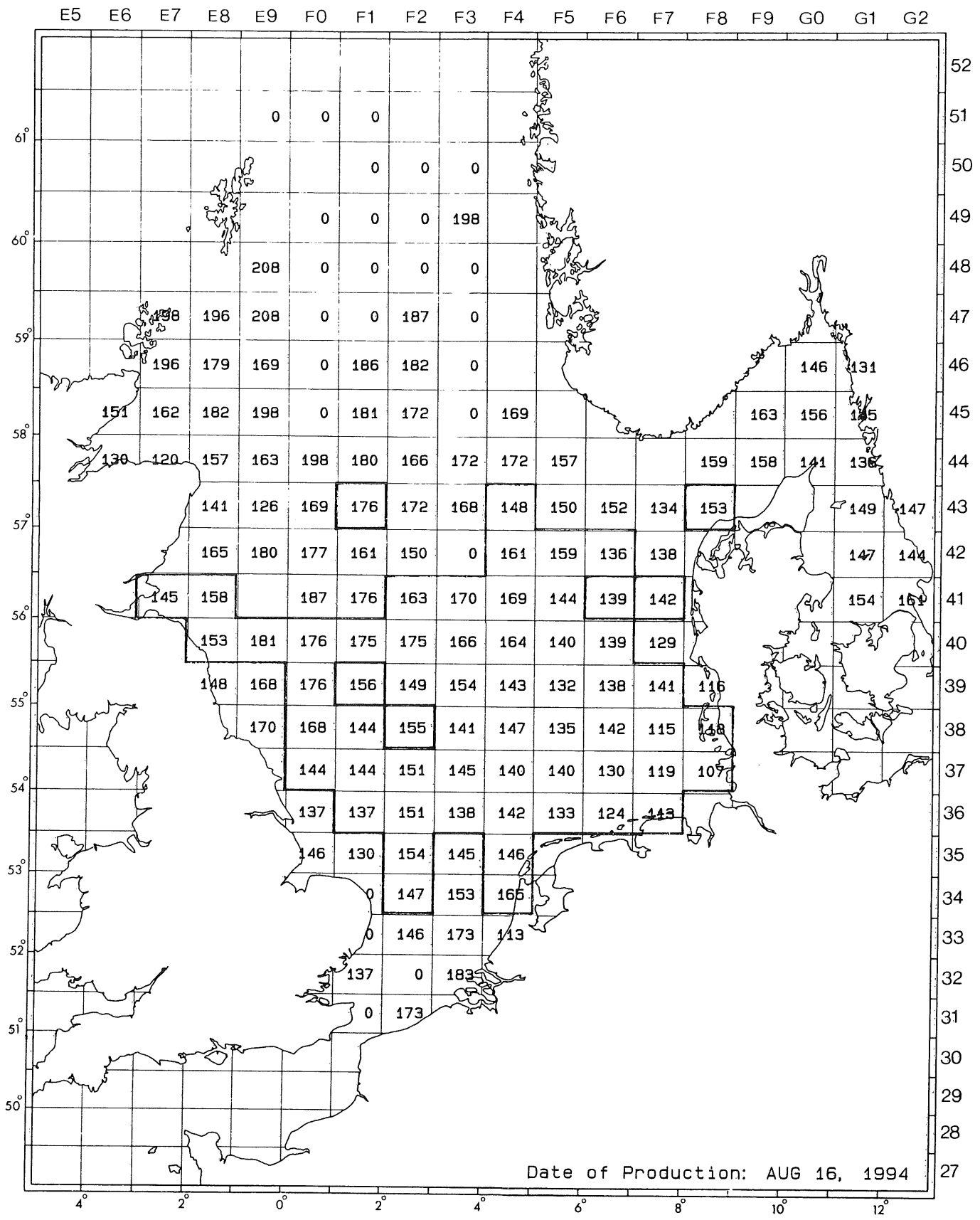

Figure 5.6 Herring: mean length, 1-ringers.

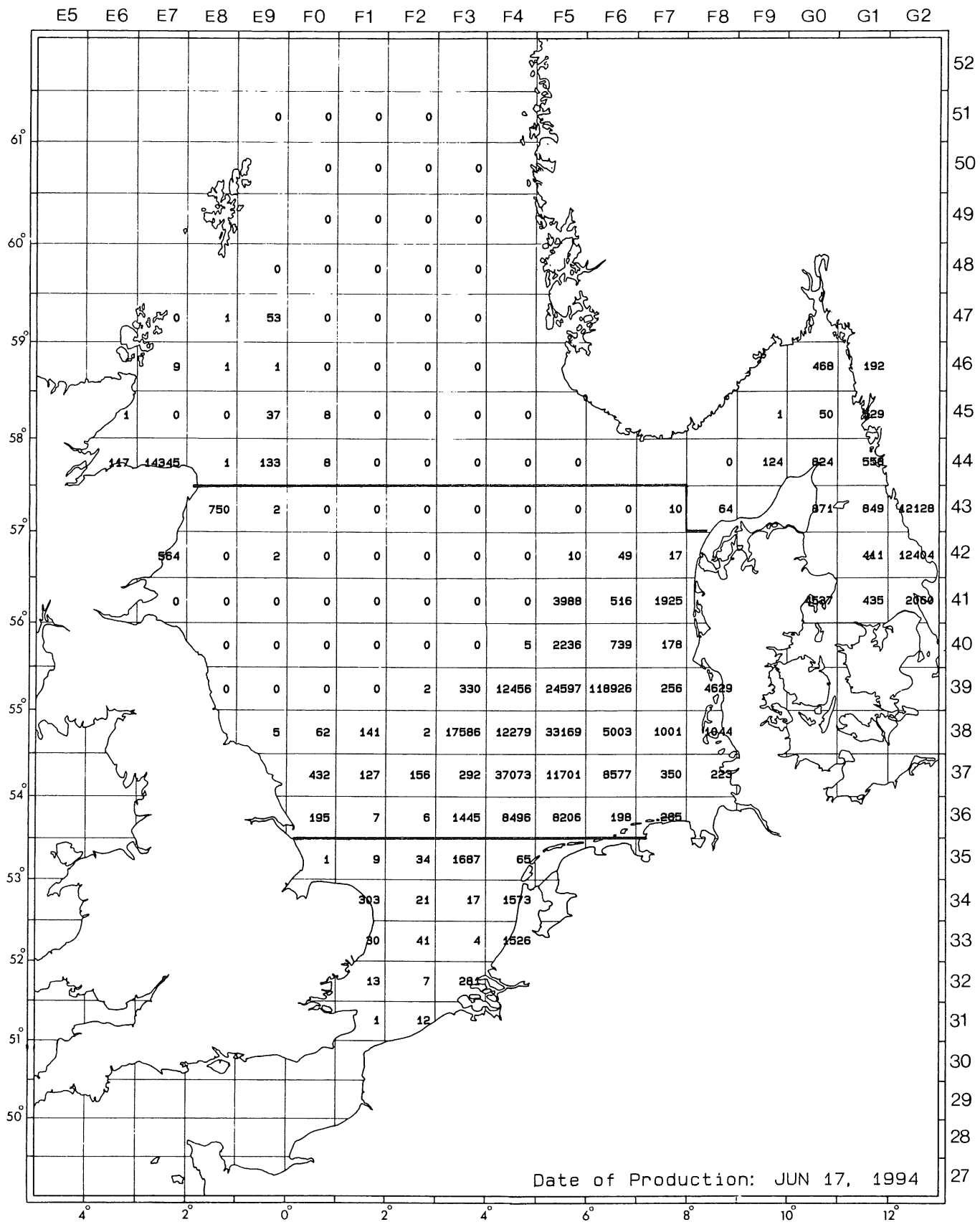

Figure 5.7 Sprat: number per hour, age group 1.

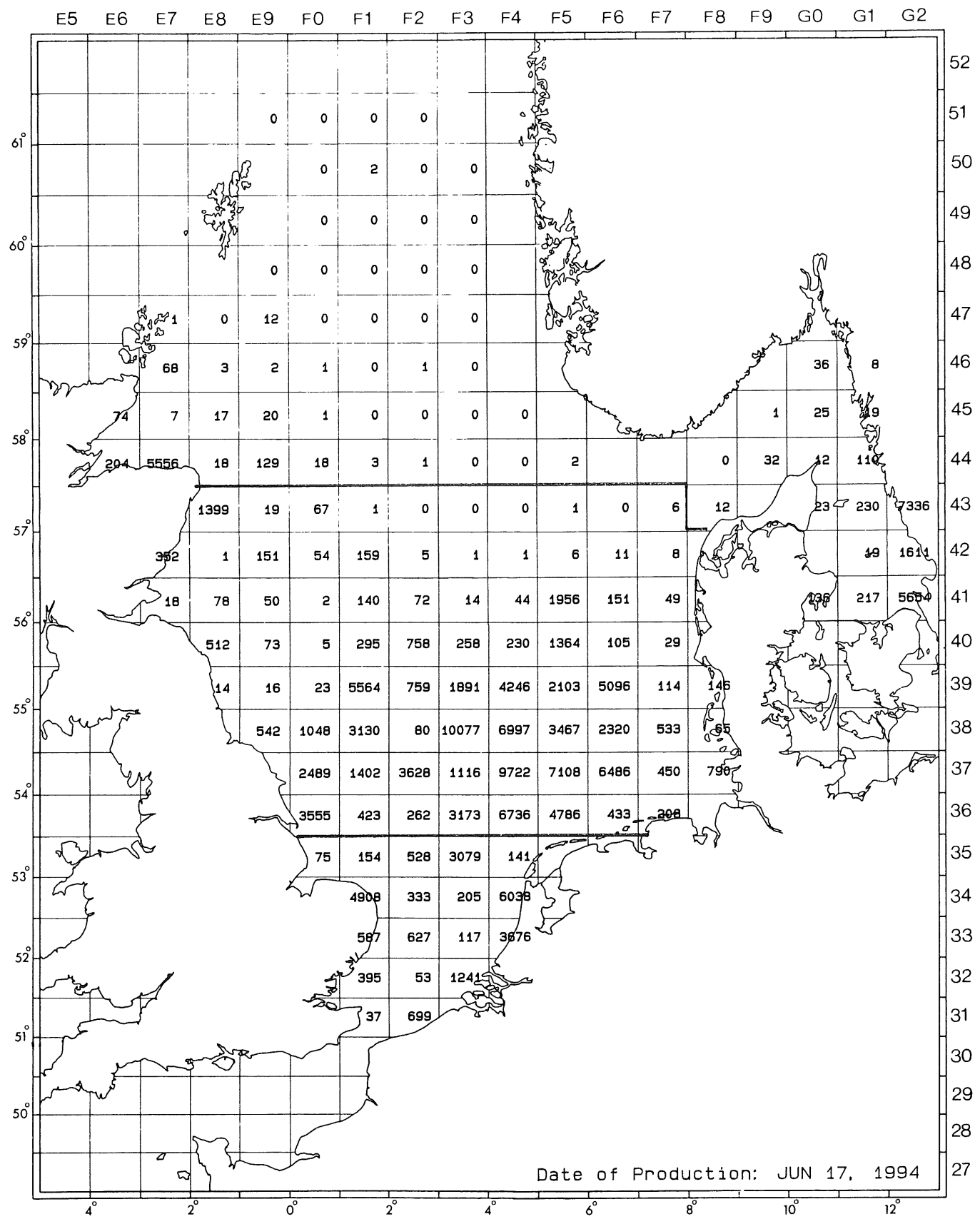

Figure 5.8 Sprat: number per hour, age group 2.

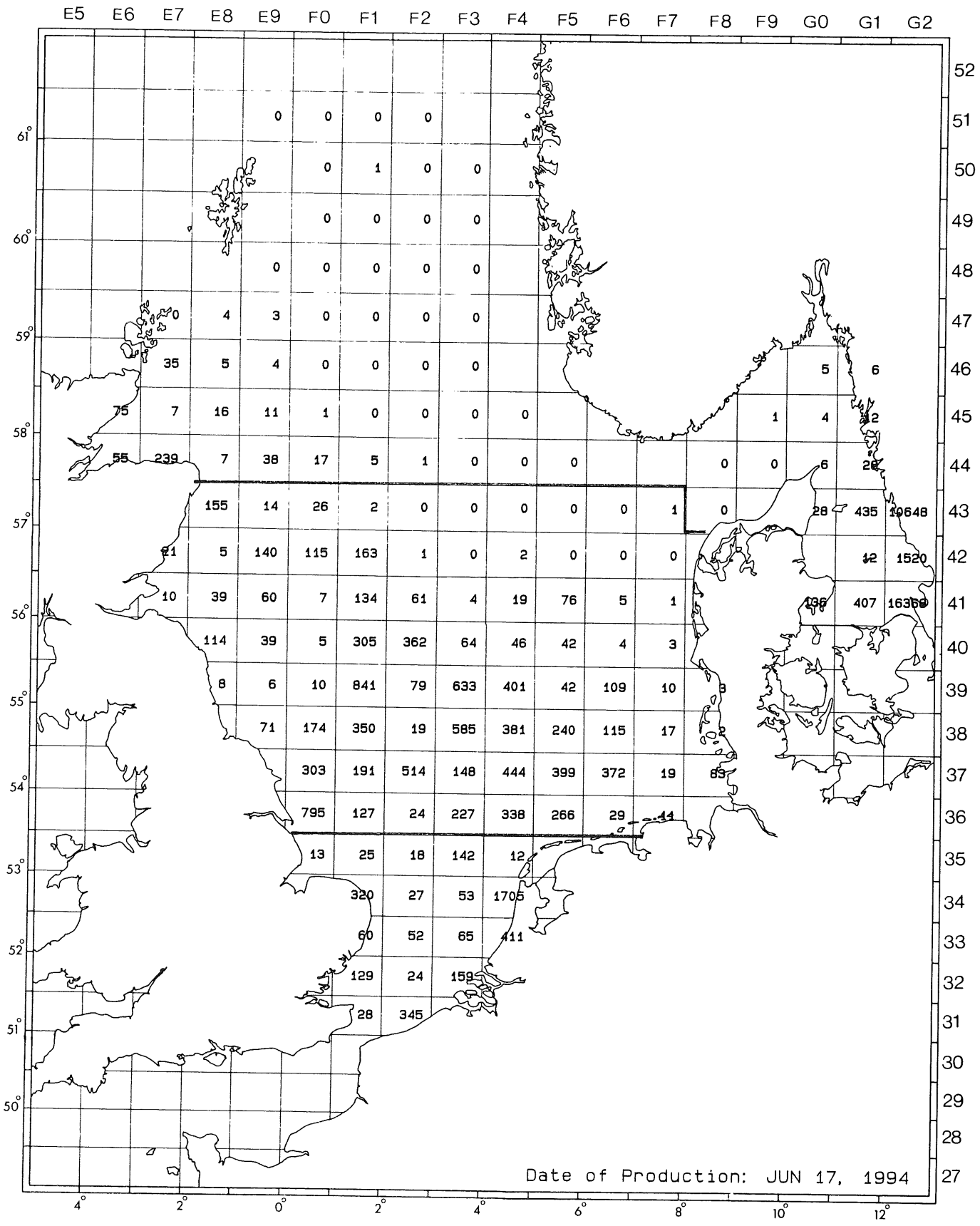

Figure 5.9 Sprat: number per hour, age group 3+.

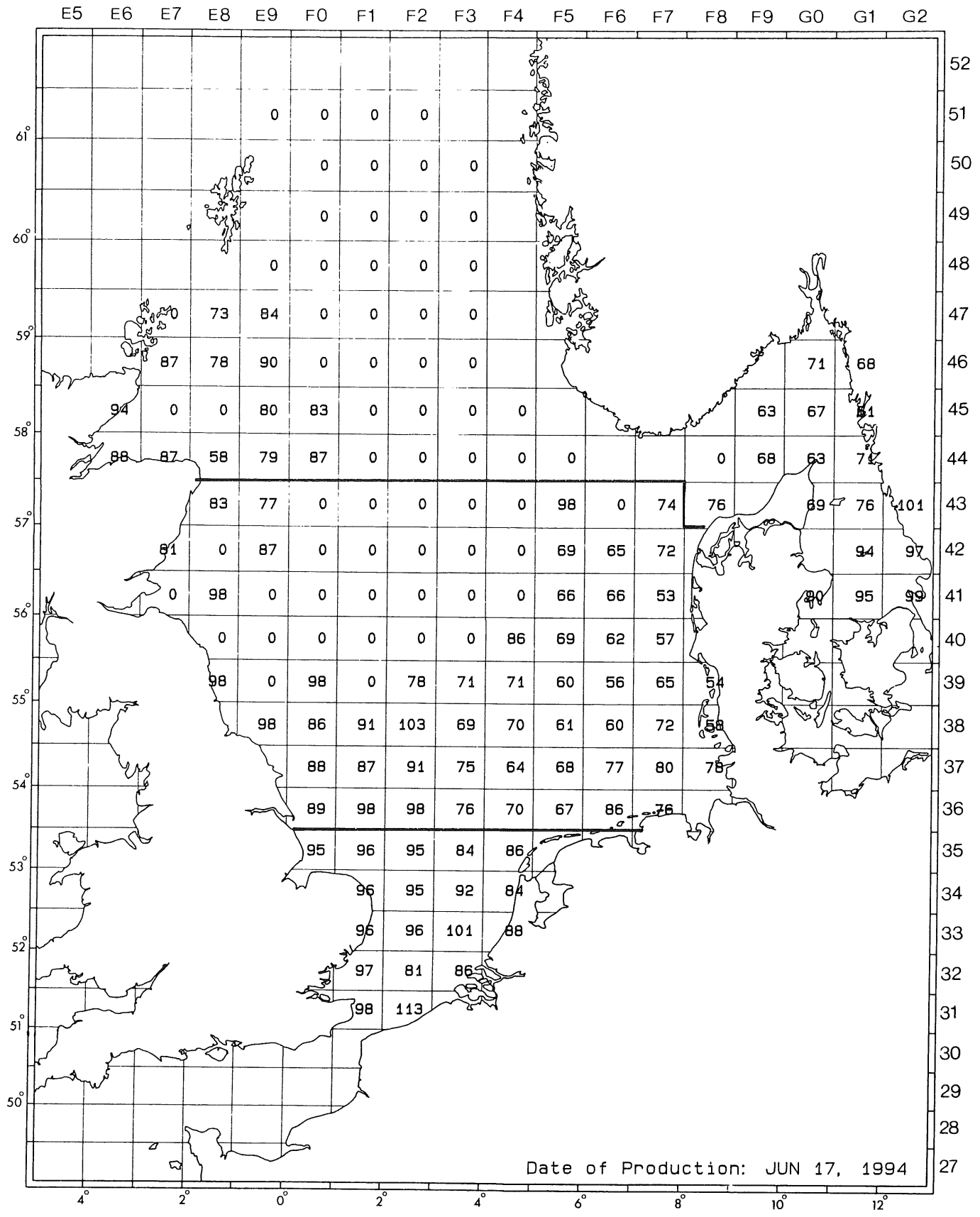

Figure 5.10 Sprat: mean length, age group 1.

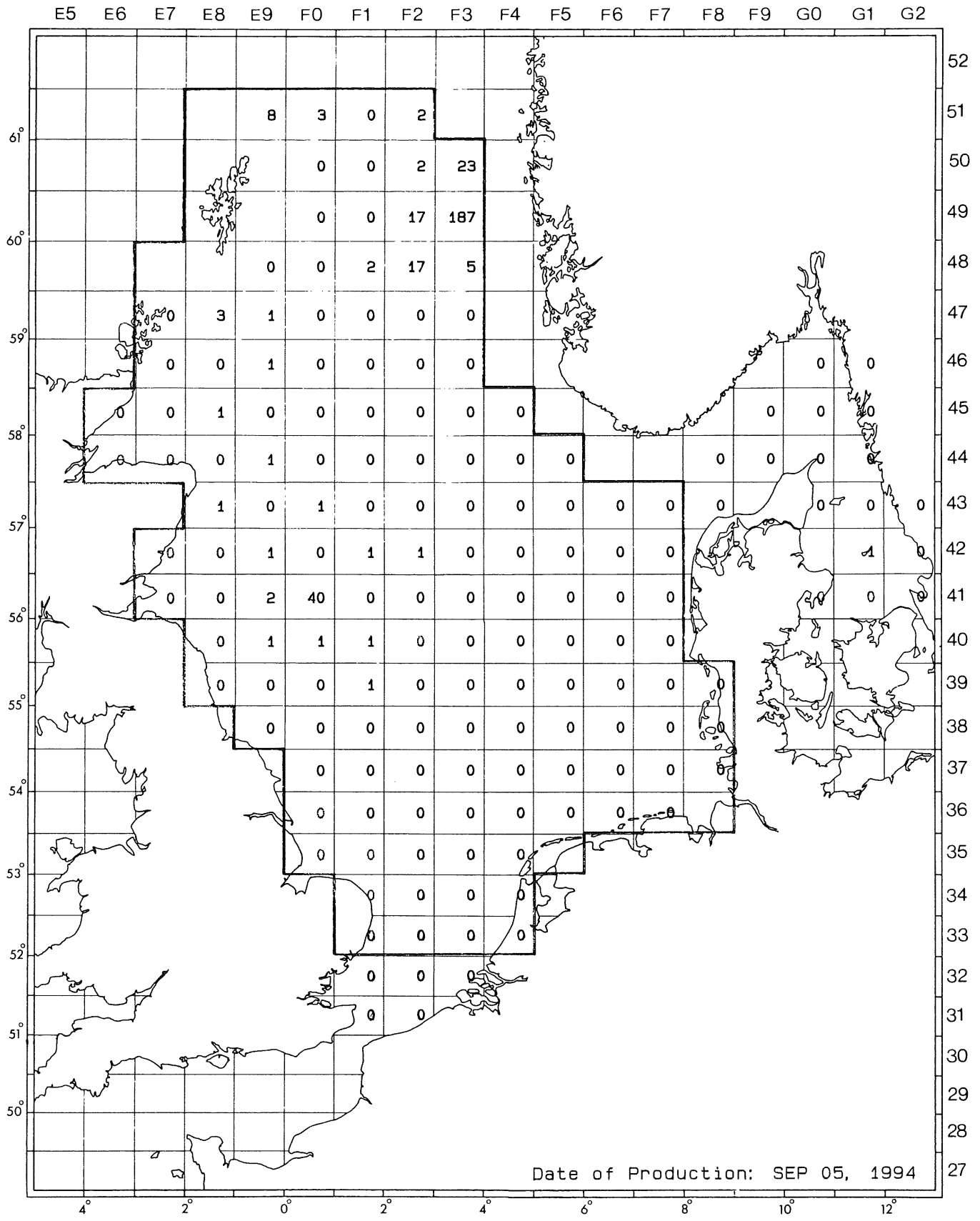

Figure 5.11 Mackerel: number per hour, age group 1.

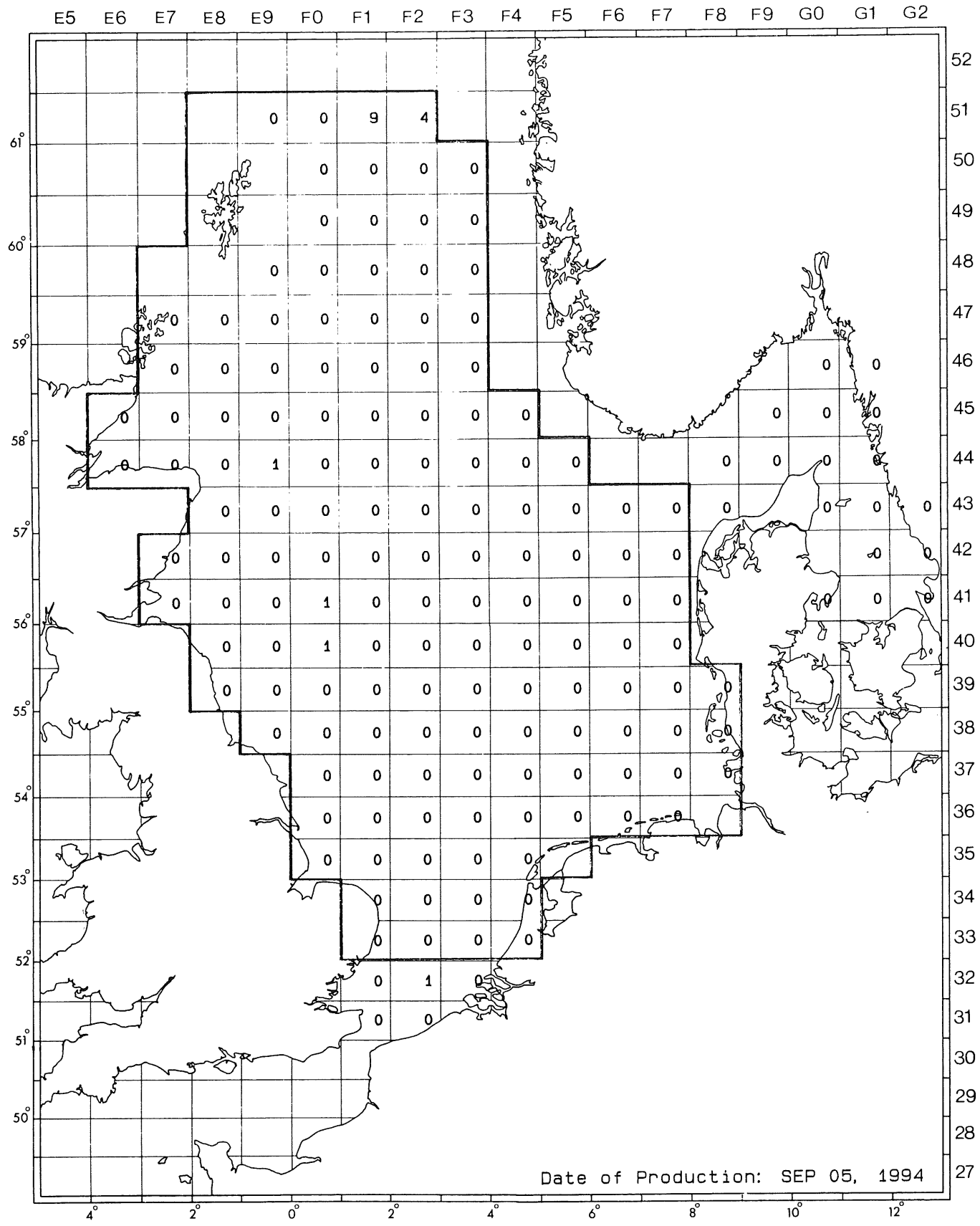

Figure 5.12 Mackerel: number per hour, age group 2.

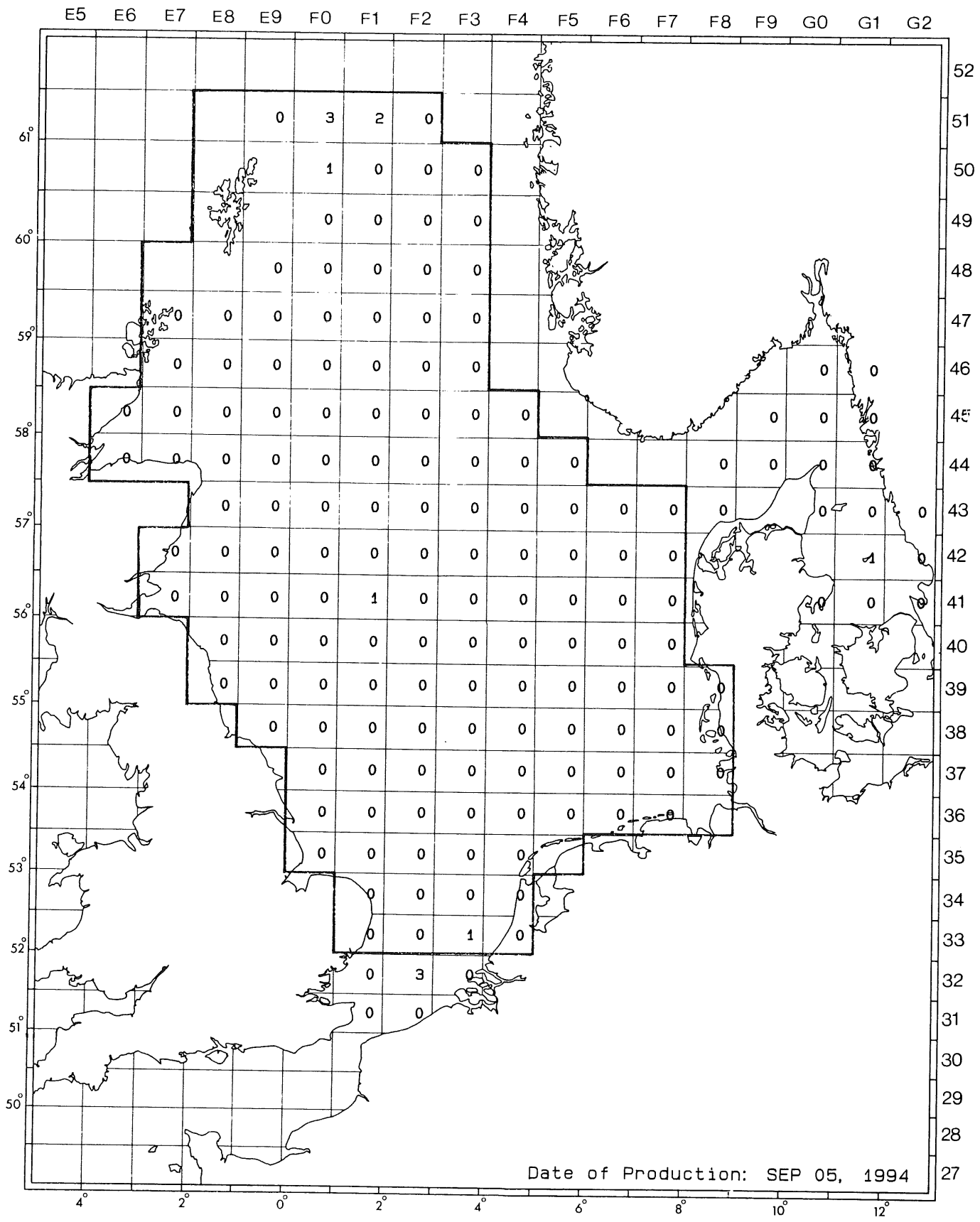

Figure 5.13 Mackerel: number per hour, age group 3+.

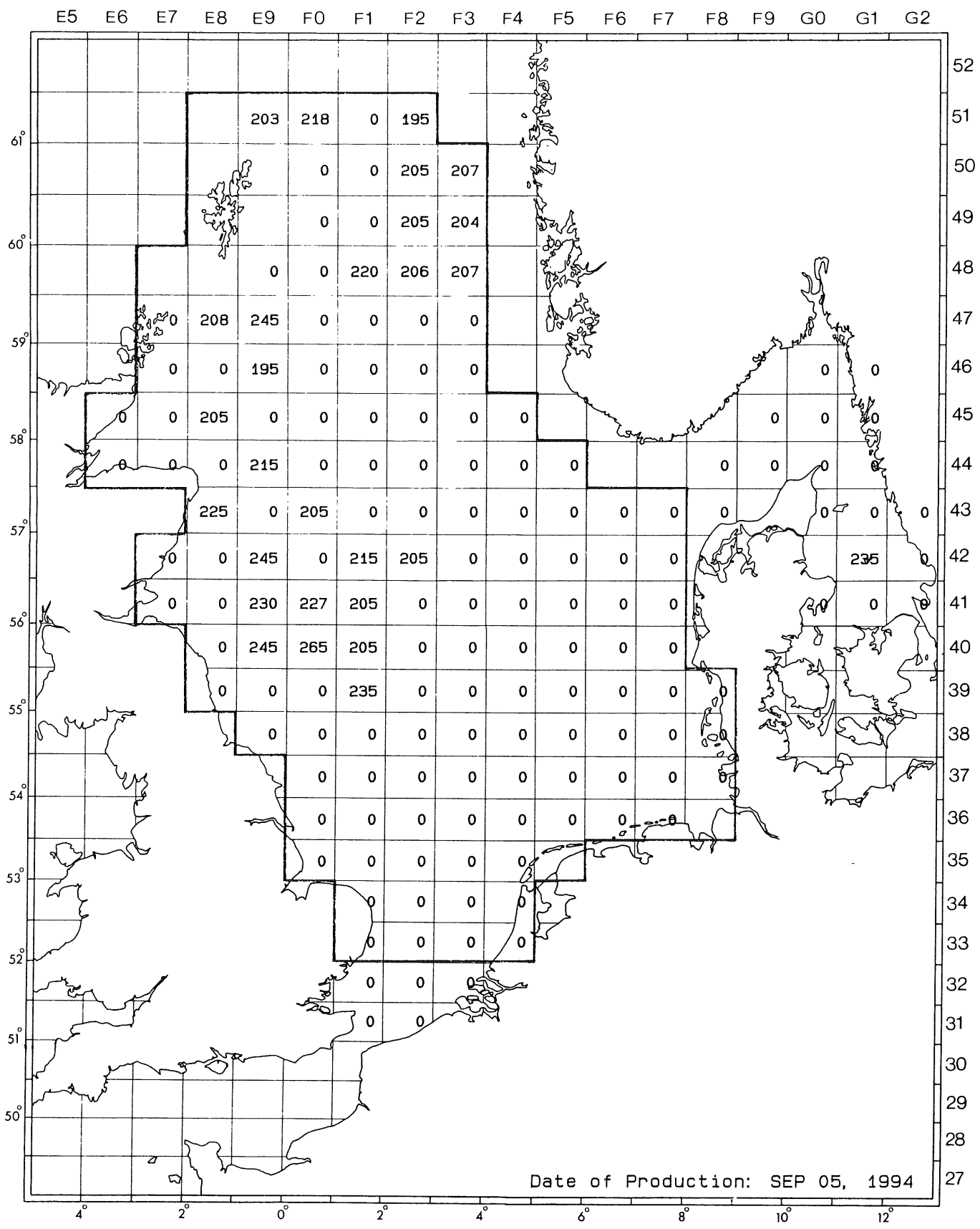

Figure 5.14 Mackerel: mean length, age group 1.

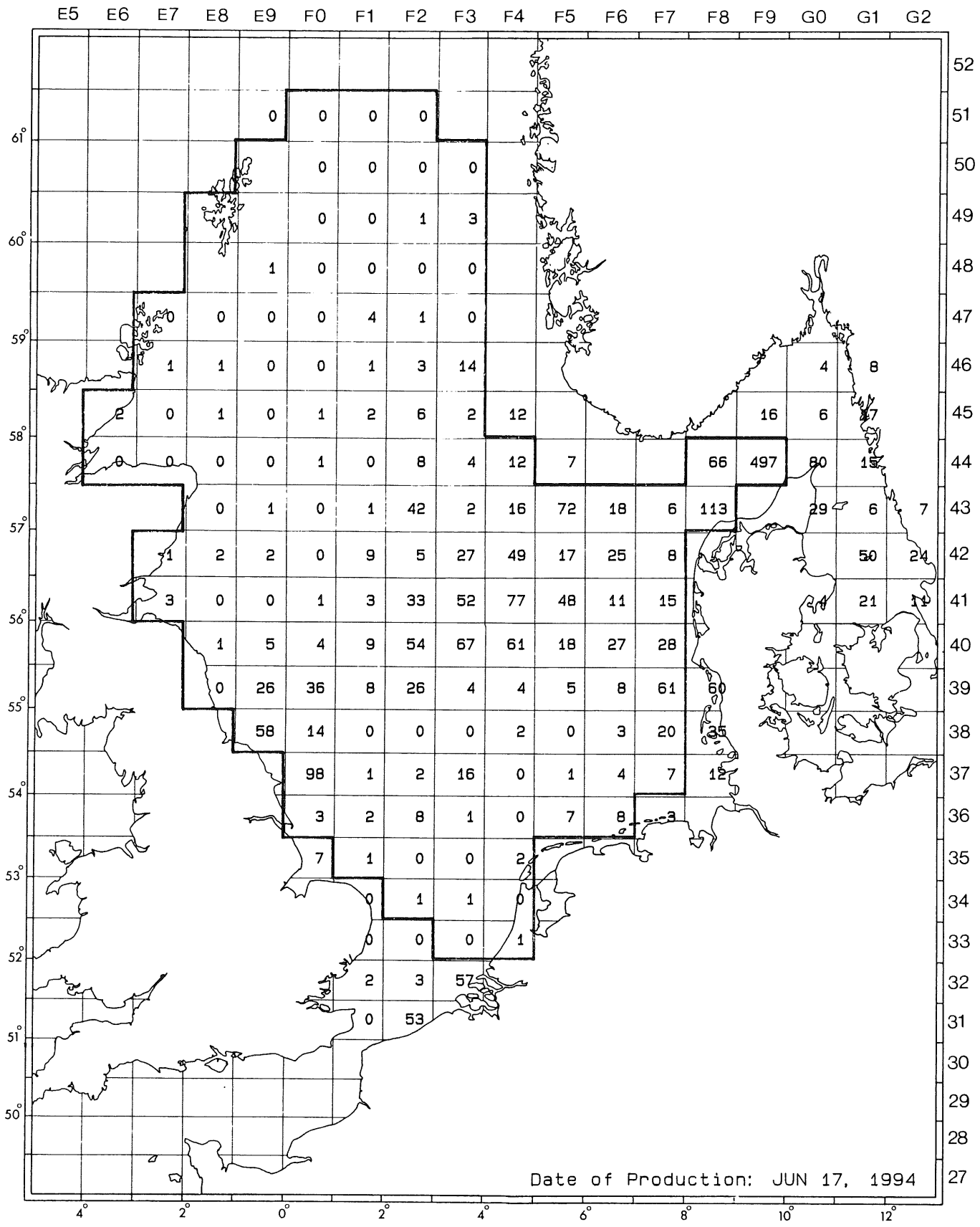

Figure 5.15 Cod: number per hour, age group 1.

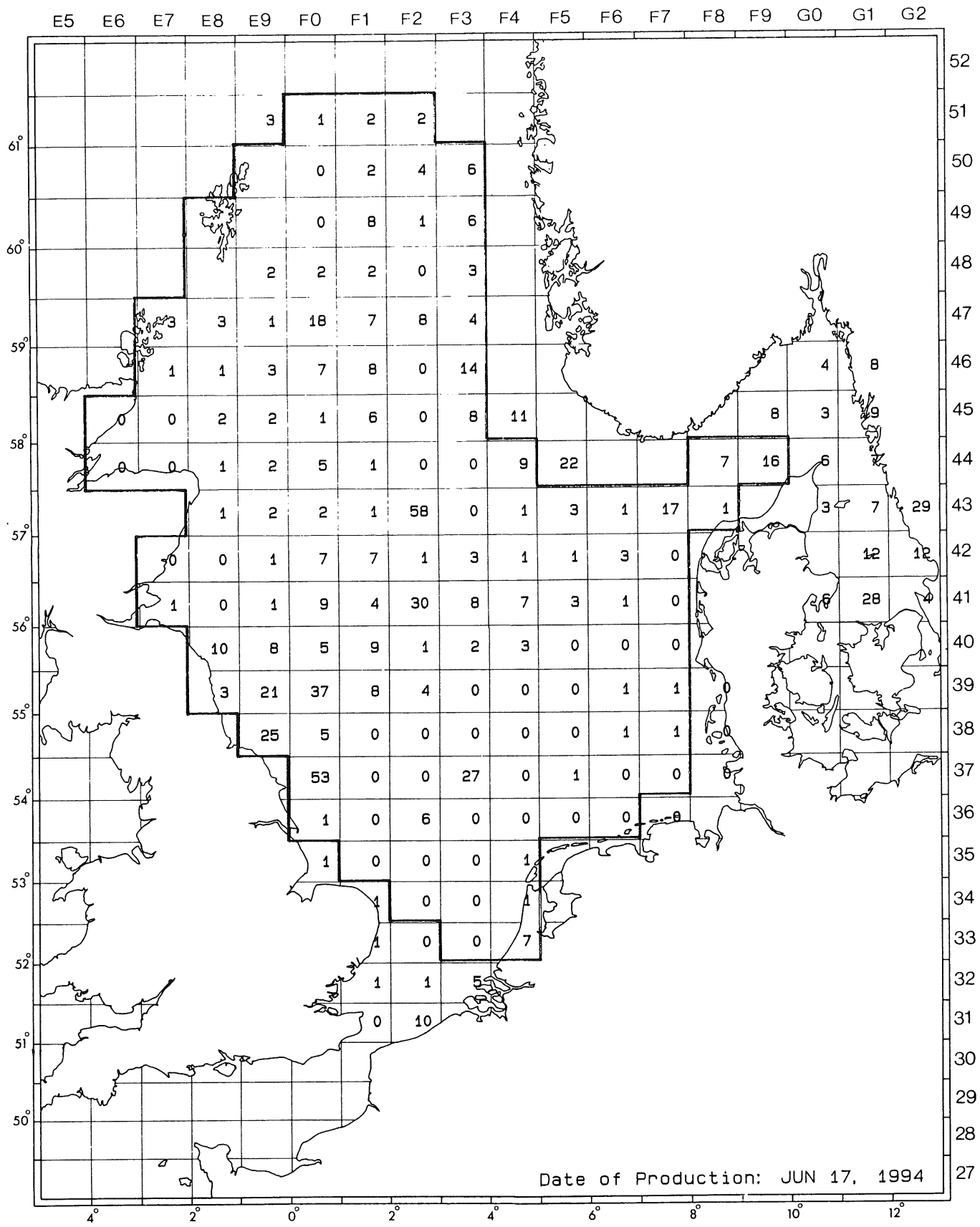

Figure 5.16 Cod: number per hour, age group 2.

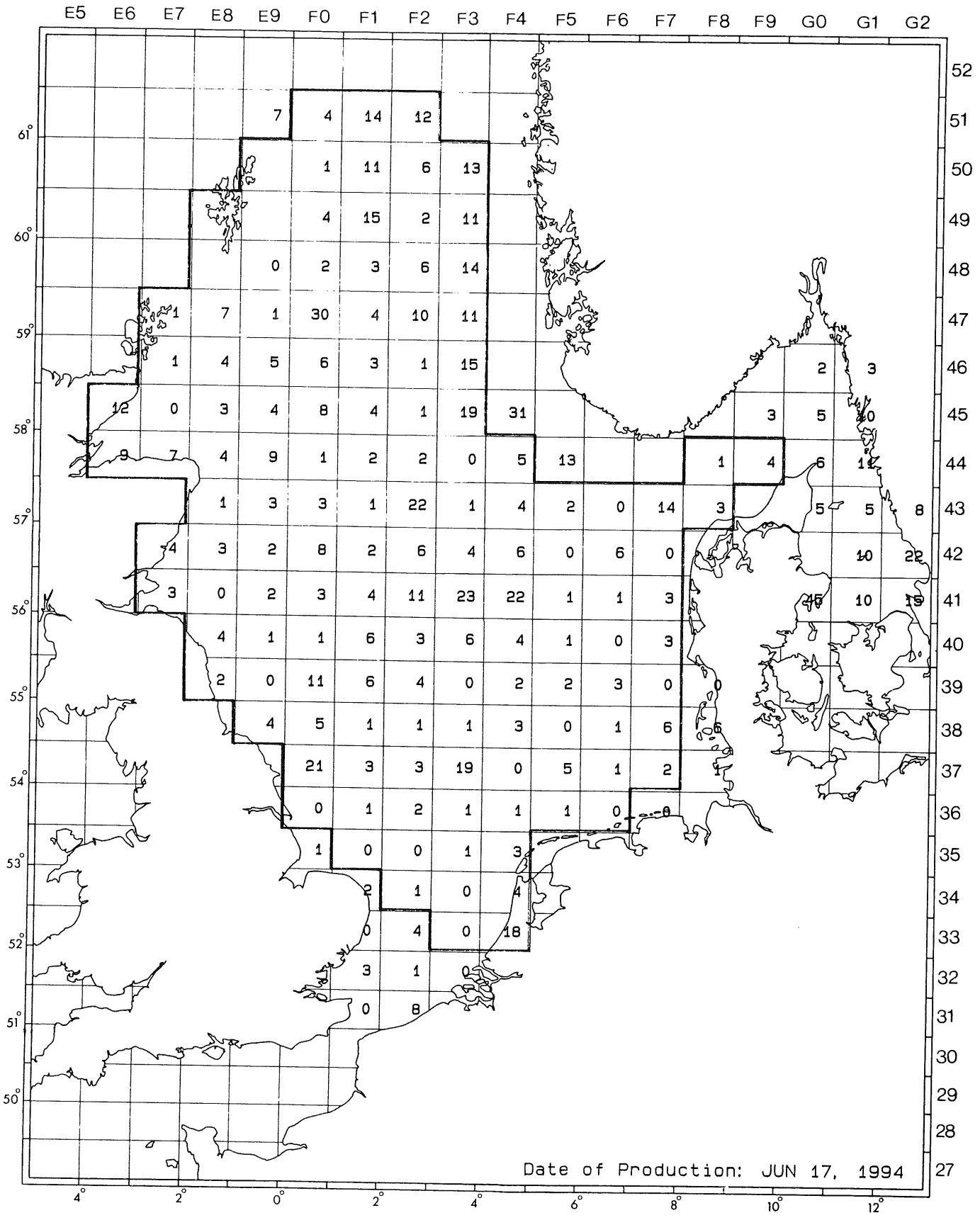

Figure 5.17 Cod: number per hour, age group 3+.

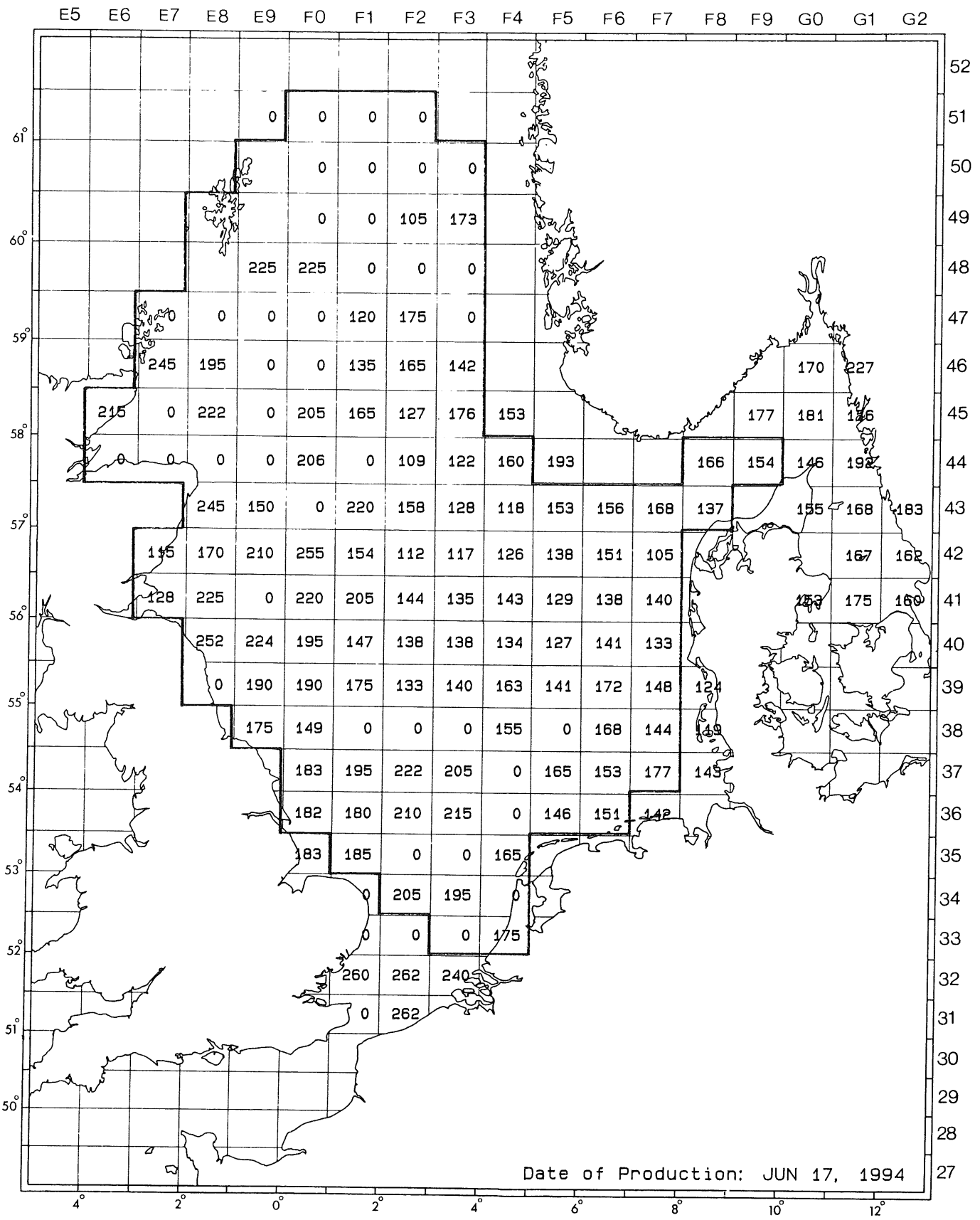

Figure 5.18 Cod: mean length, age group 1.

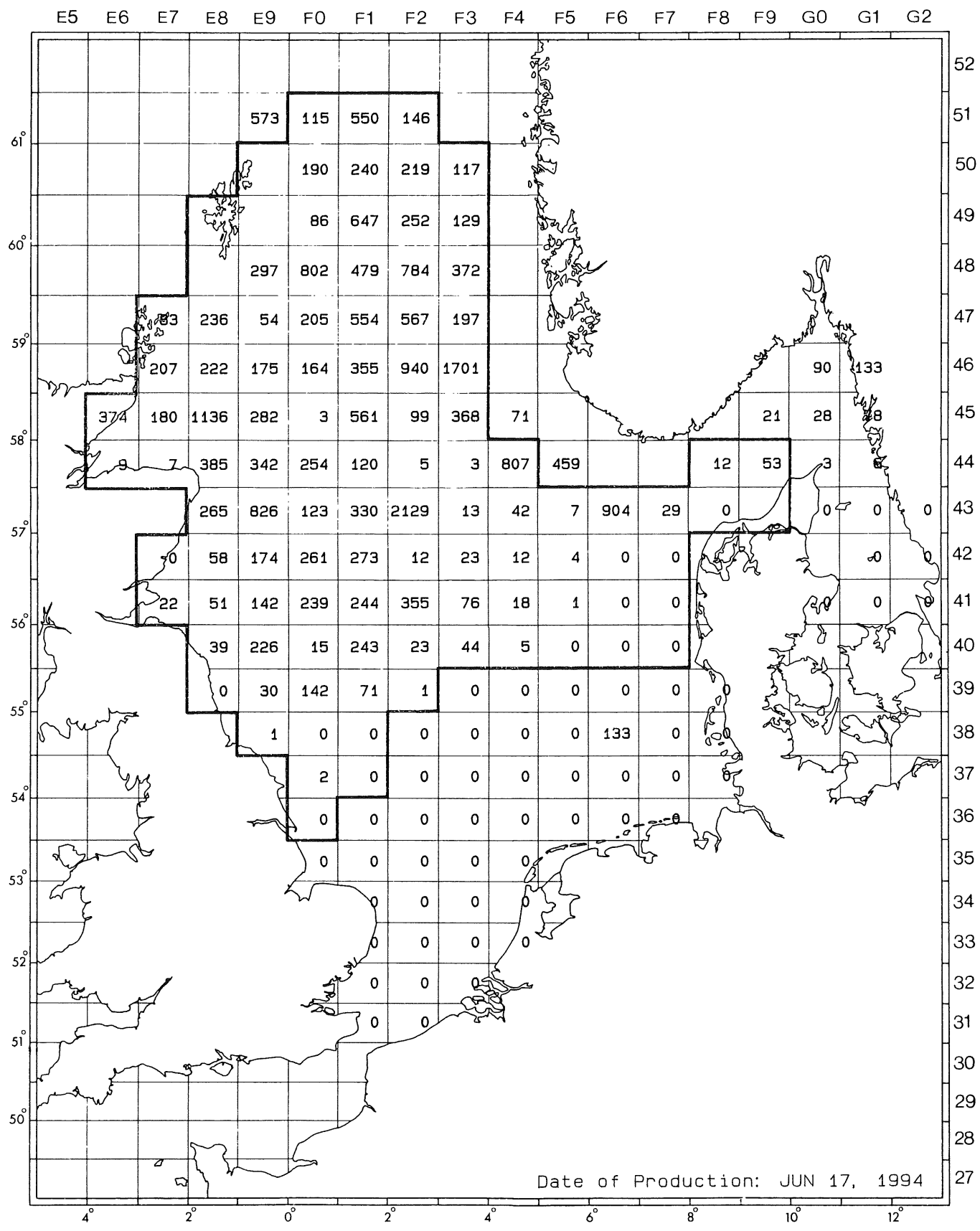

Figure 5.19 Haddock: number per hour, age group 1.

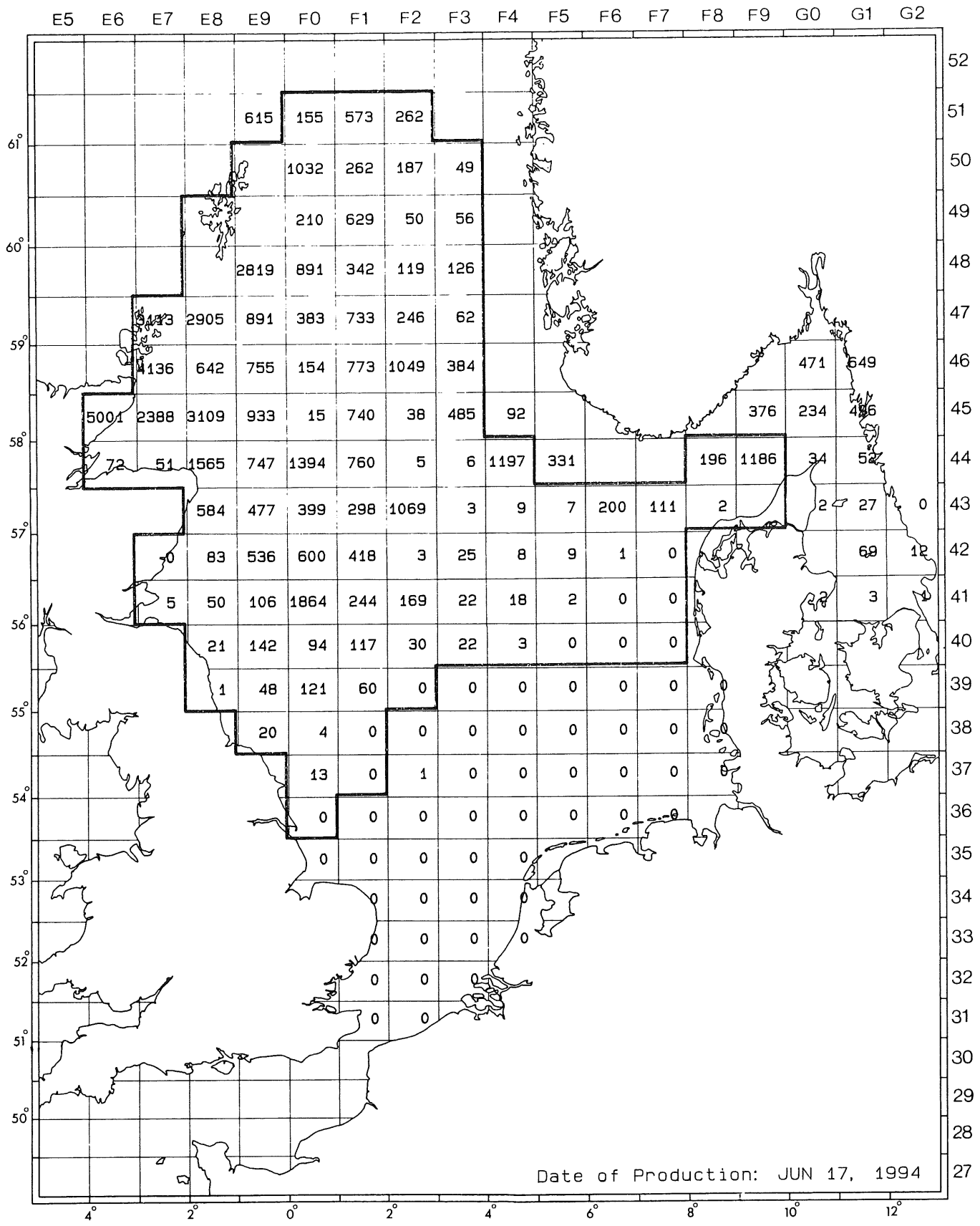

Figure 5.20 Haddock: number per hour, age group 2.

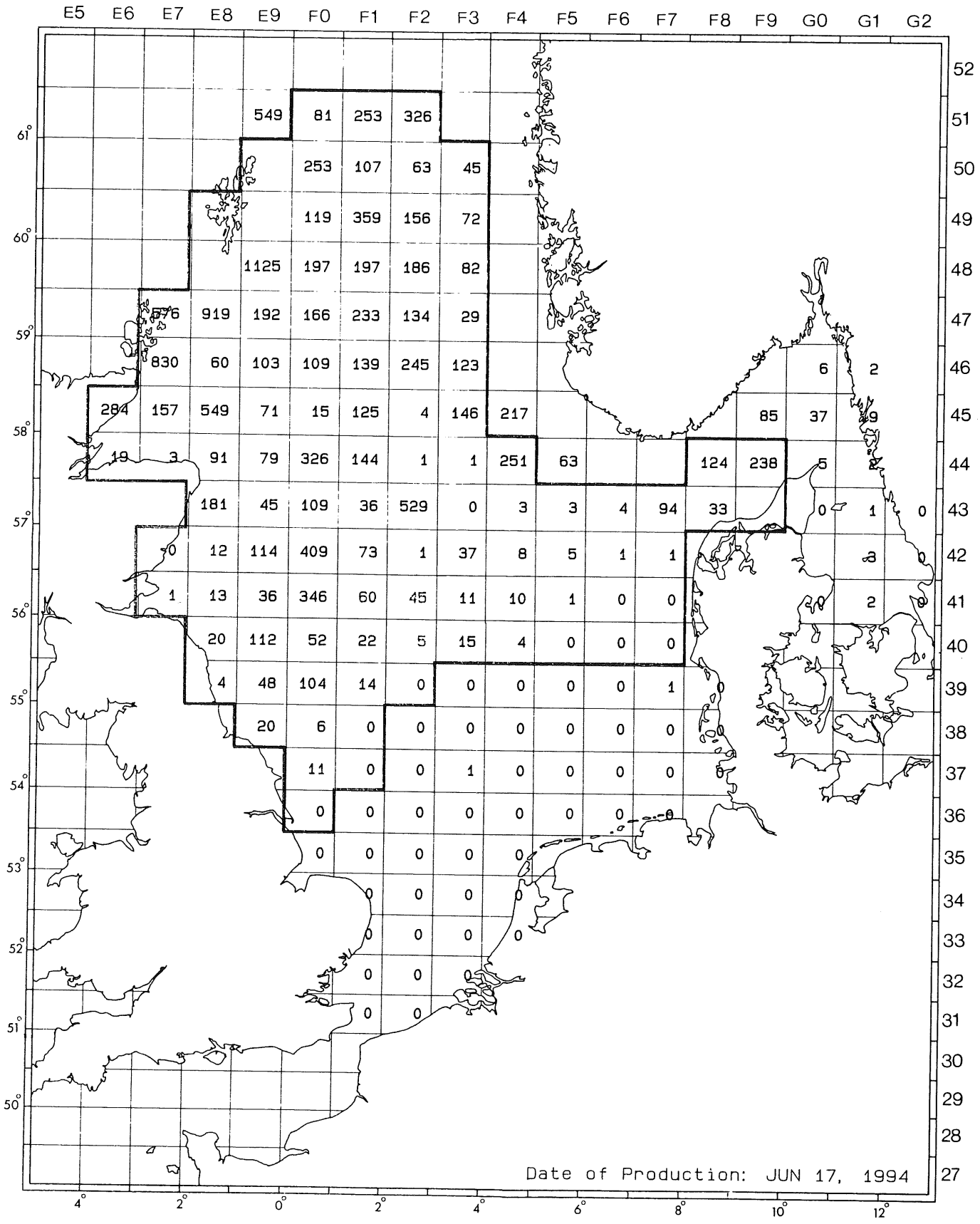

Figure 5.21 Haddock: number per hour, age group 3+.

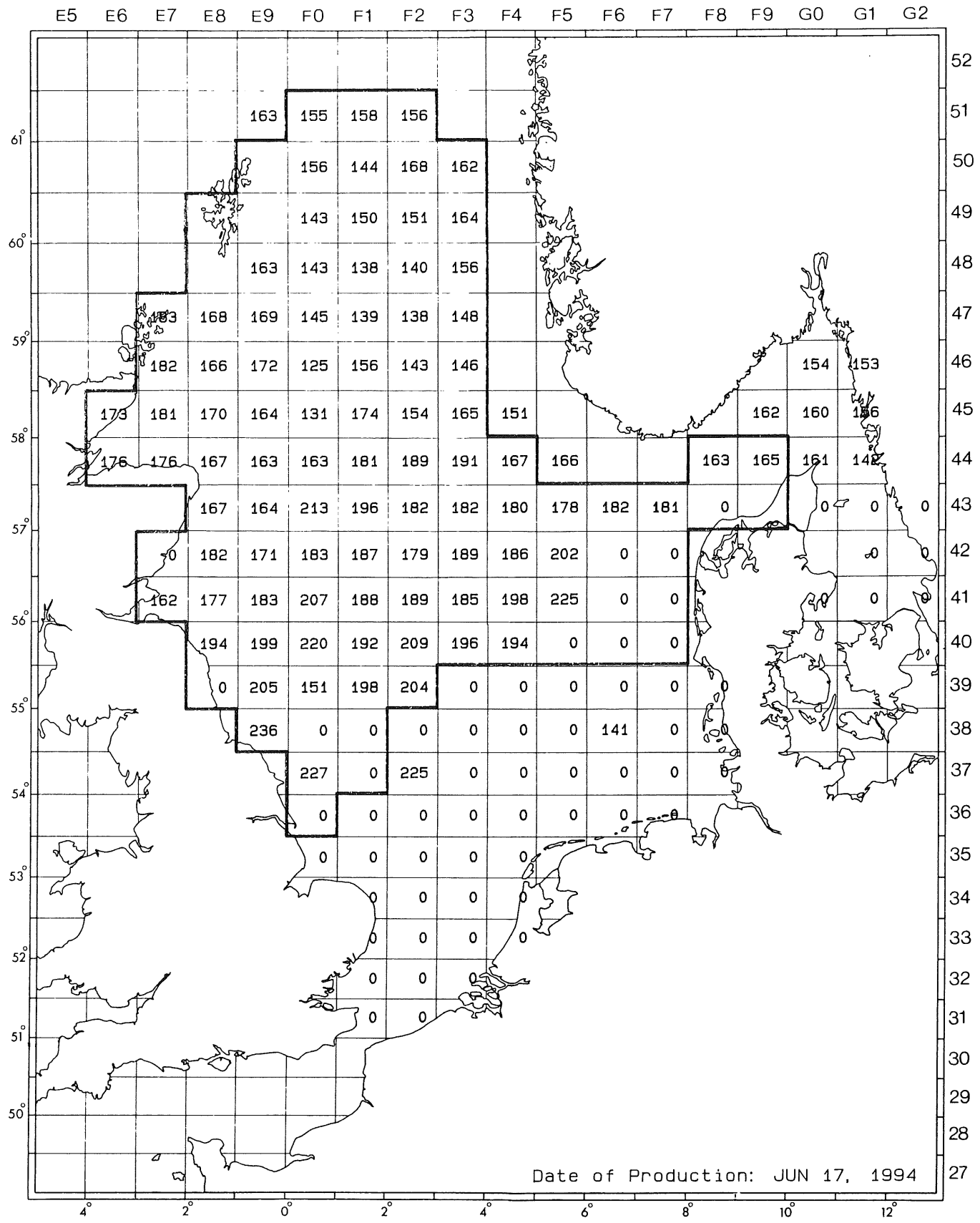

Figure 5.22 Haddock: mean length, age group 1.

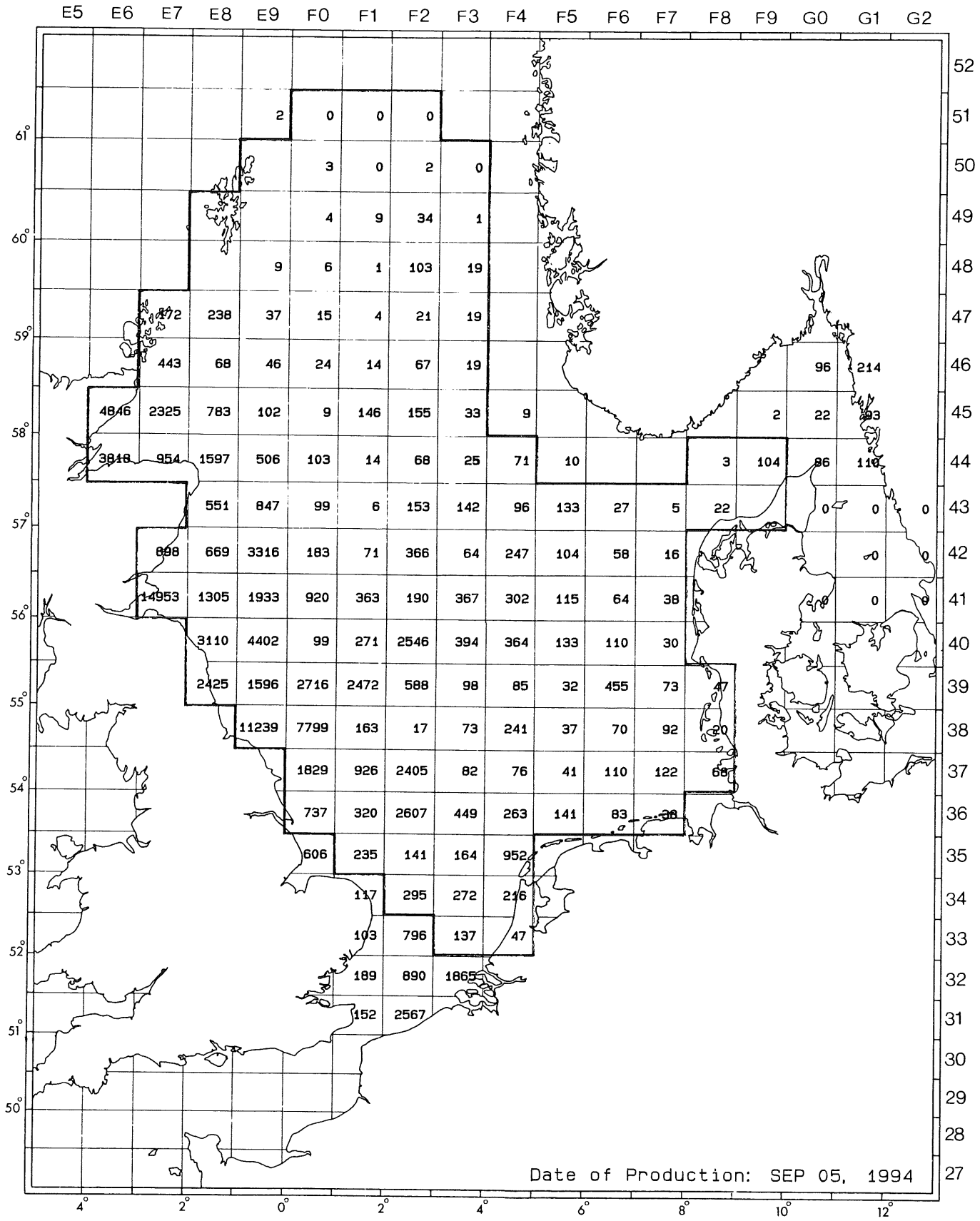

Figure 5.23 Whiting: number per hour, age group 1.

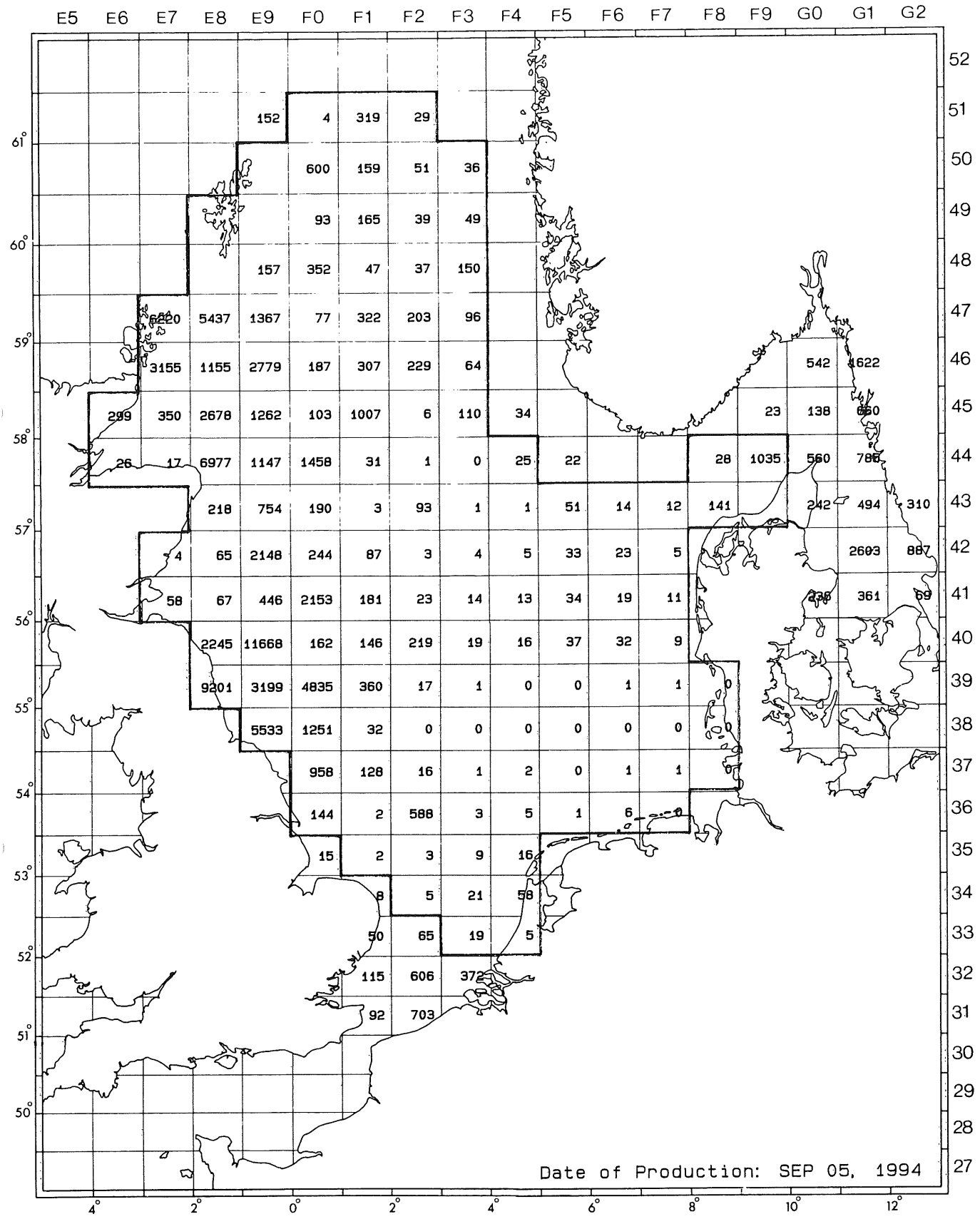

Figure 5.24 Whiting: number per hour, age group 2.

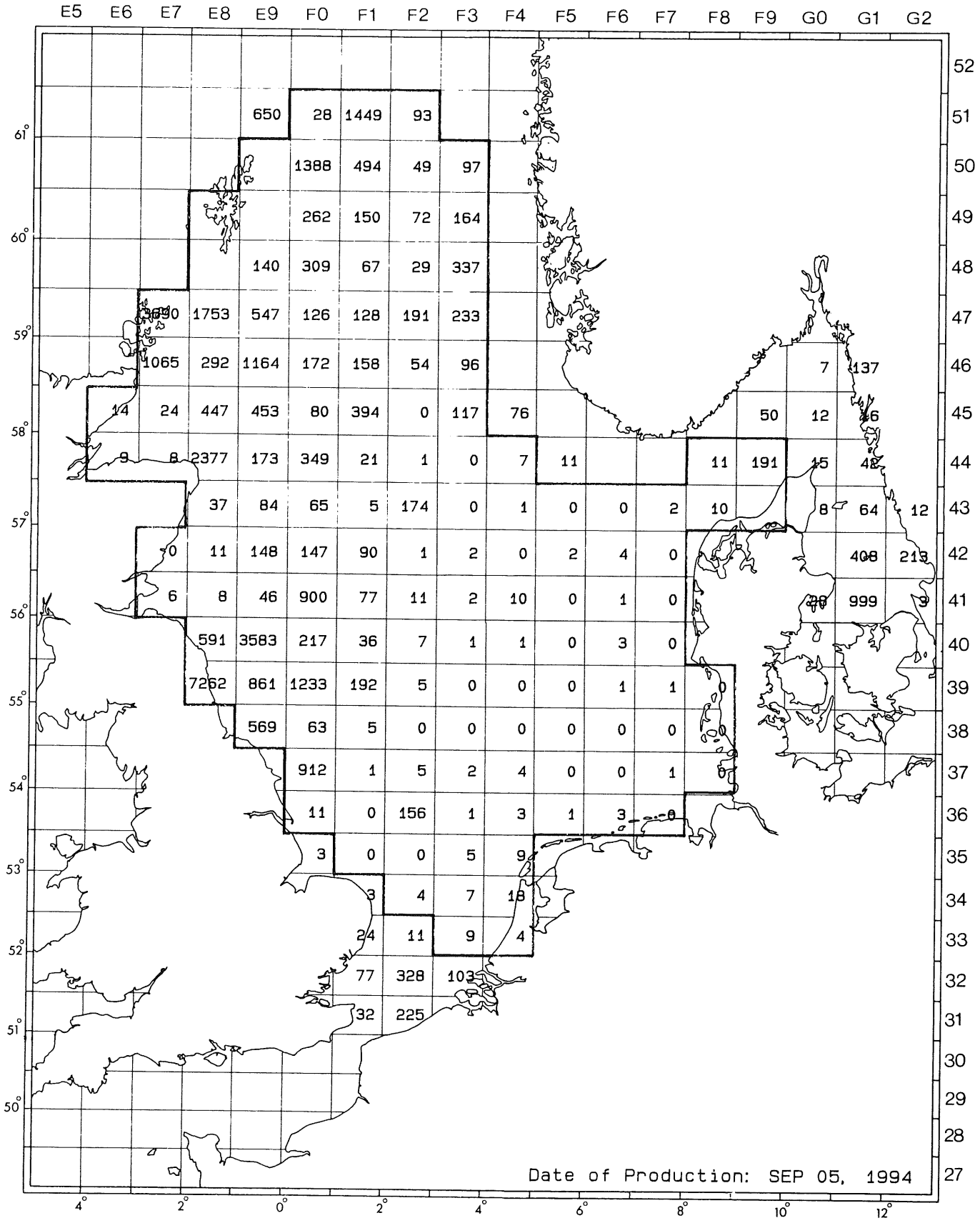

Figure 5.25 Whiting: number per hour, age group 3+.

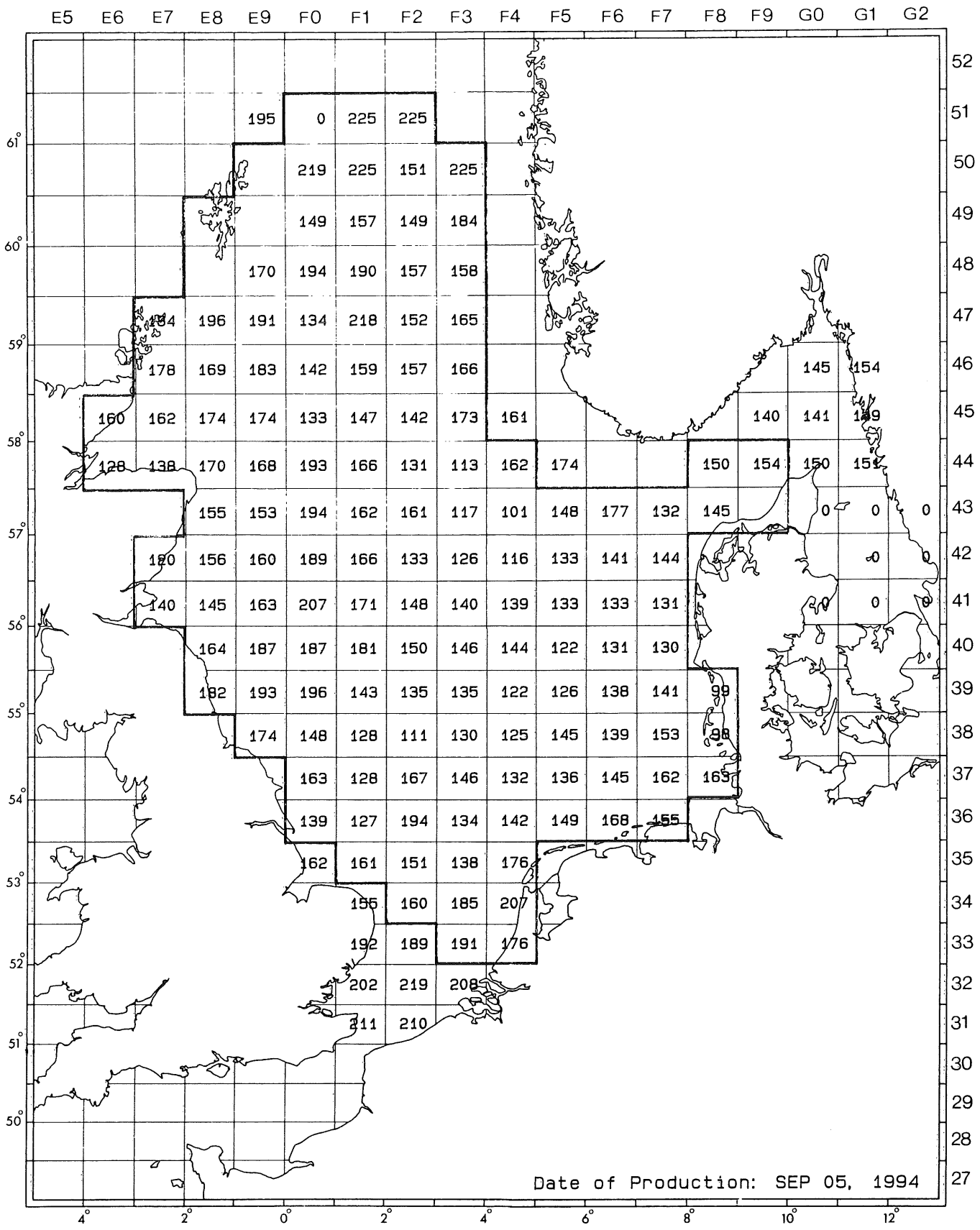

Figure 5.26 Whiting: mean length, age group 1.

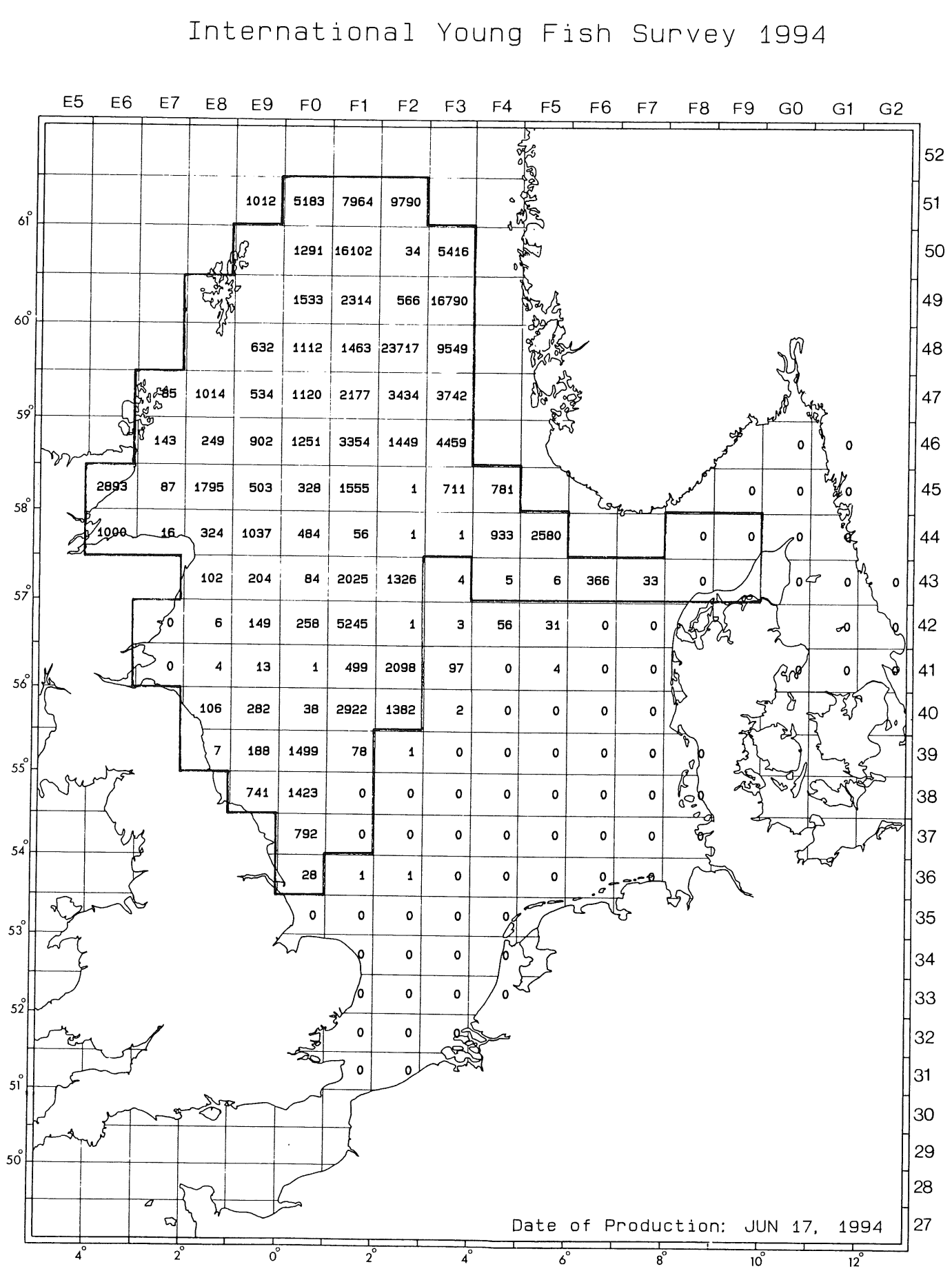

Figure 5.27 Norway pout: number per hour, age group 1.

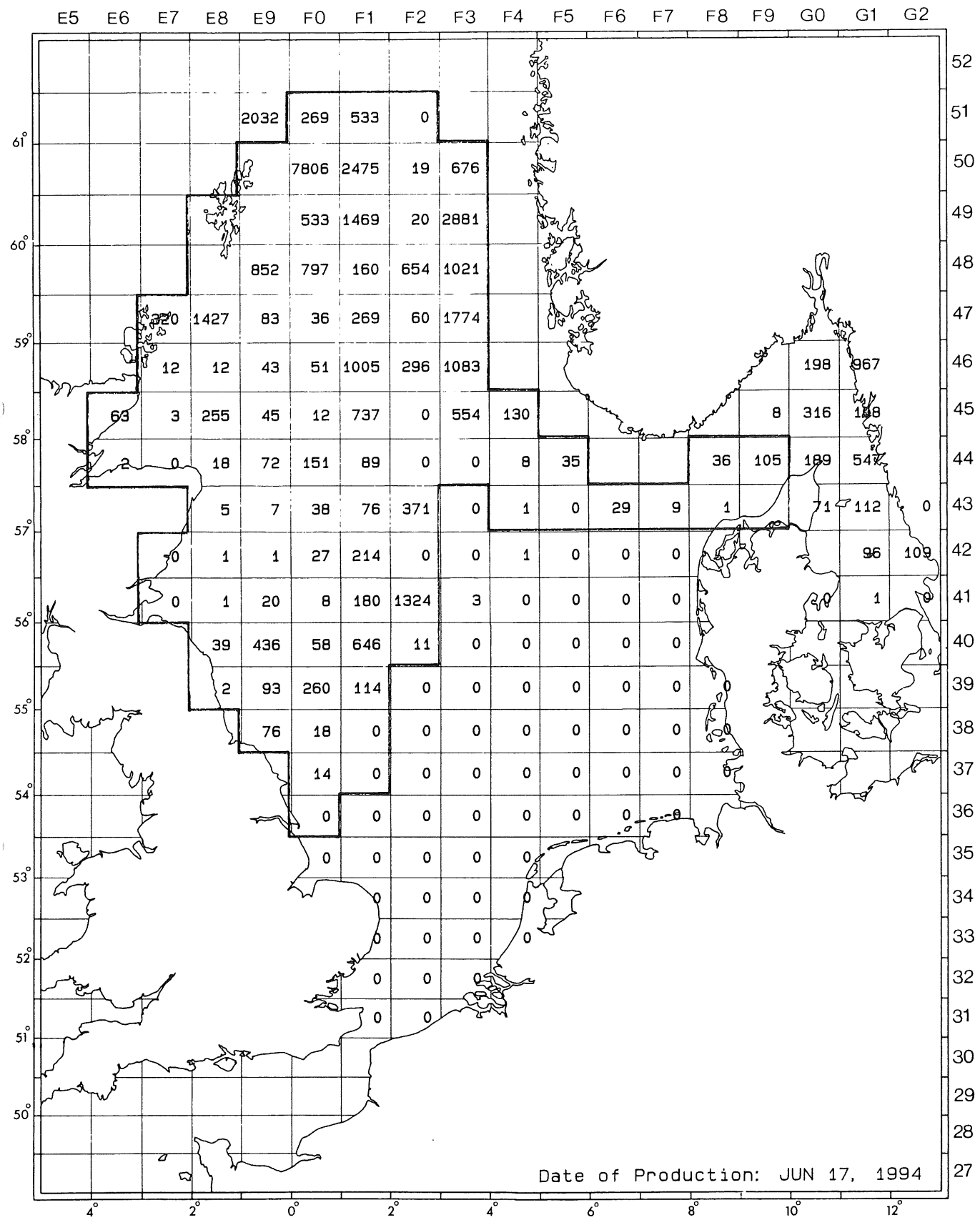

Figure 5.28 Norway pout: number per hour, age group 2.

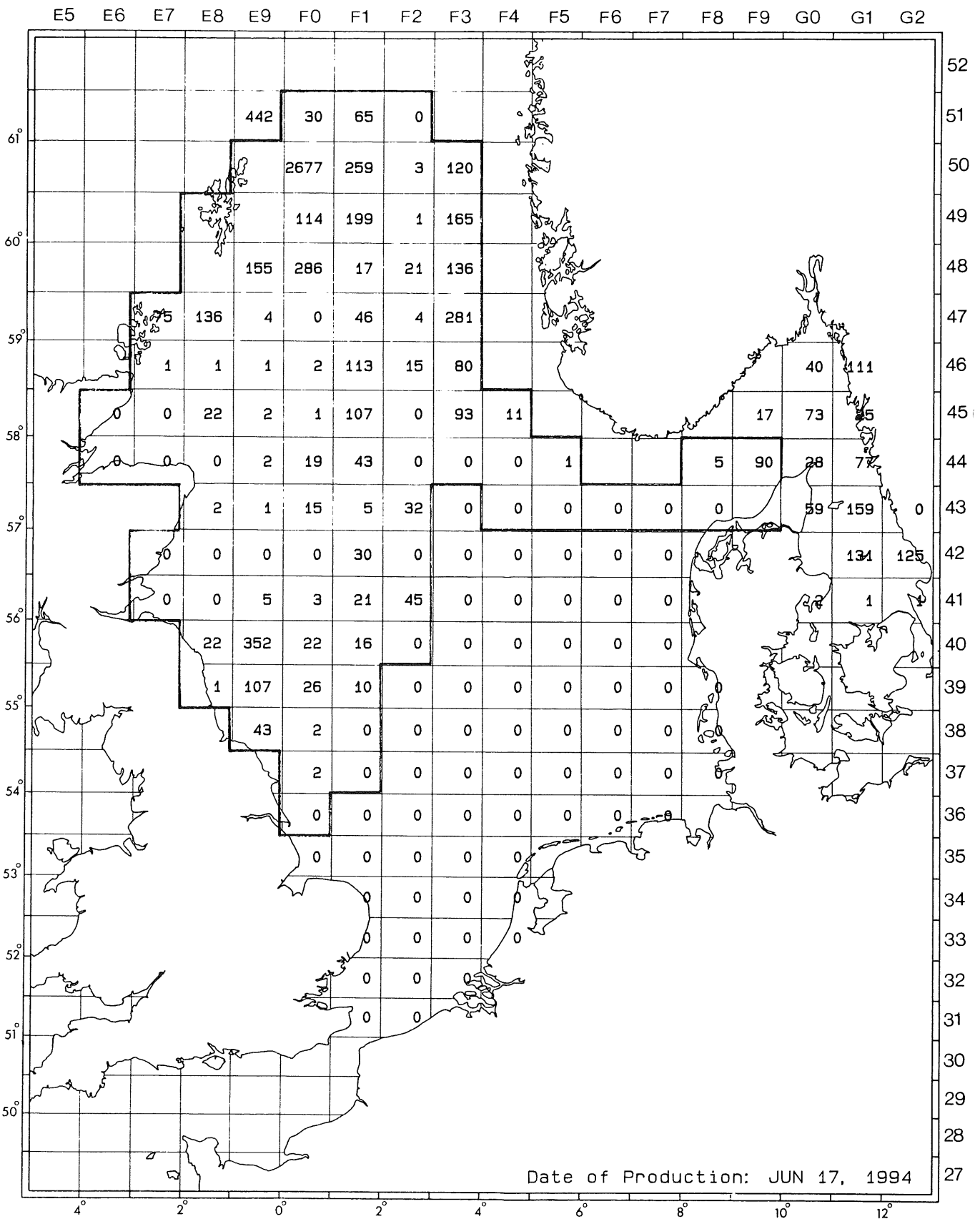

Figure 5.29 Norway pout: number per hour, age group 3+.

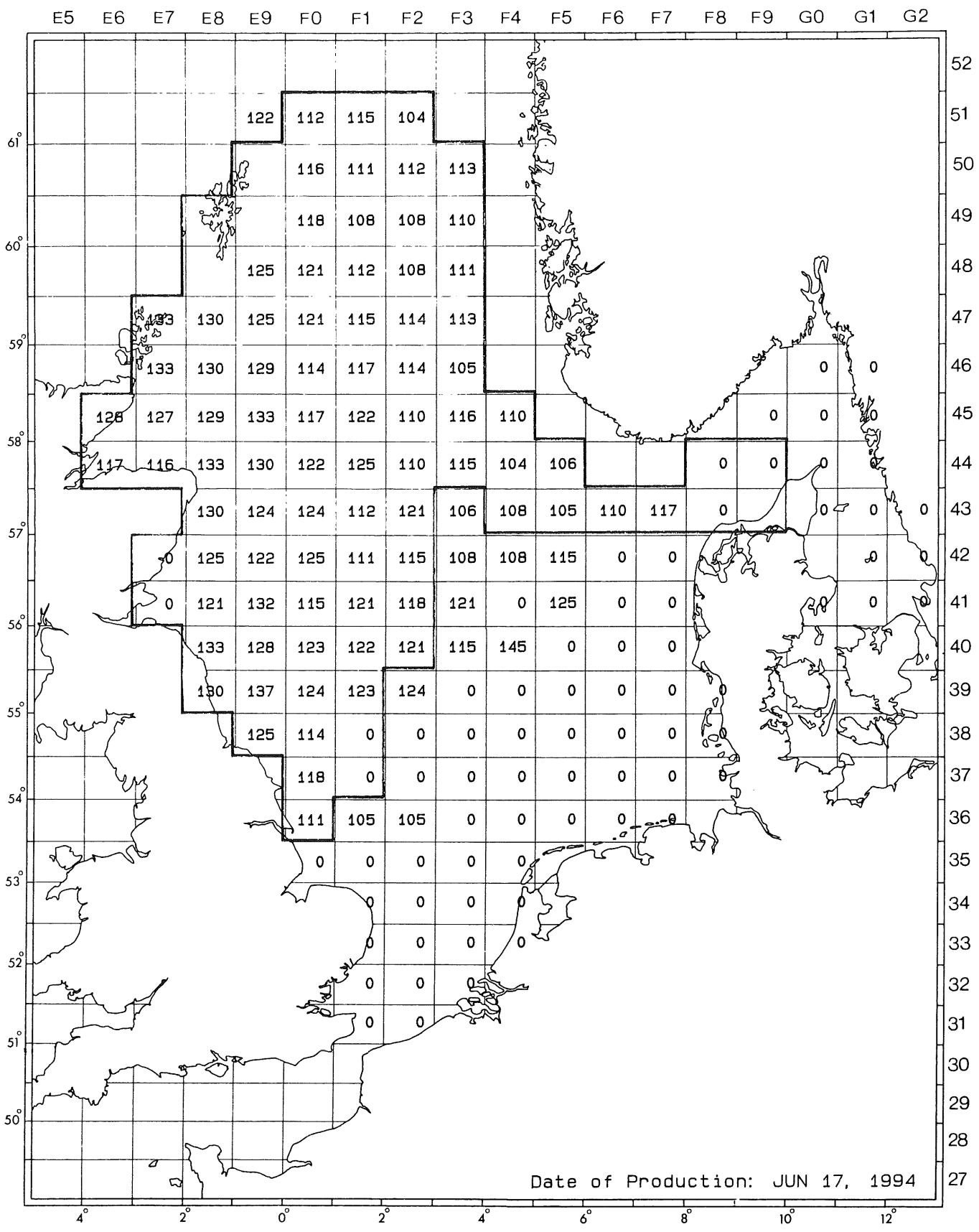

Figure 5.30 Norway pout: mean length, age group 1.

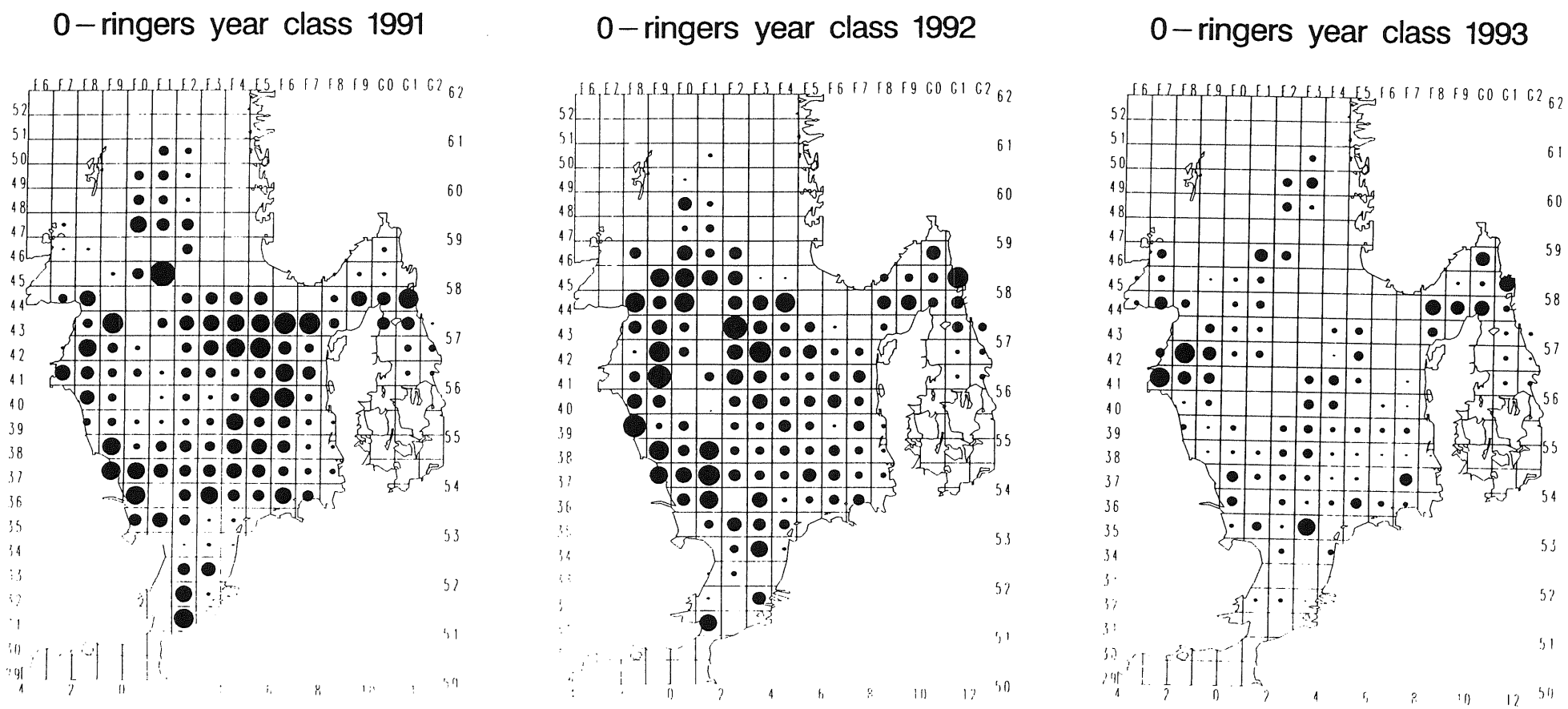

Figure 6.1 Distribution of herring larvae (0-ringers) of year classes 1991-1993. The density of 0-ringers per statistical rectangle is estimated from catches with the MIK ring-net during the IBTS in February. The surface area of the filled circles represents the density in no m^{-2}; the surface of a circle that extends to the borders of a statistical rectangle represents 1.8 larvae m^{-2}.

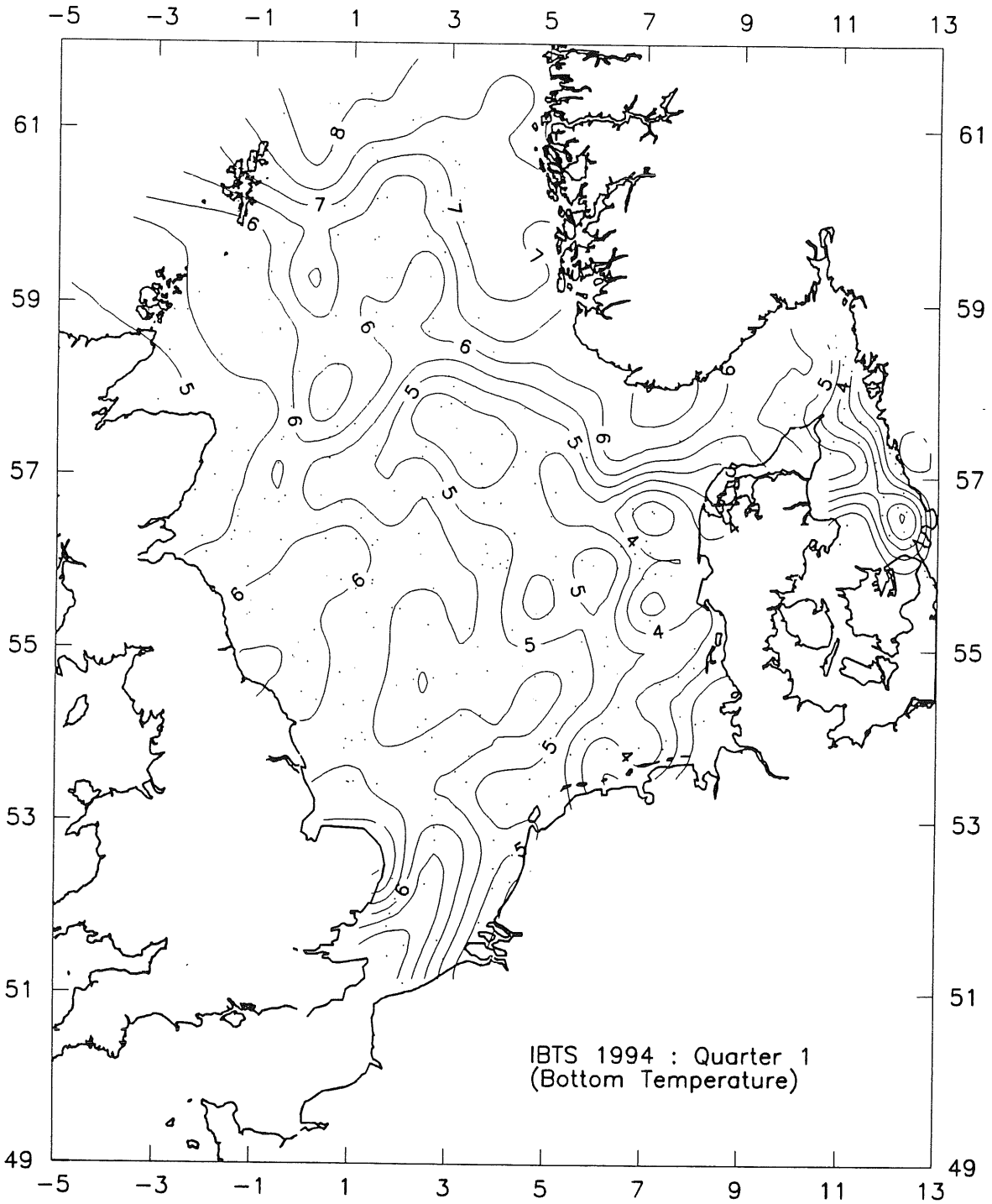
-5
-3
-1
1
3
5
7
9
11
13
61
59
57
55
53
51
49
IBTS 1994 : Quarter 1
(Bottom Temperature)

Figure 7.1

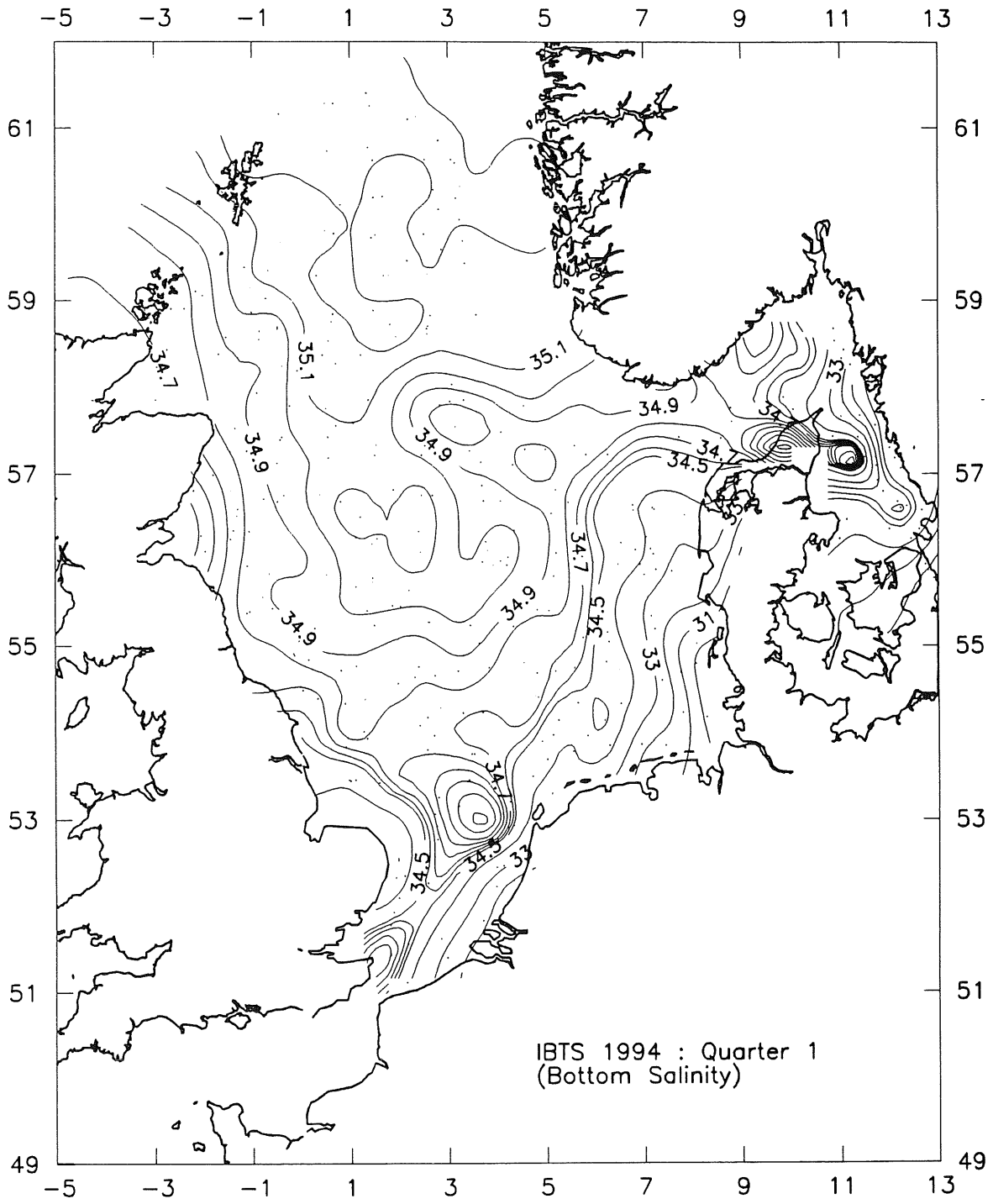

Figure 7.2