Summary of Fisheries Indicators in 2005

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Abstract : Various fisheries indicators were examined to overview the current situation of SBT stock. Indices suggested that stock levels for middle to high age groups showed increasing trends from the late 1990s to 2002 and then declined toward 2004, although 2004 levels for those age groups are still similar to or higher than the levels in the late 1990s. Although many indices suggested low recruitments for cohorts of 1999 and after, indication of extent of recruitment decline differed according to indices. Considering the acoustic indices from Recruitment Monitoring Program suggests a possibility of continuous low recruitment for five years, the further careful monitoring of recruitments and serious consideration on impacts of potential low recruitments to stock management should be needed with a high priority. Indices on parental stock are hard to interpret and no specific judgment was made.

要約：ミナミマグロ資源現況を概観するために、各種漁業資源指数を検討した。中高齢魚資源の指標は 1990 **年代終りから** 2002 **年にかけて増加傾向を示したが、**2004 **年にかけて減少傾向を示す。ただし、**2004 **年の中高齢魚資源のレベルは依然として** 1990 **年代終りのレベルと同じか高い水準にある。多くの指標は** 1999 **年級以降の年級群の加入が悪いことを示唆しているが、加入悪化の程度は指標により異なる。加入量モニタリング音響指数が** 5 **年間続けて加入が低い可能性を示唆していることを考えると、今後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ういう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. Those 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 Operating Model. This document summarizes the results of updated indicators including standardized Japanese longline CPUE and our overall interpretations. It should be noted that some indicators exchanged in past were not available in this year, maybe partly due to lack of formal agreement.

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 through 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 2001 and 2002. The RTMP covers more than 95% of efforts in SBT distributing areas in recent years.

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

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 standardized with mean values and Fig. 1-3 compares reduction rate by cohorts in logarithmic scale. CPUE of age 3, 4 and 5 generally showed consistency, suggesting that age 3 CPUE could be used as indicators of relative cohort strengths, although a large decline of 1999 cohort was not detected with age 3 CPUE. Overall levels of CPUE by cohort are higher for cohort recruited after 1990. The 1986-1990 cohorts showed more drastic decline than the other cohorts, probably due to targeting towards small fish in the early 1990s caused by depleted stock status of cohorts recruited pre1986 and less structured management schemes at that time. Those cohorts recruited 1990 and after showed much slower decline rate, suggesting a reduced level of exploitation rates for these cohorts. Peak CPUE also shifts to age 5 for the cohorts 1990 and after. Those 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 indicated more acute decline, about the level comparable to those experienced by the late 1980s cohorts, in the most recent years. Due to just one or two points observation, it is not possible to judge whether this is a reflection of oceanographic and availability changes or indicating a real situation of fishing pressure. However, a lack of small fish in the most recent years has eventually lead to an increase of number of large fish caught under the same amount of quota allocation. This indicator should be monitored with a special care 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 five years data are shown for comparison. Fish smaller than 110cm, corresponding to age 4 and younger, was almost totally disappeared from Area 4 and Area 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, fish under 115cm increases relative to the last two years, but its level is still lower than past levels. Decline of small size fish is much less distinct in Area 9, off Cape area. Those fish showing substantial reduction correspond to the same cohort that the acoustic monitoring survey detected drastic declines of recruitment level since 2000.

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 2004 (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 is available the next year. The w0.5 and w0.8 series calculated for the 2004 SAG meeting are also included in Fig. 1-5 for comparison. There are no substantial differences found between the two series.

Updated w0.5 and w0.8 indices for age 3 increase from 1997 to 1999, decline in 2000, and then moderately increase again until 2002. The indices for age 4 increase from 1997 to 2002. Both indices for 3 and 4 age classes drop substantially in 2003 to the level of mid-1980s or lower. For 2005, age 3 increases and age 4 continues to decrease slightly but in general, they stay at historical low level. The CPUE indices for age 5 show decreasing trends from 1996 to 1998, and then remain constant until 2000. The CPUE for age 6&7 show short-term decreases and increases during 1995-2000. Trends of CPUE for age 8-11 are gradually increasing from 1996 to 2000. The CPUE indices for age 12+ remain almost the same level from 1996 to 2000. For all age classes of 5, 6&7, 8-11, and 12+, the indices increase from 2000 to 2002, and then decline in 2004 to levels, which are still higher than (5, 6&7, 12+) or similar to (8-11) the 2000 levels.

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 most recent years should be interpreted with caution because data source of CPUE calculation is different in the most recent years, although this discrepancy becomes much less in the recent years as observed in 2003 data where the impact of data update is almost negligible. This decline of CPUE from 2002 to 2004 common to all age groups is observed for nominal CPUE as well but not observed in ST windows series explained below.

Another type of standardized CPUE, “Spatial-temporal(ST) window”, was also updated using the same method as described in Takahashi et al. (2002). Results are shown in Fig. 1-6, where the results for 2004 assessment are also included for comparison. Trends of the past and updated indices (normalized to the average) were very similar. The updated “ST window” increased from 2000 to 2002, then declined in 2003, and slightly increased in 2004.

Size or age composition of other longline catches

Fig. 1-7 shows changes in size composition of catch of various longline fisheries. Data developed for operating model is used for these figures. Australian domestic fishery catches small size fish of 80-120 cm in 1991 and 1992 and gradually shifts to larger size and main size of catch during 1995 to 1999 is 100-160 cm. Catch level is lowered in 2000 and fish of smaller than 120 cm disappear from catch. In 2004, more substantial catch is taken after two years' quite low catch level but its size again shifts to larger size of 150-180 cm. It is very difficult to interpret this continuous shifting to larger fish without clear and detail understandings on this fishery but it should be noted that the size ranges which are used be a main component of this fishery are now totally missing.

New Zealand domestic fishery maintains more or less stable size composition. However, in recent years, small fish does not occur as seen in Japanese longline. Almost no fish is taken for size smaller than 115 cm in 2003 and smaller than 135 cm in 2004. Those timing and size range that disappeared from catch are similar to that seen in Japanese longline. New Zealand joint venture fleet is operating in the same way as Japanese fleet but monitored 100% by observers in principle. Size composition of catch of this fleet also shows sequential disappearances of juvenile fish, i.e. fish smaller than 115 cm in 2003 and fish smaller than 130-135 cm in 2004.

Size composition of Taiwanese longline stays consistent except for 2001. No disappearance of small fish is observed. Korean fishery is excluded from this consideration since Japanese size data is used to estimate size composition of Korean catch.

Fig. 1-8 shows a logarithm plot of catch number by age by cohort for New Zealand joint venture fleet. Since this fleet has operated in quite consistent way of stable memberships, this plot can be used to examine changes of exploitation pattern. Figure shows that the recruitments of 2000 and 2001 cohorts at age 3 to this fishery are extraordinary low comparing to other cohorts. It also shows that cohorts recruited 1998 and after have experienced higher mortality, generally indicating heavier fishing pressure.

In summary, the sequential disappearance of small fish is observed commonly among longline catches except Taiwanese catch, though there are some discrepancies in boundary size of disappeared fish.

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 troublesome, both catch per shot and catch per searching hours stayed at relatively low level during the last four seasons. The proportion of age 3 fish increased in 2002 and declined again in 2003. The proportion of age 2 increased from 2002 to 2004. Other than that, no strong signal was observed in age composition of surface catches.

Fig. 2-3 shows the aerial survey index and SAPUE index obtained from the Recruitment Monitoring Program in the Great Australian Bight (GAB). Both indices monitor surface abundance of age 2-4 fish 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 would not provide a information comparable to the full scale aerial survey. The aerial survey index shows moderately declining trend throughout the survey period and 2005 value is slightly lower than the average. SAPUE is aerial spotting data of commercial activities standardized with sighting effort. SAPUE declines from 2002 to 2004 followed by an increase in 2005 to the level higher than 2003. The aerial index and SAPUE are not yet directly comparable in scale.

Fig. 2-4 shows tentative estimates of F-value for surface fisheries based on the 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 pattern with catch per effort of surface fisheries shown in Fig. 2-1. F trends for age 2 and 3 show increases in 2003-04.

Indicators obtained from surface fishery suggest moderate decline of juvenile abundance in the GAB but no signs are observed to indicate drastic drop of juvenile abundance as observed longline related indicators and acoustic survey data.

3. Recruitments:

<u>Acoustic survey:</u>

Acoustic survey of the Recruitment Monitoring Program is aimed to monitor changes in relative abundances of age 1 fish migrating through the survey area in the southwestern coast of Australia. Fig. 3-1 shows the results of survey from 1996-2005. This index represents the age 1 fish within the survey area standardized with 15 days' survey period. The index shows a drastic decline since 2000 and stays at very low level in 2002 with a slight upturn from 2001 level, then becomes 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. The most recent survey results show slight increase but still stay at very low level.

As reported in the previous year, the cohort showing a drastic decline in 2000 is now available to longline fisheries and showing substantially low CPUE. If the recruitment trend detected by acoustic survey reflects the real situation, we expect four years' low recruitments to come in sequence. This can cause devastative impacts on SBT stock. The lack of age 4 fish from Japanese longline catch is a great concern, especially since the same sign was detected with the other independent indices.

Other indices obtained through the Recruitment Monitoring Program in the Western Australia was reviewed by Itoh and Tsuji (2005).

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. Those are estimated by combining age frequency of catch provided from CSIRO with estimation catch in number obtained by dividing catch weight by average body weight derived from size composition of catch.

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 changing age composition pattern from 2001/2002. No information available to judge whether this decline reflected changes in fish abundance or changes in fishing practices. Continuing decline of the older portion of spawning stock and potentially low give some concerns.

5. Overall Conclusion:

Indicators examined generally support a view that stock levels for middle to high age groups are the same levels in the late 1990s although those age groups showed increasing trends from the late 1990s to 2002. Many indicators examined suggest recent low recruitments but differed in indication of how low they would be. Longline related indicators especially from around Australian and New Zealand waters suggests drastic decline of recruitments of 2000 and also possibly 1999 and 2001. However, surface fishery related indicators do not detect such a drastic decline of recruitment level. The acoustic indices suggest continuous low recruitments for five years (2000-03, 2005). There is some sign of increase in exploitation pressure on middle to high age groups in the most recent years, probably due to lack of small fish available under the same allowance of catch. The further careful monitoring of recruitments and serious consideration on impacts of potential low recruitments to stock management are continued to be tasks with the highest priority.

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

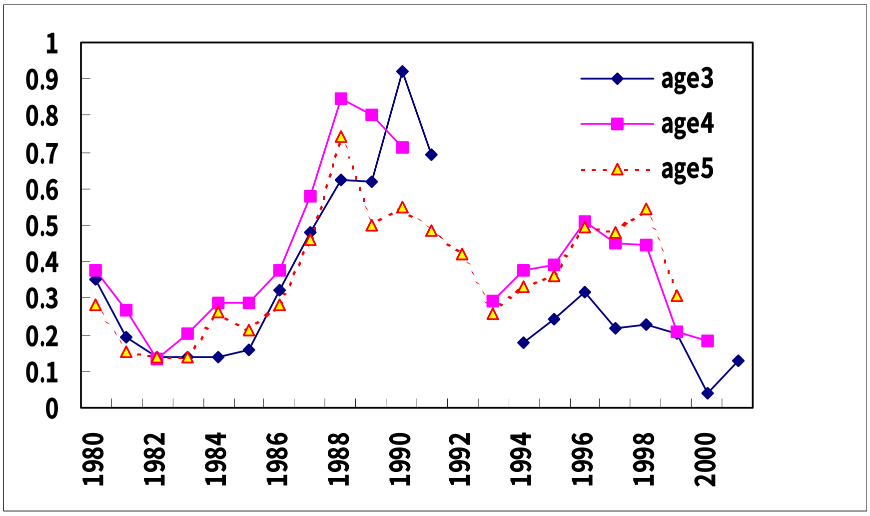


Fig. 1-2. Nominal CPUE by cohorts for age 3, 4, and 5.

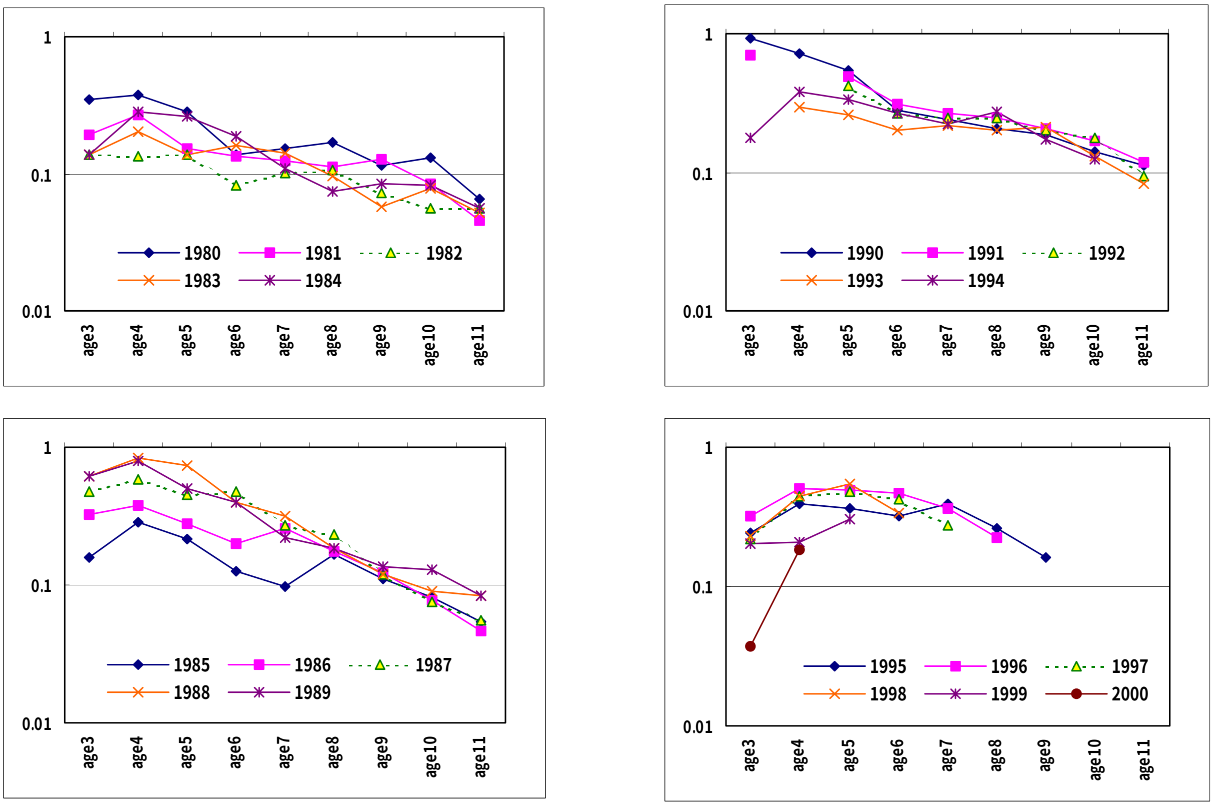


Fig. 1-3. Nominal CPUE by cohorts in log-scale.

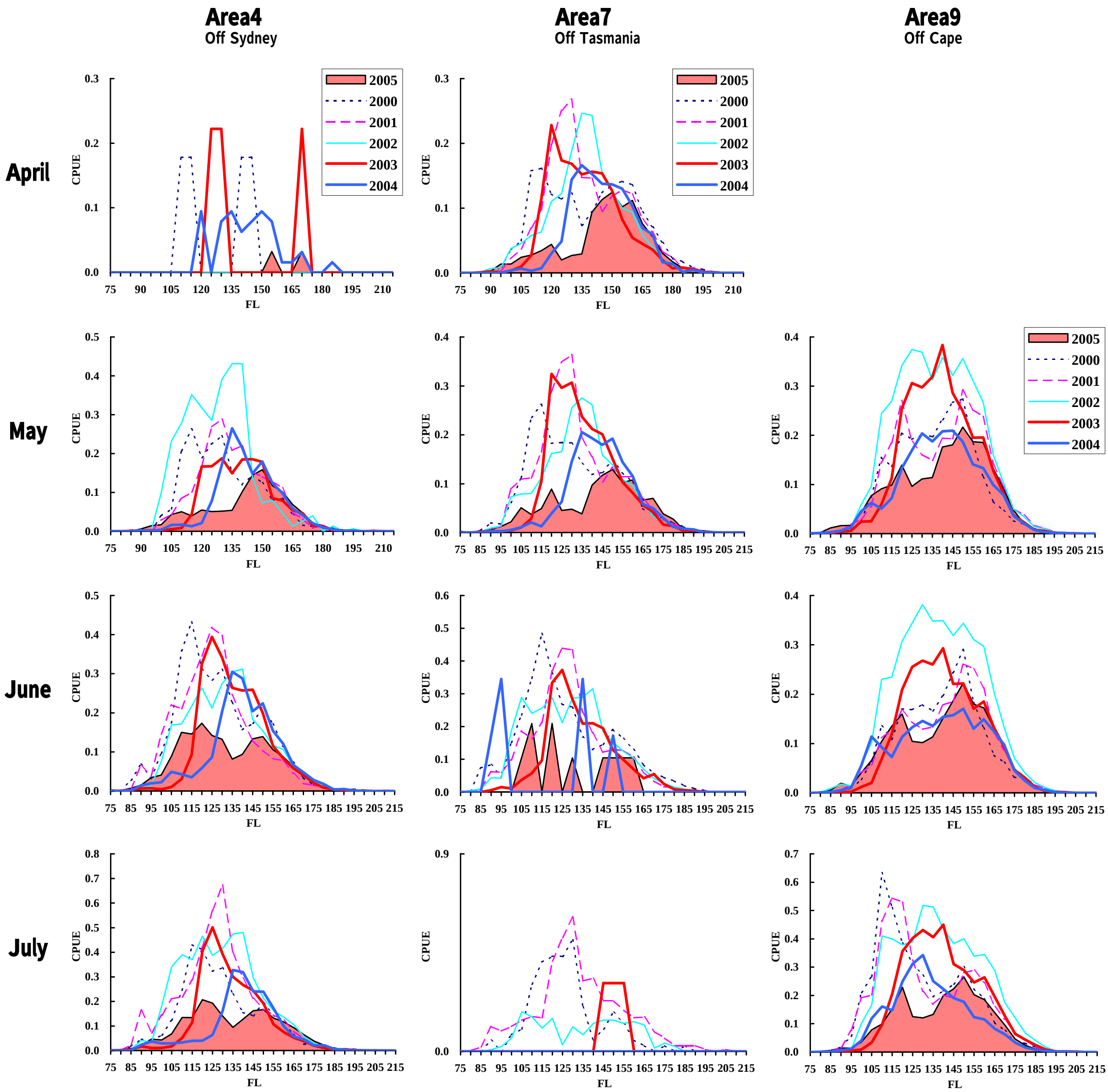


Fig. 1-4. Size composition of nominal CPUE of RTMP data for recent five years by month and areas.

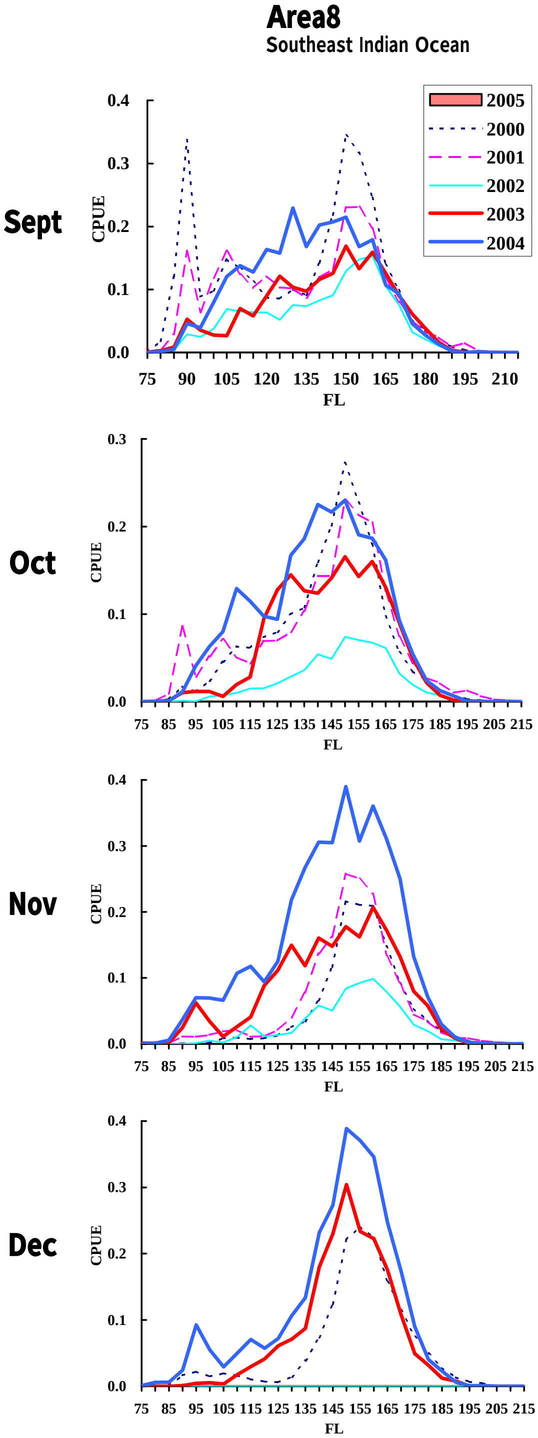
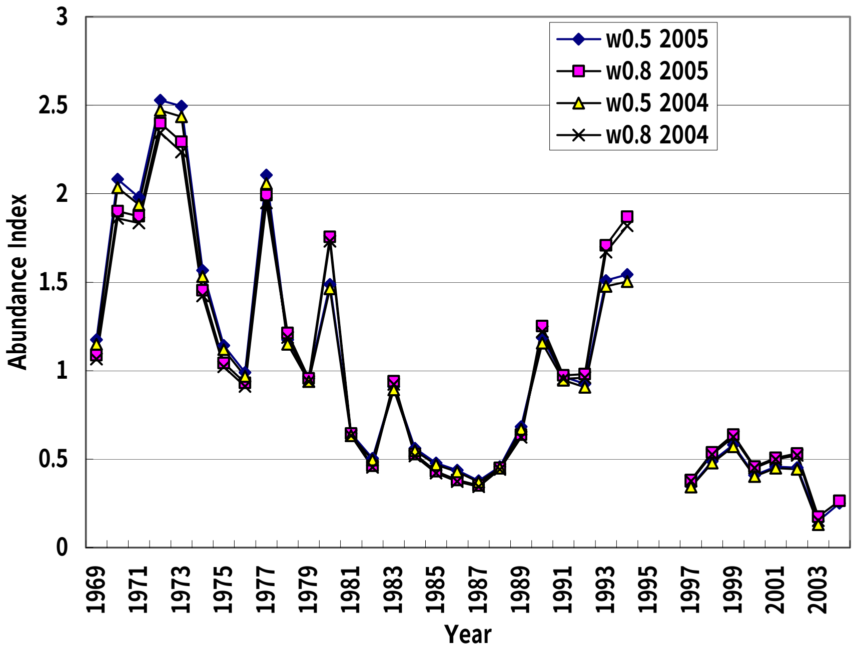


Fig. 1-4 (cont'd). Size composition of nominal CPUE of RTMP data for recent five years by month and areas.

(a) Age 3



(b) Age 4

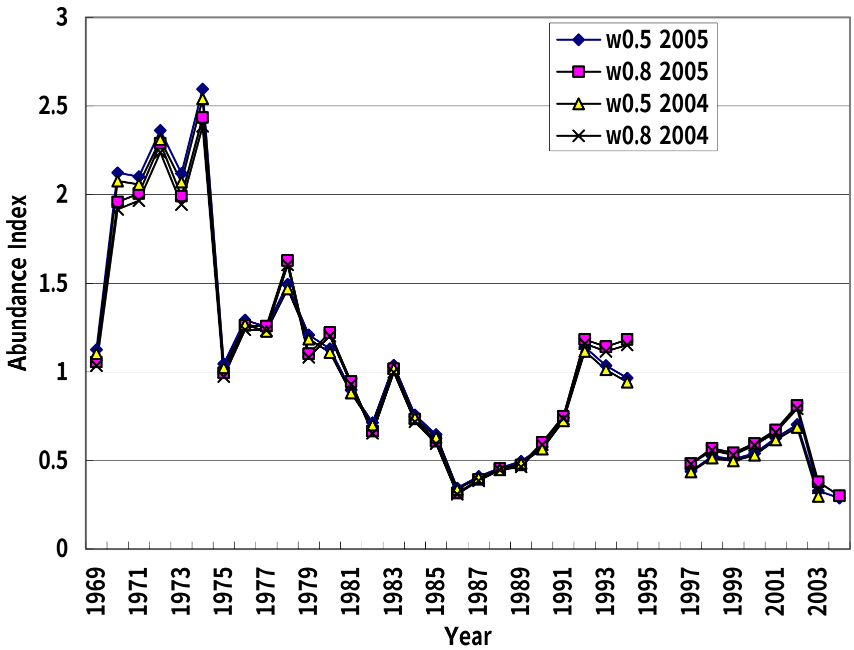
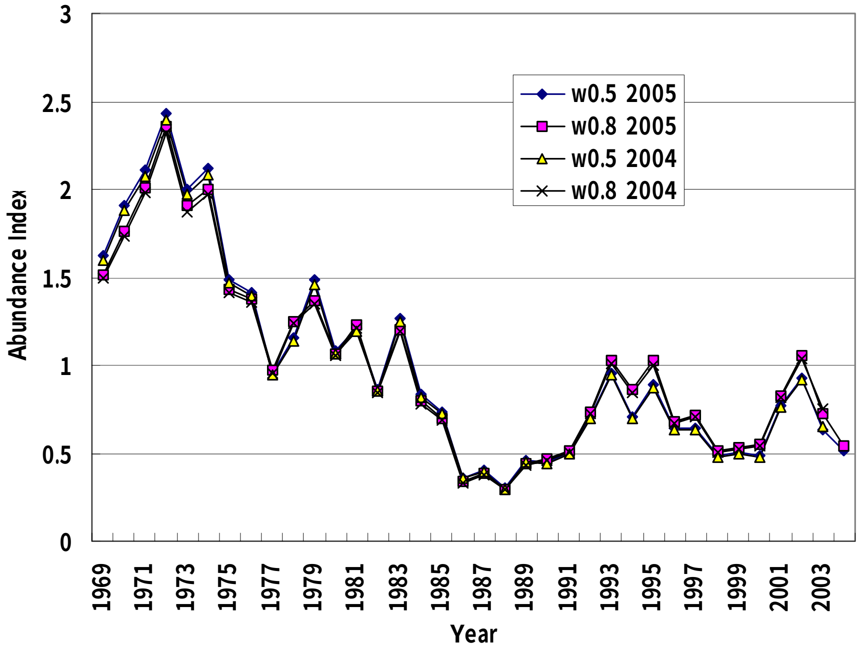


Fig. 1-5. Trends of normalized w0.5 (B-ratio proxy) and w0.8 (Geostat proxy) abundance indices, estimated from 2004 and 2005 data.

(c) Age 5



(d) Age 6&7

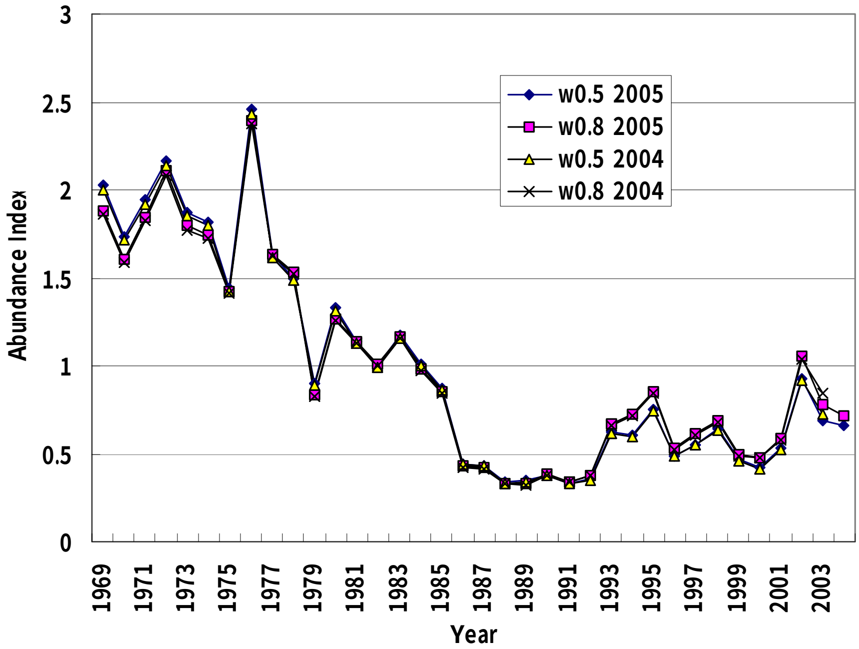
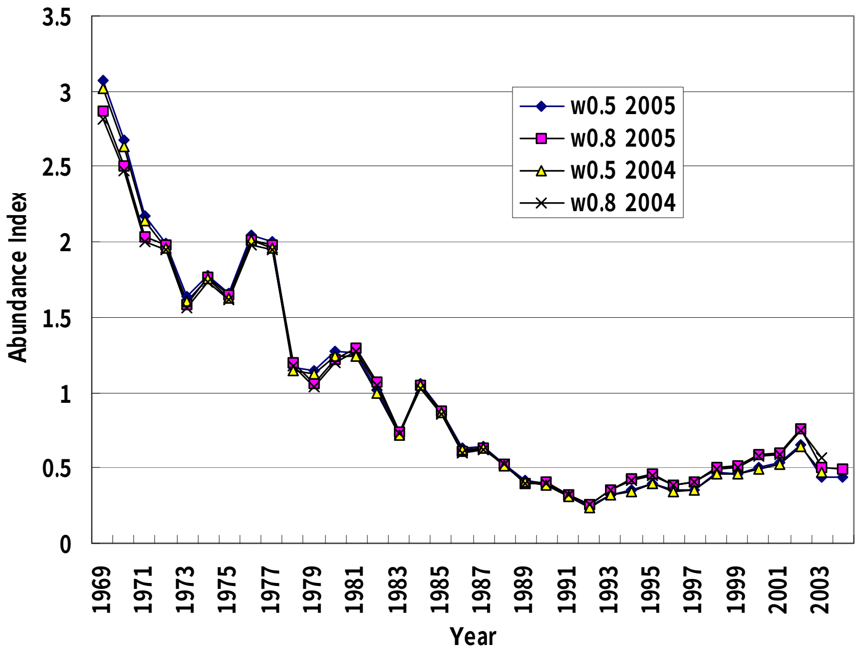


Fig. 1-5. Trends of normalized w0.5 (B-ratio proxy) and w0.8 (Geostat proxy) abundance indices, estimated from 2004 and 2005 data. (cont'd)

(e) Age 8-11



(f) Age 12+

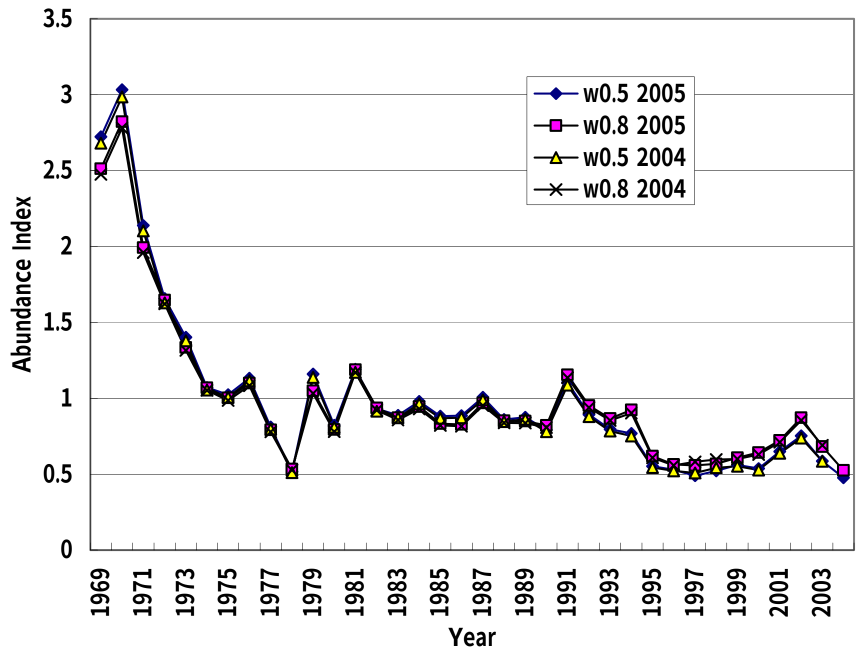


Fig. 1-5. Trends of normalized w0.5 (B-ratio proxy) and w0.8 (Geostat proxy) abundance indices, estimated from 2004 and 2005 data. (cont'd)

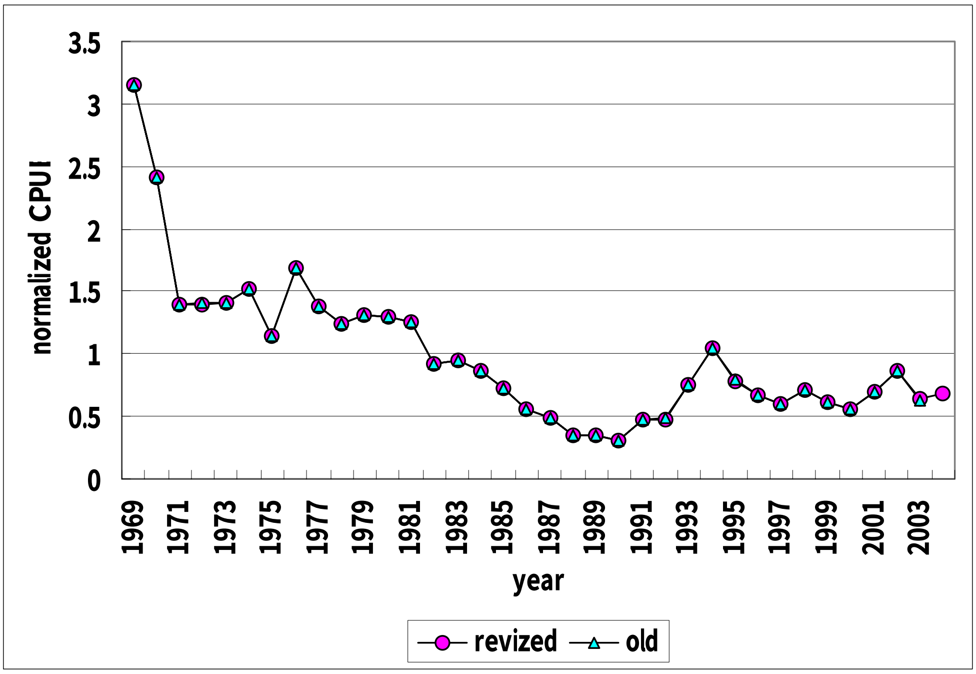


Fig. 1-6. Trends of normalized "ST Window" indices.

a) Australian domestic longline fishery

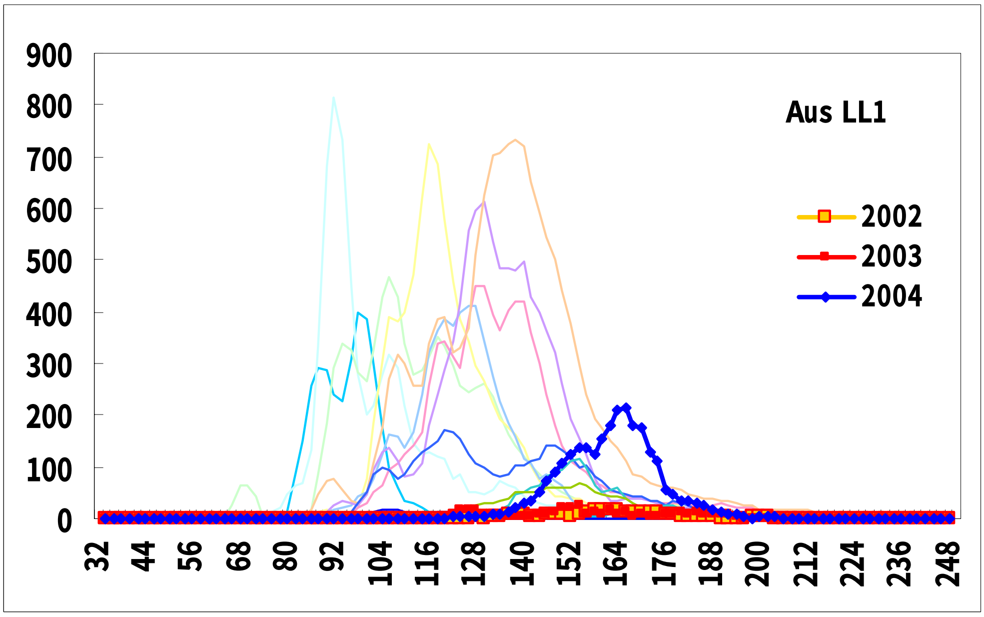
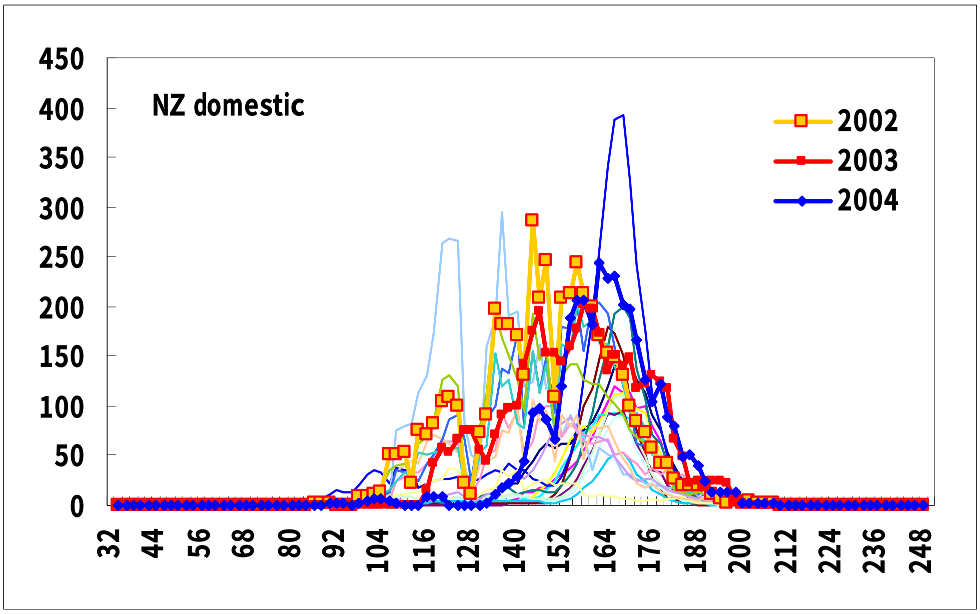


Fig. 1-7. Changes in size composition of catch of various longline fisheries.

b) New Zealand domestic fishery



c) New Zealand joint venture fleet

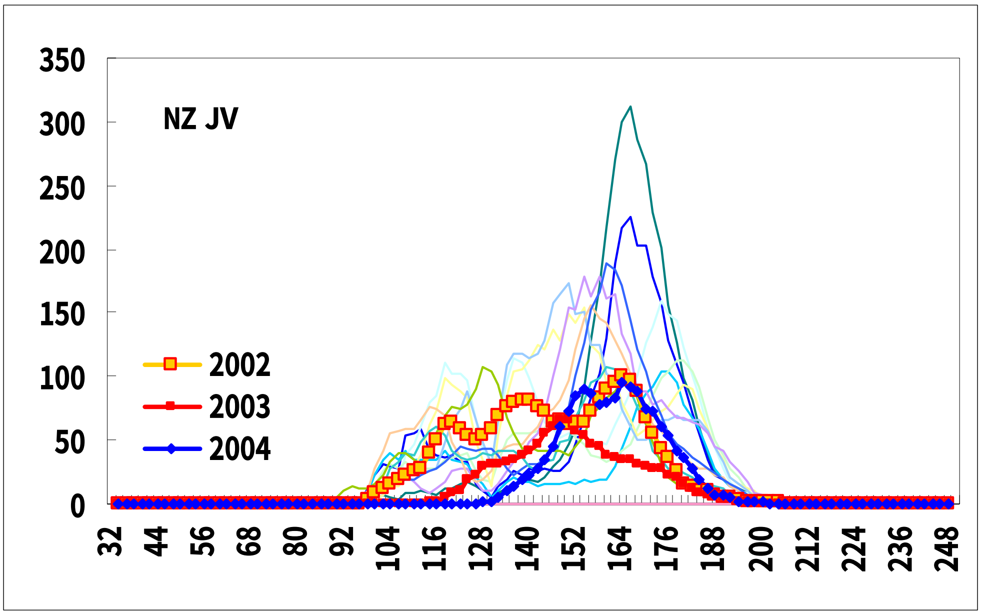


Fig. 1-7. Changes in size composition of catch of various longline fisheries. (cont.)

d) Taiwanese longline

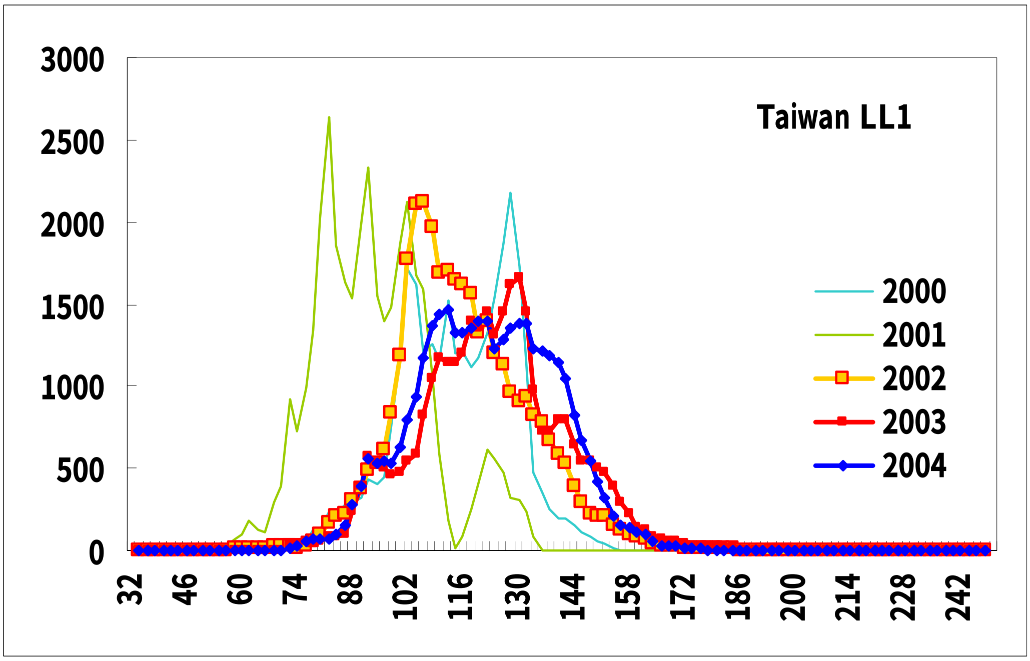


Fig. 1-7. Changes in size composition of catch of various longline fisheries. (cont.)

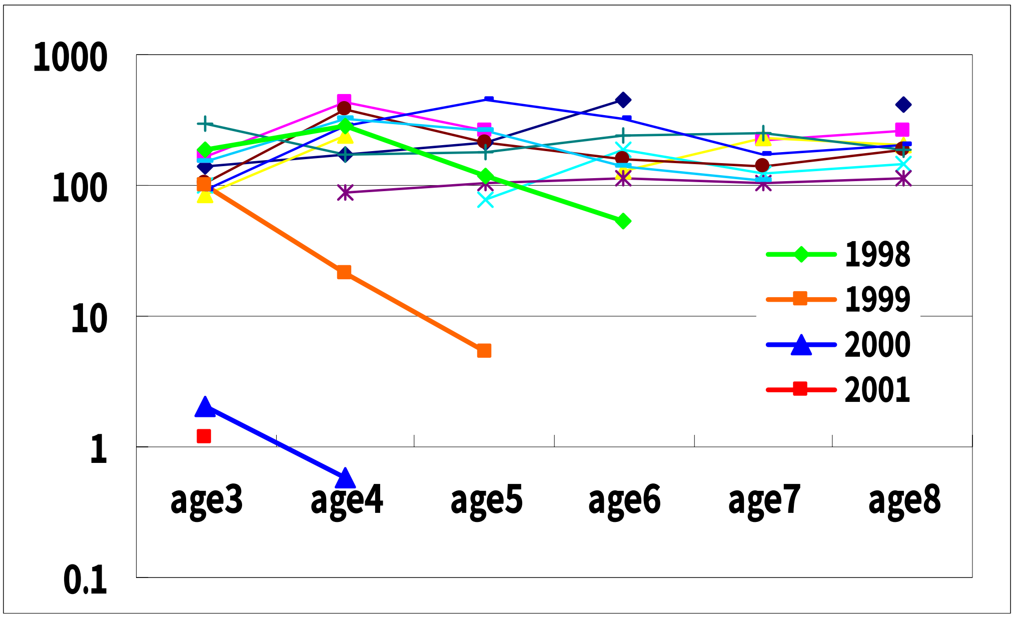


Fig. 1-8. Catches of New Zealand joint venture fleet by cohort by ages shown in logarithm.

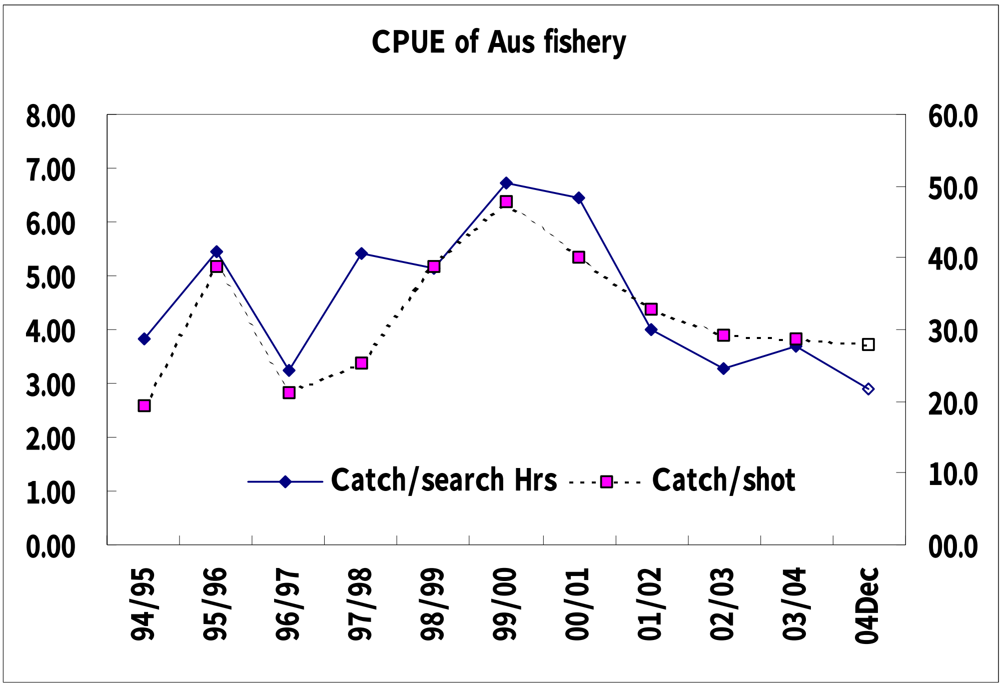


Fig. 2-1 Catch by efforts for Australia surface fishery.

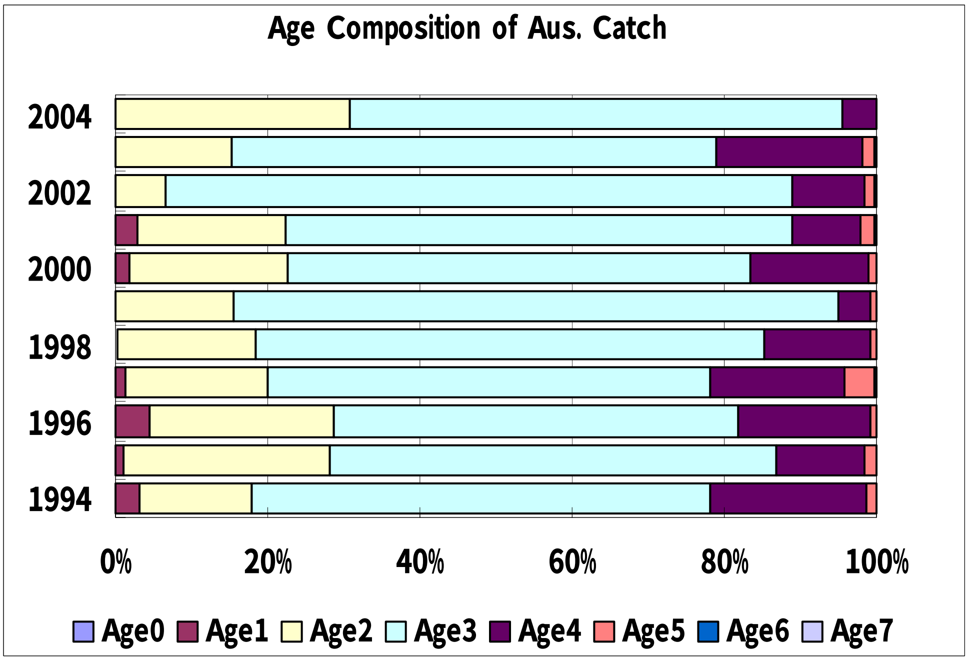


Fig. 2-2 Changes in age composition of Australia surface catches.

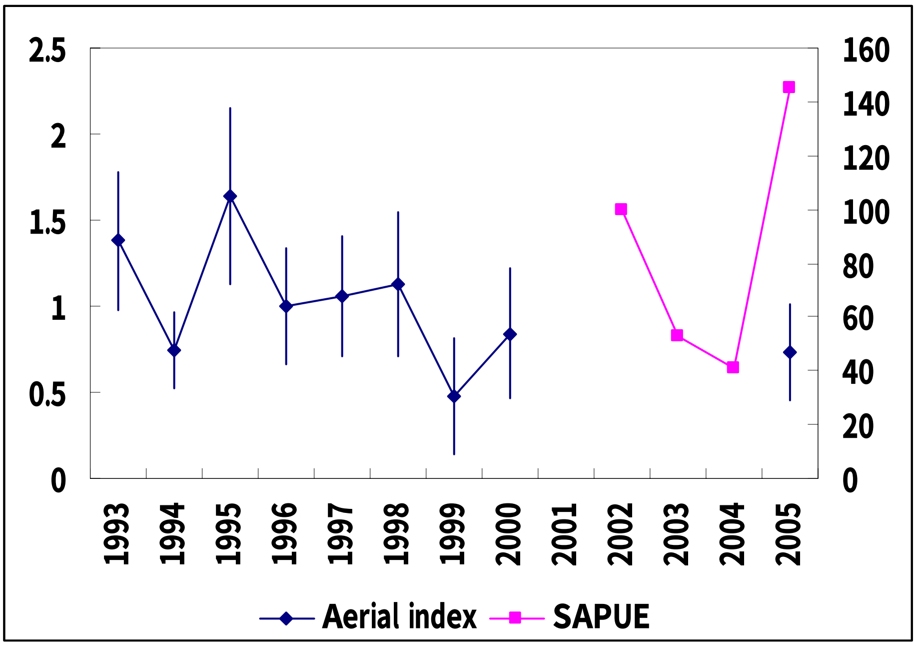


Fig. 2-3 Changes in Aerial index and SAPUE obtained from the Great Australian Bight.

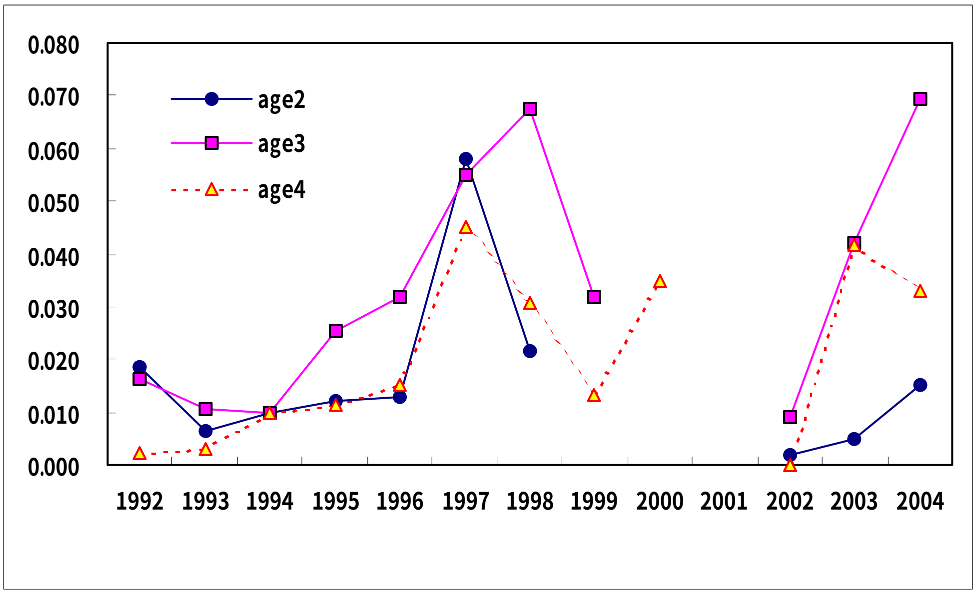


Fig. 2-3 Tentative F-estimates of surface fisheries based on conventional tag-recapture.

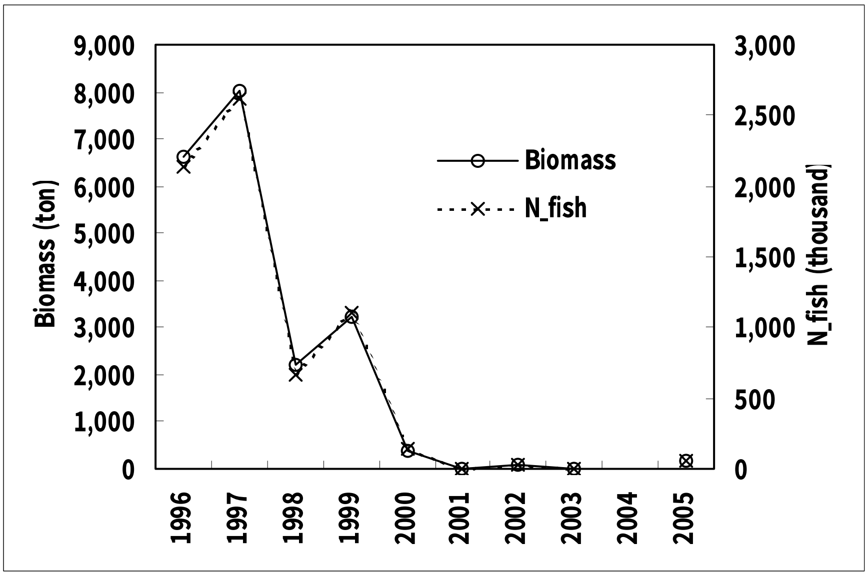


Fig. 3-1. Trends of acoustic index of age 1 SBT in the Western Australia (revised).

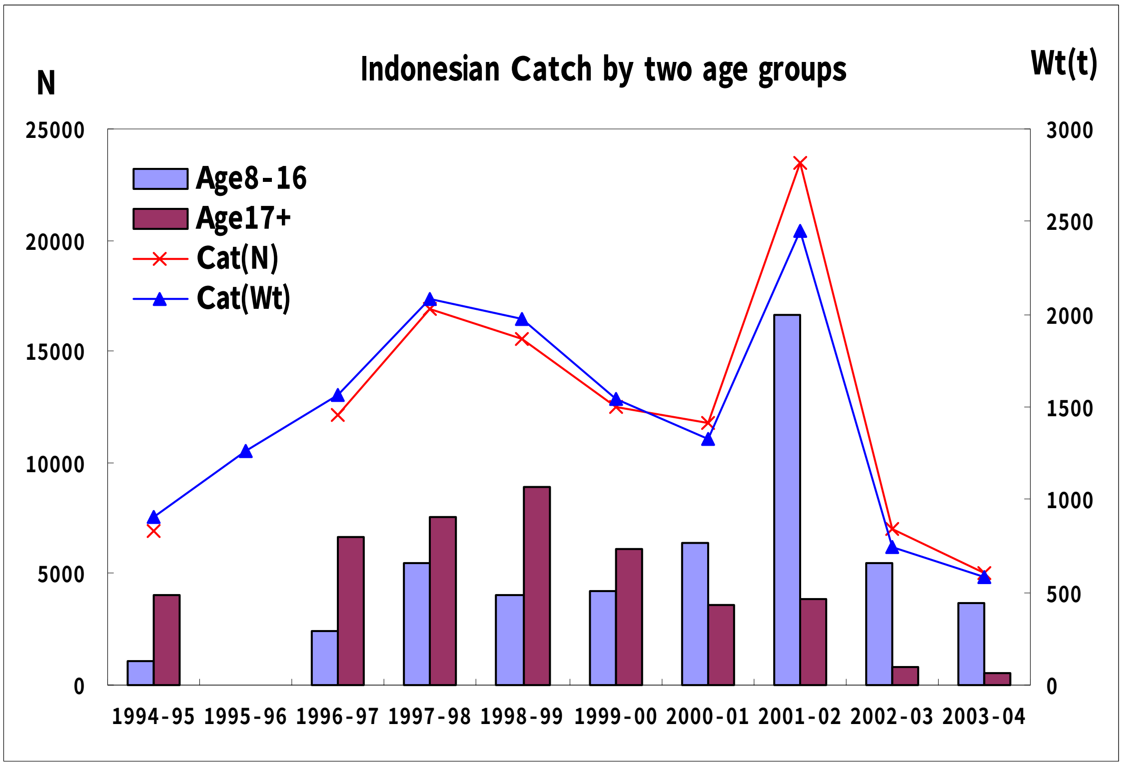


Fig. 4-1. Trends of Indonesian catches with proportion of two age groups occurrences.