REVIEW OF THE CURRENT CCSBT TAGGING PROGRAM AND POTENTIAL IMPROVEMENTS

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Abstract We briefly reviewed the overall tagging program under CCSBT, release/recapture status and expenditure of each tagging component, and general results from current recapture data. From these reviews, issues related to mixing pattern of fish and unbalanced funding contribution to the tagging program were emerged. To give future direction, reconsideration of objectives and proposed modified plans were briefly discussed.

CCSBT

1. INTRODUCTION

As a part of the Scientific Research Program (SRP) under CCSBT, a tagging program has been conducted since 2001/2002 season. There are three components to the program:

1) Conventional tagging of 1-4 year olds in the western and south Australia waters, fully managed by the CCSBT secretariat;
2) A pilot tagging program using longline vessels conducted by Japan in the off Cape waters;
3) A pilot tagging program conducted by Australia in the western Tasman Sea.

Each component has completed tagging activities of three years in 2004, and some recaptures, still in a small number though, have been reported in each component. Some practical and implemental matters to be reconsidered have been emerged in course of the three years tagging activities. This document intends to review the information accumulated and to discuss the need to reconsider the objectives and strategies of the CCSBT tagging activities.

We first briefly review the overall tagging program under CCSBT, release/recapture

status and expenditure of each tagging component. Then general results from current recapture data are reviewed. Finally implemental and financial issues emerged from in course of conducting the current tagging program for three years and future direction are discussed.

2. SUMMARY OF THE CCSBT TAGGING PROGRAM

2.1. Tagging Program Objectives

The overall objective of the SRP is to provide "statistically significant data for reducing the levels of uncertainty in stock assessments." The specific role of the conventional tagging program has been recognized as being to "provide important additional information on natural and fishing mortality rates to improve the ability to estimate changes in stock size."

Reflecting these overall SRP objectives, the primary objectives of the tagging program are considered to be (Anonymous 2001):

1) to provide age-specific estimates of fishing mortality (F) and natural mortality (M), with associated estimates of uncertainty (especially targeting 20% of CV on recruitment and F estimates for 2-4 years old fish), for as many SBT cohorts as possible;
2) to provide additional information on SBT migration and distribution patterns which may be useful in elucidating mixing rates of tagged fish;
3) to provide direct estimates of growth rates of tagged and recaptured fish.

2.2. Tagging Design and Protocols

CCSBT managed conventional tagging

As designed at the Tagging Program Workshop, this component had the following features; tagging of 5,000 -7,000 1-2 year old fish in Western Australia; tagging of 8,000 -10,000 2-4 year old fish in South Australia after the end of surface fishing season; fish to be caught using pole and line techniques; five year timescale (2002-2006). The same CCSBT standard conventional tags and applicators are used for all tagging components under CCSBT, including pilot tagging programs conducted by Japan and Australia described below. Major costs associated with the tagging program have been carried by Members, based on agreements by the Commission on budget allocation for the program (details are reviewed in the later section below). For tagging technicians and vessels to be chartered for the program, resources in Australia are utilized.

Pilot tagging program conducted by Japan

In this component, medium to large sized fish with conventional tags (some with an

archival tag or a pop-up archival tag) are released from longline vessels in the off Cape waters. All costs associated with this tagging component have been carried by Japan.

<u>Pilot tagging program conducted by Australia</u>

This tagging component also focuses on medium to large sized fish released with conventional tags (some with an archival tag or a pop-up archival tag) from longline vessels in the western Tasman Sea. All costs associated with this tagging component have been carried by Australia.

<u>Tag recovery</u>

For conventional tagging in all components above, same poster and rewards (cash, T-shirts, polo shirts, windbreakers, coffee mugs, caps, daypacks) prepared by the CCSBT secretariat are used as publicity and tag incentives materials. Each Member is responsible to monitor its own fleets and important landing sites for tag recovery. The CCSBT secretariat coordinates monitoring activities of fleets and landing sites in non-Member countries. Release/recapture data obtained from all tagging components are centralized to CCSBT database and managed by the CCSBT secretariat. All costs of tag publicity, tag rewards, management of tagging data, and support for monitoring fleets and landing sites in non-Member countries are carried by Members, based on agreements by the Commission on budget allocation for the program.

2.3. Unresolved Issues prior to Commencement of the CCSBT Tagging Program

There are some issues remained unresolved prior to commencement of the CCSBT tagging program. These are a target number of conventional tag release, expected CV for F and M estimates, reliability of assuming complete mixing, and a problem that CV for F and M estimates changes with CV for reporting rate estimate. Especially, how to estimate the reporting rate has been undecided. From simulation analyses, Polacheck et al. (2003) indicate that an observer coverage of 20-30% would be required to achieve CVs in F (for age 1-5) estimates of about 20%, and concluded that reporting rate estimates and observer coverage appear to be linked. But then, it is also noted that the practical constraints and difficulties with achieving high observer coverage levels (Anonymous 2003). This issue will be addressed by a small technical group to be convened at the 2004 SC meeting (Anonymous 2003).

3. REVIEWS OF RELEASE/RECAPTURE STATUS, EXPENDITURE, AND RECOVERY EFFORT

3.1. Releases and Recaptures

Conventional tagging managed by CCSBT

Table 3-1, 3-2, and 3-3 summarize numbers of releases (by area, year, age), total numbers of recaptures (by flag), and numbers of recaptures (by flag, year, age), respectively. The ratios (%) of recaptures to catch at age by flag, year, and age are also shown in Table 3-3. For comparison purposes, the same summarizations for CSIRO/NRIFSF Recruitment Monitoring Program (RMP) are shown in Table 3-4, 3-5, and 3-6.

Target numbers of releases are 5,000 -7,000 1-2 year old fish in Western Australia and 8,000-10,000 2-4 year old fish in South Australia (Anonymous 2001). In Western Australia, actual releases satisfied the target number in 2003 and 2004, but did not reached the target number in 2002 (Table 3-1). In South Australia, actual numbers of releases did not satisfied the target number in 2002-2004. Especially, the number of releases in 2002 is small (<1,000 fish) whereas the releases in 2003 and 2004 are greater than 5,000 fish (Table 3-1). Reasons for not reaching the target numbers were a combination of availability of fish and availability of vessels to be chartered (CCSBT Secretariat 2002, 2003, 2004).

Compared to the number of recaptures from Australia, recaptures from Japan and Taiwan are still small (Table 3-2). This is due to that Japan and Taiwanese fisheries target age 4 and older year fish while most of Australian fisheries target 2-4 year olds. When comparing the ratio of recaptures to catch at age, the ratios are similar for Australia, Japan, and Taiwan (Table 3-3).

In CSIRO/NRIFSF RMP, a large number of conventional tags was released mostly in Western Australia and South Australia for 1991-1997 (Table 3-4). There was some small number of releases occurred in later years. Most recaptures have been reported from Australia and Japan, some from New Zealand, Taiwan, and Korea (Table 3-5). The majority of recaptures from Australia were from age 4 and younger fish. (Table 3-6). Recaptures from Japan scattered more or less evenly for age range of age 2 to 7.

When comparing the ratios of recaptures to catch at age between different ages, Australia and Taiwan fleets showed higher ratios for fish older than age 4. (Table 3-6). For Japanese fisheries, this pattern is reversed, i.e., the ratios are greater in younger ages. There were not large differences in ratio throughout age classes for New Zealand fisheries. As for comparison of the recapture/catch ratios between fleets, Australia, Japan, and New Zealand showed more or less similar values for juveniles (somewhat higher in Australian fisheries). The ratios for older ages were remarkably high in Australian fisheries.

The proportions of tag recaptures through observers, port-liaison, etc. are 20.6% and 14.5% for Japanese and New Zealand fleets, respectively (Table 3-5). This ratio is 0.1 % for Australia and naught for Taiwan. For tag recovery from Japanese fisheries in 2003, 21 conventional tag returns were from scientific observers, 34 conventional tags and 1 archival

tag were from a port liaison person (combined all CCSBT, Japan, and CSIRO tag returns).

Pilot tagging program conducted by Japan

Summary of pilot tagging program conducted by Japan is shown in Table 3-7. In this component, a total of 1,159 conventional tags, 165 archival tags, and 12 pop-up archival tags have been deployed and released from longline vessels in the off Cape waters for 2001-2003. Main size classes of tagged fish were 100-109cm (age 3-4) in 2001, 105-119cm (age 4) in 2002, and 115-124cm (age 4-5) in 2003 for conventional tag release, 120-129cm (age 5) in 2001, 115-119cm (age 4) in 2002, and 130-134cm (age 6) for archival tag release (Table 3-8). A total of 15 tag returns (including 5 archival tag returns) have been reported to date (Table 3-7). Mortalities associated with this tagging component were 24.0% in 2001, 29.8% in 2002, and 20.9% in 2003. (Table 3-7).

Pilot tagging program conducted by Australia

Table 3-9 shows a summary of pilot tagging program conducted by Australia. Details of tagging activities were available for 2002 only. A total of at least 373 conventional tags and 12 pop-up archival tags were deployed and releases from longline vessels in the western Tasman Sea. A total of at least 2 tag returns have been reported to date. Mortality of this component in 2002 was 42.6%, much higher than that for the Japanese component of similar type of activities. The reasons for this difference in mortality rates have not been speculated yet.(Table 3-7 and 3-9).

3.2. Expenditures
Conventional tagging managed by CCSBT

Table 3-10 summarizes expenditures of conventional tagging by CCSBT for 2002-2004. Total annual expenditures were AUD$478,573 for 2002, AUD$589,802 for 2003, and AUD$613,875 for 2004, respectively. Expenditures required for tag deployment were AUD$115.06 for 2002, AUD$42.32 for 2003, and AUD$52.72 for 2004 per fish. Major costs associated with this tagging program have been carried by Members, based on agreements by the Commission on budget allocation for the program. Contributions from Members were allocated using the General Budget allocation formula for 2003 and 2004, except for 2002. Among total expenditure of $478,573, Australia contributed $350,000 and the rest of the expenditure was supported by the CCSBT budget agreed by the Commission (CCSBT Secretariat 2002).

Pilot tagging program conducted by Japan

Expenditures of pilot longline tagging in the off Cape waters by Japan were summarized in Table 3-11. Total annual expenditures were $1,368,494 for 2001, $1,287,032 for 2002, and $1,362,393 for 2003, respectively. Tag deployment expenditures required for one released fish were $3,184.5 for 2001, $3,593.6 for 2002, and $1,674.4 for 2003. A majority of cost was for chartering vessels and fuels. When subtracting vessel charter and fuel cost from expenditures, tag deployment cost per fish would be reduced to $420.8 for 2001, $568.5 for 2002 and $178.4 for 2004. One fish released from this component will be about equivalent with three fish released from CCSBT tagging component due to natural mortality. If taking this into consideration, cost used for one fish release were about the same level as the CCSBT component in 2001 and 2003 and about four times more in 2003 (Table 3-10 and 3-11). Table 3-11 also includes some expenses needed for rewards of the first year's of Program, special reward for archival tag return, advertising and promotion materials in Japanese and Indonesian, and port liaison person.

In Australia, the government vends catch under SRP and provides its profit to the CCSBT tagging program. In Japan, however, sales of catch must return to the Government by rule and introducing such system is impossible.

Pilot tagging program conducted by Australia

Details of expenditures of pilot longline tagging by Australia have not been available. Estimated expenditure for 2002 activity was $120,000 per 100 fish releases (Table 3-9).

3.3. Recovery Effort

Japan has continued to make effort for tag recovery as listed in the 2003 SC report (Anonymous 2003). Especially, in addition to promotion and advertisement of tagging program, Japan started to place a port liaison person at Shimizu, Yaizu, and Oigawa in 2003. The liaison person contacted a total of 37 Japanese longline vessels at major landing sites (27 at Shimizu, 3 at Yaizu, 7 at Oigawa) during November 2003 – February 2004. Tags were reported from 9 vessels. A total number of conventional tag returns were 34 (4 CCSBT SRP, 3 SRP Japan, 1 EFP, 26 CSIRO/NRIFSF RMP). One archival tag return (Japan released) was also reported. In 2002, 17 conventional tag and 2 archival tag returns were reported without scientific observers and liaison person. Tag returns increased from 2002 to 2003. Although 2004 is still second year of placing the port liaison person, this appears to be effective in increasing tag recovery. Japan plans to continue this port liaison system for several years.

The CCSBT secretariat prepared a poster for advertising conventional tag recovery. This is a common advertising material for all Members. In addition to this, Japan prepared an

original poster for advertising conventional, archival, and pop-up archival tag returns, simultaneously. Two languages, Japanese and Indonesian, are used on the same poster as Indonesian crews are getting increased in Japanese longline vessels. This poster has been distributed to Japanese longline vessels through the Federation of Japan Tuna Fisheries (FJTF). The port liaison person has also handed out the poster when visiting vessels at landing sites.

There is no specific promotion material prepared by the CCSBT secretariat for tagging program. Japan has issued news letters in Japanese and Indonesian to promote and advertise tagging program. The news letters together with the poster has been distributed to vessels through the FJTF and the port liaison person. Japan also prepared tag recovery report forms and distributed them to vessels.

For conventional tag returns, the CCSBT prepares several kinds of rewards common to all Members. These are cash of AUD$15, T shirts, polo shirts, windbreakers, daypacks, coffee mugs, and caps. In addition to these, Japan prepares original T shirts (for conventional and archival tag returns), water-proof digital cameras (for archival tag returns), and towels (handed out when a port liaison person visits vessels). The Port liaison person reported on the feelings of Japanese fishermen towards various tag rewards as follows: They favored polo shirts and windbreakers; T shirts were more or less preferable; They hardly chose daypacks, coffee mugs, or caps; As for sizes of shirt, XL or larger are too big for Japanese; Digital cameras must be preferable.

Expenditures for promotion/advertisement of tagging program and tag rewards are summarized in Table 3-10 (CCSBT) and Table 3-11 (Japan).

Results of other Members' recovery effort were not reviewed here as no such information was available.

4. REVIEWS OF GENERAL RESULTS FROM CURRENT RECAPTURE DATA

4.1. Conventional Tag Returns

<u>Movement</u>

Releases and recaptures data of CCSBT managed program, tagging program in CSIRO/NRIFSF RMP, and pilot program by Japan were plotted in Fig. 4-1, 4-2, and 4-3, respectively. To give additional information, releases and recaptures data obtained from the Experimental Fishing Program (EFP) by Japan were also mapped in Fig. 4-4.

Fish released in Western Australia, South Australia, and Tasman Sea were recaptured in wide areas from the off Cape waters to New Zealand waters (Fig. 4-1 and 4-2), suggesting that juvenile fish in the Western/South Australia and Tasman waters disperse over wide areas covering major fishing grounds as getting older. On the other hand, fish released in off

Cape were recaptured either in the same off Cape area or in South Australia (Fig. 4-3). In contrast to this, fish released in South Indian Ocean, although size of the fish was same as that released in off Cape, were recaptured in South and East Australia (Fig. 4-4).

Ratio of recaptures to catch at age by flag

As explained earlier, in case of conventional tagging by CCSBT, the ratio of recaptures to catch at age are similar for Australia, Japan, and Taiwan in 2002 (Table 3-3). In case of RMP tag returns, the recapture ratios to catch at age are more or less similar for age 3 and younger for Australia, Japan, and Taiwan (Table 3-6). The same tendency was appeared in CCSBT tagging (Table 3-3). For age 4 and older fish, the recapture ratios are higher in Australian fisheries than in Japanese, New Zealand, Taiwanese fisheries. Causes of these differences may be a combination of differences in availability of tagged and survived fish in different time and areas, and difference in tag reporting rates.

Trial estimation of Fishing mortality (F) of age 1-4 for Australian Fisheries

In order to examine a potential utility of the current tagging program, we tried quick estimation of F of age 1-4 for Australian fisheries (all combined) by year. Estimation was done with an extremely simplified model under an ideal situation of complete mixing and no mortality within fishing seasons. Recaptures from New Zealand and Taiwan were ignored. Combined release/recapture data of CCSBT and RMP tagging were used. A model used for F calculation is:

$$F(year, age) = -\log[1-C(year, age)/N(year, age)]$$

C(year, age): recaptures (excluding recaptures in the same year of release) by Australian fisheries
N(year, age): numbers of tagged fish available, computed as [N(year-1, age-1)–C(year-1, age-1)+R(year-1, age-1)-Cs(year-1, age-1)-Cj(year-1, age-1)]*exp[-M(year-1, age-1)]
R(year, age): new releases
Cs(year, age): recaptures in the same year of release by Australian fisheries
Cj(year, age): recaptures by Japanese fisheries
M(year, age): natural mortality (V6 vector)

The estimated F of age 2-4 increase from 1992 to 1997-1998 (Table 4-1). The F values in 2003 are comparable levels to 1996-1999 for age 3 and age 4, whereas the estimated F in 2003 for age 2 was lowest in 1992-2003.

Polacheck (1994) reported F estimates as 0.01-0.05 and 0.01-0.03 for age 2 in 1992 and 1993, 0.04-0.20 and 0.01-0.07 for age 3 in 1992 and 1993, 0.001-0.05 for age 4 in 1993. Compared to these previous estimates, our quick estimates of F fall about the lower end of estimated range (Table 4-1). In a sense, this is quite natural since no correction relating to

reporting rates included in our estimation. This comparison also suggests that simple calculation can give comparable results with those obtained from sophisticated models with reporting rate correction, at least for age 1-4.

4.2. Archival Tag Returns

Movement

Results from the pilot tagging by Australia have not been available yet. Only results from the pilot program by Japan were reviewed here.

Fig. 4-5 illustrates rough movement paths obtained from three archival tag returns. The movement paths were plotted from raw location estimates of tag, excluding obvious errors. No error correction was done.

One individual (ID #2136) moved from 40 degree E (off Cape) to around 100 degree E (South Indian) over 4 months, and then returned to the waters of around 30 degree E. Other two individuals (ID #1747 and #203) stayed west of 50 degree E for 5-6 months. Additional two tags have just been reported recently and are waiting for data extraction. One of the two was reported from Australia and the other was returned from the off Cape waters. We expect much of interesting information should be also retrieved from Australian component of archival tagging.

5. ISSUES EMERGED FROM CONDUCTING THE TAGGING PROGRAM FOR THREE YEARS

5.1. Question toward reliability of complete mixing hypothesis

Accumulated information about SBT movement from conventional and archival tag returns (explained above) suggests a possibility for fish to tend to stay either eastern or western sides of Indian Ocean (Western Australia and off Cape). i.e., fish do not homogeneously distribute from the off Cape waters to the Australian waters mixing uniformly, but heterogeneously distribute separately in east and west sides keeping some population exchange. Results from three archival returns indicate that none of them migrates across South Indian Ocean to reach Tasman Sea or the New Zealand waters (Fig. 4-5). Although the number of observations is extremely limited, these observations cast a shade on complete mixing hypothesis. Data obtained from archival tags deployed during the RMP indicate that many juveniles migrate seasonally between the Great Australian Bight (GAB) and middle of South Indian Ocean.

Results from conventional tag during the EFP strongly support the movement from middle of the South Indian Ocean to the GAB, and New Zealand. Conventional tag released from the off Cape waters showed different recapture pattern from those released from Australia coast, though both indicating some level of mixing between western and eastern

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sides of Indian Ocean. Fish released with conventional tag in off Cape were recaptured either in the same off Cape area or in South Australia (Fig. 4-3), whereas fish released in South Indian Ocean, although size of the fish was same as that released in off Cape, were recaptured in South and East Australia (Fig. 4-4). The ratios of recaptured fish to catch for older fish from the RMP tagging were remarkably high in Australia catch and followed by New Zealand and Taiwan, and Japan, in this order (Table 3-6). Of course, many factors should influence this ratio, though, this can be interpreted as one evidence of fish released from GAB tending to stay around Australian coast and New Zealand waters.

All of these information strongly indicate the need to reconsider a reliability of complete mixing hypothesis. The current conventional tagging program by CCSBT has assumed complete mixing. Results from simulation experiments indicate that estimates of F are biased under an assumption of incomplete mixing (Kurota et al. 2002, Table 5-1). In the current situation that mixing pattern of fish is not fully understood, it is not possible to reliably estimate F and M for all ages using tag releases only from West and South Australia even if reporting rates for all flags could be appropriately estimated.

5.2. Unbalanced Financial Burdens

In principle, benefits and obligation/burdens should be balanced. Also, burdens should be shared in an equivalent way among those who receive benefits, in this case, the CCSBT Members. Here, improvements of F and M estimation and understandings of SBT behaviors are considered as general benefits from the tagging program. Some additional benefits and compensation can be obtained from resources hired for the tagging program and tag rewards.

The CCSBT tagging program has almost exclusively utilized vessels and personnel based in Australia for tag deployments. Released tags are largely recaptured in Australian fisheries (Table 3-2 and 3-5), and thus a large portion of tag rewards goes to Australia. Considering these economical benefits, most of Members' funding contributions to the tagging program return to Australia (see Table 3-10). In this case, benefit in terms of information obtained from the tagging program is equally shared among Members or is shared proportional to catch.

For pilot tagging programs in longline fisheries, only Australia and Japan have contributed by spending a large amount of expenditures (Table 3-9 and 3-11). Despite this, information to be obtained from conventional tag returns is equally shared among all Members.

Increasing observer coverage from the current level requires a large amount of additional expenditures especially for long-distant fishing Members. Historical tag reporting

shows difference in proportion of tags returned through observers and port liaison person among different fleet; 0.1% for Australia, 14.5% for New Zealand, 13.4% from Japan, and 0% from Taiwan and Korea (Table 3-5). The low value for Australia indicates that observers are not effective to identify tag-existence in the case of surface catch. Naught for Korea and Taiwan suggests potential problem in implementation. Also, it is not clear how to interpret this level of difference between New Zealand and Japan due to difference in operating patterns, in time, area and gear, especially under questioning of complete mixing hypothesis. Request of 30% observer coverage only for reporting rate estimation is unfair by requiring a large amount of extra burden to only part of benefit takers without increasing share of benefits, impractical and infeasible by ignoring real situation, and with scientifically weak basis by simplifying various implementation and environment factors too much.

Currently, archival tagging has been conducted by each Member independently. Thus, information obtained from archival tag returns is not shared with other Members. Considering high expense for tag purchase, small number of tags available and low probability of tag return, complete sharing of both expenditures and information among Members may be the most appropriate and cost-effective way. However, it is also necessary to protect the right of group who already put a large amount of effort and contribution.

6. FUTURE DIRECTION

This section briefly describes our views on practical and cost-efficient tagging under the CCSBT.

6.1. Objectives

Understandings on mixing pattern of fish are considered as the first priority. This can be investigated by releasing a large amount of conventional tags or some archival tags over a wide area of known SBT distribution. Although archival tags are highly expensive, data to be obtained are qualitatively and quantitatively far better than that from conventional tags. With no detailed information about mixing pattern of fish, it is difficult and unachievable to reliably estimate F and M for all ages (see previous section). However, a large number of released tags have been returned in Australian fisheries, mainly by surface fisheries. Surface catch is dominant for global catch for age 2-4. As shown in Table 4.1., even a simplified model can estimate F values of age 2-4 for surface fisheries reasonably well. Big advantage here is requiring much less hypotheses than estimating F and M of older fish, due to short period between release and recapture, a large number of recaptures, almost complete dominance by single fleet to global harvest, potentially low risk in non-reporting, and easy monitoring of reporting rates. Judging from lack of reliable fishery indicators for surface fisheries and quest toward recruitment indices as many and earliest as possible, estimation of F trends for

age 2-4 fish by surface fisheries should be considered as high priority.

6.2. Proposed Modified Plan

Reflecting consideration above, the following modifications to the program are proposed:

➢ Conventional tag release in West and South Australia is continued but the size and scale of tagging is reduced. The objective of this tagging is to monitor F trend of Australian surface fisheries. In principle, Australia funds expenditure of this tagging component.

➢ Seek procedures and opportunities to place both conventional and archival tags from a wide area of SBT distribution with an adequate cost efficiency.

➢ Increased number of Archival tags should be released from a wide area of SBT distribution. Expenditure of the tag deployment can be funded by each Member, if tag deployment can be arranged for opportunistic release.

➢ Common tags should be used for both archival and conventional tags to prevent discriminate reporting. Expenditures for tag purchase, advertising expense, and database management should be shared equivalently among Members.

➢ Each Member must continue to make effort for tag recovery.

➢ All data obtained from the tagging program are managed by the CCSBT and can be shared by all Members. A certain protection needs to establish for archival tags data toward group who had already placed tags.

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Table 3-1   Number of conventional tag releases (CCSBT) by area, year, age.

Western Australia

year	age0	age1	age2	age3	age4	age5	age6	total
2002	0	2504	345	6	0	0	0	2855
2003	20	3305	3380	27	0	0	0	6732

Total number of 2004 releases was 5,268 (CCSBT Secretariat 2004). Age of tagged fish was mostly 2-3 year old. Because length information was not available, number of releases at age was not calculated for 2004.

South Australia

year	age0	age1	age2	age3	age4	age5	age6	total
2002	0	347	117	0	0	0	0	464
2003	18	866	4667	634	176	42	1	6404

Total 2004 number of releases was 5,009 (CCSBT Secretariat 2004). Age of tagged fish was mostly 2-3 year old. Because length information was not available, number of releases at age was not calculated for 2004.

Table 3-2   Total number of conventional tag recaptures (CCSBT) by flag.

Year	Recaptures					
	Aus	Aus w/obs	Jpn	Jpn w/obs	Twn	Twn w/obs
2002	9	0			1	0
2003	341	1	9	5 (4)	14	0

Aus: Australia
Jpn: Japan
Twn: Taiwan
w/obs: Recapture number with observer, port liaison person, etc.
Four of 9 recaptures from Japan have not been in CCSBT database yet.
There is no recapture from New Zealand and Korea.
Recaptures in parentheses for Japan were reported by a port liaison person.

Table 3-3　Number of conventional tag recaptures (CCSBT), catch at age, recaptures/catch ratio by flag, year, age.

Australia

Recatures

year	age0	age1	age2	age3	age4	age5	age6
2002	0	0	6	2	1	0	0
2003	0	10	265	59	2	0	0

Catch

year	age0	age1	age2	age3	age4	age5	age6
2002	0	4040	17198	198552	24178	2647	488
2003	0	17488	62522	170103	51993	3758	848

Recatures/Catch*100

year	age0	age1	age2	age3	age4	age5	age6
2002	-	0.0	0.035	0.001	0.004	0.0	0.0
2003	-	0.057	0.424	0.035	0.004	0.0	0.0

Japan

Recatures

year	age0	age1	age2	age3	age4	age5	age6
2002	0	0	0	0	0	0	0
2003	0	1	4	2	1	0	0

Catch

year	age0	age1	age2	age3	age4	age5	age6
2002	0	10	999	7972	17050	18321	17913
2003	0	10	801	1583	8150	20315	16499

Recatures/Catch*100

year	age0	age1	age2	age3	age4	age5	age6
2002	-	0.0	0.0	0.0	0.0	0.0	0.0
2003	-	10.31	0.499	0.126	0.012	0.0	0.0

Taiwan

Recatures

year	age0	age1	age2	age3	age4	age5	age6
2002	0	0	1	0	0	0	0
2003	0	0	10	5	0	0	0

Catch

year	age0	age1	age2	age3	age4	age5	age6
2002	5	113	3033	19060	11009	5533	3602
2003	0	35	2149	5799	8378	8189	4513

Recatures/Catch*100

year	age0	age1	age2	age3	age4	age5	age6
2002	0.0	0.0	0.033	0.0	0.0	0.0	0.0
2003	-	0.0	0.465	0.086	0.0	0.0	0.0

Table 3-4   Number of conventional tag releases (RMP) by area, year, age.

Western Australia

year	age0	age1	age2	age3	age4	age5	age6	total
1991	2874	429	4	0	0	0	0	3307
1992	843	1790	419	0	0	0	0	3052
1993	83	4527	243	86	0	0	0	4939
1994	0	8624	55	0	0	0	0	8679
1995	0	8358	1870	34	2	0	0	10264
1996	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0
2001	0	1946	821	1	0	0	0	2768
2002	0	0	0	0	0	0	0	0
2003	49	52	0	0	0	0	0	101

South Australia

year	age0	age1	age2	age3	age4	age5	age6	total
1991	0	615	2862	874	1	0	0	4352
1992	0	31	3762	1203	2	0	0	4998
1993	0	389	2601	2872	39	0	0	5901
1994	0	545	3086	3977	152	4	0	7764
1995	0	472	4286	2895	126	3	0	7782
1996	44	1651	2030	600	33	2	0	4360
1997	0	901	604	549	19	0	0	2073
1998	0	0	3	96	11	0	0	110
1999	0	0	0	31	28	2	0	61
2000	0	0	0	21	6	0	0	27
2001	0	0	0	0	0	0	0	0
2002	0	0	62	28	9	0	0	99
2003	0	0	0	0	0	0	0	0

Tasmania

year	age0	age1	age2	age3	age4	age5	age6	total
1991	0	0	84	1	0	0	0	85
1992	0	0	72	15	1	0	0	88
1993	0	0	250	147	1	0	0	398
1994	0	0	19	89	71	2	0	181
1995	0	0	10	68	11	0	0	89
1996	0	0	4	3	0	0	0	7
1997	0	0	1	27	1	0	0	29
1998	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0
2002	0	0	0	2	1	0	0	3
2003	0	0	0	0	0	0	0	0

Table 3-5   Total number of conventional tag recaptures (RMP) by flag.

Year					Recaptures					
	Aus	Aus w/obs	Jpn	Jpn w/obs	NZ	NZ w/obs	Twn	Twn w/obs	Kor	Kor w/obs
1991	168	0	51	15						
1992	224	0	131	30						
1993	272	0	237	45						
1994	456	2	211	51						
1995	870	0	269	71	9	0	2	0		
1996	1337	0	264	51	3	0	13	0		
1997	1812	0	294	40	7	3	49	0	2	0
1998	592	4	98	17	4	0	33	0		
1999	106	0	138	12	11	1	35	0		
2000	44	0	43	3	9	0	15	0		
2001	22	0	51	8	5	3	10	0		
2002	25	1	28	13	10	1	7	0		
2003	140	0	49	34 (26)	4	1	5	0		
Total	6068	7	1864	390	62	9	169	0	2	0

Aus: Australia

Jpn: Japan

Twn: Taiwan

w/obs: Recapture number with observer, port liaison person, etc.

Twenty six of 49 recaptures from Japan have not been in CCSBT database CD distributed in April 2004.

Recaptures in parentheses for Japan were reported by a port liaison person.

Table 3-6   Number of conventional tag recaptures (RMP), catch at age, recaptures/catch ratio by flag, year, age.

Australia

Recatures

year	age0	age1	age2	age3	age4	age5	age6	age7	age8	age9	age10	age11	age12	age13
1991	15	13	88	52	0	0	0	0	0	0	0	0	0	0
1992	0	12	85	122	4	0	0	0	0	0	0	0	0	0
1993	0	26	78	146	19	3	0	0	0	0	0	0	0	0
1994	0	12	138	166	119	17	1	0	0	0	0	0	0	0
1995	0	17	310	340	163	36	3	0	0	0	0	0	0	0
1996	1	81	315	683	209	36	10	1	0	0	0	0	0	0
1997	0	2	154	776	697	134	34	8	4	0	0	0	0	0
1998	0	0	29	167	293	56	26	14	4	3	0	0	0	0
1999	0	0	0	33	34	24	7	1	2	0	1	0	0	0
2000	0	0	0	0	29	7	4	0	0	2	1	0	1	0
2001	0	0	1	0	2	9	4	5	0	0	0	1	0	0
2002	0	0	6	12	1	1	1	2	1	0	0	1	0	0
2003	0	0	0	88	43	3	0	1	1	2	1	0	0	1

Catch

year	age0	age1	age2	age3	age4	age5	age6	age7	age8	age9	age10	age11	age12	age13
1991	997	48866	64799	113999	7096	2873	1113	491	477	240	234	275	368	417
1992	23	7429	32753	89006	23580	5874	3041	1337	878	876	591	718	620	711
1993	2	644	39675	75073	22380	9683	4683	2796	1264	902	472	398	442	502
1994	0	3349	18716	75158	36028	8574	4916	2888	1886	1216	692	462	377	345
1995	0	1593	39375	87858	23093	8258	3018	1711	1221	630	442	316	217	178
1996	41	10727	56862	126060	42308	3454	1729	1210	464	237	126	96	63	51
1997	0	3360	43355	137137	42211	11868	2595	1521	870	386	137	68	47	56
1998	0	448	39876	147068	32643	3781	2998	2174	1368	701	394	274	164	104
1999	0	297	47098	243951	13530	3479	344	393	410	261	177	89	73	57
2000	0	4914	57472	168299	43260	2477	322	208	271	283	113	126	57	10
2001	0	8556	59189	202688	27096	5188	1204	184	175	155	108	76	60	26
2002	0	4040	17198	198552	24178	2647	488	274	28	19	51	32	22	17
2003	0	17488	62522	170103	51993	3758	848	280	65	25	23	24	8	12

Recaptures/Catch*100

year	age0	age1	age2	age3	age4	age5	age6	age7	age8	age9	age10	age11	age12	age13
1991	1.505	0.027	0.136	0.046	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.162	0.26	0.137	0.017	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	4.037	0.197	0.194	0.085	0.031	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	-	0.358	0.737	0.221	0.33	0.198	0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	-	1.067	0.787	0.387	0.706	0.436	0.099	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	2.415	0.755	0.554	0.542	0.494	1.042	0.578	0.083	0.0	0.0	0.0	0.0	0.0	0.0
1997	-	0.06	0.355	0.566	1.651	1.129	1.31	0.526	0.46	0.0	0.0	0.0	0.0	0.0
1998	-	0.0	0.073	0.114	0.898	1.481	0.867	0.644	0.292	0.428	0.0	0.0	0.0	0.0
1999	-	0.0	0.0	0.014	0.251	0.69	2.033	0.254	0.488	0.0	0.564	0.0	0.0	0.0
2000	-	0.0	0.0	0.0	0.067	0.283	1.242	0.0	0.0	0.706	0.888	0.0	1.743	0.0
2001	-	0.0	0.002	0.0	0.007	0.173	0.332	2.719	0.0	0.0	0.0	1.322	0.0	0.0
2002	-	0.0	0.035	0.006	0.004	0.038	0.205	0.729	3.572	0.0	0.0	3.101	0.0	0.0
2003	-	0.0	0.0	0.052	0.083	0.08	0.0	0.357	1.548	7.994	4.283	0.0	0.0	8.206

Table 3-6 (cont'd)

Japan

Recatures

year	age0	age1	age2	age3	age4	age5	age6	age7	age8	age9	age10	age11	age12	age13
1991	1	1	36	13	0	0	0	0	0	0	0	0	0	0
1992	0	8	44	71	8	0	0	0	0	0	0	0	0	0
1993	0	4	52	107	59	15	0	0	0	0	0	0	0	0
1994	0	0	19	83	81	24	4	0	0	0	0	0	0	0
1995	0	0	52	66	82	46	22	1	0	0	0	0	0	0
1996	0	13	54	54	55	47	26	9	6	0	0	0	0	0
1997	0	0	21	68	85	58	35	21	5	1	0	0	0	0
1998	0	0	1	12	24	21	19	11	7	2	1	0	0	0
1999	0	0	0	6	17	39	29	20	14	12	1	0	0	0
2000	0	0	0	0	3	4	8	11	6	6	5	0	0	0
2001	0	0	0	0	2	3	4	15	9	10	7	2	0	0
2002	0	0	0	2	0	0	2	2	5	7	5	2	2	1
2003	0	0	0	0	1	0	0	1	1	9	2	1	4	3

Catch

year	age0	age1	age2	age3	age4	age5	age6	age7	age8	age9	age10	age11	age12	age13
1991	0	668	16678	27692	31265	15183	7249	6416	5705	4356	5047	3944	4368	4269
1992	1	306	8984	22149	41365	23468	9950	5127	4207	3251	3218	2574	2930	2867
1993	0	44	6798	30365	32575	34675	22461	12028	7822	3795	3670	2712	2444	2432
1994	0	73	5042	26063	23993	18579	15532	10342	6323	3814	3000	1912	2322	2531
1995	0	21	5335	9181	17321	22525	17196	14420	10514	5701	3727	2666	2069	2141
1996	0	319	2377	2798	13369	25393	16148	13415	11569	7650	5029	3578	2672	2566
1997	0	54	1573	9637	15906	23211	17562	14277	11247	7079	4348	2710	1805	1486
1998	12	294	26419	19715	22800	15585	17353	18986	15964	10574	6885	4257	2692	2121
1999	1	207	17632	34149	24115	17880	10937	14413	15076	11481	7766	4914	3092	2276
2000	2	57	4351	8718	18899	13836	10888	10116	12352	10607	7235	4574	3026	2005
2001	0	22	3367	11476	21176	23163	15896	11687	11357	11237	9062	6041	3808	2707
2002	0	10	999	7972	17050	18321	17913	14931	10699	8417	6948	4622	3294	2319
2003	0	10	801	1583	8150	20315	16499	14310	10657	7291	5609	4200	3011	2120

Recaptures/Catch*100

year	age0	age1	age2	age3	age4	age5	age6	age7	age8	age9	age10	age11	age12	age13
1991	-	0.15	0.216	0.047	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	2.618	0.49	0.321	0.019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	-	9.077	0.765	0.352	0.181	0.043	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	-	0.0	0.377	0.318	0.338	0.129	0.026	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	-	0.0	0.975	0.719	0.473	0.204	0.128	0.007	0.0	0.0	0.0	0.0	0.0	0.0
1996	-	4.071	2.272	1.93	0.411	0.185	0.161	0.067	0.052	0.0	0.0	0.0	0.0	0.0
1997	-	0.0	1.335	0.706	0.534	0.25	0.199	0.147	0.044	0.014	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.004	0.061	0.105	0.135	0.109	0.058	0.044	0.019	0.015	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.018	0.07	0.218	0.265	0.139	0.093	0.105	0.013	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.016	0.029	0.073	0.109	0.049	0.057	0.069	0.0	0.0	0.0
2001	-	0.0	0.0	0.0	0.009	0.013	0.025	0.128	0.079	0.089	0.077	0.033	0.0	0.0
2002	-	0.0	0.0	0.025	0.0	0.0	0.011	0.013	0.047	0.083	0.072	0.043	0.061	0.043
2003	-	0.0	0.0	0.0	0.012	0.0	0.0	0.007	0.009	0.123	0.036	0.024	0.133	0.141

Table 3-6 (cont'd)

New Zealand

Recatures

year	age0	age1	age2	age3	age4	age5	age6	age7	age8	age9	age10	age11	age12	age13
1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	5	1	3	0	0	0	0	0	0	0
1996	0	0	0	0	1	1	0	1	0	0	0	0	0	0
1997	0	0	0	1	1	2	1	1	0	1	0	0	0	0
1998	0	0	0	0	1	0	2	1	0	0	0	0	0	0
1999	0	0	0	0	1	4	2	2	0	1	0	1	0	0
2000	0	0	0	0	1	2	1	3	0	1	1	0	0	0
2001	0	0	0	0	0	1	0	2	1	1	0	0	0	0
2002	0	0	0	0	0	0	0	0	5	0	3	1	1	0
2003	0	0	0	0	0	0	0	0	0	0	0	0	2	1

Catch

year	age0	age1	age2	age3	age4	age5	age6	age7	age8	age9	age10	age11	age12	age13
1991	0	0	79	229	204	114	73	72	44	98	109	149	223	200
1992	0	1	49	230	536	308	338	265	145	143	144	173	215	200
1993	0	0	90	373	297	212	349	243	220	141	145	169	196	183
1994	0	30	31	144	606	520	593	607	510	498	276	174	102	74
1995	0	12	31	184	1213	1738	1717	1026	785	620	303	235	114	93
1996	0	0	16	26	215	212	311	296	289	226	126	101	68	77
1997	0	0	0	145	106	150	219	335	656	721	558	413	244	165
1998	0	0	2	360	836	325	384	504	538	703	609	448	319	204
1999	0	0	0	151	383	488	674	488	490	758	772	631	472	242
2000	0	0	0	40	310	687	659	891	767	565	384	477	293	360
2001	0	0	0	36	387	572	594	1089	949	793	565	584	359	434
2002	0	0	0	35	363	403	342	956	785	782	556	511	244	325
2003	0	0	0	0	1	1	388	492	681	707	557	521	425	216

Recaptures/Catch*100

year	age0	age1	age2	age3	age4	age5	age6	age7	age8	age9	age10	age11	age12	age13
1991	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	-	0.0	0.0	0.0	0.412	0.058	0.175	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	-	-	0.0	0.0	0.465	0.472	0.0	0.338	0.0	0.0	0.0	0.0	0.0	0.0
1997	-	-	-	0.691	0.941	1.336	0.457	0.299	0.0	0.139	0.0	0.0	0.0	0.0
1998	-	-	0.0	0.0	0.12	0.0	0.521	0.198	0.0	0.0	0.0	0.0	0.0	0.0
1999	-	-	-	0.0	0.261	0.819	0.297	0.41	0.0	0.132	0.0	0.158	0.0	0.0
2000	-	-	-	0.0	0.323	0.291	0.152	0.337	0.0	0.177	0.26	0.0	0.0	0.0
2001	-	-	-	0.0	0.0	0.175	0.0	0.184	0.105	0.126	0.0	0.0	0.0	0.0
2002	-	-	-	0.0	0.0	0.0	0.0	0.0	0.637	0.0	0.54	0.196	0.41	0.0
2003	-	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.471	0.462

Table 3-6 (cont'd)

Taiwan

Recatures

year	age0	age1	age2	age3	age4	age5	age6	age7	age8	age9	age10	age11	age12	age13
1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	1	0	1	0	0	0	0	0	0	0	0
1996	0	0	1	8	3	1	0	0	0	0	0	0	0	0
1997	0	0	4	17	16	10	2	0	0	0	0	0	0	0
1998	0	0	0	6	14	9	2	1	1	0	0	0	0	0
1999	0	0	0	3	8	12	7	3	2	0	0	0	0	0
2000	0	0	0	0	4	3	5	1	1	0	1	0	0	0
2001	0	0	0	0	0	0	6	1	2	0	0	0	1	0
2002	0	0	0	1	0	1	1	2	1	0	0	1	0	0
2003	0	0	0	2	1	0	0	0	0	2	0	0	0	0

Catch

year	age0	age1	age2	age3	age4	age5	age6	age7	age8	age9	age10	age11	age12	age13
1991	1	114	3258	24840	13335	4330	4168	2379	1143	376	307	186	169	127
1992	0	9	1798	22169	11505	3848	3535	1918	903	288	219	129	108	89
1993	0	0	1280	13089	8639	3177	2997	1608	739	232	173	98	70	58
1994	0	2	1573	15540	9981	3323	3312	1862	866	288	207	112	96	90
1995	0	1	2076	19835	13047	4549	4406	2623	1310	441	298	149	115	99
1996	1	12	2139	21445	14080	5149	4819	2774	1423	527	351	191	133	118
1997	0	1	914	16526	6538	1911	2079	1571	921	226	243	138	75	68
1998	0	4	5132	23664	16412	3841	3659	3885	1656	636	350	131	125	70
1999	0	2	2102	29470	15787	7935	3868	2278	1436	604	521	157	129	92
2000	0	2	879	11081	15499	5259	7867	2830	1561	766	386	203	153	107
2001	48	4456	18104	13641	2560	2556	658	336	94	23	14	1	3	3
2002	5	113	3033	19060	11009	5533	3602	1903	690	331	171	64	40	37
2003	0	35	2149	5799	8378	8189	4513	2723	1552	718	394	218	89	116

Recaptures/Catch*100

year	age0	age1	age2	age3	age4	age5	age6	age7	age8	age9	age10	age11	age12	age13
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	-	-	0.0	0.005	0.0	0.022	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	-	0.0	0.047	0.037	0.021	0.019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	-	0.0	0.437	0.103	0.245	0.523	0.096	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	-	0.0	0.0	0.025	0.085	0.234	0.055	0.026	0.06	0.0	0.0	0.0	0.0	0.0
1999	-	0.0	0.0	0.01	0.051	0.151	0.181	0.132	0.139	0.0	0.0	0.0	0.0	0.0
2000	-	0.0	0.0	0.0	0.026	0.057	0.064	0.035	0.064	0.0	0.259	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.912	0.298	2.127	0.0	0.0	-	33.784	0.0
2002	0.0	0.0	0.0	0.005	0.0	0.018	0.028	0.105	0.145	0.0	0.0	1.558	0.0	0.0
2003	-	0.0	0.0	0.034	0.012	0.0	0.0	0.0	0.0	0.279	0.0	0.0	0.0	0.0

Table 3-7　Summary of pilot longline tagging in off Cape waters by Japan

Year	2001	2002	2003	Total
conventional tags only	329	273	557	1159
with archival tag	45	40	80	165
with PAT	7	5		12
retained (wt in kg)	120 (3,359)	135 (3,849)	168 (5,313)	423 (12,521)
Total	501	453	805	1759
Mortality (%)	24.0	29.8	20.9	24.0
Recaptures				
Cape (-60E)	6(3*)	2 (1*)		8
South Indian (60-120E)	1			1
Australian (120E-)	3		1*	4
Unknown	2			2
Total	12	2		15

*: Archival tags

Table 3-8　Length frequency distribution of longline tagging in off Cape waters by Japan

2001

FL(cm)	Conventional tags only	With archival tag	With PAT	Retained	Total	(Tag release rate)
60-64						
65-69						
70-74						
75-79						
80-84	1				1	(1.00)
85-89				1	1	(0.00)
90-94	22			5	27	(0.81)
95-99	32			4	36	(0.89)
100-104	57			19	76	(0.75)
105-109	92			36	128	(0.72)
110-114	44			8	52	(0.85)
115-119	48	3		11	62	(0.82)
120-124	19	10		9	38	(0.76)
125-129	8	15	1	6	30	(0.80)
130-134	3	6	1	2	12	(0.83)
135-139		5	2	1	8	(0.88)
140-144	1	2	1	1	5	(0.80)
145-149		1		3	4	(0.25)
150-154			2	1	3	(0.67)
155-159	1	1		1	3	(0.67)
160-164		1		2	3	(0.33)
165-169	1				1	(1.00)
Total	329	44[1]	7	110	490	(0.78)

1: Length was not measured for one individual.

Table 3-8　(cont'd)

2002

FL(cm)	Conventional tags only	With archival tag		Retained	Total	(Tag release rate)
60-64						
65-69						
70-74						
75-79	1				1	
80-84						
85-89	1				1	(1.00)
90-94	3			1	4	(0.75)
95-99	12	2		6	20	(0.70)
100-104	17			7	24	(0.71)
105-109	68	7		38	113	(0.66)
110-114	59	4		25	88	(0.72)
115-119	56	10		23	89	(0.74)
120-124	36	4		16	56	(0.71)
125-129	10	6		6	22	(0.73)
130-134	3	2	1	3	9	(0.67)
135-139	2	1		2	5	(0.60)
140-144	1	3	2		6	(1.00)
145-149	2	1		1	4	(0.75)
150-154			1	1	2	(0.50)
155-159	1		1		2	(1.00)
160-164	1				1	(1.00)
165-169						
Total	273	40	5	129[1]	447[1]	(0.71)

1: Length was not measured for six fish.

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Table 3-8   (cont'd)

2003

FL(cm)	Conventional tags only	With archival tag	Retained	Total	(Tag release rate)
60-64	1			1	(1.00)
65-69				0	
70-74			1	1	(0.00)
75-79				0	
80-84	1		1	2	(0.50)
85-89	2			2	(1.00)
90-94	12	1	3	16	(0.81)
95-99	32	5	14	51	(0.73)
100-104	33	5	11	49	(0.78)
105-109	29	5	11	45	(0.76)
110-114	63	8	22	93	(0.76)
115-119	101	6	26	133	(0.80)
120-124	112	8	32	152	(0.79)
125-129	76	8	19	103	(0.82)
130-134	43	11	10	64	(0.84)
135-139	20	4	2	26	(0.92)
140-144	14	9	4	27	(0.85)
145-149	7	3	4	14	(0.71)
150-154	5	3	2	10	(0.80)
155-159	3	3	1	7	(0.86)
160-164		1	1	2	(0.50)
165-169	2		3	5	(0.40)
Total	556[1]	80	167[2]	803[3]	(0.79)

1: Length was not measured for one individual.
2: Length was not measured for two individuals.
3: Length was not measured for three individuals.

Table 3-9   Summary of pilot longline taggin by Australia

Year	2002	2003*	Total
conventional tags only	163	210	?
with archival tag	-	-	?
with PAT	3	9	?
retained	123	(30-40% reduced)	?
Total	289	?	?
Mortality (%)	42.6		
Recaptures	2		
Estimated expenditure ($)	120,000	?	

*: Information for 2003 was tentative, cited from 2003 SC Report (Anonymous 2003).

Table 3-10   Expenditure of conventional tagging by CCSBT

Expenditure Type	2002 ($)	2003 ($)	2004 ($)
Coordination expenses			
- Tag purchase	39,500	26,100	27,000
- Tag reward	32,196	5,000	35,000
- Advertising materials	18,258	-	-
- Promotion expenses	-	-	-
- General administration	2,556	2,780	10,000
Total coordination expenses	96,678	33,880	72,000
Tag deployment expenses			
- Tag placement contract	202,695	231,272	229,825
- Vessel charter	179,200	324,650	312,050
Total deployment expenses	381,895	555,922	541,875
Expenses per tag	115.06	42.32	52.72
Total expenditure	478,573	589,802	613,875

Table 3-11 Expenditure of pilot longline tagging in off Cape waters by Japan

Expenditure Type	2001 ($)	2002 ($)	2003 ($)
Vessel charter	984,864	879,342	886,025
Fuel	68,118	82,633	66,902
Travel agency	956	1,836	226
Tagger	75,620	73,324	61,579
Research materials	19,495	21,680	17,471
General administration	57,785	65,476	23,107
Conveyance[1]	6,464	18,474	11,271
Total deployment expenses	1,213,302	1,142,765	1,066,581
Expenses per tag	3,184.5	3,593.6	1,674.4
(w/o vessel charter)	(420.8)	(568.5)	(178.4)
Archival tags	155,192	137,948	275,897
Reward			5,129
Advertising materials[2]		2,255	2,255
Promotion materials[3]		4,064	7,914
Port liaison person			4,617[4]
Total	1,368,494	1,287,032	1,362,393

1: Included ARGOS data communication.
2: Poster
3: News letter (2002), news letter and tag recovery report form (2003)
4: Only for 4 months.

Table 4-1   Estimated fishing mortality rates (F) of age 1-4 for Australian fisheries and comparison with estimates in Polacheck (1994).

year	age1	age2	age3	age4
1992	0.002	0.018	0.017	0.003
1993	0.012	0.006	0.012	0.003
1994	0.008	0.010	0.012	0.010
1995	-	0.012	0.025	0.012
1996	-	0.013	0.032	0.016
1997	0.015	0.059	0.054	0.045
1998	-	0.020	0.064	0.031
1999	-	-	0.031	0.018
2000	-	-	-	0.037
2001	-	-	-	0.057
2002	-	0.002	0.009	0.000
2003	-	0.001	0.038	0.040

year	age	this paper	Polacheck 1994
1992	age2	0.018	0.01-0.05
1992	age3	0.017	0.04-0.20
1993	age2	0.006	0.01-0.05
1993	age3	0.012	0.01-0.07
1993	age4	0.003	0.001-0.05

Table 5-1   Estimated F in simulation experiments changing the movement rate from area 1 to 2 (P_1).

Fish movement from area 1 to area 2 in the 1st season (P_1)   (R_{long} = 1.0 (true), $n_{2,1,1}$ = 500000, P_2 = 0.1)

| parameter	true value	$P_1 = 1.0$			$P_1 = 0.8$			$P_1 = 0.6$			$P_1 = 0.4$			$P_1 = 0.2$			$P_1 = 0.1$		
		value	std	CV	value	std	CV	value	std	CV	value	std	CV	value	std	CV	value	std	CV
$F_{surf,1}$	0.100	0.154	0.0013	1%	0.154	0.0013	1%	0.154	0.0013	1%	0.154	0.0013	1%	0.154	0.0013	1%	0.154	0.0013	1%
$F_{surf,2}$	0.100	0.100	0.0013	1%	0.133	0.0015	1%	0.144	0.0016	1%	0.149	0.0016	1%	0.152	0.0016	1%	0.153	0.0016	1%
$F_{surf,3}$	0.100	0.100	0.0016	2%	0.107	0.0017	2%	0.124	0.0019	1%	0.138	0.0020	1%	0.147	0.0021	1%	0.150	0.0021	1%
$F_{long,3}$	0.100	0.100	0.0018	2%	0.100	0.0019	2%	0.099	0.0019	2%	0.093	0.0018	2%	0.074	0.0016	2%	0.052	0.0014	3%
$F_{long,4}$	0.100	0.100	0.0023	2%	0.100	0.0023	2%	0.099	0.0023	2%	0.096	0.0023	2%	0.081	0.0021	3%	0.059	0.0017	3%
$F_{long,5}$	0.100	0.100	0.0028	3%	0.100	0.0028	3%	0.100	0.0029	3%	0.098	0.0028	3%	0.085	0.0026	3%	0.066	0.0022	3%
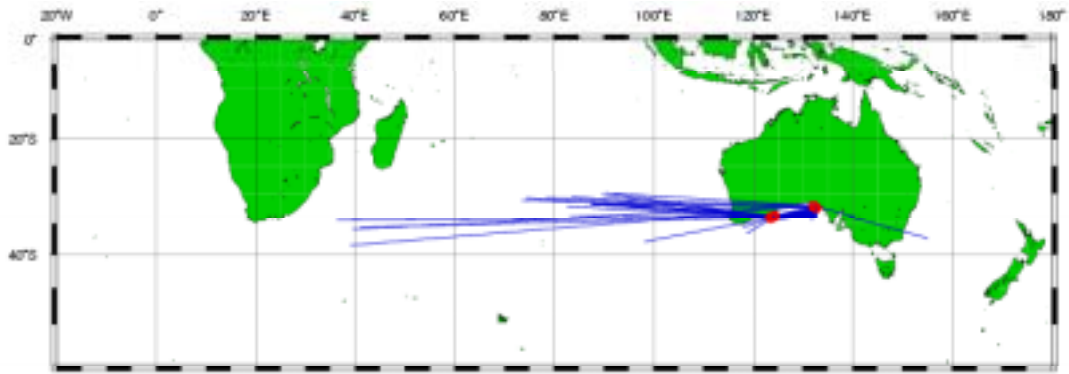
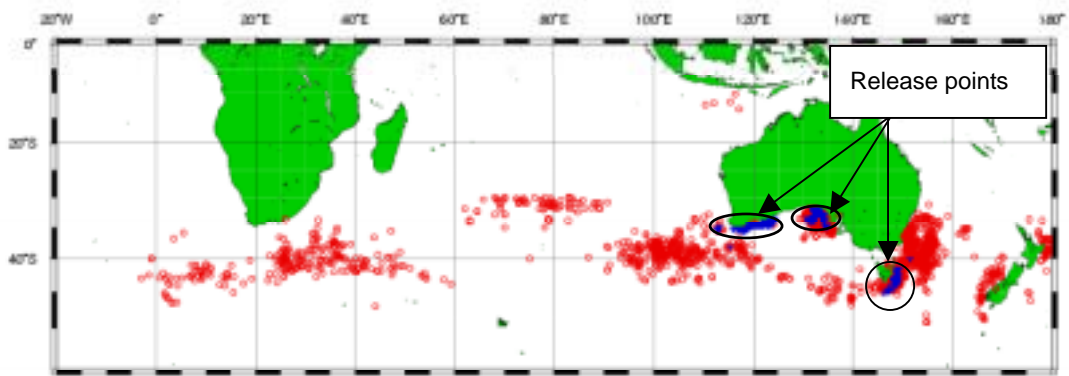Fig. 4-1　Releases and recaptures of tagging by CCSBT. Circles indicate release points.

Fig. 4-2　Releases and recaptures of tagging by RMP. Small circles indicate recapture points.
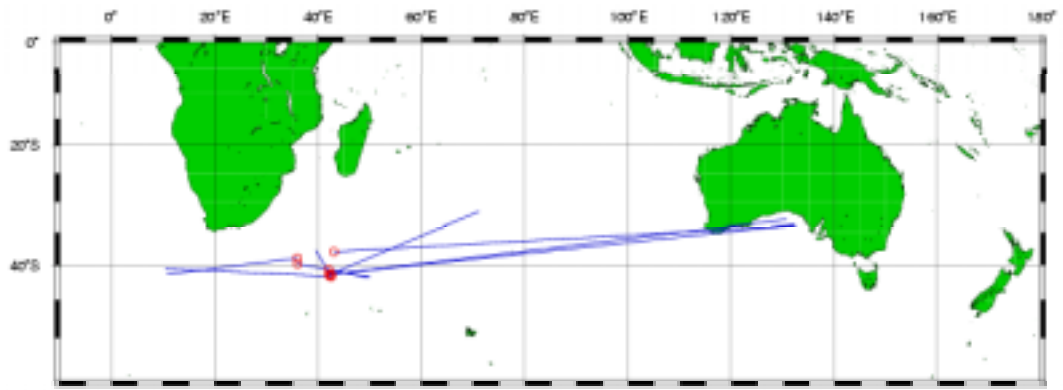
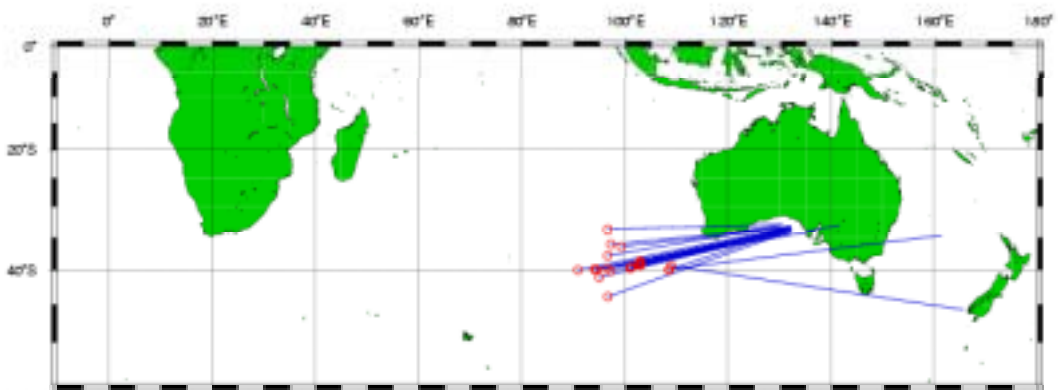Fig. 4-3   Releases and recaptures of pilot longline tagging by Japan. Circles indicate release points.

Fig. 4-4   Releases and recaptures of tagging by EFP. Circles indicate release points.

a   ID #2136

b   ID #1747

c   ID #203

Fig. 4-5   Raw estimates of movement path from 3 recaptured archival tag, released by
Japanese pilot longline tagging. Circles indicate release points. **Note: DO NOT cite this
information.**