Summary of Fisheries Indicators in 2006

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Abstract : Various fisheries indicators were examined to overview the current status of SBT stock. The indices suggested that current stock levels for middle to high age groups were the same levels in the late 1990s (except for age 5). CPUE indices for most age groups showed increasing trends from the late 1990s to 2002. In recent years, the indices for age 3 and 4 have stayed at historically low levels and ones for age 5 and 6&7 have continued to decline. Many indices indicated recent low recruitments of at least 1999 and 2000 cohorts. The acoustic survey indices from Recruitment Monitoring Program (RMP) suggested continuous low recruitments for six years (1999-2002 cohorts, 2004 and 2005 cohorts). The further careful monitoring of recruitments and serious consideration on impacts of potential low recruitments on stock management are continuous tasks with the highest priority. Indices on spawning stock are difficult to interpret and thus no specific conclusion was drawn.

要旨：ミナミマグロ資源状態を概観するために、各種漁業指数を検討した。現時点での中高齢魚の資源状態は、5 歳魚を除いて 1990 年代終りと同レベルにある。ほとんどの年齢クラスの CPUE 指標は、1990 年代の終りから 2002 年にかけて増加傾向を示しめしている。近年、3 歳および 4 歳魚の CPUE 指標は歴史的に低いレベルを推移し、5 歳および 6＆7 歳魚の CPUE 指標は減少し続けている。多くの指標は少なくとも 1999 年級、2000 年級の加入が悪いことを示した。加入量モニタリング音響指数が 6 年間（1999-2002 年級, 2004 および 2005 年級）続けて加入が低いことを示唆している。今後は、さらに慎重に加入動向をモニターすること、加入の悪化が資源管理にどのような影響を及ぼすかを鋭意検討することの 2 点が重要である。親魚資源指標は解釈が難しく、これといった判断は行わなかった。

The 2001 Scientific Committee selected a set of fisheries indicators to overview the SBT stock status. These indicators were revised and used in past Stock Assessment Group (SAG) meetings to examine whether unexpected changes of stock status requiring full stock assessment were occurring. Also, the 3rd Meeting of Management Procedure Workshop held in April 2004 agreed to utilize every year's review of fisheries indicators to monitor whether stock stays within an expected range of the operating model. This document summarizes results of updated indicators including standardized Japanese longline CPUE and our overall interpretations. It should be noted that results of the Japanese market Panel and Australian farming Panel will be discussed during this year's SAG/SC meeting, so conclusions from these two Panels are not considered in this summary of indicators analyses.

1. Japanese longline CPUE:

Nominal CPUE

Fig. 1-1 shows nominal CPUE of Japanese longline operations including those by joint-venture vessels by age-groups. The most recent year's data almost exclusively rely on the data collected by the RTMP that covers only SBT targeting vessels. When all the other vessels' data become available in the following year, the CPUE of the most recent year tends to drop slightly (Takahashi et al. 2001). However, those differences have decreased gradually according to years, and almost no difference is found in recent years. The RTMP covers more than 95% of efforts in SBT distribution in recent years.

Nominal CPUE of middle to high age groups, i.e. age 5-11, had increased since the late 1990s until 2002, and then declined to the late 1990s levels. CPUE of age 3 and 4 showed substantial decreases in 2003 after staying at more or less consistent level for last six years. Caution is need for an interpretation of age 3 and 4 CPUE in 1995 and 1996 because of direct impact of non-retention of fish smaller than 25kg occurred in these years. Age 12+ CPUE were more or less stable during the 1970s, 1980s and early 1990s, then declined from 1994 to 1997 and stayed at the low level afterwards.

Fig. 1-2 and 1-3 show nominal CPUE of Japanese longline by cohort by age. Fig. 1-2 shows a comparison of nominal CPUE of juveniles among different cohorts and Fig. 1-3 compares decrease rate by cohort in logarithmic scale. CPUE of age 3, 4 and 5 fish generally showed consistent trends, suggesting that age 3 CPUE could be used as an indicator of relative cohort strength, although a large decline of 1999 cohort was not be able to detected by age 3 CPUE (Fig. 1-2). Overall levels of CPUE by cohort after 1990 were higher than that of cohorts recruited in pre1990 years (Fig. 1-3). The 1986-1991 cohorts showed more drastic declines than the other cohorts, probably due to targeting towards small fish in the early 1990s caused by depleted stock status of cohorts recruited in pre1986 years and less structured management schemes at that time. Those cohorts recruited in 1992 and after show slower decline rate, suggesting a reduced level of exploitation rates for these cohorts. Peak CPUE also tends to shift to age 4-5 for the cohorts 1992 and after. These seems to indicate steady recovery of stock size and better management for the cohorts recruited after 1990, the year when a substantial reduction of TAC was occurred. Fig. 1-3 also indicated more acute decline of age 3 fish, about the level comparable to those experienced by the early 1980s cohorts, in the recent years. From only one or two points observation, it may not be possible to see if this is a reflection of oceanographic and fish availability changes, or indicating a real situation of fishing pressure. However, a lack of small fish in the recent years may eventually lead to an increase of number of large fish caught under the same amount of quota allocation. This indicator should be carefully monitored for the next several years.

Fig. 1-4 shows size frequencies of nominal CPUE obtained from RTMP. Comparison with observer data proved high reliability of size information obtained from RTMP (Itoh

and Miyauchi 2005). Recent seven years (six years for Area 8) data are shown for comparison. Fish smaller than 110cm, corresponding to age 4 or younger, was almost totally disappeared from Area 4 and 7 catch in 2003. Substantial reduction of fish under 115cm was detected in 2003 and 2004, especially in Area 4 and 7, e.g. Australian coast. For 2005, there was no apparent increase of fish under 115cm observed relative to the last two years, except for Area 8/September and October. Decline of small size fish was much less distinct in Area 9, off Cape area for a 2003-2005 period. Those fish showing substantial reduction correspond to the same cohort that the acoustic monitoring survey detected drastic declines of recruitment level since 2000. CPUE of around 90cm-sized (age 3) fish was noticeably high relative to past five years in Area 8/September and October, 2005.

In 2006, only a small number of fish under 135cm (age 7 or younger) were caught in Area9/June and July, except that there were some catch around 100-105cm (age 3) in July. Such a small catch was not observed in past six years. In Area 4 and 7/June and July, CPUE of fish around 85cmFL (age 2) considerably high.

Standardized CPUE

Two GLM standardized CPUE indices of w0.5 (B-ratio proxy) and w0.8 (Geostat proxy) were updated using the same agreed method as described in Takahashi et al. (2001). Results are shown in Fig. 1-5. Estimates of CPUE indices for 2005 (the most recent year) were based on RTMP data only not on logbook, and thus should be examined with caution as described above (Takahashi et al. 2001). These estimates may be changed when logbook data becomes available the next year. The w0.5 and w0.8 series calculated for the 2005 SAG meeting are also plotted in Fig. 1-5 for comparison. There were no apparent differences found between the two series of 2005 and 2006.

The w0.5 and w0.8 indices for age 3 kept more or less the same levels from 1997 to 2002. The indices for age 4 stably increased from 1997 to 2002. The indices for age 3 and 4 notably decreased in 2003 and 2004, respectively, to a level of mid-1980s or lower. These declines correspond to extreme low recruitment (2000 cohort) observed in the acoustic survey of the Recruitment Monitoring Program (RMP) conducted in 2001. The indices for age 3 were not be able to detect low recruitment (1999 cohort) observed in the 2000 acoustic survey whereas this low recruitment was detected by substantial drop of age 4 indices in 2003. The indices for age 3 and 4 seem to slightly increased from 2003 to 2005, but its levels were still very low. The CPUE indices for age 5 and 6&7 classes steadily declined from 2002 to 2005. The low recruitments observed in the 2000 and 2001 acoustic survey (1999 and 2000 cohort) correspond to low index values in recent years. Trends of CPUE for age 8-11 were gradually increasing from 1996 to 2002, then dropped in 2003, and kept the same levels afterwards. The CPUE indices for age 12+ also gradually increased from 1996 to 2002 and then declined thereafter.

In summary, the w0.5 and w0.8 CPUE series of all age classes show increase trends from 2000 to 2002 and declines toward 2004. The extent of the declines in the most

recent year should be interpreted with caution because data source of CPUE calculation is different in the most recent year. This decline of CPUE from 2002 to 2004 common to most age groups is observed for nominal CPUE as well but not observed in ST windows series explained below.

Spatial-Temporal (ST) windows CPUE for age 4+

"Spatial-temporal (ST) windows" CPUE index for age 4+ was also updated using the same method as described in Takahashi et al. (2002). "ST windows" represents Area 9/May and June, and Area 8/September and October. Results are shown in Fig. 1-6, where the results for 2004 assessment are also plotted for comparison. Trends of the past and updated indices (normalized to the average) were very similar. The updated "ST windows" increased from 2000 to 2002, then declined in 2003, and stayed at the same level as the late 1990s afterwards.

2. Australia surface fishery:

Fig. 2-1 and 2-2 show changes of catch per efforts and age composition of Australia surface catches. Although an interpretation of catch per efforts of surface fisheries is controversial, both catch per shot and catch per searching hours stayed at relatively low level during 2002/03 to 2004/05 seasons. In contrast, there was substantial high catch observed in 2005/December (Fig. 2-1). The proportion of age 3 fish increased in 2002, then declined in 2003 and kept the same level as 2003 in 2004, and decreased in 2005 (Fig. 2-2). The proportion of age 2 stably increased from 2002 to 2005. A small proportion for age 1 appeared in 2005 while there was no age 1 fish appeared during 2002-2004. In 2004 and 2005, proportions of age 4 were low relative to past years. Other than that, no strong signal was observed in age composition of surface catches.

Fig. 2-3 shows the aerial survey index obtained from the Recruitment Monitoring Program (RMP) in the Great Australian Bight (GAB). The index monitors surface abundance of age 2-4 fish combined distributed in the GAB. Full scale line transect aerial survey was suspended between 2001 and 2004. Although a limited number of lines was continued to survey during this period, it was concluded that the index of limited scale survey was not able to provide information comparable to the full scale aerial survey. The aerial survey index shows moderately declining trend throughout the survey period. The 2005 and 2006 index values are slightly lower than the average.

Fig. 2-4 shows tentative estimates of F-value for surface fisheries based on the simple method described in Takahashi et el. (2004) with updated conventional tag recaptures. Except for 2002 with relatively a small number of releases in 2001 and extremely low recovery in 2002, F trend shows roughly consistent patterns of catch per effort and age composition of surface fisheries shown in Fig. 2-1 and 2-2. F trends for age 2 and 3 showed increases in 2003-04. F for age 2 continued to increase in 2005 while that for age 3 declined.

Indicators obtained from surface fishery suggest moderate decline of juvenile abundance in the GAB, however no signs were observed to indicate drastic decrease of juvenile abundance such as observed longline-related indicators and acoustic survey data.

3. Recruitments:

Acoustic survey

Acoustic survey of the Recruitment Monitoring Program (RMP) is aimed to monitor changes in relative abundances of age 1 fish moving through the survey area in the southwestern coast of Australia. Fig. 3-1 shows the results of survey from 1996-2006. This index represents the age 1 fish abundance within the survey area standardized with 15 days' survey period. The index showed a drastic decline in 2000 and stayed at very low level in 2002 with a very slight upturn from 2001 level, then became non-estimatable level because of lack of records identified as SBT with a certain estimated biomass with sonar. No field activities were made in 2003/2004 season.

As reported in the previous year, cohorts showing extreme low abundance levels in the 2000, 2001, 2002, and 2003 surveys are now available to longline fisheries and mostly showing substantially low CPUE. If the recruitment trend detected by acoustic survey reflects the real situation, we expect six years' low recruitments to come in sequence. This must cause devastative impacts on SBT stock. Decrease of age 4 fish from Japanese longline catch is a great concern, especially since the same sign was detected with the other independent indices.

4. Indonesian Catch (Spawning ground fishery) :

Fig. 4-1 shows changes of Indonesian SBT catch both in number and weight as well as catches by two age groups, age 8-16 and age 17 and older.

A substantial increase of catch in 2001/2002 season was mainly derived by large increase of younger age classes. Then, catches were drastically declined in 2002/2003 and 2003/2004 seasons without change in age composition pattern from 2001/2002. No information available to conclude whether this decline reflected changes in fish abundance or changes in fishing practices. In 2004/2005 season, a large increase of catch occurred, similar to that observed in 2001/2002. Low levels of the older portion of spawning stock in recent years and potentially low reproduction give some concerns.

5. Overall Conclusion:

Indicators examined generally support a view that current stock levels for middle to high

age groups are the same levels in the late 1990s (except for age 5). CPUE indices for most age groups showed increasing trends from the late 1990s to 2002. In recent years, the indices for age 3 and 4 have stayed at historically low levels and ones for age 5 and 6&7 have continued to decline. Many indicators examined suggest recent low recruitments but differ in indication of how low they would be. Longline-related indicators suggest considerable decline of recruitment of 1999 and 2000 cohorts, and also possibly 2001 cohort. The acoustic indices suggest continuous low recruitments for six years (1999-2002 cohorts, 2004 and 2005 cohorts). The further careful monitoring of recruitments and serious consideration on impacts of potential low recruitments on stock management are continuous tasks with the highest priority.

References

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Takahashi, N., S. Tsuji, T. Itoh, and H. Shono. 2001. Abundance indices of southern bluefin tuna based on the Japanese longline fisheries data, 1969-2000, along the interim approach agreed for the 2001 assessment. CCSBT-SC/0108/28. 39 pp.

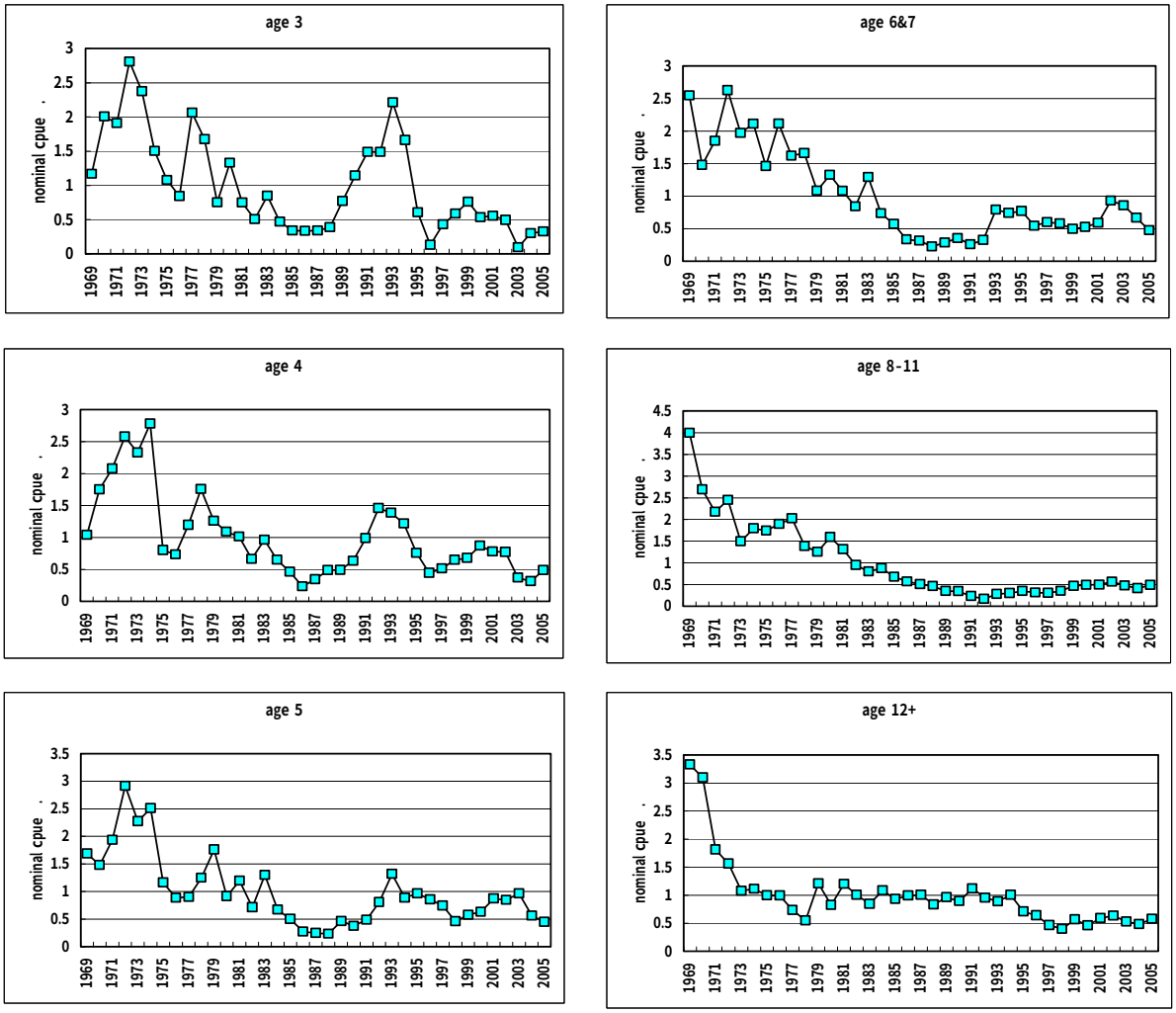


Fig. 1-1. Nominal CPUE of Japanese longline by age groups.

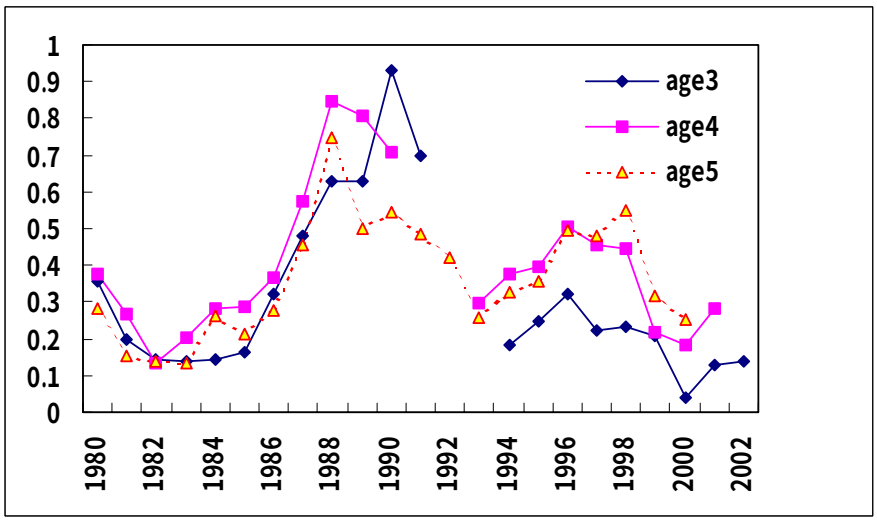


Fig. 1-2. Nominal CPUE of Japanese longline by cohorts for age 3, 4, and 5.

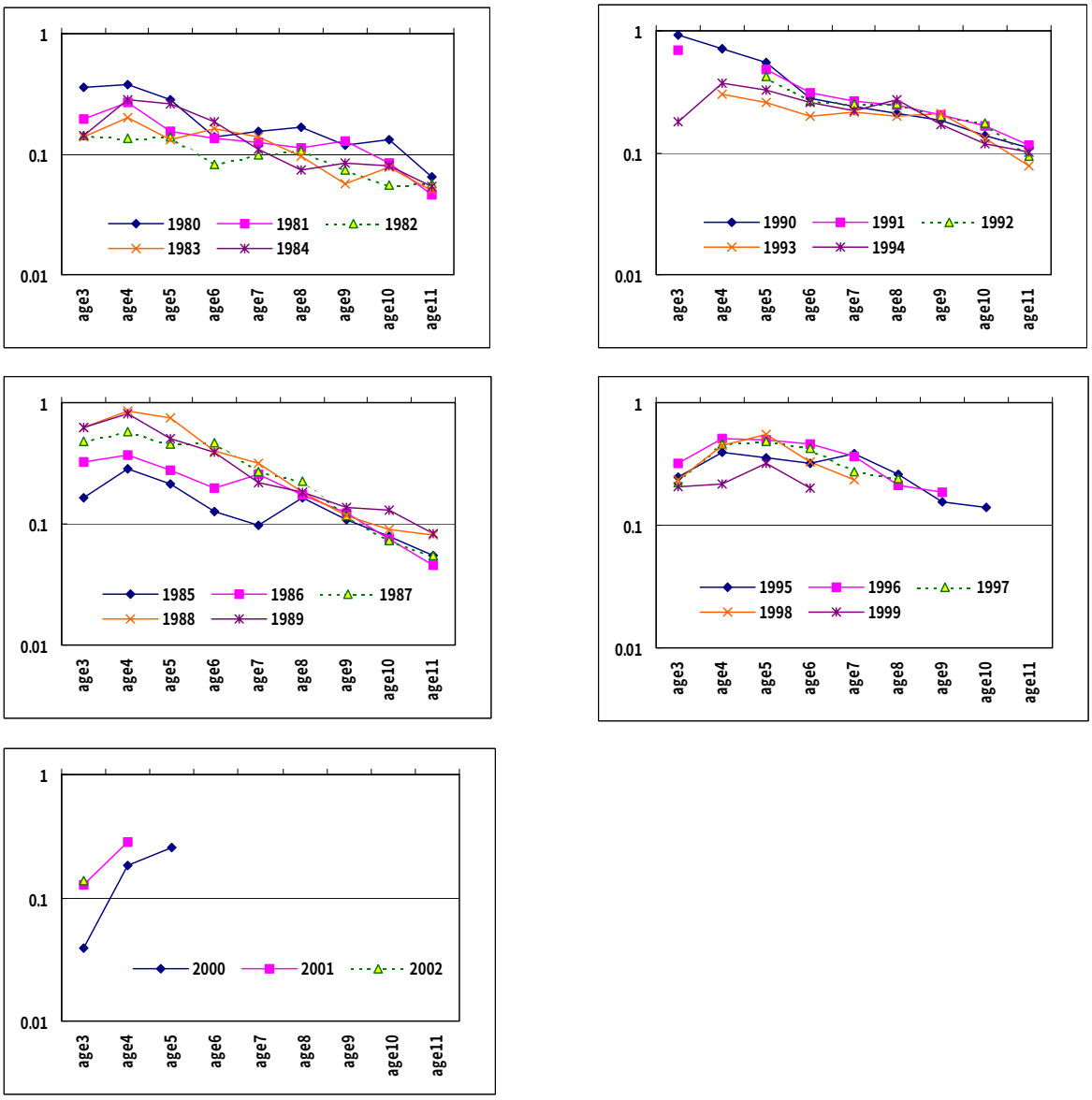


Fig. 1-3. Nominal CPUE of Japanese longline by cohorts in log-scale.

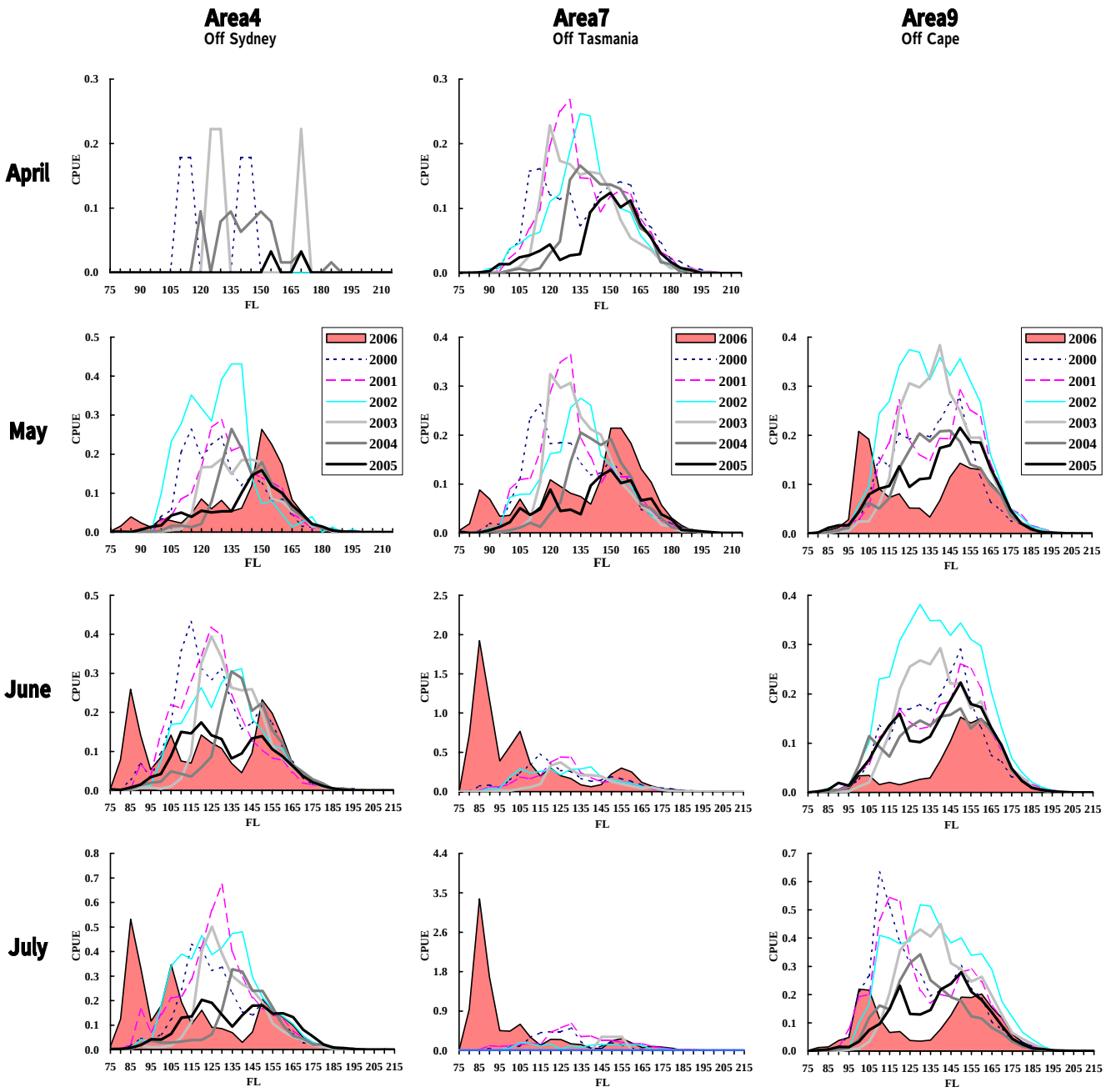


Fig. 1-4. Size composition of nominal CPUE of RTMP data for recent seven years (six years for Area 8) by month and areas.

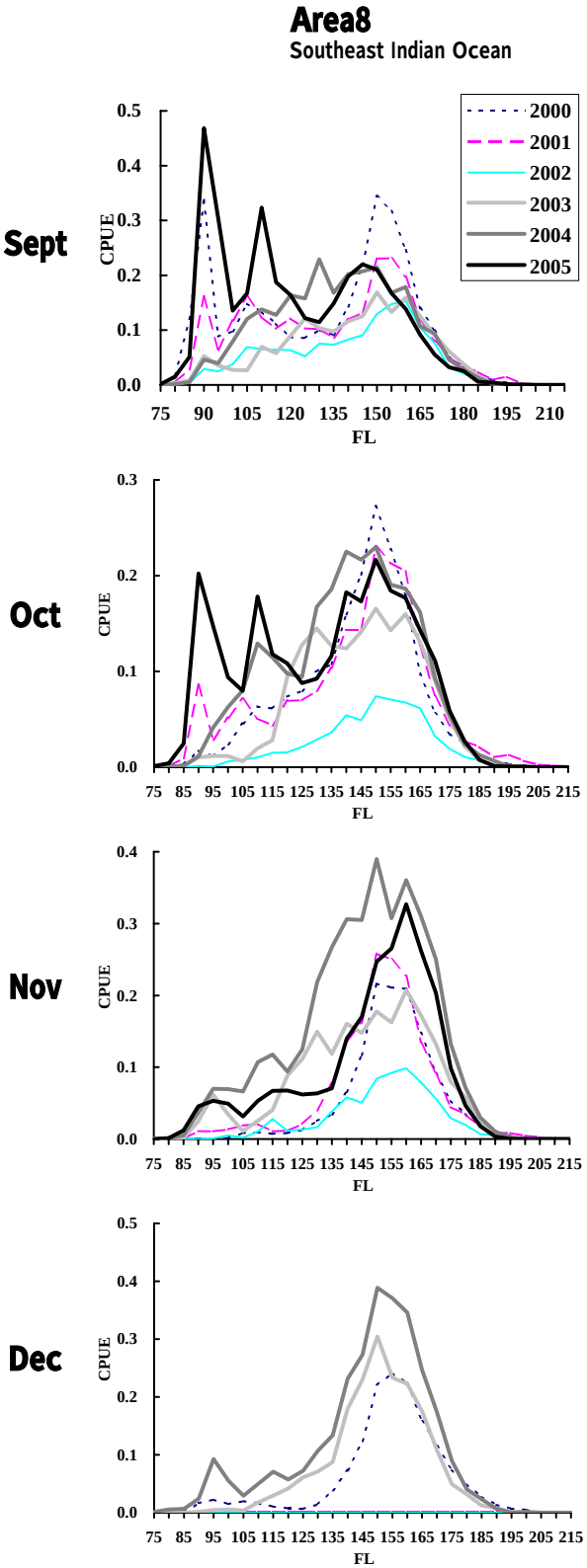
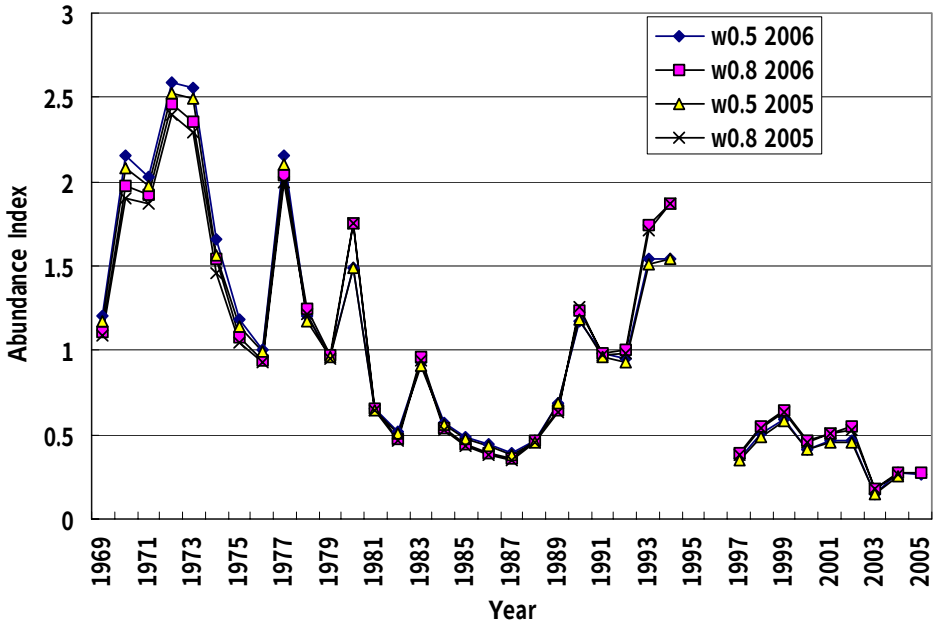


Fig. 1-4 (cont'd). Size composition of nominal CPUE of RTMP data for recent seven years (six years for Area 8) by month and areas. Note that CPUE for large fish (>=160cmFL) in December 2005 was extremely higher than that in past years and thus this data was not shown in the figure regarding inappropriate for comparison purpose.

(a) Age 3



(b) Age 4

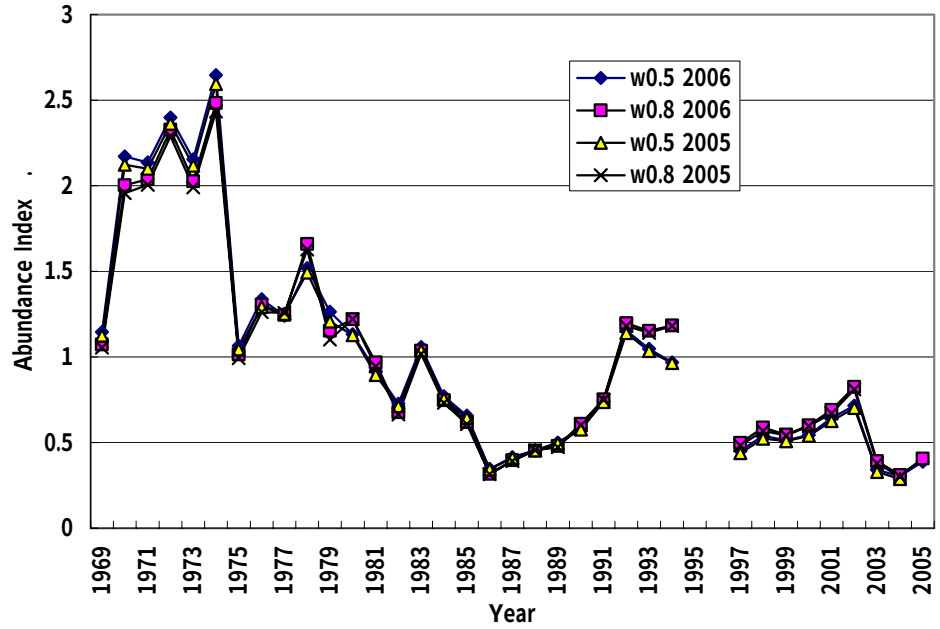
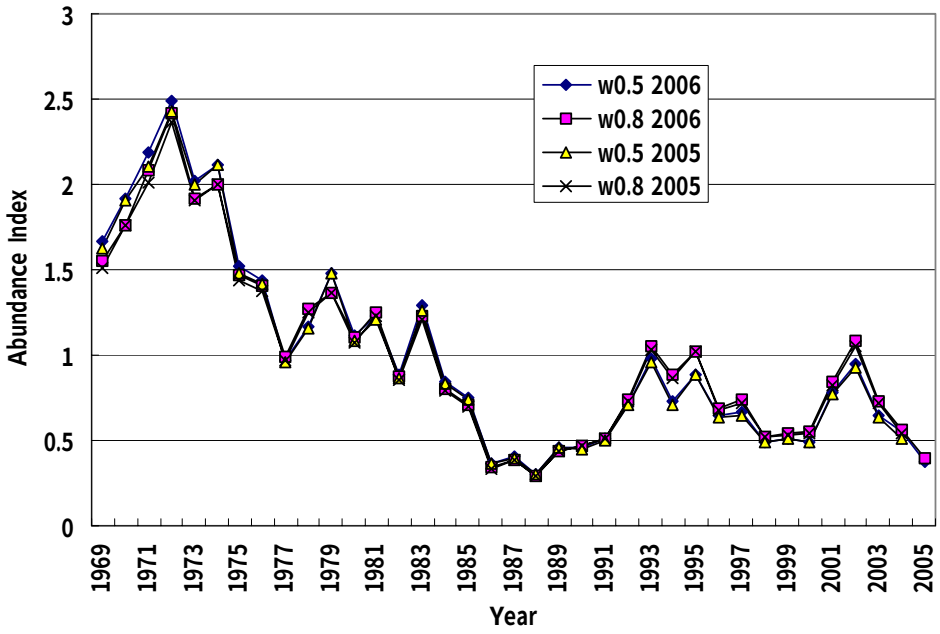


Fig. 1-5. Trends of normalized w0.5 (B-ratio proxy) and w0.8 (Geostat proxy) abundance indices, estimated from 2005 and 2006 data.

(c) Age 5



(d) Age 6&7

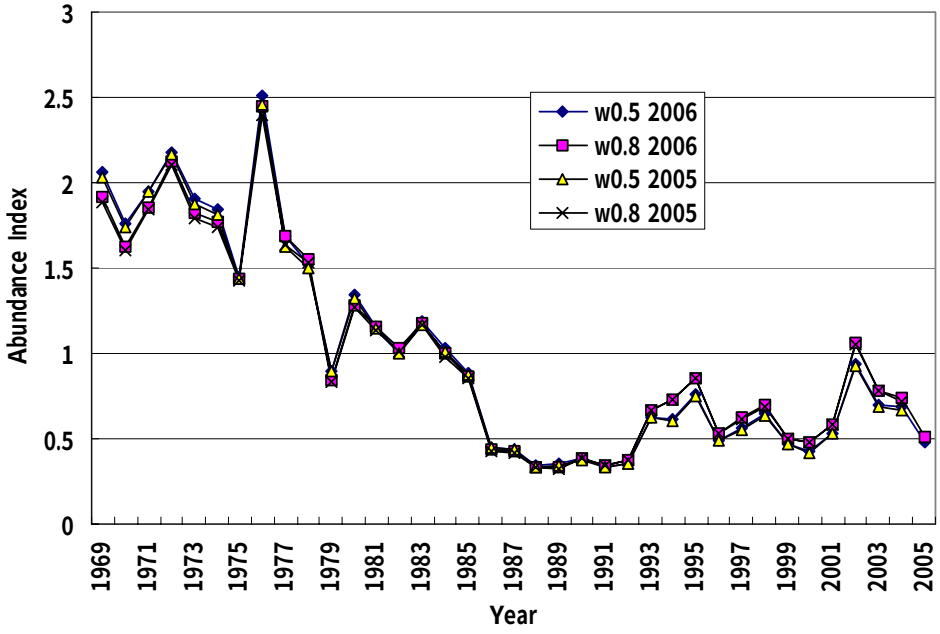
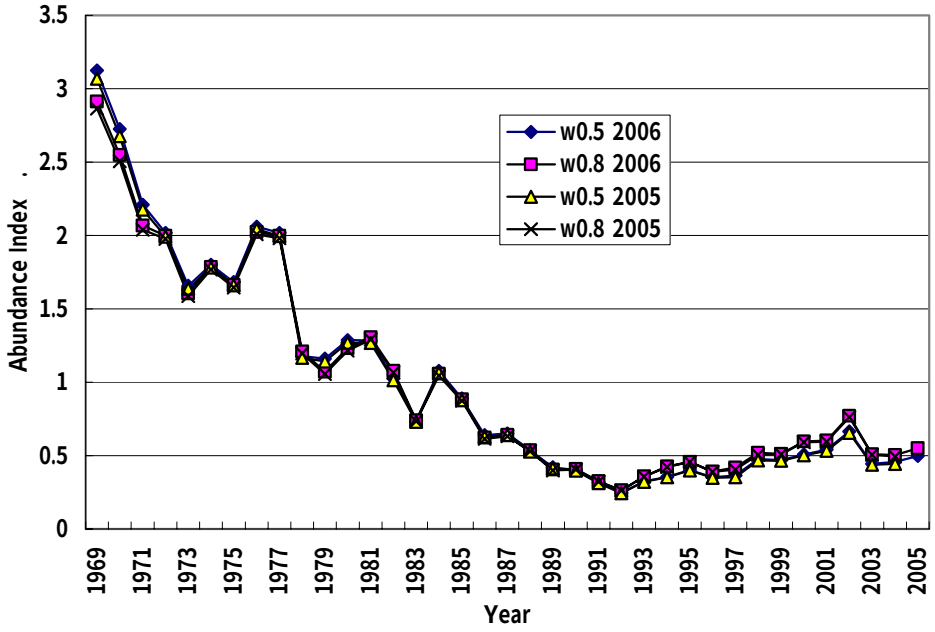


Fig. 1-5. Trends of normalized w0.5 (B-ratio proxy) and w0.8 (Geostat proxy) abundance indices, estimated from 2005 and 2006 data. (cont'd)

(e) Age 8-11



(f) Age 12+

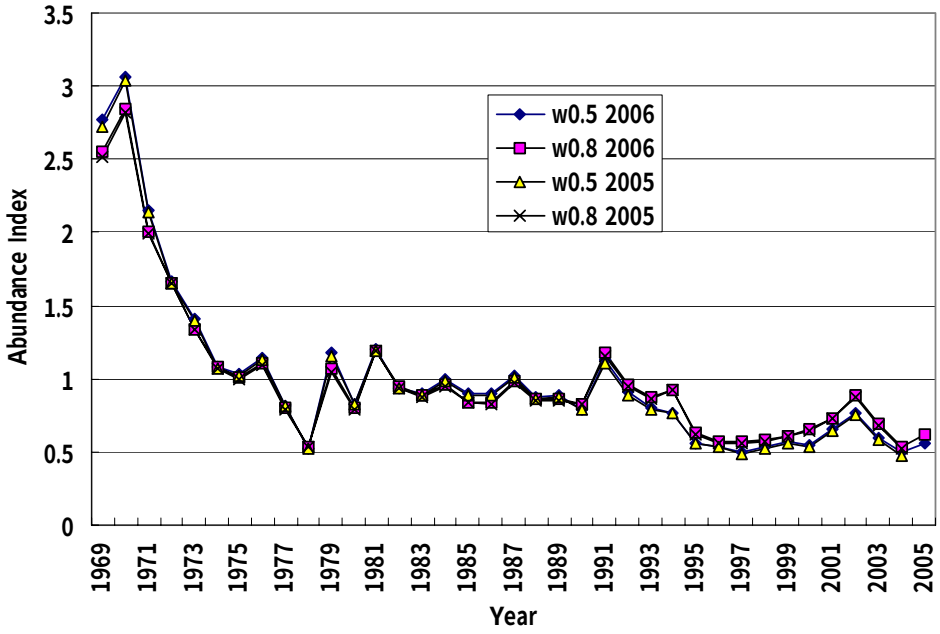


Fig. 1-5. Trends of normalized w0.5 (B-ratio proxy) and w0.8 (Geostat proxy) abundance indices, estimated from 2005 and 2006 data. (cont'd)

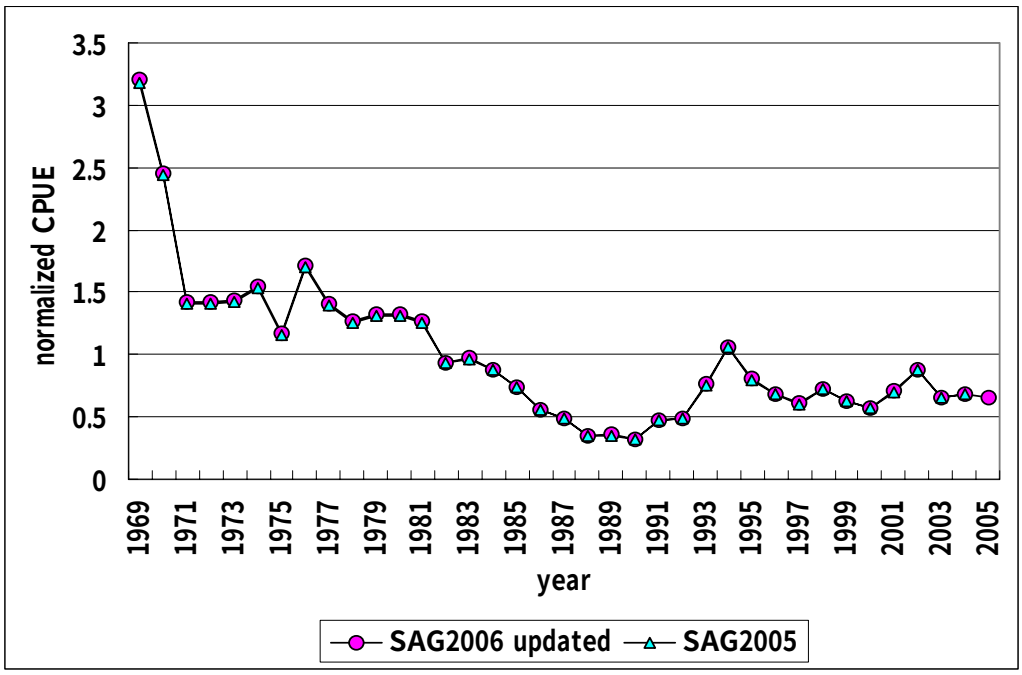


Fig. 1-6. Trends of normalized “ST Windows” indices for age 4+ fish.

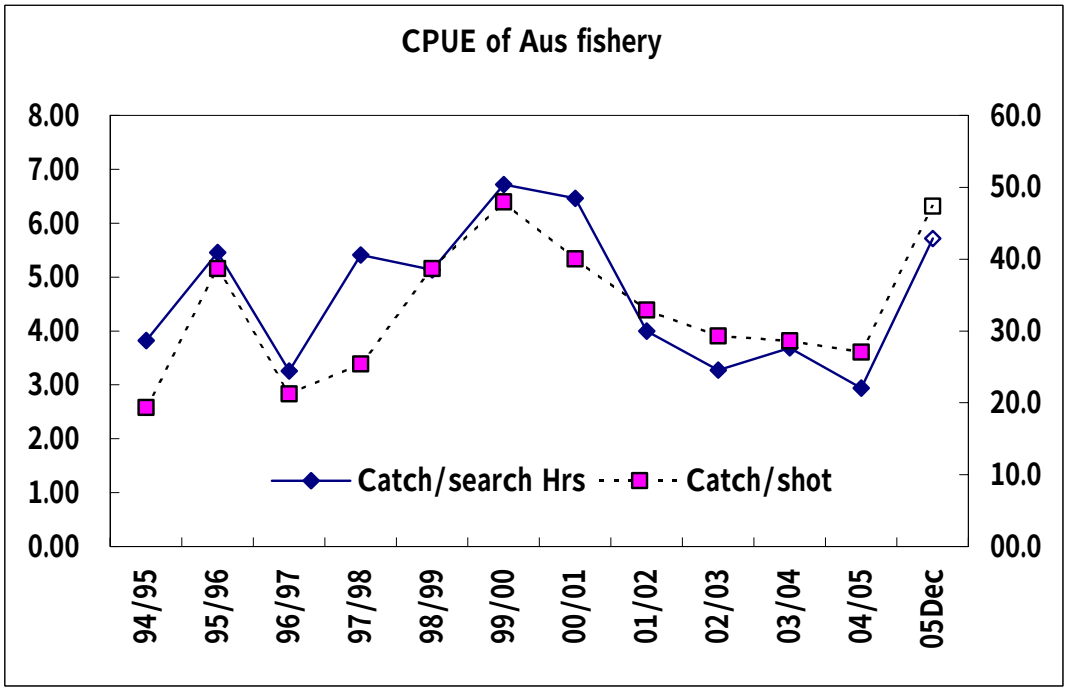


Fig. 2-1 Catch by efforts for Australia surface fishery.

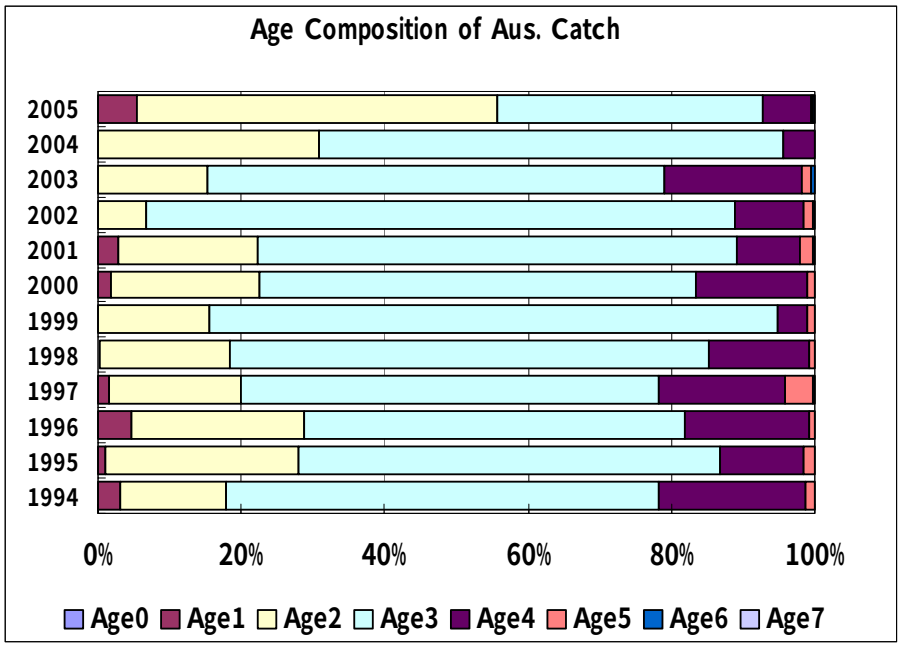


Fig. 2-2 Changes in age composition of Australia surface catches.

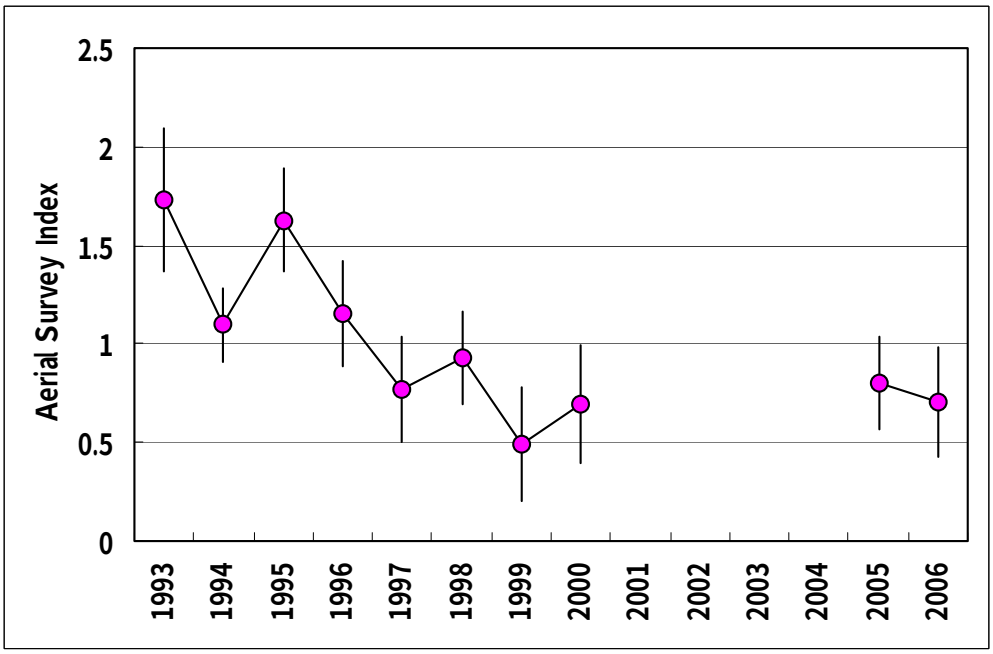


Fig. 2-3 Changes in Aerial index obtained from the Great Australian Bight.

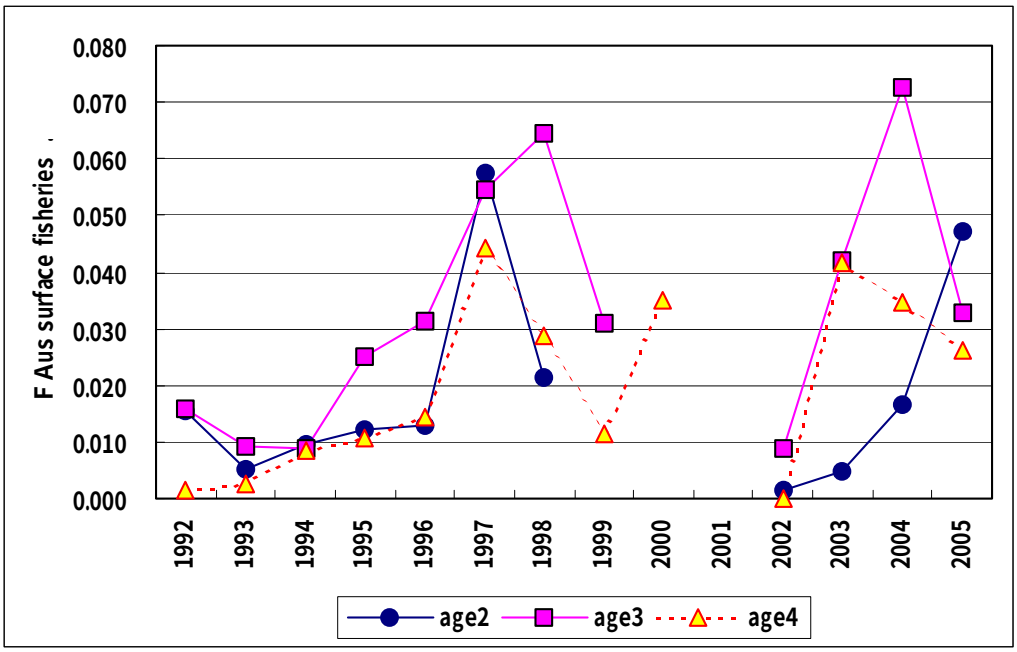


Fig. 2-4 Tentative F-estimates of surface fisheries based on conventional tag-recapture.

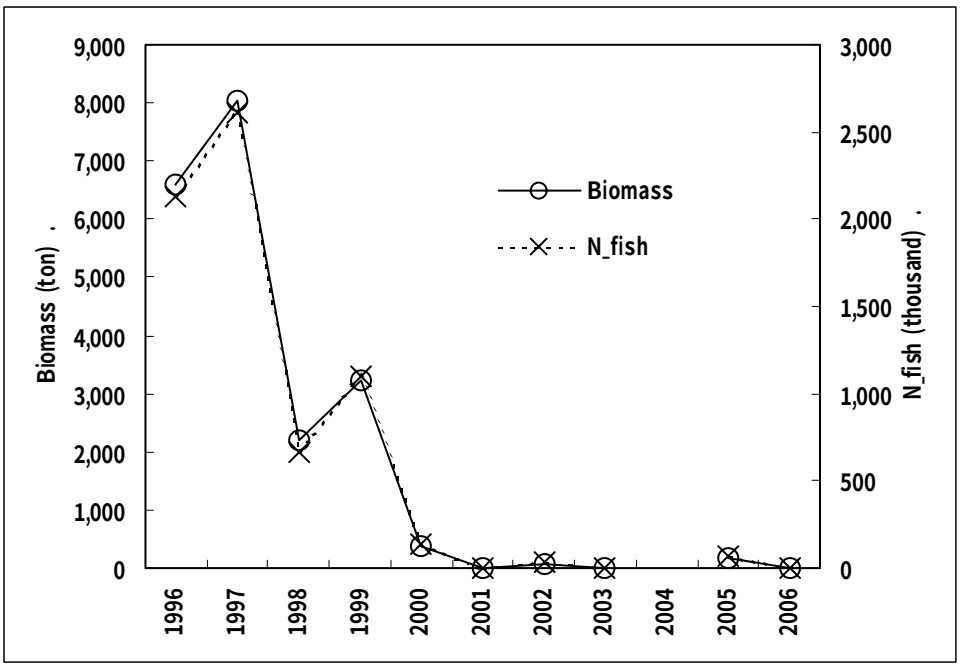


Fig. 3-1. Trends of acoustic index of age 1 SBT in the Western Australia.

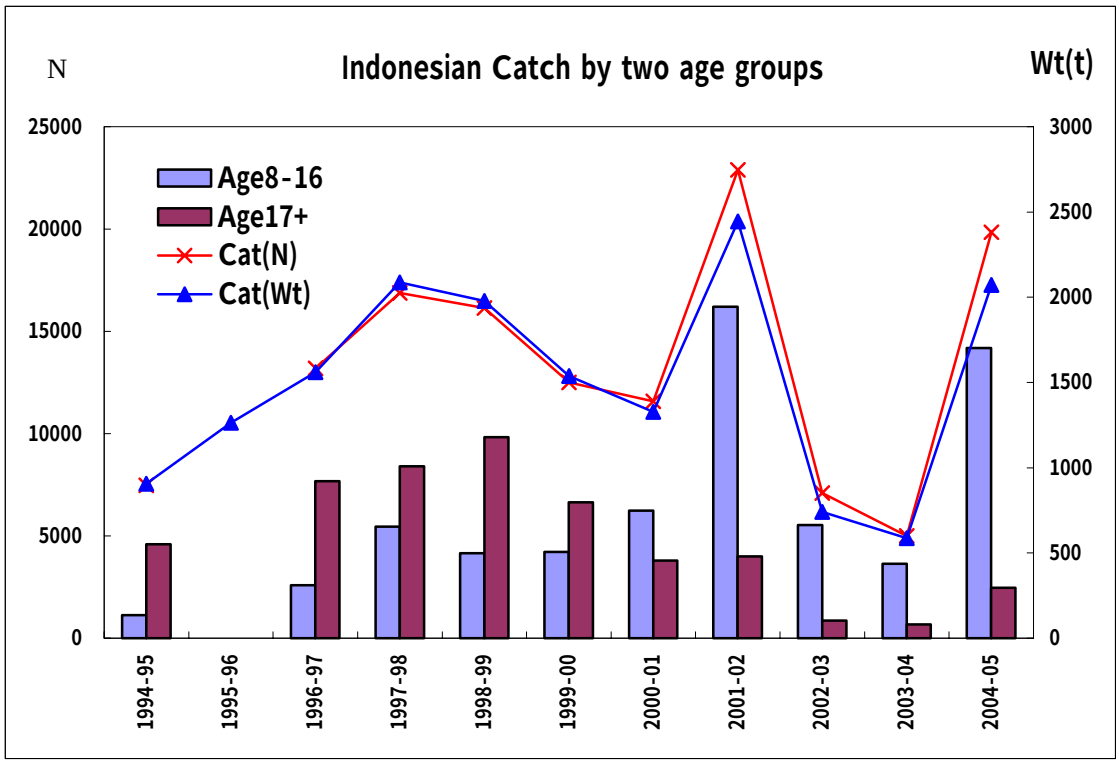


Fig. 4-1. Trends of Indonesian catches with proportion of two age groups occurrences.