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Trends in reported catch, effort and nominal catch rates in the Japanese longline fishery for SBT – 2006 update.

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TABLE OF CONTENTS

1 Abstract 1
2 Introduction 2
3 Data 3
4 Catch trends 5
5 Seasonal and Spatial distribution of effort 7
6 Trends in nominal catch rates 18
6.1 Catch rates by cohorts 26
7 Literature cited 31

List of Figures

Figure 3-1 Traditional SBT statistical areas used for Japanese longline data. 4
Figure 4-1 Estimates of the annual catch of SBT in metric tonnes by country. 6
Figure 5-1 The geographic location of the five-degree squares in which fishing effort has occurred within statistical areas 4–9 during the second and third quarters of the year. 8
Figure 5-2 The frequency distribution of the number of years that a five degree square has been fished between 1969 and 2005 during the second and third quarters of the year. The x-axis values are the upper limit for each frequency bin. 9
Figure 5-3 Distribution of fishing effort in the years 1998-2001, statistical areas 4-9, months 4-9. The grey shaded areas indicate the squares that have been fished for more than 30 years. 10
Figure 5-4 Distribution of fishing effort in the years 2002-2005, statistical areas 4-9, months 4-9. The grey shaded areas indicate the squares that have been fished for more than 30 years. 11
Figure 5-5 Fishing effort in Statistical Areas 4-7, 8 and 9, months 4-9. 12
Figure 5-6 Monthly fishing effort in Statistical Areas 4-7 (horizontal dash fill), 8 (solid black) and 9 (vertical line fill). 13
Figure 6-1 Nominal CPUE vs. Year for Japanese longline, Australian Joint Venture and New Zealand Joint Venture in Statistical Areas 4-9, ages 3,4,5,6,7 and 3-7. All indicies have been standardized by their means. 19
Figure 6-2 Nominal CPUE vs. Year for Japanese longline, Australian Joint Venture and New Zealand Joint Venture in Statistical Areas 4-9, ages 8,9,10,11,12+ and 8+. All indices have been standardized by their means. 20
Figure 6-3 Comparison of age-specific nominal catch rates (Number per 1000 hooks) in recent years for different fishing regions. These indices have not been standardised by their means. 21
Figure 6-4 Comparison of age-specific nominal catch rates (Number per 1000 hooks) in recent years for different fishing regions. These indices have not been standardized by their means. 22
Figure 6-5 Comparison of recent nominal age-specific catch rates (Number per 1000 hooks) for Statistical Areas 4-7. These indices have not been standardized by their means. 23
Figure 6-6 Comparison of recent nominal age-specific catch rates (Number per 1000 hooks) for Statistical Area 8. These indices have not been standardized by their means. 24
Figure 6-7 Comparison of recent nominal age-specific catch rates (Number per 1000 hooks) for Statistical Area 9. These indices have not been standardized by their means. 25
Figure 6-8 Nominal CPUE in Statistical Areas 4-9, months 4-9 for cohorts born between (a) 1970 and 1974, and (b) 1975 and 1979. The cohort born in 1980 is also shown for reference. These indices have not been standardized by their means. 27
Figure 6-9 Nominal CPUE in Statistical Areas 4-9, months 4-9 for cohorts born between (a) 1980 and 1984, and (b) 1985 and 1989. The cohort born in 1980 is also shown for reference. These indices have not been standardized by their means. 28
Figure 6-10 Nominal CPUE in Statistical Areas 4-9, months 4-9 for cohorts born between (a) 1990 and 1994, and (b) 1995 and 1999. The cohort born in 1980 is also shown for reference. These indices have not been standardized by their means. 29
Figure 6-11 Nominal CPUE in Statistical Areas 4-9, months 4-9 for cohorts born between 2000 and 2001. The cohort born in 1980 is also shown for reference. These indices have not been standardized by their means. 30

List of Tables

Table 5-1 Number of squares fished by year and month in statistical areas 4-9. Note that total is the total number of 5x5 square/month strata (i.e. some 5x5 squares are fished in more than one month). 14
Table 5-2 Number of squares fished by year and month in statistical areas 4-7. Note that total is the total number of 5x5 square/month strata (i.e. some 5x5 squares are fished in more than one month). 15
Table 5-3 Number of squares fished by year and month in statistical area 8. Note that total is the total number of 5x5 square/month strata (i.e. some 5x5 squares are fished in more than one month)................................... 16
Table 5-4 Number of squares fished by year and month in statistical area 9. . Note that total is the total number of 5x5 square/month strata (i.e. some 5x5 squares are fished in more than one month). 17

1 Abstract

This paper updates previous analyses of catch, effort and catch-rate data from the Japanese longline fishery. The outcomes from the review of Japanese Market Data (Lou et al.) suggest that the data used to generate these catch and effort results may not be reliable. As such, caution should be used in the interpretation of the results presented here.

There have been significant decreases in the estimate of catches by Taiwan and Korea since 1999. The catches for Japan and Indonesia are up significantly on last years reports. Total fishing effort has been steadily decreasing since the late 1980s till 2000, with a small reversal of this trend in the mid 90s, and currently levelling at around 40 million hooks. This decrease is particularly strong in Areas 4-7. Catch rates, when aggregated by age group (3-7, 8+), have decreased in recent years for the younger ages, and have increased slightly for the older ages.

2 Introduction

The Scientific Committee conducted a detailed assessment of the SBT stock in 2004, with the next stock assessment scheduled for 2007. In the meantime fishery indicators will play an important role in the provision of advice to managers on the status of the SBT stock. The Japanese longline catch and effort data have been the basis for a number of the indicators used by the CCSBT Scientific Committee (e.g. Anon. 1988, 2001, 2002, 2003, 2004, 2005). Indicators have been used to provide a broad perspective on recent changes in the status of the stock independent of the dynamical and weighting assumptions embedded in the analytical stock assessment models.

The outcomes from the review of Japanese Market Data (Lou et al.) suggest that the data used to generate catch and effort results presented here may not be reliable. The patterns over time (and by area and even age) may no longer be reliable, but in the absence of information on where, when and by whom any unreported longline catches were taken, it is impossible to say whether, or to what extent, the catch and effort, and therefore CPUE are affected. We have nonetheless, updated these results with the data provided in the data exchange.

Within the more recent SBT analytical stock assessment models, only aggregated CPUE indices are used, although estimates of age specific indices have formed an important component of the fishery indicators that are examined. Given the critical role that these aggregated indices play and the role of fishery indicators in the CCSBT Scientific Committee's assessment process, it is useful to have a more detailed understanding of the actual trends underlying the aggregated indices. This document presents a more in depth examination of the Japanese catch, effort and catch-rate data. The document is an update of similar documents presented in the past and is similar in format to those presented at the 2001-2005 meetings of the Stock Assessment Group (SAG) and Scientific Committee (SC) of the CCSBT (Polacheck and Ricard 2001, Ricard and Polacheck 2002, Hartog et al 2003, Hartog et al 2004, Hartog et al 2005).

3 Data

The primary data used in this paper are the catch, effort and size data provided by the National Research Institute of Far Seas Fisheries of Japan (NRIFSF) for the Japanese SBT longline fishery. All the data provided by NRIFSF are in aggregated form. The catch and effort and size data have been aggregated by NRIFSF into monthly and 5° latitudinal and longitudinal square strata. The monthly catch has been aged using cohort slicing following procedures developed within the CCSBT Scientific Committee (Anon. 1994, Anon. 2001, Preece et al. 2001). In addition to the data supplied by NRIFSF, data from joint venture operations in Australia and charter operations in New Zealand involving Japanese vessels have been included in the basic data sets used in this paper. The vessels involved in these operations also fished as Japanese vessels at other times of the year and their basic operational characteristics were similar whether the vessel was fishing as a Japanese vessel or under a joint venture/charter arrangement.

Most of the catch rate and effort results presented in this paper are restricted to data from commercial operations in Statistical Areas 4-9 (Figure 3-1) and from the second and third quarter of the year (April through September). This was done because the data from these areas and quarters are used in the construction of the CPUE indices that are in the analytical catch-at-age assessments. These statistical areas represent the primary fishing areas and major known feeding areas for SBT. The second and third quarters have been the periods of most consistent fishing effort within these statistical areas. Moreover, most SBT are expected to be within these areas during this period. In the rest of the year, interpretation of CPUE indices is confounded by the migration of adults to the spawning grounds off Indonesia and the migration of juvenile below age 5 to inshore waters around Australia.

It should be noted that Japan previously reported for 1995 and 1996 that a large number of small fish (<25kg) had not been retained as a result of an industry instituted practice on non-observed vessels to return all landed non-dead small SBT in these two years. The estimated number of non-retained fish in these two years constituted a substantial number of fish. However, large uncertainty exists about these non-retained catches and how the figures relate to non-retained catches in other years. The estimates of the non-retained catches in 1995 and 1996 have never been included in the estimated CPUE trends. As such, the age specific CPUE estimates for younger ages and the aggregated estimates for these two years should be interpreted with caution.

Note that catch trends (unless otherwise noted) are for the entire calendar year and include all SBT catches.

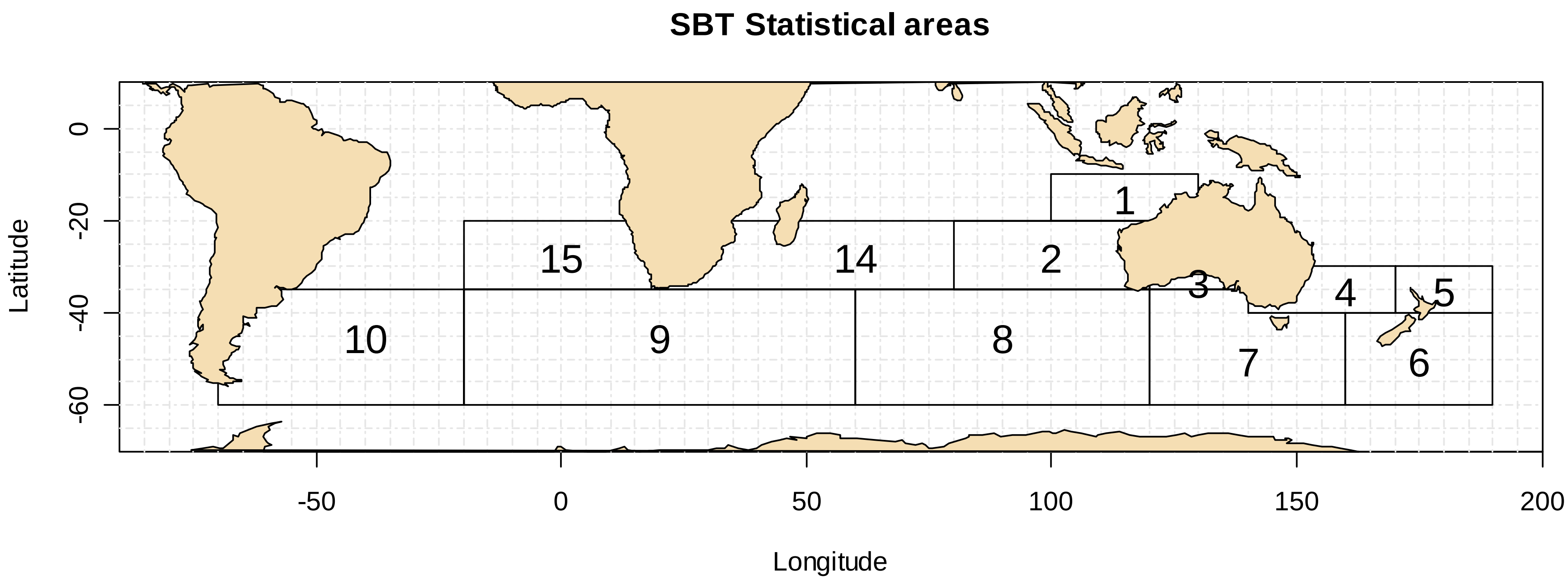


Figure 3-1 Traditional SBT statistical areas defined by CCSBT. Note that areas 1-10 have been those traditionally used for Japanese longline data. Areas 14 and 15 are recently defined areas to encompass areas where there has been significant Taiwanese catch and effort. Also, Japan does not provide complete effort data for these latter two areas, but only effort in months and 5°squares in which SBT have been caught.

4 Catch trends

Figure 4-1 provides estimates of the total annual catch of SBT in metric tonnes by country. Total estimated catches of SBT were decreasing between the early 1980s and the early 1990s. This was followed by a period of increase in global catch, peaking in 1999. There was a marked decline of 20% in the estimated global SBT catches in 2000, bit a recent decreasing trend in global catches of around 5% per year since 2002, however total global catch is back to 2001 levels, a 16% increase in one year.

Some of the changes in global catch stem from the fact that the Australian quota year starts in December and the fluctuation of catches that are taken during December. However, more significant, has been substantive decreases in the estimate of catches by Taiwan (down 38% since 1999) and Korea (down 97% from 1999). Indonesian catch is still less than the catch in 1999 (down 28%), but is in fact the third highest annual catch on record for that country (up 166% on 2004). Estimates of Japanese catch in 2004 are comparable with estimates from 1999 (down 3%), but higher than 2004 (up 25%).

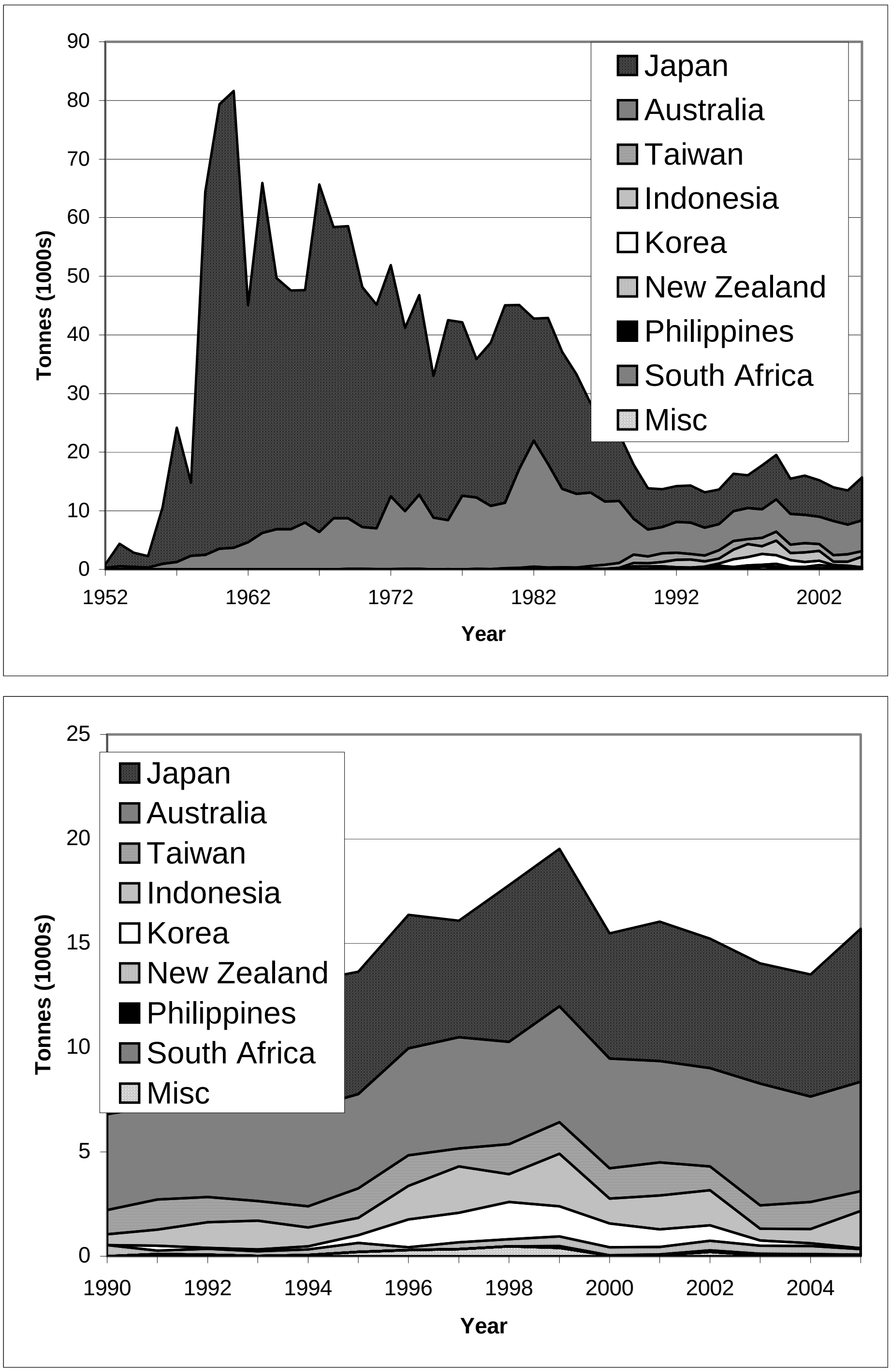


Figure 4-1 Estimates of the annual catch of SBT in metric tonnes by country.

5 Seasonal and Spatial distribution of effort

Figure 5-1 shows the number of years a particular five-degree square has been fished, with the data shown restricted to statistical areas 4–9 during the second and third quarters of the year. Some 41 squares fall into the category of having been fished more than 31 times at some point during a year since 1969, and 16 of these squares have been fished every year, 15 every year except one (Figure 5-2).

Figure 5-3 and Figure 5-4 provide an overview of the annual distribution of longline effort for 1998 through 2005 in Statistical Areas 4-9 during the second and third quarters. For comparison purposes, the 41 squares mentioned previously as having been regularly fished are shown as a highlighted area on the map. The general distributional patterns were similar over this period with effort concentrated over a relative wide longitudinal band around South Africa; a narrow band in the Southeast Indian Ocean; and in the Tasman Sea region. However, also evident in these figures are annual changes in the location and intensity of fishing (e.g. southeast area of New Zealand). The westerly shift of effort in Area 8 seen in 2004 has continued, but in 2005 the effort in the core regions (grey shading) has been substantially reduced (Figure 5-4). The expansion of effort in Area 9 has continued, particularly in the south (Figure 5-4). There is no effort in Area 7 west of Tasmania, a halt to a continuing spatial contraction in this once regularly fished area. New effort has appeared to the north east of New Zealand, and effort that had been concentrated in the 5° x 5° square to the east of Tasmania, is now concentrated in the Tasman Sea, further to the north.

Total fishing effort has been steadily decreasing since the late 1980s till 2000, with a small reversal of this trend in the mid 90s, and currently levelling at around 40 million hooks with some inter-annual variation around that mark (Figure 5-5). The effort in Area 4-7 continues to decrease and has in fact has dropped by 64% since 1989, and 32% since 1999. There has been an increase in effort in Area 8 (22%) in the last year, which has brought effort in that area to the level of effort in 1999; since 1989, however, there has been a decrease of 66%. Effort in Area 9 has decreased by 28% since 1989, but has increased by 15% since 1999. Note that the 2005 figures are preliminary and are likely to increase when complete data become available.

The recent increase in effort in the west of Area 8 (Figure 5-4), is also shown in the increase of fishing effort in the 5th month (Figure 5-6). Area 8 also dominates the effort in the 9th month, albeit at a reduced level. Area 4-7 dominates the effort in the 4th month. Long term patterns in effort split in month 6 remain the same. Months 7 and 8 are now dominated by the effort in Area 9.

The total number of 5°x 5° square/month strata being fished each year suggests a spatial and temporal contraction of fishing effort. There was a slight decrease in the number of squares fished in 2005 (which is likely to increase when new data are added), but the number of squares being fished in 2005 (136) is still small when compared with the number being fished (>200) prior to 1994 (Table 5-1). Fishing effort in recent years is concentrated in May–August (months 5–8) for Area 9, May and September (months 5 and 9) for Area 8 and April–July (months 4–7) for Areas 4–7 (Figure 5-6, Table 5-2, Table 5-3 and Table 5-4).

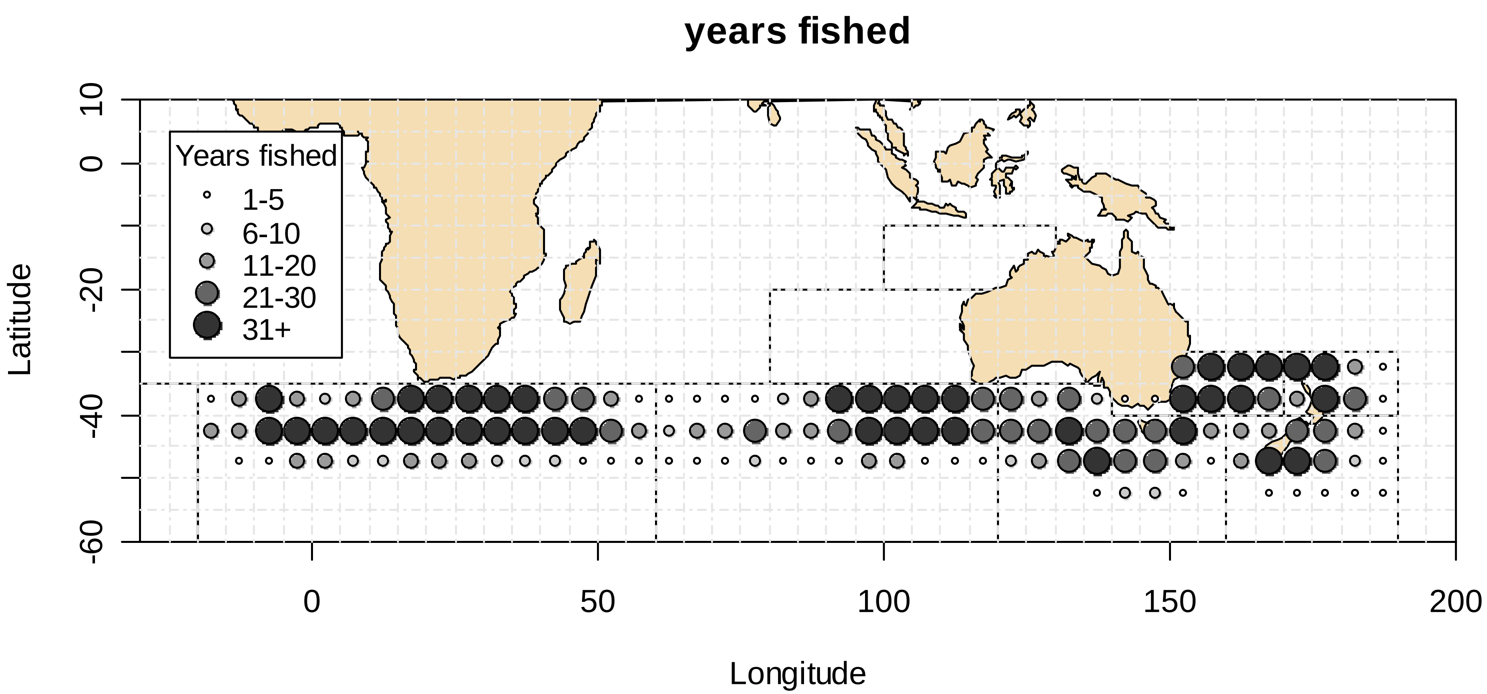


Figure 5-1 The geographic location of the five-degree squares in which fishing effort has occurred within statistical areas 4–9 during the second and third quarters of the year.

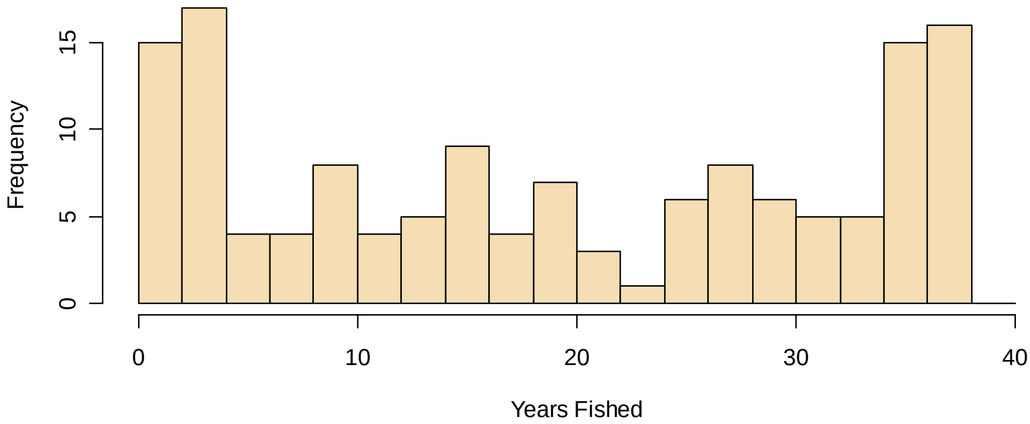


Figure 5-2 The frequency distribution of the number of years that a five degree square has been fished between 1969 and 2005 during the second and third quarters of the year. The x-axis values are the upper limit for each frequency bin.

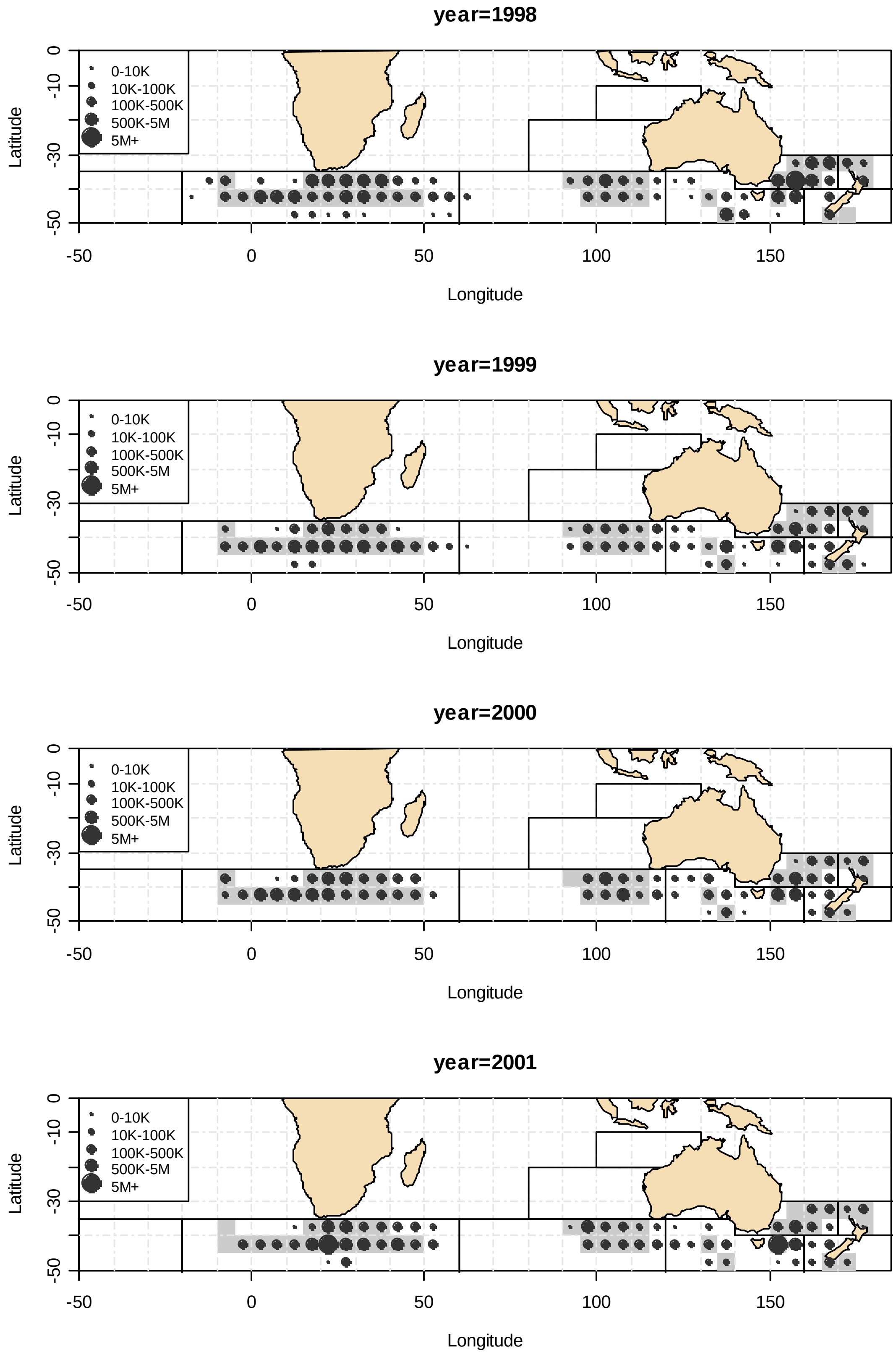


Figure 5-3 Distribution of fishing effort in the years 1998-2001, statistical areas 4-9, months 4-9. The grey shaded areas indicate the squares that have been fished for more than 30 years.

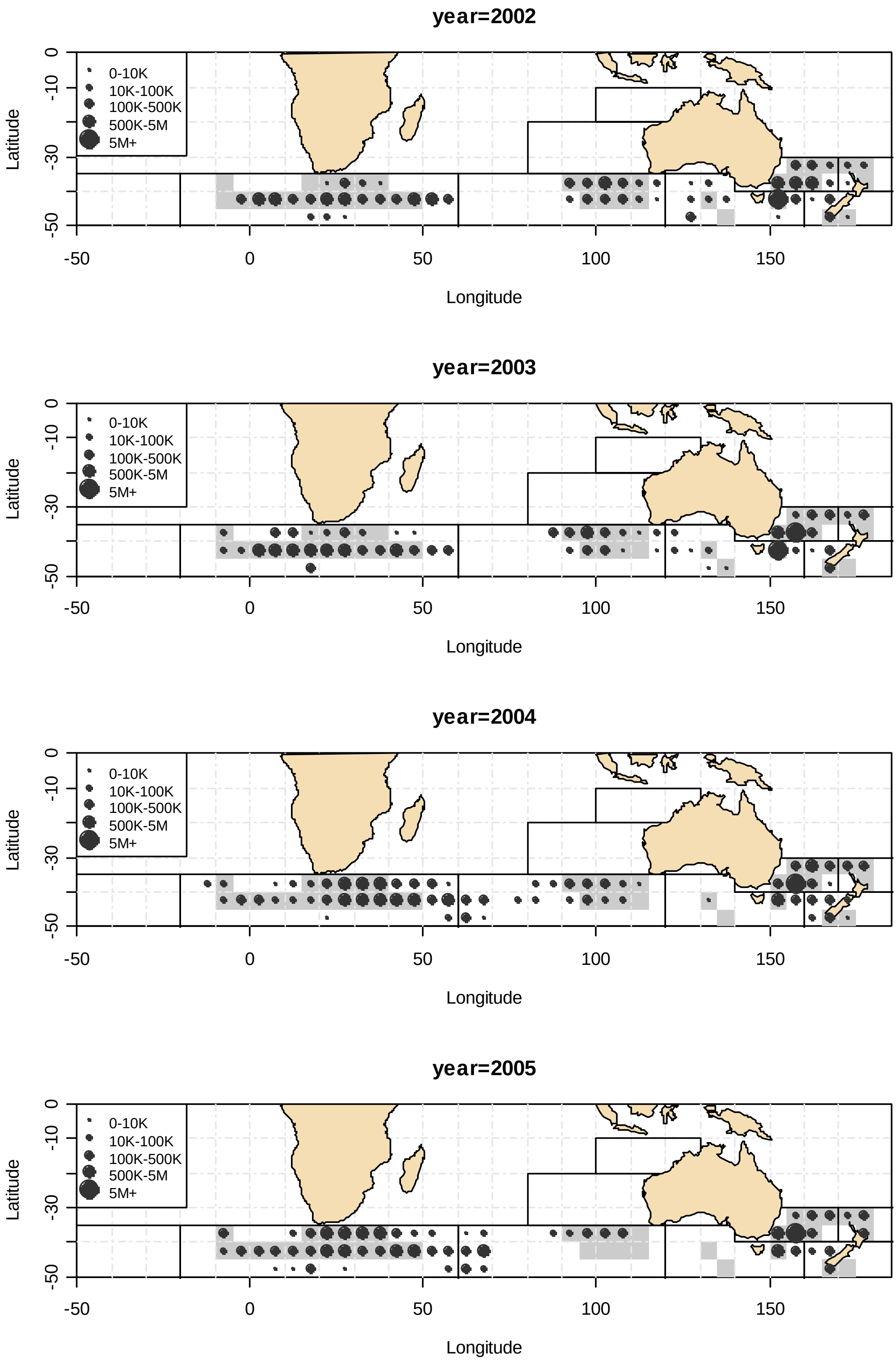


Figure 5-4 Distribution of fishing effort in the years 2002-2005, statistical areas 4-9, months 4-9. The grey shaded areas indicate the squares that have been fished for more than 30 years.

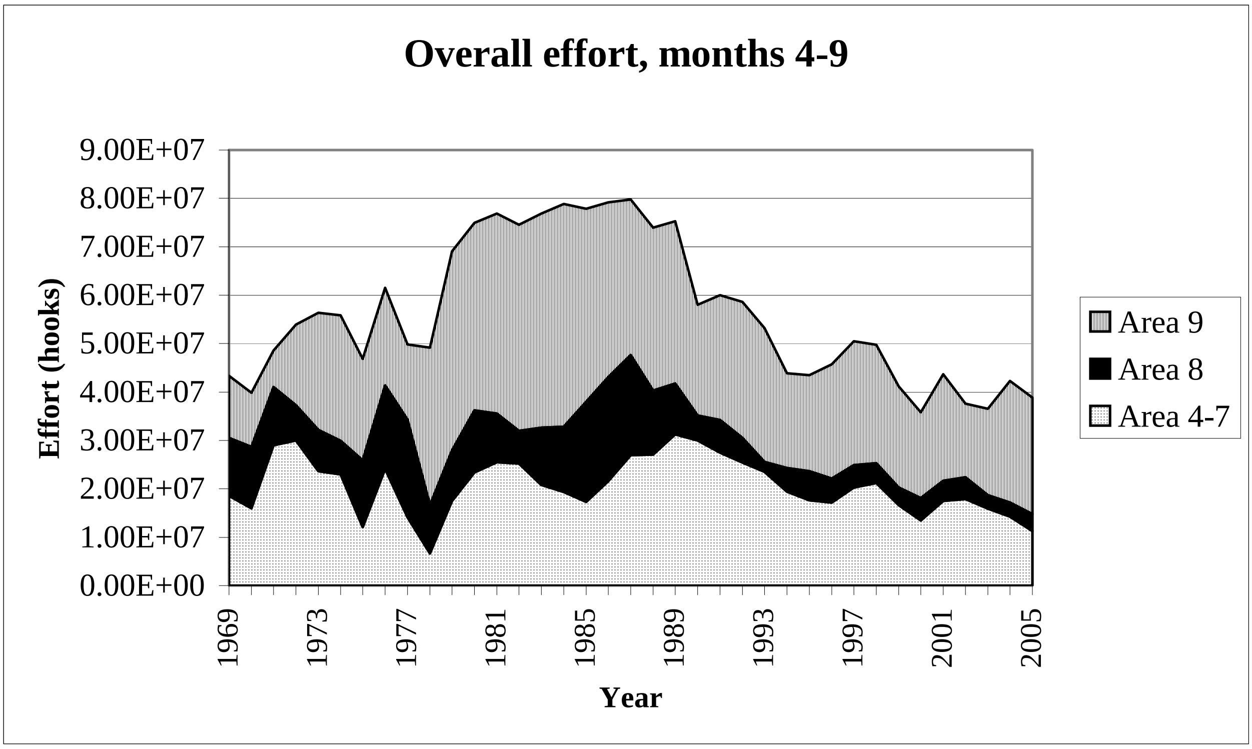
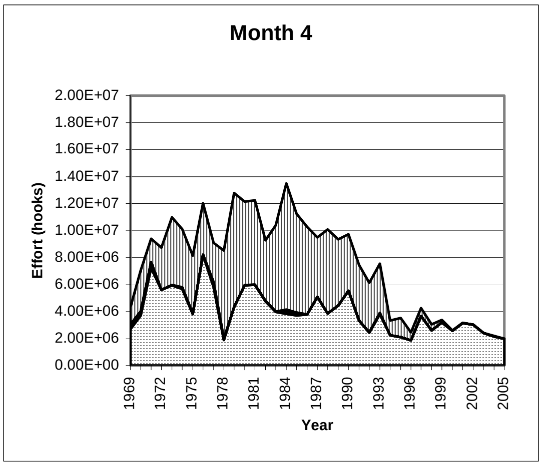
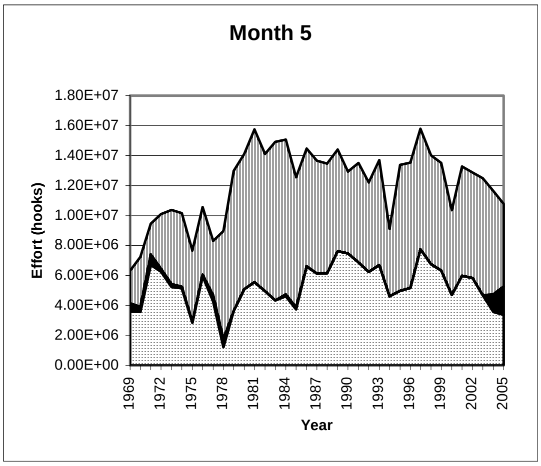
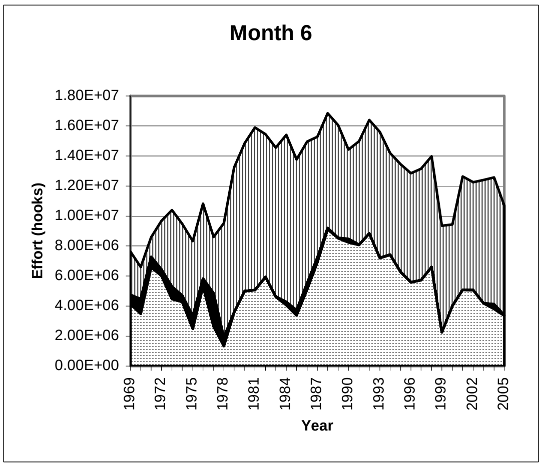
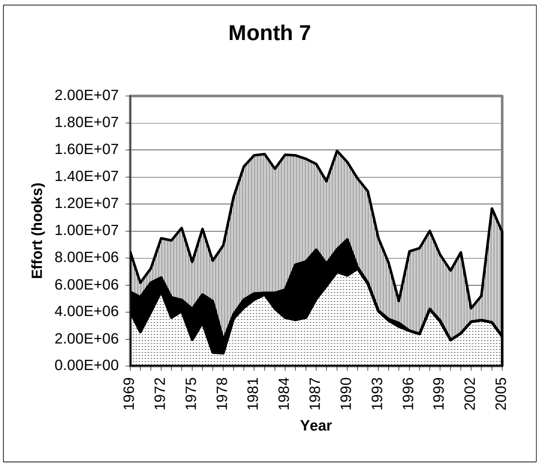


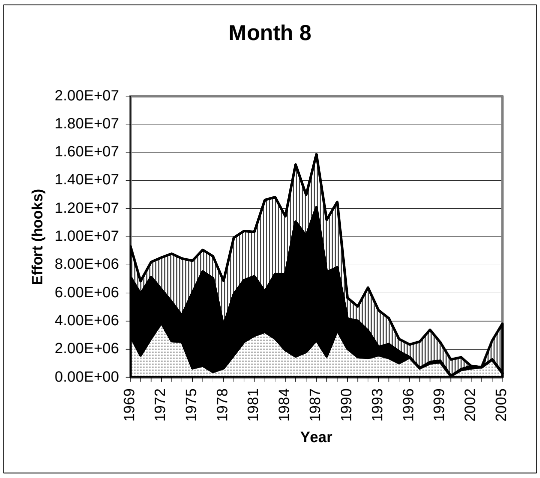
Figure 5-5 Fishing effort in Statistical Areas 4-7, 8 and 9, months 4-9.











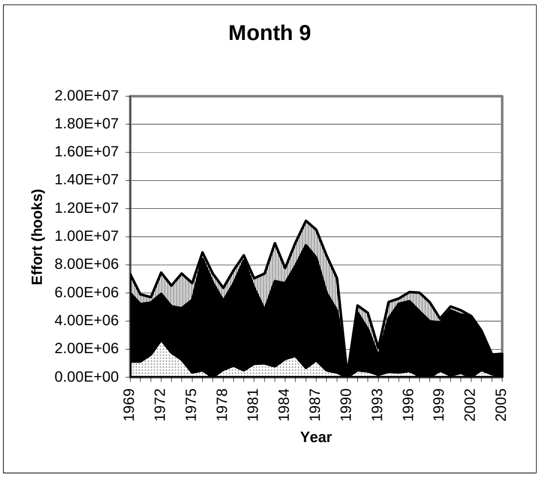


Figure 5-6 Monthly fishing effort in Statistical Areas 4-7 (horizontal dash fill), 8 (solid black) and 9 (vertical line fill).

Table 5-1 Number of squares fished by year and month in statistical areas 4-9. Note that total is the total number of 5x5 square/month strata (i.e. some 5x5 squares are fished in more than one month).

NUMBER_OF_SQUARES_SA_4-9							
YEAR	MONTH_4	MONTH_5	MONTH_6	MONTH_7	MONTH_8	MONTH_9	TOTAL
1969	48	69	55	59	52	38	321
1970	68	75	68	42	41	37	331
1971	55	63	52	42	34	40	286
1972	41	47	38	38	36	40	240
1973	42	47	48	44	39	34	254
1974	52	59	41	32	33	42	259
1975	44	50	42	44	39	36	255
1976	37	51	47	40	37	42	254
1977	46	52	44	33	26	28	229
1978	43	48	35	34	32	23	215
1979	35	44	34	40	34	42	229
1980	43	40	39	36	34	28	220
1981	42	42	37	37	31	30	219
1982	42	41	37	40	40	37	237
1983	39	37	39	36	35	35	221
1984	45	57	47	40	26	32	247
1985	44	51	52	38	31	29	245
1986	43	48	52	40	36	29	248
1987	39	44	49	45	32	34	243
1988	43	48	45	43	35	30	244
1989	36	39	47	46	36	31	235
1990	42	48	47	49	33	12	231
1991	31	51	44	45	33	28	232
1992	37	44	41	46	24	24	216
1993	38	46	40	44	24	20	212
1994	19	33	51	28	20	18	169
1995	21	44	40	26	22	18	171
1996	15	46	49	37	16	17	180
1997	25	42	43	33	7	17	167
1998	19	44	47	36	22	17	185
1999	26	38	30	38	25	19	176
2000	23	32	35	34	9	17	150
2001	17	33	32	32	19	21	154
2002	13	28	27	28	10	14	120
2003	14	22	27	25	4	18	110
2004	12	33	38	29	18	18	148
2005	8	37	36	29	19	7	136

Table 5-2 Number of squares fished by year and month in statistical areas 4-7. Note that total is the total number of 5x5 square/month strata (i.e. some 5x5 squares are fished in more than one month).

NUMBER_OF_SQUARES_SA_4-7							
YEAR	MONTH_4	MONTH_5	MONTH_6	MONTH_7	MONTH_8	MONTH_9	TOTAL
1969	16	32	18	18	19	12	115
1970	33	34	27	14	17	11	136
1971	17	34	27	14	17	17	126
1972	22	27	19	12	17	16	113
1973	26	28	19	14	14	14	115
1974	23	33	20	12	13	19	120
1975	20	27	16	11	12	11	97
1976	22	29	23	13	13	15	115
1977	20	28	18	4	4	3	77
1978	18	18	8	7	7	4	62
1979	14	21	15	11	9	15	85
1980	18	20	16	7	10	8	79
1981	15	21	18	10	13	12	89
1982	18	19	17	14	14	15	97
1983	22	20	15	11	14	10	92
1984	20	31	23	12	12	10	108
1985	22	23	20	10	9	8	92
1986	20	27	24	16	9	10	106
1987	20	25	27	16	12	13	113
1988	20	23	23	18	12	10	106
1989	17	20	25	19	11	6	98
1990	22	24	26	19	13	2	106
1991	14	28	26	23	14	7	112
1992	13	22	26	23	10	6	100
1993	13	24	21	22	7	3	90
1994	9	12	23	12	5	2	63
1995	12	20	19	12	8	3	74
1996	9	20	19	12	10	5	75
1997	21	20	23	12	3	3	82
1998	14	15	19	13	8	2	71
1999	19	19	7	14	9	4	72
2000	18	16	14	13	5	4	70
2001	16	16	12	14	6	5	69
2002	13	13	12	14	6	2	60
2003	14	7	7	8	4	6	46
2004	11	8	9	9	5	4	46
2005	8	6	9	8	5	2	38

Table 5-3 Number of squares fished by year and month in statistical area 8. Note that total is the total number of 5x5 square/month strata (i.e. some 5x5 squares are fished in more than one month).

NUMBER_OF_SQUARES_SA_8							
YEAR	MONTH_4	MONTH_5	MONTH_6	MONTH_7	MONTH_8	MONTH_9	TOTAL
1969	10	18	17	18	14	18	95
1970	10	14	19	11	10	12	76
1971	15	11	9	10	10	12	67
1972	0	5	6	9	9	8	37
1973	1	4	10	9	13	9	46
1974	7	3	5	8	7	10	40
1975	6	4	5	15	14	16	60
1976	0	5	9	12	16	15	57
1977	10	7	12	14	12	15	70
1978	5	12	7	8	13	11	56
1979	1	1	3	6	13	18	42
1980	3	0	2	8	11	14	38
1981	0	1	0	9	7	13	30
1982	2	0	0	6	10	14	32
1983	2	1	3	7	10	12	35
1984	4	5	8	9	6	12	44
1985	3	6	11	11	11	13	55
1986	1	1	6	11	15	12	46
1987	0	0	8	12	12	12	44
1988	0	1	3	10	10	12	36
1989	0	1	3	9	12	13	38
1990	0	0	1	13	13	7	34
1991	0	0	2	3	11	12	28
1992	2	0	0	2	8	11	23
1993	2	1	2	2	8	12	27
1994	0	0	2	2	6	11	21
1995	0	0	1	5	9	10	25
1996	0	2	2	1	0	8	13
1997	0	0	0	0	0	10	10
1998	0	1	0	2	2	11	16
1999	0	1	1	4	3	12	21
2000	0	0	0	0	0	10	10
2001	0	0	0	0	2	11	13
2002	0	0	0	1	4	12	17
2003	0	0	0	0	0	12	12
2004	0	3	4	0	0	13	20
2005	0	5	5	0	0	5	15

Table 5-4 Number of squares fished by year and month in statistical area 9. . Note that total is the total number of 5x5 square/month strata (i.e. some 5x5 squares are fished in more than one month).

NUMBER_OF_SQUARES_SA_9							
YEAR	MONTH_4	MONTH_5	MONTH_6	MONTH_7	MONTH_8	MONTH_9	TOTAL
1969	22	19	20	23	19	8	111
1970	25	27	22	17	14	14	119
1971	23	18	16	18	7	11	93
1972	19	15	13	17	10	16	90
1973	15	15	19	21	12	11	93
1974	22	23	16	12	13	13	99
1975	18	19	21	18	13	9	98
1976	15	17	15	15	8	12	82
1977	16	17	14	15	10	10	82
1978	20	18	20	19	12	8	97
1979	20	22	16	23	12	9	102
1980	22	20	21	21	13	6	103
1981	27	20	19	18	11	5	100
1982	22	22	20	20	16	8	108
1983	15	16	21	18	11	13	94
1984	21	21	16	19	8	10	95
1985	19	22	21	17	11	8	98
1986	22	20	22	13	12	7	96
1987	19	19	14	17	8	9	86
1988	23	24	19	15	13	8	102
1989	19	18	19	18	13	12	99
1990	20	24	20	17	7	3	91
1991	17	23	16	19	8	9	92
1992	22	22	15	21	6	7	93
1993	23	21	17	20	9	5	95
1994	10	21	26	14	9	5	85
1995	9	24	20	9	5	5	72
1996	6	24	28	24	6	4	92
1997	4	22	20	21	4	4	75
1998	5	28	28	21	12	4	98
1999	7	18	22	20	13	3	83
2000	5	16	21	21	4	3	70
2001	1	17	20	18	11	5	72
2002	0	15	15	13	0	0	43
2003	0	15	20	17	0	0	52
2004	1	22	25	20	13	1	82
2005	0	26	22	21	14	0	83

6 Trends in nominal catch rates

Figure 6-1 and Figure 6-2 provide nominal catch rate estimates (total catch divided by total effort) by age for Japanese longline vessels based on the combined data for statistical areas 4-9 from quarters 2 and 3.

There is a negative trend in catch rates for ages 3–7 in recent years that has followed a positive trend from 1996-2002. Nominal catch rates for ages 3–7 are now at a lower level than what they were in the mid 1990s. There was an increase in the catch rates of 3 and 4 year olds, but the 2005 catch rate is still at a similar level to the catch rates of 3 and 4 year olds in the late 1980s. The decrease in the aggregated age 3-7 index in 2005 is driven by the decreases in the age 5, 6 and 7 indices, which have dropped from previous years, some significantly. The large drop in catch rates in 2003 for 4 year olds, in 2004 for 5 year olds and in 2005 for 6 year olds suggests a particularly weak 1999 cohort (Figure 6-1). There was an increase in catch rates for 3 year olds in 2004, and an increase in catch rates for 4 year olds in 2005, which may also suggest a stronger 2001 cohort. However, changes in juvenile catch rates (particularly in the early 1990's) are not necessarily reflected in subsequent changes at older ages and emphasize that interpretation of catch rate changes can be confounded by changes in selectivity among age classes (potentially as the result of changes in targeting).

The older age classes (8+) show an increase in catch rates (Figure 6-2), reversing a decline in all older age classes seen in recent years. The catch rates for ages 12+ is still well below the catch rates seen in the 1980s and early 1990s.

Catch rates for the older age classes (10, 11, 12+) in recent years for Area 4-7 are increasing after a period of decrease since between the late 1990s and early 2000s (Figure 6-4), however the catch rates for the younger age classes (4-7) are all decreasing except for 1 year of increase for age 4 and 5 (Figure 6-3 and Figure 6-4). Area 8 shows an increasing trend in catch rates for all ages in recent years. The trend in catch rates in recent years for Area 9 is negative for all ages (following a general increase in catch rates for all ages prior to 2002, with a small turnaround in the last year for the older (8+) age classes (Figure 6-3 and Figure 6-4).

The recent trends by fishing grounds are also quite different and conflicting for the age-specific indices. Area 4-7 shows an increase for the very young (4-5), a decline in catch rates for the young (6-9) age class, but an increase in catch rates for ages 10 and above (Figure 6-5). Area 8 continues to show improvement in catch rates across most ages - the 6, 7 and 12+ groups being the exception (Figure 6-6). Area 9 shows improvement in catch rates across all age indices, but the recent trend is still down from the highs of 2002 (Figure 6-7).

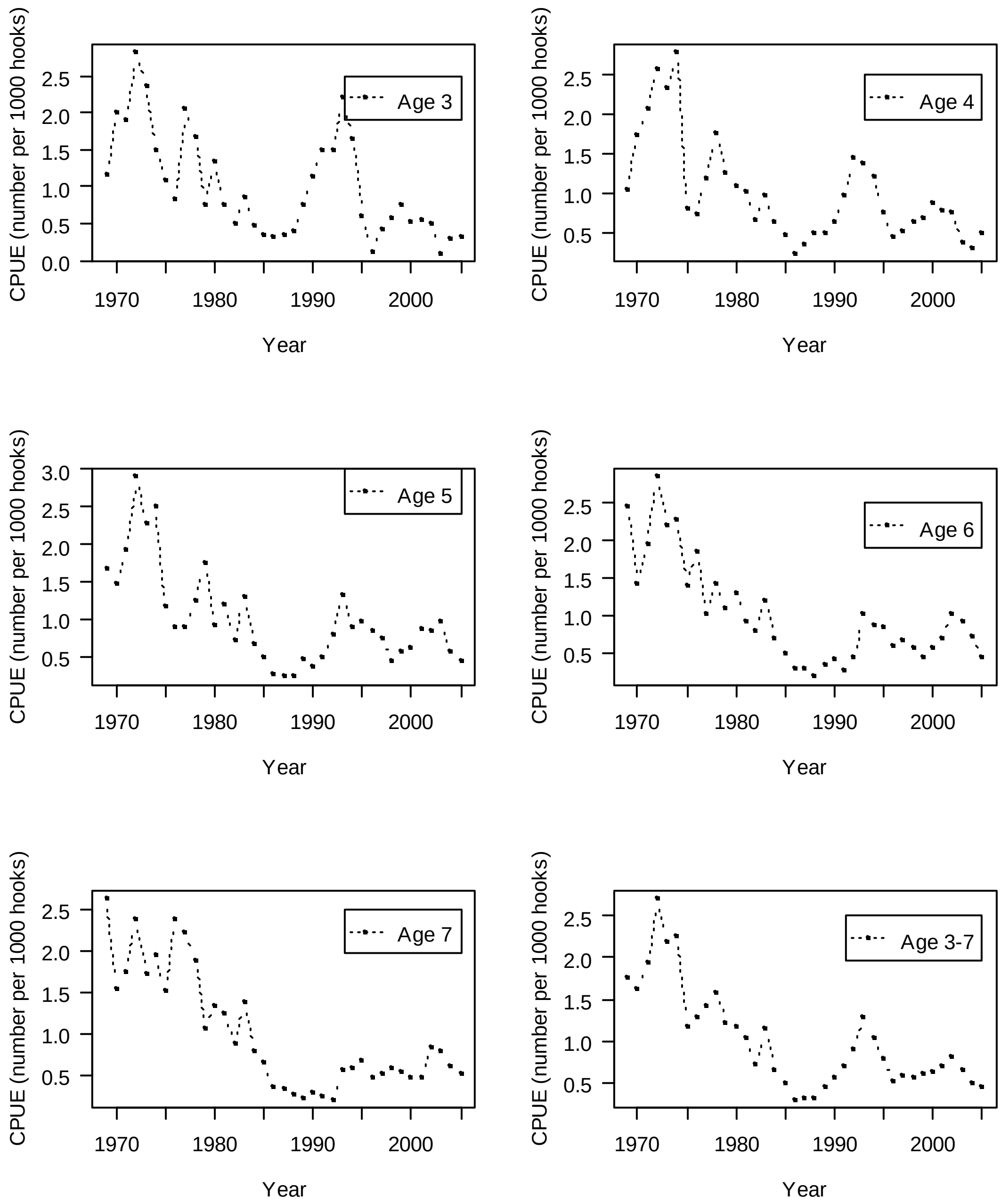


Figure 6-1 Nominal CPUE vs. Year for Japanese longline, Australian Joint Venture and New Zealand Joint Venture in Statistical Areas 4-9, ages 3,4,5,6,7 and 3-7. All indicies have been standardized by their means.

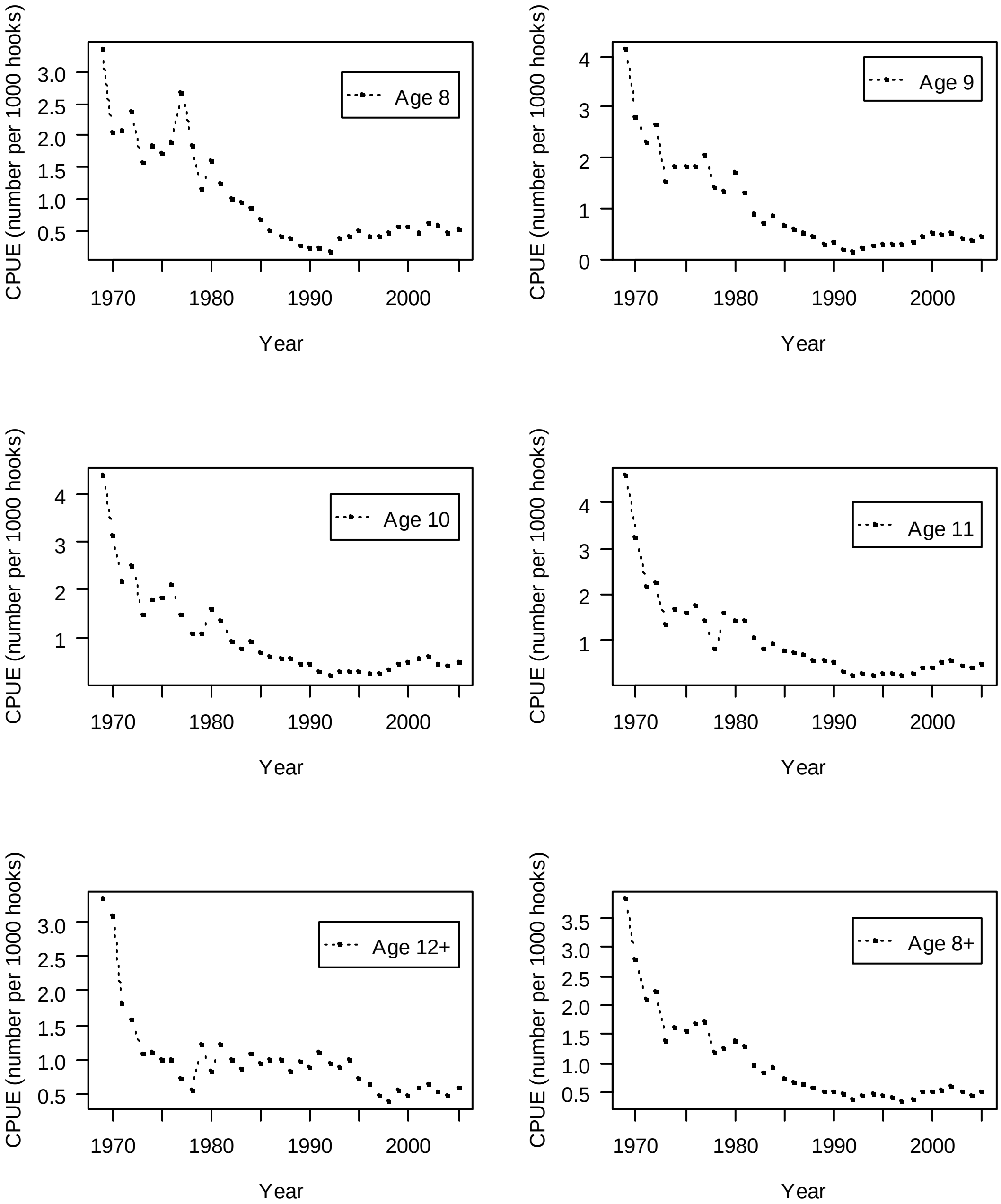


Figure 6-2 Nominal CPUE vs. Year for Japanese longline, Australian Joint Venture and New Zealand Joint Venture in Statistical Areas 4-9, ages 8,9,10,11,12+ and 8+. All indices have been standardized by their means.

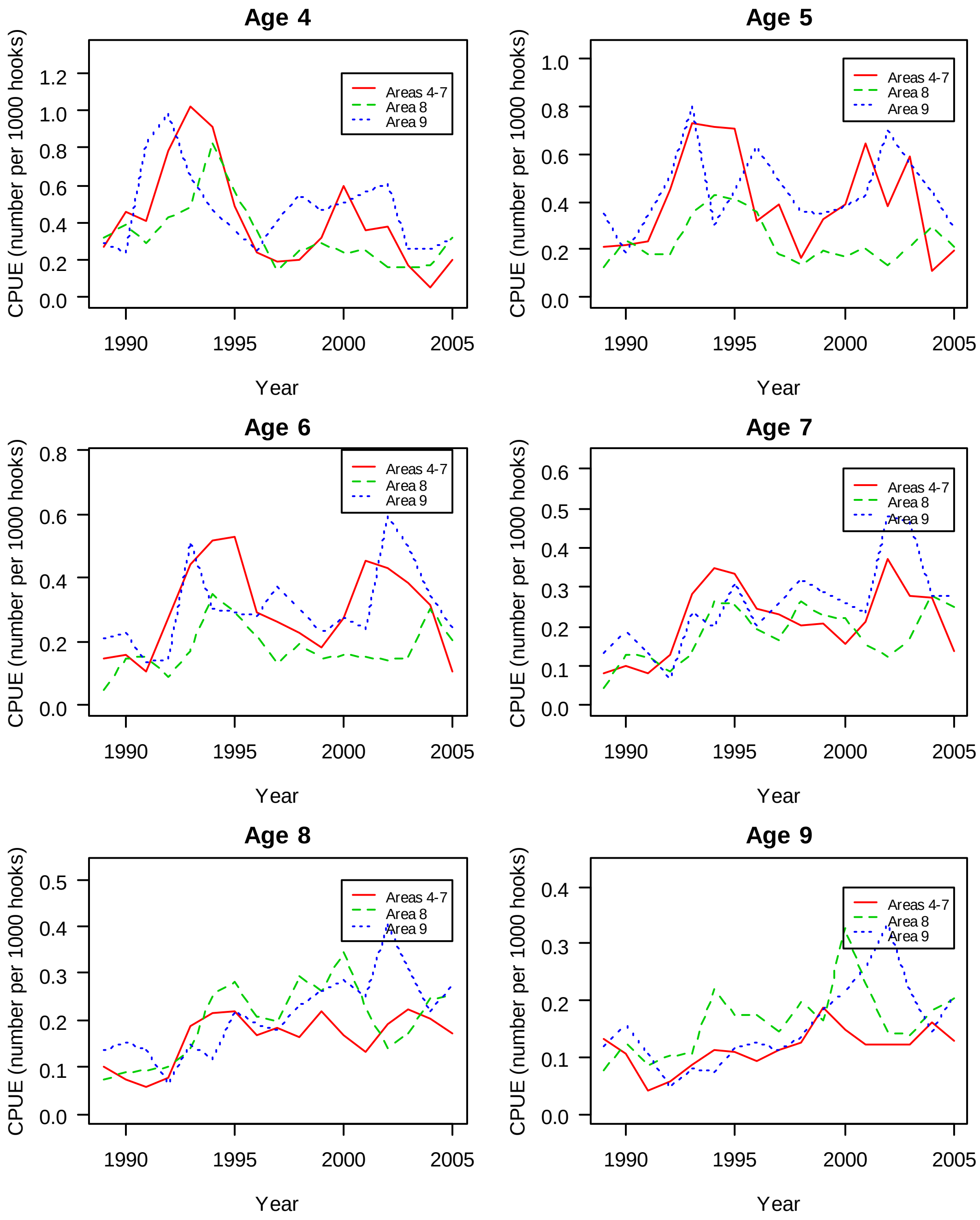


Figure 6-3 Comparison of age-specific nominal catch rates (Number per 1000 hooks) in recent years for different fishing regions. These indices have not been standardised by their means.

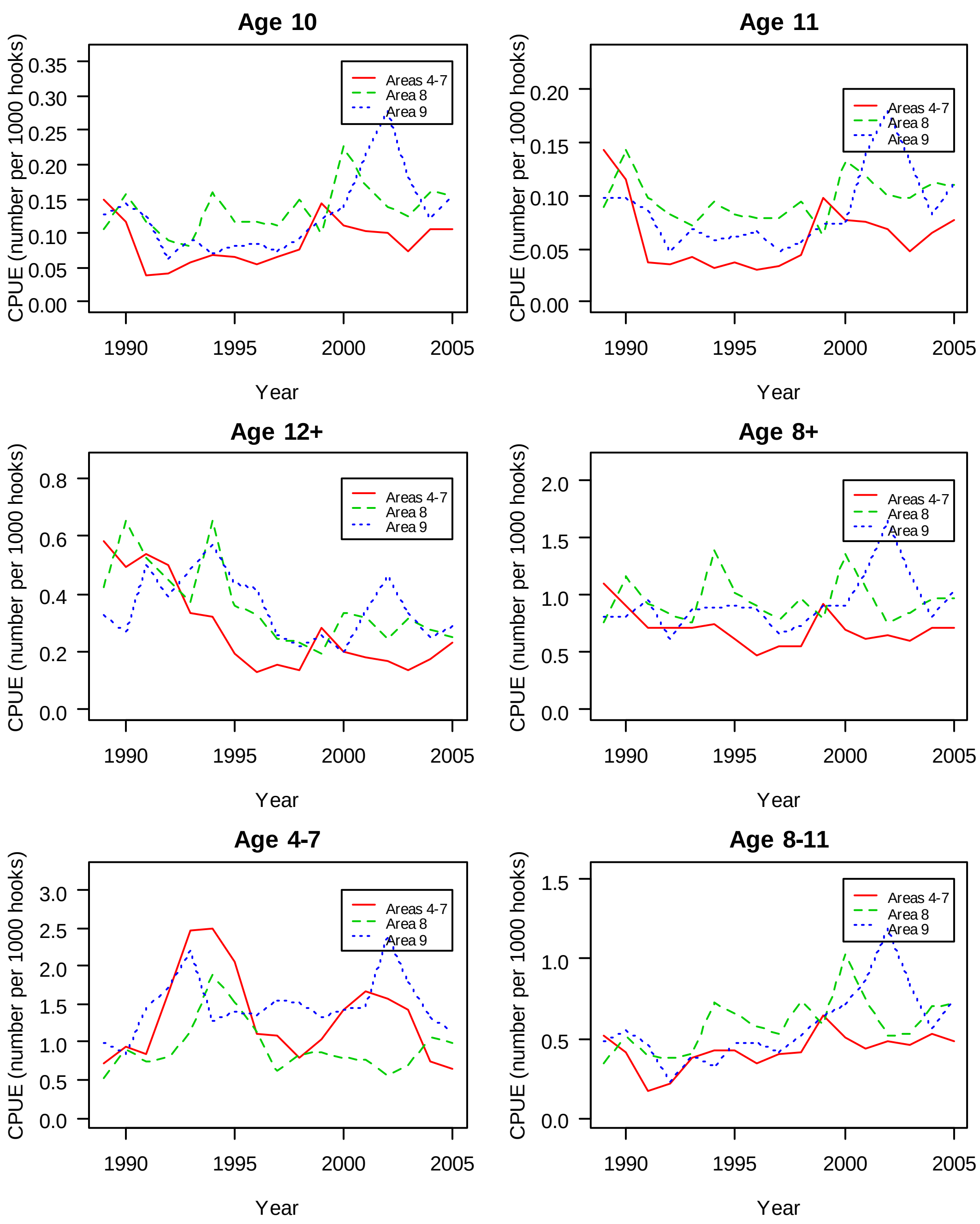


Figure 6-4 Comparison of age-specific nominal catch rates (Number per 1000 hooks) in recent years for different fishing regions. These indices have not been standardized by their means.

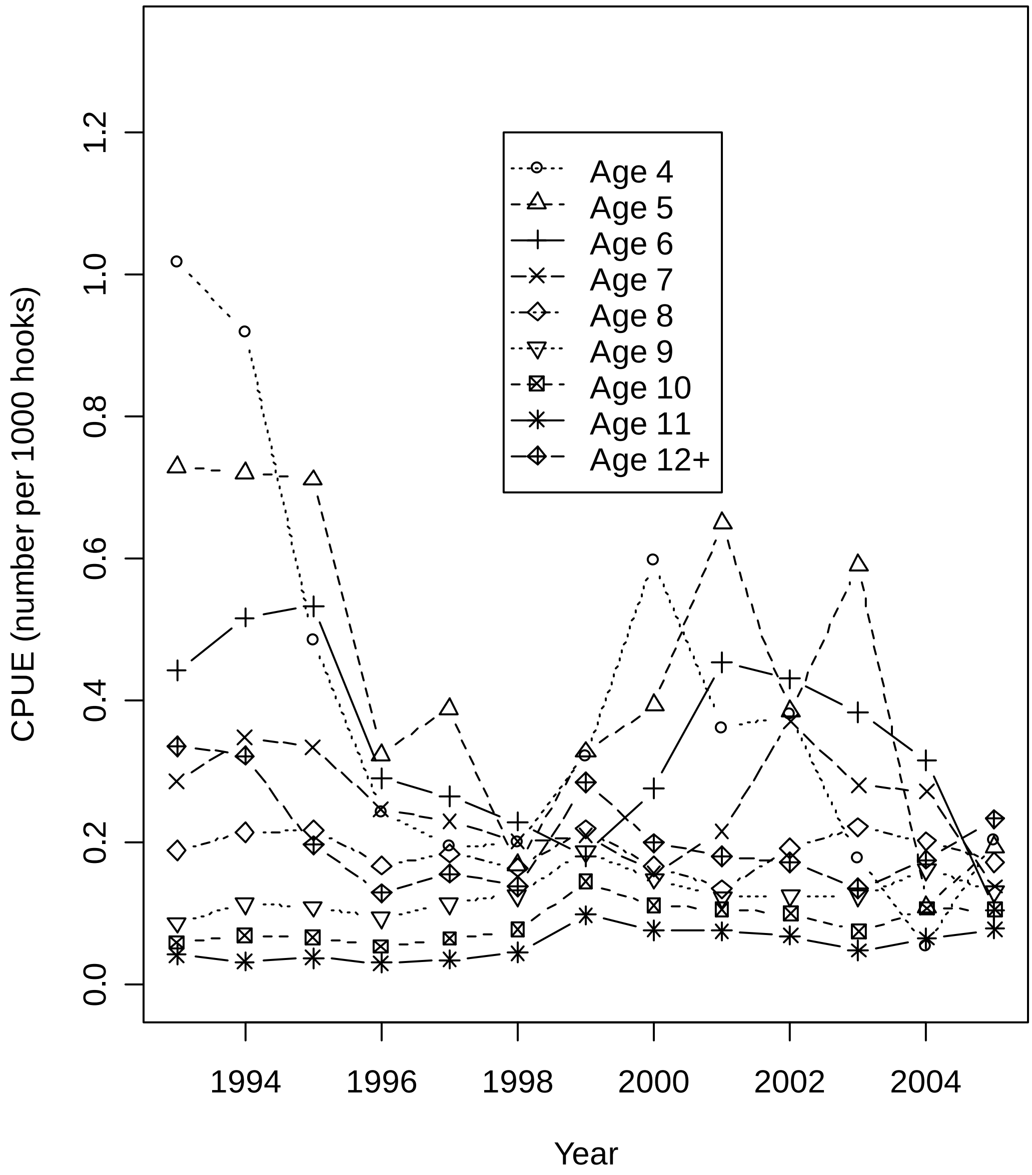


Figure 6-5 Comparison of recent nominal age-specific catch rates (Number per 1000 hooks) for Statistical Areas 4-7. These indices have not been standardized by their means.

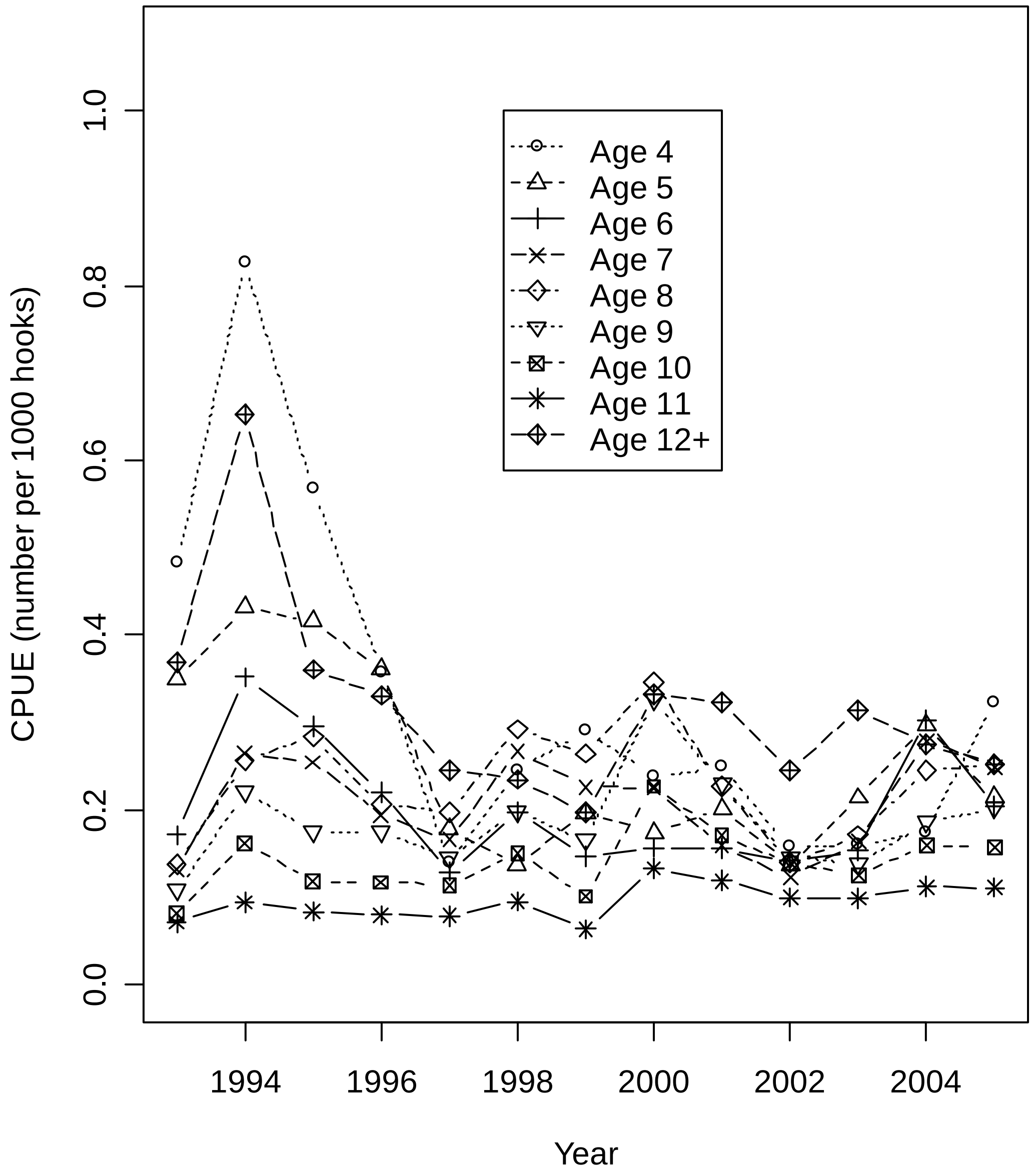


Figure 6-6 Comparison of recent nominal age-specific catch rates (Number per 1000 hooks) for Statistical Area 8. These indices have not been standardized by their means.

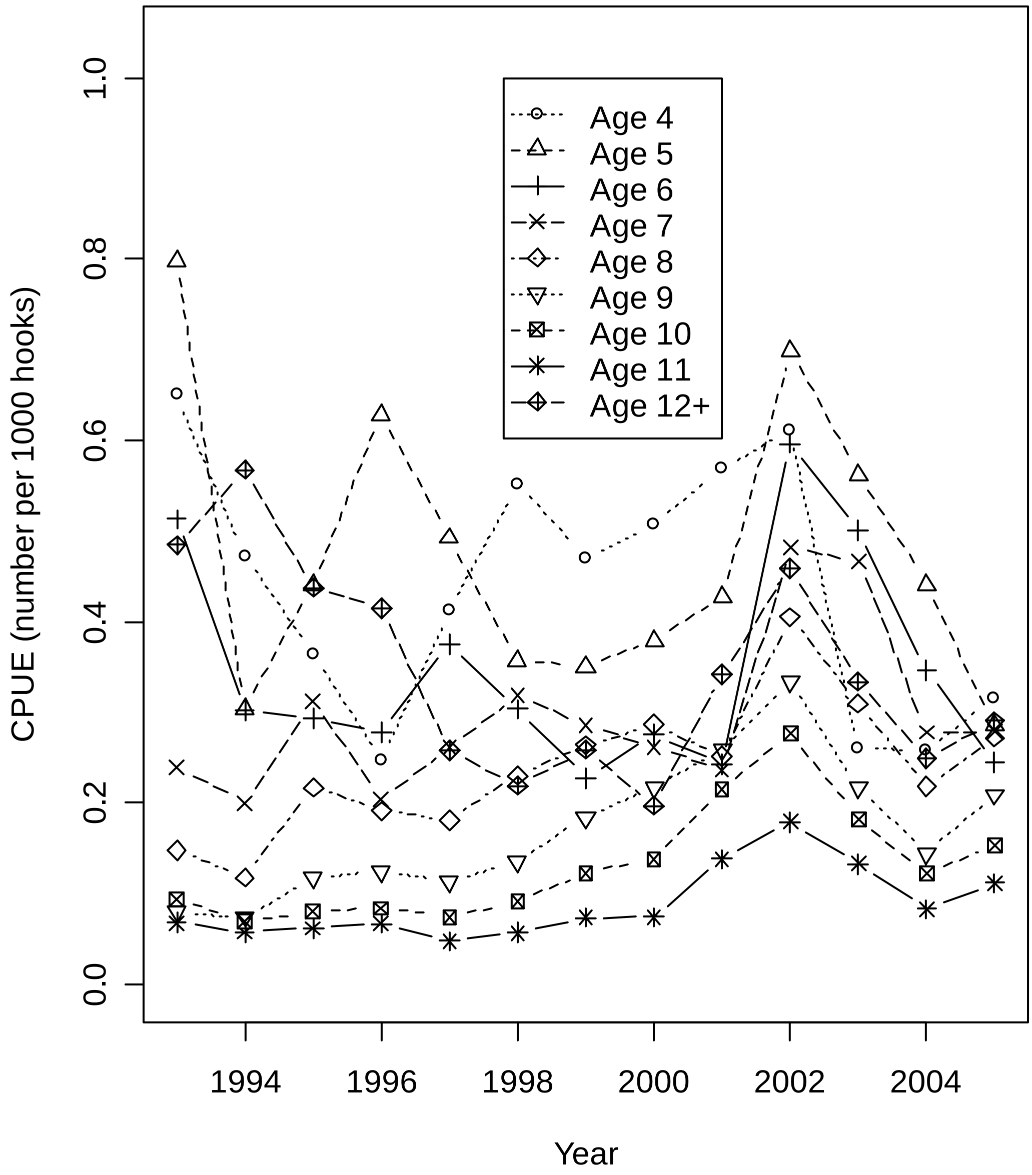


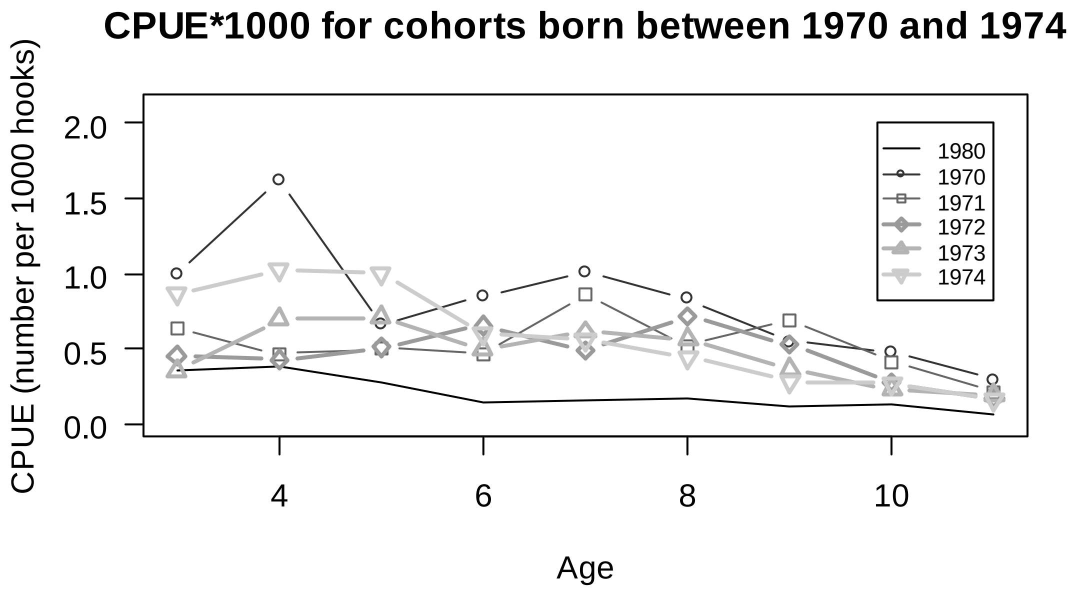
Figure 6-7 Comparison of recent nominal age-specific catch rates (Number per 1000 hooks) for Statistical Area 9. These indices have not been standardized by their means.

6.1 Catch rates by cohorts

Figure 6-8 to Figure 6-11 provides an alternative examination of the nominal age specific CPUE rates. In these figures, the catch rates for individual cohorts are plotted as a function of age. These figures provide a graphical means to evaluate how the changes in CPUE for younger ages sequentially translate into subsequent catch rates as the cohort ages. A line showing the nominal catch rates for the 1980 cohort has been included in all of the figures as a reference.

For cohorts born in the 1990's, catch rates for a given age are tending to remain above the corresponding catch rate for those in the 1980's (Figure 6-10). As these more recent cohorts are beginning to mature, this suggests that they may have potential to contribute to rebuilding the spawning stock.

For cohorts born in recent years (Figure 6-11), catch rates of 3 year olds are at a level similar to the early 1980s.



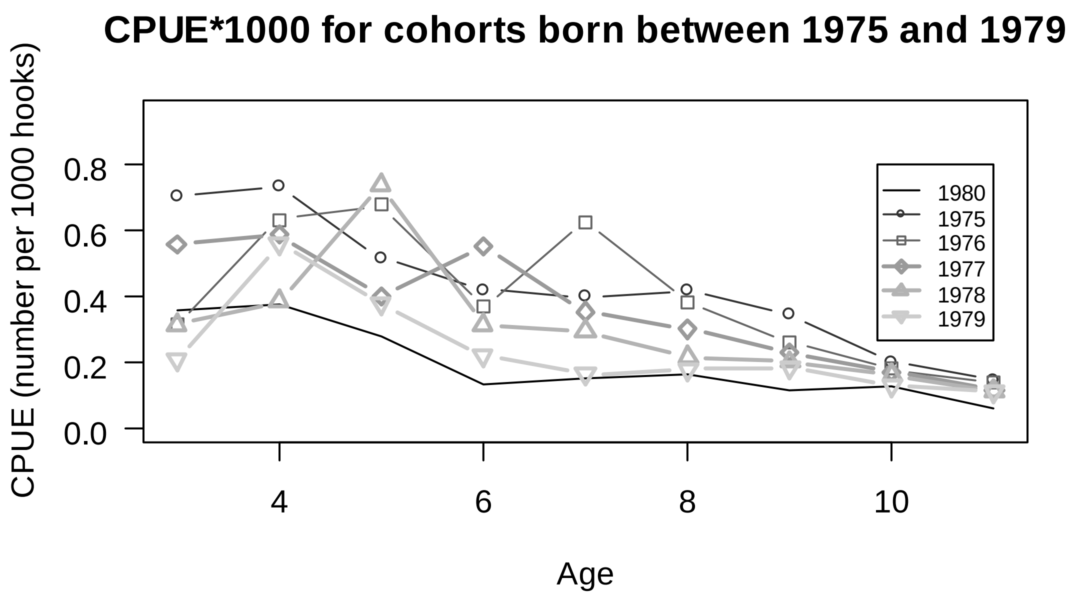
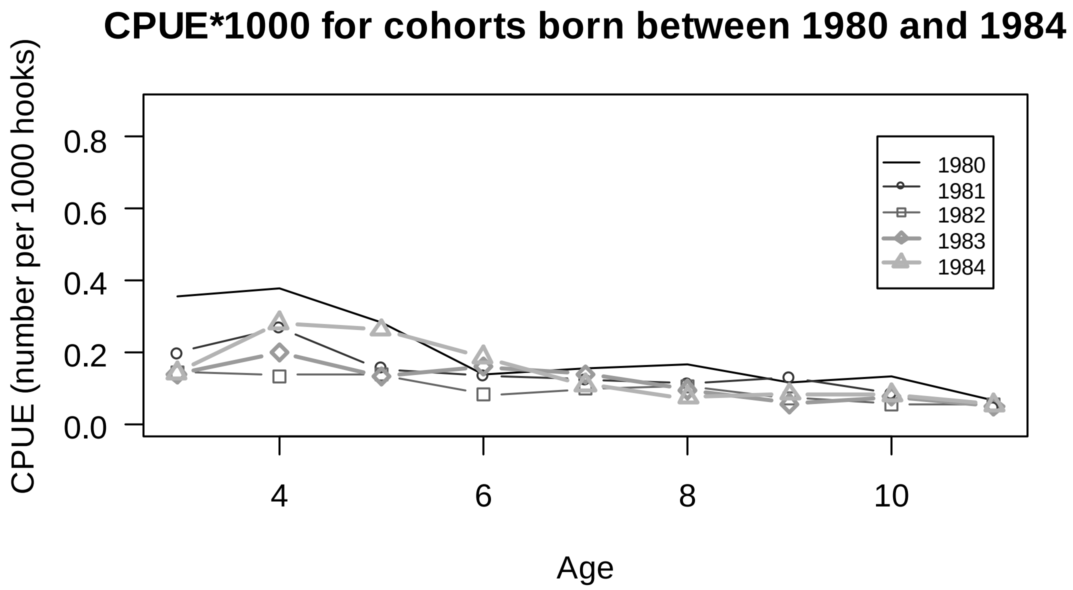


Figure 6-8 Nominal CPUE in Statistical Areas 4-9, months 4-9 for cohorts born between (a) 1970 and 1974, and (b) 1975 and 1979. The cohort born in 1980 is also shown for reference. These indices have not been standardized by their means.



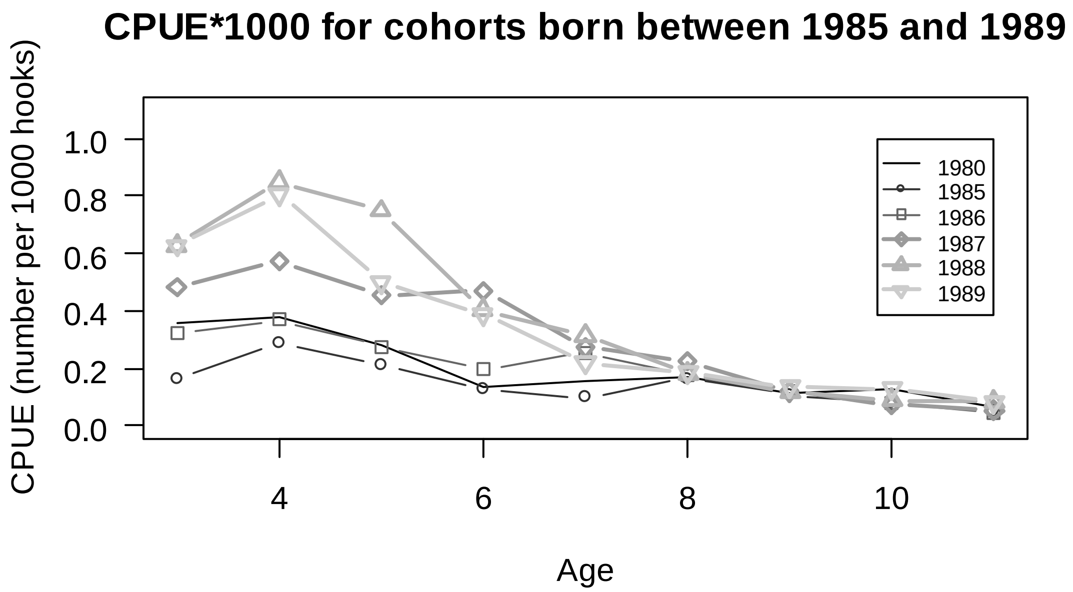
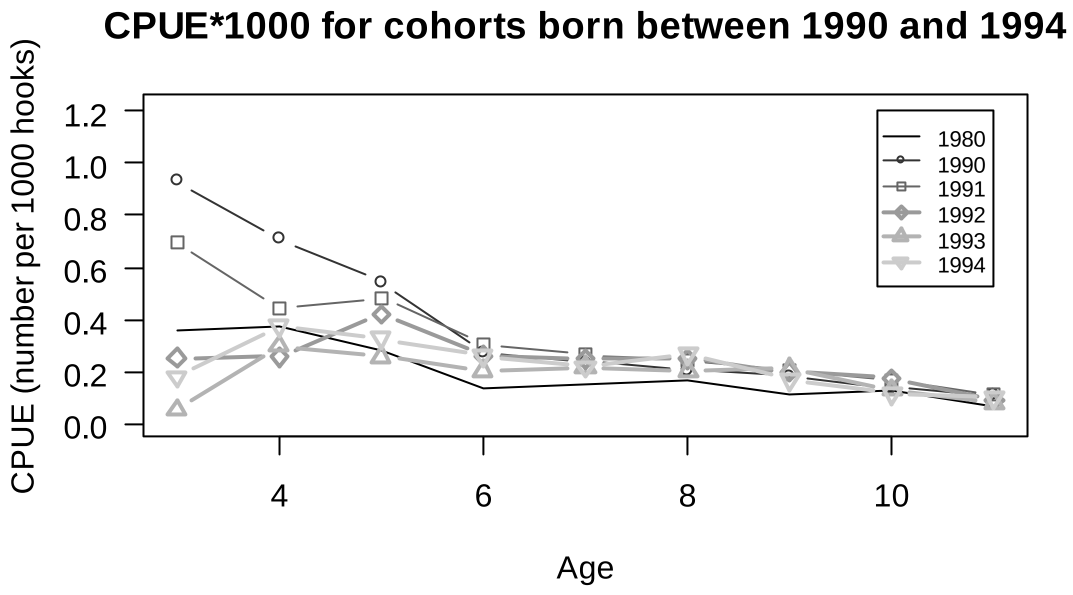


Figure 6-9 Nominal CPUE in Statistical Areas 4-9, months 4-9 for cohorts born between (a) 1980 and 1984, and (b) 1985 and 1989. The cohort born in 1980 is also shown for reference. These indices have not been standardized by their means.



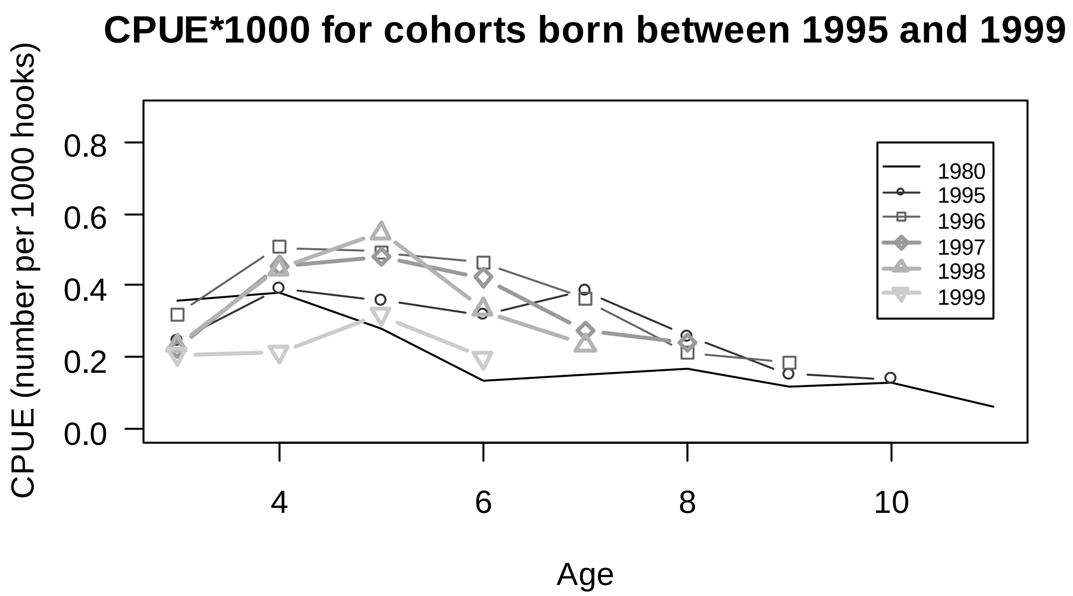


Figure 6-10 Nominal CPUE in Statistical Areas 4-9, months 4-9 for cohorts born between (a) 1990 and 1994, and (b) 1995 and 1999. The cohort born in 1980 is also shown for reference. These indices have not been standardized by their means.

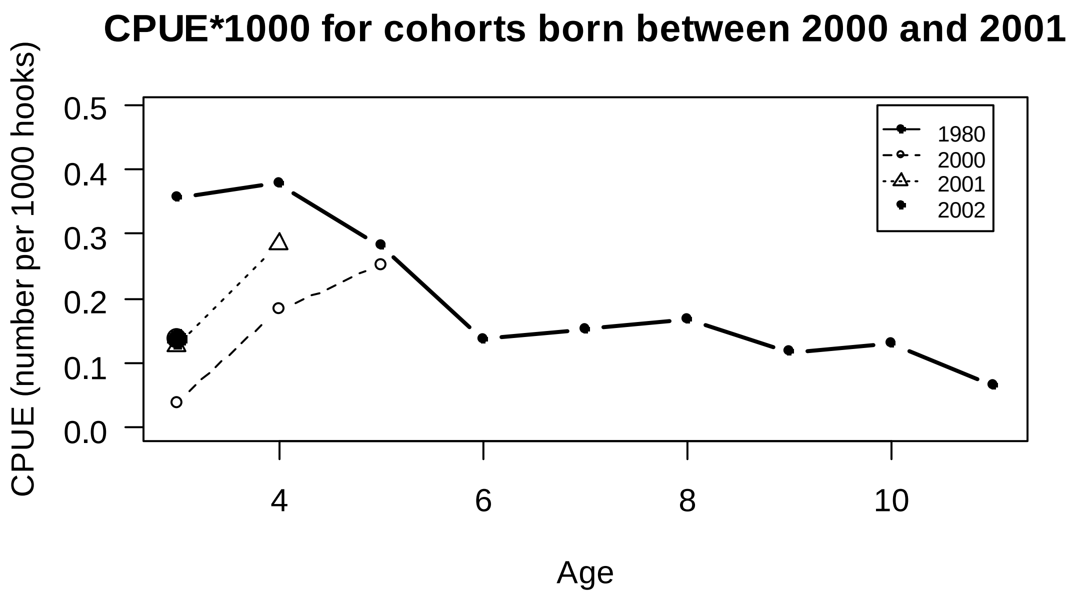


Figure 6-11 Nominal CPUE in Statistical Areas 4-9, months 4-9 for cohorts born between 2000 and 2001. The cohort born in 1980 is also shown for reference. These indices have not been standardized by their means.

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