

ADDENDUM TO

REPORT OF THE

WORKING GROUP ON THE ASSESSMENT OF MACKEREL, HORSE MACKEREL, SARDINE AND ANCHOVY

ICES Headquarters

28 September–7 October 1998

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Table 2.9.1.11 Western mackerel. Catch numbers at age.

Mackerel West (run: ICAELT16/I16)

Output Generated by ICA Version 1.4

Catch in Number

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	1.6	.0	1.3	1.0	34.2	2.0	10.3	79.5	19.5	38.3	2.0	.0	.5	.0	18.1
1	12.4	33.8	87.0	52.5	279.4	153.5	31.3	351.1	484.5	266.1	203.0	43.6	15.2	234.3	25.7
2	12.1	49.4	24.3	104.0	184.9	289.5	563.8	61.6	468.7	506.4	435.9	712.7	79.5	16.0	397.8
3	29.4	64.0	123.5	94.5	322.3	154.0	425.0	602.5	75.2	225.1	483.6	444.6	661.8	49.1	29.9
4	507.7	115.5	108.5	306.3	170.6	166.0	243.7	365.5	381.3	31.7	184.1	391.6	374.6	420.3	63.6
5	.0	582.3	191.8	192.2	288.8	51.0	258.3	217.2	282.0	174.8	24.7	130.4	238.2	242.6	331.9
6	.0	.0	567.0	143.8	118.6	140.0	71.9	233.1	145.2	158.5	136.6	20.2	92.0	158.4	193.9
7	.0	.0	.0	1246.2	279.7	64.4	151.9	86.8	158.4	99.5	108.6	91.3	15.5	58.9	119.5
8	.0	.0	.0	.0	438.8	89.4	56.7	154.2	52.4	116.6	84.5	70.9	51.5	16.2	38.3
9	.0	.0	.0	.0	.0	158.5	83.2	70.5	139.6	35.3	87.0	47.1	39.3	42.0	11.1
10	.0	.0	.0	.0	.0	.0	210.8	74.6	43.6	138.7	24.4	48.9	25.1	33.0	28.6
11	.0	.0	.0	.0	.0	.0	.0	189.1	47.9	29.4	90.3	19.1	21.4	20.4	20.2
12	.0	.0	.0	.0	.0	.0	.0	.0	115.4	176.1	147.6	126.2	44.2	80.3	60.1

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	2.5	.3	24.4	5.4	4.9	1.7	13.1	.5	3.7	7.1	8.2
1	22.9	99.0	42.8	108.6	47.1	75.0	114.7	144.5	74.1	90.8	120.6
2	148.4	127.3	306.9	202.3	202.7	150.9	202.8	215.1	335.0	158.3	161.3
3	653.6	175.4	203.3	408.1	194.9	347.3	264.2	301.1	331.0	323.3	232.7
4	51.9	505.1	163.4	205.3	362.8	261.1	387.4	261.0	268.3	263.9	353.1
5	79.3	66.5	356.5	152.1	181.8	298.3	239.9	289.7	181.8	171.4	229.5
6	237.4	77.9	45.9	247.4	125.0	152.6	247.2	176.3	190.6	91.3	128.4
7	148.8	179.2	54.0	40.6	192.3	111.8	145.6	183.8	135.4	110.2	77.7
8	83.9	111.5	105.7	45.0	49.7	135.6	95.6	103.5	106.5	49.6	60.8
9	33.0	51.6	66.7	80.0	42.0	50.3	119.1	77.5	65.4	53.6	34.7
10	18.0	19.3	31.4	31.5	67.9	35.6	37.4	56.4	39.8	23.0	24.0
11	24.7	12.3	13.6	15.9	29.2	39.8	28.2	19.6	35.7	16.2	12.4
12	60.8	52.4	34.8	27.0	52.4	67.5	65.6	56.4	36.6	29.0	22.9

x 10 ^ 6

Table 2.9.1.12 Western mackerel. Biomass estimates from egg surveys of which the 1998 estimate is preliminary.

INDICES OF SPAWNING BIOMASS

INDEX1		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1		3250.0	*****	*****	2430.0	*****	*****	2510.0	*****	*****	2150.0	*****	*****	2560.0	*****	*****
		x 10 ^ 3														

INDEX1		1992	1993	1994	1995	1996	1997	1998
1		2930.0	*****	*****	2470.0	*****	*****	2099.5
		x 10 ^ 3						

Table 2.9.1.13 Western mackerel. Catch weights at age.

Weights at age in the catches (Kg)

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	.06600	.06600	.06600	.06600	.06600	.06600	.00000	.00000	.06600	.06600	.06600	.06600	.06900	.00000	.00000
1	.13700	.13700	.13700	.13700	.13700	.13700	.13700	.13700	.13100	.13100	.13100	.17800	.13700	.15100	.16600
2	.15800	.15800	.15800	.15800	.15800	.15800	.15800	.15800	.24800	.24800	.24800	.21600	.17600	.27300	.24500
3	.24100	.24100	.24100	.24100	.24100	.24100	.24100	.24100	.28300	.28300	.28300	.27000	.29400	.34900	.33900
4	.41600	.31400	.31400	.31400	.31400	.31400	.31400	.31400	.34300	.34300	.34300	.30600	.32400	.41800	.42100
5	.00000	.43700	.33400	.33400	.33400	.33400	.33400	.33400	.37300	.37300	.37300	.38300	.34100	.41600	.47300
6	.00000	.00000	.47200	.39800	.39800	.39800	.39800	.39800	.45500	.45500	.45500	.42500	.42900	.43400	.44400
7	.00000	.00000	.00000	.48000	.41000	.41000	.41000	.41000	.49700	.49700	.49700	.43000	.53800	.52000	.45600
8	.00000	.00000	.00000	.00000	.50800	.50300	.50300	.50300	.50800	.50800	.50800	.49100	.46800	.54400	.54100
9	.00000	.00000	.00000	.00000	.00000	.51100	.51100	.51100	.53900	.53900	.53900	.54200	.56100	.56200	.59300
10	.00000	.00000	.00000	.00000	.00000	.51100	.51100	.51100	.57300	.57300	.57300	.60800	.61900	.62700	.54600
11	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.51100	.57300	.57300	.57300	.60800	.63600	.66600	.69200
12	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.57300	.57300	.57300	.60800	.63600	.70400	.69200

Weights at age in the catches (Kg)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	.04900	.07100	.06100	.06100	.06000	.05500	.05300	.05400	.07300	.05500	.07600
1	.17600	.15700	.15400	.16700	.15500	.16400	.13600	.13500	.14100	.15200	.15000
2	.22200	.26000	.23800	.23400	.25500	.23800	.24100	.25700	.23400	.22900	.23500
3	.31800	.32600	.32100	.33700	.33200	.33400	.31700	.34100	.33400	.31400	.29500
4	.39900	.39000	.37700	.38000	.39700	.39800	.37700	.39100	.39000	.38000	.36100
5	.47800	.46200	.43400	.42500	.42600	.46200	.43700	.45100	.45300	.42600	.41800
6	.51300	.53700	.45500	.46900	.47100	.49700	.48600	.51700	.50300	.48600	.45500
7	.49200	.56700	.54600	.53000	.50800	.53400	.53000	.54600	.54200	.52200	.48400
8	.49600	.56300	.59600	.55800	.55600	.55700	.55000	.59300	.58200	.55800	.52900
9	.57700	.56800	.57900	.61200	.61200	.59900	.58500	.58500	.59800	.58300	.55900
10	.63500	.61700	.58200	.61100	.63500	.65400	.59900	.62900	.60900	.60200	.58300
11	.63400	.62700	.64900	.59200	.65100	.66700	.65100	.68300	.63500	.61100	.59800
12	.72100	.70500	.74200	.71700	.70800	.67000	.68000	.71400	.67500	.67500	.64000

Table 2.9.1.14 Western mackerel. Stock weights at age.

Weights at age in the stock (Kg)

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
1	.11300	.11300	.11300	.11300	.11300	.11300	.09500	.09500	.09500	.07000	.07000	.07000	.07000	.07000	.07000
2	.13100	.13100	.13100	.13100	.13100	.13100	.15000	.15000	.15000	.17200	.10800	.15600	.18700	.15000	.16400
3	.20100	.20100	.20100	.20100	.20100	.20100	.21500	.21500	.21500	.24100	.20200	.22000	.24600	.29200	.26100
4	.38000	.25100	.25100	.25100	.25100	.25100	.27500	.27500	.27500	.30000	.26000	.26100	.28300	.30000	.29000
5	.00000	.41000	.26400	.26400	.26400	.26400	.32000	.32000	.32000	.30000	.37900	.32200	.30500	.32800	.34500
6	.00000	.00000	.44000	.31600	.31600	.31600	.35500	.35500	.35500	.35900	.32900	.36000	.37900	.36600	.33700
7	.00000	.00000	.00000	.47000	.38000	.38000	.38000	.38000	.38000	.40100	.38800	.38400	.42900	.42100	.39500
8	.00000	.00000	.00000	.00000	.49000	.41200	.40000	.40000	.40000	.41200	.41700	.42000	.42100	.44000	.46700
9	.00000	.00000	.00000	.00000	.00000	.51100	.42000	.42000	.42000	.42700	.42500	.49700	.46500	.44800	.44100
10	.00000	.00000	.00000	.00000	.00000	.51100	.48500	.48500	.48500	.41300	.46000	.45300	.51500	.55400	.45100
11	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.48500	.48500	.50900	.51300	.55000	.49700	.57900	.47200
12	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.48500	.50900	.51300	.55000	.54900	.59900	.56800

Weights at age in the stock (Kg)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
1	.07000	.07000	.07000	.07000	.07000	.07000	.07000	.07000	.07000	.07000	.07000
2	.13900	.14600	.17600	.12800	.14900	.21600	.19300	.17500	.15100	.12200	.18700
3	.23300	.23300	.23800	.21300	.22700	.25700	.26400	.23000	.25900	.24400	.21600
4	.26800	.30200	.29900	.28000	.30700	.30900	.31100	.28900	.31600	.31400	.29000
5	.36300	.32700	.34200	.33100	.35600	.35900	.35700	.35300	.39200	.35600	.35700
6	.37100	.43400	.36300	.36500	.40800	.40000	.41600	.40700	.44500	.44300	.39800
7	.39200	.45500	.41900	.40500	.43100	.42400	.45800	.46800	.49300	.46400	.44600
8	.40200	.43600	.46800	.39300	.50600	.46400	.46400	.46400	.50600	.50500	.48000
9	.45900	.46000	.44100	.42000	.54700	.48900	.48000	.47200	.54600	.57600	.52000
10	.48300	.52800	.45100	.51400	.57400	.52300	.51200	.55000	.50200	.58000	.53900
11	.44200	.60600	.49600	.51400	.57400	.55600	.59700	.61200	.62700	.62400	.53000
12	.54700	.64500	.58500	.51400	.57400	.58200	.56100	.56800	.63300	.63800	.57900

Table 2.9.1.15 Western mackerel. Natural mortality.

Natural Mortality (per year)

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
1	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
2	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
3	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
4	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
5	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
6	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
7	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
8	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
9	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
10	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
11	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
12	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000

Natural Mortality (per year)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
1	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
2	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
3	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
4	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
5	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
6	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
7	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
8	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
9	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
10	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
11	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000
12	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000	.15000

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Table 2.9.1.16 Western mackerel. Proportion of fish spawning.

Proportion of fish spawning															
AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
1	.0800	.0800	.0800	.0800	.0800	.0800	.0800	.0800	.0800	.0800	.0800	.0800	.0800	.0800	.0800
2	.6000	.6000	.6000	.6000	.6000	.6000	.6000	.6000	.6000	.6000	.6000	.6000	.6000	.6000	.6000
3	.9000	.9000	.9000	.9000	.9000	.9000	.9000	.9000	.9000	.9000	.9000	.9000	.9000	.9000	.9000
4	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700
5	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700
6	.9900	.9900	.9900	.9900	.9900	.9900	.9900	.9900	.9900	.9900	.9900	.9900	.9900	.9900	.9900
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
12	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Proportion of fish spawning											
AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
1	.0800	.0800	.0800	.0800	.0800	.0800	.0800	.0800	.0800	.0800	.0800
2	.6000	.6000	.6000	.6000	.6000	.6000	.6000	.6000	.6000	.6000	.6000
3	.9000	.9000	.9000	.9000	.9000	.9000	.9000	.9000	.9000	.9000	.9000
4	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700
5	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700	.9700
6	.9900	.9900	.9900	.9900	.9900	.9900	.9900	.9900	.9900	.9900	.9900
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
12	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 2.9.1.17a Western mackerel. Diagnostic output.

Predicted Catch in Number												
AGE	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	1.63	3.40	2.36	3.88	2.55	3.28	4.48	7.56	4.47	5.35	6.73	8.31
1	27.34	34.32	62.20	54.84	77.93	53.84	75.01	111.54	144.52	82.91	79.12	120.92
2	263.49	158.72	172.48	217.90	144.68	215.91	160.15	240.60	273.12	343.52	158.38	184.84
3	60.46	336.19	173.97	180.89	321.59	223.40	355.02	279.53	317.24	349.75	357.24	203.69
4	74.71	70.33	334.95	183.32	189.52	351.30	258.05	429.33	252.22	278.04	250.92	320.91
5	212.35	99.19	79.64	338.08	163.39	175.71	342.68	260.97	320.97	183.17	166.17	189.52
6	147.02	247.08	97.74	55.72	254.32	127.76	144.34	290.93	162.77	194.40	91.34	105.32
7	98.93	163.11	230.40	57.80	46.69	221.26	116.51	135.48	200.61	109.03	107.62	64.31
8	41.24	83.05	114.35	104.39	43.28	36.28	179.90	97.17	82.56	118.73	53.39	67.37
9	15.71	27.14	45.78	61.98	90.88	39.01	34.06	171.79	67.72	55.92	67.03	38.61
10	29.13	14.94	21.77	30.98	39.48	59.93	26.80	23.79	86.65	33.17	22.74	35.24
11	20.15	24.16	10.44	13.50	22.02	29.09	46.10	21.04	13.58	48.06	15.26	13.44

x 10 ^ 6

Weighting factors for the catches in number												
AGE	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	.0100	.0100	.0100	.0100	.0100	.0100	.0100	.0100	.0100	.0100	.0100	.0100
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
11	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 2.9.1.17b Western mackerel. Diagnostic output.

Predicted SSB Index Values

INDEX1															
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	2629.1	*****	*****	2119.4	*****	*****	2360.1	*****	*****	2367.0	*****	*****	2533.3	*****	*****
x 10 ^ 3															
INDEX1															
	1992	1993	1994	1995	1996	1997	1998								
1	2691.8	*****	*****	2081.6	*****	*****	2079.2								
x 10 ^ 3															

IFAP run code: I16

 No of years for separable analysis : 12
 Age range in the analysis : 0 . . . 12
 Year range in the analysis : 1972 . . . 1997
 Number of indices of SSB : 1
 Number of age-structured indices : 0

Parameters to estimate : 55
 Number of observations : 152

Two selection vectors to be fitted.
 Selection assumed constant up to and including : 1988
 Abrupt change in selection specified.

Table 2.9.1.17c Western mackerel. Diagnostic output.

PARAMETER ESTIMATES

Parm. No.	Maximum Likelihood Estimate	CV (%)	Lower 95% CL	Upper 95% CL	-s.e.	+s.e.	Mean of Param. Distrib.
-----------	-----------------------------	--------	--------------	--------------	-------	-------	-------------------------

Separable model : F by year

1	1986	.1332	15	.0975	.1820	.1136	.1562	.1349
2	1987	.1670	15	.1245	.2242	.1438	.1941	.1689
3	1988	.1823	14	.1377	.2413	.1580	.2103	.1841
4	1989	.1779	11	.1412	.2242	.1581	.2002	.1792
5	1990	.1871	11	.1489	.2352	.1665	.2103	.1884
6	1991	.2075	11	.1655	.2602	.1849	.2329	.2089
7	1992	.2492	11	.1986	.3128	.2219	.2798	.2509
8	1993	.3280	12	.2592	.4150	.2909	.3698	.3303
9	1994	.3313	13	.2563	.4282	.2906	.3776	.3341
10	1995	.3245	15	.2412	.4366	.2789	.3775	.3282
11	1996	.2522	17	.1776	.3580	.2109	.3016	.2562
12	1997	.2380	20	.1589	.3566	.1937	.2925	.2431

Separable Model: Selection (S1) by age 1986 1988

13	0	.0042	142	.0003	.0700	.0010	.0177	.0118
14	1	.0834	20	.0562	.1239	.0682	.1021	.0852
15	2	.4687	19	.3176	.6916	.3843	.5716	.4780
16	3	.6005	19	.4073	.8854	.4926	.7321	.6124
17	4	.7144	19	.4848	1.0527	.5862	.8707	.7285
	5	1.0000		Fixed : Reference Age				
18	6	1.2792	19	.8708	1.8794	1.0513	1.5566	1.3041
19	7	1.6361	19	1.1166	2.3972	1.3463	1.9881	1.6674
20	8	1.6218	19	1.1058	2.3786	1.3340	1.9718	1.6531
21	9	1.2201	19	.8344	1.7841	1.0051	1.4811	1.2433
22	10	1.2970	19	.8916	1.8869	1.0713	1.5704	1.3210
	11	1.2000		Fixed : Last true age				

Table 2.9.1.17d Western mackerel. Diagnostic output.

Separable Model: Selection (S2) by age from 1989 to 1997

23	0	.0053	87	.0010	.0294	.0022	.0127	.0078
24	1	.1188	13	.0913	.1546	.1039	.1359	.1199
25	2	.3617	12	.2823	.4635	.3188	.4105	.3646
26	3	.6463	12	.5096	.8197	.5726	.7296	.6511
27	4	.8577	11	.6811	1.0800	.7625	.9647	.8636
	5	1.0000		Fixed : Reference Age				
28	6	.9969	11	.8018	1.2397	.8921	1.1142	1.0031
29	7	1.1187	10	.9064	1.3807	1.0048	1.2455	1.1252
30	8	1.1367	10	.9283	1.3919	1.0251	1.2605	1.1428
31	9	1.3730	9	1.1301	1.6682	1.2432	1.5164	1.3798
32	10	1.2249	10	1.0015	1.4982	1.1053	1.3574	1.2314
	11	1.2000		Fixed : Last true age				

Separable model: Populations in year 1997

33	0	.7102E+07	258	.4495E+05	.1122E+10	.5366E+06	.9400E+08	.1996E+09
34	1	4667976	31	2532372	8604578	3416787	6377336	4900833
35	2	2410083	25	1476051	3935160	1876696	3095066	2486679
36	3	1535255	21	1001513	2353448	1234598	1909131	1572156
37	4	1866656	19	1272312	2738640	1535078	2269856	1902696
38	5	960630	18	662232	1393485	794575	1161389	978087
39	6	535306	18	368949	776673	442726	647246	545044
40	7	295265	18	203669	428053	244299	356862	300613
41	8	304992	19	209910	443144	252060	369039	310584
42	9	148535	19	101405	217571	122251	180471	151379
43	10	149504	20	99668	224259	121565	183865	152738
44	11	58028	21	37703	89309	46569	72306	59449

Table 2.9.1.17e Western mackerel. Diagnostic output.

Separable model: Populations at age

45	1986	146605	28	83618	257038	110087	195237	152746
46	1987	142853	22	91156	223868	113592	179652	146655
47	1988	57080	20	38448	84741	46658	69830	58252
48	1989	75419	18	52480	108386	62680	90748	76721
49	1990	117588	16	84777	163098	99511	138949	119238
50	1991	141652	15	103885	193149	120925	165933	143436
51	1992	191326	14	142752	256429	164771	222161	193474
52	1993	69312	14	52014	92363	59868	80247	70060
53	1994	44367	15	32815	59987	38039	51748	44896
54	1995	159674	17	114166	223321	134555	189482	162030
55	1996	62681	19	42767	91867	51574	76180	63885

SSB Index catchabilities

INDEX1

Absolute estimator. No fitted catchability.

RESIDUALS ABOUT THE MODEL FIT

 Separable Model Residuals

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	2.407	-.311	-2.096	1.840	.743	.398	-.955	.552	-2.255	-.361	.053	-.015
1	-.062	-.404	.465	-.247	.332	-.133	-.001	.028	.000	-.112	.138	-.002
2	.412	-.067	-.304	.342	.335	-.063	-.059	-.171	-.239	-.025	.000	-.136
3	-.704	.665	.008	.117	.238	-.137	-.022	-.056	-.052	-.055	-.100	.133
4	-.161	-.303	.411	-.115	.080	.032	.012	-.103	.034	-.036	.050	.096
5	.447	-.224	-.180	.053	-.072	.034	-.139	-.084	-.102	-.008	.031	.191
6	.277	-.040	-.227	-.193	-.028	-.022	.056	-.163	.080	-.020	-.001	.198
7	.189	-.092	-.251	-.068	-.139	-.140	-.041	.072	-.087	.217	.023	.190
8	-.074	.010	-.025	.013	.038	.316	-.283	-.016	.226	-.109	-.073	-.103
9	-.348	.195	.121	.073	-.128	.074	.391	-.366	.134	.157	-.223	-.106
10	-.018	.185	-.122	.014	-.225	.125	.283	.452	-.429	.183	.011	-.385
11	.002	.021	.165	.005	-.326	.005	-.148	.291	.367	-.296	.058	-.084

Table 2.9.1.17f Western mackerel. Diagnostic output.

SPAWNING BIOMASS INDEX RESIDUALS

INDEX1		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1		.2120	*****	*****	.1368	*****	*****	.0616	*****	*****	-.0962	*****	*****	.0105	*****	*****

INDEX1		1992	1993	1994	1995	1996	1997	1998
1		.0848	*****	*****	.1711	*****	*****	.0097

PARAMETERS OF THE DISTRIBUTION OF $\ln(\text{CATCHES AT AGE})$

Separable model fitted from 1986 to 1997

Variance	.0649
Skewness test stat.	.8900
Kurtosis test statistic	2.7396
Partial chi-square	.5207
Significance in fit	.0000
Degrees of freedom	99

Table 2.9.1.17g Western mackerel. Diagnostic output.

PARAMETERS OF DISTRIBUTIONS OF THE SSB INDICES

DISTRIBUTION STATISTICS FOR INDEX1

Index used as absolute measure of abundance

Variance	.0142
Skewness test stat.	1.4591
Kurtosis test statistic	-.5177
Partial chi-square	.0077
Significance in fit	.0000
Number of observations	8
Degrees of freedom	8
Weight in the analysis	1.0000

ANALYSIS OF VARIANCE

Unweighted Statistics

Variance	SSQ	Data	Parameters	d.f.	Variance
Total for model	26.4925	152	55	97	.2731
Catches at age	26.3792	144	55	89	.2964
SSB Indices					
INDEX1	.1133	8	0	8	.0142

Weighted Statistics

Variance	SSQ	Data	Parameters	d.f.	Variance
Total for model	5.8868	152	55	97	.0607
Catches at age	5.7734	144	55	89	.0649
SSB Indices					
INDEX1	.1133	8	0	8	.0142

Table 2.9.1.18 Western mackerel. Fishing mortality at age.

Fishing Mortality (per year)															
AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	.00085	.00000	.00041	.00022	.00727	.00222	.00332	.01564	.00382	.00579	.00115	.00000	.00008	.00000	.00057
1	.00252	.02112	.02484	.01921	.07346	.03876	.04132	.14101	.11818	.06263	.03641	.02966	.01402	.04529	.01111
2	.00681	.01173	.01799	.03554	.08262	.09622	.18432	.10135	.26722	.16516	.13114	.16370	.06587	.01737	.06243
3	.01351	.04285	.03486	.08552	.13939	.08701	.18882	.28897	.16390	.18765	.22203	.18147	.21291	.05010	.07998
4	.07571	.06404	.09012	.10771	.20699	.09382	.18266	.23261	.28286	.09135	.21824	.26627	.21653	.19251	.09516
5	.00000	.11066	.13637	.21541	.13301	.08338	.19553	.23243	.26743	.19155	.09057	.22400	.24293	.20083	.13319
6	.00000	.14156	.14194	.13613	.18921	.08357	.15351	.25652	.22720	.22355	.21275	.09439	.23041	.23884	.17039
7	.00000	.18105	.22311	.49064	.39822	.14097	.11635	.26448	.26247	.22701	.22242	.20349	.09264	.21415	.21791
8	.00000	.17947	.22117	.34936	.30072	.20101	.16820	.15718	.23878	.29650	.28936	.20946	.16004	.12502	.21602
9	.00000	.13502	.16639	.26283	.16229	.15957	.27511	.30673	.19716	.23711	.35522	.24518	.16256	.17973	.16251
10	.00000	.14353	.17688	.27940	.17252	.10815	.31038	.39956	.29835	.28939	.24191	.32658	.18909	.18908	.17276
11	.00000	.13279	.16365	.25850	.15962	.10006	.23464	.47568	.45596	.31785	.29283	.28604	.21883	.21856	.15983
12	.00000	.13279	.16365	.25850	.15962	.10006	.23464	.47568	.45596	.31785	.29283	.28604	.21883	.21856	.15983

Fishing Mortality (per year)											
AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
0	.00071	.00077	.00094	.00099	.00110	.00132	.00174	.00175	.00172	.00134	.00126
1	.01394	.01521	.02114	.02223	.02466	.02961	.03897	.03936	.03855	.02996	.02828
2	.07830	.08543	.06436	.06769	.07507	.09015	.11864	.11983	.11738	.09122	.08611
3	.10031	.10945	.11500	.12094	.13413	.16108	.21199	.21411	.20974	.16299	.15385
4	.11934	.13022	.15260	.16048	.17799	.21375	.28130	.28412	.27831	.21628	.20415
5	.16705	.18227	.17793	.18711	.20752	.24922	.32798	.33127	.32449	.25217	.23803
6	.21370	.23317	.17738	.18654	.20689	.24846	.32698	.33026	.32350	.25140	.23731
7	.27330	.29821	.19905	.20933	.23216	.27880	.36691	.37060	.36302	.28210	.26629
8	.27092	.29561	.20225	.21269	.23589	.28328	.37281	.37655	.36885	.28664	.27057
9	.20382	.22239	.24430	.25692	.28494	.34219	.45033	.45485	.44555	.34624	.32683
10	.21667	.23641	.21794	.22920	.25419	.30527	.40174	.40577	.39747	.30888	.29156
11	.20046	.21872	.21351	.22454	.24903	.29906	.39357	.39752	.38939	.30260	.28564
12	.20046	.21872	.21351	.22454	.24903	.29906	.39357	.39752	.38939	.30260	.28564

Table 2.9.1.19 Western mackerel. Population numbers at age.

Population Abundance (1 January)															
AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	2024.5	4436.1	3453.1	4932.4	5086.4	969.1	3345.4	5516.1	5500.6	7142.1	1868.2	1369.3	6617.5	3094.8	3103.3
1	5313.6	1741.0	3818.2	2970.9	4244.4	4346.2	832.3	2869.8	4674.0	4716.3	6111.7	1606.1	1178.6	5695.3	2663.7
2	1921.1	4562.0	1467.2	3205.8	2508.5	3394.5	3598.6	687.4	2145.2	3574.6	3812.9	5072.3	1342.0	1000.3	4684.9
3	2359.4	1642.3	3880.8	1240.3	2662.9	1987.8	2653.6	2576.0	534.6	1413.4	2608.3	2878.5	3706.6	1081.4	846.1
4	7491.2	2003.5	1354.2	3225.8	980.0	1993.7	1568.4	1891.0	1660.7	390.6	1008.4	1798.0	2066.4	2578.5	885.3
5	.0	5977.6	1617.4	1065.2	2492.9	685.8	1562.3	1124.5	1289.8	1077.2	306.8	697.8	1185.8	1432.3	1830.7
6	.0	.0	4606.0	1214.7	739.1	1878.4	543.1	1105.9	767.2	849.7	765.5	241.2	480.0	800.5	1008.5
7	.0	.0	.0	3439.8	912.4	526.5	1487.2	400.9	736.5	526.1	584.8	532.6	188.9	328.2	542.6
8	.0	.0	.0	.0	1812.6	527.4	393.6	1139.4	264.9	487.6	360.9	403.0	374.0	148.2	228.0
9	.0	.0	.0	.0	.0	1155.0	371.2	286.3	838.1	179.5	312.0	232.6	281.3	274.3	112.6
10	.0	.0	.0	.0	.0	.0	847.5	242.7	181.3	592.3	121.9	188.2	156.6	205.8	197.3
11	.0	.0	.0	.0	.0	.0	.0	534.8	140.1	115.8	381.7	82.4	116.9	111.6	146.6
12	.0	.0	.0	.0	.0	.0	.0	.0	337.5	693.7	623.9	544.4	241.7	439.3	437.3

Population Abundance (1 January)												
AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
0	5158.6	3282.0	4437.2	2767.4	3218.9	3654.5	4690.9	2746.2	3358.0	5430.7	7102.0	3441.4
1	2669.6	4436.9	2822.6	3815.6	2379.6	2767.5	3141.3	4030.5	2359.6	2885.3	4668.0	6105.0
2	2267.4	2265.9	3761.2	2378.7	3211.9	1998.3	2312.5	2600.4	3335.2	1954.1	2410.1	3905.7
3	3788.3	1804.6	1790.6	3035.5	1913.3	2564.6	1571.6	1767.7	1985.5	2552.7	1535.3	1903.2
4	672.3	2949.4	1392.2	1373.8	2315.1	1440.1	1878.9	1094.3	1228.2	1385.6	1866.7	1133.0
5	692.8	513.5	2228.7	1028.7	1007.1	1667.7	1001.0	1220.7	708.9	800.3	960.6	1310.0
6	1379.2	504.6	368.4	1605.6	734.3	704.4	1118.8	620.6	754.4	441.1	535.3	651.7
7	732.0	958.7	344.0	265.5	1146.7	513.9	472.9	694.4	383.9	469.8	295.3	363.4
8	375.6	479.4	612.4	242.6	185.4	782.5	334.7	282.0	412.6	229.9	305.0	194.7
9	158.1	246.5	307.0	430.6	168.8	126.0	507.4	198.4	166.6	245.6	148.5	200.3
10	82.4	111.0	169.9	207.0	286.6	109.3	77.0	278.4	108.4	91.8	149.5	92.2
11	142.9	57.1	75.4	117.6	141.7	191.3	69.3	44.4	159.7	62.7	58.0	96.1
12	359.4	286.6	194.4	144.0	255.1	280.2	216.0	184.2	121.6	119.0	98.8	101.4

x 10 ^ 6

Table 2.9.1.20 Western mackerel. Stock summary.

STOCK SUMMARY

Year	Recruits Age 0 thousands	Total Biomass tonnes	Spawning Biomass tonnes	Landings tonnes	Yield /SSB ratio	Mean F Ages 4- 8	SoP (%)
1972	2024470	4172999	3109688	170775	.0549	.0151	76
1973	4436130	4078151	3215522	219445	.0682	.1354	68
1974	3453120	4197256	3246134	298054	.0918	.1625	72
1975	4932390	4096393	2997521	491380	.1639	.2599	56
1976	5086380	3716057	2642713	507178	.1919	.2456	74
1977	969140	3617950	2629147	325974	.1240	.1206	85
1978	3345350	3602928	2815282	503913	.1790	.1632	80
1979	5516050	3307488	2485005	605744	.2438	.2286	78
1980	5500590	3079908	2119375	604761	.2853	.2557	75
1981	7142050	3176143	2216040	661762	.2986	.2060	94
1982	1868210	3078714	2108887	623819	.2958	.2067	89
1983	1369280	3237102	2360146	614287	.2603	.1995	90
1984	6617540	3014430	2361555	550929	.2333	.1885	97
1985	3094810	3168791	2342505	561292	.2396	.1943	100
1986	3103340	3180794	2367033	537615	.2271	.1665	100
1987	5158590	3138066	2408048	615380	.2556	.2089	97
1988	3281980	3376198	2522814	628000	.2489	.2279	100
1989	4437240	3391764	2533322	567400	.2240	.1818	99
1990	2767430	3153863	2371228	605937	.2555	.1912	100
1991	3218870	3520957	2703217	646169	.2390	.2121	98
1992	3654540	3579095	2691780	742305	.2758	.2547	99
1993	4690860	3305619	2380003	805039	.3383	.3352	100
1994	2746220	2977881	2063211	797688	.3866	.3386	100
1995	3357980	2905223	2081618	728637	.3500	.3316	99
1996	5430660	2622412	1941234	529464	.2727	.2577	100
1997	7101970	2730259	1896375	528835	.2789	.2433	99

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