MARINE RESEARCH

Trends in Catch, Effort and Nominal Catch Rates In the Japanese Longline Fishery for SBT – 2003 update

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1 Abstract

This paper updates previous analyses of catch, effort and catch-rate data from the Japanese longline fishery. The estimated global catch of SBT increased by 4% from 2000 to 2001 followed by a 2% reduction in 2002.

Fishing effort in Statistical Areas 4-7, 8 and 9 had been steadily decreasing since the late 1980s. However, there was a substantial increase (e.g. 22%) in overall fishing effort from 2000 to 2001 followed by a decrease of almost similar magnitude in 2002. Fishing effort continues to become more concentrated spatially and temporally. 2002 had had the smallest number of 5°X5° squares ever fished (92 compared to the previous low of 119) and this is the first year for which no effort was reported during August and there was nearly a 50% reduction in the number of squares fished in April.

The aggregated nominal CPUE indices for age 3-7 and ages 8 plus show a positive trend in catch rates in recent years which is maintained when the 2002 data are added. However, the increase in the aggregated age 3-7 index is due to increases in the indices for ages 6 and 7 while the indices for the younger ages (three, four and five) decreased between 2001 and 2002. The recent trends by fishing grounds are also quite different and conflicting. Thus, the increases between 2001 and 2002 in the spatially aggregated index for all areas for ages 9. 10, 11 and 12+ is the result of increased catch rates in Area 9 while in Areas 8 and 4-7 they declined or were essentially unchanged. Comparison of all the age specific indices by area since 1992 suggest that there has been a rather continuous increase in Area 9 for all ages since the mid 1990's. In contrast, for area 4-7 the indices for the three oldest age classes have been declining since 1999 and in area 8 they have been decreasing nearly for all ages since 2000.

2 Introduction

The CCSBT decided that a full stock assessment of the southern bluefin resources would not be conducted in 2002 and 2002. This decision was based on the report from the 2001 Scientific Committee which endorsed

> that it was not necessary to conduct full assessments every year, and noted that current trends in the status of the SBT stock were not expected to change suddenly. However, it was recognized that the impact of fisheries, particularly of non-party catches, might unexpectedly change. There would certainly be concern should effort or catch in any of the SBT fishery components increase significantly, even though impacts on the stock might not become immediately apparent in assessments. It was therefore agreed that some form of monitoring and review of fishery indicators was required on an annual basis. (Anon 2001).

The CCSBT Scientific Committee adopted a set of indicators for monitoring whether there are indication of any dramatic trends. Indicators based on aggregated catch rate data from the Japanese longline fishery provide some of the principle indicators for this monitoring purpose. Given the critical role that these aggregated indices play, it is useful to have a more detail 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 and 2002 meetings of the Stock Assessment Group (SAG) and Scientific Committee (SC) of the CCSBT (Polacheck and Ricard 2001, Ricard and Polacheck 2002).

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 data have been aggregated by NRIFSF into monthly and 5° latitudinal and longitudinal square strata. The size data are supplied aggregated into quarterly and 5° latitudinal by 10° longitudinal strata. The monthly catch data 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.

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

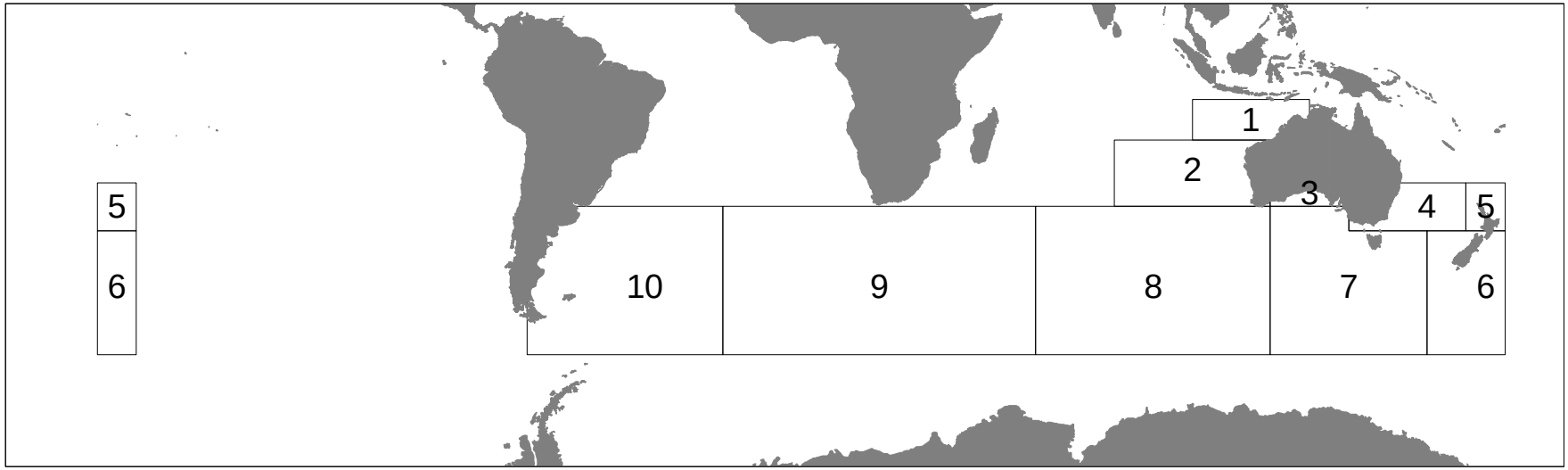

Figure 3-1 - Traditional SBT statistical area used for Japanese longline data.

4 Catch trends

Figure 4.1 provides estimates of the total annual catch of SBT in metric tonnes by country. Since the early 1990s, total estimated catches of SBT have been increasing. However, between 1999 and 2000, there has been a marked decline of 20% in the estimated global SBT catches, followed by a 4% increase between 2000 and 2001 and then a small decrease of around 2% between 2001 and 2002. Part of the increases and decreases in the last two years stem from the fact that the Australian quota year starts in December and fluctuations in the extent of catches taken during December.

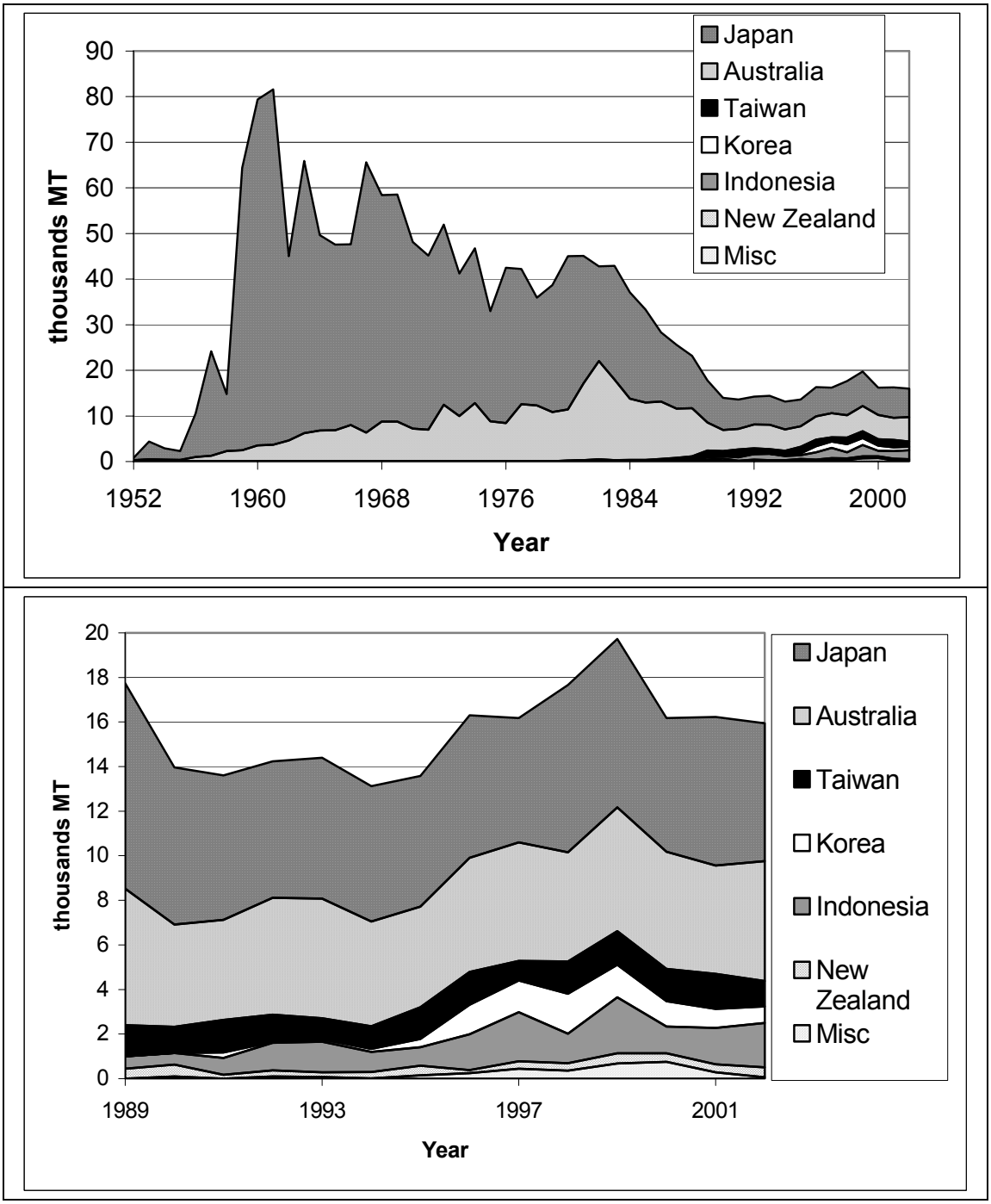

Figure 4-1 Estimates of the annual catch of SBT in metric tonnes by country

5 Seasonal and spatial distribution of effort

Figures 5-1 to 5-7 provide an overview of the annual distribution of longline effort for 1996 through 2002 in Statistical Areas 4-9 during the second and third quarters. 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).

Fishing effort in Statistical Areas 4-7, 8 and 9 had been steadily decreasing since the late 1980s. However, there had been a substantial increase (e.g. 22%) in overall fishing effort from 2000 to 2001 followed by a decrease of almost similar magnitude in 2002 (although the 2002 figure is preliminary and is likely to increase when complete data become available) (Figure 5-2). A large fraction of the fluctuations in effort in the last two years was the result of changes in Statistical Area 9. Thus, effort in this area increased by 26% between 2000 and 2001 followed by a 30% decrease in 2002. There has also been a small shift in the relative amount of effort in Area 9 compared to other areas. Thus, 2002 was the first year since 1977 that the effort in Area 9 did not exceed that in the other two regions.

Fishing effort continues to be concentrated spatially and temporally. Thus, fishing effort was only reported in ninety two 5°X5° squares, which is the smallest number ever reported (Table 5-1). The previous low was 119. In addition, this is the first year for which no effort was reported during August and fishing was reported in only seven 5°X5° squares in April compared to the previous low of 13 for this month.

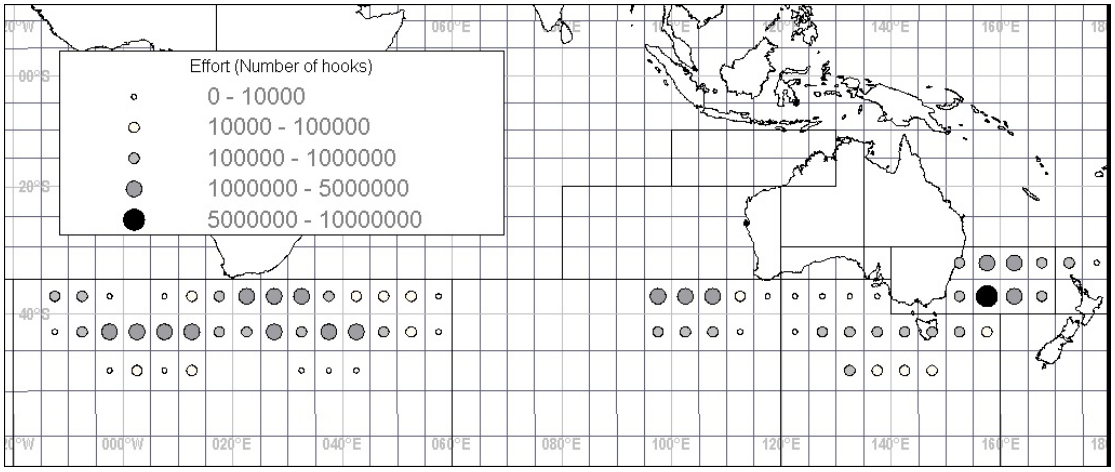

Figure 5-1 Distribution of fishing effort in 1996, statistical areas 4-9, months 4-9.

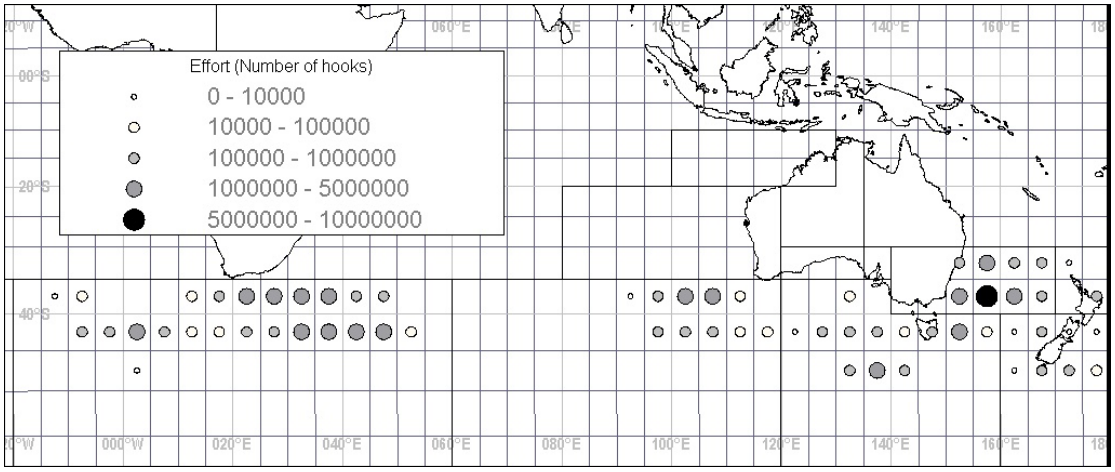

Figure 5-2 Distribution of fishing effort in 1997, statistical areas 4-9, months 4-9.

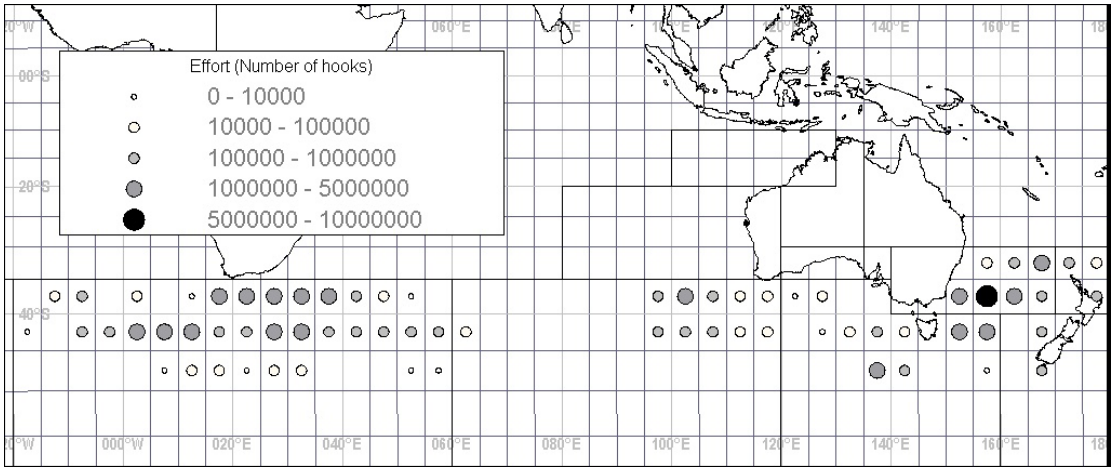

Figure 5-3 Distribution of fishing effort in 1998, statistical areas 4-9, months 4-9.

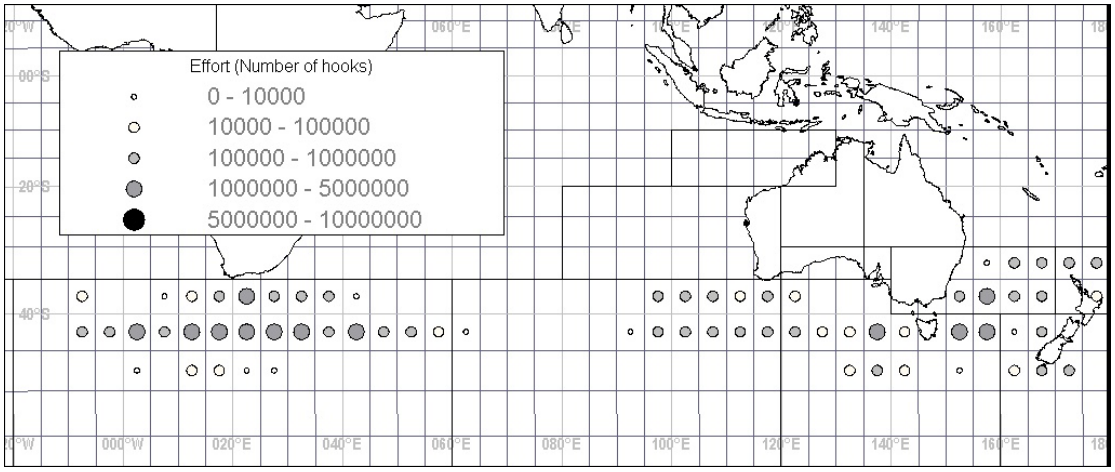

Figure 5-4 Distribution of fishing effort in 1999, statistical areas 4-9, months 4-9.

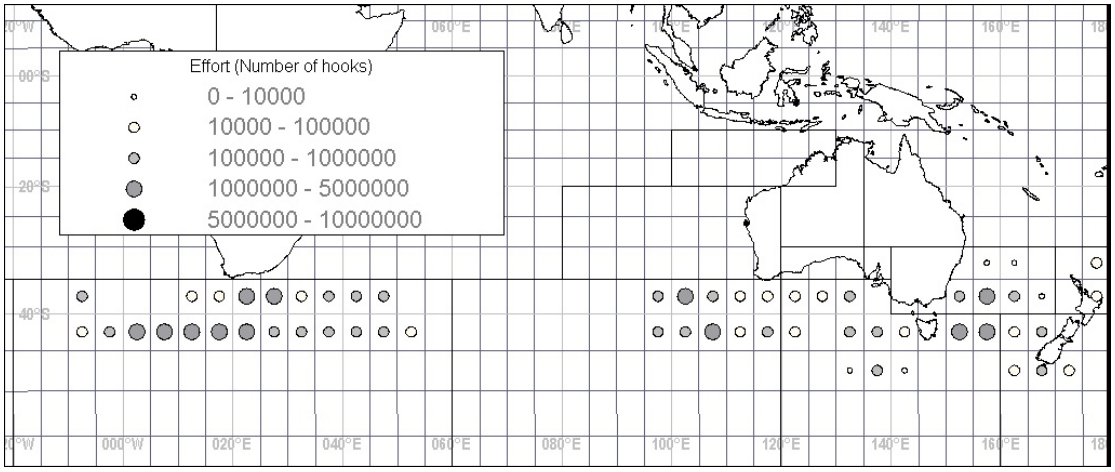

Figure 5-5 Distribution of fishing effort in 2000, statistical areas 4-9, months 4-9.

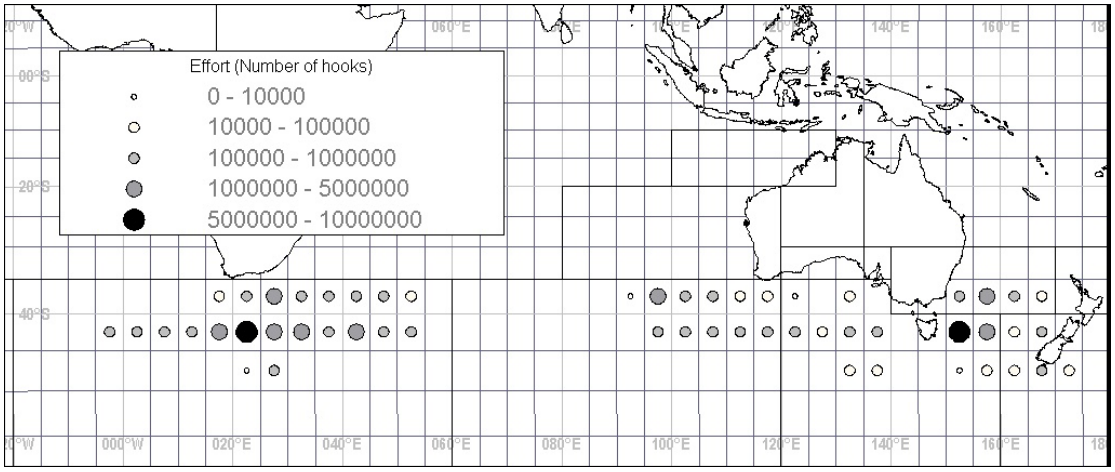

Figure 5-6 Distribution of fishing effort in 2001, statistical areas 4-9, months 4-9.

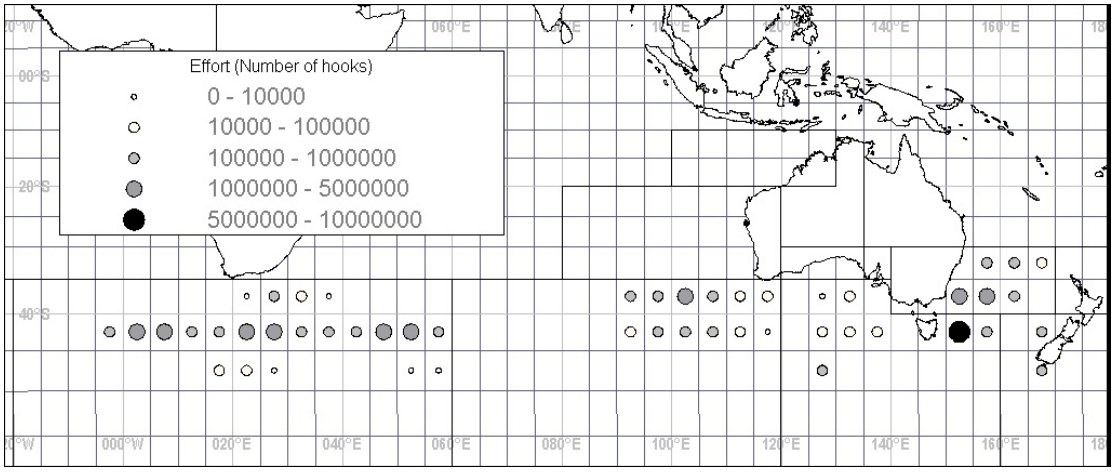

Figure 5-7 Distribution of fishing effort in 2002, statistical areas 4-9, months 4-9.

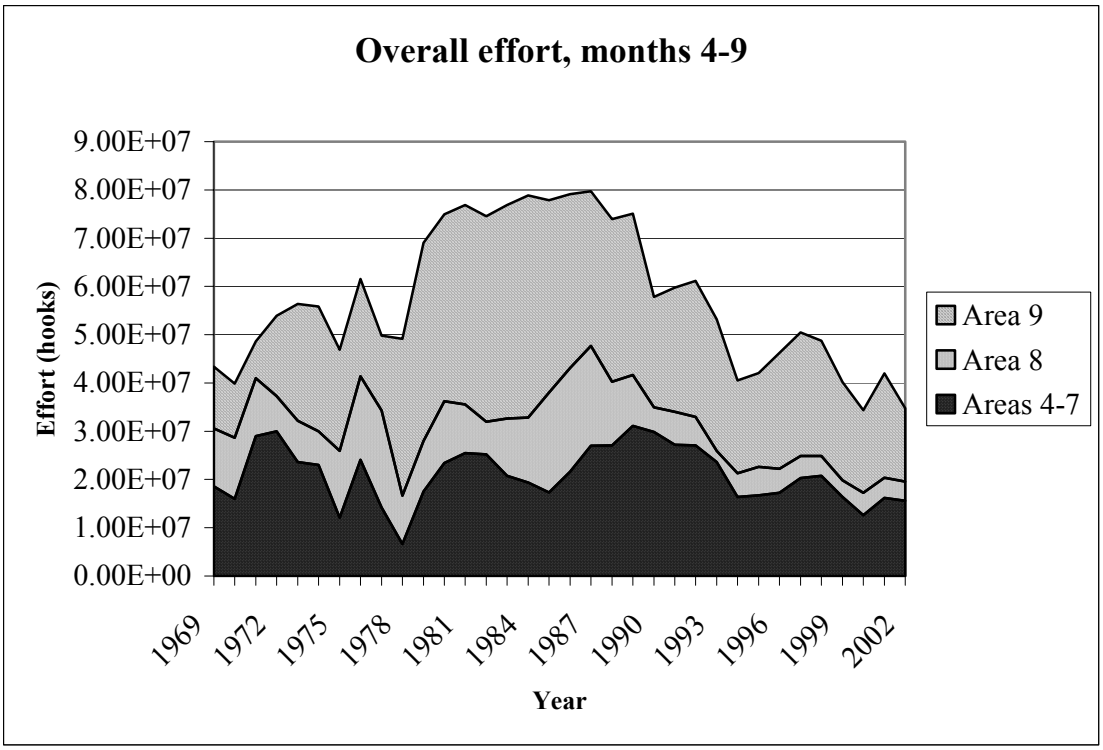

Figure 5-8 Fishing effort in Statistical Areas 4-7, 8 and 9, months 4-9.

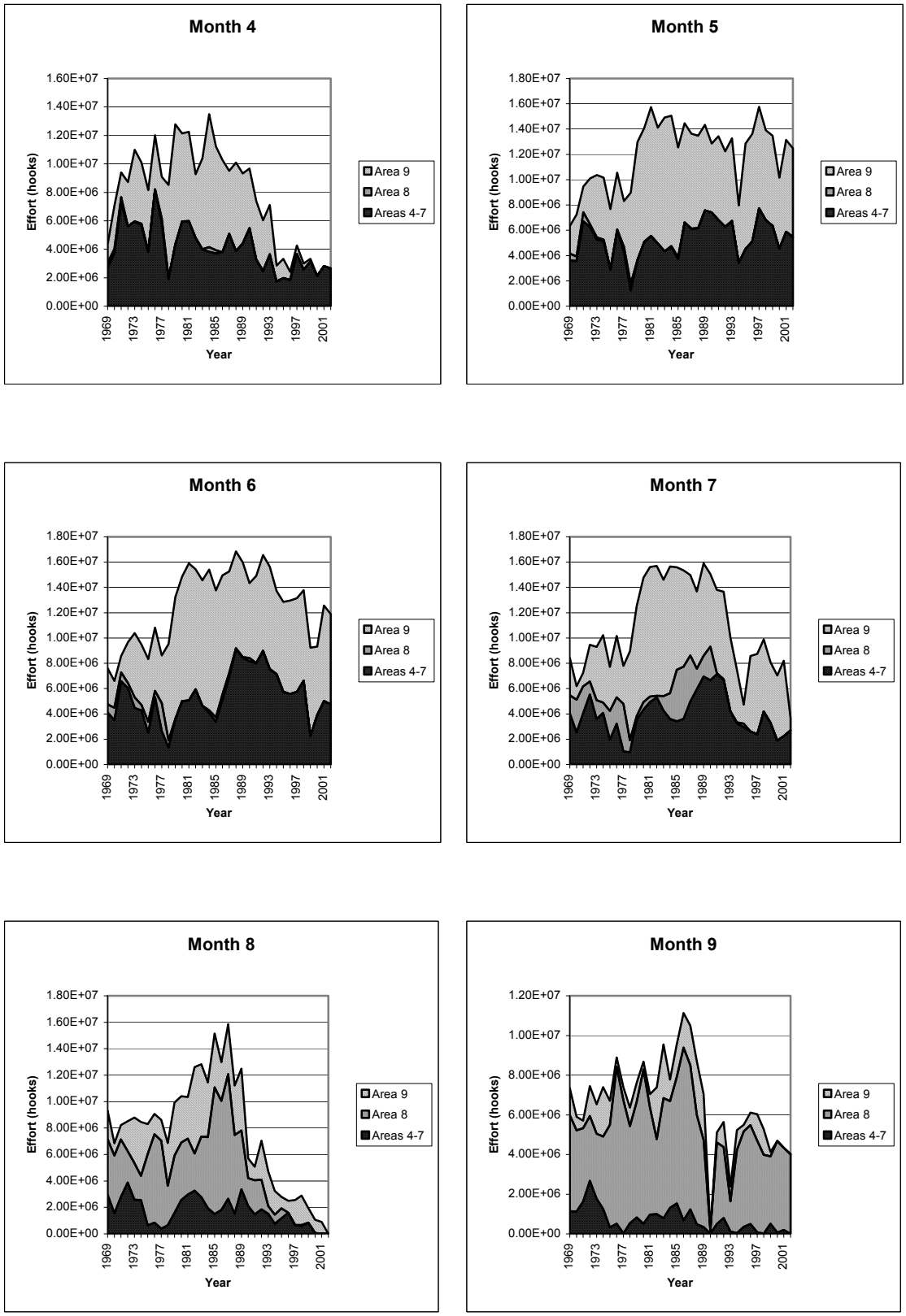

Figure 5-9 Monthly fishing effort in Statistical Areas 4-7, 8 and 9.

Table 5-1 Number of squares fished by year and month in statistical areas 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	44	33	28	231
1992	37	44	40	46	24	24	215
1993	37	46	39	44	24	20	210
1994	19	33	51	25	19	17	164
1995	20	44	42	26	20	18	170
1996	15	48	49	37	16	16	181
1997	25	42	43	33	7	17	167
1998	19	44	49	37	23	16	188
1999	26	37	32	41	22	18	176
2000	14	26	32	30	5	12	119
2001	13	27	30	26	11	13	120
2002	7	27	22	24	0	12	92

Table 5-2 Number of squares fished by year and month in statistical areas 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	22	14	7	111
1992	13	22	25	23	10	6	99
1993	12	24	20	22	7	3	88
1994	9	12	23	10	5	1	60
1995	12	20	20	12	7	3	74
1996	9	20	19	12	10	4	74
1997	21	20	23	12	3	3	82
1998	14	15	19	13	8	2	71
1999	19	17	9	15	8	4	72
2000	13	13	12	9	3	2	52
2001	13	12	10	9	1	2	47
2002	7	10	7	12	0	0	36

Table 5-3 Number of squares fished by year and month in statistical area 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	1	5	11	19
1995	0	0	1	5	8	10	24
1996	0	2	2	1	0	8	13
1997	0	0	0	0	0	10	10
1998	0	1	0	2	2	10	15
1999	0	1	1	2	0	11	15
2000	0	0	0	0	0	10	10
2001	0	0	0	0	0	11	11
2002	0	0	0	0	0	12	12

Table 5-4 Number of squares fished by year and month in statistical area 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	8	24	21	9	5	5	72
1996	6	26	28	24	6	4	94
1997	4	22	20	21	4	4	75
1998	5	28	30	22	13	4	102
1999	7	19	22	24	14	3	89
2000	1	13	20	21	2	0	57
2001	0	15	20	17	10	0	62
2002	0	17	15	12	0	0	44

6 Trends in nominal catch rates

Figure 6-1 and 6-2 provide nominal catch rate estimates (total catch over total effort) by age for Japanese longline vessels based on the combined data for statistical areas 4-9 from quarters 2 and 3. Figure 6-3 provides a more detailed representation of recent changes in age specific catch rates. In Figure 6.3 the catch rates for ages 4-11 have all been overlaid and the series of figures provides a synopsis of the changes over 2-3 year intervals. Figure 6.4 provides a synopsis of the catch rate for the 12+ age group.

The aggregated indices for age 3-7 and ages 8 plus show a positive trend in catch rates in recent years which is maintained when the 2002 data are added. However, the increase in the aggregated age 3-7 index is driven by the increases in the age 6 and 7 indices while the indices for the younger ages (three, four and five) decreased between 2001 and 2002. This may indicate that the most recent cohorts may not be as strong as those immediately preceding them. However, Figure 6-3 indicates that in the past that 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 recent trends by fishing grounds are also quite different and conflicting for the age-specific indices. Thus, the increases between 2001 and 2002 in the spatially aggregated indices for all areas for ages 9, 10, 11 and 12+ are the result of increased catch rate in Area 9 while the indices for these ages either declined or were essentially unchanged in Areas 8 and 4-7 (Figures 6-5 and 6-6). Comparison of all the age specific indices by area since 1992 suggests that for all ages that there has been a rather continuous increase in Area 9 since the mid 1990's. In contrast, for Area 4-7 the indices for the three oldest age classes have been declining since 1999 and in Area 8 the indices have been decreasing for nearly all ages since 2000. The variations among the age specific trends by area suggest quite different potential for the ages 8-11 to contribute to rebuilding of the spawning stock. It is not clear to what extent the differences among statistical areas reflect differences in targeting/selectivity and the extent to which they reflect large scale spatial structure and different spatial trends in the population. The differences also confound interpretation of any combined index. Any trends in the nominal indices will be sensitive to the relative amounts of effort in the different statistical areas. Spatially weighted indices would similarly be sensitive to the relative number of squares fished in each statistical area (see Tables 5-2 to 5-4).

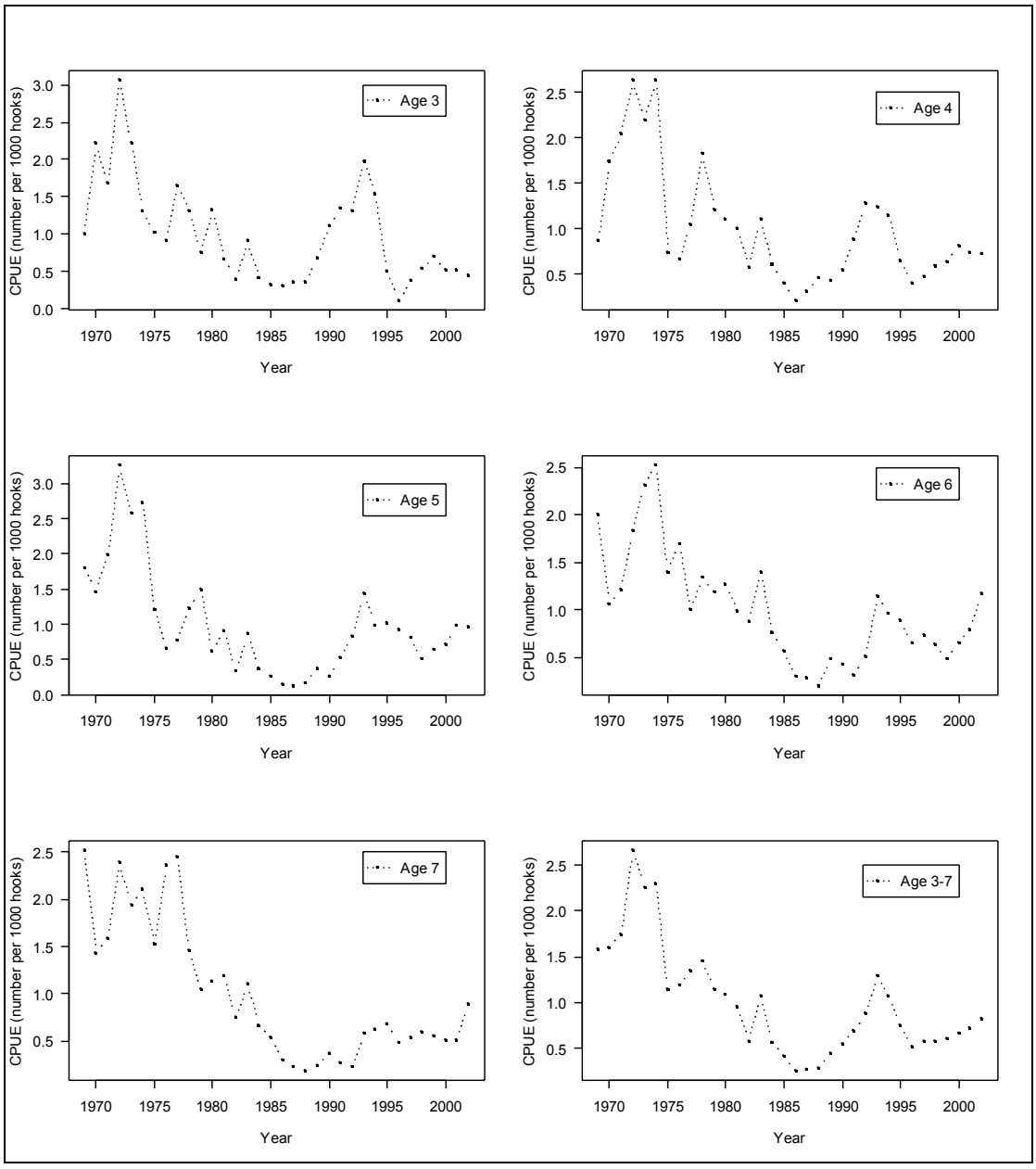

Figure 6-1 Nominal CPUE vs Year for Japanese longline, Australian Joint Venture and New Zealand Joint Venture in Statistical Areas 4-9, ages 3,4,5,6,7 and 3-7. All indicies have been standardized by their means.

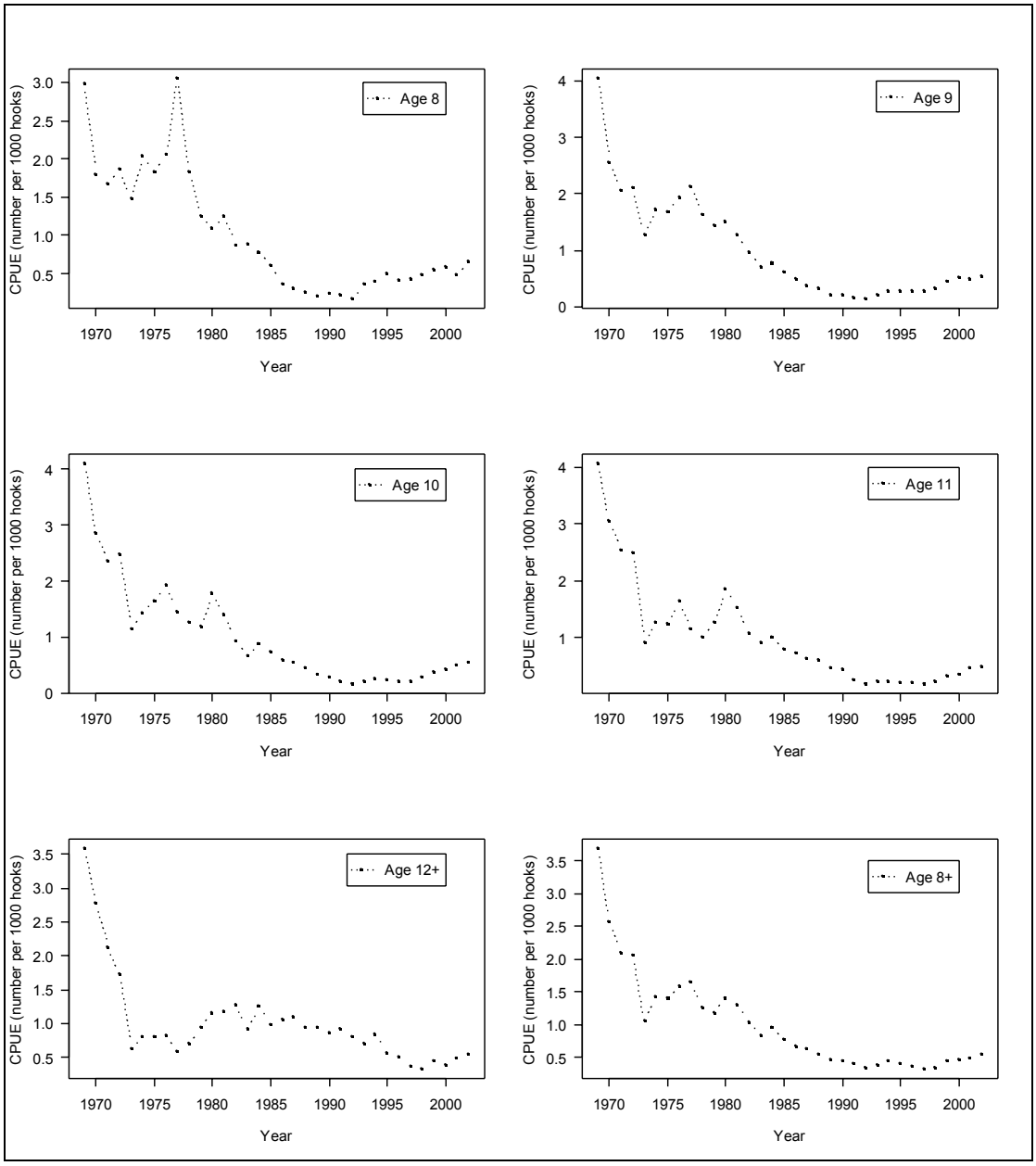

Figure 6-2 Nominal CPUE vs Year for Japanese longline, Australian Joint Venture and New Zealand Joint Venture in Statistical Areas 4-9, ages 8,9,10,11,12+ and 8+. All indicies have been standardized by their means.

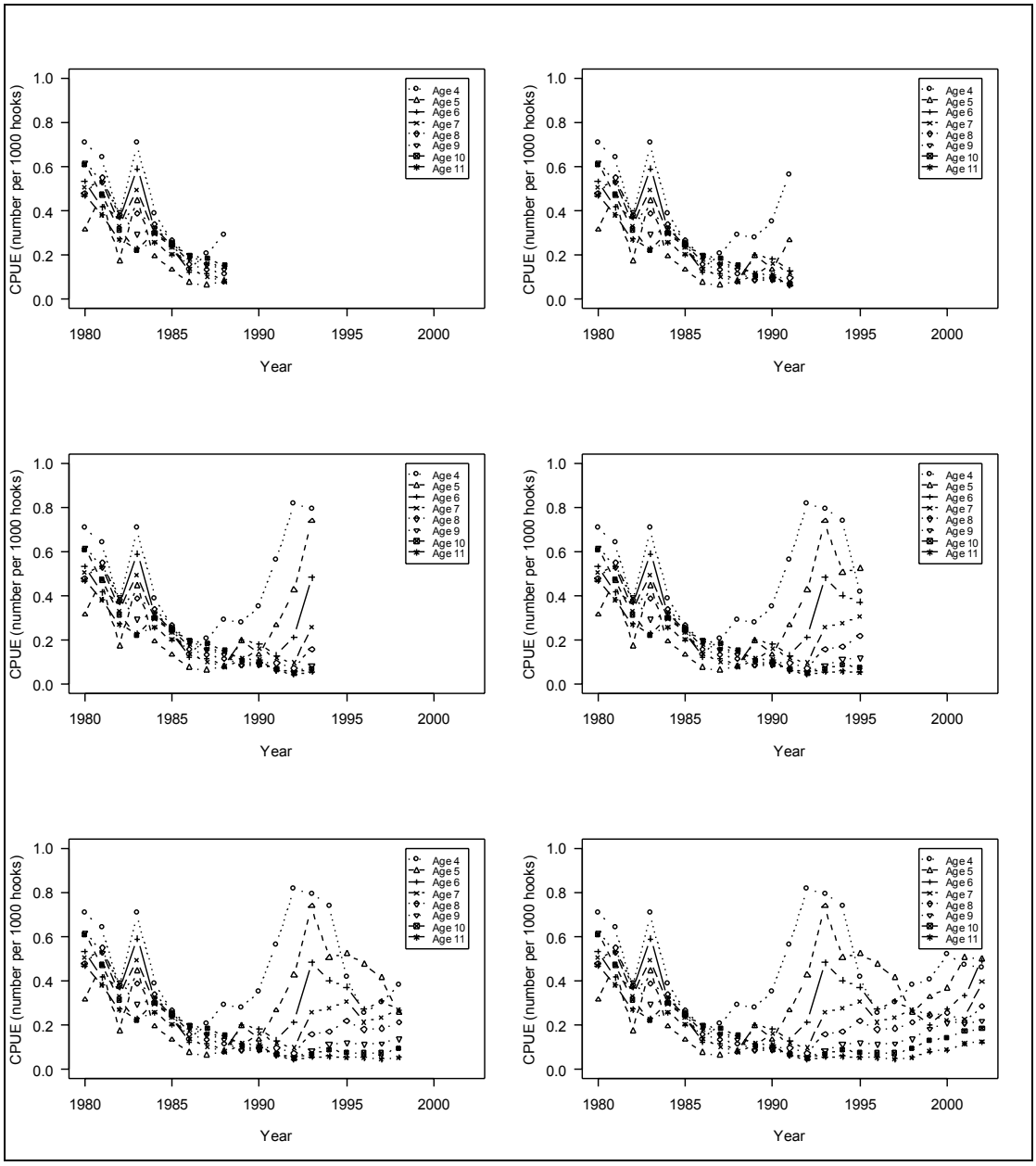

Figure 6-3 Synopsis of changes in nominal age-specific CPUE indices in recent years. Theses indices have not been standardized by their means.

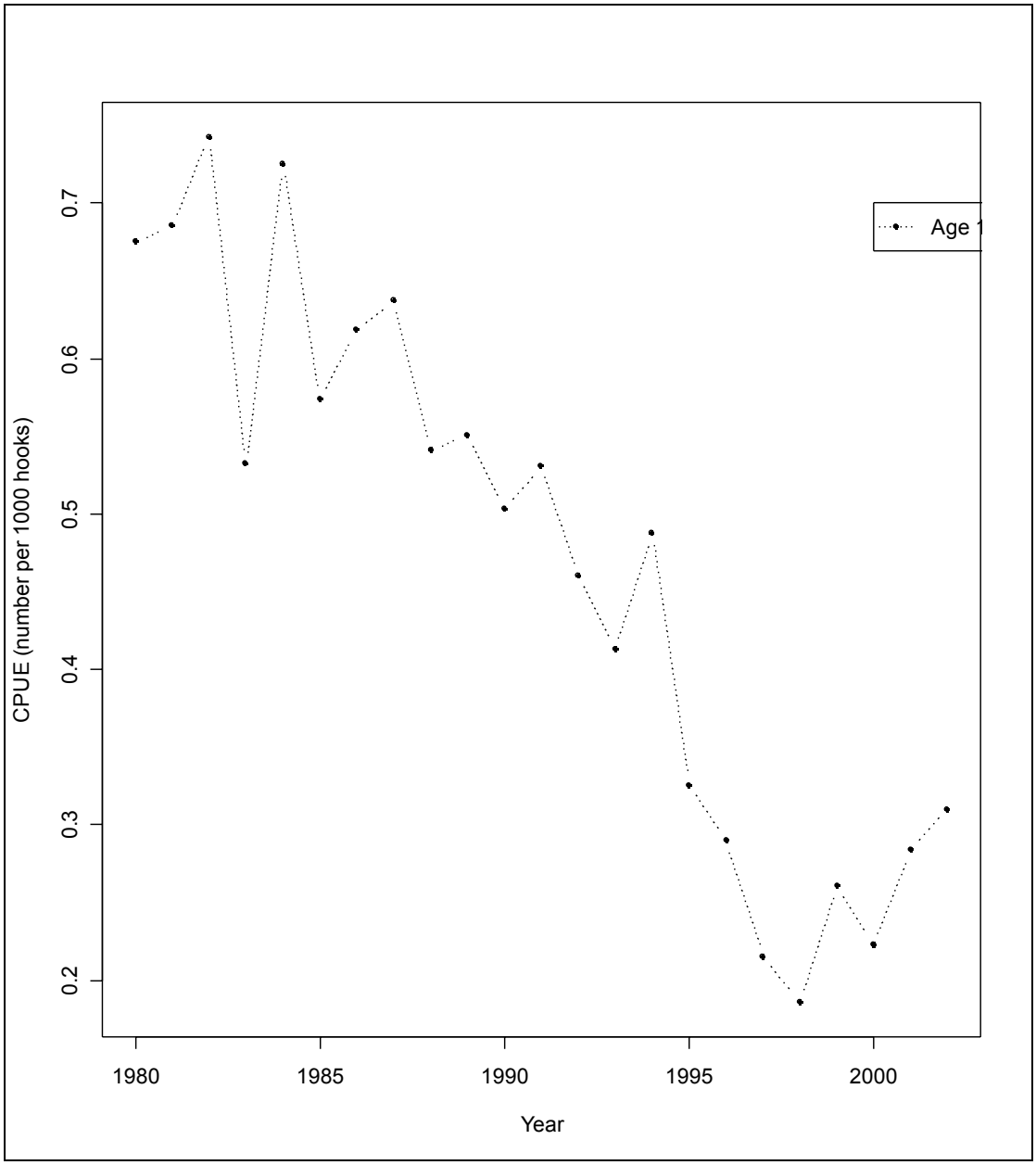

Figure 6-4 Synopsis of changes in nominal age-specific CPUE index for the 12+ age group in recent years. Theis index has not been standardized by its mean.

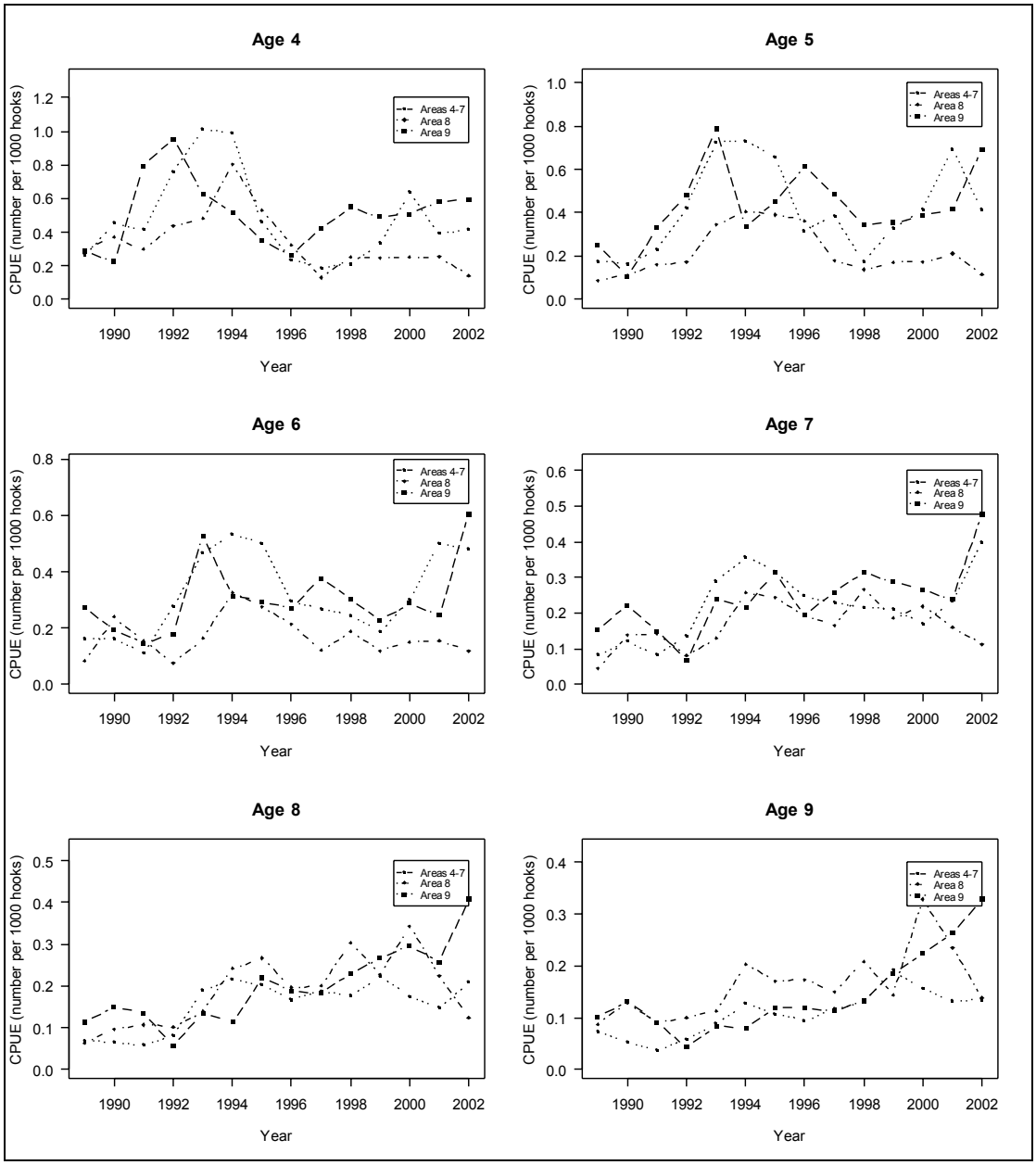

Figure 6-5 Comparison of age-specific nominal catch rates(Number per 1000 hooks) in recent years for different fishing regions. These indices have not been stadardized by their means.

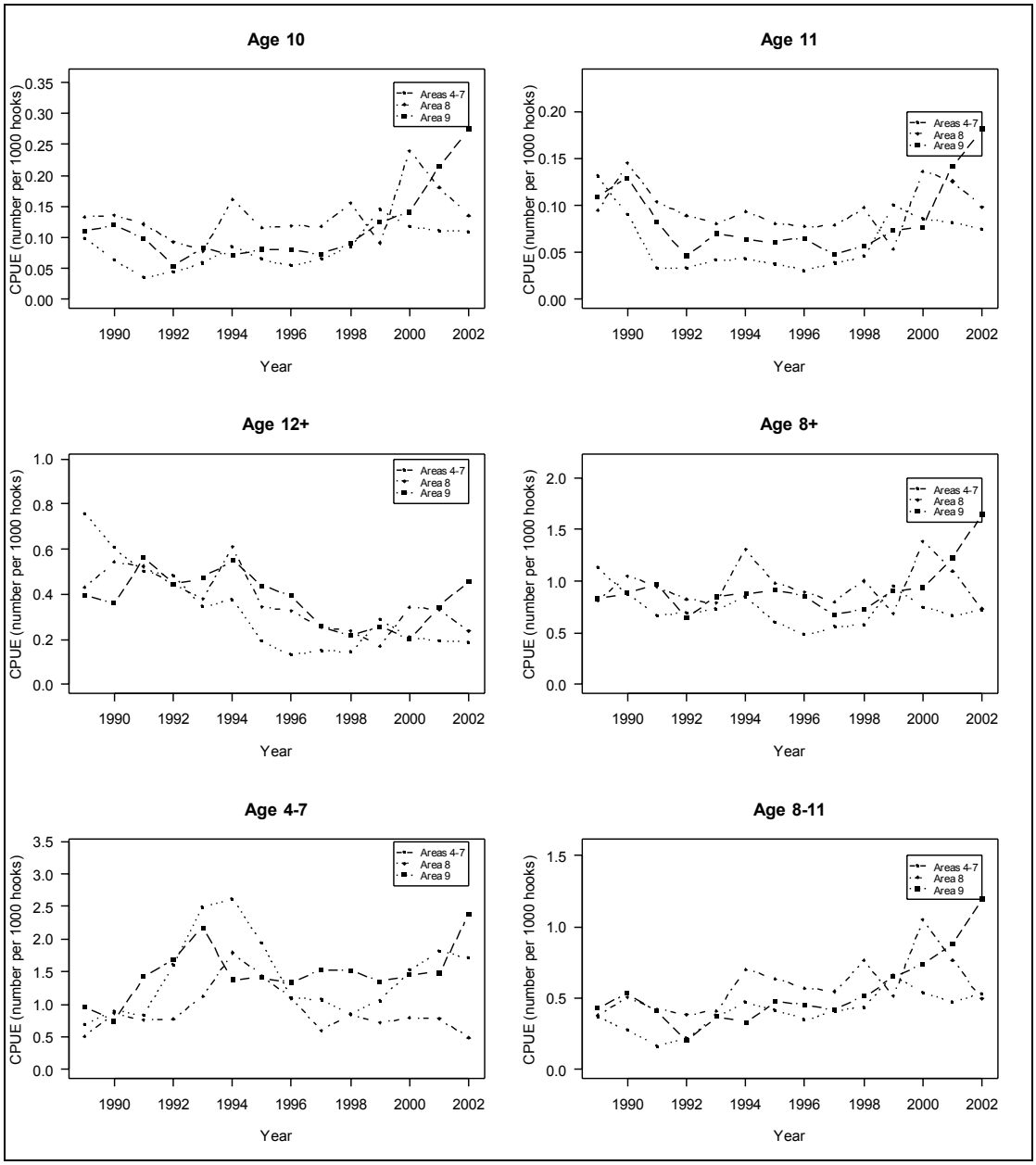

Figure 6-6 Comparison of age-specific nominal catch rates (Number per 1000 hooks) in recent years for different fishing regions. These indices have not been standardized by their means.

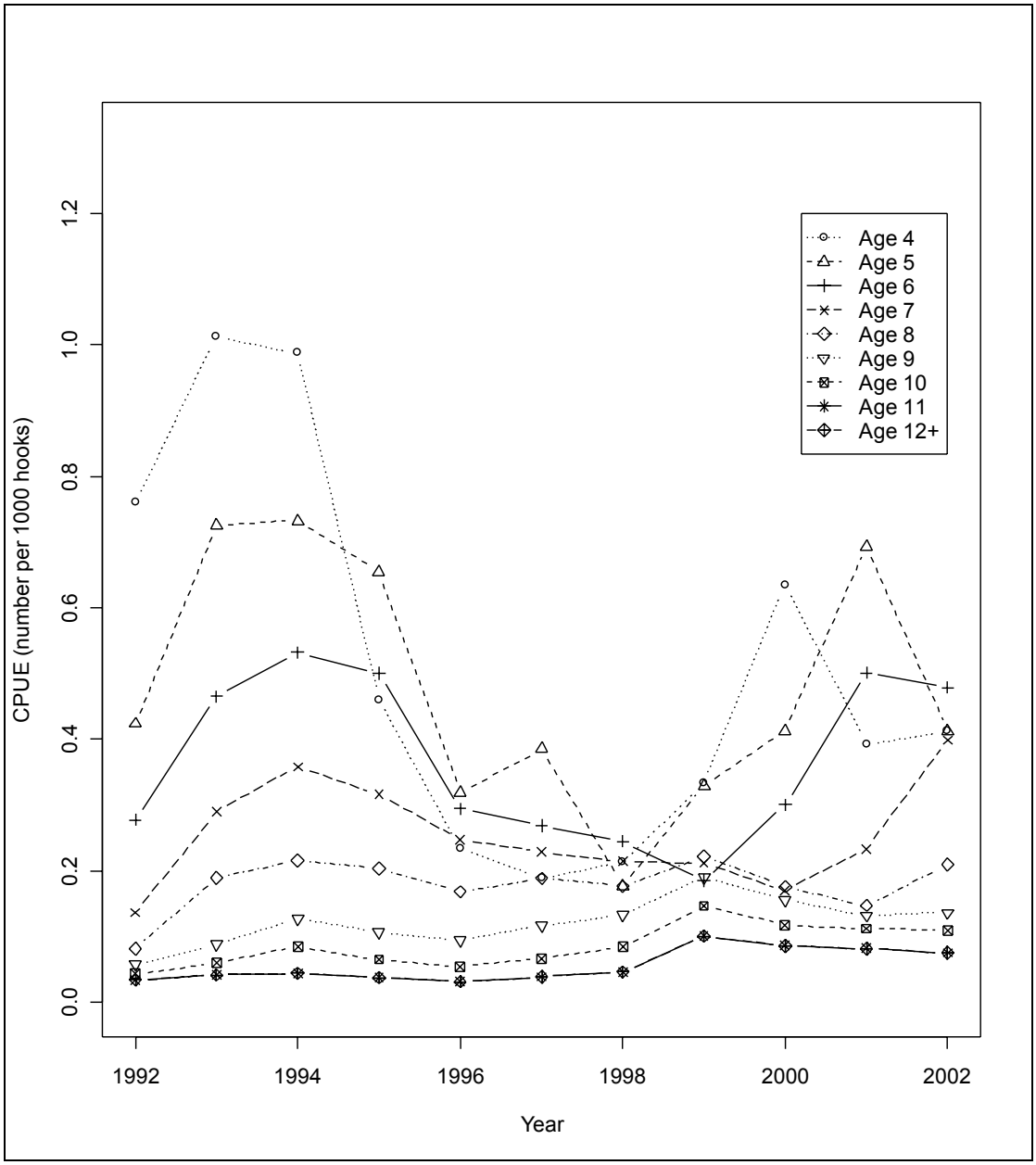

Figure 6-7 Comparison of recent nominal age-specific catch rates (Number per 1000 hooks) for Statistical Areas 4-7. These indices have not been standardized by their means.

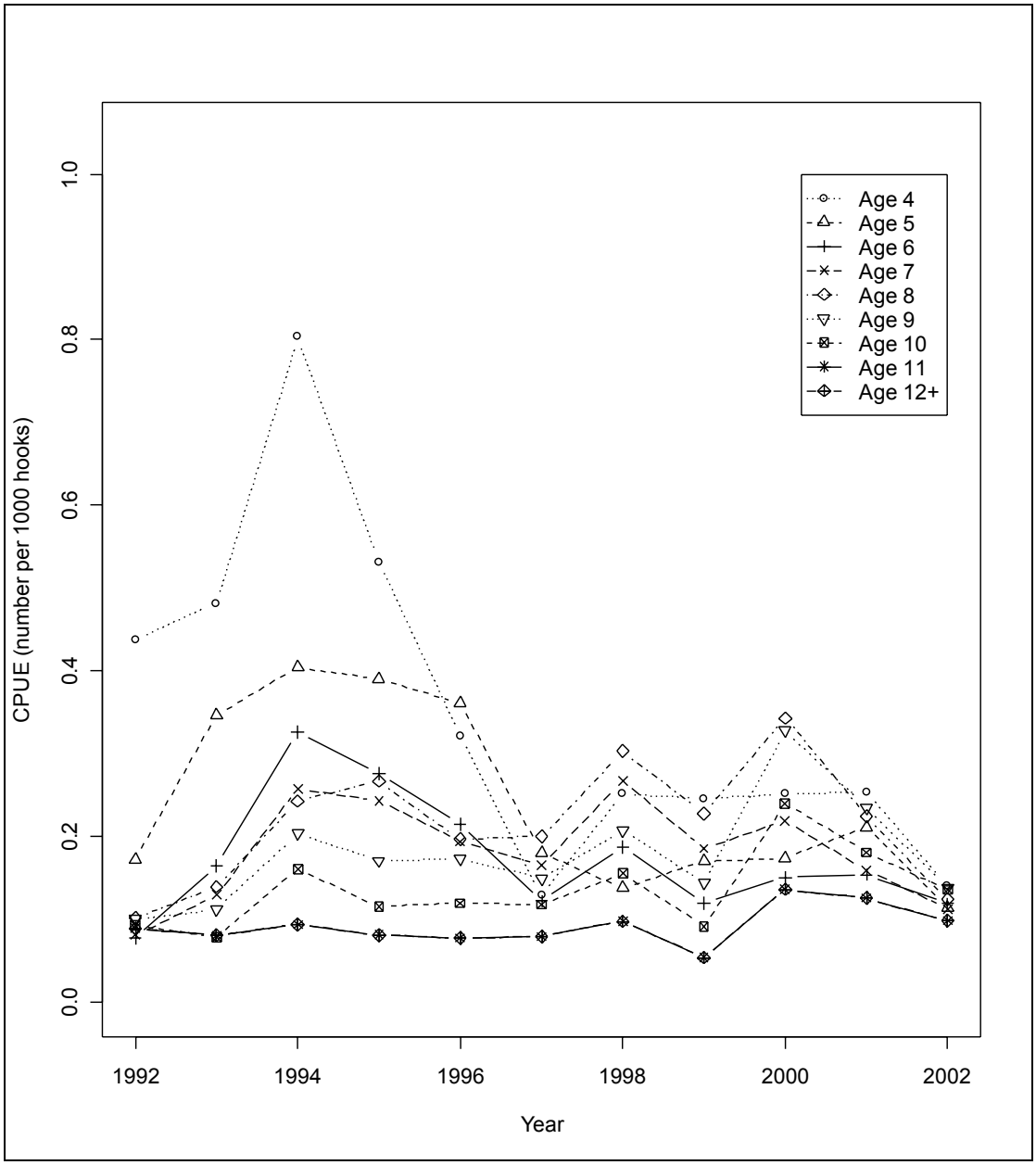

Figure 6-8 Comparison of recent nominal age-specific catch rates (Number per 1000 hooks) for Statistical Area 8. These indices have not been standardized by their means.

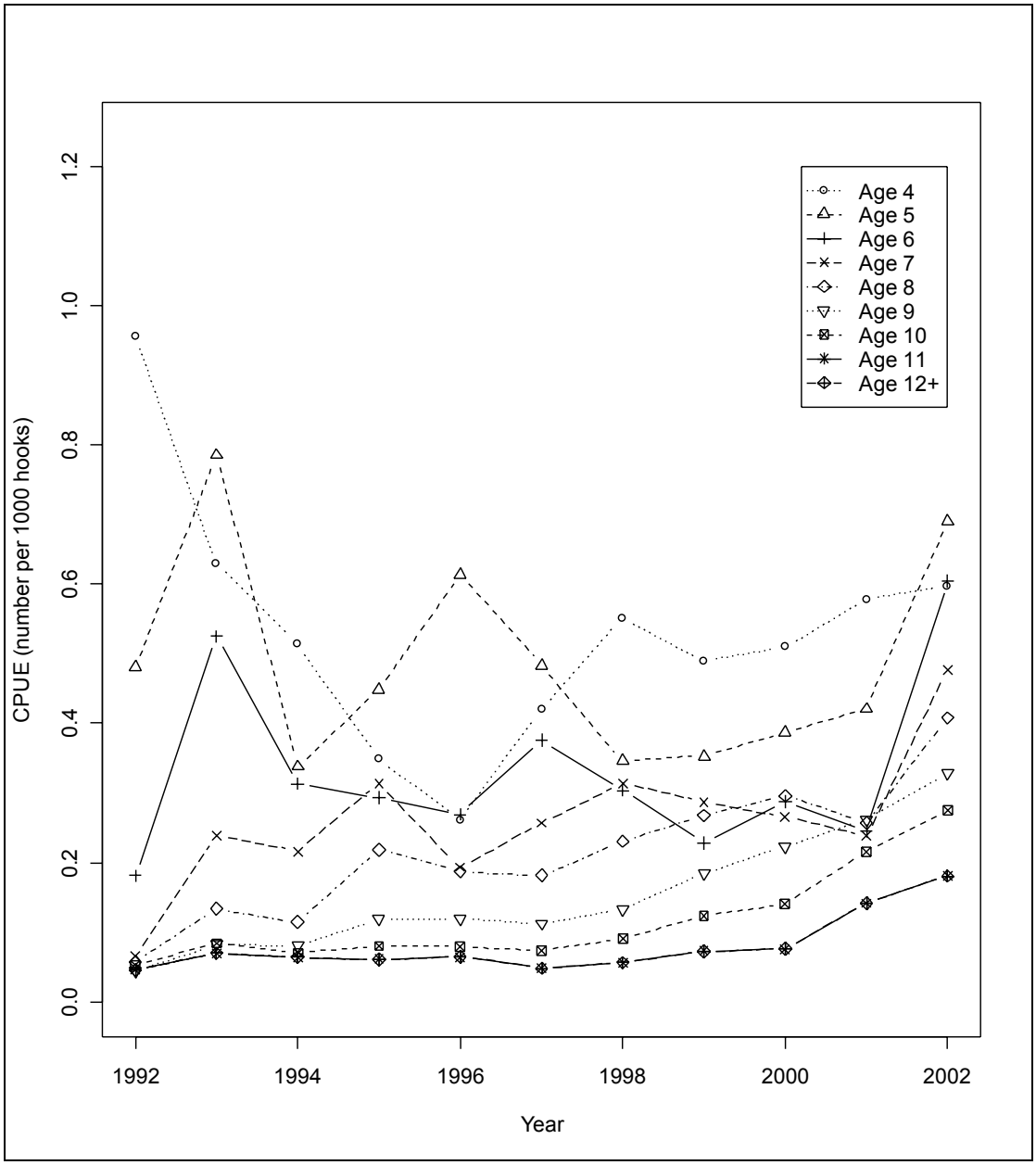

Figure 6-9 Comparison of recent nominal age-specific catch rates (Number per 1000 hooks) for Statistical Area 9. These indices have not been standardized by their means.

6.1 Catch rates by cohorts

Figures 6-10 to 6-12 provide 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 subseqeunt catch rates as cohorts age. 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. As these more recent cohorts are beginning to mature, this suggesting that they may potentially have more to contribute to rebuilding the spawning stock.

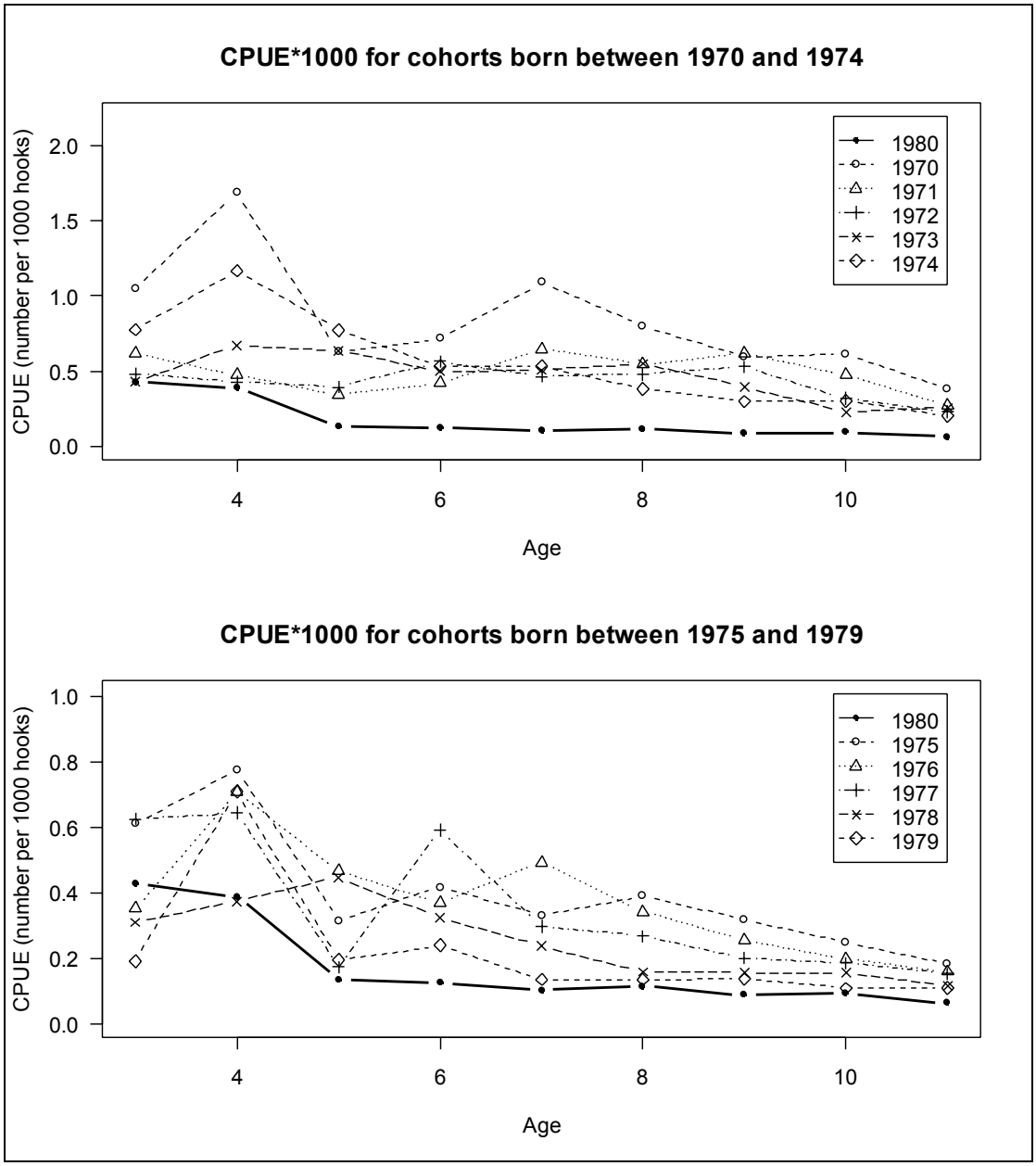

Figure 6-10 Nominal CPUE in Statistical Areas 4-9, months 4-9 for cohorts born between (a) 1970 and 1974, and (b) 1975 and 1979. The cohort born in 1980 is also shown for reference. These indices have not been standardized by their means.

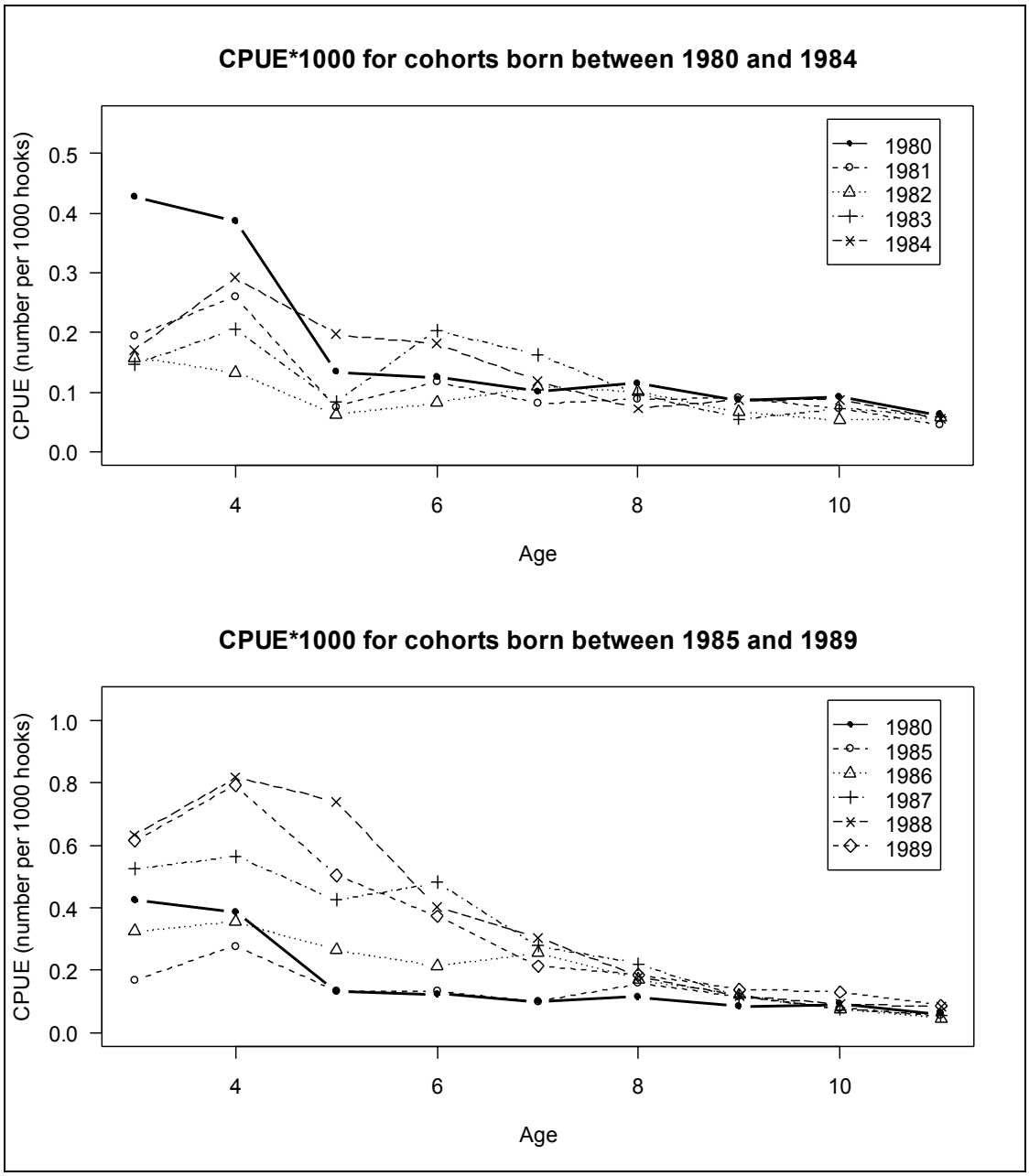

Figure 6-11 Nominal CPUE in Statistical Areas 4-9, months 4-9 for cohorts born between (a) 1980 and 1984, and (b) 1985 and 1989. The cohort born in 1980 is also shown for reference. These indices have not been standardized by their means.

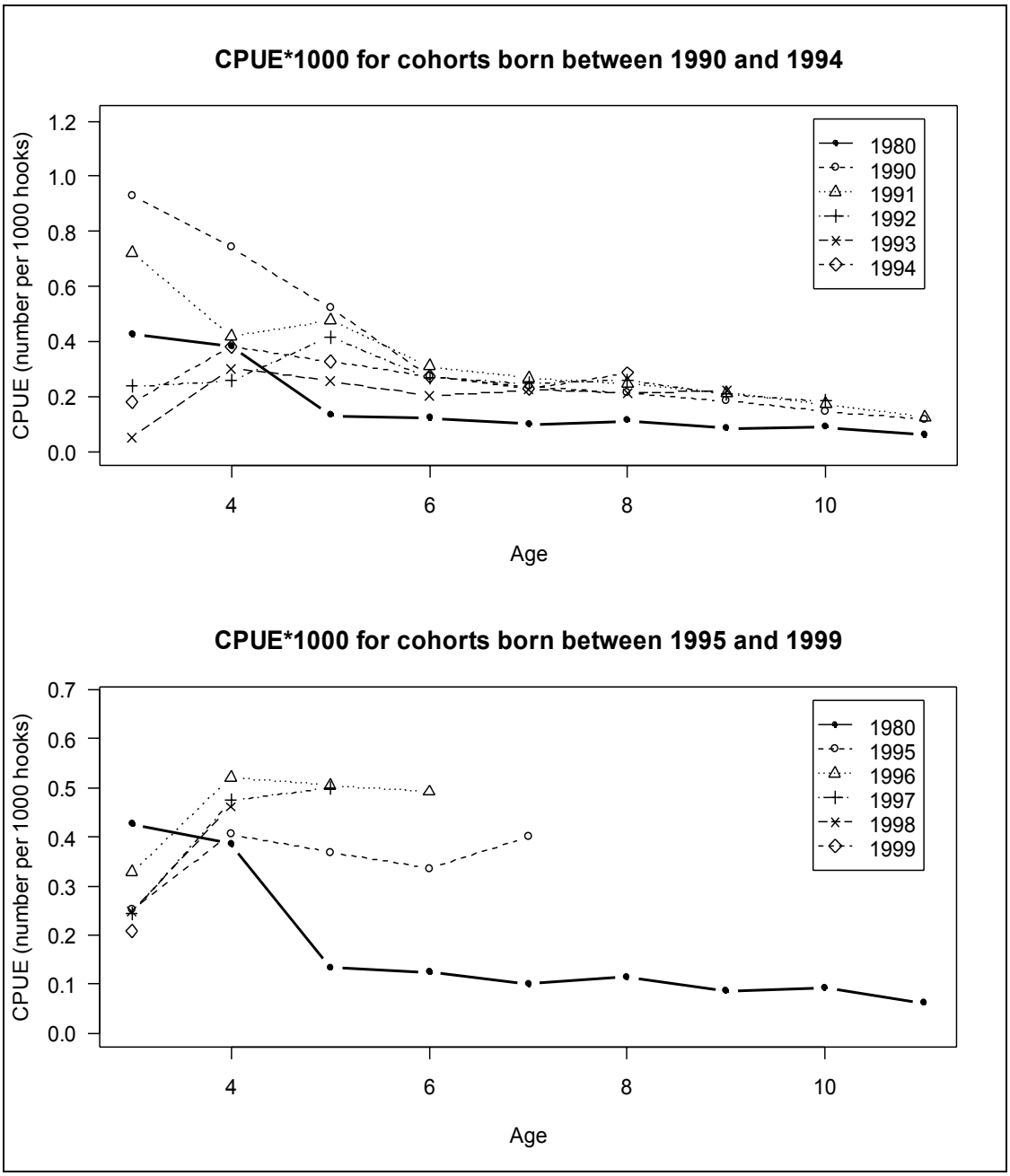

Figure 6-12 Nominal CPUE in Statistical Areas 4-9, months 4-9 for cohorts born between (a) 1990 and 1994, and (b) 1995 and 1999. The cohort born in 1980 is also shown for reference. These indices have not been standardized by their means.

7 Literature cited

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Preece, A., T. Polacheck, D. Kolody, P. Eveson, D. Ricard, P. Jumppanen, J. Farley and T.Davis. 2001. Summary of the Primary Data Inputs to CSIRO's 2001 Stock Assessment Models. CCSBT-SC/0108/21.

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8 Appendix

Annual trends in nominal SBT catch rates by area and in the monthly nominal catch rates by areas and for all areas combined.

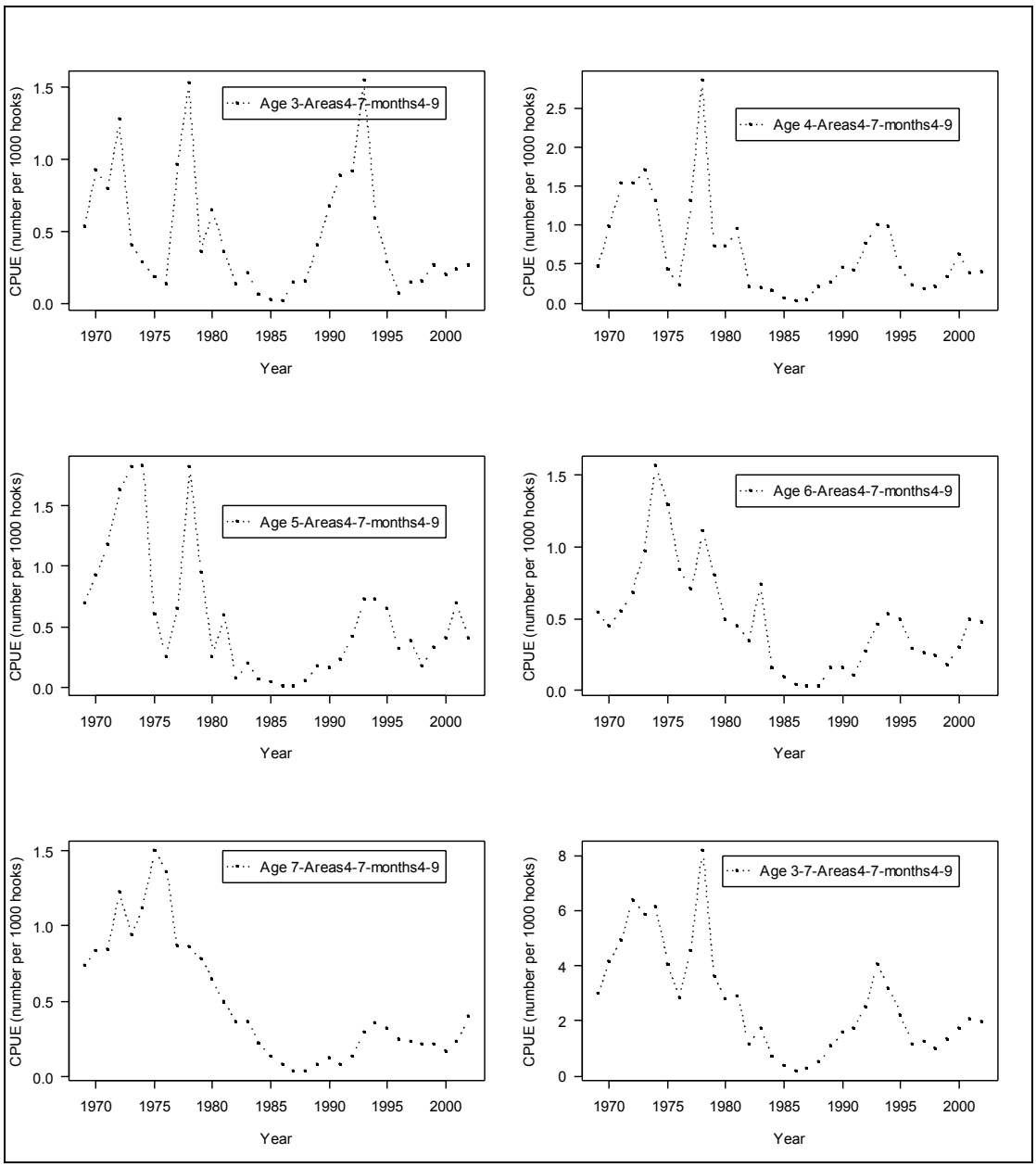

Figure 8-1 Nominal CPUE vs Year for Japanese longline, Australian Joint Venture and New Zealand Joint Venture in Statistical Areas 4-7, ages 3,4,5,6,7 and 3-7.

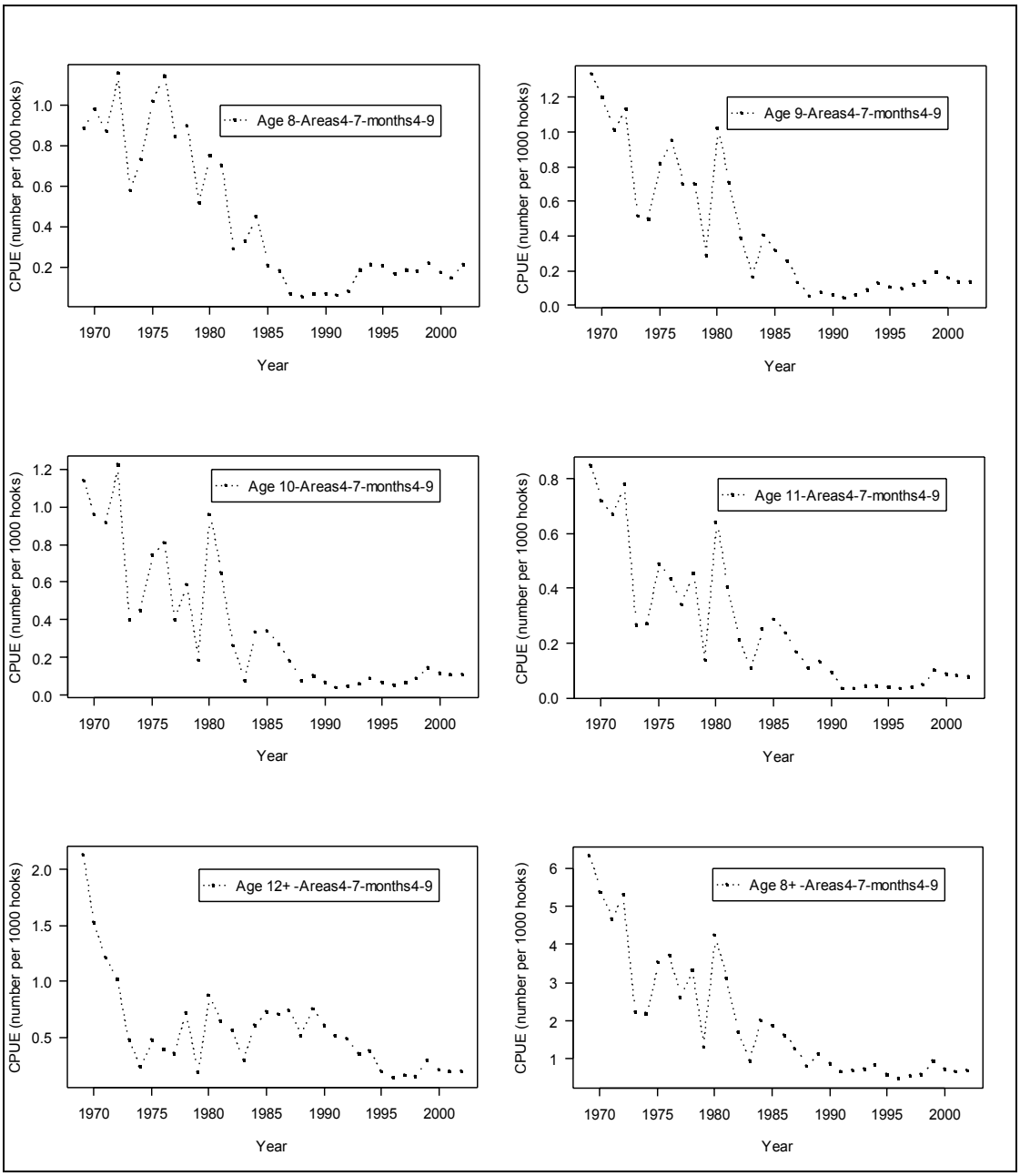

Figure 8-2 Nominal CPUE vs Year for Japanese longline, Australian Joint Venture and New Zealand Joint Venture in Statistical Areas 4-7, ages 8,9,10,11,12+ and 8+.

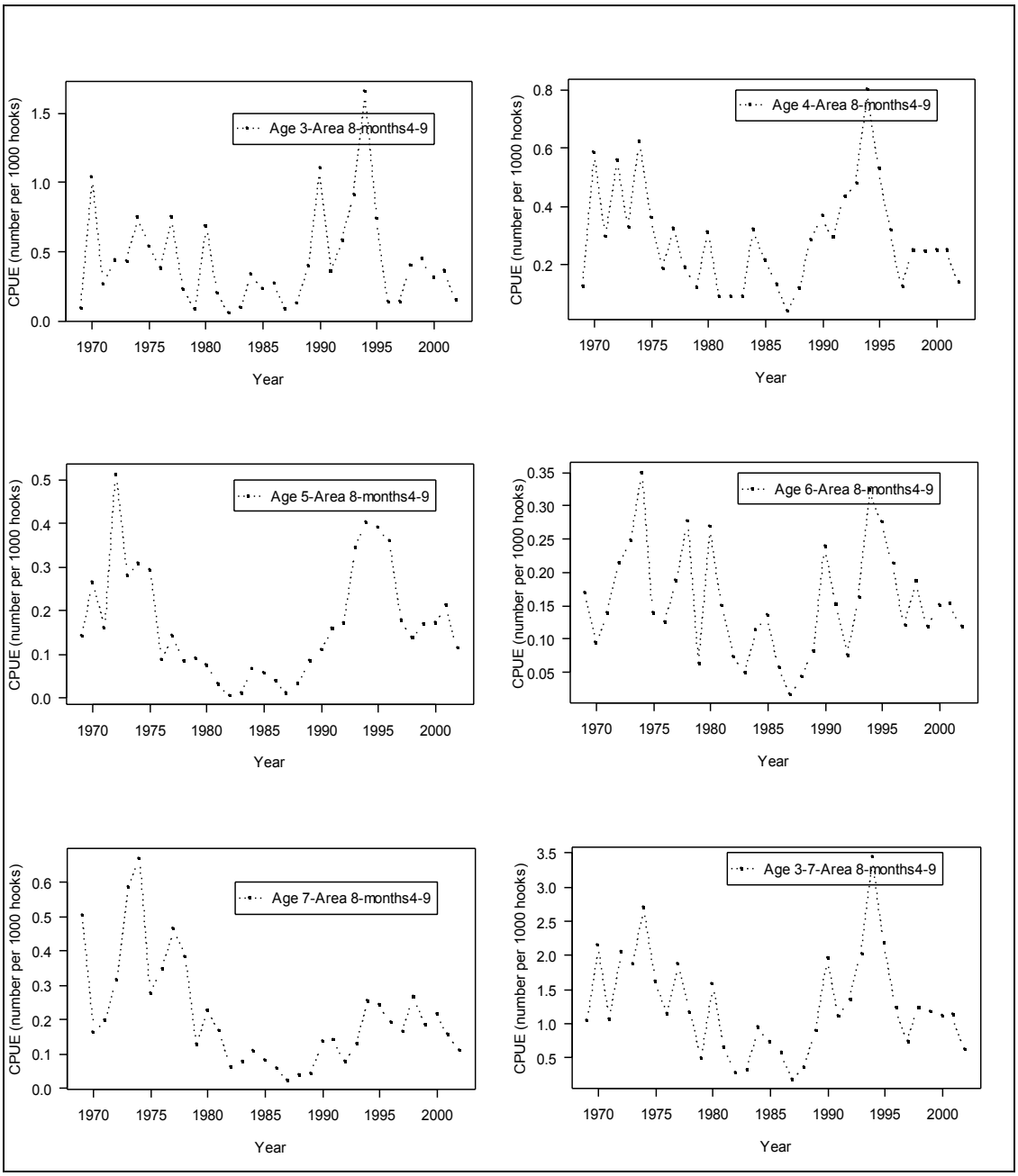

Figure 8-3 Nominal CPUE vs Year for Japanese longline, Australian Joint Venture and New Zealand Joint Venture in Statistical Area 8, ages 3,4,5,6,7 and 3-7.

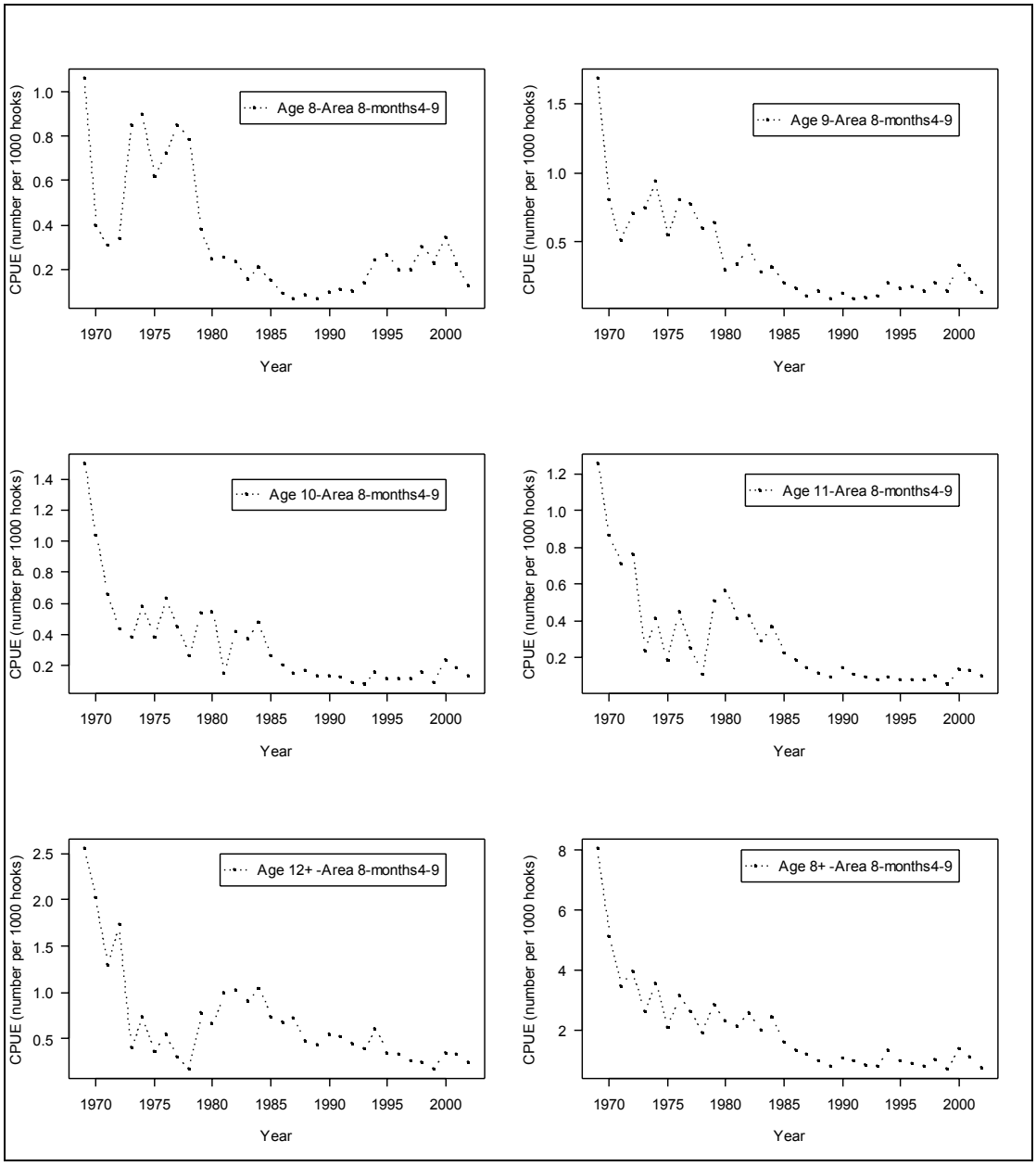

Figure 8-4 Nominal CPUE vs Year for Japanese longline, Australian Joint Venture and New Zealand Joint Venture in Statistical Area 8, ages 8,9,10,11,12+ and 8+.

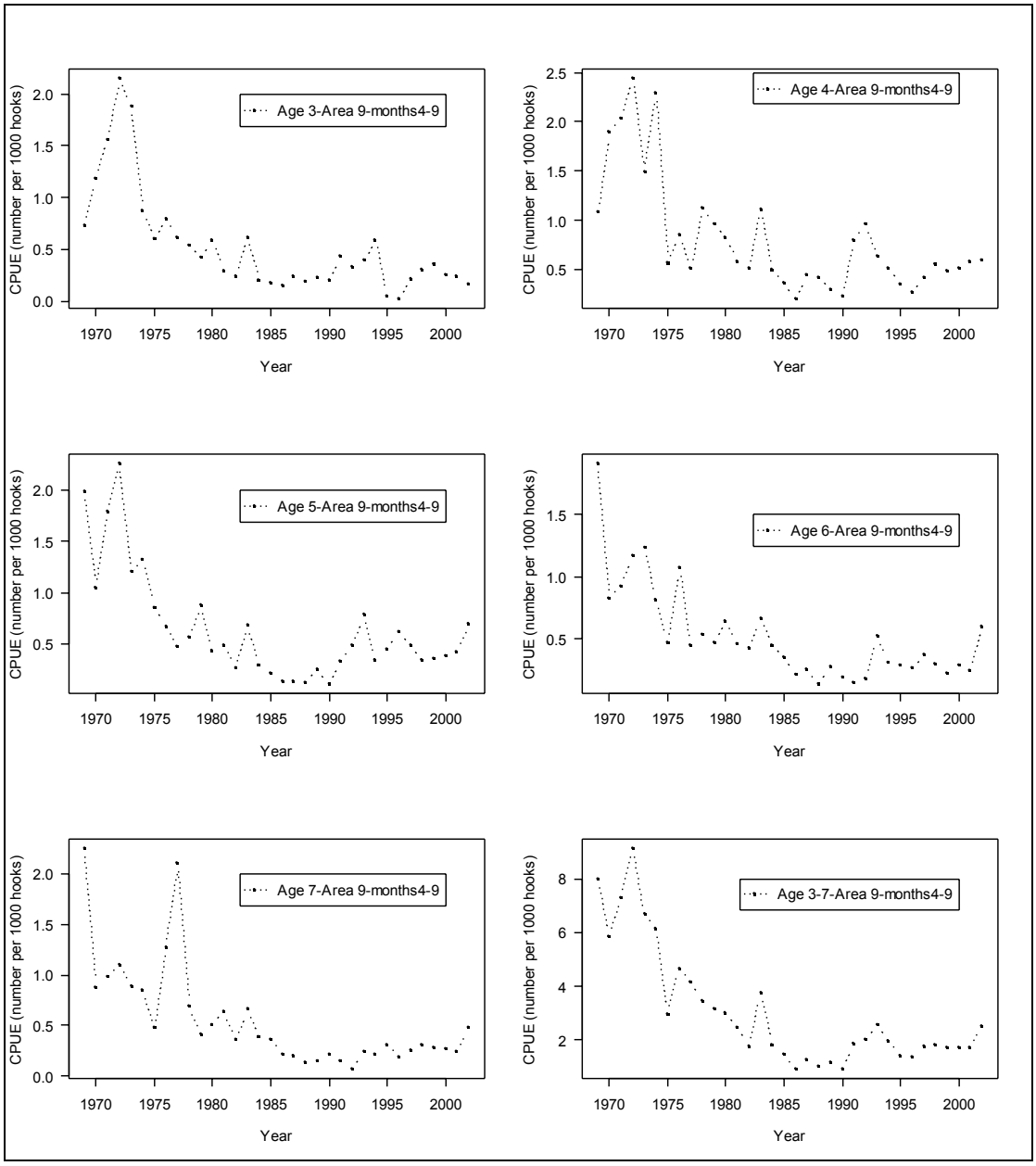

Figure 8-5 Nominal CPUE vs Year for Japanese longline, Australian Joint Venture and New Zealand Joint Venture in Statistical Area 9, ages 3,4,5,6,7 and 3-7.

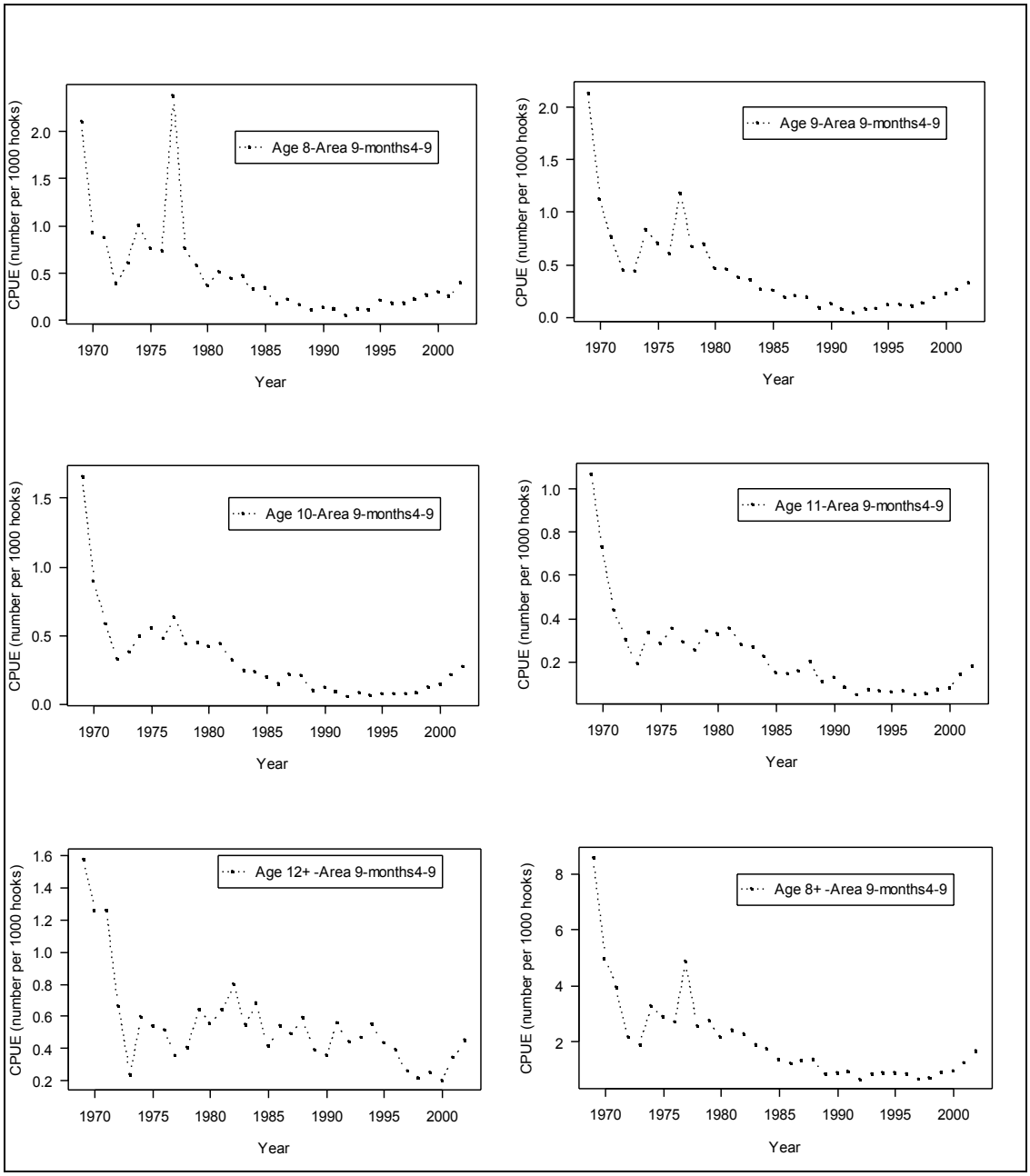

Figure 8-6 Nominal CPUE vs Year for Japanese longline, Australian Joint Venture and New Zealand Joint Venture in Statistical Area 9, ages 8,9,10,11,12+ and 8+.

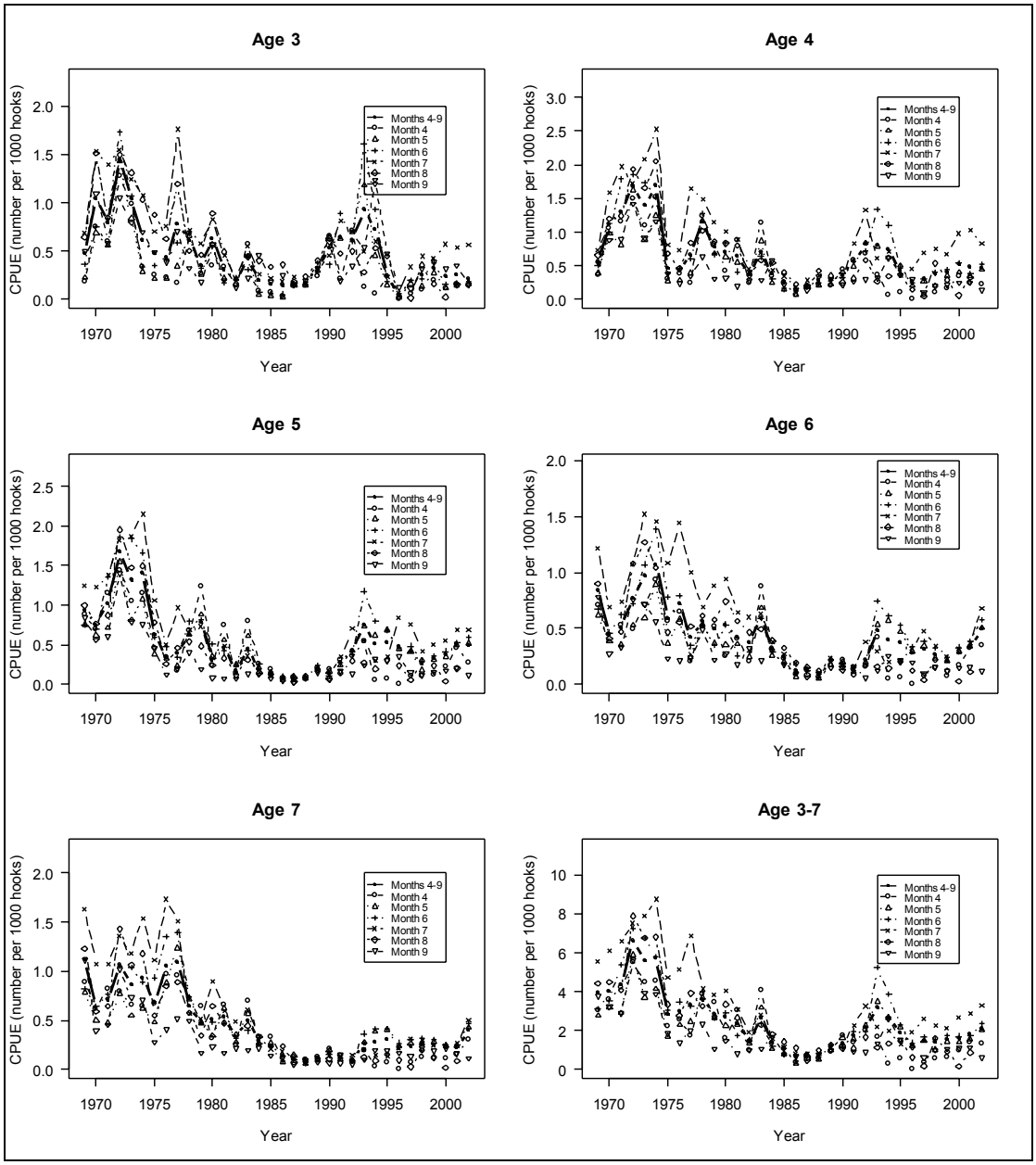

Figure 8-7 Nominal CPUE vs Year for Japanese longline, Australian Joint Venture and New Zealand Joint Venture in Statistical Areas 4-9, ages 3,4,5,6,7 and 3-7. The total yearly CPUE is shown along with the monthly CPUEs.

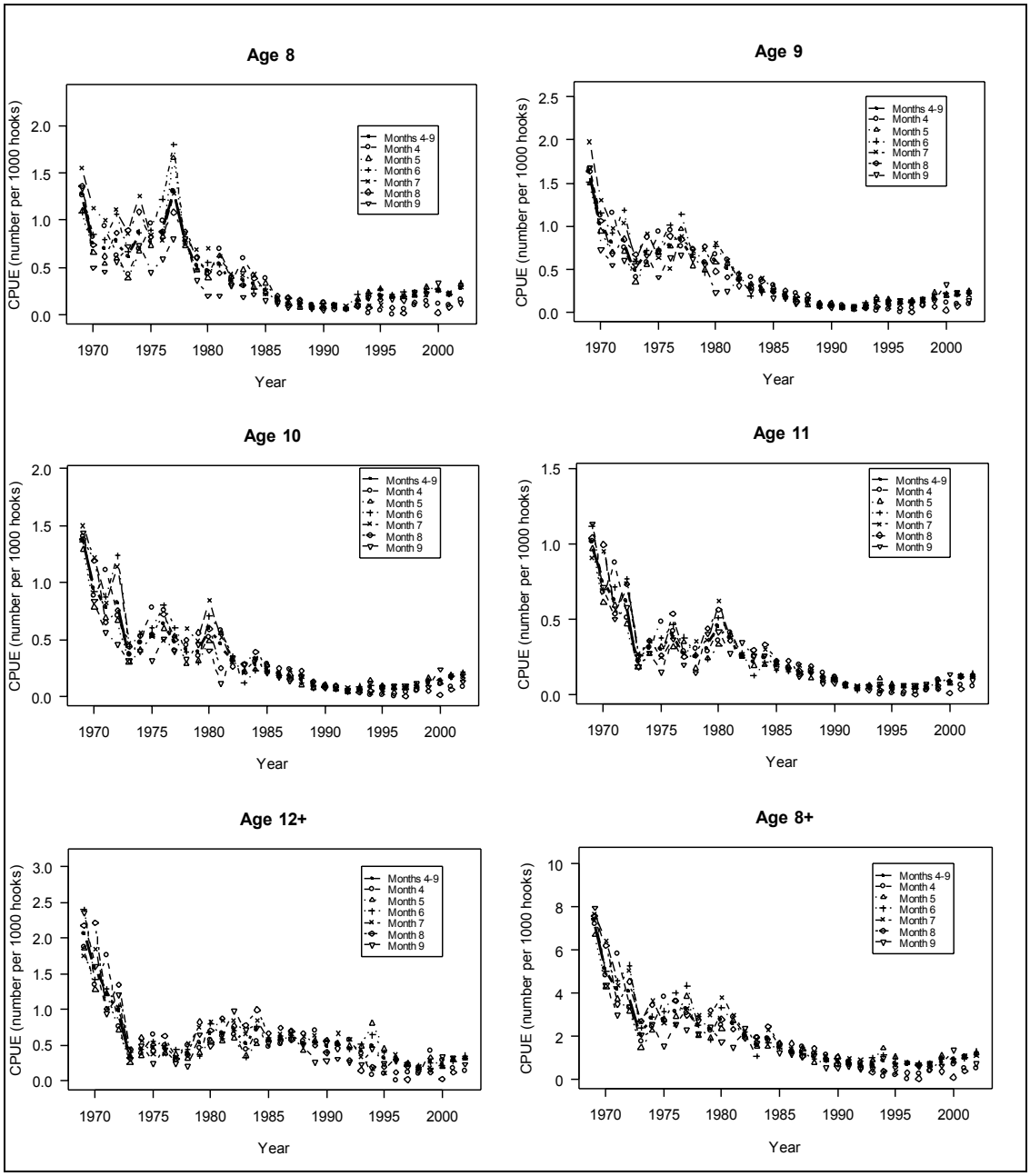

Figure 8-8 Nominal CPUE vs Year for Japanese longline, Australian Joint Venture and New Zealand Joint Venture in Statistical Areas 4-9, ages 8,9,10,11,12+ and 8+. The total yearly CPUE is shown along with the monthly CPUEs.