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Report of the
Working Group on Beam Trawl Surveys (WGBEAM)

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1 Introduction

Fisheries independent beam trawl surveys using research vessels were established in the 1980s by countries bordering the North Sea to monitor stocks of plaice and sole. Collation and analysis of some of the data derived from these surveys was undertaken by the Beam Trawl Study Group, which in 1998 was re-established as the Working Group on Beam Trawl Surveys. Although the initial focus of its efforts was in the North Sea and Eastern Channel, the Working Group now evaluates all major surveys in Sub-area IV and VII (ICES, 1991).

The Working Group comprises regular participants from Belgium, Germany, Netherlands and the UK. In addition this year there was a representative from ICES. An annual report describing the surveys and summarising the distribution and catch rate of fish species has been produced every year since 1990.

1.1 Terms of reference

At the 2003 Annual Science Conference it was resolved that the **Working Group on Beam Trawl Surveys** [WGBEAM] (Chair: Dr. G. J. Piet, Netherlands) will meet from 9–11 December 2003 in IJmuiden to:

a) Prepare a progress report summarising the results of the 2003 beam trawl surveys;

b) calculate population abundance indices by age-group for sole and plaice in the North Sea, Division VIIa and Divisions VIId-g;

c) Further co-ordinate offshore and coastal beam trawl surveys in the North Sea and Divisions VIIa and VIId-g;

d) Describe and evaluate the current methods for calculating population abundance indices and consider possibilities of delivering improved indices;

e) Continue the work on developing relative catchabilities of the different gears used in the surveys;

f) Continue work of developing and standardising an international database of beam trawl survey data and co-ordinate such activities with those of the IBTSWG in particular on the compliance to DATRAS, the bottom trawl database to be developed at ICES;

g) Continue the work on collating information on the epibenthic invertebrate by-catch during beam trawl surveys into a common database and discuss which summary results should be reported;

h) Develop protocols and criteria to ensure standardisation of all sampling tools and surveys gears.

1.2 Participants

Bart Maertens	Belgium
Gerjan Piet	Netherlands
Henk Heessen	Netherlands
John Dann	UK, England
Lena Larsen	ICES
Richard Millner	UK, England
Thomas Neudecker	Germany
Ulrich Damm	Germany

2 Results offshore surveys 2003

2.1 Coverage of the area

The coverage of the area by each of the participating countries' surveys is shown in Annex 1.

2.2 Population abundance indices

In the past year a new database (FRISBE) was set up at the Netherlands Institute for Fisheries Research. As a consequence all survey files went through new and improved checking procedures and many newly discovered errors were corrected. Indices were recalculated using these new files. As a result the indices provided in this year's report may differ slightly from those in previous reports. The indices as provided in this report should be considered the correct ones. This applies for the catch rates of sole and plaice in the North Sea (Tables 2.2.1 and 2.2.2) as well as the indices of juvenile sole and plaice abundance for the Netherlands DFS in Tables 2.2.3 and 2.2.4.

In Tables 2.2.3 and 2.2.4 the indices of juvenile sole and plaice abundance for the Netherlands SNS are not reported as there has been no autumn SNS survey in 2003.

Table 2.2.1. Catch rate of sole from Netherlands and UK surveys in the North Sea and VII d,a,e,f, and g.

Netherlands (N.hr^-1/8m trawl) North Sea

Year/Age	0	1	2	3	4	5	6	7	8	9	10+
1985	0.0	2.7	7.9	3.5	1.7	0.6	0.3	0.0	0.0	0.0	0.0
1986	0.0	7.9	4.5	1.7	0.8	0.6	0.2	0.1	0.0	0.0	0.1
1987	0.0	7.0	12.5	1.8	0.6	0.6	0.2	0.2	0.1	0.0	0.0
1988	0.0	81.2	12.8	2.8	1.0	0.1	0.2	0.1	0.1	0.0	0.1
1989	0.0	9.4	68.1	4.2	4.1	0.7	0.1	0.2	0.0	0.1	0.0
1990	0.0	22.6	22.4	20.1	0.6	0.7	0.5	0.1	0.1	0.0	0.0
1991	1.1	3.3	23.2	5.8	6.0	0.1	0.1	0.1	0.0	0.0	0.0
1992	0.2	74.2	23.2	9.9	2.3	2.9	0.1	0.1	0.1	0.0	0.1
1993	0.0	5.0	27.4	1.0	4.4	2.4	4.3	0.0	0.1	0.1	0.1
1994	0.9	5.9	5.0	15.4	0.1	1.4	0.1	1.0	0.0	0.0	0.0
1995	0.7	27.6	8.5	7.0	6.7	0.5	0.9	0.3	1.0	0.0	0.0
1996	0.2	3.5	6.2	1.9	1.5	2.5	0.3	0.4	0.1	0.3	0.1
1997	1.3	173.2	5.4	3.2	0.8	0.8	0.4	0.1	0.0	0.0	0.1
1998	0.3	14.1	29.2	2.0	1.3	0.1	0.0	0.4	0.0	0.0	0.0
1999	6.6	11.4	19.3	16.6	0.6	2.1	0.3	0.2	0.7	0.0	0.3
2000	0.1	12.9	6.5	4.1	1.6	0.3	0.2	0.1	0.0	0.2	0.1
2001	10.0	8.0	10.8	2.4	1.7	0.7	0.1	0.0	0.0	0.0	0.2
2002	6.9	21.5	4.2	3.4	0.9	0.4	0.4	0.0	0.1	0.0	0.1
2003	0.8	12.0	11.6	2.6	1.8	0.4	0.2	0.3	0.0	0.0	0.0

United Kingdom (N.hr^-1/8m trawl) Eastern Channel (VIId)

Age	0	1	2	3	4	5	6	7	8	9	10+
1988	0.0	8.2	14.2	9.9	0.8	1.3	0.6	0.1	0.1	0.2	0.2
1989	0.0	2.6	15.4	3.4	1.7	0.6	0.2	0.2	0.0	0.0	0.7
1990	0.0	12.1	3.7	3.7	0.7	0.8	0.2	0.1	0.2	0.0	0.1
1991	0.0	8.9	22.8	2.2	2.3	0.3	0.5	0.1	0.2	0.1	0.1
1992	0.0	1.4	12.0	10.0	0.7	1.1	0.3	0.5	0.1	0.2	0.6
1993	0.0	0.5	17.5	8.4	7.0	0.8	1.0	0.3	0.2	0.0	0.4
1994	0.0	4.8	3.2	8.3	3.3	3.3	0.2	0.6	0.1	0.3	0.3
1995	0.0	5.2	16.9	2.1	3.8	2.2	2.4	0.2	0.3	0.2	0.2
1996	0.0	3.5	7.3	3.8	0.7	1.3	0.9	1.1	0.1	0.5	0.4
1997	0.0	19.0	7.3	3.2	1.3	0.2	0.5	0.4	0.9	0.0	0.7
1998	0.1	2.1	20.9	2.3	0.9	0.9	0.1	0.3	0.0	0.1	0.3
1999	1.2	25.5	9.0	12.4	2.6	1.5	0.7	0.2	0.9	0.8	0.5
2000	0.1	11.0	26.8	5.3	4.6	1.4	0.7	0.4	0.0	0.2	0.9
2001	1.2	8.5	25.1	11.2	1.9	2.4	0.8	0.6	0.3	0.1	0.9
2002	0.0	46.1	18.4	8.5	5.2	0.4	1.0	0.5	0.2	0.0	0.7
2003	0.0	8.5	33.8	6.4	3.7	1.7	0.4	0.5	0.2	0.0	0.8

Table 2.2.1 Continued. Catch rate of sole from Netherlands and UK surveys in the North Sea and VII d,a,e,f, and g.

United Kingdom (N.hr^-1/8m trawl) Western Channel (VIIe)

	0	1	2	3	4	5	6	7	8	9	10+
1989	0.0	0.2	2.5	4.9	4.3	1.5	1.6	0.7	0.3	0.3	0.4
1990	0.0	0.6	1.7	3.1	1.3	1.0	0.3	0.6	0.1	0.2	0.5
1991	0.0	0.3	7.9	2.9	2.1	1.0	0.8	0.3	0.7	0.2	0.7
1992	0.0	0.2	5.8	11.6	1.5	1.3	0.5	0.3	0.2	0.4	0.5
1993	0.0	0.3	2.7	5.4	5.4	1.0	0.5	0.3	0.2	0.1	0.7
1994	0.0	0.1	1.7	3.3	2.4	1.4	0.2	0.3	0.0	0.1	0.3
1995	0.1	1.1	1.5	1.9	1.7	1.0	1.3	0.2	0.2	0.2	0.5
1996	0.0	1.9	4.7	2.4	1.0	1.3	0.7	0.6	0.1	0.0	0.4
1997	0.2	3.0	5.5	5.1	1.7	0.5	0.6	0.5	0.4	0.2	0.6
1998	0.0	0.9	6.0	4.4	2.6	0.9	0.3	0.4	0.2	0.3	0.4
1999	0.0	0.9	4.4	5.5	2.0	1.0	0.2	0.2	0.1	0.1	0.7
2000	0.0	0.9	5.3	2.9	2.0	1.1	0.6	0.2	0.1	0.2	0.3
2001	0.0	0.6	7.8	5.9	2.2	1.3	.4	0.5	0.2	0.0	0.3
2002	0.00	0.48	1.33	4.18	1.64	0.85	0.36	0.06	0.06	0.00	0.24
2003	0.00	2.49	6.70	3.78	3.84	2.16	0.54	0.22	0.16	0.22	0.22

United Kingdom (N.hr^-1/8m trawl) Bristol Channel (VIIf)

Age	0	1	2	3	4	5	6	7	8	9	10+
1988	3.7	10.0	40.3	6.0	2.3	0.7	0.0	0.0	0.0	0.0	1.0
1989	22.0	34.0	50.7	27.0	3.0	2.3	1.0	0.7	0.3	0.3	0.7
1990	4.2	53.8	43.8	7.0	2.2	0.6	1.0	0.4	0.0	0.0	0.2
1991	4.8	36.0	77.3	10.1	2.5	2.2	0.6	0.0	0.4	0.2	0.1
1992	0.6	58.0	38.2	20.5	4.4	2.7	1.4	0.1	0.2	0.1	0.6
1993	0.7	24.2	51.2	6.1	3.3	0.4	0.2	0.2	0.1	0.1	0.2
1994	0.1	51.4	52.1	16.1	2.8	1.3	1.1	0.0	0.0	0.4	0.4
1995	4.3	16.3	29.4	6.6	1.6	0.9	1.6	0.4	0.3	0.3	0.5
1996	0.7	22.5	30.2	7.6	3.4	0.7	0.4	0.5	0.4	0.4	0.4
1997	4.8	64.9	27.8	2.9	1.7	2.1	0.7	0.5	0.8	0.0	0.7
1998	12.0	105.6	57.5	6.9	1.1	1.7	0.9	0.3	0.1	0.7	0.7
1999	3.5	358.2	35.2	4.7	2.0	0.8	0.5	0.8	0.3	0.0	1.1
2000	1.8	128.3	173.3	4.9	3.4	0.6	0.0	0.3	0.1	0.3	0.5
2001	2.6	42.8	72.3	31.7	2.7	0.8	0.3	0.3	0.1	0.0	1.2
2002	0.8	66.2	27.0	12.7	12.3	1.2	0.7	0.2	0.4	0.0	0.7
2003	1.2	38.7	53.4	6.7	4.6	6.7	1.0	0.4	0.3	0.0	0.1

Catch rate United Kingdom sole (N.hr^-1/8m trawl) in Irish Sea (VIIa)

Age	0	1	2	3	4	5	6	7	8	9	10+
1988	0.2	8.8	24.3	23.3	43.8	8.6	4.6	0.1	0.0	0.0	0.0
1989	2.0	15.8	25.9	22.1	9.9	25.0	4.9	1.8	0.0	0.0	0.2
1990	0.9	122.7	53.8	12.1	4.0	9.5	15.2	2.6	1.4	0.6	0.1
1991	0.3	13.2	105.2	17.0	2.8	1.1	2.1	8.4	2.3	0.2	0.3
1992	0.1	14.9	26.2	53.9	14.3	6.2	1.2	0.5	7.9	1.7	0.8
1993	0.0	3.6	13.3	7.0	11.3	2.7	1.0	0.4	0.7	1.9	0.9
1994	0.0	1.7	17.9	10.0	4.3	6.5	2.4	0.7	0.5	0.2	1.6
1995	1.8	13.2	8.8	11.2	4.8	2.2	2.9	0.6	0.3	0.1	1.2
1996	0.2	46.2	8.3	2.5	5.8	3.3	1.7	2.1	0.6	0.2	0.7
1997	0.5	65.7	39.8	4.9	1.8	3.9	1.9	1.1	2.3	0.6	0.8
1998	0.5	35.9	44.2	21.9	2.5	0.6	2.2	1.8	0.3	1.5	0.9
1999	0.3	29.6	22.4	23.2	18.0	2.5	1.1	2.1	0.4	0.6	1.9
2000	0.0	15.8	41.2	10.3	12.0	6.3	1.1	0.1	0.8	0.4	1.6
2001	0.3	5.2	17.6	15.1	4.6	5.6	3.6	0.5	0.2	0.7	0.9
2002	0.1	15.1	7.6	7.8	9.2	3.0	4.7	2.8	0.1	0.1	1.1
2003	0.4	17.0	16.5	3.8	6.7	6.0	2.3	2.6	1.5	0.1	0.8

Table 2.2.2. Catch rate of plaice from Netherlands and UK surveys in the North Sea and VII d,a,e,f, and g.

Netherlands (N.hr^-1/8m trawl) North Sea

Age	0	1	2	3	4	5	6	7	8	9	10+
1985	134.7	115.6	179.9	38.8	11.8	1.4	1.0	0.4	0.2	0.1	0.2
1986	16.5	660.2	131.8	51.0	8.9	3.3	0.4	0.3	0.1	0.0	0.2
1987	44.1	225.8	764.3	33.1	4.8	2.0	1.0	0.4	0.1	0.1	0.3
1988	79.1	577.3	140.1	173.7	9.2	2.6	0.8	0.4	0.0	0.1	0.2
1989	71.0	428.7	319.3	38.7	47.3	5.8	0.8	0.3	0.7	0.1	0.1
1990	14.7	112.1	102.6	55.7	22.8	5.6	0.8	0.2	0.4	0.3	0.2
1991	4.4	185.4	122.1	28.6	11.9	4.3	5.7	0.3	0.2	0.1	0.1
1992	13.2	171.5	125.9	27.3	5.6	3.2	2.7	1.1	0.3	0.1	0.1
1993	54.8	124.8	179.1	38.4	6.1	0.9	0.8	0.6	0.4	0.2	0.1
1994	145.6	145.2	64.2	35.2	10.9	2.9	0.6	0.9	1.0	0.4	0.0
1995	92.0	252.2	43.6	14.2	8.1	1.2	0.9	0.4	1.1	0.2	0.1
1996	209.8	218.3	212.1	22.9	4.8	3.7	0.9	0.0	0.2	0.1	0.1
1997	31.9	439.5	743.6	19.9	2.8	0.2	0.4	0.2	0.1	0.0	0.0
1998	243.0	338.2	436.2	47.4	8.9	1.4	0.8	0.1	0.1	0.1	0.1
1999	198.9	305.9	130.0	182.5	3.7	2.1	0.1	0.1	0.0	0.0	0.1
2000	175.6	278.8	75.2	31.6	24.2	0.6	0.2	0.5	0.0	0.0	0.1
2001	603.7	225.8	78.9	19.6	10.0	9.5	0.3	0.1	0.0	0.0	0.2
2002	241.4	568.7	45.5	15.4	5.5	2.7	1.4	0.1	0.1	0.0	0.1
2003	234.7	132.8	170.9	9.9	5.7	1.4	1.1	0.7	0.1	0.1	0.5

United Kingdom (N.hr^-1/8m trawl) Eastern Channel (VIId)

Age	0	1	2	3	4	5	6	7	8	9	10+
1988	0.0	26.5	31.3	43.8	7.0	4.6	1.5	0.8	0.7	0.6	1.2
1989	0.0	2.3	12.1	16.6	19.9	3.3	1.5	1.3	0.5	0.3	1.7
1990	0.6	5.2	4.9	5.8	6.7	7.5	1.8	0.7	1.0	0.8	0.4
1991	0.0	11.7	9.1	7.0	5.3	5.4	3.2	1.2	1.0	0.1	1.2
1992	0.0	16.5	12.5	4.2	4.2	5.6	4.9	3.4	0.7	0.5	0.7
1993	0.1	3.2	13.4	5.0	1.7	1.9	1.6	2.0	2.8	0.4	0.6
1994	1.2	8.3	7.5	9.2	5.6	2.0	0.8	0.9	1.8	1.2	0.8
1995	0.0	11.3	4.1	3.0	3.7	1.5	0.6	0.6	1.3	0.8	0.8
1996	13.6	13.2	11.9	1.3	0.7	1.3	0.9	0.4	0.3	0.4	2.8
1997	0.7	33.2	13.5	4.2	0.7	0.3	0.3	0.2	0.2	0.2	1.9
1998	0.3	11.4	27.3	7.0	3.1	0.3	0.2	0.2	0.1	0.0	1.0
1999	1.6	9.2	11.6	15.7	2.8	0.9	0.1	0.0	0.2	0.1	0.6
2000	1.2	17.9	24.9	14.6	19.1	4.5	1.7	0.5	0.3	0.4	2.2
2001	4.9	21.6	26.7	16.2	9.3	14.6	2.9	0.8	0.4	0.3	1.9
2002	2.0	34.0	22.1	12.2	5.7	2.5	5.4	1.3	0.1	0.2	1.0
2003	2.5	7.4	30.5	7.7	3.5	1.7	1.1	2.2	0.7	0.1	0.4

Table 2.2.2. Continued. Catch rate of plaice from Netherlands and UK surveys in the North Sea and VII d,a,e,f, and g.

United Kingdom (N.hr^-1/8m trawl) Western Channel (VIIe)											
Age	0	1	2	3	4	5	6	7	8	9	10+
1989	0.0	0.8	2.2	10.6	7.5	1.4	0.2	0.3	0.2	0.1	0.3
1990	0.0	0.8	1.1	7.0	3.4	2.4	0.0	0.2	0.1	0.1	0.3
1991	0.0	0.6	0.8	1.4	2.7	2.1	1.6	0.7	0.1	0.0	0.3
1992	0.0	4.3	1.0	1.4	0.5	1.3	0.7	0.5	0.1	0.2	0.2
1993	0.0	0.7	2.4	3.3	1.1	0.5	1.2	0.7	0.6	0.0	0.1
1994	0.0	0.8	0.8	3.6	1.2	0.4	0.2	0.5	0.6	0.3	0.0
1995	0.3	2.1	1.7	1.9	2.1	0.5	0.2	0.3	0.2	0.1	0.2
1996	5.4	2.3	3.9	1.3	0.8	0.9	0.2	0.0	0.1	0.3	0.4
1997	10.4	8.1	4.8	8.1	0.9	0.3	0.6	0.3	0.1	0.0	0.4
1998	0.1	5.7	5.2	4.7	3.2	0.4	0.2	0.2	0.1	0.0	6.0
1999	5.1	2.0	2.1	8.2	2.1	1.3	0.1	0.1	0.3	0.1	0.1
2000	0.0	3.3	2.7	5.7	7.0	1.6	1.0	0.0	0.1	0.0	0.3
2001	4.1	1.4	2.8	1.9	3.9	3.7	0.8	0.6	0.0	0.1	0.2
2002	0.00	6.00	3.21	2.97	0.85	1.03	1.39	0.18	0.06	0.00	0.12
2003	0.76	1.19	4.54	3.08	1.78	0.38	0.70	1.14	0.38	0.16	0.16

United Kingdom (N.hr^-1/8m trawl) Bristol Channel (VIIf)											
Age	0	1	2	3	4	5	6	7	8	9	10+
1988	0.0	12.8	45.2	11.5	0.0	0.3	0.3	0.0	0.0	0.3	0.0
1989	0.3	34.3	52.2	12.0	2.5	0.8	0.0	0.3	0.0	0.0	0.0
1990	2.4	32.2	43.0	12.8	3.0	1.2	0.0	0.0	0.4	0.0	0.2
1991	0.2	101.9	4.0	7.9	2.5	1.5	0.4	0.0	0.1	0.0	0.0
1992	0.4	57.3	36.1	1.5	0.6	1.8	0.2	0.6	0.0	0.0	0.2
1993	0.5	14.1	12.6	5.2	0.2	0.6	0.1	0.1	0.0	0.0	0.0
1994	17.5	15.4	4.8	2.4	1.3	0.1	0.0	0.0	0.0	0.0	0.0
1995	0.1	31.4	11.0	2.1	0.5	1.0	0.1	0.0	0.0	0.3	0.0
1996	1.2	32.0	41.8	4.8	0.1	0.4	0.1	0.0	0.0	0.0	0.0
1997	1.1	34.3	15.2	5.2	0.7	0.3	0.1	0.1	0.0	0.0	0.0
1998	0.7	31.5	18.2	6.7	1.5	0.5	0.3	0.0	0.0	0.0	0.1
1999	24.9	22.1	11.7	4.3	2.9	1.4	0.0	0.0	0.1	0.0	0.0
2000	11.2	46.1	8.1	4.3	0.8	0.8	0.0	0.3	0.0	0.0	0.0
2001	3.8	26.6	18.5	2.3	1.2	0.4	0.5	0.2	0.0	0.0	0.0
2002	0.1	14.6	19.1	10.0	0.9	0.6	0.2	0.3	0.1	0.0	0.0
2003	5.6	9.7	10.2	6.2	2.5	0.3	0.2	0.1	0.1	0.3	0.0

United Kingdom (N.hr^-1/8m trawl) Irish Sea (VIIa)											
Age	0	1	2	3	4	5	6	7	8	9	10+
1988	2.9	72.6	145.3	30.8	1.2	6.8	1.2	0.5	0.0	0.1	0.8
1989	5.9	41.3	67.6	64.8	11.3	1.4	3.4	0.3	0.0	0.0	0.1
1990	63.4	146.9	36.7	19.9	9.1	4.8	4.1	0.2	0.1	0.9	0.3
1991	6.7	60.4	59.8	8.1	4.4	0.1	0.9	1.8	0.1	0.0	0.4
1992	4.8	50.7	96.1	38.0	2.0	2.1	1.5	1.6	0.1	0.0	2.0
1993	9.3	168.5	155.4	38.7	13.0	2.0	1.9	1.0	0.4	0.4	0.6
1994	14.6	207.0	124.6	81.4	17.5	5.6	1.4	1.4	0.6	0.2	0.6
1995	17.8	249.7	101.0	38.8	32.2	2.9	1.5	0.6	0.4	0.4	0.3
1996	6.3	144.0	69.3	20.4	9.1	7.1	2.3	1.0	0.1	0.4	0.5
1997	33.3	169.2	98.1	41.4	13.5	7.4	6.1	2.7	0.9	0.5	0.9
1998	23.8	124.4	112.1	41.9	1.6	10.4	4.9	4.3	1.1	0.5	1.2
1999	52.9	108.2	106.4	61.8	28.1	13.3	4.8	3.2	2.1	2.0	0.3
2000	61.3	200.4	81.7	44.0	34.6	16.3	3.6	3.0	1.6	1.5	0.9
2001	34.2	121.5	88.4	28.1	15.9	13.1	6.1	2.1	1.2	0.8	0.3
2002	8.1	155.6	147.0	83.5	31.9	16.2	17.4	7.1	2.1	2.4	1.7
2003	47.4	146.6	182.0	95.8	52.0	14.9	11.5	7.3	2.8	1.2	0.9

Table 2.2.3. Indices of juvenile sole abundance from other coastal beam trawl surveys. Abundance indices for sole are given as numbers per 1000 m2 sampled during the Netherlands DFS, as millions of fish sampled during the UKYFS (IVc and VIId) (see section 3.2 for details).

Year/	Netherlands DFS			UKYFS(IVc)		UKYFS(VIId)	
Age	0	1	2	0	1	0	1
1980	20.9	1.0	0.0				
1981	16.8	0.4	0.1	32.06	5.99	0.11	0.45
1982	17.0	0.6	0.1	26.99	4.02	4.63	0.36
1983	4.1	0.7	0.0	70.66	5.64	25.45	1.52
1984	9.2	0.3	0.0	59.84	11.3	4.33	4.04
1985	16.1	0.1	0.0	20.53	2.8	7.65	2.94
1986	3.4	0.3	0.0	28.98	3.1	6.45	1.45
1987	30.8	0.3	0.0	20.87	1.89	16.85	1.38
1988	1.8	0.6	0.0	35.55	9.7	2.59	1.87
1989	3.6	0.2	0.1	47.2	3.78	6.67	0.62
1990	0.5	0.2	0.0	36.82	12.27	6.7	1.9
1991	22.9	0.0	0.1	22.72	19.69	1.81	3.69
1992	0.9	0.5	0.0	33.45	5.21	2.26	1.5
1993	0.8	0.0	0.0	36.42	24.46	14.19	1.33
1994	3.6	0.0	0.0	27.32	9.14	13.07	2.68
1995	0.3	0.1	0.0	33.55	13.04	7.53	2.91
1996	1.8	0.0	0.0	50.16	6.78	1.85	0.57
1997	2.2	0.3	0.0	14.87	4.91	4.23	1.12
1998	2.1	0.1	0.0	37.99	2.12	7.97	1.12
1999	1.0	0.0	0.0	19.02	7.67	2.63	1.47
2000	0.6	0.0	0.0	13.54	9.76	1.16	2.47
2001	2.8	0.0	0.0	39.83	2.31	4.75	0.38
2002	1.4	0.0	0.0	32.48	7.76	4.45	4.15
2003	0.7	0.1	0.0	14.41	4.9	4.55	1.44

Table 2.2.4. Indices of juvenile sole abundance from other coastal beam trawl surveys. Abundance indices for plaice are given as numbers per 1000 m2 sampled during the Netherlands DFS, as millions of fish sampled during the UKYFS (IVc and VIId) (see section 3.2 for details).

Year/	Netherlands DFS			UKYFS(IVc)		UKYFS(VIId)	
Age	0	1	2	0	1	0	1
1980	5.9	11.1	0.8				
1981	29.9	8.6	2.4	59.24	5.95	0.55	0.11
1982	25.0	15.9	0.7	11.65	13.15	0.58	0.06
1983	19.6	8.8	1.7	74.11	6.86	10.71	0.77
1984	11.7	6.8	0.5	76.52	10.85	3.62	0.41
1985	40.3	5.1	0.6	48.33	13.74	5.18	1.16
1986	10.5	15.9	0.3	23.62	17.93	12.53	1.08
1987	28.5	11.2	3.6	20.38	5.41	13.95	1.07
1988	16.2	6.0	1.3	28.12	7.72	9.31	0.81
1989	22.4	6.3	1.4	27.8	12.9	2.26	0.7
1990	23.8	6.8	0.6	31.75	10.25	4.73	0.52
1991	27.0	7.7	0.7	14.89	9.06	1.34	0.43
1992	19.9	6.5	0.4	26.16	5.64	2.92	1.09
1993	13.1	4.2	0.1	43.1	7.96	5.77	0.64
1994	24.2	1.9	0.0	19.14	9.38	12.63	0.59
1995	7.0	1.2	0.0	51.58	11.65	7.42	2.47
1996	20.3	12.1	0.1	60.16	4.07	1.22	0.72
1997	6.9	10.4	0.5	11.19	5.48	1.2	0.26
1998	9.8	3.8	0.8	40.26	0.92	5.23	0.29
1999	5.7	0.2	0.0	14.38	1.65	4.83	0.16
2000	10.6	0.2	0.0	10.57	4.82	0.29	0.72
2001	23.4	0.2	0.0	76.96	0.74	2.52	0.05
2002	10.4	0.1	0.0	40.04	4.59	0.33	1.61
2003	19.1	0.3	0.0	30.24	3.15	8.33	0.21

Table 2.2.5. Mean length-at-age for sole in the North Sea based on BTS.

Year/Age	0	1	2	3	4	5	6	7	8	9	10+
1985		17.2	23.6	27.6	31.8	31.0	31.6				
1986		17.3	23.3	27.3	30.0	32.9	36.1	36.5		40.0	40.2
1987		16.7	24.2	28.1	32.9	33.3	34.3	33.0	38.0	9.4	
1988		16.4	21.1	28.2	31.1	32.2	31.6	37.0	33.5	35.0	41.3
1989		17.5	23.0	26.0	27.8	30.1	35.0	35.9		21.3	37.0
1990		18.0	22.7	27.0	31.9	34.5	33.4	33.2	40.4	43.0	45.0
1991	9.6	20.0	24.0	26.8	30.4	33.4	34.9	35.4	39.0		45.0
1992		18.2	20.8	26.8	28.3	30.6	31.3	36.4	35.0	40.6	31.9
1993	8.7	19.5	22.9	24.0	26.3	26.1	26.2	38.0	31.3	35.4	38.2
1994	13.7	19.4	22.5	25.6	31.7	27.1	27.4	32.3	46.0		34.0
1995	11.5	18.5	22.8	24.3	26.9	30.8	30.9	28.3	27.8	42.3	
1996	8.9	19.1	23.2	25.5	26.6	28.2	26.5	27.0	30.7	32.3	35.1
1997	9.8	17.9	25.1	26.9	27.7	29.0	33.9	29.3	30.6	31.0	37.9
1998	11.1	19.1	23.7	24.0	28.4	27.1	30.0	31.2			
1999	9.1	19.4	23.1	26.1	26.4	26.1	33.3	28.5	27.9	32.0	28.4
2000	8.4	18.8	22.6	27.0	28.0	28.8	28.0	32.7	30.0	28.3	29.6
2001	7.3	18.9	23.1	25.4	27.3	29.2	26.2	28.0	26.3		25.3
2002	8.4	17.6	21.7	24.8	26.1	29.8	28.8	25.5	30.8		32.8
2003	12.6	19.0	22.9	25.8	27.1	26.3	27.8	26.1		25.0	27.3

Table 2.2.6. Mean length-at-age for plaice in the North Sea based on BTS.

Year/Age	0	1	2	3	4	5	6	7	8	9	10+
1985	8.1	16.4	24.2	28.9	32.9	37.8	41.0	43.1	41.4	44.1	49.1
1986	9.2	16.5	23.4	28.4	30.6	36.8	38.7	38.6	38.8	42.4	48.2
1987	9.7	15.4	21.8	26.9	33.9	35.9	37.3	40.2	44.5	42.7	44.3
1988	9.4	15.5	22.1	26.0	31.1	36.2	39.3	41.7	51.0	46.1	51.8
1989	10.4	16.0	22.1	28.5	29.2	28.5	41.1	42.0	43.2	41.9	50.4
1990	8.4	16.7	22.9	26.9	30.5	35.6	38.5	42.6	41.7	41.2	45.1
1991	11.9	16.9	23.6	26.8	31.1	33.0	36.2	36.9	34.3	46.8	46.9
1992	11.1	17.1	22.6	28.2	30.3	33.0	32.1	35.7	39.2	44.8	47.0
1993	10.9	16.9	21.3	25.5	31.1	35.3	36.9	37.3	40.2	45.8	45.5
1994	10.5	16.9	23.1	27.3	27.2	34.7	36.3	38.1	31.0	44.3	48.4
1995	10.6	17.4	24.1	29.5	33.6	36.2	36.5	34.2	37.2	37.8	46.2
1996	9.5	16.9	22.6	28.6	32.7	35.0	37.8	43.9	35.8	42.4	48.1
1997	8.8	14.6	16.7	28.3	32.5	35.5	37.8	42.5	44.2	0.0	47.7
1998	9.9	15.9	20.6	22.5	28.4	35.1	39.9	40.6	48.7	42.3	49.3
1999	10.2	16.4	20.2	24.8	32.2	34.7	41.0	42.7	43.0	47.4	44.4
2000	10.2	17.4	22.4	25.1	27.4	31.7	38.9	23.3	43.7	45.0	42.7
2001	11.0	18.0	22.6	27.2	28.6	31.6	38.1	42.6	38.1	51.0	47.5
2002	11.6	17.0	22.7	27.2	29.6	32.0	35.4	35.6	43.3	0.0	29.7
2003	11.4	18.0	22.1	28.5	29.6	32.8	34.4	36.3	28.7	30.0	20.0

2.3 Abundance and distribution of fish species

The yearly abundance per sub-area of the main fish species are shown in Tables 2.3.1–2.3.9. The distribution is shown in maps per species in Annex 2.

Table 2.3.1. Abundance of fish species (per hour fishing) in sub-area VIIa per year.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AMERICAN PLAICE (LR DAB)	20	1	2	3	8	17	8	29	9	6	4	2	2	2
ANGLERFISH (MONK)	1	4	4	9	6	5	5	4	4	4	3	4	7	4
BRILL	3	5	3	4	2	2	3	2	2	2	2	3	1	3
COD	49	21	8	46	30	17	15	13	1	21	22	11	4	3
COMMON DRAGONET	262	298	423	394	350	269	255	283	247	324	377	206	247	328
DAB	795	697	448	762	1097	960	823	1172	1032	1544	1447	1515	1269	2542
EUROPEAN PLAICE	440	283	360	596	547	544	493	716	682	742	913	798	931	1091
FLOUNDER (EUROPEAN)	5	2	4	2	2	1	1	4	4	3	3	9	1	5
GREY GURNARD	92	95	199	180	161	86	90	111	101	112	99	96	65	96
HADDOCK	3		1	1	23	3	15	9	7	22	7	12	2	14
JOHN DORY	1	1	1	1	1	1	1	2	1	2	1	1	1	1
LEMON SOLE	6	4	6	26	22	25	17	24	20	16	15	20	21	28
LESSER SPOTTED DOGFISH	29	39	55	46	39	37	40	80	67	58	55	77	71	64
LESSER WEEVER FISH	19	49	102	90	111	104	38	67	57	51	114	34	65	40
POGGE (ARMED BULLHEAD)	113	73	88	131	114	103	93	78	77	63	83	60	69	64
POOR COD	340	165	184	438	248	302	209	279	187	358	325	144	188	465
RED GURNARD	2	12	6	8	11	6	11	18	20	23	19	22	17	28
RED MULLET		1	1	1		1		1	1	1	1	1	1	1
SCALD FISH	34	75	73	80	94	66	92	81	98	132	201	189	224	247
SOLE (DOVER SOLE)	257	348	321	152	131	118	155	256	224	178	185	124	102	112
SOLENETTE	192	497	292	419	392	497	334	480	460	568	608	606	1192	608
THICKBACK SOLE	16	41	68	60	49	43	51	48	55	52	74	56	63	56
TUB GURNARD	10	13	29	16	14	15	18	19	27	21	22	20	19	24
TURBOT	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WHITING	101	89	156	195	166	341	163	247	203	174	121	159	130	167
WHITING POUT (BIB)	55	54	55	15	3	22	7	33	58	23	13	11	14	12

Table 2.3.2. Abundance of fish species (per hour fishing) in sub-area VIId per year.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
ANGLERFISH (MONK)	1			1	1		1	1	1					
BRILL	5	2	1	2	2	3	3	3	2	2	3	2	3	3
COD			1	1	1	1	1	1	1	1	1	1	2	1
COMMON DRAGONET	248	423	540	440	594	247	405	508	978	548	367	421	334	367
DAB	92	165	375	133	258	136	94	138	66	102	70	123	128	184
EUROPEAN PLAICE	101	117	133	116	70	62	127	133	221	107	140	153	142	131
FLOUNDER (EUROPEAN)	1	11	24	9	4	5	30	5	5	7	11	7	16	18
GREY GURNARD	2	2	1	1	1	1	1	1	1	4	1	1	2	2
JOHN DORY		1	1	1	1	1	1	1	1	1	1	1	2	1
LEMON SOLE	14	7	7	14	22	26	16	6	5	2	8	14	17	24
LESSER SPOTTED DOGFISH	6	10	14	21	13	13	11	20	11	12	10	11	18	11
LESSER WEEVER FISH	20	10	23	25	21	10	20	9	17	18	23	27	16	18
POGGE (ARMED BULLHEAD)	30	49	81	83	86	70	51	107	41	64	38	75	88	66
POOR COD	354	162	118	98	193	195	139	111	100	190	80	108	89	159
RED GURNARD	15	16	13	15	24	19	24	13	22	18	23	27	19	27
RED MULLET	1		1	1		1	1	1	1	1	1	1	1	1
SCALD FISH	13	36	27	30	20	12	16	19	15	29	16	13	18	24
SOLE (DOVER SOLE)	60	94	74	117	66	55	58	76	63	110	87	89	127	114
SOLENETTE	205	375	312	372	351	154	289	280	184	307	168	180	177	237
THICKBACK SOLE	4	8	12	19	14	12	17	18	20	16	18	33	23	39
TUB GURNARD	8	5	11	11	8	7	4	6	6	8	5	6	7	11
TURBOT	1	1	1	1	1	1	1	1	1	1	1	1	1	2
WHITING	1	2	12	2	3	8	1	1	1	1	5	5	18	2
WHITING POUT (BIB)	540	77	99	67	122	92	127	183	273	182	41	133	30	278

Table 2.3.3. Abundance of fish species (per hour fishing) in sub-area VIIe per year.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
ANGLERFISH (MONK)	2	1	1	5	2	4	3	1	1	1	1	1	5	4
BRILL	1	1	1	1	1	1	1	1	1	1	1	1	1	1
COD			1		1			1	1	1	1	1	1	1
COMMON DRAGONET	25	84	3							3	4	31	268	412
DAB	34	25	17	20	64	43	40	39	32	40	20	85	111	69
EUROPEAN PLAICE	37	21	29	19	19	18	30	68	39	43	44	54	29	26
FLOUNDER (EUROPEAN)				1		1	1		1	1	1	1		
GREY GURNARD	11	7	5	8	20	6	13	5	13	25	17	2	15	25
HADDOCK						1							1	1
JOHN DORY	1	2	2	4	2	1	1	1	1	2	1	4	3	2
LEMON SOLE	4	3	1	1	2	3	2	2	2	1	1	3	3	4
LESSER SPOTTED DOGFISH	19	3	1	29	22	30	26	56	41	54	25	51	31	45
LESSER WEEVER FISH			1							1	1	1	10	17
POGGE (ARMED BULLHEAD)	1	1									1	1	29	31
POOR COD	19	61	11							16	10	13	132	405
RED GURNARD	68	17	47	66	101	63	51	43	42	62	55	20	61	68
RED MULLET	2	2	2	3	2	3	4	3	2	8	4	8	1	14
SCALD FISH	4	1									1	12	136	189
SOLE (DOVER SOLE)	20	41	44	26	21	18	26	36	33	30	28	38	17	38
SOLENETTE	1									1	2	41	678	889
THICKBACK SOLE	9	3								1	6	8	201	266
TUB GURNARD	1	1	3	1	1	1	2	1	3	2	2	2	2	5
TURBOT	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WHITING	2	24	10	22	4	7	9	13	7	3	3	10	9	8
WHITING POUT (BIB)	25	34	22	15	9	2	11	28	15	4	2	1	9	3

Table 2.3.4. Abundance of fish species (per hour fishing) in sub-area VIIf per year.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
ANGLERFISH (MONK)	1	6	22	10	10	6	5	2	1	18	3	3	12	5
BRILL	4	5	3	3	4	5	3	4	2	3	7	1	2	3
COD	1	2	3	1	2	2	1	1	1	3	7	2	1	
COMMON DRAGONET	38	81	152	88	238	99	173	93	81	148	174	87	73	89
DAB	127	156	306	198	335	165	210	162	246	359	250	236	188	197
EUROPEAN PLAICE	190	244	203	57	73	83	144	96	119	139	138	117	97	75
FLOUNDER (EUROPEAN)	2	2	2	1	3	3	2	1	3	1	5	11	6	3
GREY GURNARD	29	104	170	106	90	50	46	49	66	111	124	85	86	63
HADDOCK					1		1	1			1		1	1
JOHN DORY	2	4	1	5	2	1	1	3	2	6	5	12	6	6
LEMON SOLE	3	4	7	8	18	12	24	11	8	11	13	18	33	41
LESSER SPOTTED DOGFISH	138	173	201	82	80	64	68	93	103	168	93	75	93	49
LESSER WEEVER FISH	1	6	2	5	6	7	7	3	4	5	15	8	7	8
POGGE (ARMED BULLHEAD)	1	4	6	13	7	8	9	5	31	22	18	14	17	29
POOR COD	611	587	670	502	226	227	243	334	763	646	593	159	311	698
RED GURNARD	3	10	2	12	21	13	19	12	1	8	11	21	22	24
RED MULLET	4	1		1	1	1	2	3		6	3	5	1	19
SCALD FISH	1	4	3	2	6	7	8	7	1	4	6	8	8	19
SOLE (DOVER SOLE)	225	274	260	136	220	107	118	178	378	834	625	330	257	240
SOLENETTE	215	561	306	232	494	233	222	137	282	492	368	306	249	393
THICKBACK SOLE	14	54	62	46	47	45	45	31	20	46	56	30	33	23
TUB GURNARD	18	15	25	5	17	13	12	11	21	42	21	17	22	21
TURBOT	2	5	2	2	4	5	3	1	3	9	6	3	4	3
WHITING	162	175	246	275	106	109	183	283	146	355	135	40	126	84
WHITING POUT (BIB)	485	201	58	23	11	15	31	316	229	109	23	35	85	44

Table 2.3.5. Abundance of fish species (per hour fishing) in sub-area VIIg per year.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AMERICAN PLAICE (LR DAB)				45	174	112	85	43					23	31
ANGLERFISH (MONK)				26	52	38	19	9	13	19		5	13	17
BRILL	8		8	1	1				8					
COD				2	2	2	1	1		5				1
COMMON DRAGONET		8	8	101	194	121	83	80	67	133	8	131	64	53
DAB		8		150	131	101	87	197	365	681	8	184	80	77
EUROPEAN PLAICE		24	8	14	15	17	23	35	104	56	24	8	11	13
GREY GURNARD		64	8	124	198	97	77	50	256	267	16	173	91	123
HADDOCK				36	88	31	41	33	3	133		43	58	7
JOHN DORY				1	1		1		5	11			6	1
LEMON SOLE				26	38	31	25	13	32	8		8	2	7
LESSER SPOTTED DOGFISH			16	21	27	35	29	91	8	72	16	277	414	40
LESSER WEEVER FISH		8			1		2							
POGGE (ARMED BULLHEAD)				39	19	23	10	32	59	83		32	194	29
POOR COD	12	936	360	252	136	103	105	325	277	429	464	115	216	153
RED GURNARD				5	3	1	1	3	5	3		5		
SCALD FISH				106	88	82	88	42	173	141		3	24	23
SOLE (DOVER SOLE)	12	120	32	27	25	22	16	46	21	107	56	163	32	67
SOLENETTE			8	98	89	77	18	41	251	189				
THICKBACK SOLE		16		105	137	129	95	72	123	352		160	266	113
TUB GURNARD		8					1	1	3	3				1
TURBOT	4		8	1		1			5		8	8	5	3
WHITING	20	216	80	86	38	67	57	248	189	1586	616	333	95	107
WHITING POUT (BIB)		24	8		2			15	3				2	1

Table 2.3.6. Abundance of fish species (per hour fishing) in roundfish area 4 per year.

	1990	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AMERICAN PLAICE (LR DAB)						39	66	73	103	56	65	68	85
ANGLERFISH (MONK)		1				2	1	2	1	1	1	1	1
BRILL		3	5	1	2	2	1	1	1	1		1	1
COD		3	11	1	10	8	100	9	5	5	2	10	3
COMMON DRAGONET	128					12	9	15	14	39	21	20	22
DAB	136	295	316	128	291	503	398	217	471	412	415	281	398
EUROPEAN PLAICE	8	62	93	33	259	45	54	35	55	65	56	54	127
FLOUNDER (EUROPEAN)						1							
GREY GURNARD	8	27		3	24	143	37	40	120	43	79	27	29
HADDOCK					6	27	34	29	12	32	29	16	11
LEMON SOLE	120	7	45	24	87	55	87	32	27	38	37	60	49
LESSER SPOTTED DOGFISH									1				
LESSER WEEVER FISH						72	2	6	9	9	6	16	55
POGGE (ARMED BULLHEAD)	32					1	4	2	22	20	9	80	7
POOR COD			1				2	1	1	1	1	2	
RED GURNARD		8	16	8	17								
RED MULLET								1		1		1	
SCALD FISH		8			15	69	7	2	11	12	17	9	25
SOLE (DOVER SOLE)		24	35	81	130	38	29	30	18	29	9	30	13
SOLENETTE		9			39	61	52	9	4	11	10	3	28
THICKBACK SOLE										1			
TUB GURNARD		2	13		3					1		1	
TURBOT		1			1		1			1	1		1
WHITING		1	20	24	126	39	64	165	13	66	35	49	56
WHITING POUT (BIB)			32	43	8	9	18	2	3	9	3	25	2

Table 2.3.7. Abundance of fish species (per hour fishing) in roundfish area 5 per year.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AMERICAN PLAICE (LR DAB)													1	
ANGLERFISH (MONK)			1							1	1			1
BRILL	3	1	1	1	1	1	1	1	1	1	1	1	1	1
COD	2	1	2	1	4	3	4	21	4	2	1	2	2	1
COMMON DRAGONET	98	44	3	3	3	66	50	4	8	14	12	44	8	10
DAB	141	53	221	50	96	194	292	266	124	199	187	216	154	187
EUROPEAN PLAICE	54	52	38	20	48	74	75	66	57	53	53	69	80	73
FLOUNDER (EUROPEAN)	19	9	2	1	2	20	9	13	2	14	14	10	48	9
GREY GURNARD	11	12	32	8	19	13	20	26	15	22	7	6	10	4
HADDOCK									1		1			
LEMON SOLE	22	27	8	25	53	65	60	30	24	23	19	33	30	21
LESSER SPOTTED DOGFISH	13	27	2	10	5	6	6	3	8	6	13	9	23	10
LESSER WEEVER FISH	44	42	32	27	39	4	69	36	19	23	17	21	30	30
POGGE (ARMED BULLHEAD)	74	57	6	18	29	115	103	45	12	22	44	59	27	44
POOR COD	221	258	10	28	47	44	17	7	21	31	20	58	43	37
RED GURNARD	1	2	1	1	1	8	2	1	1	1	1	1	1	1
RED MULLET		1	1	1	1	1	1	1	1	1	1	1	1	1
SCALD FISH	35	7	47	26	16	64	36	25	17	28	25	16	23	29
SOLE (DOVER SOLE)	230	270	79	147	211	173	144	160	133	215	222	196	159	265
SOLENETTE	59	5	69	18	9	72	98	72	45	38	54	27	38	39
THICKBACK SOLE		2		1				1	1			1	1	1
TUB GURNARD	2	1	2	5	1	1	1	1	1	1	2	1	2	2
TURBOT	1	1	1	1	1	1	1	1		1	1	1	1	1
WHITING	149	24	43	70	43	74	59	49	124	69	105	114	123	78
WHITING POUT (BIB)	264	143	25	24	162	181	34	42	157	262	60	174	73	171

Table 2.3.8. Abundance of fish species (per hour fishing) in roundfish area 6 per year.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
AMERICAN PLAICE (LR DAB)	3	2	1	1	2	2	3	8	31	14	6	4	8	5
ANGLERFISH (MONK)			1	1	1	1	1				1	1	1	1
BRILL	2	1	3	3	2	1	1	1	2	1	2	1	1	1
COD	5	10	2	1	11	9	9	23	3	1	3	2	1	1
COMMON DRAGONET		1				139	14	103	103	114	64	67	124	95
DAB	1937	1143	1102	1136	1074	764	1475	1354	1352	1267	985	916	779	851
EUROPEAN PLAICE	524	668	586	652	597	523	778	1173	1048	808	587	1178	747	497
FLOUNDER (EUROPEAN)	10	16	5	9	5	7	10	11	5	2	3	4	4	5
GREY GURNARD	24	24	33	35	61	36	36	34	59	95	44	25	35	36
HADDOCK				1		1			1		1	1	1	1
JOHN DORY					1		1							
LEMON SOLE	2	2	1	2	13	9	9	76	6	6	5	8	10	17
LESSER SPOTTED DOGFISH	1	1	1		1			1		1	1		1	1
LESSER WEEVER FISH	28	24	31	44	58	59	19	50	37	48	37	74	41	61
POGGE (ARMED BULLHEAD)	45	64	59	40	157	111	58	176	146	40	44	58	86	59
POOR COD	3	2	1	1	1	5	2	1	6	2	1	1	2	2
RED GURNARD		2	1	1		1	1	1	1	1	1	1	1	1
RED MULLET	1	1	1	1	4	2	1	1	1	13	1	2	4	10
SCALD FISH	93	70	73	189	91	83	17	40	88	87	76	136	166	224
SOLE (DOVER SOLE)	89	52	137	75	49	59	24	152	70	49	34	36	53	30
SOLENETTE	79	77	122	178	166	140	34	89	67	295	396	215	267	148
THICKBACK SOLE	1	1				1			1			1		
TUB GURNARD	8	6	13	12	11	6	5	4	7	4	6	4	5	7
TURBOT	5	4	3	3	5	3	2	2	3	3	5	3	3	4
WHITING	370	72	76	80	121	110	40	51	196	172	178	267	104	81
WHITING POUT (BIB)	27	5	11	2	4	30	3	30	40	99	14	9	9	10

Table 2.3.9. Abundance of fish species (per hour fishing) in roundfish area 7 per year.

	1990	1991	1993	1996	1997	1998	1999	2000	2001	2002	2003
AMERICAN PLAICE (LR DAB)	27	28	73	184	71	178	63	116	80	114	64
ANGLERFISH (MONK)		1		3	1	1	1	2	1	1	1
BRILL			1	1	1	1	1	1			1
COD	1	3	2	101	14	15	3	15	7	7	15
COMMON DRAGONET				6	1	9	9	7	3	5	30
DAB	2799	1532	3382	1646	415	1435	574	2849	579	426	669
EUROPEAN PLAICE	871	692	286	200	256	566	215	671	78	83	139
FLOUNDER (EUROPEAN)	7	3	1	6	2	1	1	1			1
GREY GURNARD	110	86	92	84	30	100	63	251	45	33	25
HADDOCK				3	5	2	5	46	13	2	4
LEMON SOLE	8	3	1	10	8	7	2	7	7	9	9
LESSER WEEVER FISH			5				1			1	1
POGGE (ARMED BULLHEAD)	35	52	84	27	8	22	4	24	5	2	11
POOR COD					1						
SCALD FISH	5	18	21			4	3	54	13	10	34
SOLE (DOVER SOLE)	16	12	9	4	1	6	2	10	1	1	1
SOLENETTE	5	3	24	2	1	1	1	27	12	12	147
TUB GURNARD	3		2	5	5	3	1	2	1	1	1
TURBOT	2	1	1	1	1	1	1	4	1	1	1
WHITING	659	152	89	11	2	9	9	43	148	22	11
WHITING POUT (BIB)	1										

3 Coordination beam trawl surveys

3.1 Offshore beam trawl surveys

The WG reviewed the available beam trawl surveys which are used to derive indices of year class strength for plaice and sole. Table 3.1.1 lists the existing surveys which include all the surveys using heavy beam trawls and covering mostly offshore but also inshore stations in the North Sea and ICES area VII. Although the surveys are intended to sample the youngest age-groups of plaice and sole they also catch the older ages and can deliver indices for those. The main surveys are listed below:

Table 3.1.1 Details of the beam trawl surveys currently undertaken by each country.

	Belgium	Germany	Netherlands	Netherlands	UK	UK	UK
Survey area:	IVb, and c west	IVb east	IVb, and c east	Central N Sea	VIId	VIIe	VIIa, f, and g
Year survey started:	1992	1991	1985	1996	1988	1988	1988
Dates:	August	early September	end August	end August	early August	late September	late August
Ship:	RV “Belgica”	RV “Solea”	RV “Isis”	RV “Tridens”	RV “Corystes”	MFV “Carhelmar”	RV “Corystes”
Ship length:	50 m	35 m	28 m	73.5	53 m	22 m	53 m
Beam trawl length:	4 m	7 m	8 m	8 m	4 m	4 m	4 m
Number of beams fished:	1	2	2	2	1	2	1
Trawl duration (min):	30	30	30	30	30	30	30
Tow speed (knots):	4	4	4	4	4	4	4
Cod end liner stretched mesh (mm):	40	44	40	40	40	40	40
Number of ticklers:	0	5	8	8	0	0	0
Gear code:	BT4M	BT7	BT8	BT8S	BT4FM	BT4FM	BT4FM
Attachment:	*	(none)	(none)	**	*	*	*
Station positions:	fixed	pseudo-random	pseudo-random	pseudo-random	fixed	fixed	fixed
Benthos sampling since:	1992	1992	1985	1996	1991	1992	1992

* chain mat and flip-up rope
** flip-up rope only

3.2 Inshore surveys

Table 3.2.1 lists the additional surveys together with the geographic area covered, the gear used and the date started. More details on the surveys are described in ICES, 2002.

Table 3.2.1. Inventory of International Inshore Young fish Surveys.

Country	Netherlands (SNS)	Netherlands (DFS)	Netherlands (DFS)	Netherlands (DFS)	England (YFS)	Belgium (DFS)	Germany (DFS)	Germany (DFS)
Geographical Area of Survey	Dutch coastal to Danish coastal, Scheveningen to Esbjerg	Waddensea	Scheldt Estuary	Dutch coastal to Danish coastal areas 1– 4 inner stations	Eastern/South-Eastern English Coast	Belgian Coast	Niedersachsen Waddensea + Elbe Estuary	Schlesweig-Holstein Waddensea
Ship	Tridens/ISIS	Stern/Waddenzee	Schollevaar	ISIS/ Breukels/G)28	Chartered vessels	Hinders/Brood winner	Chartered vessels	Chartered vessels
Date started	1969–1984 Tridens 1984 - ISIS	1970	1970	1970	1973	1970	1972	1974
Sampling Period	Sept/Oct	Sept/Oct	Sept/Oct	Sept/Oct	Sept/Oct	Sept/Oct	Apr/May Sept/Oct	Apr/May Sept/Oct
Gear Type	6m Beam Trawl	3m Beam Trawl	3m Beam Trawl	6m Beam Trawl	2m Beam Trawl	6m Beam trawl	3m shrimp trawl	3m shrimp trawl
Tickler Chains	4	1	1	1	3	0	0	0
Mesh size net in cm. Codend	80 40	35 20	35 20	35 20	10 4	40 18	32 18	32 18
Speed fished	3.5 knots / 4 knots	3 knots	3 knots	3 knots	1 knot	3 knots	3 knots	3 knots
Time Fished	15 min	15 min	15 min	15 min	10 min	15 min	15 min	15 min
Species Target	1– 2-group sole/plaice	0–1-group sole/plaice	0–1-group sole/plaice	0–1-group sole/plaice	0 –1 - 2+ sole/plaice	0 –1 - 2 sole/plaice	0–1-group sole/plaice	0–1-group sole/plaice
other	All	crangon/All	crangon/All	crangon/All	Turbot Brill crangon/All	All (no crangon since 1992)	crangon/All	crangon/All
Age information	All years	All years	All years	All years	None	None	None	None

3.3 Inclusion in the BTS database

The WG agreed that only the surveys where aged data were available on plaice and sole should be included in the international database. The existing database includes data from the 7 offshore beam trawl surveys listed in Section 3.1. The Netherlands SNS survey covers the main inshore distribution of plaice and sole and although it is considered an inshore survey, it was felt that these data could also be included in the international database.

The international DFS surveys also have aged data on plaice and sole but only few countries have the data available in electronic format and an international database may therefore be premature. In addition, the differences in the gear types used in these surveys would make comparisons of catch rates difficult until analyses of catch efficiencies have been made.

In view of the wide range of beam trawl surveys available aimed primarily at estimating year class strength of plaice and sole, WGBEAM would be the appropriate forum for discussing the methodology of these surveys and for reviewing ways of standardising the collection, archiving and analyses of data. One important matter is that even though the surveys are part of the same database it will be necessary to carry out some gear efficiency comparisons before the data from the surveys could be used for analyses on combined data.

4 Evaluation population abundance indices

4.1 Calculation of existing Indices

Tuning fleets and estimates of recruitment from beam trawl surveys are provided for plaice and sole to the Working Group on the Assessment of Northern Shelf Demersal Stocks (VIIa); Working Group on the Assessment of Southern Shelf Demersal Stocks (VIIe, VIIfg) and Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. The calculation of the indices for the various stocks is described below:

4.1.1 Offshore survey indices

The beam trawl surveys are developed to deliver indices for sole and plaice. The Netherlands Institute for Fisheries Research (RIVO) runs a beam trawl survey (BTS) in the North Sea conducted by two vessels RV “Isis” and RV “Tridens”. CEFAS runs three beam trawl surveys: In the Irish Sea and Bristol Channel (ISBTS), in the western Channel (WCBTS), and in the eastern Channel and south-western North Sea (ECBTS). The principles underlying estimation of abundance indices for each species are the same in each case.

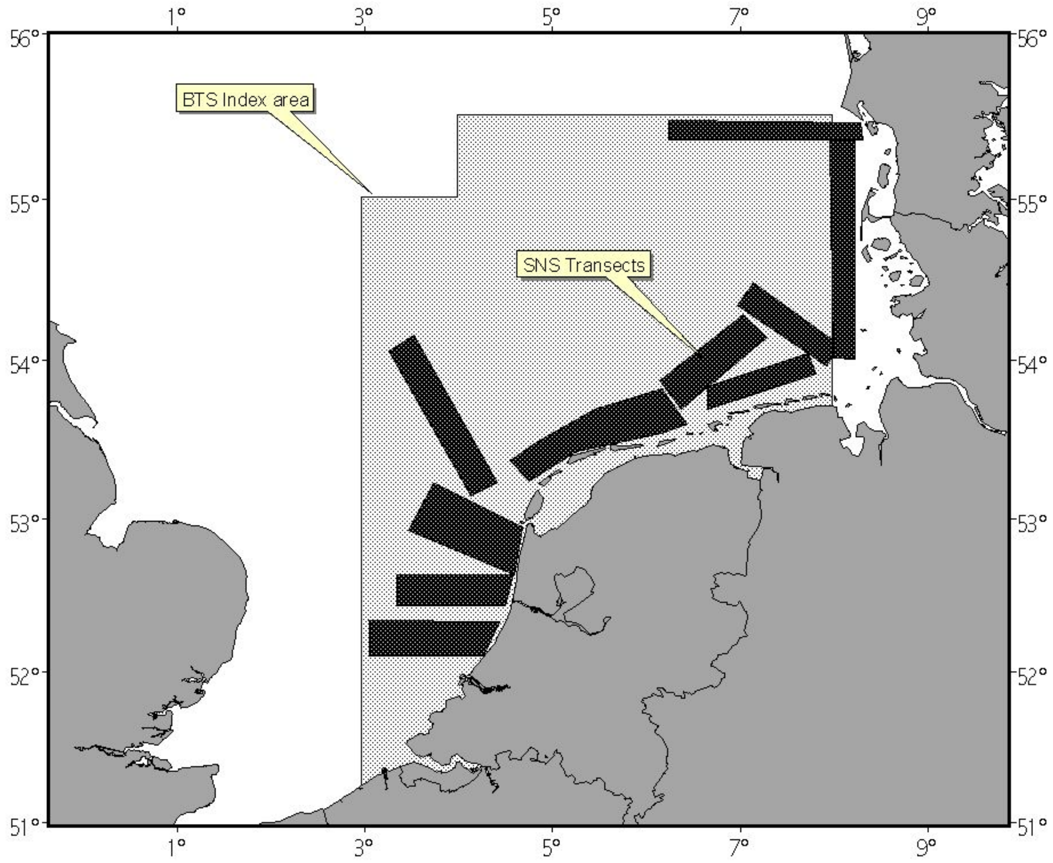


Figure 4.1.1. Locations of the BTS Index area and SNS transects in the North Sea.

North Sea

1) The total survey area is divided into strata (ICES rectangles) and otolith areas, the latter primarily to localise age-length keys (ALK).
2) Numbers-at-length caught standardised to a half-hour tow are averaged across all hauls within a stratum to estimate a length frequency distribution (LFD) for each rectangle.
3) Otoliths are collected from most plaice and sole caught on these surveys. ALK's are assembled for each rectangle or otolith area.
4) ALK's are applied to LFD's to estimate age-length distributions (ALD) in each rectangle.
5) Numbers-at-age-given-length are summed across all lengths to estimate numbers-at-age by rectangle.
6) Mean catch in numbers-at-age for half an hour trawling are determined for the index area (see figure)

Irish Sea and Western Channel surveys (VIIa, f, g and VIIe).

1) The total survey area is divided into strata, primarily to localise age-length keys (ALK).
2) Numbers-at-length caught standardised to a half-hour tow are added across all prime stations within a stratum to estimate a length frequency distribution (LFD) for each stratum.
3) Otoliths are collected from most plaice and sole caught on these surveys. ALK's are assembled for each stratum.
4) ALK's are applied to LFD's to estimate age-length distributions (ALD) in each stratum.
5) Numbers-at-age-given-length are summed across all lengths to estimate numbers-at-age by stratum. These are divided by total fishing effort in the stratum (hours or kilometres towed) to give stratum catch per unit effort (CPUE)-at-age.
6) A weighted average of estimated CPUE-at-age by stratum is formed using stratum areas as weights. This gives the estimated abundance index for the survey.

Eastern Channel survey VIId

1) For the purpose of assembling ALK's the survey area comprises of 2 strata these being the English and French sectors of the eastern Channel.
2) ALK's are constructed for each sector by sex.
3) Station Length frequency distributions are proportioned using these ALK's to give the numbers at age per hours fishing by sex for each trawl position.
4) The numbers at age by sex are then combined to give an overall number of fish per hour.
5) The average numbers per hour by rectangle are then calculated by dividing the summed numbers per hour for all stations worked within a rectangle by the number of stations worked within the rectangle that year.
6) The numbers per hour are then summed for all rectangles and divided by the total number of rectangles worked to give a cruise average number per hour.

4.1.2 Inshore survey indices

Two inshore surveys exist that deliver indices for North Sea plaice and sole: the Netherlands SNS and the international DFS.

The Netherlands SNS: The catches are summed for each transect and multiplied so as to arrive at a catch/100 hours trawling. The index of abundance is derived from the unweighted arithmetic mean across all transects.

The International DFS: The method used to calculate a combined international index using Belgian, English, German and Netherlands DFS surveys has been described in detail (ICES, 1985). Numbers per $1000m^2$ are calculated by station within depth strata. The mean abundance by strata is calculated and standardised for gear efficiency. A population estimate is then derived by raising the mean number per $1000m^2$ to the area of the depth strata. The combined North Sea index is the sum of the area totals.

4.2 Evaluation of the DFS

For the DFS the main potential sources of bias were identified:

- factors used for correction of gear efficiency
- the sampling and area-based raising of strata

4.2.1 Factors used for correction of gear efficiency

In deriving the international combined index, factors were used to account for variation in gear efficiency and for estimating area-based population abundance. Both these factors may lead to biases in the combined index. Although some information was available from comparative tows, gear efficiency figures were based on a limited number of cross comparisons. The raising figures used are shown in Table 4.2.1. It has not been possible to review these estimates, as no further work on the comparative efficiency of the gears has been carried out. This is further discussed in chapter 5.

Table 4.2.1. Raising factors used since 1983 to standardise gear efficiencies in international demersal fish surveys (ICES, 1985).

Area	Gear	Plaice		Sole	
		0-gp	1-gp	0-gp	1-gp
Belgian coast	6m no tickler[1]	1.22	1.00	1.59	1.88
Coastal areas	6m + tickler	1.00	1.00	1.00	1.00
Scheldt Estuary/Dutch Waddensea	3m + tickler	1.00	1.00	1.00	1.00
German Waddensea	3m no tickler	1.22	1.00	1.59	1.88
English coast	2m + 3 ticklers	0.75	1.00	0.30	0.35

Note 1: Since the comparison, the Belgian gear has changed and now carries 8–10 tickler chains.

4.2.2 The sampling and area-based raising of strata

The combined index is obtained by calculating individual strata indices for each region. Strata were originally defined on the basis of depth from 0–20 m. However, WGBEAM became aware that for the German Wadden Sea an area of 1559 km^2 had been added later, which probably does not really fit to the survey area the current indices originate from. This could cause some bias. Therefore the German area used for raising indices and survey areas need to be checked and adjusted if necessary.

The individual, national survey results should be based on a comparable, consistent survey design. However, external factors like weather, tidal phases and other parameters may have strongly influenced numbers of hauls and their distribution within strata, resulting in unpredictable shifts of the overall arithmetic means of abundance indices of both fish and invertebrate species. Therefore existing data sets should be evaluated for variations in the distribution of hauls within area and strata. In particular, the validity of the depth strata should be reviewed. Initially, the shallow 0–5 m strata and strata deeper than 20 m were not well sampled and so these strata were not included in the overall calculation of abundance indices. In more recent years, it is probable that sampling has been improved in the different strata but it is not evident that the estimation procedure has been modified to take account of any changes. This is probably not important for the derivation of a combined sole index but could affect the estimation of a 0 gp plaice index as a significant proportion of the population occurs in water less than 5 m deep. Other parameters should be listed, that is recorded routinely or is available from other sources and could influence species abundance or distribution for future improvements.

Another factor which influences the combined index is the raising of strata abundance estimates to the area of the strata. As there is some concern on the accuracy of the weighting factors of the strata these should be recalculated using GIS. In principle the raising itself should not be a cause for concern when the strata are well sampled. However, in surveys where the number of hauls in a stratum can vary depending on the weather or other external factors, raising may have an unpredictable effect on the calculation of a combined index.

4.2.3 Indices of abundance by survey sub-area

The Netherlands DFS survey-data from sub-areas along the coast of Netherlands and the Dutch Waddensea and Scheldt estuaries (see figure 4.2.1) were examined to assess the annual variability and see if regions of high abundance could be identified.

Population estimates for each area were not available and so it has only been possible to compare catch rates between 0- and 1-gp estimates. The results are shown in Figures 4.2.2 and 4.2.3. Catch rates of plaice in the Scheldt estuary (sub-areas 631, 634, 638) were consistently low as 0-gp and low as 1-gp for part of the area. High catch rates were found in area 616 (Dutch Waddensea both as 0- and 1-gp. Coastal area 407 off the German/Danish border had moderate catch rates of 0-gp but very high catch rates of 1-gp plaice. For sole, the coastal stations (401–404) were consistently high for both 0- and 1-gp.

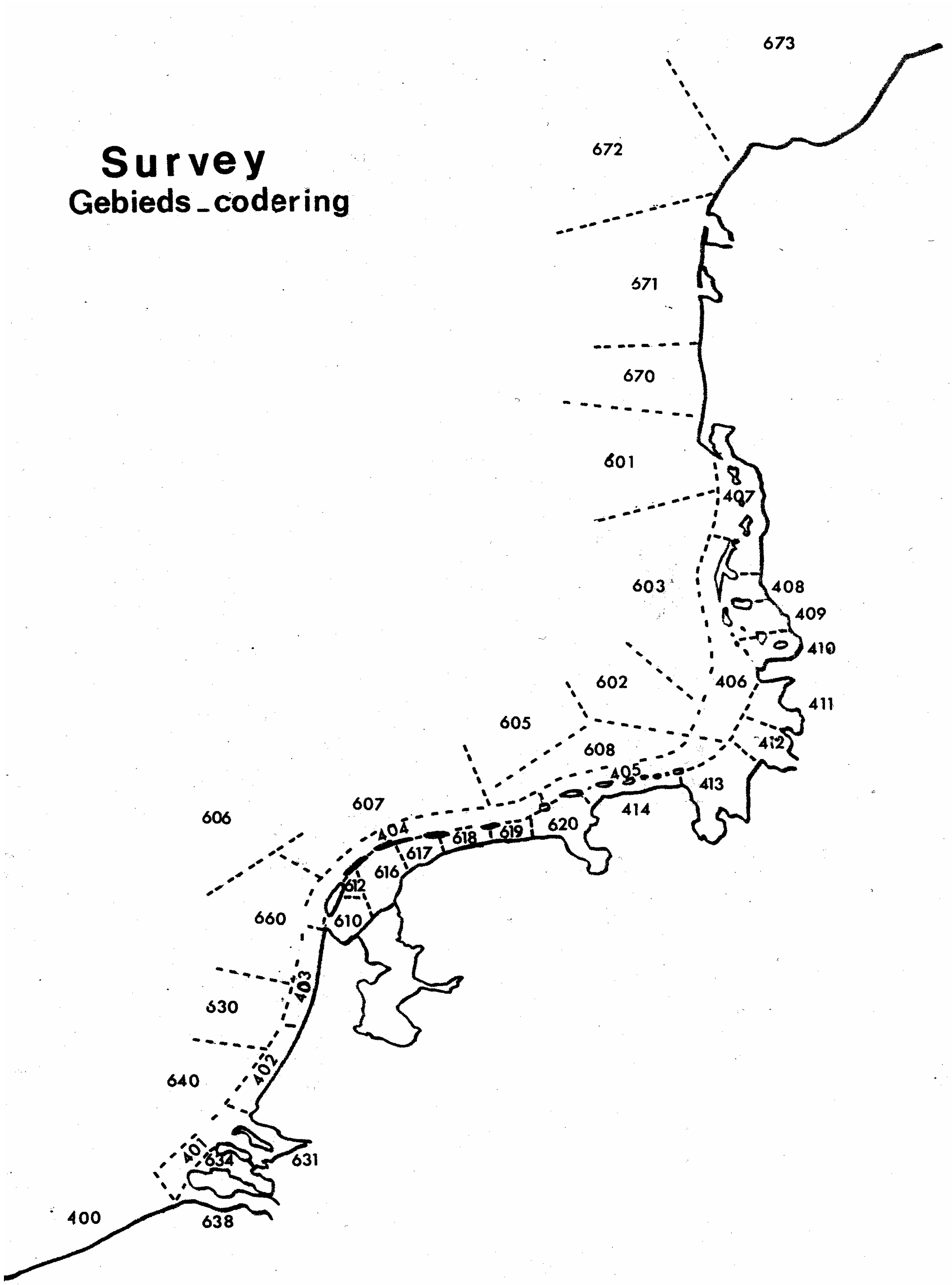
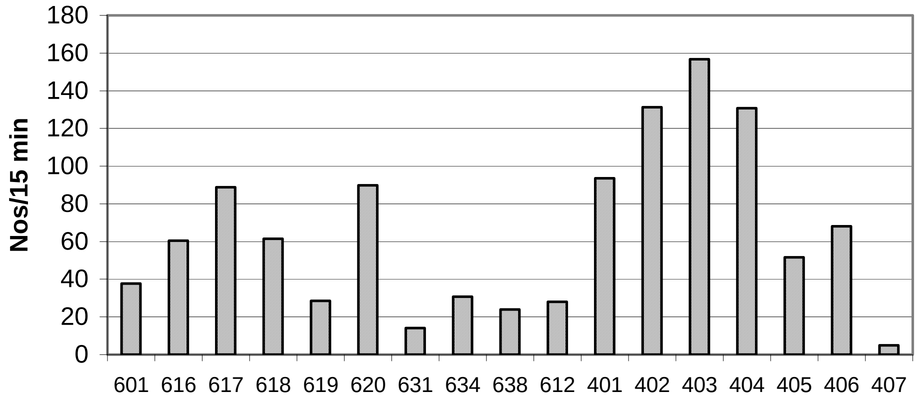


Figure 4.2.1. DFS areas.

Neth DFS 0gp sole Av 1970-2000 raised to 6m BT



Neth DFS 1gp sole Av 1970-2000 raised to 6m BT

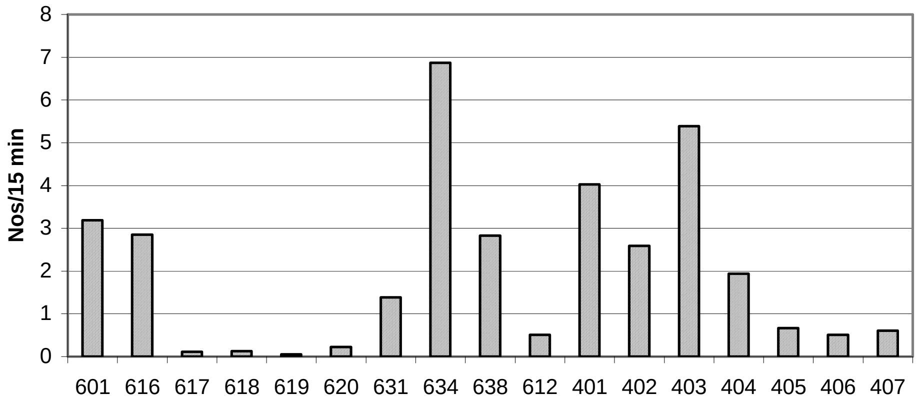
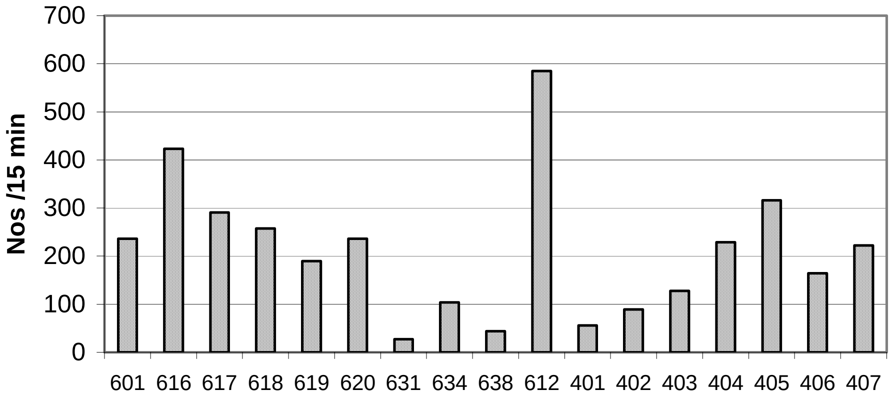


Figure 4.2.2. Catches of 0- and 1-gp sole in the Netherlands DFS.

Neth DFS 0gp pla Av 1970-2000 raised to 6m BT



Neth DFS 1gp pla Av 1970-2000 raised to 6m BT

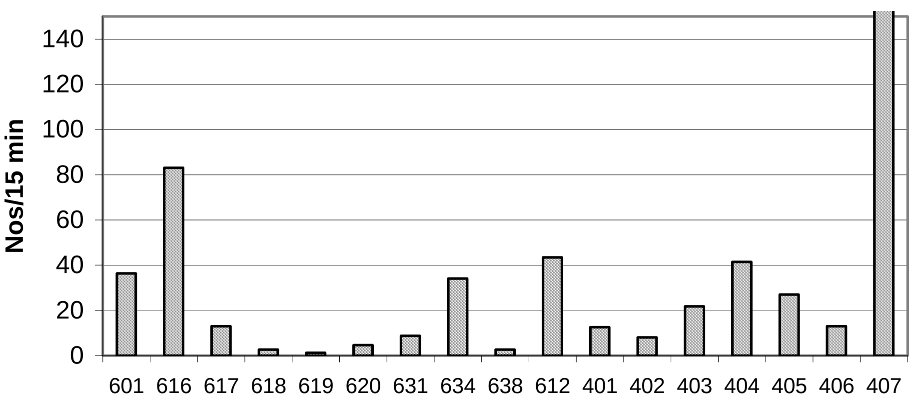


Figure 4.2.3. Catches of 0- and 1-gp plaice in the Netherlands DFS.

Comparisons between 0- and 1-gp indices are shown in Figures 4.2.4, and 4.2.5. There is little consistency between estimates of year class strength for each cohort from 0-gp to 1-gp. The increase in abundance of plaice in the 1980s is evident in many sub-areas. There is also a noticeable decline in abundance in the recent period especially for 1-gp plaice.

The WG recommends that further analysis should be carried out to determine which areas have the most influence on the combined index and review the methodology for deriving indices of year class strength.

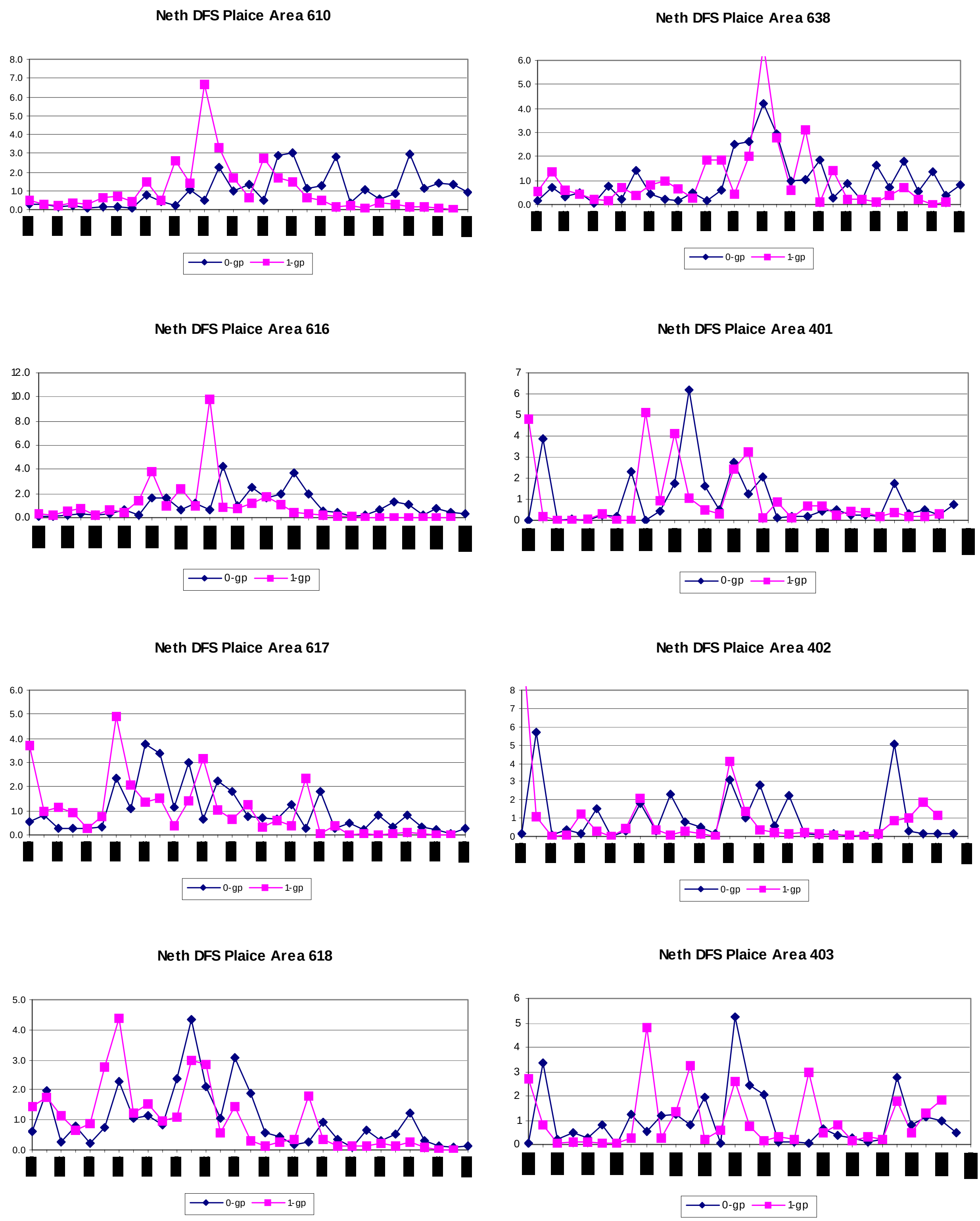


Figure 4.2.4. Comparison between 0- and 1-gp plaice indices from Netherlands DFS.

Figure 4.2.4. Continued. Comparison between 0- and 1-gp plaice indices from Netherlands DFS.

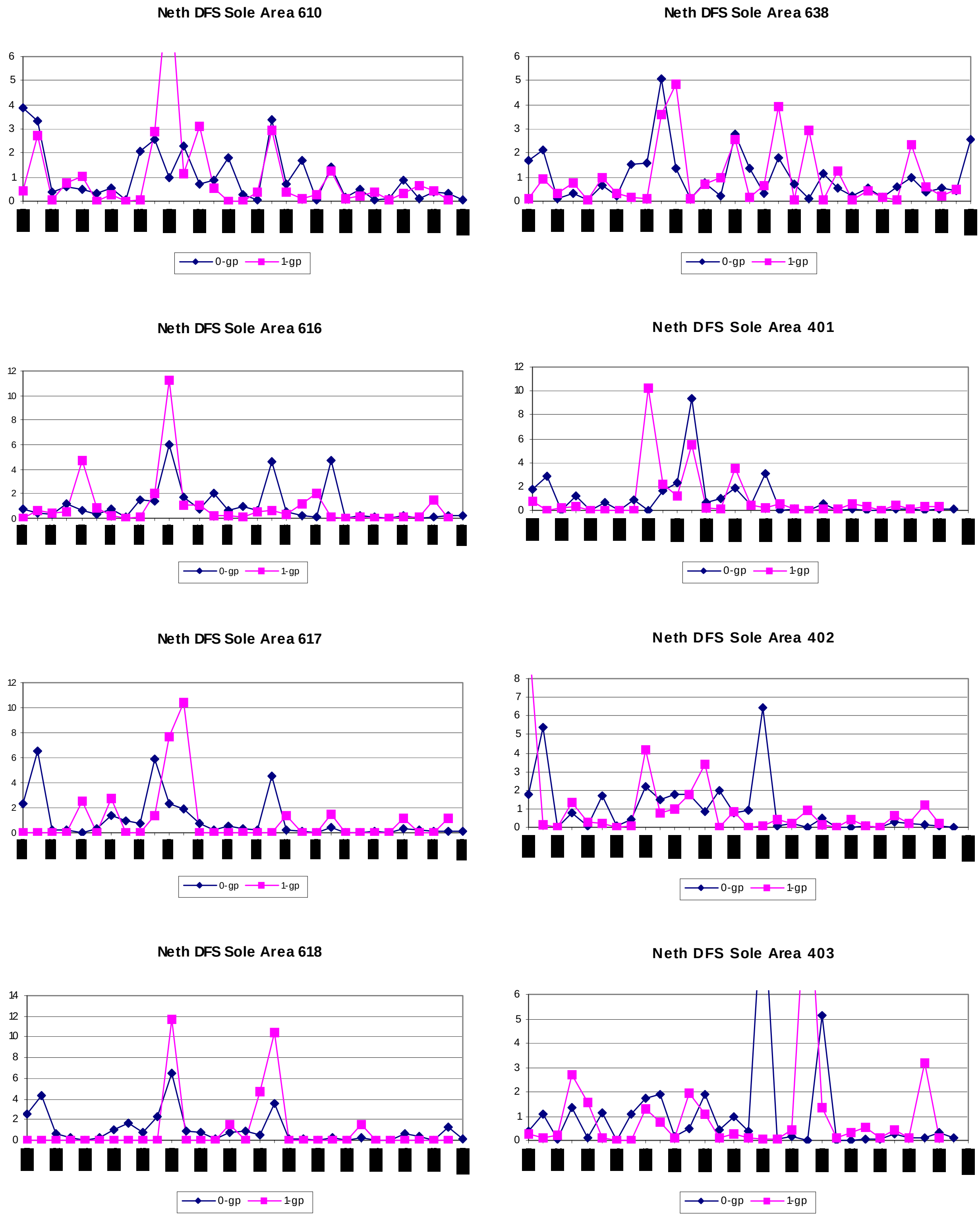


Figure 4.2.5. Comparison between 0- and 1-gp plaice indices from Netherlands DFS.

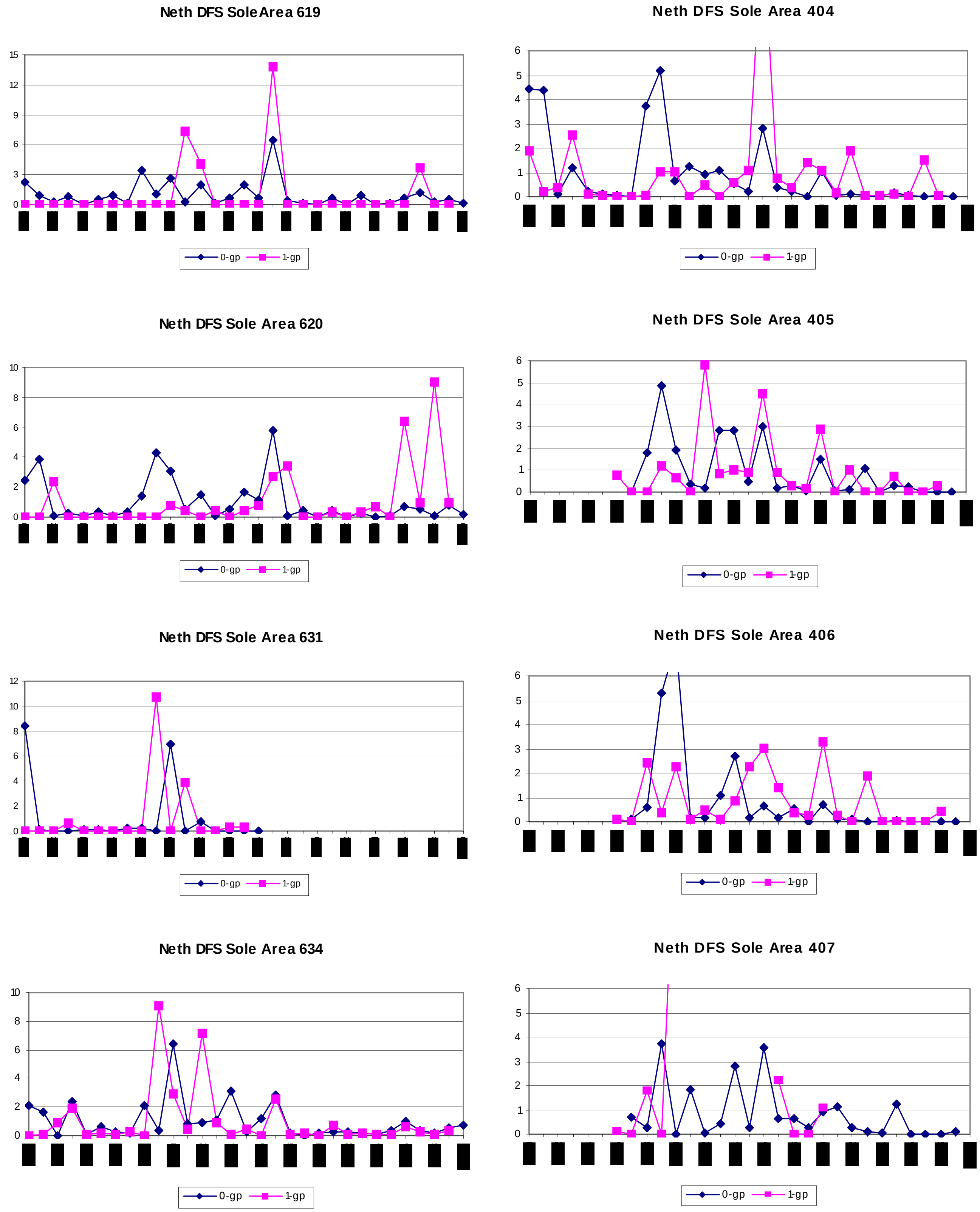


Figure 4.2.5. Continued. Comparison between 0- and 1-gp plaice indices from Netherlands DFS.

4.3 Evaluation BTS and SNS

Two surveys provide tuning indices for North Sea plaice and sole: BTS and SNS. The quality of these indices was evaluated through a series of analyses consisting of:

- Correlation between cohorts, the so-called within survey consistency
- Correlation between surveys
- Correlation between survey indices and stock abundance

For plaice, correlations between cohorts showed for the BTS highest correlations for combinations ages 2–3 and ages 3–4 (Table 4.3.1). Correlations between cohorts for SNS during 1970–2001 showed similar correlation coefficients, except ages 1–2. For the SNS as used by the last Working Group (1982–2000) correlations between cohorts showed highest correlations for ages 2–3 and ages 3–4.

Table 4.3.1 Within-survey consistency, correlation coefficients (r) and number of observations (n) for plaice.

	BTS		**SNS 1970–2001**		**SNS 1982–2000**	
Ages	**r**	**n**	**r**	**n**	**r**	**n**
0–1	0.40	17	0.67	32	0.39	19
1–2	0.55	17	0.51	32	0.58	19
2–3	0.78	17	0.68	32	0.79	19
3–4	0.70	17	0.69	32	0.80	19
4–5	0.68	17	0.69	32	0.71	19
5–6	0.47	17	0.68	32	0.70	19

For sole, low correlations were observed between ages 0–1 for both BTS and SNS (figure 4.3.1). Higher correlations were observed for sole up to age 5 for both SNS and BTS. For age 4 sole caught with SNS, CPUE data were only available for 2 years (Table 4.3.2).

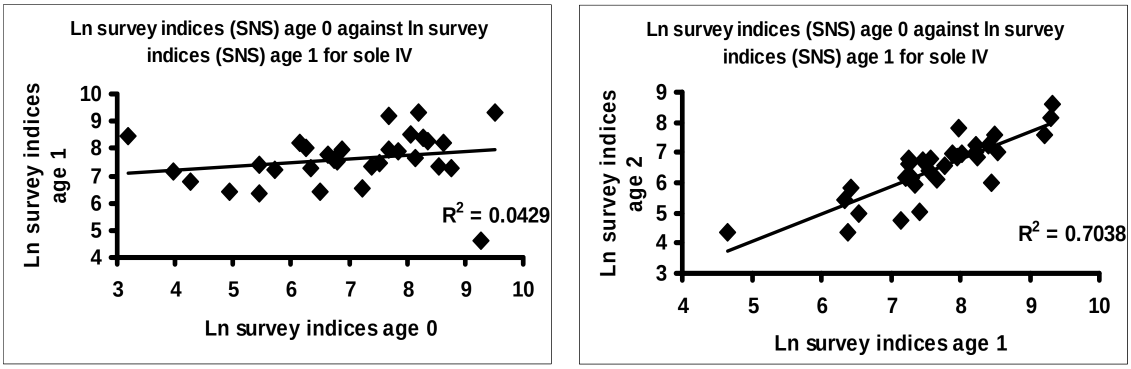


Figure 4.3.1. Correlations (R^2) within survey SNS for age 0 - age 1 and age 1 - age 2 for North Sea Sole.

Table 4.3.2. Within-survey consistency, correlation coefficients (r) and number of observations (n) for sole.

	BTS		SNS	
Ages	**r**	**n**	**r**	**n**
0–1	0.28	17	0.21	32
1–2	0.66	17	0.84	32
2–3	0.68	17	0.74	32
3–4	0.69	17	1	2
4–5	0.67	17		
5–6	0.37	17		

Table 4.3.3. Between-survey consistency, correlation coefficients (r) and number of observations (n) for plaice.

	BTS / SNS	
Ages	**r**	**n**
0	0.77	17
1	0.57	17
2	0.89	17
3	0.85	17
4	0.60	17
5	0.79	17
6	0.50	17

Table 4.3.4. Between-survey consistency, correlation coefficients (r) and number of observations (n) for sole.

	BTS / SNS	
Ages	**r**	**n**
0	0.36	17
1	0.79	17
2	0.70	17
3	0.83	17
4	-1	2

Correlations between BTS and SNS are presented in Table 4.3.3 for plaice and in Table 4.3.4 for sole. Overall correlation coefficients between BTS and SNS were high except for age 0 sole (Figure 4.3.2).

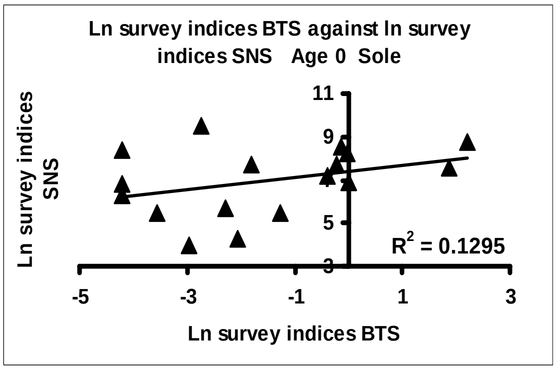


Figure 4.3.2 Correlations (R^2) between survey BTS and survey SNS for age 0 sole.

Correlations between survey indices and estimated XSA population numbers are presented for plaice in Table 4.3.5. BTS appears to provide a better tuning index for the older ages (3–6) and SNS for the youngest age (1) whereas both surveys perform about equal for age 2. SNS in the period 1982–2000, as used by the Working Group, provides a better tuning index then SNS 1970–2000.

Table 4.3.5. Consistency between survey indices and stock abundance, correlation coefficients (r) and number of observations (n) for plaice.

	BTS		SNS 1970–2000		SNS 1982–2000	
Ages	**r**	**n**	**r**	**n**	**r**	**n**
1	0.49	16	0.64	31	0.77	19
2	0.59	16	0.60	31	0.61	19
3	0.81	16	0.47	31	0.55	19
4	0.84	16	0.59	31	0.65	19
5	0.59	16	0.43	31	0.42	19
6	0.65	16	0.40	31	0.38	19

Correlations between survey indices and estimated XSA population numbers are presented for sole in Table 4.3.6. Again BTS performs best for the older ages (3–6) whereas SNS performs best for the youngest ages (1–2).

Table 4.3.6. Consistency between survey indices and stock abundance, correlation coefficients (r) and number of observations (n) for sole.

	BTS		SNS	
Ages	**r**	**n**	**r**	**n**
1	0.87	17	0.94	31
2	0.80	17	0.85	31
3	0.84	17	0.78	31
4	0.72	17		1
5	0.76	17		
6	0.73	17		

4.4 Improving indices

Beam trawl surveys are the major provider of information on pre-recruit year class abundance to be used as tuning indices in flatfish stock assessments throughout ICES areas IV and VII. The indices stabilize catch-at-age models for pre-recruit ages, where fisheries information is highly variable and inconsistent. In addition they play a major role in determining the model predictions of future recruitment to the fishery and are thus essential tools in forecasting and management of flatfish fisheries. A reliable index, one that accurately tracks year class strength prior to recruitment into the fishery, can greatly improve model performance and enhance management effort to conserve important stocks.

WGBEAM has provided indices of relative abundance for plaice and sole for the offshore survey series, supplied by the respective institutes. Some work has been carried out to determine the suitability of such indices in predicting future year class strength in the commercial catch information. These investigations suggested that indices were not always internally consistent (followed year classes within subsequent survey years) or that in some areas they were not very predictive of future year class strength in the fishery. High correlation coefficients were usually more indicative of samples with inordinately high weightings (outliers) than a good correlation between index and recruitment. In addition the indices were sometimes beset by strong year effects (high/low abundance of all ages in a year) which are not thought to be indicative of year class strength, but more likely to be associated with the environmental conditions during that years' survey. The response of catch-at-age models with regard to index-year-effects is unpredictable, and can vary with the addition of a further years' data making forecasting and elucidation of spawner-recruit relationships difficult. Therefore it is necessary to develop more suitable indices and to examine methods by which these indices can be combined to give better representation of future year class strength.

Incorporating external information using GAMs

Survey information is generally highly variable between years and stations and much of this variability is associated with spatial and temporal variability in the distribution of species and not with fluctuations in year class strength important in the assessment process. Environmentally corrected indices developed to account for fluctuations in the distribution of species/year classes due to fluctuations in the associated environmental conditions such as temperature, tide, sediment etc., are likely to outperform indices based solely on mean abundances at stations as indicated in previous WGBEAM reports (ICES, 2001). Indices based on random survey designs are likely to benefit particularly from such environmental corrections as they are likely to encounter different environmental conditions in different years, even under the assumption of a stable environment. Fixed station survey designs are generally more robust with regards to the assumption of a stable environment, but improvements of indices should still be possible, particularly in variable coastal and nearshore environments which will result in changes in the distribution of fish, rather than the survey. The WG suggests that the use of environmental correction for the different survey indices should be further investigated for improved performance as established through test of internal consistency, both within and between surveys as well as comparison to independent catch-at-age models.

Alternate error distributions
Survey data usually deviate strongly from the normal distribution, with outliers of high catches dominating current indices. Methods based on the maximum likelihood theory will more adequately deal with such deviations from the normal distribution and will tend to down-weight the influence of high catches at individual stations associated with the patchy distributions expected particularly for young fish. The Generalized Additive Model (GAM) approach combines the likelihood approach with the inclusion of non-linear relationships between environment and abundance and as such appears to be the ideal tool for index development.
However, the method can not cope with the situation where a single station can contribute more than 50% of the total survey index for a year, and individual stations in fixed survey designs can consistently make up the major contribution of a particular index. Given this dominance it is not clear what information is retained in such an index, or even if it is worthwhile sampling other stations, when their influence over the survey index is so minor. More detailed information on the distribution of juveniles and the recruitment process is necessary to answer these questions and others, important to the development of more useful indices. Ecological theory may provide some sensible avenues for investigation.

Maximal carrying capacity and habitat suitability
The information on abundance trends retained in an index can be relative provided that the survey is consistent between years. Optimal environments are thought to be occupied in preference to less suitable habitat. If optimal environments are consistently filled to their carrying capacity such habitats may contribute little or no information to the year class signal. Similarly, unsuitable habitat, which is never occupied, will contribute no relevant information. It is likely that the intermediate habitats represent the most useful indications of future recruitment as they will represent the size of the spill over effect from those habitats that are most frequently occupied into the marginal habitats. The random variability in abundance estimates associated with sampling variability from the stations having the highest abundances will tend to mask the effects of variations in the marginal habitats so that their omission should improve the performance of the index, whilst it may still be necessary to sample them in order to get sufficient age/length information. Stations not contributing to the index will not dampen the signal and can be retained, but it may be possible to reduce survey expenditure or increase survey coverage by dropping stations from the design after thorough evaluation of their contributions to a particular index series.

Distributional shifts due to changing environmental conditions
It is quite likely that there will be minor changes in the environmental conditions between years. Many of these minor changes will be compensated for by the use of environmental covariables as described in the GAM approach earlier, but potentially larger shifts, and those associated with environmental conditions not currently recorded during surveys can invalidate the assumption of a constant proportion of the population being available to the sampling gear during the survey. The impacts of such changes will become more severe, the more spatially constrained the survey is, as the assumption of a constant proportion of the population being available is violated. In such cases it may be necessary to combine data from several surveys to get the appropriate area coverage, although this can present its own set of problems (see chapter 5).

Evaluation
The evaluation of any new index developed through the approaches described above needs to consider not only the degree of internal and external (with catch-at-age) correlation, but also the spatial and temporal patterns of residuals. These can give important clues to the origin of the variance components and suggest more suitable recombinations of the station data. However, it is important that the new indices are tested independently to avoid haphazard correlations. This can be either done by bootstrapping or by utilizing only part of the series to derive the index, using the remainder to test it’s suitability long-term.

5 Relative catchabilities of the different gears

Relative catchability, or better fishing power, has to be accounted for when separate indices, based on different gears, are to be combined across surveys. Classically, one tries to estimate a conversion factor which compensates for differences in fishing power of gear/vessel combinations. This can be achieved by comparing hauls of a single vessel (two different beam trawls on either side), or by two vessels operating close to each other in an experiment. Without a planned experiment, one may compare hauls which fall reasonably close together in space and time (e.g. same month, same rectangle).

It is well-known that survey abundance estimates are typically associated with a large and non-symmetric scatter due to the spatial patchiness of the surveyed populations. While dividing by any type of stochastic variables widens the original scatter and generates a positive bias, this may be still more pronounced with the highly skewed distributions of survey estimates. Therefore, if a ratio is explicitly wanted, the quantity (average X)/(average Y) should be preferred over average(X/Y). Otherwise, a GLM approach can provide more stable indices of abundance corrected for fishing power.

For assessment purposes, it might be sufficient to statistically bundle different survey series without quantifying fishing power, analogous to the RCT3 procedure. However, since the partial survey areas are largely non-overlapping, shifts of the main concentration of a survey target species within the overall area could turn up in a negative deviation in one (set of) survey(s) and a positive one in another, thus dampening or eliminating the signal. For faunistical considerations, however, standardized density estimates, comparable for the whole area, are desirable.

In the inshore surveys (DFS/DYFS), gear correction factors are used in the derivation of the ‘Combined Index’ for 0- and 1-group sole and plaice. These factors are based on a moderate number of experimental hauls undertaken some 20 years ago and were left unchanged since.

For the offshore surveys (BTS), occasional attempts were made in the past (ICES, 1990, 1993) for some within-rectangle comparisons, but still were regarded as preliminary. Results from another evaluation using recent data from overlapping rectangles and from comparative trawling are described below.

Inshore beam trawl surveys

In deriving the international combined index, factors were used to account for variation in gear efficiency and for estimating area-based population abundance. Both these factors may lead to biases in the combined index. Although some information was available from comparative tows, gear efficiency figures were based on a limited number of cross comparisons. The raising figures used are shown in Table 5.1.

Table 5.1. Raising factors used since 1983 to standardise gear efficiencies in international demersal fish surveys (ICES, 1985).

Area	Gear	Plaice		Sole	
		0-gp	1-gp	0-gp	1-gp
Belgian coast	6m no tickler[1]	1.22	1.00	1.59	1.88
Coastal areas	6m + tickler	1.00	1.00	1.00	1.00
Scheldt Estuary/Dutch Waddensea	3m + tickler	1.00	1.00	1.00	1.00
German Waddensea	3m no tickler	1.22	1.00	1.59	1.88
English coast	2m + 3 ticklers	0.75	1.00	0.30	0.35

Note 1: Since the comparison, the Belgian gear has changed and now carries 8–10 tickler chains.

It has not been possible to review these estimates, as no further work on the comparative efficiency of the gears has been carried out.

Gear raising factors for the combined international young fish index

WGBEAM had taken up information on coastal beam trawl surveys already in the 2001 and 2002 reports. The 2001 report (ICES, 2001) gives information on the current procedure of calculating the combined International DFS indices including raising factors for the gear efficiency of individual, national surveys (Table 5.1).

The use of raising factors to standardise gear efficiency could also lead to errors in the estimation of a combined index. There was considerable variability in the comparison of gear efficiency, particularly when comparing the UK 2m beam with 3 tickler chains and the Dutch 3m beam with a single tickler. Raising factors varied between 2 and 3 times for experiments carried out in the Thames and Wadden Sea.

The WG noted that there have been changes in survey areas, vessels and gears in the Dutch and German Young Fish surveys. For instance, the areas covered by RV “ISIS” in the DFS have changed over time and will no longer cover the eastern German Bight after 2004. Similarly, the gear used in the Belgian survey has changed with the addition of 8–10 tickler chains whereas previously there were no chains. In view of these changes, the WG recommends that new studies would be helpful to verify the raising factors used since 1983. These studies could use covariables such as sediment type or depth (distinguishing inshore and offshore), to better explain differences between gears.

Survey details and standardisation
For the sake of better standardisation, the WG recommended that existing survey manuals should be exchanged between countries as an aid to developing standard survey techniques.

The development of the DATRAS database at ICES HQ that also contains beam trawl survey data (see chapter 5) has increased the pace at which the WGBEAM database develops. At present the database contains only information on fish catches and hauls of the offshore surveys. Several sources of data were identified that potentially can be added to the database:

- SMALK data (Sex, Maturity, Age, Length), offshore. It was agreed that each institute will provide these data to the next meeting for representative years in the DATRAS format
- Catches of benthic invertebrates, offshore. It was agreed that each institute will provide data on standard list of species (see Section TOR g) to the next meeting
- Inshore survey data (catches of fish and shrimp, haul information). It was agreed that each institute will provide data to the next meeting that allows comparison of the inshore data available between the WGBEAM participants. If there have been changes in the sampling or recording procedures that may have implications for the database the participant is requested to deliver separate sets that reflect these differences

As most of the effort of the WG in the past years was dedicated to the offshore surveys the data of these surveys are in a more developed stage. Therefore expansion of the database by including a particular type of data will first be implemented on the offshore survey data.

With regards to the delivery of data to databases outside WGBEAM (e.g., DATRAS see Chapter 5) it was decided that only data that are present in the WGBEAM database and scrutinized by the Working Group can be considered (by the Working Group) to become available for other databases.

6 Compliance to DATRAS

WGBEAM was informed that the DATRAS project ends on 1 April 2004. By then checking routines will be operational and tested against the Dutch beam trawl data (Haul information and Length frequency distribution, see ICES, 2002) and these will be added to the DATRAS database.

For the other countries' data that are part of the WGBEAM database it was decided that each country/institute should deliver their data from the offshore surveys to the DATRAS database as there are bound to be errors coming out of the checking procedures and these have to be corrected and reported back to the institutes who collected the data. As the Netherlands currently holds the WGBEAM database they can provide data (if necessary) to each of the WGBEAM participants in the correct format.

In the future DATRAS will be expected to deliver the indices that are currently provided by the WG. For this to become possible it is necessary that the way indices are calculated is described (see Section on TOR d) and that SMALK data (Sex, Maturity, Age, Length see ICES, 2002) (or CA records in the IBTS dataset) also become part of the DATRAS database. For data not yet part of the WGBEAM database it was decided that these data should first be collated in the WGBEAM database and scrutinized by the group before they can be added to the DATRAS database. Therefore it was decided that for the future meeting each participant should bring (a subset of) the CA records of their beam trawl surveys that would allow the group to decide on how these data can be combined into a WGBEAM database and subsequently into the DATRAS database.

The planning is that from the 2005 surveys onwards the offshore survey data including age/length information (CA records) will be provided directly to the DATRAS database.

At present the indices are calculated by each of the institutes separately using their national surveys only. These indices are delivered to WGBEAM to be incorporated in the report. The calculation is not done by the WG. As part of TOR d (see section) the WG will investigate the possibilities for making international indices. If and when the WG decides on new indices and wants those calculated by DATRAS then the WG will provide descriptions of the calculations and ascertain that the necessary data are available in the DATRAS database.

7 Protocols and criteria for standardisation

The Tables 3.1.1 and 3.2.1 show that a wide range of gears are used both in the offshore and inshore beam trawl surveys. In the eastern North Sea offshore surveys for example, the Netherlands uses 2 x 8m beam trawls with tickler chains on RV “Isis” because most of the stations covered by their surveys is on relatively soft sandy sediments. In contrast, the UK, Belgian and Netherlands (using RV “Tridens”) surveys in the North Sea, includes many stations on harder ground where it is not possible to use open tickler chain gear and as a result, chain mats and/or flip-up ropes have become the standard gear. Also, not all vessels are equipped to use 8m beam trawls. Although these constraints prevent further standardisation between surveys, it is essential to maintain within survey repeatability by developing and implementing protocols for ensuring that the gear is rigged and used in standard ways by each survey.

Protocols for ensuring standardisation of gears has been developed over many years by the IBTS WG for otter trawl surveys in the North Sea. It was agreed that these could form a useful basis for developing appropriate standard operating procedures and quality control checks for the international beam trawl surveys. Key features of any protocols are:

- precise descriptions of the gear with detailed rigging diagrams.
- paper audit of any changes made to the gear, including dates of re-rigging or purchase of new gear
- defined responsibilities and paper audit for checking gear before, during and after surveys
- agreed replacement strategy to prevent performance dropping to unacceptable levels

In the case of beam trawls one important feature affecting performance is the level of wear on tickler chains and chain mats. It is therefore important that there are protocols for deciding when chains are replaced and as far as possible ensuring that this is standardised in relation to the timing of the survey.

Annex 3 summarises the protocols developed for maintenance and deployment of the GOV trawl used by England in the North Sea third quarter IBTS. It is suggested that this could be adapted for use as a standard operating procedure in the offshore and inshore beam trawl surveys.

8 References

ICES. 1985. Report of the 0–Group North Sea Flatfish Working Group. ICES CM 1985/G:2.

ICES. 1990. Report of the study group on beam trawl surveys in the North Sea and Eastern Channel. ICES CM 1990/G:59.

ICES. 1993. Report of the study group on beam trawl surveys. ICES CM 1993/G:5.

ICES. 2001. Report of the Working Group on Beam Trawl Surveys. ICES CM 2001/G:06.

9 Annexes

Annex 1. Coverage of the area

Figure 2.1.1 Total number of beam trawl hauls per rectangle.
Total hauls in 2003 (above) and total for 1990 – 2003 (below) for BEL .

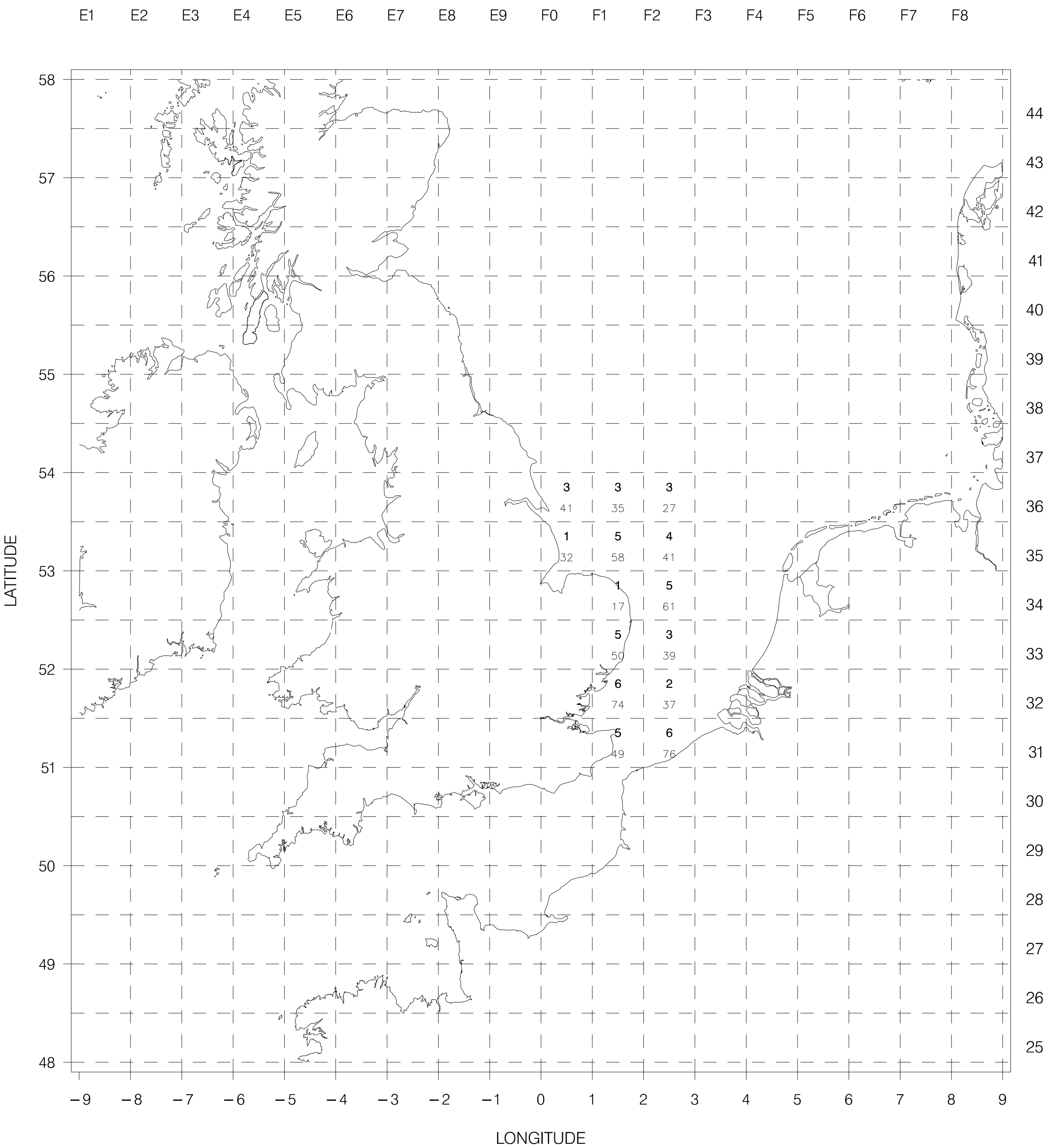


Figure 2.1.2 Total number of beam trawl hauls per rectangle.
Total hauls in 2003 (above) and total for 1990 – 2003 (below) for ENG .

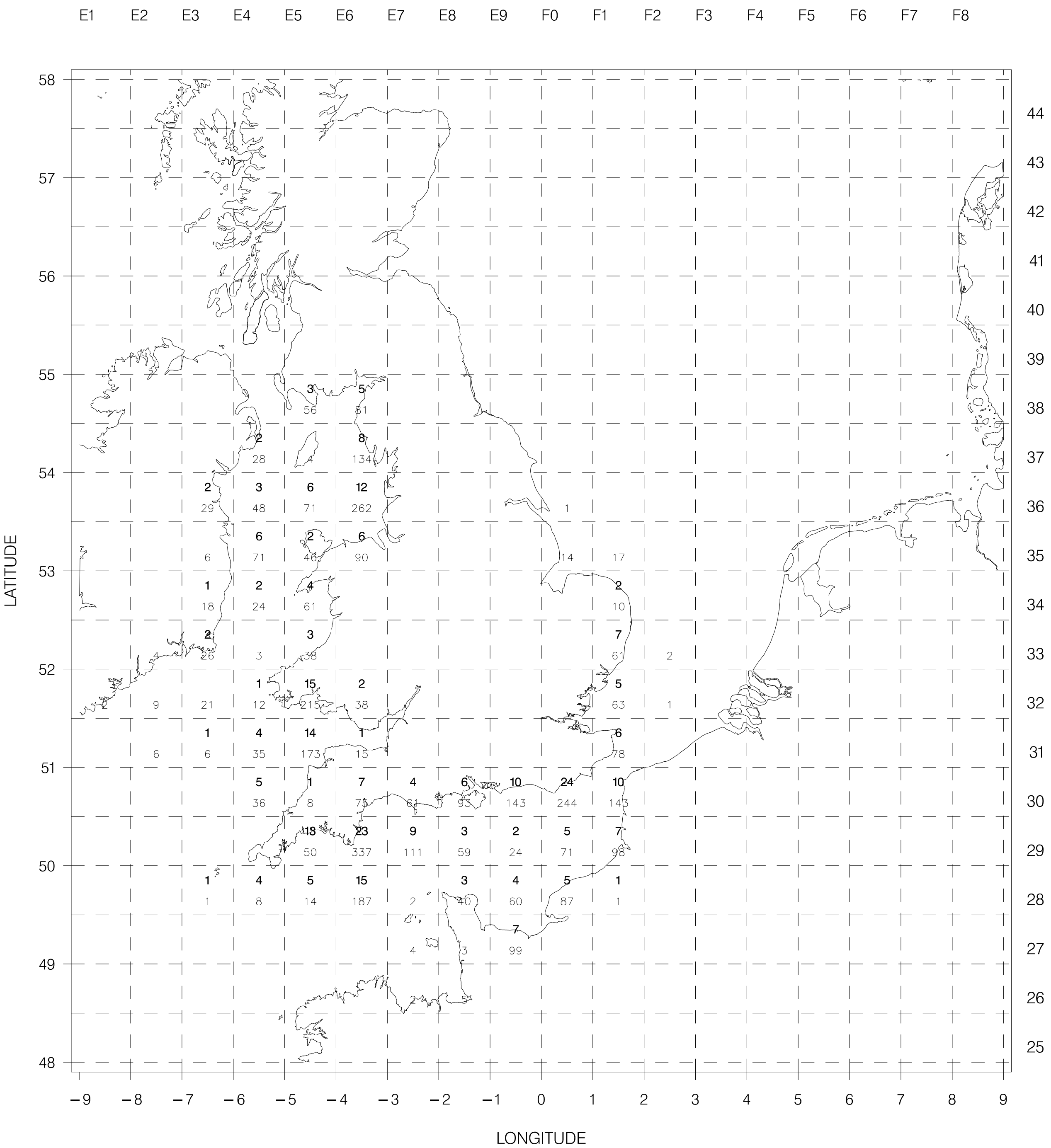


Figure 2.1.3 Total number of beam trawl hauls per rectangle.
Total hauls in 2003 (above) and total for 1990 – 2003 (below) for GFR .

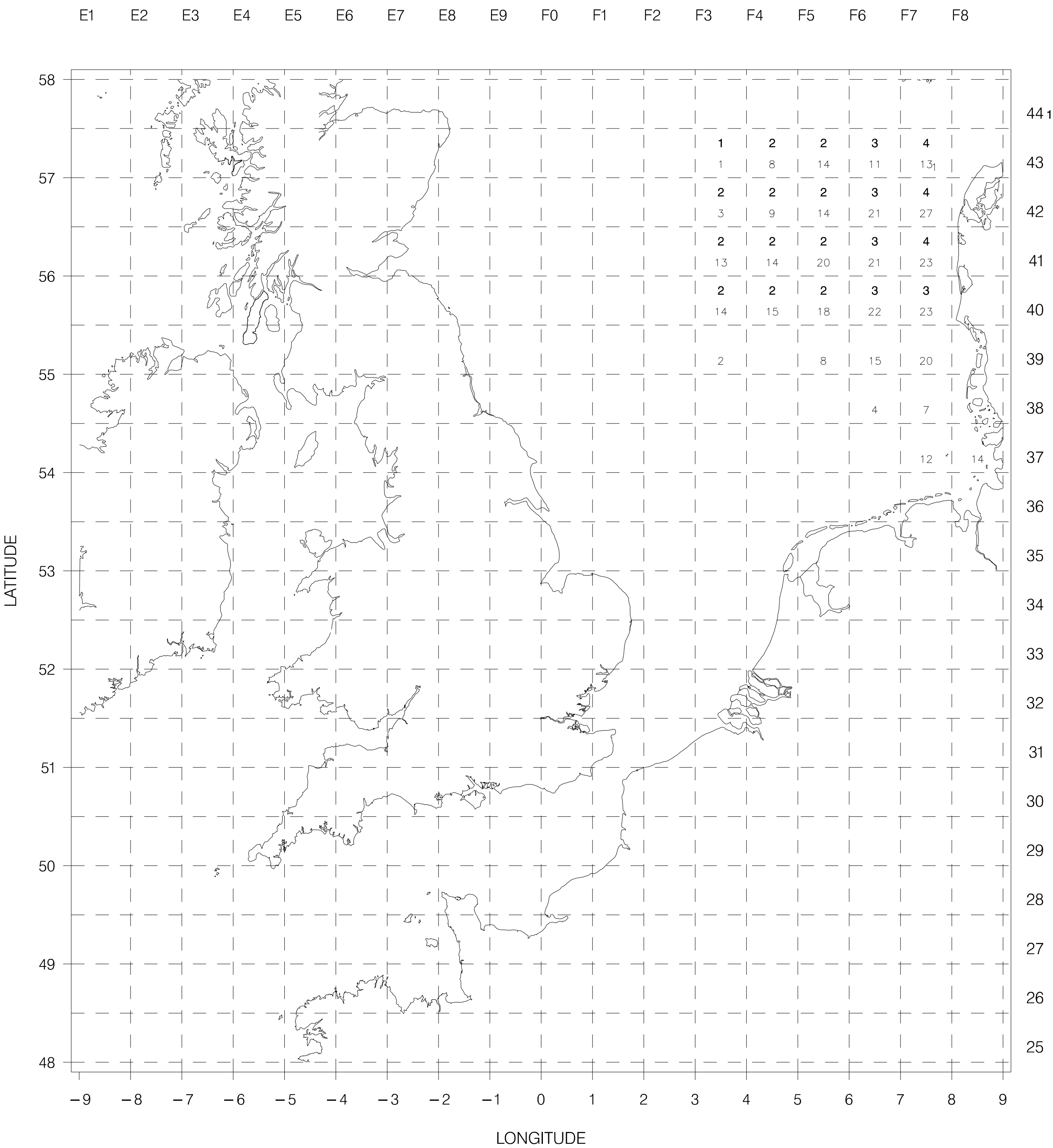
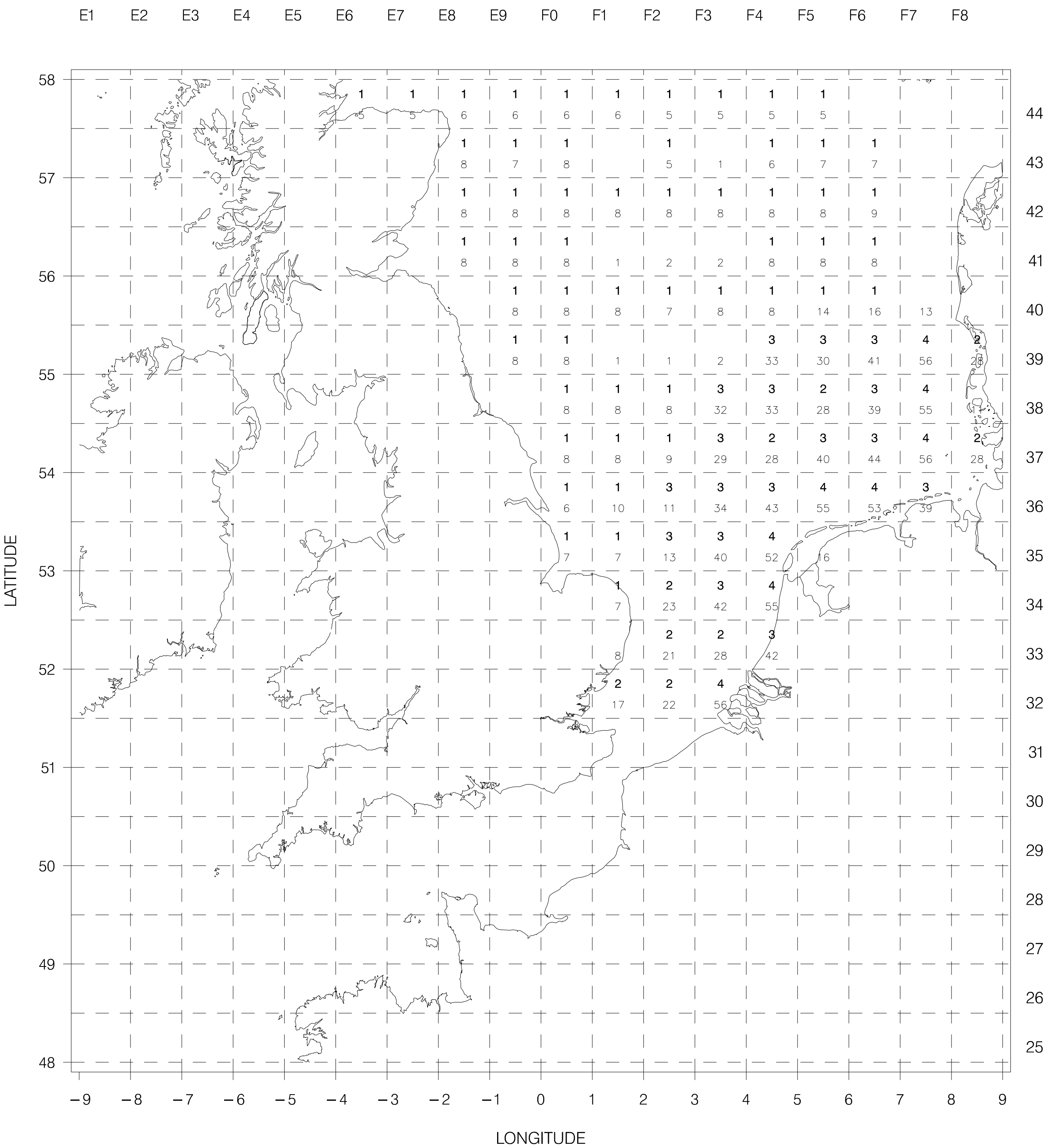


Figure 2.1.4 Total number of beam trawl hauls per rectangle.
Total hauls in 2003 (above) and total for 1990 – 2003 (below) for NED .



Annex 2. Spatial distribution of fish species

Figure 2.3.1 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Dab

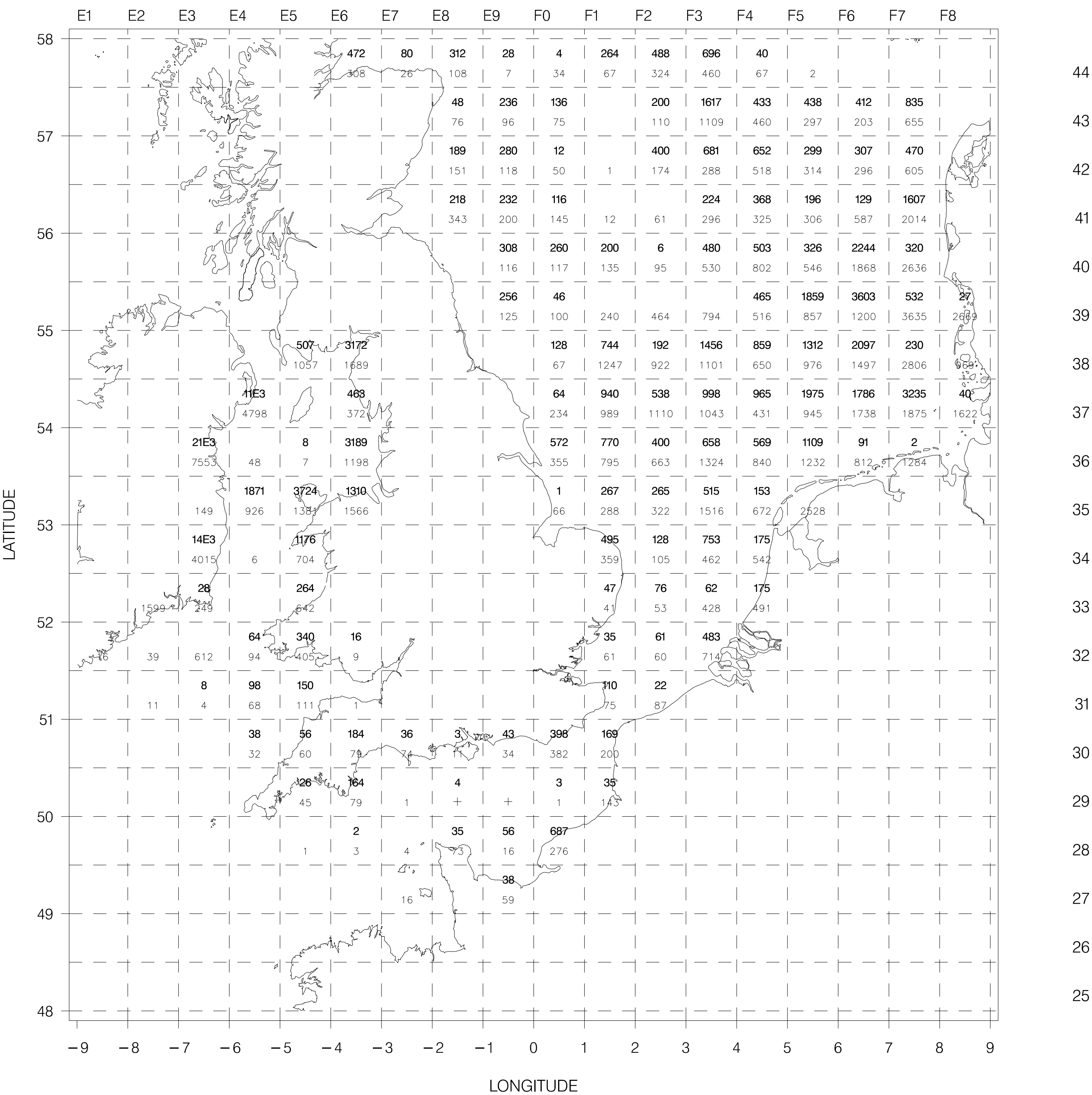


Figure 2.3.2 International Beam Trawl Surveys 1990–2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Sole

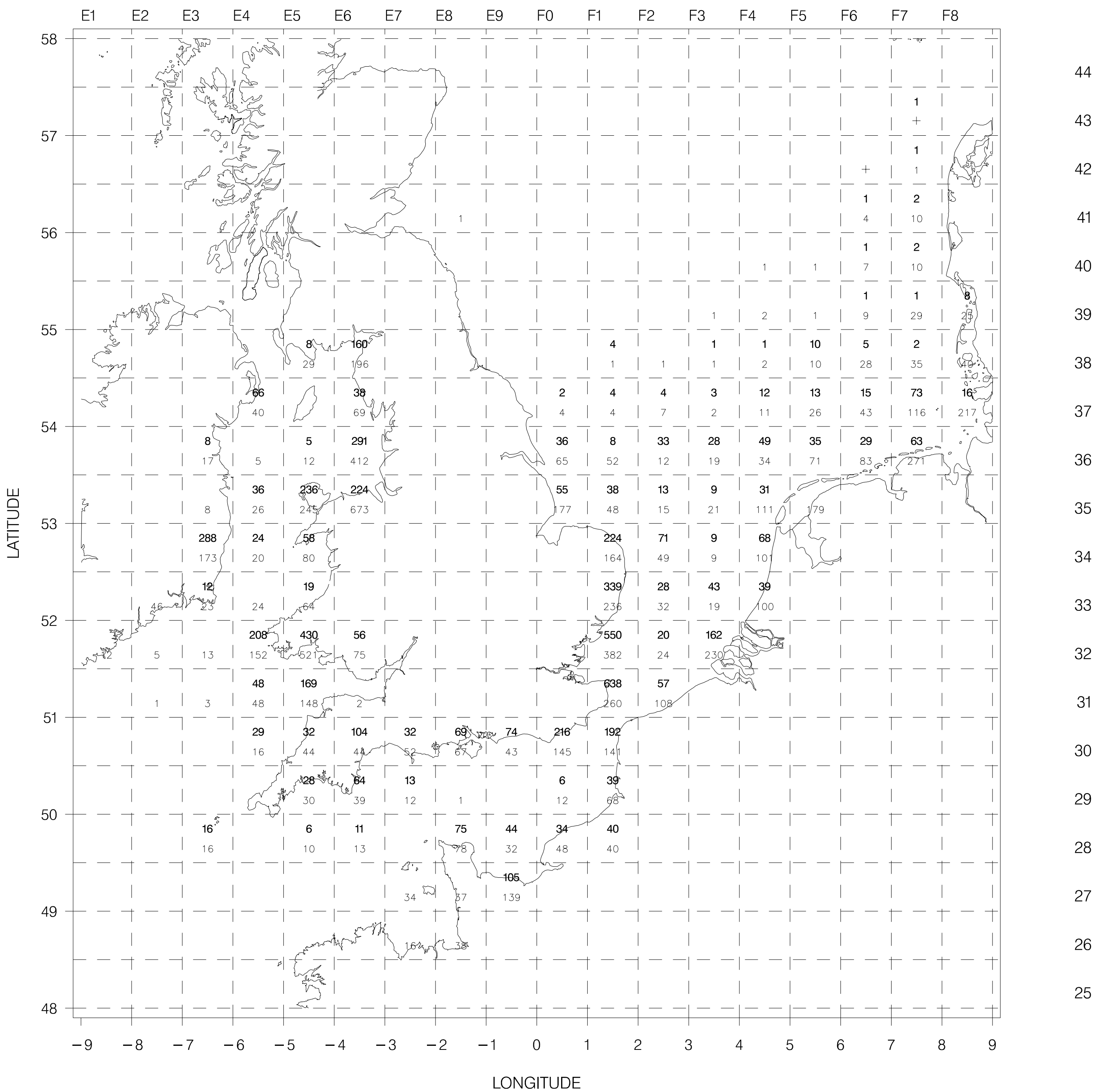


Figure 2.3.3 International Beam Trawl Surveys 1990–2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Plaice

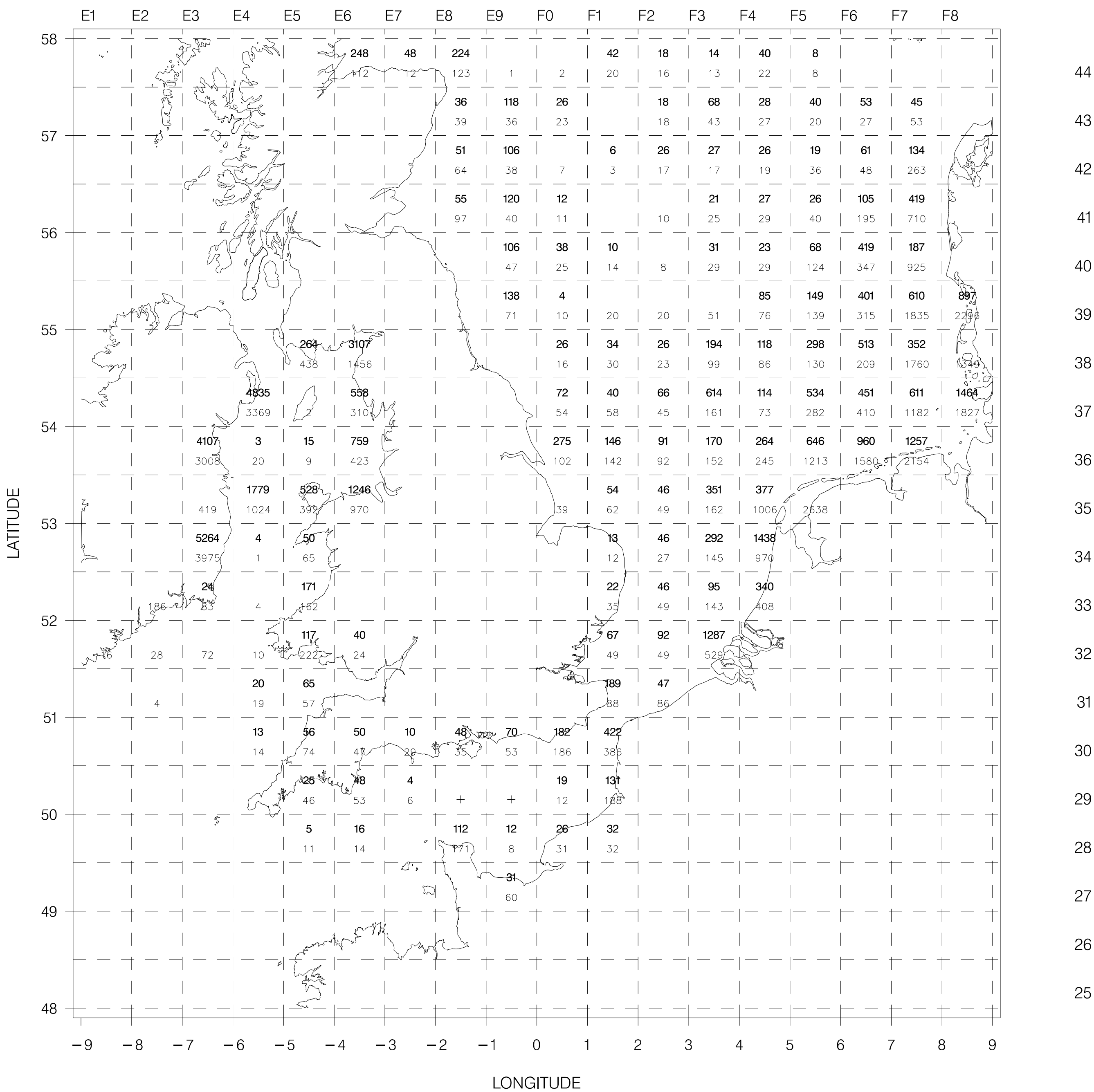


Figure 2.3.4 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Turbot

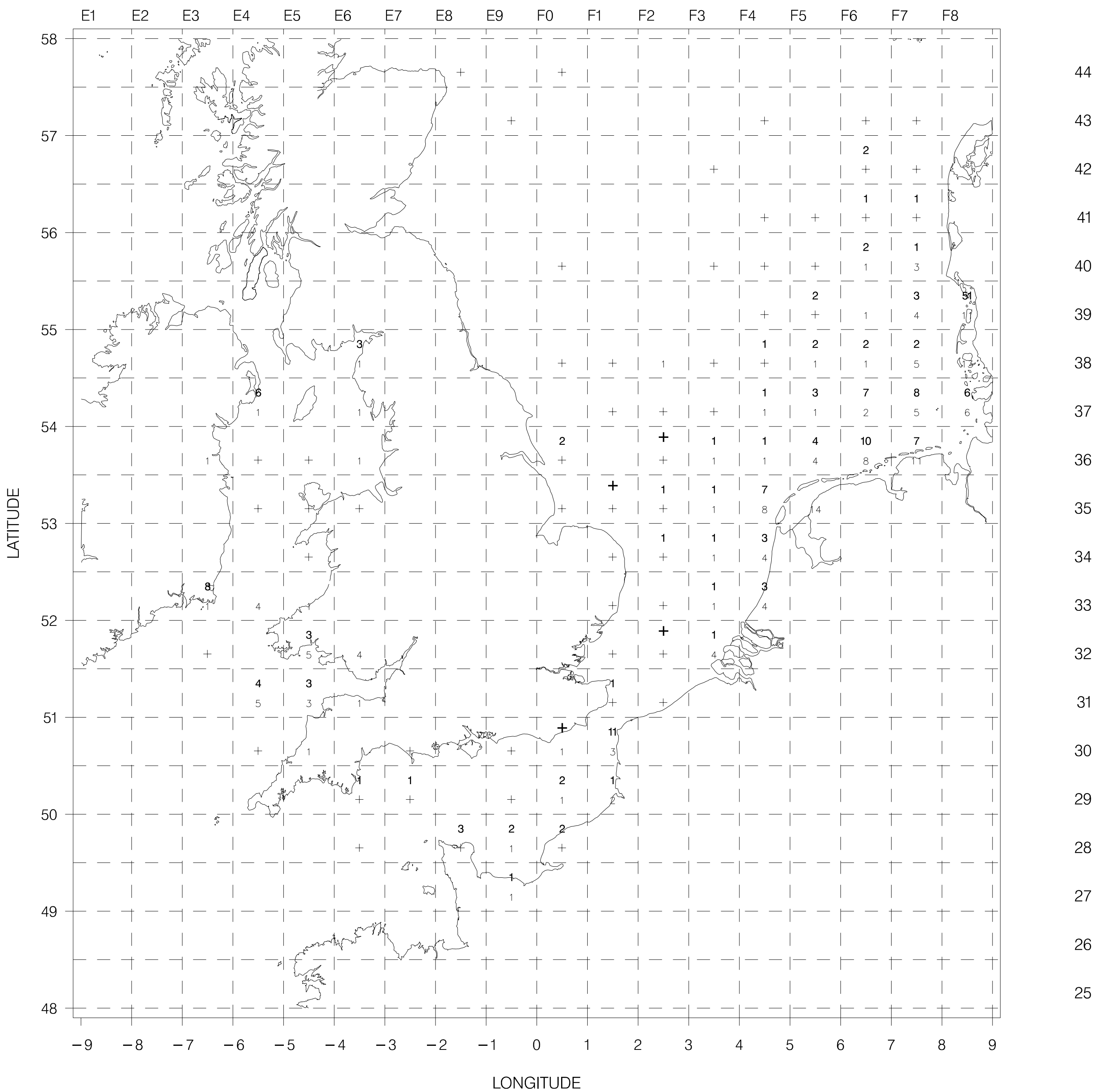


Figure 2.3.5 International Beam Trawl Surveys 1990 – 2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Brill

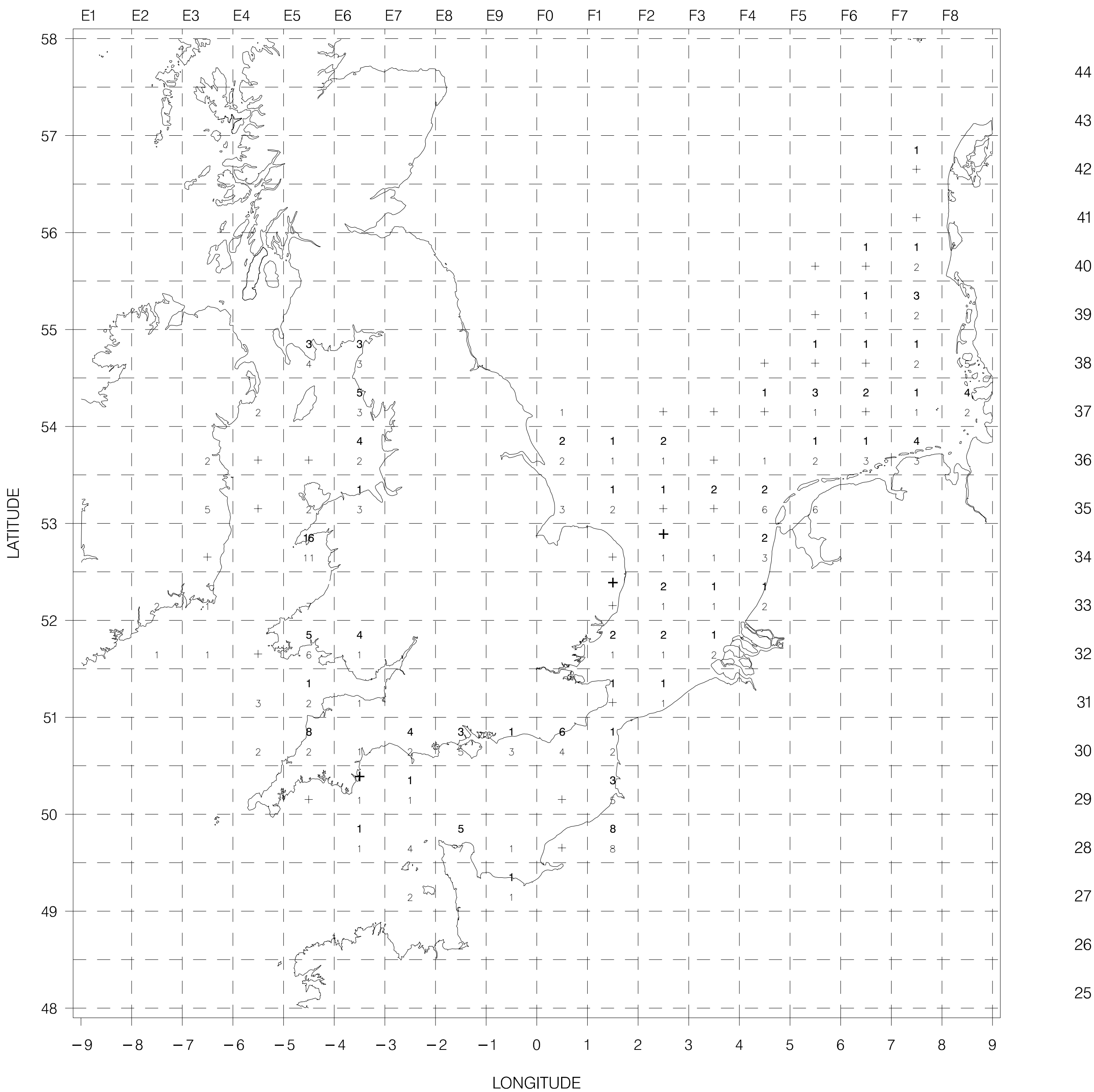


Figure 2.3.6 International Beam Trawl Surveys 1990–2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)
Scaldfish

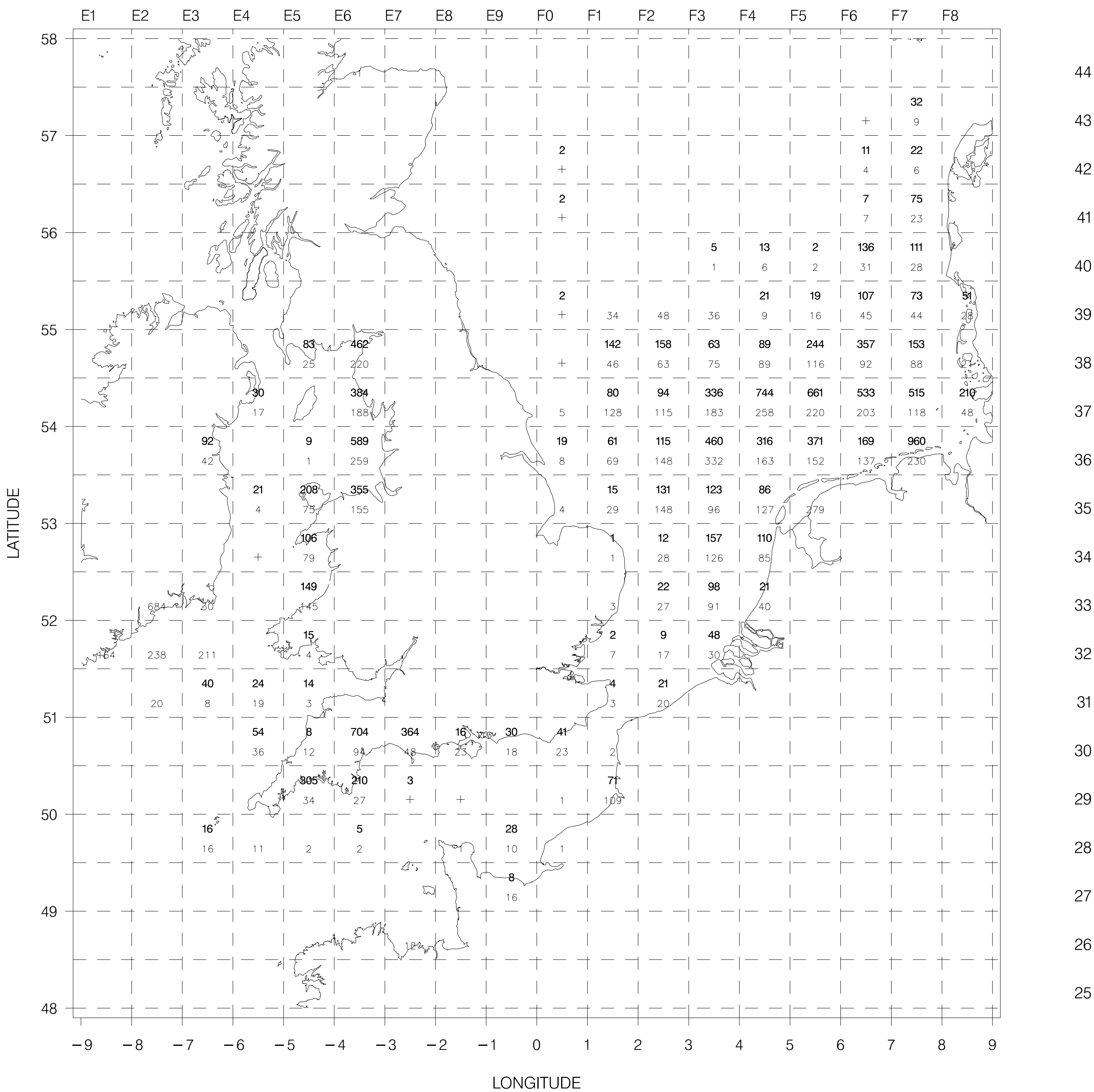


Figure 2.3.7 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Lemon sole

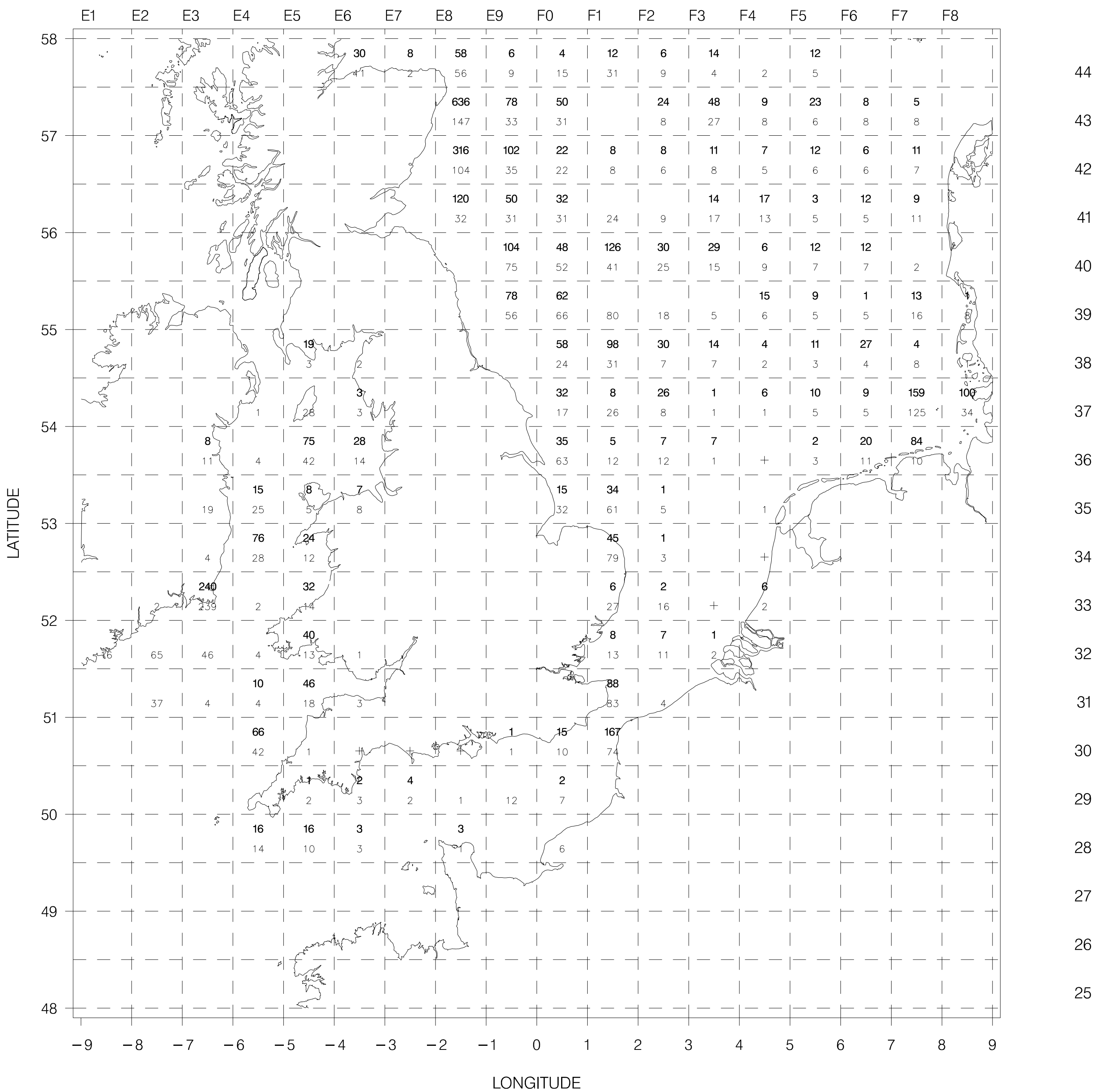


Figure 2.3.8 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

American plaice (Long rough dab)

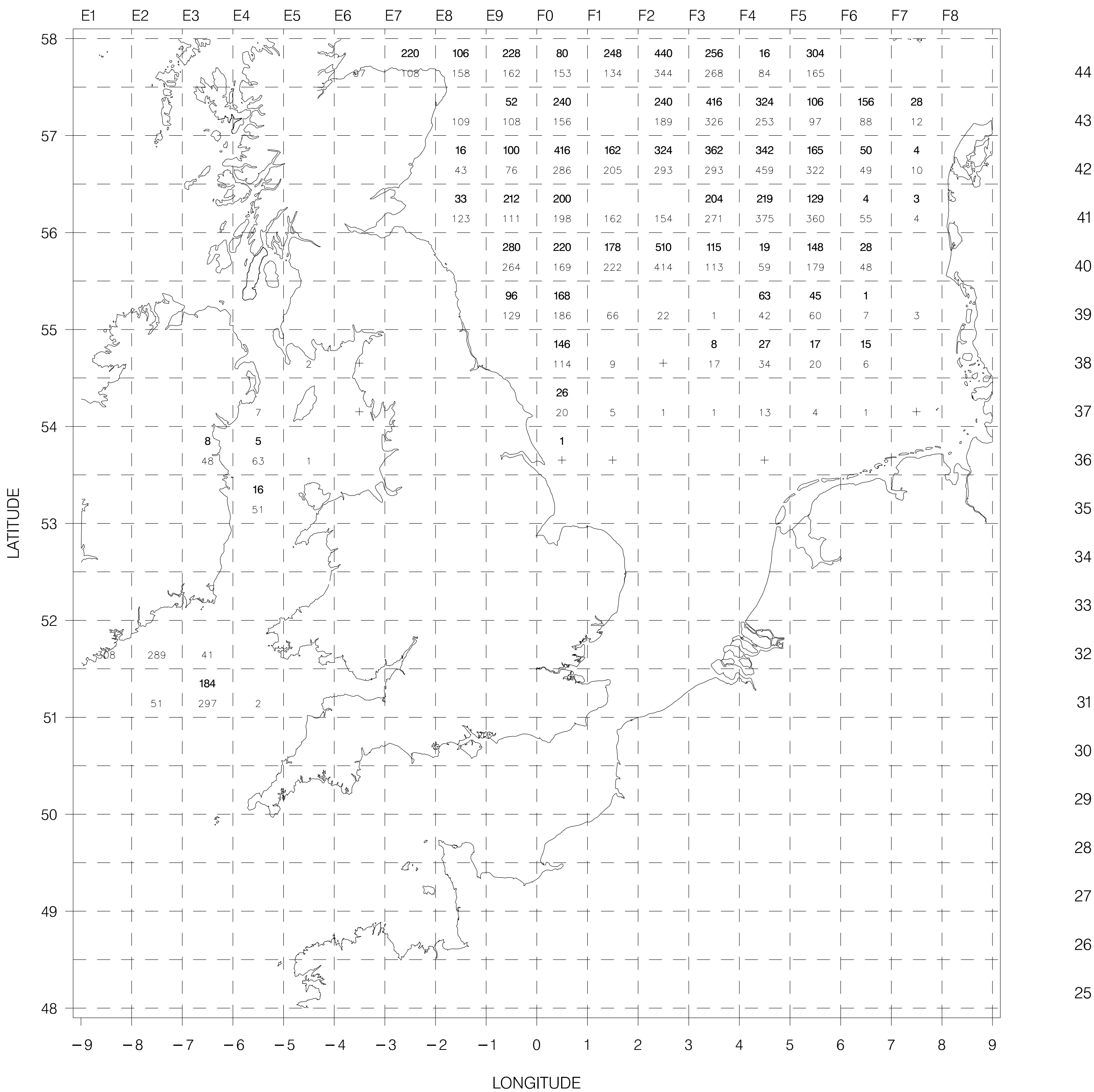


Figure 2.3.9 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Flounder

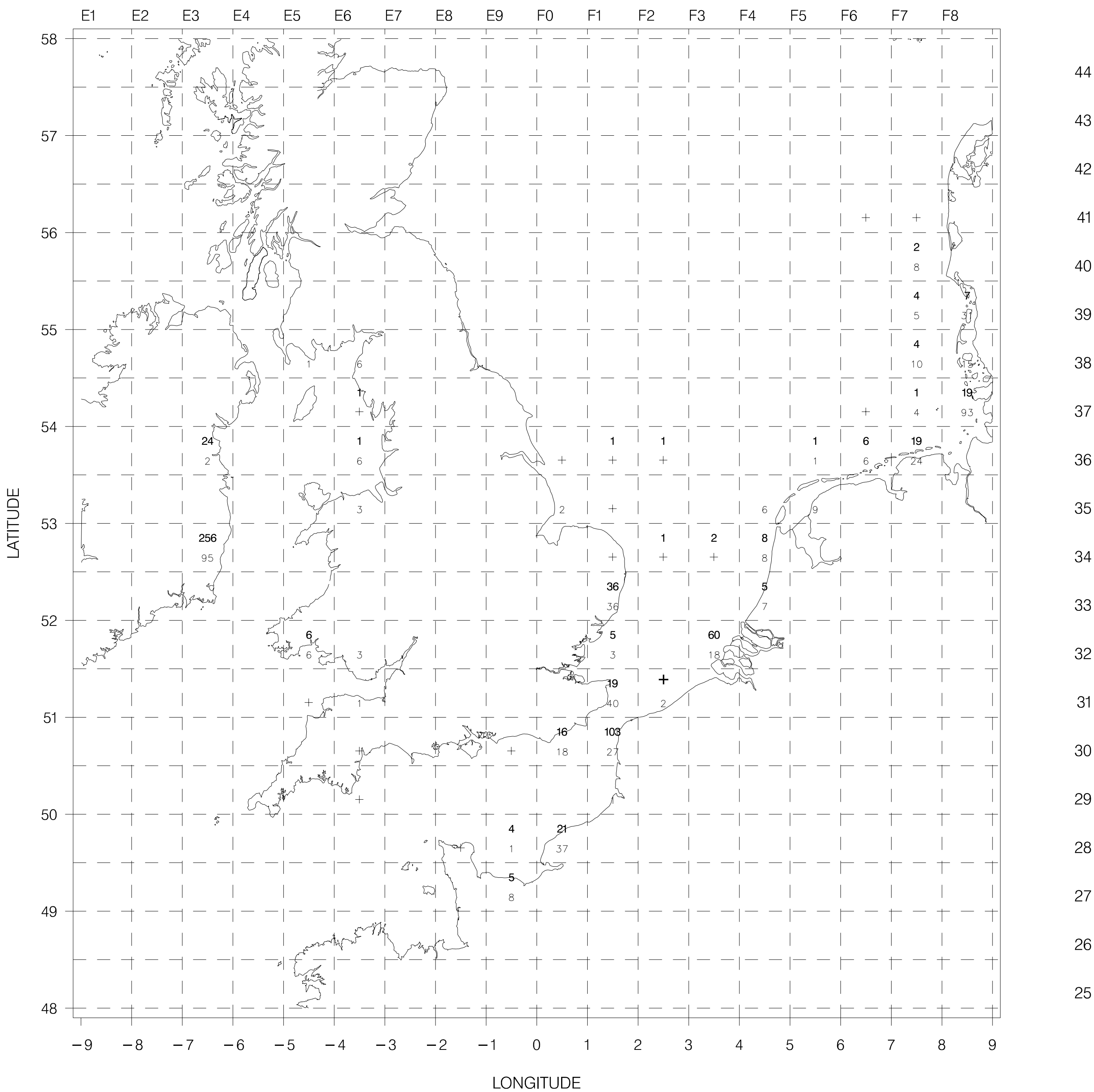


Figure 2.3.10 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Solenette

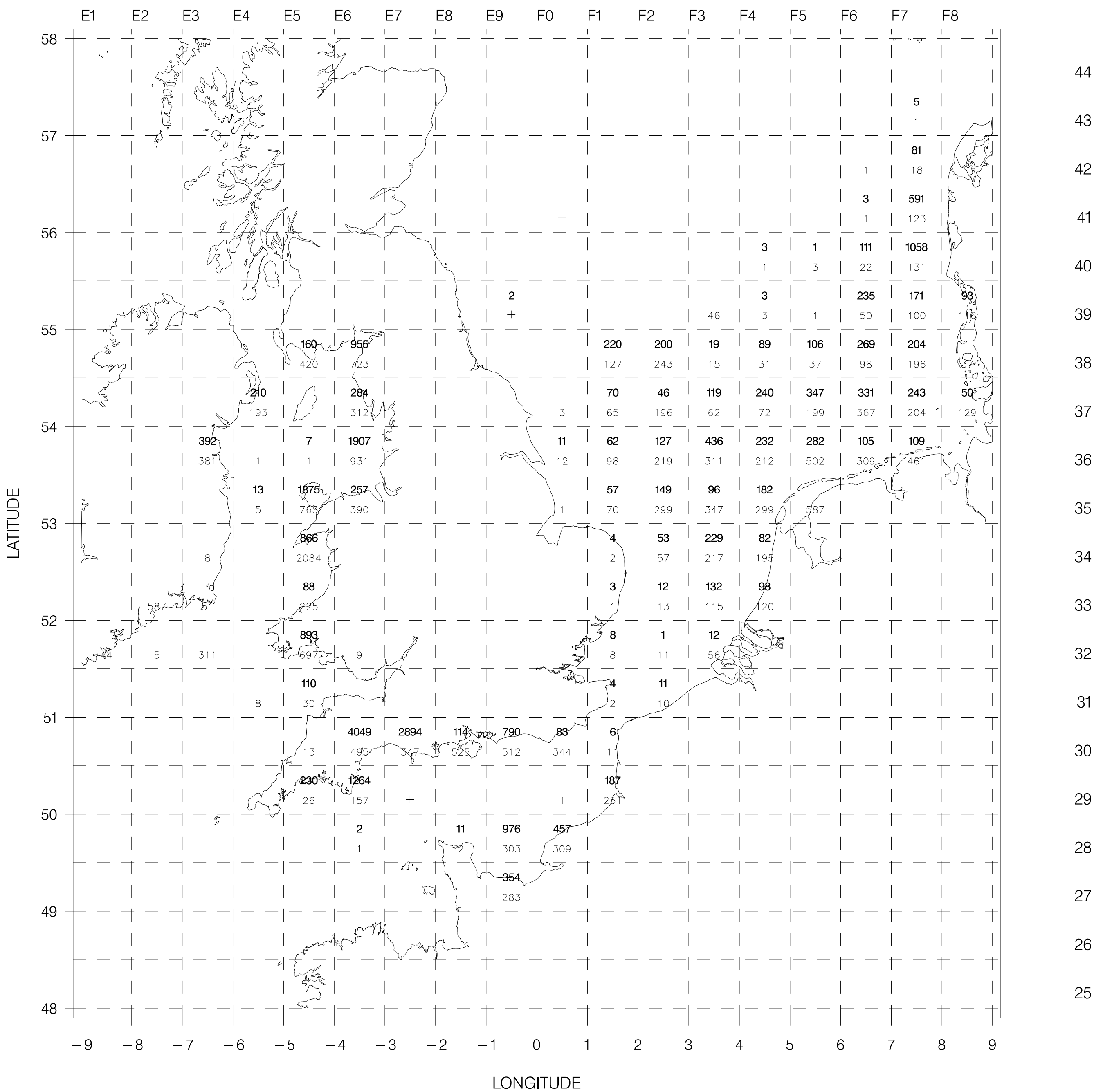


Figure 2.3.11 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Thickback sole

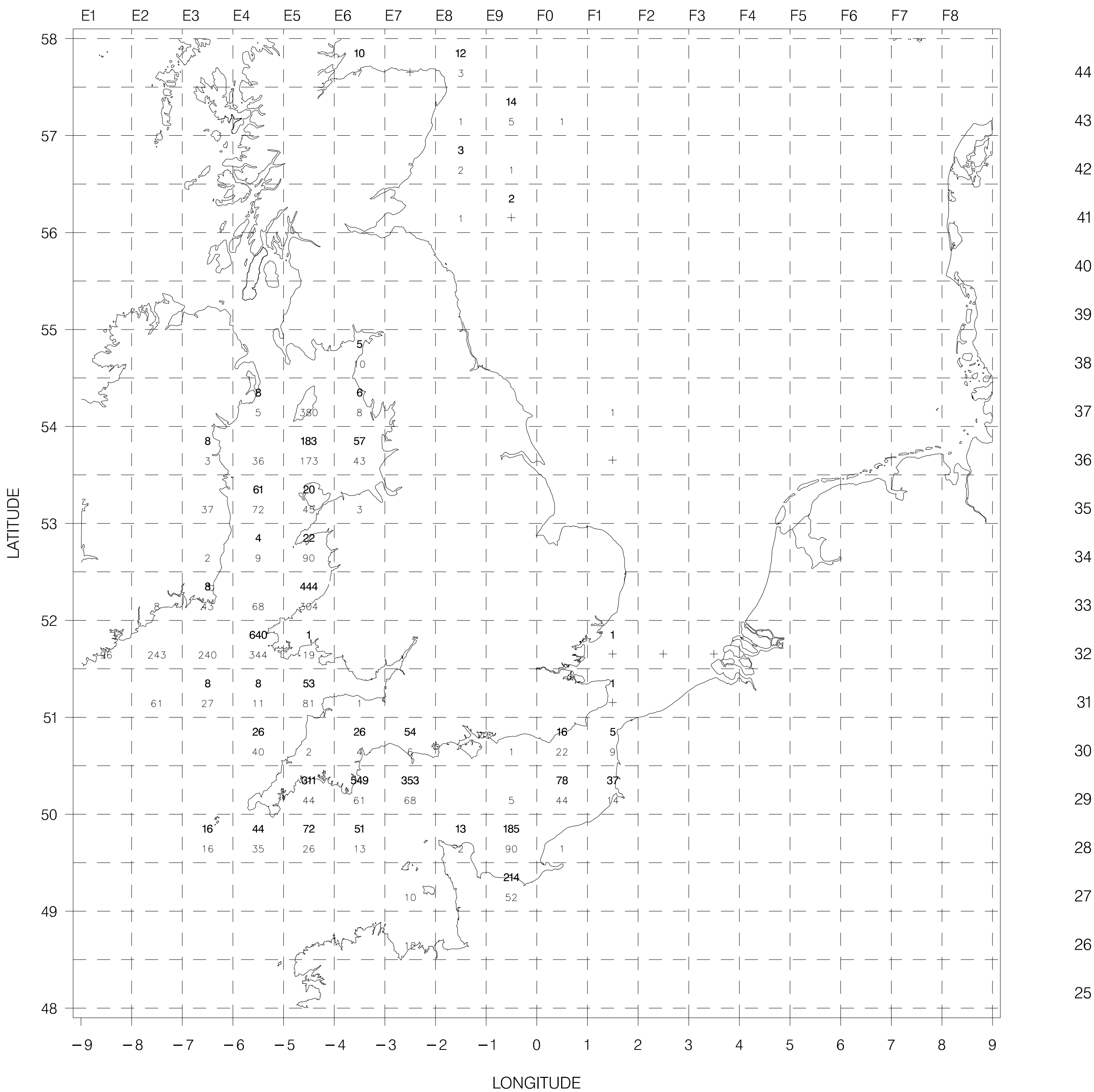


Figure 2.3.12 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Pogge (Armoured bullhead)

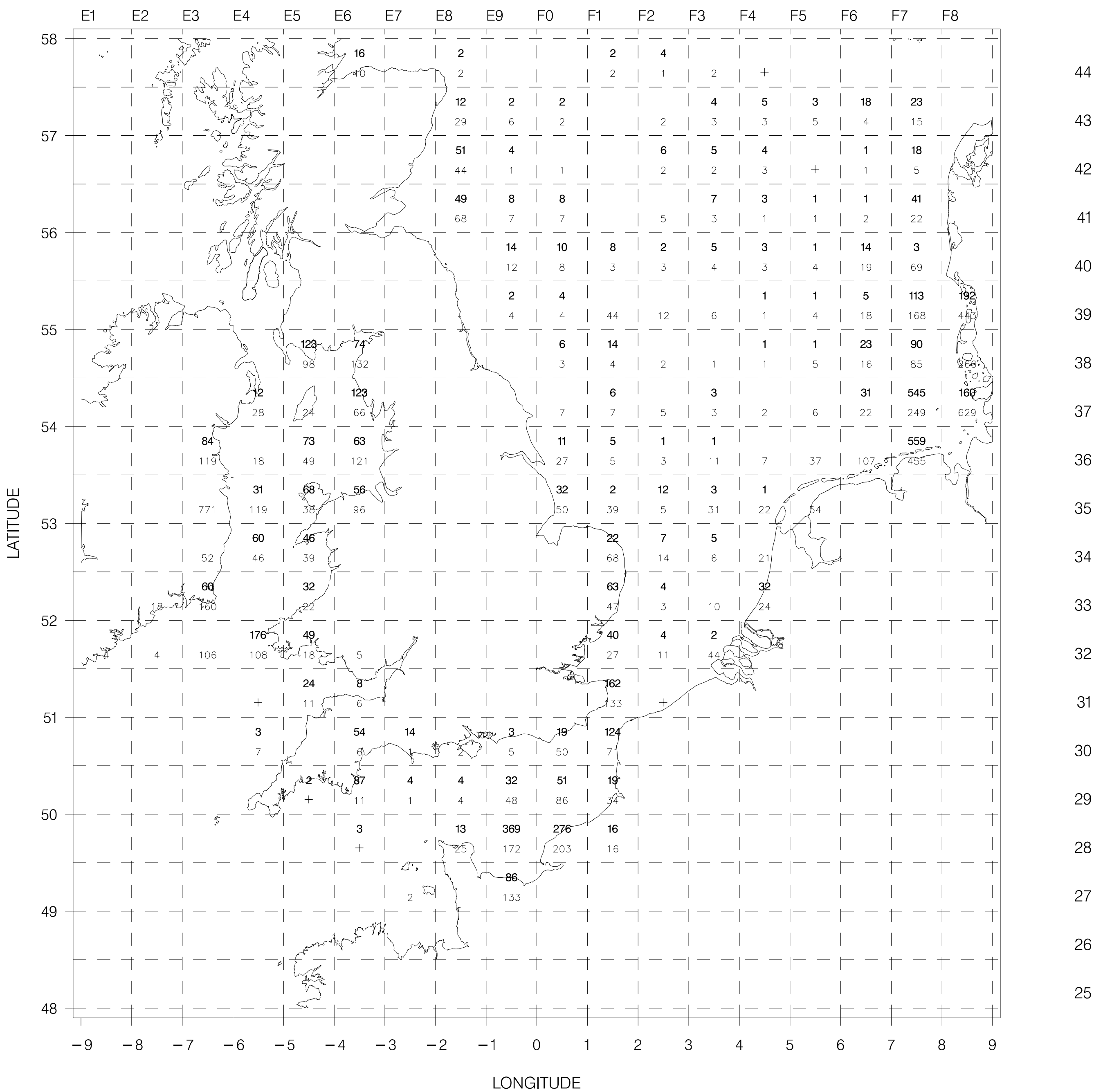


Figure 2.3.13 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Tub gurnard

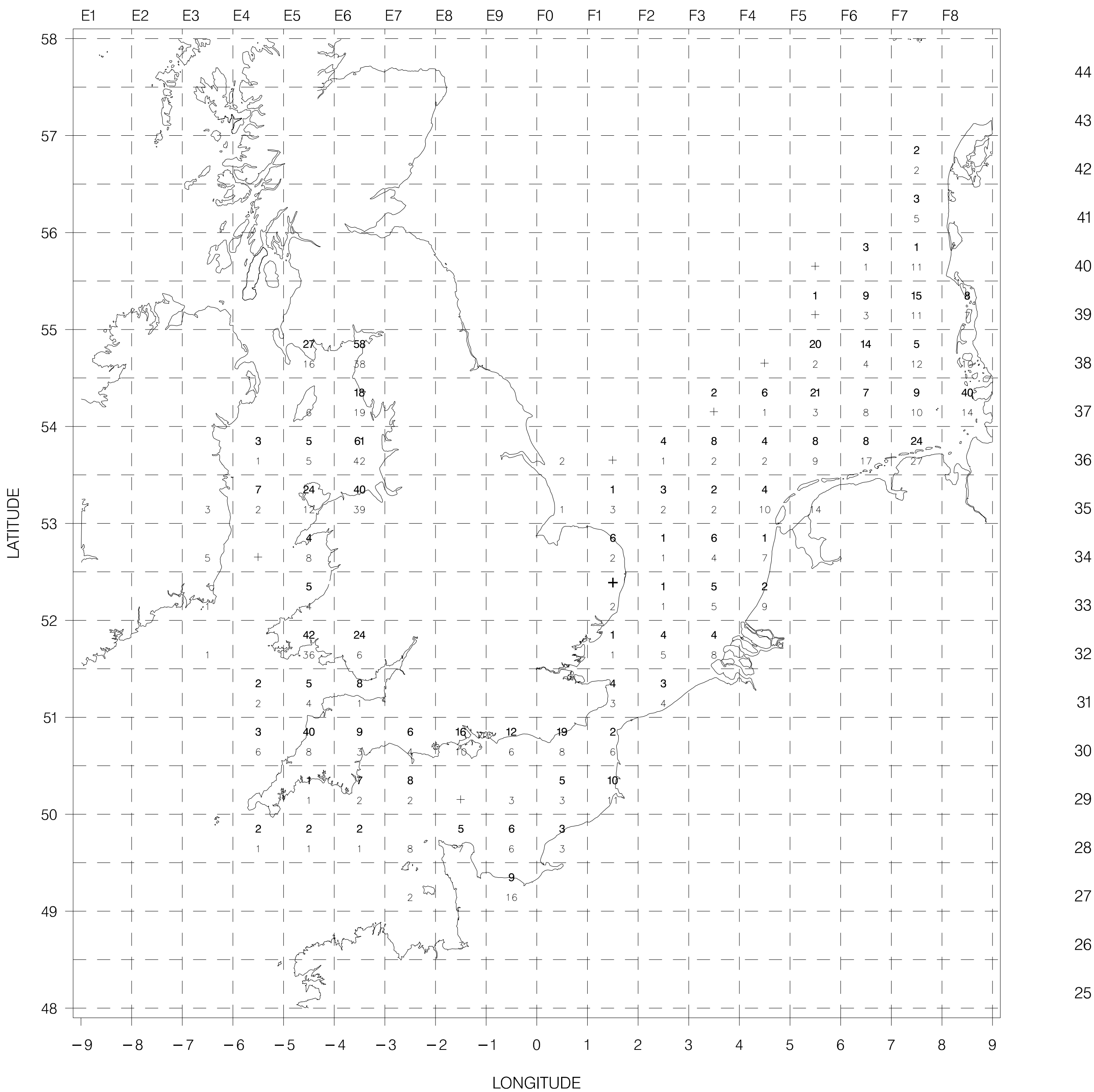


Figure 2.3.14 International Beam Trawl Surveys 1990–2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Grey gurnard

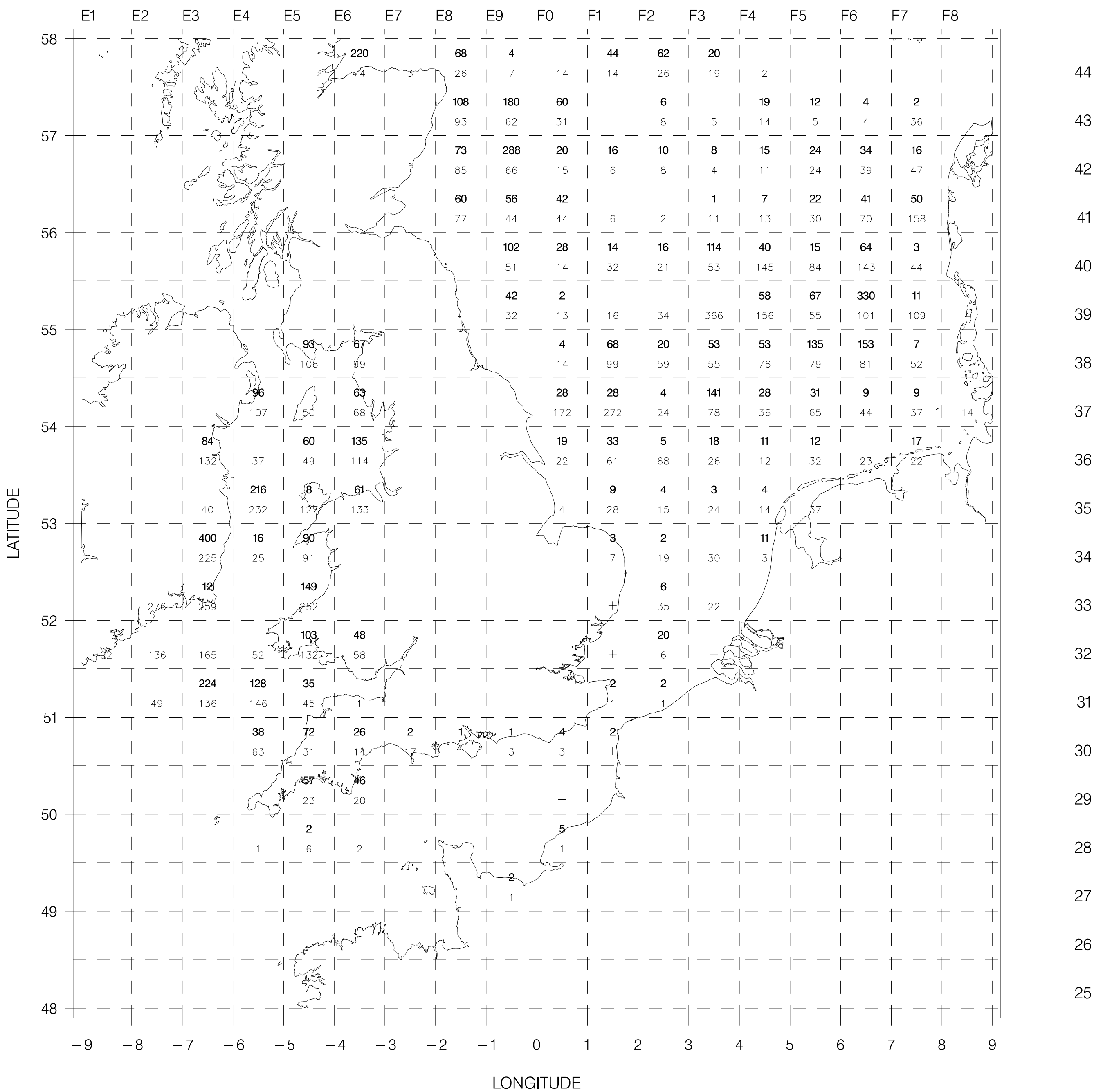


Figure 2.3.15 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Lesser weever

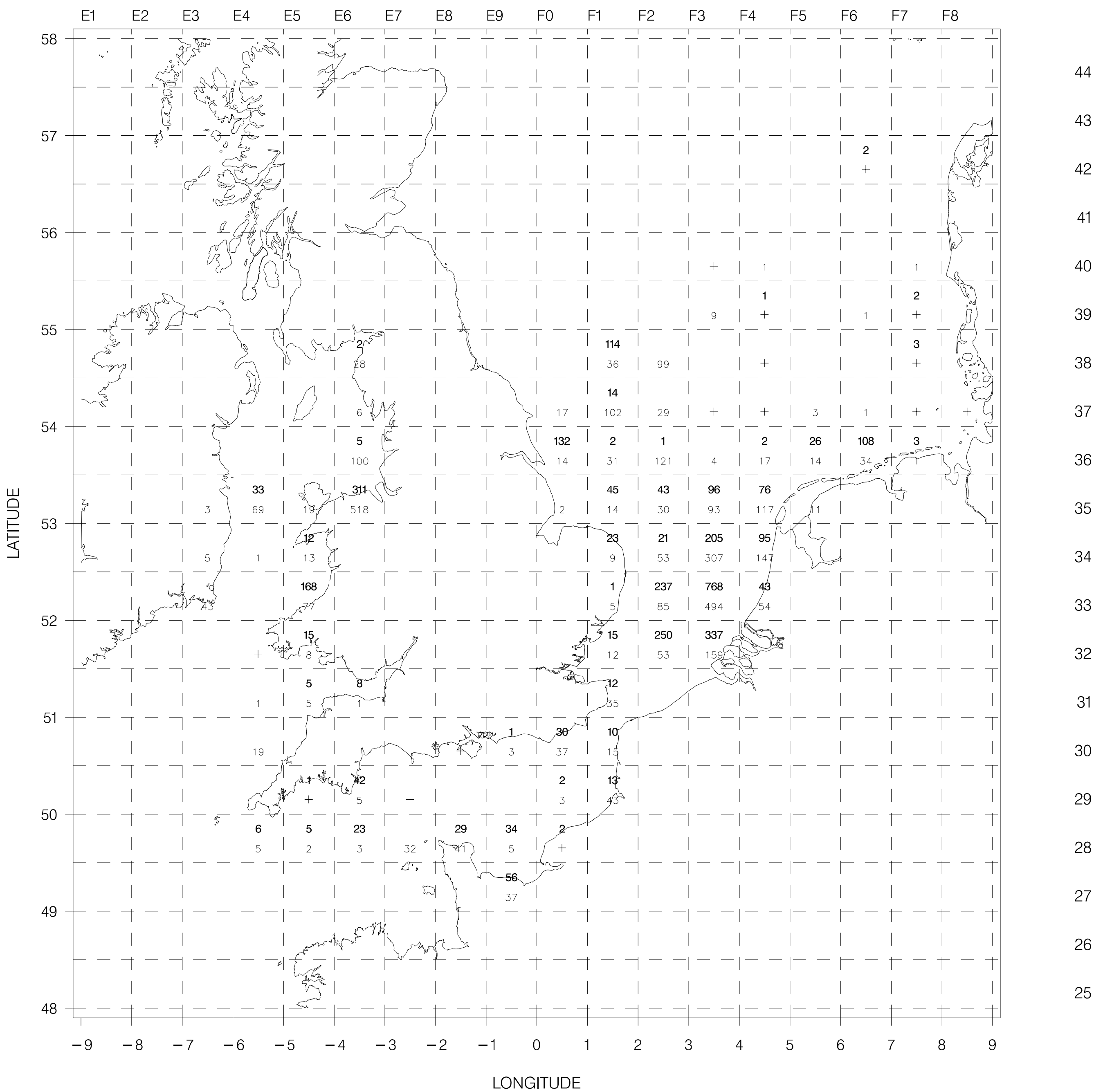


Figure 2.3.16 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Common dragonet

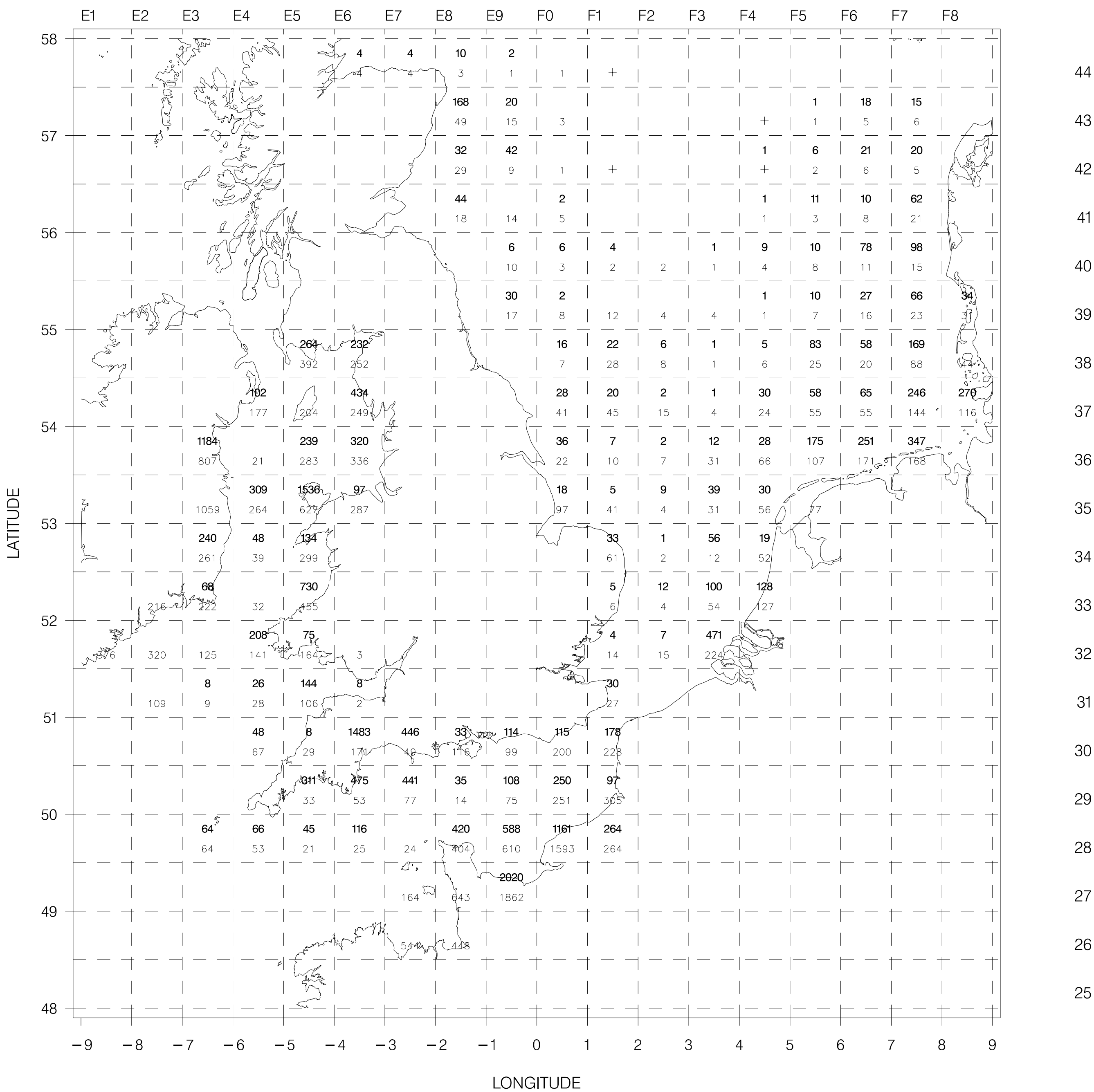


Figure 2.3.17 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Lesser spotted dogfish

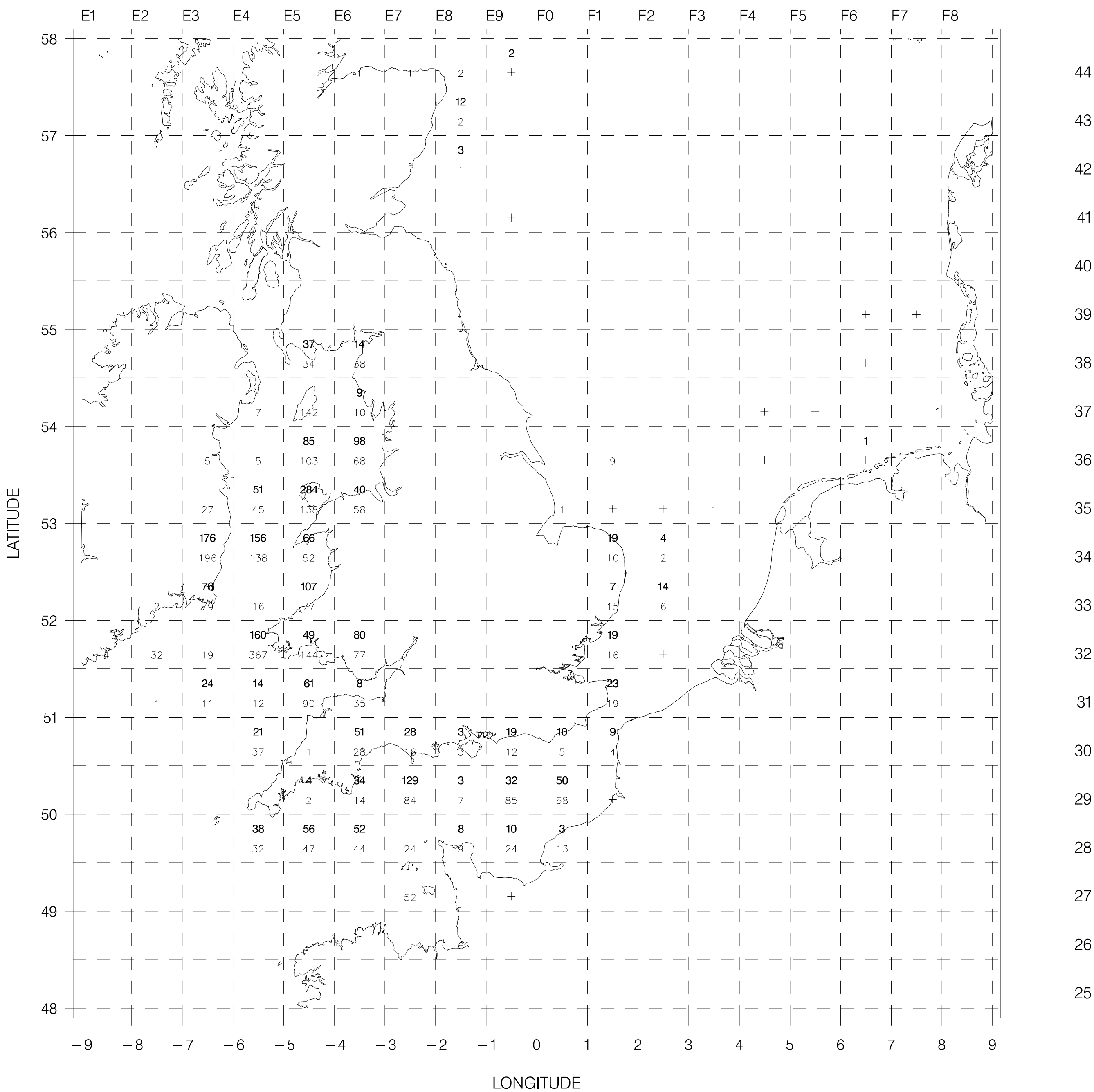


Figure 2.3.18 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)
Rays

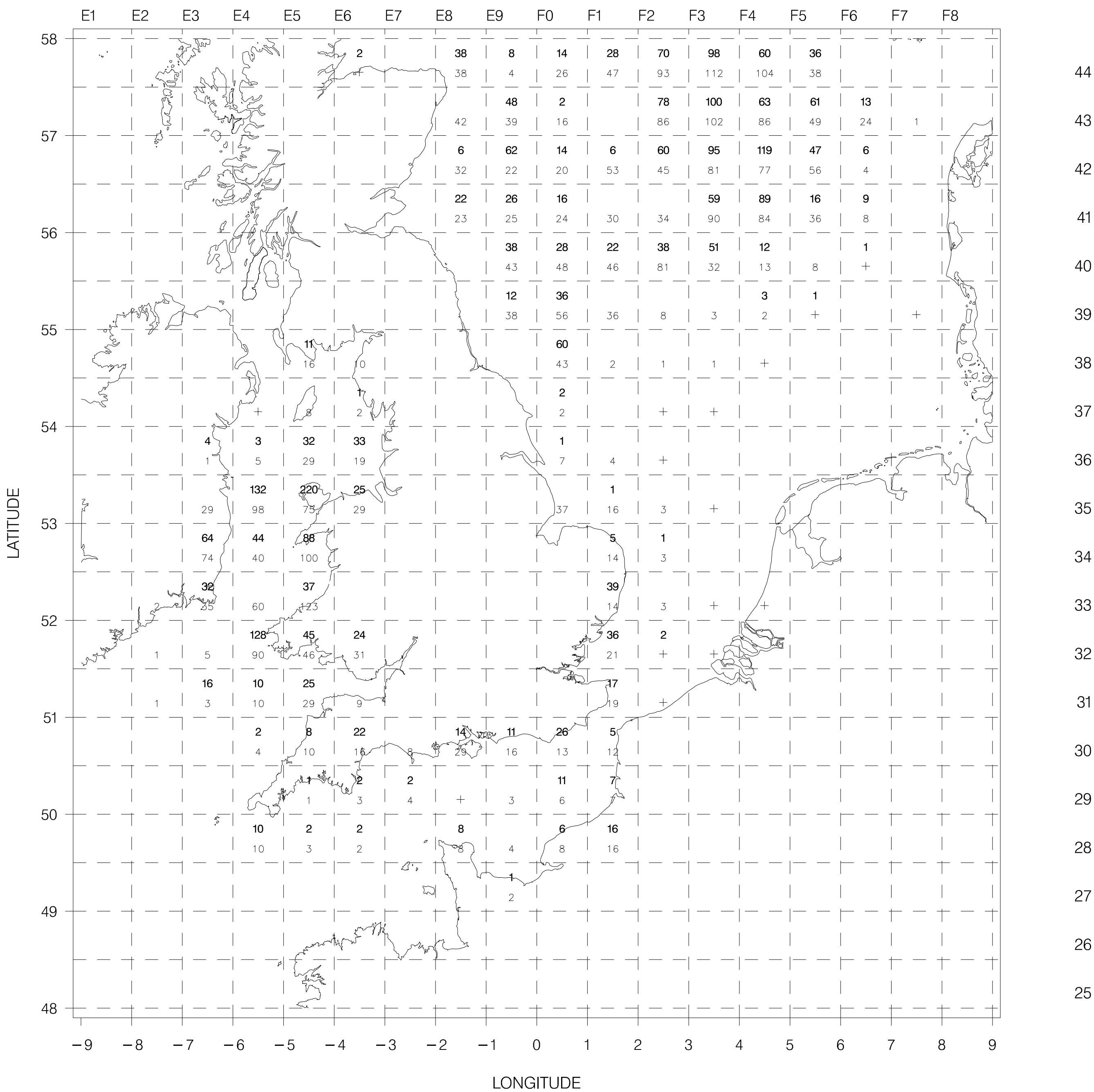


Figure 2.3.19 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Cod

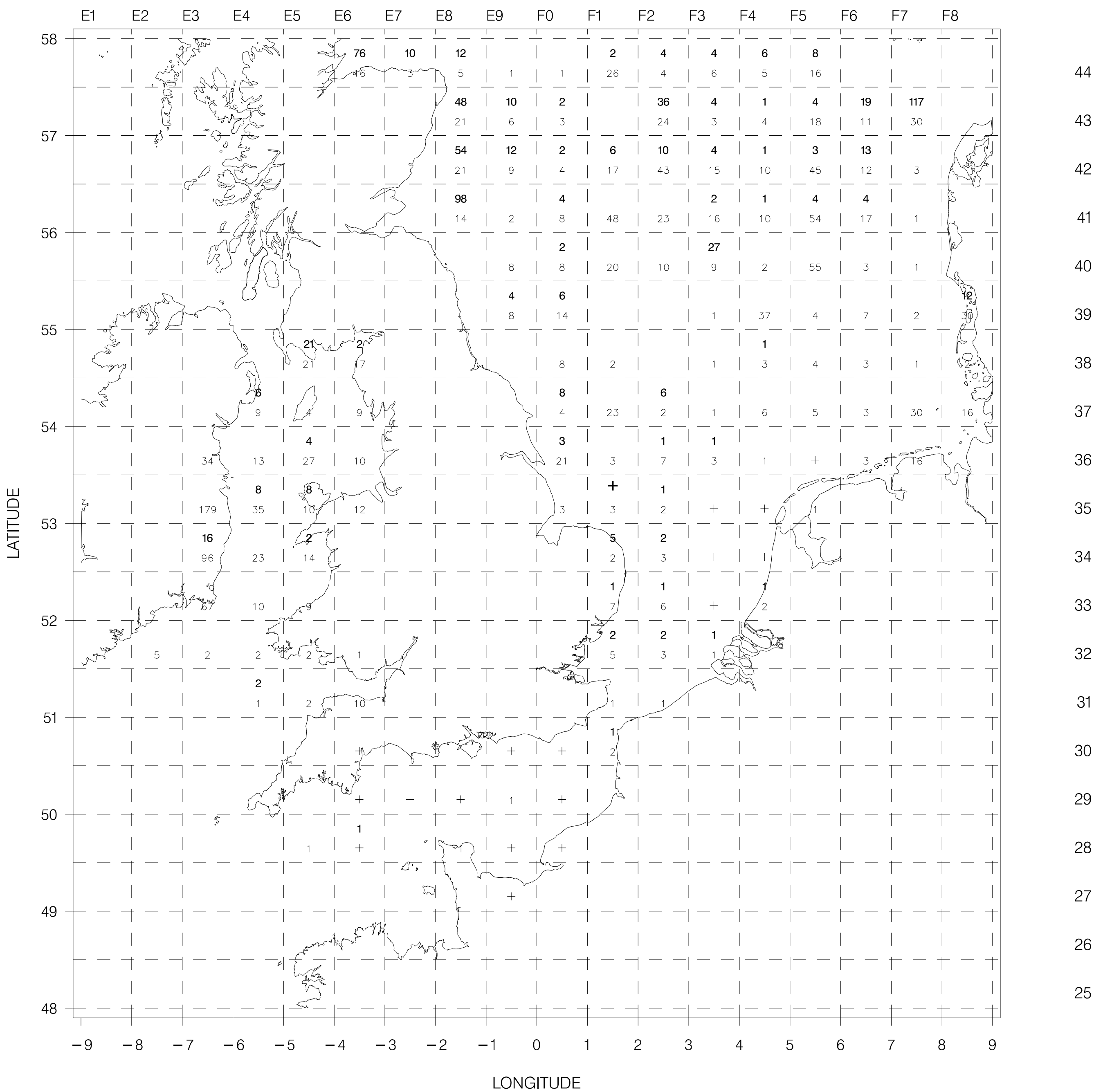


Figure 2.3.20 International Beam Trawl Surveys 1990–2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Poor cod

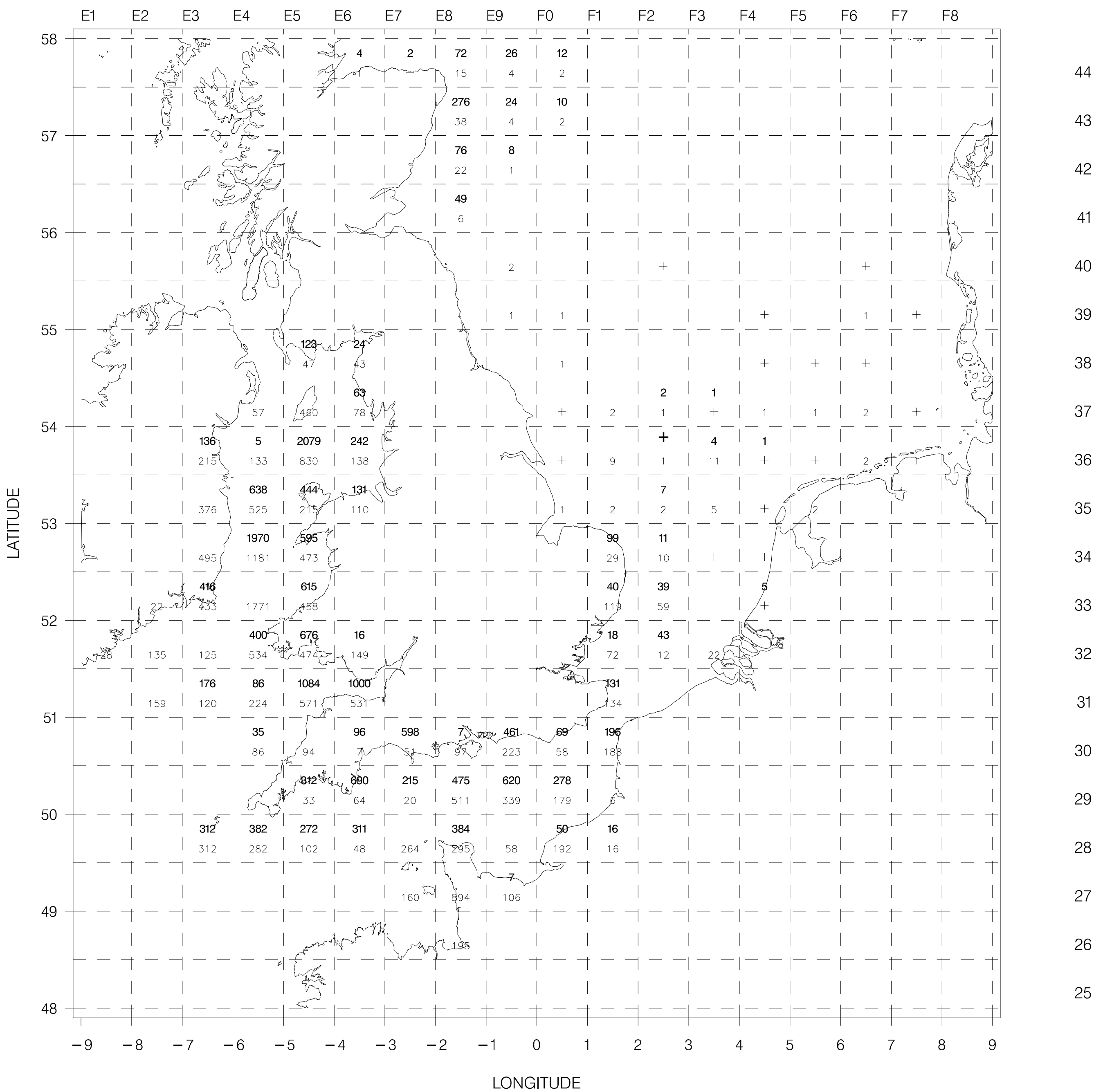


Figure 2.3.21 International Beam Trawl Surveys 1990–2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Haddock

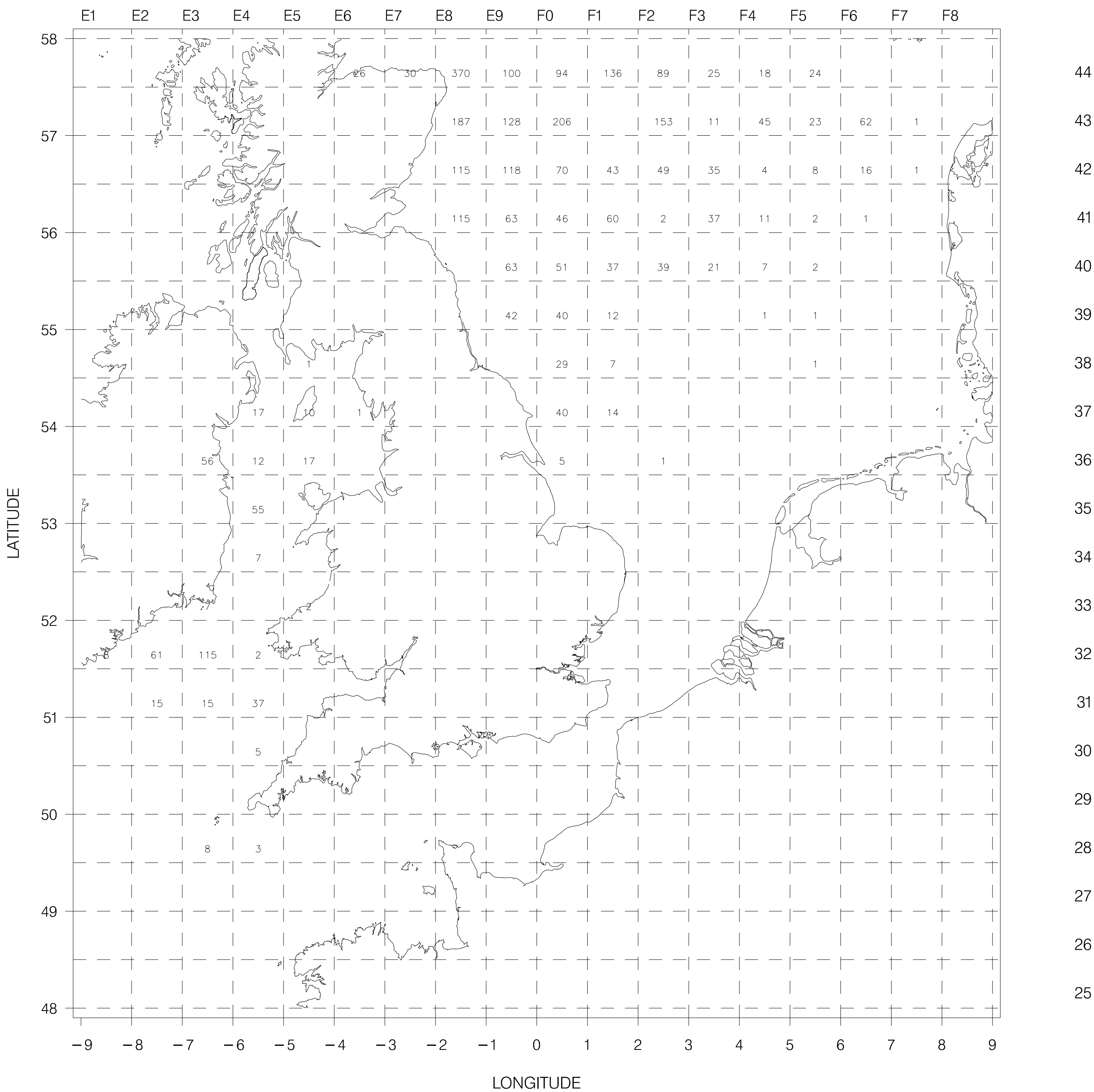


Figure 2.3.22 International Beam Trawl Surveys 1990–2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Pout whiting (Bib)

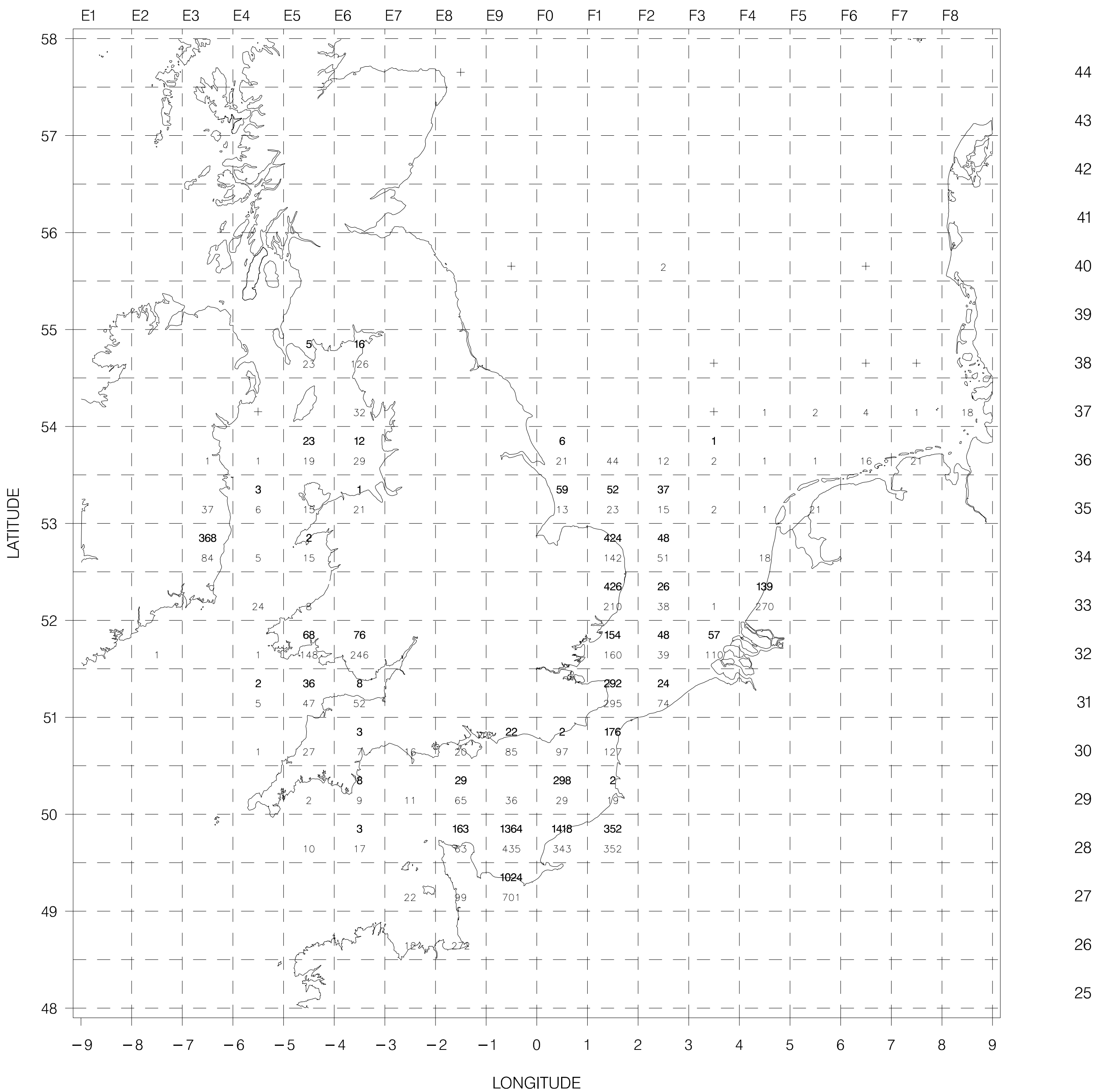


Figure 2.3.23 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Whiting

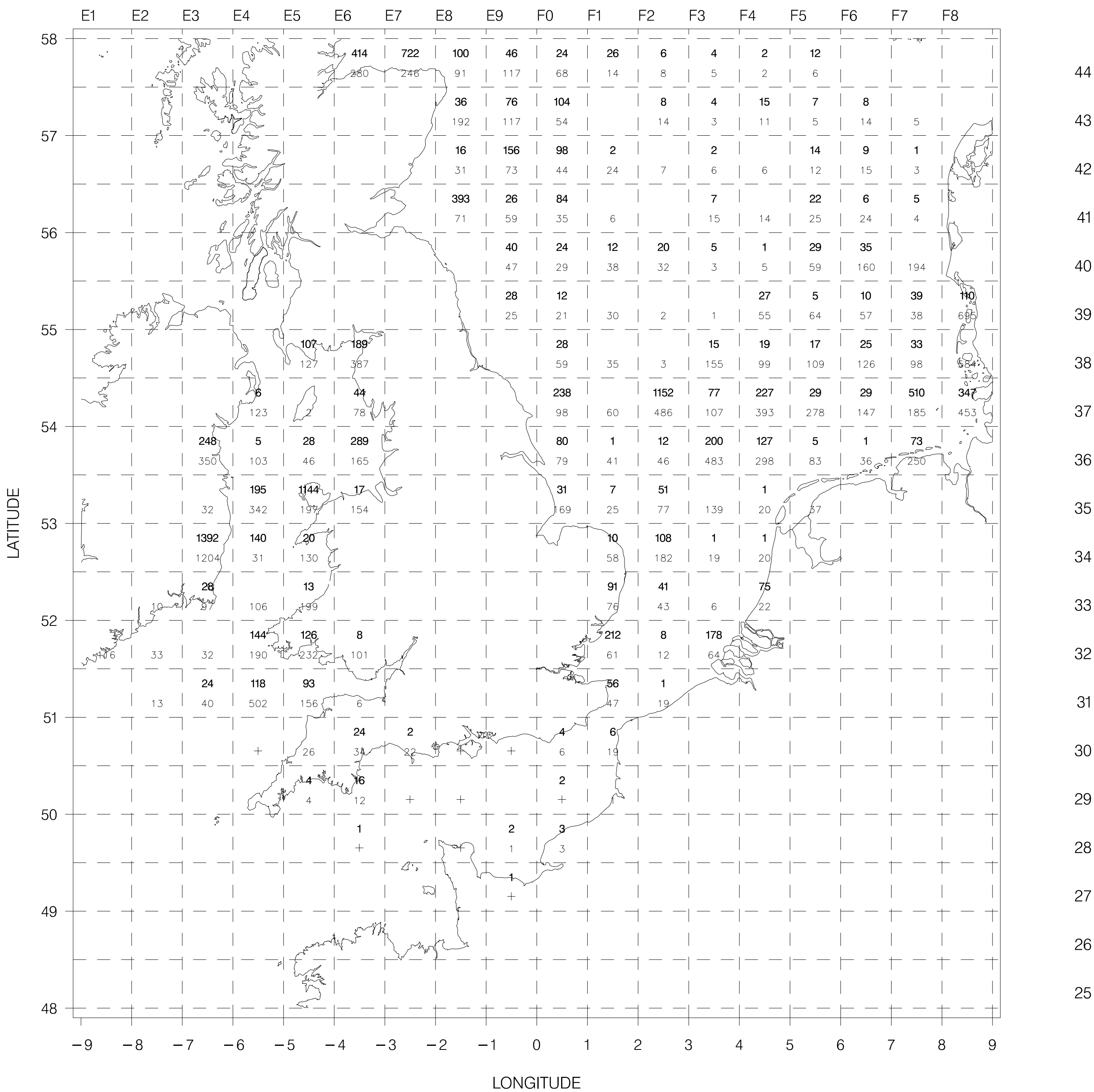


Figure 2.3.24 International Beam Trawl Surveys 1990–2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Angler fish (Monk fish)

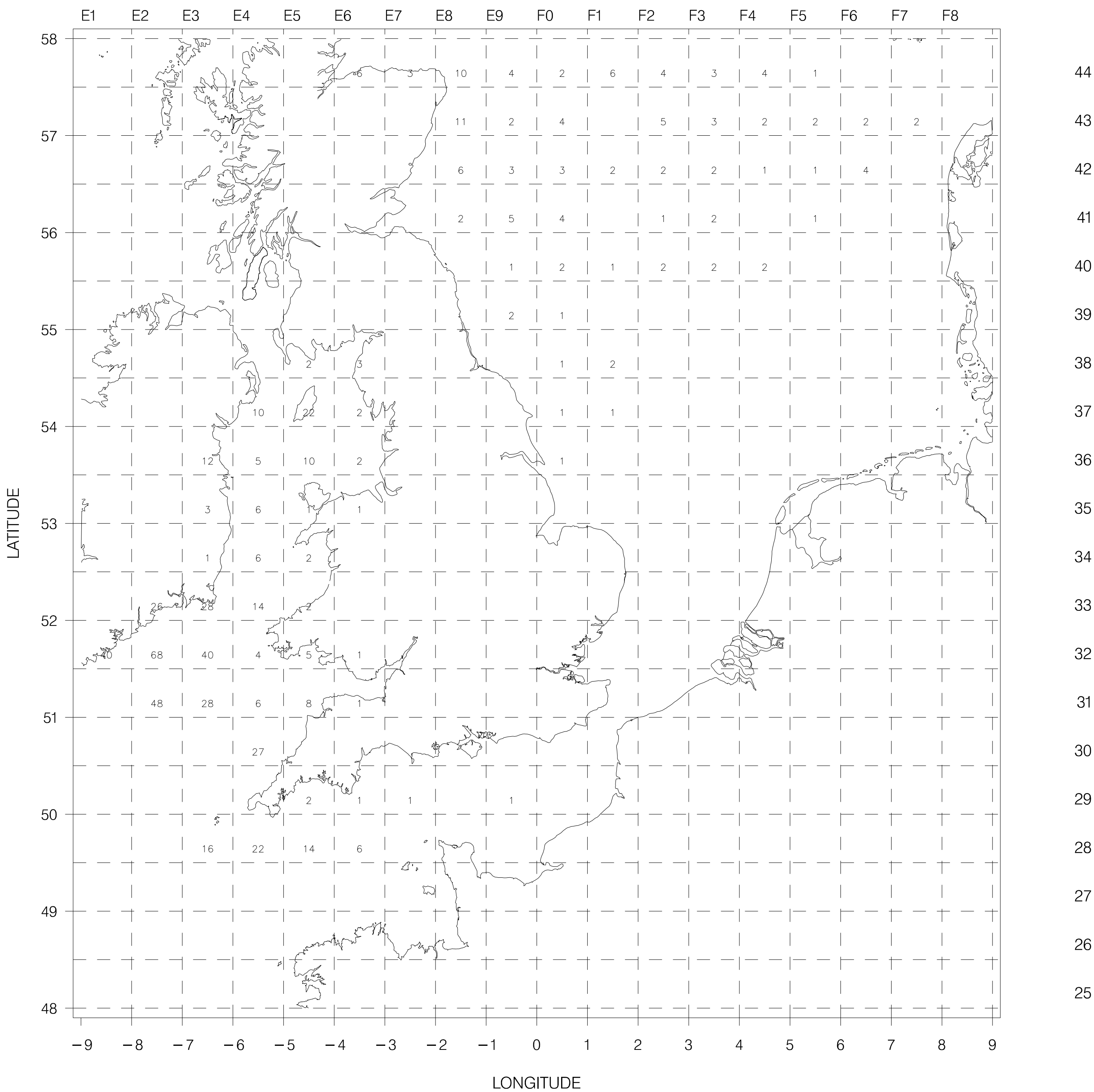


Figure 2.3.25 International Beam Trawl Surveys 1990 – 2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+' = < 0.5)

John dory

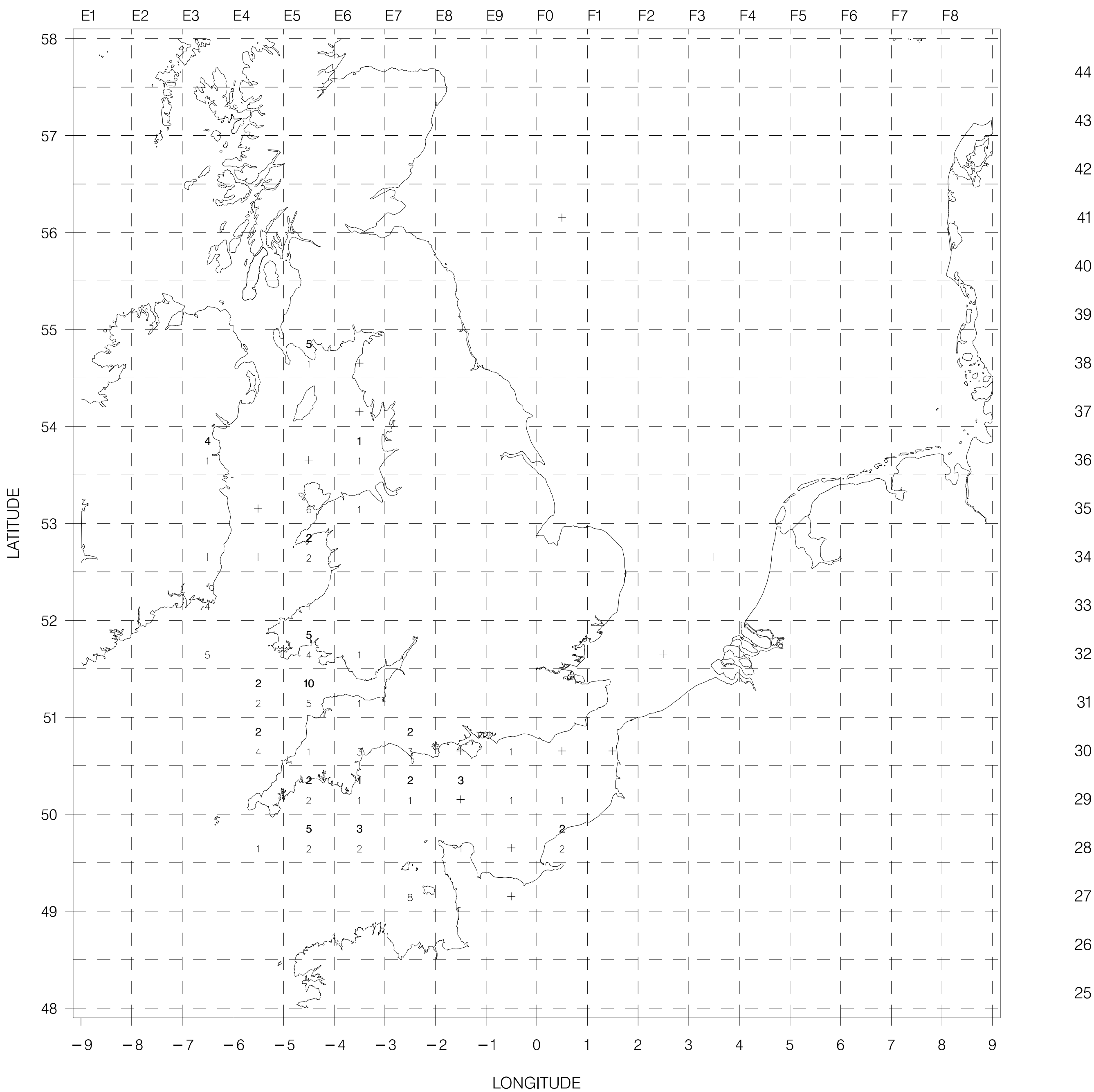
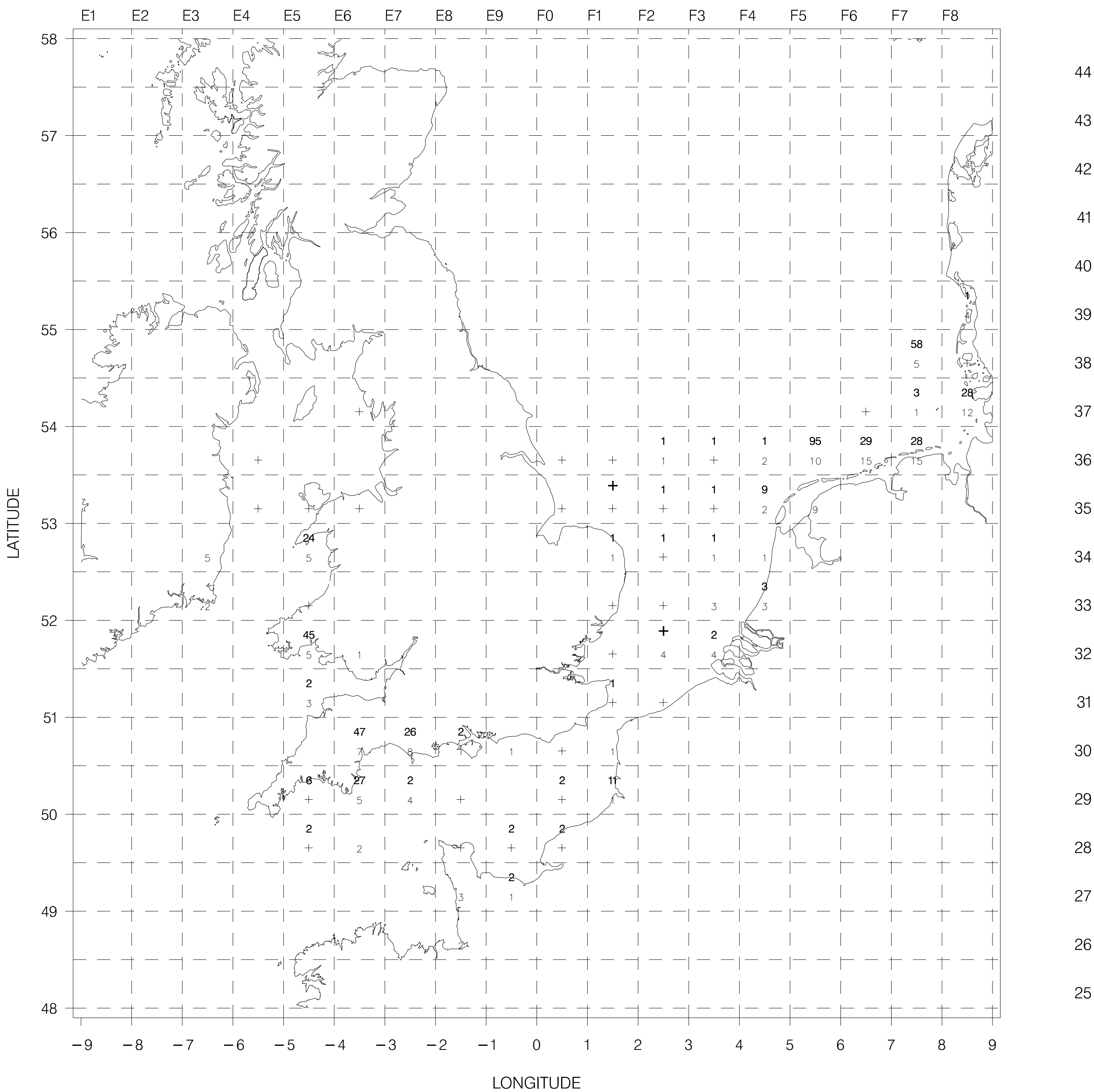


Figure 2.3.26 International Beam Trawl Surveys 1990−2003
Catches in number / 8m beam / hour / rectangle
2003 data in bold, above the survey mean ('+'= < 0.5)

Red mullet



Annex 3. Summary of the IBTS protocols for the deployment of trawls

GOV-Trawl Construction
The construction of the 36/47 GOV-trawl is shown in Figure . A set of check sheets should be used to maintain a standard rigged GOV. These should be used to check all dimensions of the GOV and to ensure that it is rigged correctly on the vessel. When a new net is delivered check sheets 1 and 2 should be filled in to ensure that the net is manufactured to the correct specification.

GOV Trawl Rigging
The rigging is given in Figure . On board the vessel when attaching the trawl to the bridles and doors, check sheet 3 should be used.

During the first quarter survey the length of the sweeps should depend on the bottom depth:

- 60m sweeps (including backstrops) are used in water depths less than 70 m,
- 110m sweeps (including backstrops) are used in deeper waters.

In the other quarters a sweep length of 60 m (including backstrops) is used throughout the survey area.
The standard groundrope with rubber discs as shown in Figure should be used throughout the survey area. Again a check sheet should be used to ensure the ground gear is to specification. The extra weights in the groundrope are 70 kg in the square, 35 kg in each quarter and 35 kg in each forward wing-end. These weights should be evenly spread over the appropriate length of groundrope and this can be achieved by wrapping chain externally around the groundrope or, preferably, by interspersing the groundrope rubber discs with steel discs of the same diameter. Approximate weight in air is given for each section of the groundrope.

It is very important to achieve good bottom contact over the whole groundrope and this should be checked regularly. A proper contact of the net could be indicated by acoustic devices, wearing on chains and presence of benthic organisms and flatfish in the catch. The contact of the net with the bottom can also be greatly influenced by changing the length of the adjustment chain between the lower leg and the bumper bobbin. The normal length of this chain is 2 metres but on rough ground it can be shortened to 1.7 metres; if the gear is fishing too light it can be lengthened to 2.2 metres.

For a proper performance of the net it is essential that the four upper bridles are of identical length, and regular checks should be made to ensure this. It is also recommended that a total check of the trawl is carried out prior to the survey.