Summary of Fisheries Indicators in 2007

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Abstract : Various fisheries indicators were examined to overview the current status of Southern Bluefin tuna stock. The indicators suggest that current stock levels for 4, 5, 6&7 age groups are the same as or lower than that observed in the late 1980s, which is the historically lowest level. When looking to recent four years, CPUE indices for these age classes show steadily declining trends. Other age classes, 3, 8-11, and 12+ tend to increase or keep at the same level after 2003. Current stock levels for these age groups, however, are still at low levels similar to ones observed in past. Many indices indicate recent low recruitments 1999, 2000, 2001, and 2002 cohorts. This reflects the fact that the acoustic survey indices from Recruitment Monitoring Program (RMP) suggest sequential 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：ミナミマグロの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 4、5、6&7 年齢グループの資源状態は、1980 年代後半に見られた歴史的に最低レベルと同じかそれより低い状態にある。最近 4 年間を詳しく見ると、これら年齢クラスの CPUE 指数は着実な減少傾向を示している。その他の年齢クラスである、3、8-11、12+は、2003 年以降、増加あるいは同じレベルを保っている。しかし、現時点でのこれら年齢グループの資源状態は依然として過去に見られたものと同じ低いレベルにある。多くの指標は 1999、2000、2001、2002 年級の加入が悪いことを示している。これは、加入量モニタリング調査による音響指数が 6 年間（1999-2002 年級, 2004 および 2005 年級）続けて加入が低いことに対応している。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 occurred. Also, the 3rd Meeting of Management Procedure Workshop in 2004 agreed to review fisheries indicators every year to monitor whether the SBT stock status stays within an expected range of uncertainty which the operating model considered. This document summarizes results of updated indicators including standardized Japanese longline CPUE and our overall interpretations. It should be noted that conclusions in the reports of the Japanese Market and Australian Farming

Investigation Panels are not considered in this summary because discussion on how catch anomalies are used to update CPUE data still continues in the CCSBT Scientific Committee.

1. Japanese longline CPUE:

<u>Nominal CPUE</u>

Fig. 1-1 shows nominal CPUE by age group of Japanese longline fisheries including those of joint-venture with Australia and New Zealand. The most recent year’s data exclusively rely on information collected by the Real Time Monitoring Program (RTMP) which covers only SBT targeting vessels. When all the other non SBT-targeting vessels’ data (based on logbooks) become available in the following year, CPUE of the most recent year tends to drop slightly (Takahashi et al. 2001). So the most recent year’s CPUE must be examined with caution. 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.

CPUE of the most recent year must be further looked to carefully because Japanese longline fisheries introduced Individual Quota (IQ) system in 2006.

When focusing on trends of the recent five years, nominal CPUE of age classes, 4, 5 and 6&7 decline to the same lowest levels observed in past (the late 1980s to the early 1990s). CPUE of age 3 shows substantial decrease to the historically lowest level in 2003, and then increases afterwards. In 2006 a drastic increase is observed. Caution is necessary for interpretation of age 3 and 4 CPUE in 1995 and 1996 because of direct impact of non-retention of smaller fish than 25kg occurred in these years. CPUE trends of age groups 8-11 and 12+ have been more or less stable at the low level since the late 1990s.

Fig. 1-2 and 1-3 show nominal CPUE of Japanese longline by cohort. Fig. 1-2 represents 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 show 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 are higher than that of cohorts recruited in pre1990 years (Fig. 1-3). The 1986-1991 cohorts show 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 rates, 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 seem 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 indicates acute decline of age 3 fish, about the same or lower levels comparable to those experienced by the early 1980s cohorts, in the recent years, except for 2003. From only one or two points of observation, it may not be possible to conclude that this is a reflection of oceanographic and fish availability changes, or indication of a consequence 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 age compositions of nominal CPUE obtained from RTMP. Comparison with observer data proved high reliability of size (i.e., age) information obtained from RTMP (Itoh and Miyauchi 2005). Recent seven years (six years for Area 8) data are shown for comparison. Although there are some exceptions, substantial CPUE reductions of age 4 and younger fish are detected in 2003-2006, especially in Area 4 and 7, e.g. Australian coast. Declines of such small fish are much less distinct in Area 9, off Cape area for the same period. These fish showing substantial CPUE reduction correspond to the same cohort that the acoustic monitoring survey had detected drastic declines of recruitment level since 2000 (see Fig. 3-1). Reflecting such decreases of the small fish CPUE, reductions of corresponded CPUE for medium size fish (e.g., age 5-8) are detected in later years (2003-2007) in Area 4, 7, and 9. Similar patterns of the CPUE declines are not observed in Area 8.

Increases of CPUE for around age 3 fish are observed in 2005-2007. These CPUE values are noticeably high relative to previous years in Area 4/June and July (2007), Area 7/May (2007), Area 9/May (2007), Area 7/June and July (2006), and Area 8/September (2006). In 2007, markedly high CPUE for about age 5 is observed in Area 9/April. Whether these increases of CPUE for small fish reflect rediscovery of recruitment or influence of operation pattern by introduction of IQ system is unclear.

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 2006 (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. Further, as mentioned above, the most recent year’s CPUE must be examined carefully because Japanese longline fisheries introduced IQ system in 2006.

The w0.5 and w0.8 series calculated for the previous SAG meeting are also plotted in Fig. 1-5 for comparison. There were no apparent differences found between the two series of 2006 and 2007.

Looking to trends of the recent five years, the w0.5 and w0.8 indices for age 3 largely decline to the historically lowest level in 2003. Then the two indices increase afterwards.

Trends of the age 4 indices keep more or less the same levels between 2003 and 2006 after a notably decrease to the 1986 level in 2003, which is the historical lowest. Low index values for age 4 observed in 2003-2006 correspond to extreme low recruitment (1999, 2000, 2001, and 2002 cohorts) observed in the acoustic survey of the Recruitment Monitoring Program (RMP) conducted in 2000-2003, respectively (see Fig. 3-1). 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 a substantial drop of age 4 indices in 2003. The CPUE indices for 5 and 6&7 age groups steadily declined from 2002 to 2006. The most recent index levels for these age classes are the same as or lower than the historical low levels observed in the late 1980s. The low recruitments observed in the 2000, 2001, and 2002 acoustic survey (1999, 2000, and 2001 cohorts) correspond to these low index values in recent years (see Fig. 3-1). Trends of CPUE for age 8-11 stay at the same level in recent years. The CPUE indices for age 12+ gradually increased in the last two years after declining to the historical low levels from 2002 to 2004 as same as ones in the late 1990s.

In summary, the w0.5 and w0.8 CPUE series for age groups 3, 8-11,and 12+ show increase or stable trends in recent years. Other age groups' indices are decreasing to the historically lowest levels toward 2006. These tendencies are also observed in both nominal CPUE and ST windows (for age 4+, explained below).

<u>Spatial-Temporal (ST) windows CPUE for age 4+</u>

"Spatial-temporal (ST) windows" CPUE index for age 4+ (Takahashi et al. 2002) was also updated using the new method as described in Takahashi (2006). "ST windows" represents Area 9/May and June, and Area 8/September and October. Results are shown in Fig. 1-6. The updated "ST windows" more or less keeps the same level ranging between 0.5-1.0 index values from 1992 to 2005. In 2006 the index decreases to the same historical low levels as in the late 1980s.

2. Australia surface fishery:

Fig. 2-1 and 2-2 show changes of catch per efforts and age composition of Australia surface catches. Although interpretation of catch per efforts of surface fisheries is contentious, both catch per shot and catch per searching hours appear to be gradually declining from 1999/00 to 2005/06 seasons (Fig. 2-1). The proportion of age 2 fish tends to increase from 2002 to 2006 (Fig. 2-2). The proportion of age 3 seems to decrease 2002-2006. A small proportion for age 1 appears in 2005 and 2006 while there was no age 1 fish appeared during 2002-2004. In 2004-2006, proportions of age 4 are low relative to past years. Other than that, no strong signal is 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). Estimates for previous years are different than those provided last year because the analysis methods have changed slightly (as will be documented in a paper for the upcoming CCSBT meetings). 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 index values continue to decrease from 2005 to 2007.

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 trends show roughly consistent patterns of catch per effort and age composition of surface fisheries shown in Fig. 2-1 and 2-2.

Indicators obtained from surface fishery suggest moderate decline of juvenile abundance in the GAB, however no sign was 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-estimative level because of lack of records identified as SBT with a certain estimated biomass with sonar. No field activities were conducted in 2003/2004 season.

As reported previously, 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 (see Fig. 1-1, 1-4 , and 1-5). 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 because the same sign was detected by the other independent indices.

The RMP acoustic survey ended in the 2005/2006 season due to budget matter and is replaced by much lower-cost trolling survey to monitor relative abundance of age 1 fish (see below).

<u>Trolling survey</u>

Since the RMP acoustic survey needed a vast amount of cost, recruitment index of age 1 fish estimated from results of much lower-cost trolling survey has been currently developing. Details of survey design, estimation method, results and its interpretation are documented in Itoh and Sakai (2007) and Itoh (2007). Fig. 3-2 illustrates trends of the trolling catch indices. Cohorts of 1999, 2000, and 2001 (2000, 2001, and 2002 surveys) show extremely low recruitment levels. These low recruitment levels are consistent with the ones estimated from results of the acoustic surveys (see Fig. 3-1). In contrast, trolling indices for 2002, 2004, and 2005 cohorts (2003, 2005, and 2006 surveys) show inconsistent (higher) levels to that of the acoustic survey. Situation for 2003 cohort is unknown because no survey was conducted in 2004. Trolling indices for 2005 to 2007 surveys show an increasing trend.

Levels of trolling indices are consistent with that of other indices (e.g., acoustic indices, Japanese longline CPUE) for some years and inconsistent for some other years. Thus, some usefulness of the indices to monitor age 1 recruitment is recognized. Reliability of the trolling indices is still being verified and it is necessary to compare these indices with CPUE for corresponded cohorts recruited into longline target for further verification. The trolling indices cannot be used as strictly quantitative indicators. However, they can be used as indicators to detect some qualitative signals of recruitment level such as “high”, “medium”, and “low.”

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 marked increase of catch in 2001/02 season may mainly be due to large increase of younger age classes. Then, catches drastically decline in 2002/03 and 2003/04 seasons without change in the age composition pattern for 2001/02. No information available to conclude whether this decline reflected changes in fish abundance or changes in fishing practices. In 2004/05 season, a large increase of catch occurred, similar to that observed in 2001/02. Again catch dropped in 2005/06. 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 4, 5, 6&7 age groups are the same as or lower than that observed in the late 1980s, which is the historically lowest level. Looking at recent four years, CPUE indices for these age classes show steadily declining trends. Other age classes, 3, 8-11, and 12+ tend to increase or keep at the same level after 2003. Current stock levels for these age groups, however, are still at low levels similar to ones observed in past. 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, 2000, 2001, and 2002 cohorts. 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.

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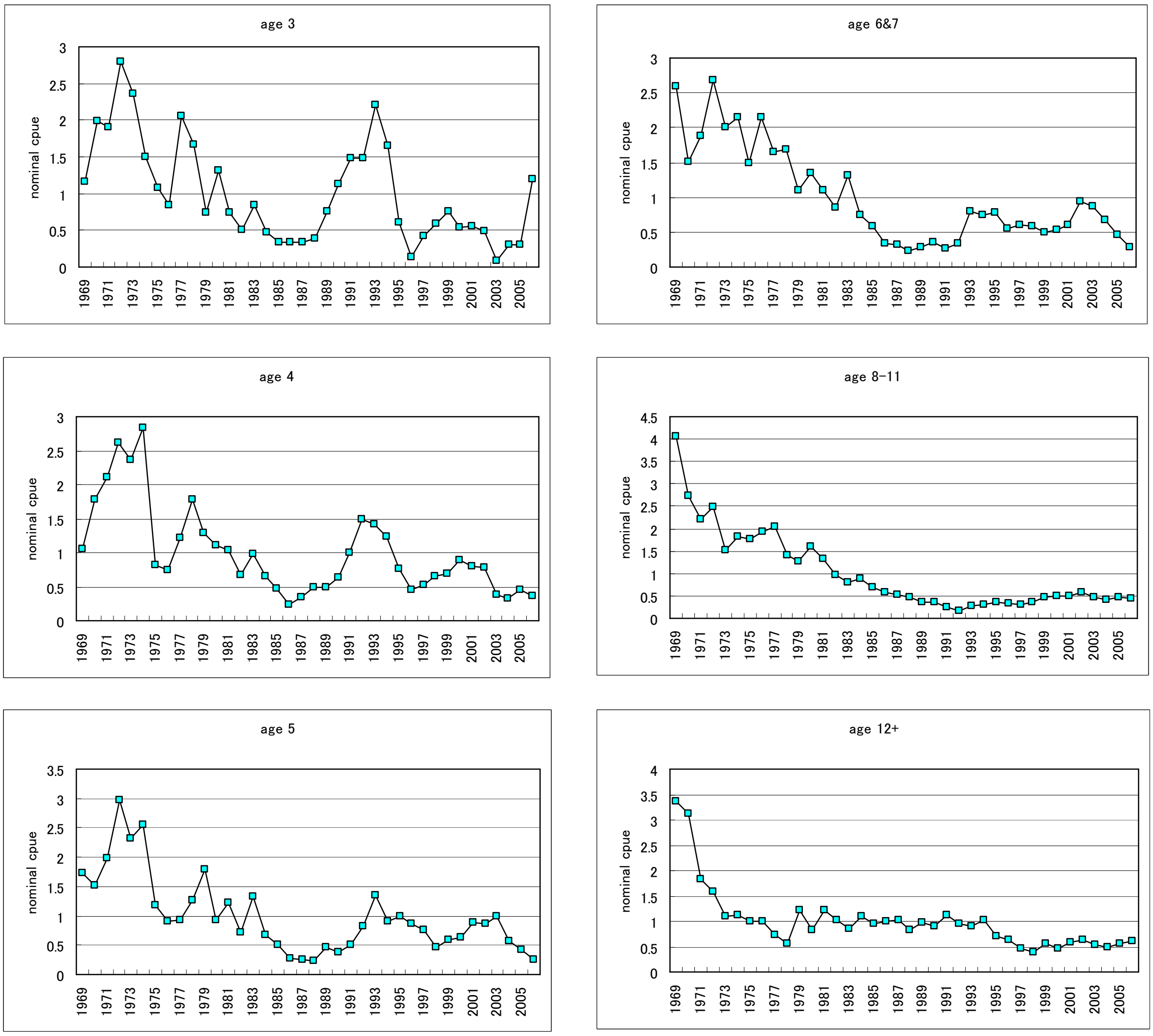


Fig. 1-1. Nominal CPUE of Japanese longline by age groups.

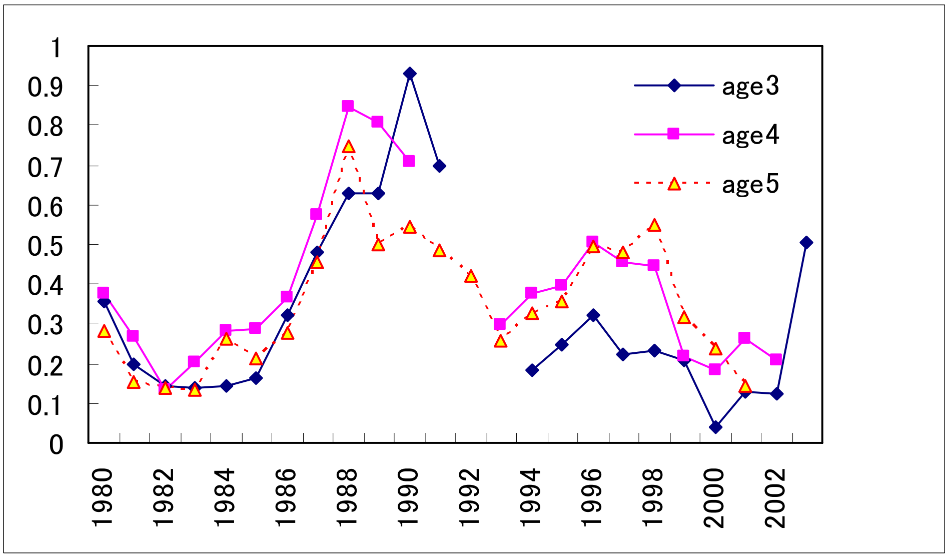


Fig. 1-2. Nominal CPUE of Japanese longline by cohorts for age 3, 4, and 5.

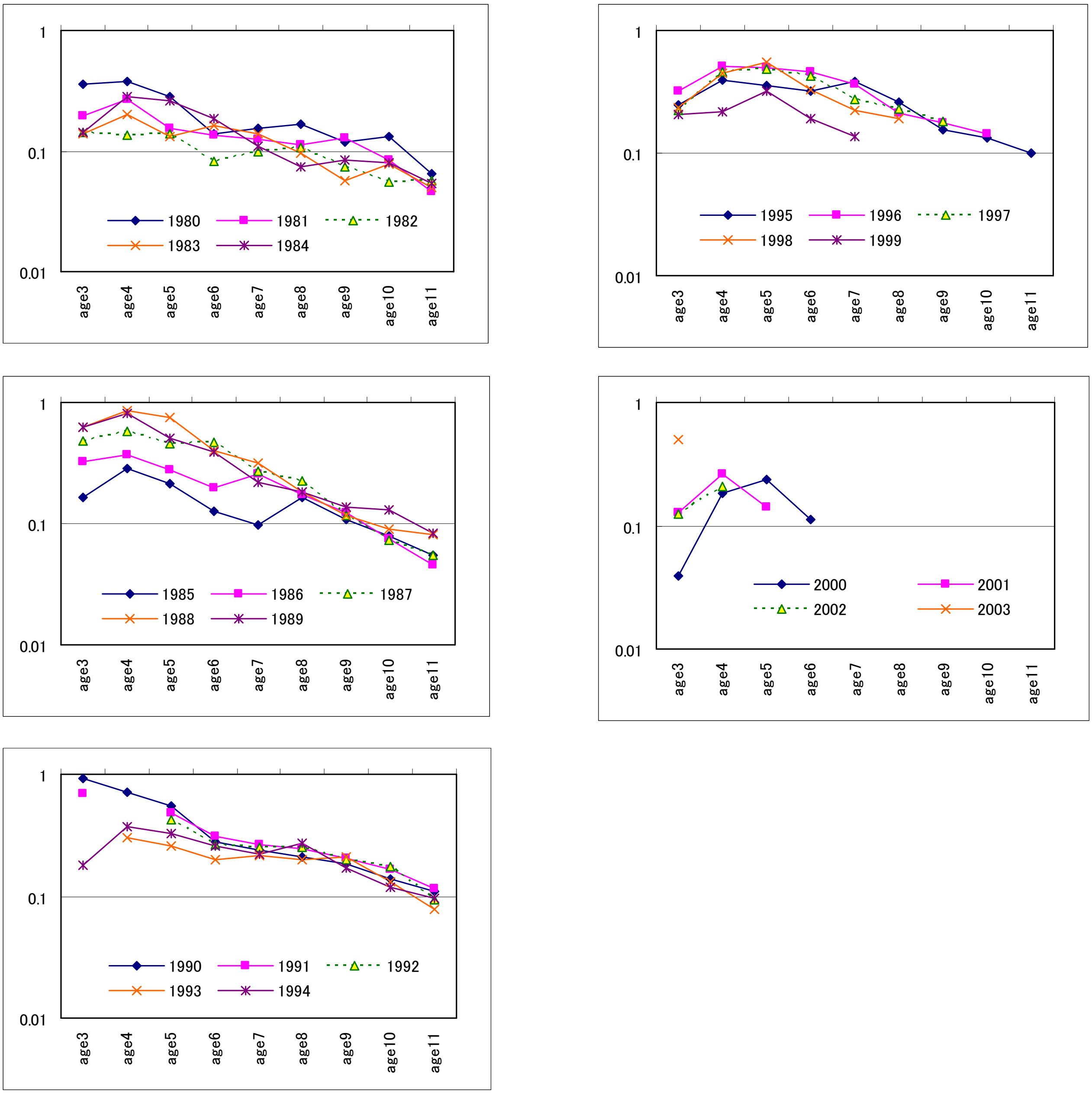


Fig. 1-3. Nominal CPUE of Japanese longline by cohorts in log-scale.

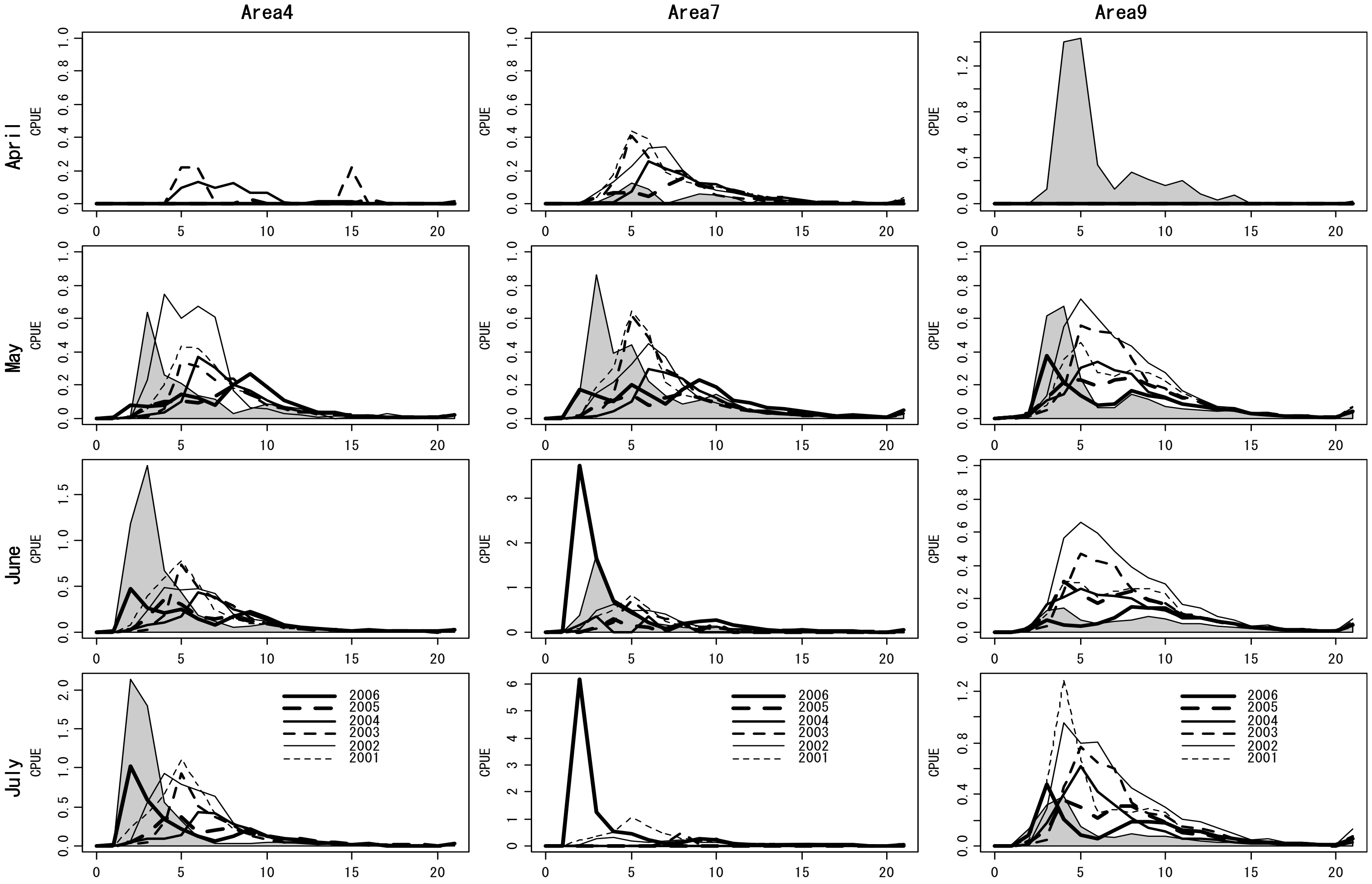


Fig. 1-4. Age composition of nominal CPUE of RTMP data for recent seven years by month and areas. Note that x-axes are age and shaded portions represent the year 2007.

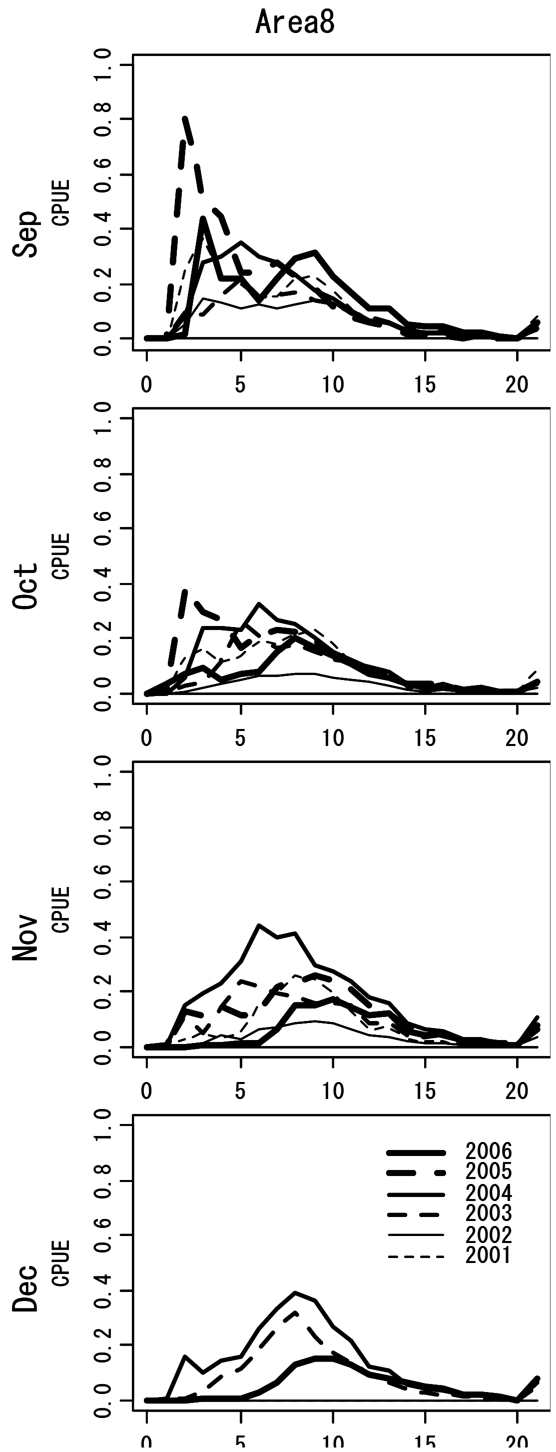
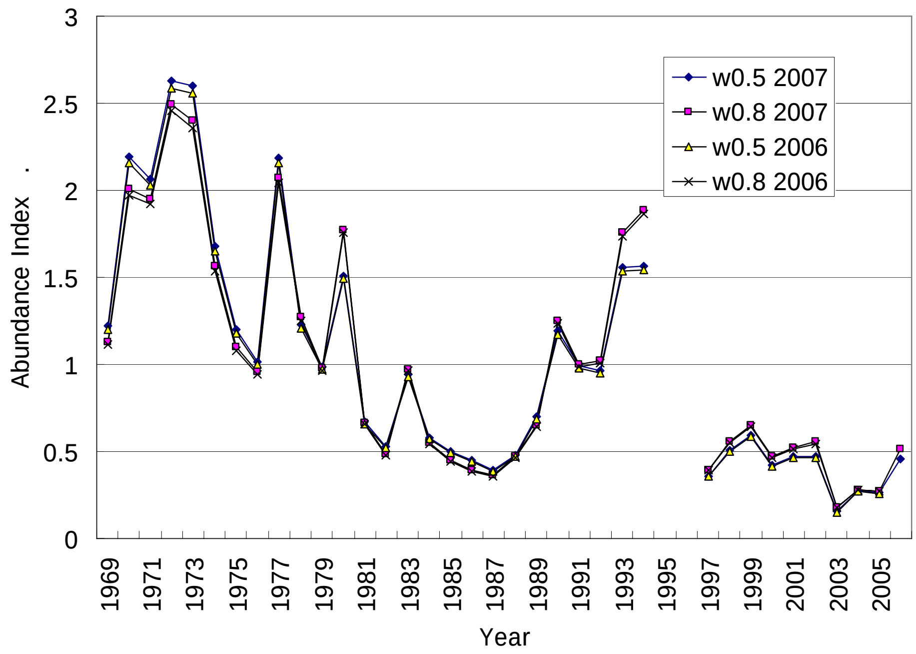


Fig. 1-4 (cont'd). Age composition of nominal CPUE of RTMP data for recent six years by month and areas. Note that x-axes are age. Also note that CPUE for large fish in December 2005 was extremely higher than that in past years and thus this data was not shown in the figure regarding inappropriate for comparison purpose.

(a) Age 3



(b) Age 4

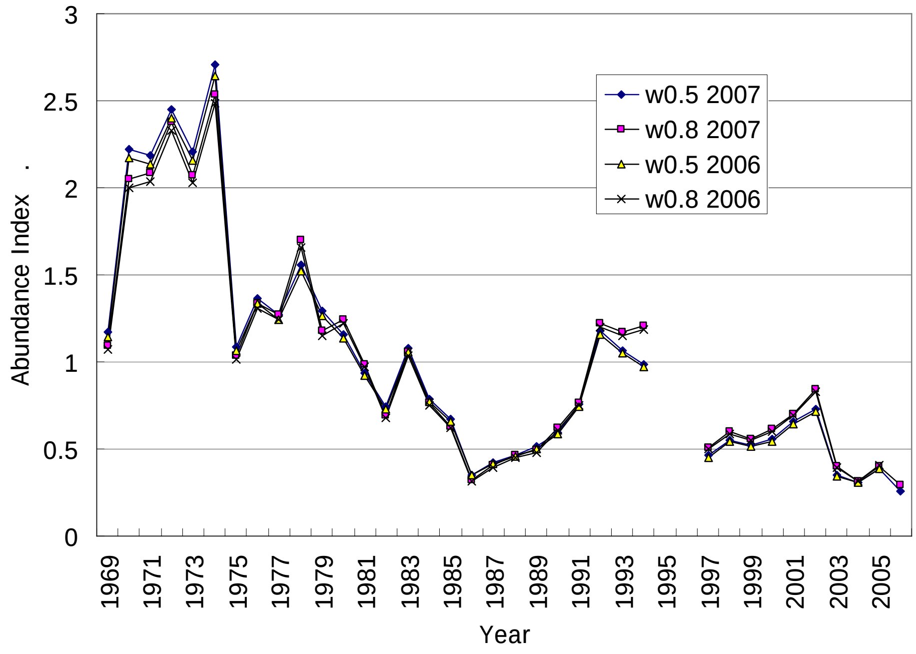
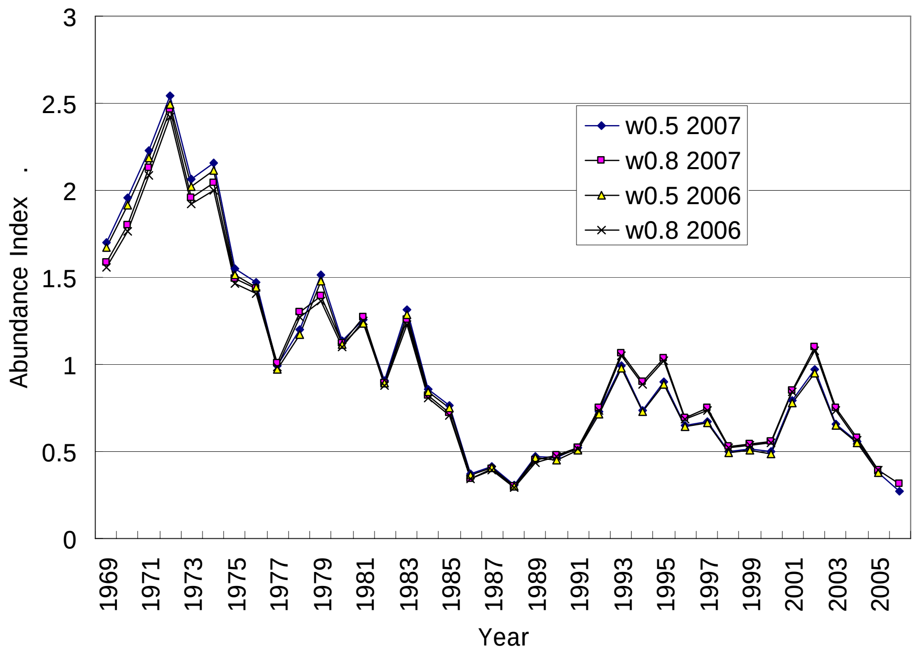


Fig. 1-5. Trends of normalized w0.5 (B-ratio proxy) and w0.8 (Geostat proxy) abundance indices, estimated from 2006 and 2007 data.

(c) Age 5



(d) Age 6&7

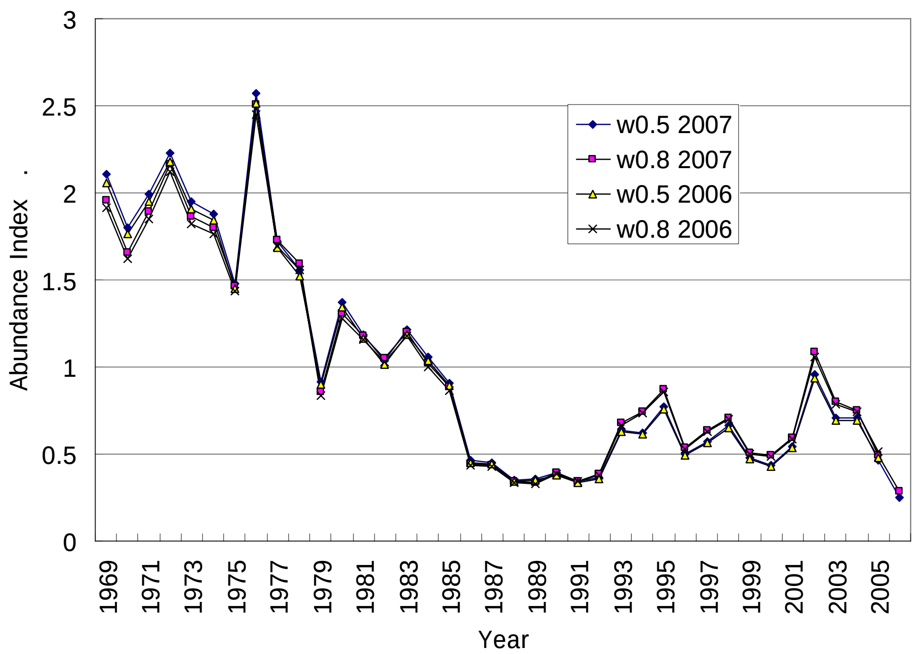
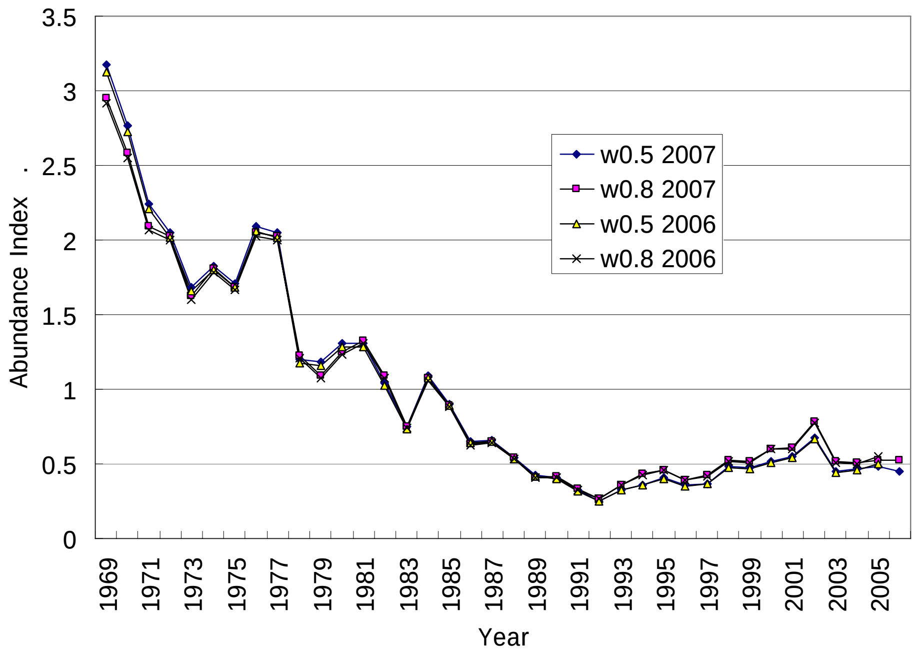


Fig. 1-5. Trends of normalized w0.5 (B-ratio proxy) and w0.8 (Geostat proxy) abundance indices, estimated from 2006 and 2007 data. (cont'd)

(e) Age 8-11



(f) Age 12+

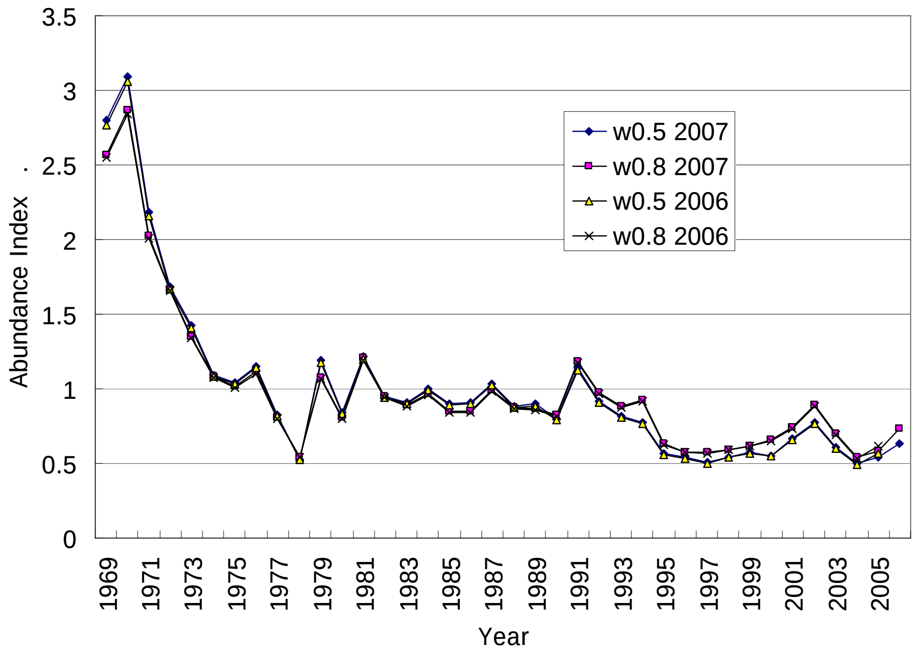


Fig. 1-5. Trends of normalized w0.5 (B-ratio proxy) and w0.8 (Geostat proxy) abundance indices, estimated from 2006 and 2007 data. (cont'd)

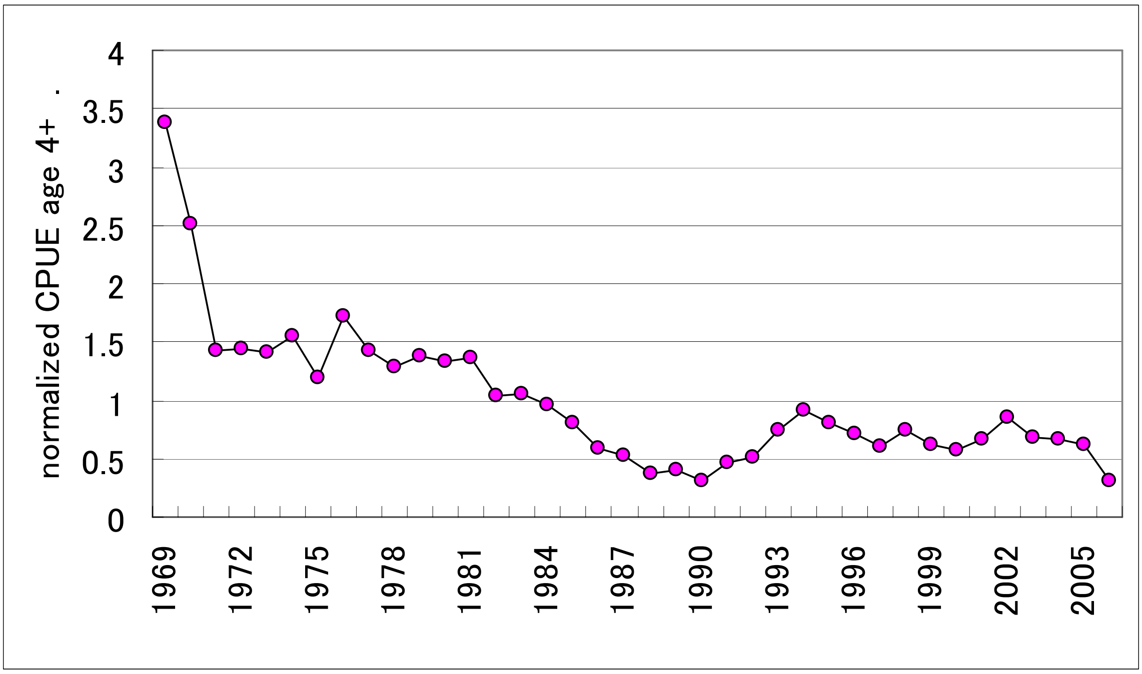


Fig. 1-6. Trends of normalized "ST Windows" indices for age 4+ fish by the new calculation method.

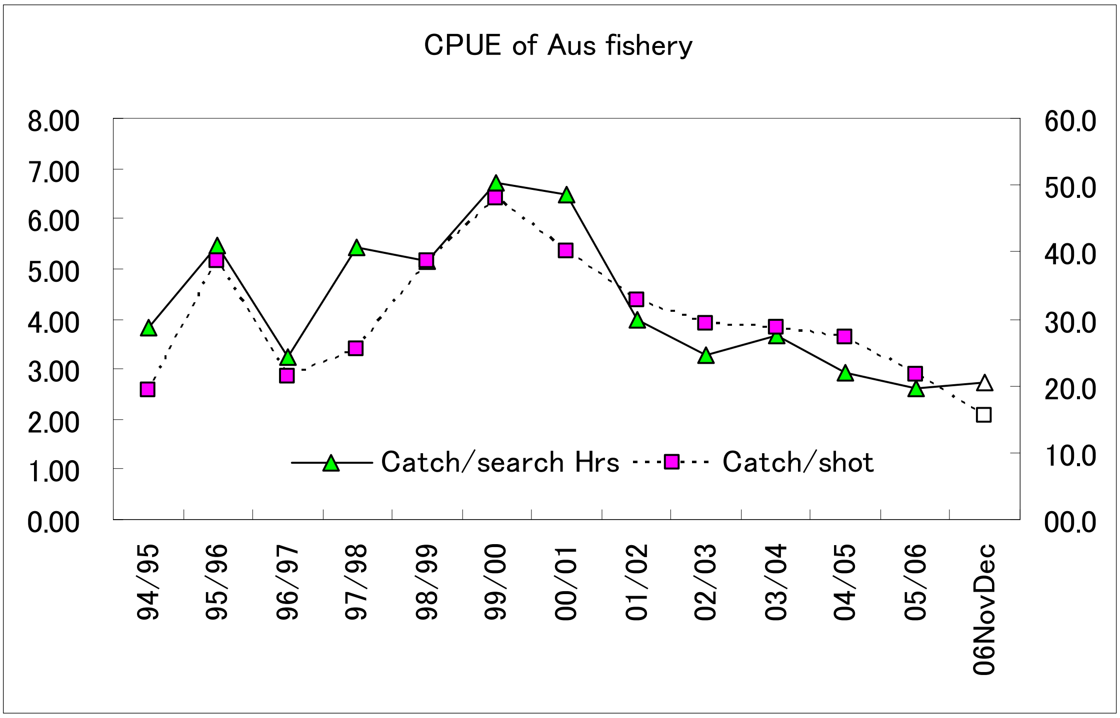


Fig. 2-1 Catch by efforts for Australia surface fishery.

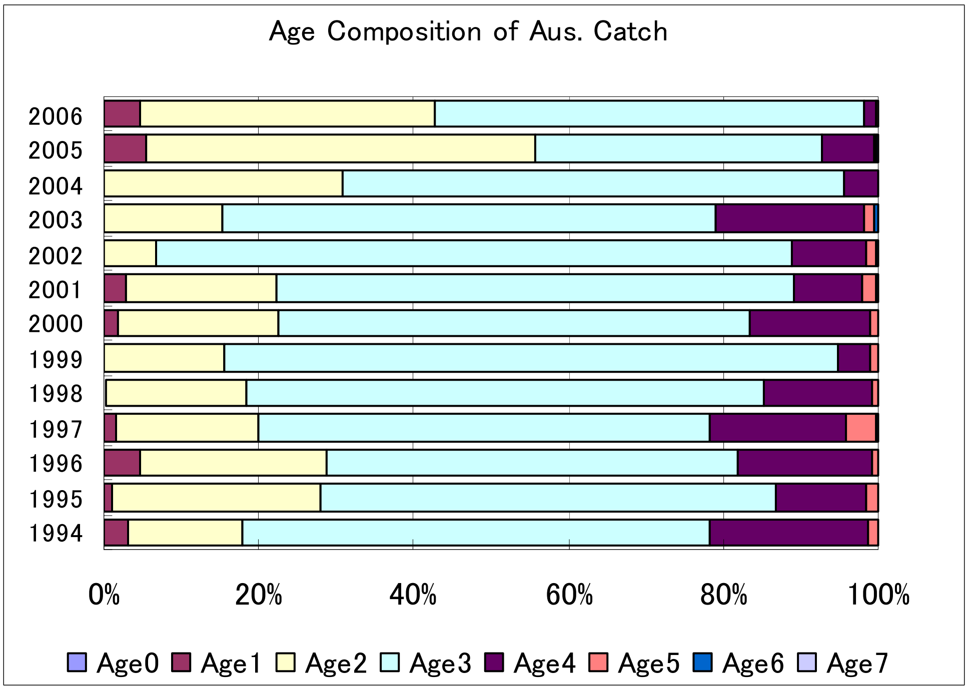


Fig. 2-2 Changes in age composition of Australia surface catches.

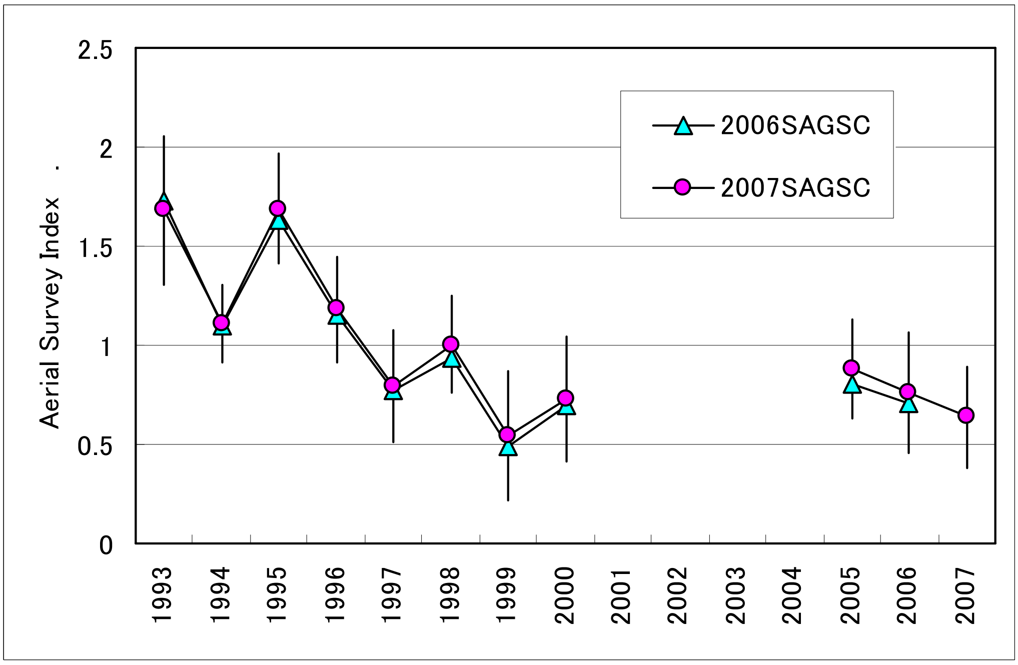


Fig. 2-3 Changes in Aerial index obtained from the Great Australian Bight. Estimates for previous years are different than those provided at the 2006SAG/SC because the analysis methods have changed slightly.

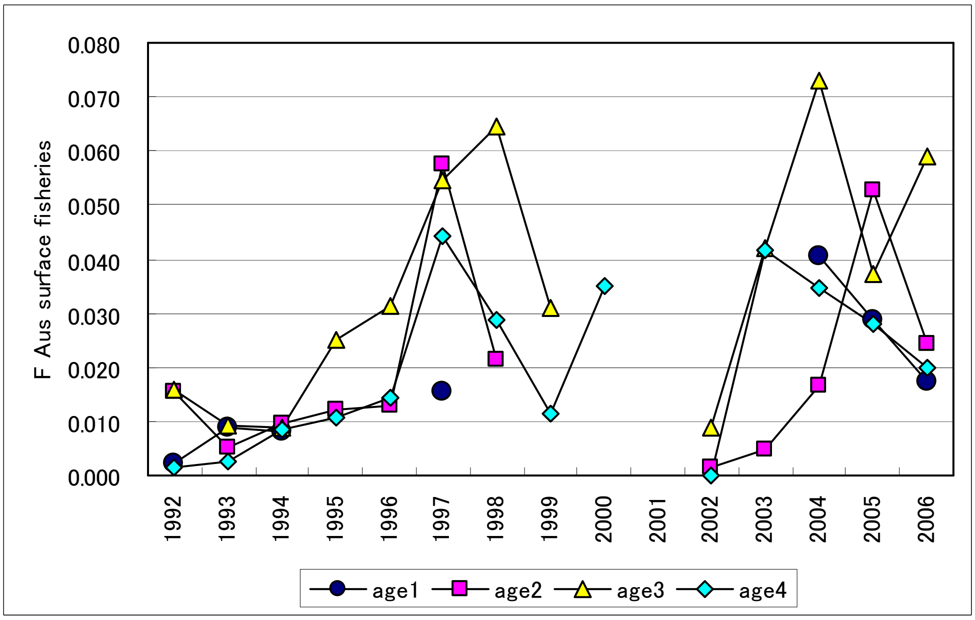


Fig. 2-4 Tentative F-estimates of surface fisheries based on conventional tag-recapture.

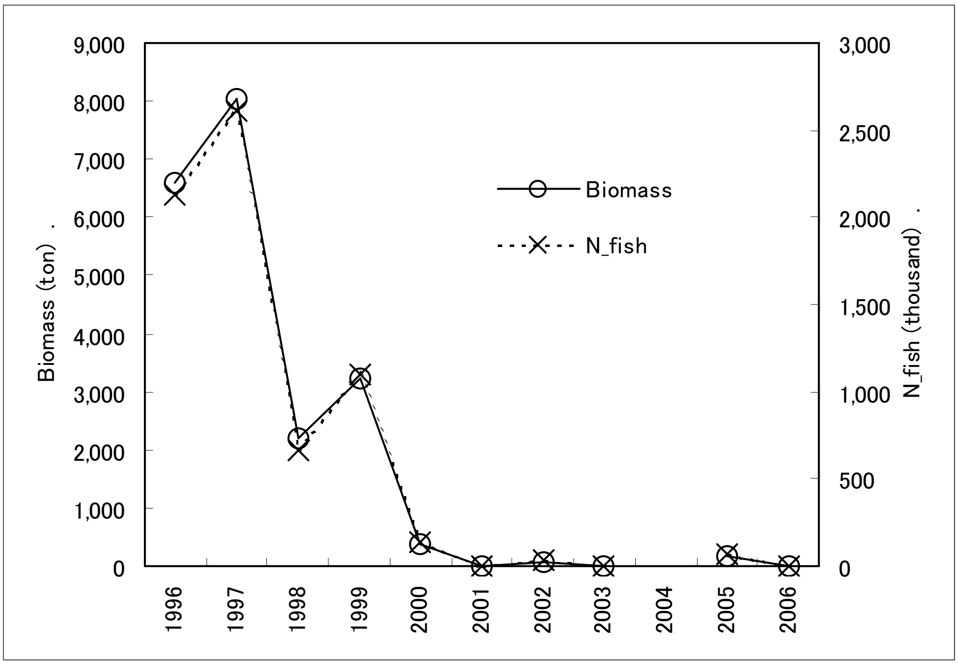


Fig. 3-1. Trends of acoustic index of age 1 SBT in the Western Australia. The acoustic survey ended in the 2005/2006 season (shown as “2006” in the figure).

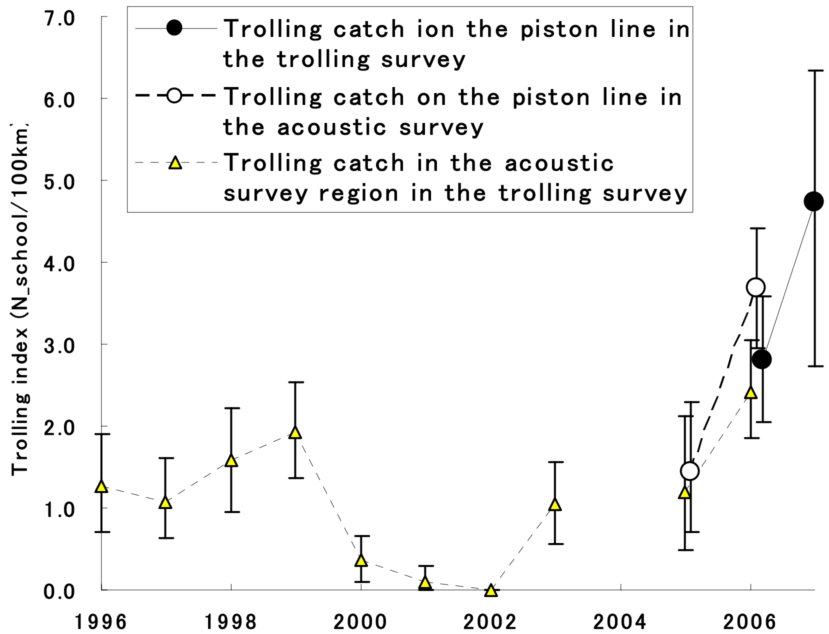


Fig. 3-2. Trends of trolling catch index of age 1 SBT in the Western Australia.

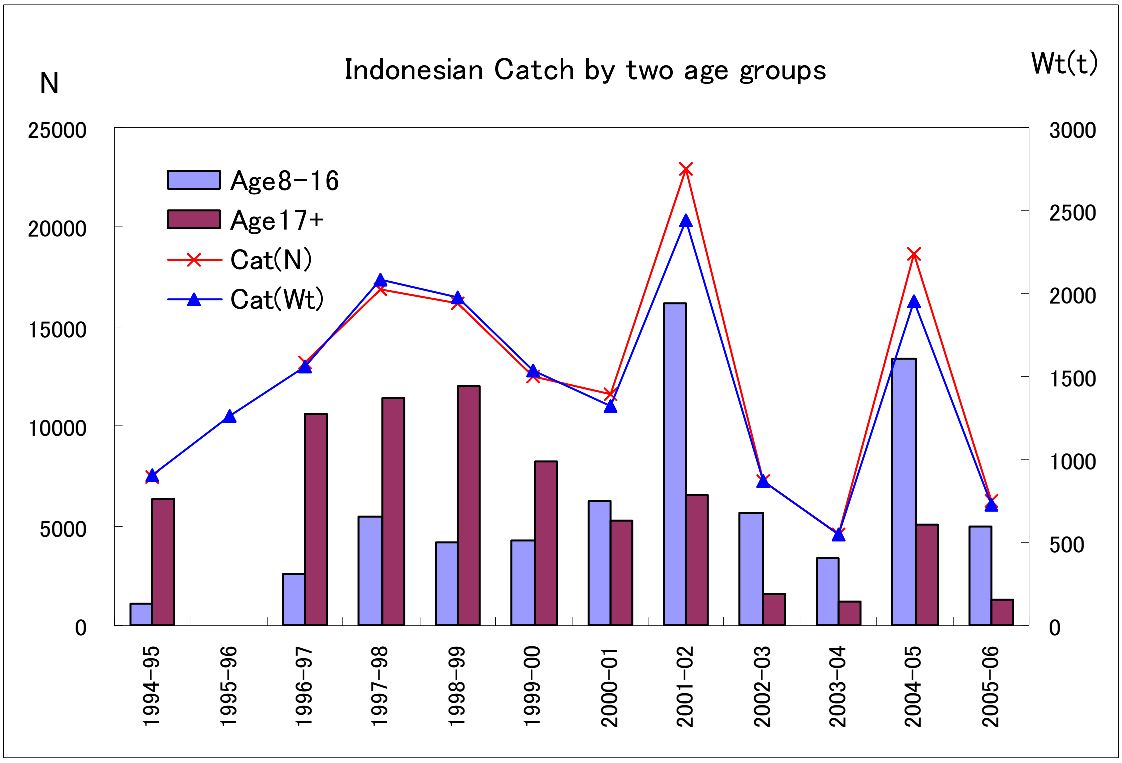


Fig. 4-1. Trends of Indonesian catches with proportion of two age groups occurrences.