

Southern Bluefin Tuna Recruitment Monitoring Program



(FINAL DRAFT)

SOUTHERN BLUEFIN TUNA RECRUITMENT MONITORING AND TAGGING PROGRAM

REPORT OF THE SEVENTEENTH WORKSHOP

27-29 July 2005

CSIRO Marine and Atmospheric Research

Hobart, Tasmania

Australia

SEVENTEENTH WORKSHOP ON SBT RECRUITMENT MONITORING
SURVEYS AND TAGGING PROGRAM

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1. OPENING REMARKS

Alistair Hobday opened the meeting and welcomed all delegates to the workshop. Takafumi Ura also welcomed everyone to the workshop and wished for a fruitful meeting. He noted that there had been confrontations between Japan and Australia/New Zealand on SBT issues in the past, but that SBT was important for all countries involved. The current low recruitment of SBT, and their late age at maturity, means that recovery would be slow. Therefore, research on recruitment is important. He hoped that the workshop would develop appropriate surveys within the current budget situation.

2. APPOINTMENT OF CHAIR AND RAPORTEURS

Sachiko Tsuji and Alistair Hobday were appointed as co-chairs and Jessica Farley, Tomoyuki Itoh, Yoshimi Takao, Kazushi Miyashita, Paige Eveson, James Dell, and Jay Willis agreed to act as rapporteurs.

3. ADOPTION OF AGENDA

The agenda was adopted.

4. REVIEW OF 2004/2005 FRA/CSIRO COOPERATIVE RMP RESEARCH AND RELATED RECRUITMENT MONITORING WORK

A. Aerial Survey

The aerial survey paper RMWS/05/01 was presented. In 2005, the full scale line-transect aerial survey was re-established in the GAB. The weather was relatively good in January and February and three replicates of the GAB were surveyed. In March, the weather deteriorated and only three days were suitable for the survey. In order to produce an index that is comparable with previous years, analysis was restricted to January and February data. Preliminary analyses suggest that the abundance of 2-4 year olds in the GAB in 2005 was lower than it was in the mid-90s, but perhaps higher than in 1999. Unadjusted sighting rates and patch biomasses were higher in 2005 than in either 1999 or 2000, but the efficiency of the observer teams in 1999 and 2000 is very uncertain and makes direct comparisons difficult. The comparison with the mid-90s is therefore more reliable.

Commercial spotting data was also collected in 2005 for the SAPUE index. At this stage, only the nominal SAPUE index (unstandardised for environmental conditions or spotter effects) is available for 2005. The nominal index is sensitive to the interpretation of search effort type, but is generally higher in 2005 than in 2004. Based on preliminary explorations to standardise the index, it seems unlikely that this picture would change substantially after standardisation.

In discussion of RMWS/05/01 it was noted that the aerial survey was conducted in years 1993 through 2000 and not again until 2005, whereas commercial spotting data were collected in 2002 through 2005. The lack of overlap between the two sets of information is unfortunate because it does not allow for meaningful comparisons. A reduced line-transect survey was flown in 2002 through 2004 and it was questioned whether this information could be used to facilitate comparison; however, it was noted that the data from the reduced surveys are very limited (refer to RMWS/04/ 01) and unlikely to be much help in this regard.

In discussion of RMWS/05/01, the possible effect of temperature changes/weather fronts on the surfacing behaviour of SBT was considered. It was suggested that

surfacing may increase a few days after a front moves through, and that lagged temperature measurements could potentially be used as covariates in the model predicting number of sightings. Evidence of such behaviour has been found in bluefin tuna from the North Atlantic.

Figure 2 of document RMWS/05/01 shows the distribution of SBT sightings in each of the survey years. It was questioned whether the data support a change in the distribution of fish, such as an increase in the ratio of offshore versus inshore patches.

There is perhaps some evidence in the fish size estimates from both the aerial survey and commercial spotting data of a small increase in the percent of small (<10kg) fish in 2005 (see Figures 4, 12 and 13 of RMWS/05/01). This would be consistent with the suggestion by fishermen that there were large numbers of small fish early in the season; however, fishermen also suggested that a lot of large fish were present later in the season. It was noted that the fish being spotted do not necessarily correspond to those being caught, although a high correlation would generally be expected.

B. Acoustic Survey

RMPWS/05/02 and RMPWS/05/04 were presented. The acoustic survey, which began in 1996 (1995/1996 season) and was suspended in 2004, resumed again in 2005. In 2005, the survey area, species composition observed, distribution of SBT and age composition of SBT were similar to that of the previous surveys. The acoustic index in 2005 was 183.5 tonnes or 63,700 individuals. The index has been low since 2000, but in 2005 it was slightly higher than for 2001-2003. The piston line was also surveyed during each of the transect lines in 2005. In addition to the usual acoustic indices, two additional indices were calculated: (1) for lines including the piston line and (2) for the piston lines only.

In discussion of RMWS/05/02 and RMWS/05/04 it was noted that the area of the survey had been reduced to about two thirds of its original size due to lack of observations in previous years outside the shelf break. It was asked if it were possible to reanalyze data from previous years to retrieve data focused around the position of the piston line, so as to aid calibration of piston line data. The piston line data started in 2005, and the vessel *Taikei-maru No. 2* only surveyed part of this area in previous years. The survey was a zig zag line and it would not be easy to assimilate fish distribution along the piston line without large assumptions. Responding to the questions on compatibility between trolling data and acoustic data, it was noted that trolling was undertaken only in the daytime, and that it sampled only a very small area whereas the sonar sampled an area of diameter of 600 m and reached deeper.

RMPWS/05/03 was presented. In the 2004/2005 season, a new survey that provides the recruitment level of age one SBT with low cost was conducted as a feasibility study. In the survey, a chartered Australian vessel traveled along a straight line (piston line) repeatedly using a side scan sonar. The piston line was surveyed for six days and hot spots surveyed for two days. Several fish schools, presumably small pelagic fish, were detected by the side scan sonar as well as the vessels echo sounder and sonar. By trolling, 23 SBT were caught: 21 were age one and 2 were age two. Unfortunately it is difficult to identify SBT schools using the side scanning sonar.

In discussion of RMWS/05/03 it was noted that the side-scan sonar used in the current survey was relatively old, but that new equipment was available which has much greater sensitivity.

RMPWS/05/05 was presented. Multiple indices from the acoustic transect survey were established. They were the trolling catch index, eye sighting index, and sonar index. These three indices were based on the number of school (sonar number indices) and are defined as the number of SBT school of age one per 100 search hours. The fourth index was the sonar biomass index which was based on school biomass. Between the period 1997-1999 and 2000-2002, all four indices decreased. In 2003, only the trolling catch index increased.

In discussion of RMWS/05/05 it was noted that acoustic survey would be useful for an emergency index. However, the current survey procedure required a huge amount of cost, partly due to the need to bringing a high resolution device from Japan. If the objective was refined to look for indices of emergency it may be possible to derive the same level of information with much reduced cost. The chair summarized the presentation with the general sense that a piston survey carried out several times from December to March might be suitable and that it might be improved with the addition of a high resolution acoustic device. Budget considerations were important and finding a suitable acoustic vessel was not easy and was expensive. The RMP scientists are continuing to investigate a suitable charter vessel.

RMPWS/05/06 was presented. Three studies that focus on the Leeuwin Current (using CTD and SST datasets); the distribution of SBT and other pelagic predators (using catch, CTD and SST datasets); and the feeding ecology of SBT and other pelagic predators (using stomach content and catch datasets) were reviewed and future plans were presented.

There was no discussion of RMWS/05/06.

RMWS/05/07 was presented. The echo integration surveys of pelagic fish in Survey A area were conducted from 2002 to 2005. The acoustic equipment was Kaijo KFC series split-beam echo sounder and its frequency was 70 kHz. The echo sounder transmitting was synchronized with SONAR to avoid interference. SonarData "Echoview" software was used to post-process the data. Almost all fish schools were observed on the shelf and the shelf edge. Hook & line and an underwater TV camera were used for species identification. Pilchards and mackerel were mainly caught and observed. The locations of schools observed using the echo sounder were close to the SBT schools observed by SONAR specialist. The average values of nautical area scattering coefficient (NASC) were 28 m²/nmi² in 2002 survey, 35 m²/nmi² in 2003 survey, and 97 m²/nmi² in 2005 survey. Large schools were encountered in a restricted area and these schools lead the high average value of NASC in 2005.

In discussion of RMWS/05/07 it was confirmed that the surveys were conducted both during the day and night. There was some discussion on species identification from the echogram. It was concluded that identification was difficult but in all likelihood most of the record was not mesopelagic and was rather assumed to be small pelagic species such as sardines and mackerels. It was confirmed that physical measurements were taken using a simple CTD but that the data was not yet analysed.

A general note of caution was raised regarding baitfish surveys related to stomach survey data which showed tunas were feeding on whitebait, which measured 1 cm or less and therefore would be difficult to detect by echo sounder. This was accepted but it was noted that there was nevertheless some correlation between catch of SBT and sonar response. It was noted that a previous RMP report (RMWS04/08) has looked at the stomach contents of SBT and noted that whitebait, as well as various sizes of small pelagics, were found. Care must be taken to distinguish fish eaten during

trolling and those while the fish were feeding freely.

RMWS/05/08 was presented. Spatial distribution of schools of juvenile SBT and bait fishes were examined by using data from the scanning sonar survey. Schools of juvenile SBT were found more frequently in 2005 than in 2003, but those of bait fishes were found less frequently in 2005. Aggregation of bait fish schools was visualized on a map using the data of geographical position of points by kernel density estimation.

There was no discussion of RMWS/05/08.

RMWS/05/09, RMWS/05/10 and RMWS/05/11 were presented consecutively with discussion held at the end of the presentations. Universal scaling in the power-law size distribution of pelagic fish schools is established. The power-law exponent of size distributions is extracted through the data collapse. The distribution depends on the school size only through the ratio of the size to the expected size of the schools an arbitrary individual engages in. This expected size is proportional to the spatial population density of fish.

RMWS/05/10 investigated whether sonar specialists precisely estimate the school size from sonar images. Data of SBT school sizes from sonar-specialists' estimates are analyzed based on school-size statistics. The data over 5 years from 1996 to 2000 have been aggregated, and the data exhibit a fat-tail behavior with large fluctuations. The aggregate distribution of all years follows a universal scaling law for school sizes of pelagic fishes. The bootstrap analysis based on school-size statistics shows that relative variation in 95% CI of the estimated population density of SBT amounts to about 70%.

RMWS/05/11 investigated whether the precision of sonar-specialists' estimates varies according to the year. Data of bait school sizes from sonar-specialists' estimates are analyzed based on school-size statistics. The data over 9 years from 1996 to 2005 exhibit a fat-tail behavior with large fluctuations. The distributions for 9 years follow a universal scaling law for school sizes of pelagic fishes. The precision of estimates changes greatly in every year: the root-mean-square of log-residual amounts to 0.30-1.43.

In discussion of RMWS/05/09, RMWS/05/10 and RMWS/05/11 it was noted that the count of bait schools was noticeably higher in 2003 and 2005 possibly because there was a change in the type of sonar that was used. It was noted that this analysis did not provide strong support for SBT based on sonar estimates at this stage but that it looks good for bait fish. It was summarized that sonar data gives some indication of abundance when combined with frequency distribution data and some indication of potential bias and detection, but unfortunately the sample size of SBT in the acoustic data is too small. It was noted that the technique suggested by Dr. Niwa could be applied to the school size frequency data obtained from the aerial survey. It was agreed to explore this analysis for the aerial survey data between members of the RMP.

RMWS/05/12 was presented. The muscle and abdominal temperature of juvenile SBT was measured using data storage tags in net cages to calculate accurate target strength. A total of 10 SBT (mean fork length: 57.1cm, mean weight: 2.90kg) were tagged but data was obtained from only 8 fish. One fish died just after release and another fish lost its tag. In addition, because the external temperature sensor had a water leak during the experiment, reliable data was obtained from only 3 fish (No.1, No.3, and No.4). The temperature of the muscle and the abdominal cavity of SBT

differed during swimming. The differences in temperature between the muscle and the abdominal cavity were 0.6°C for No.1 (mean muscle temperature: 23.2°C and abdominal temperature: 22.7°C), 7.1°C for No.3 (mean muscle temperature: 30.2°C and abdominal temperature: 23.1°C) and 1.0°C for No.4 (mean muscle temperature: 23.7°C and abdominal temperature: 23.8°C), respectively. Given that the data was recorded for only a short period, the large difference (No.3) and inversion of the temperatures (No.4) might be due to the effects of handling and tagging. This means these results might not indicate true values of temperatures. Therefore, further studies are needed to determine the true temperature values.

In discussion of RMWS/05/12, it was clarified that data from only two SBT was complete, rather than the three shown. It was noted that the sound speed in fish was dependent on condition, fat content, etc. There was a discussion regarding the handling of the fish in the experiment and whether the death of fish was due to surgery or the cage. It was noted that the length of time for surgery was 1 minute (minimum) for a team of two, but that the size of the cage was a serious problem and that the fish remained one to two nights in the fish tanks onboard the vessel before the experiments. However, all fish in the 35 m cage were alright. It was concluded that that it would be better to have a large cage of the type used in fish farms. It was noted that full knowledge of the target strength/body temperature relationship would not resolve the question of accuracy of sonar because, for instance, orientation of the fish was much more important. Orientation measurement work has already been conducted by using another type of tag.

C. Sonic Tagging Experiments in WA

A report on the WA sonic tagging experiments (RMWS/05/13) was presented. The primary goals of the acoustic monitoring experiment is to determine the time and spatial pattern of movement paths and residency time of juvenile (age 1) SBT in the acoustic survey region of southern Western Australia. These factors influence the detection of tuna in the survey region and the may enable correction of abundance indices derived from the survey. The experimental array consisted of 70 acoustic receivers deployed in three lines crossing the shelf and at three hotspots between the lines. The listening stations were deployed for approximately 100 days between December 2004 and March 2005 to evaluate the long-shelf movements of juvenile SBT. A total of 79 fish were tagged with acoustic tags; 13 were also tagged with temperature-depth dataloggers, while 16 were tagged only with dataloggers. A total of 55 (70%) acoustic tagged fish were detected at the stations, the most in any year of this experiment. Fish were present within the area covered by the lines for the majority of the experimental period and detailed tracks were obtained. The basic detection patterns are discussed in this paper and preliminary analyses presented.

The discussion following the presentation of RMWS/05/13 included general questions related to the practicalities of the tagging method and locations, the survey design and the set-up, location, retrieval and loss of listening stations. The outcome of this part of the discussion was the clarification that the current methods, survey design and the array of listening stations was sufficient. There is a need to upgrade the fastening materials used in the moorings of the gear needs upgrading from Galvanized steel to Stainless steel. There was a suggestion that the addition of a number of Hotspots further west of “Line 1” (at Mauds) would be an informative addition to the present array structure. There were also discussions regarding the potential causes of the variability in the detection range of listening stations, noting that as depth decreased signals can be detected from further away due to scattering from the reflective surfaces (surface and bottom). It was also noted that further statistical development relating to the true dimensions of the detection “spheres”

around the stations within the array would be an informative venture.

It was noted that the tagging locations during the last two seasons were inshore, off shore and around the hotspots. The data recorded suggested a 1-2 month residence in the region within the acoustic monitoring gears, with a majority of fish traveling between multiple lines of listening stations and hotspots during this time, followed by a period of sustained eastward movement, (mostly inshore) before fish left the monitored region for good. These behaviours were notably different to the perceived movements from historical studies (based on the tagging of larger fish on the shelf break during the conventional tagging programs) and the opinions of the fishers. Acoustic monitoring shows that fish are often present in areas and not caught by fishers or tagging operations. There was also a query relating to the day/night residence of one year fish at Hotspots suggesting that figure 17 of the report be reanalyzed.

The two-phase residence and migration behaviors, noted in this years report, were compared to studies on the Northern Bluefin Tuna. It was suggested that there were similar behavioural mechanisms in place. The similarity of behaviours observed for the two congeners was noted and a further comment was made regarding the spatial scales at which these behaviours were observed, which were below the current resolution of archival tags, the devices commonly used to monitor migrations and other behaviours of this type. Final comments related to the proximity of the bait survey at the piston line (RMWS/05/08) and the relevant meta-analyses that would be possible given the physical and biological data, recorded both directly and remotely, that is now available.

D. Archival tagging

A report on archival tagging (RMWS/05/14) was presented. No archival tags were released in either Western Australia or South Australia in 2004/05. During the year, a further 4 tags were recovered from the farms at Port Lincoln and more are expected when harvesting resumes.

There was no substantive discussion of RMWS/05/14.

E. Summary of presentations

The chairs briefly summarised the science presentations. It was noted that the Acoustic Survey and Aerial Survey were giving slightly different signals on recent recruitment, but that the RMP should maintain efforts to monitor both at the current time. There has been much effort recently to collect ancillary information for the Acoustic Survey area such as aspects of fish behaviour and distribution, as well as advances in procedures and technological aspects of the survey. In trying to understand the WA area, the RMP has explored a range of surveys (eg piston survey, target strength work etc) and that this exploration should continue for the next 1-2 years, and at that stage we should be able to recommend a long term cost-effective monitoring solution. It was noted that the level of information accumulated for Western Australia is now closer to that collected for South Australia. There is now a need to develop ways to use the ancillary information collected to help establish recruitment levels. Research effort should be targeted at trying to reduce uncertainty in the indices for both 1 year-olds and 2-4 year-olds. It was also noted that we are now closer to a long-term monitoring phase of the RMP.

5. PROPOSED FRA/CSIRO RECRUITMENT MONITORING COOPERATIVE RESEARCH IN

2005/2006

A. Aerial Survey 2006

RMWS/05/15 was presented. The proposed activities in for the aerial survey in 2006 are based on the 2005 survey. The main objectives of the survey are to conduct a full scientific line-transect aerial survey and to collect data on SBT sightings by commercial spotters (for the SAPUE index). Experiments will also be conducted to calibrate between spotters for sightability and biomass estimates. The proposed research will use SAPUE and scientific aerial spotting data to continue to develop indices of relative abundance of juvenile SBT in the GAB, which could be used as an indicator for determining trends in recruitment of the species.

In discussion of RMWS/05/15, it was noted that the calibration experiments could be undertaken earlier in the survey only if a commercial spotter was available. However, these experiments could not occur during flight by commercial spotters from Ceduna to the fishing ground as there would not be enough SBT schools sighted in this area. The most appropriate place to conduct the experiments would be along the shelf edge where greater numbers of schools would be encountered.

B. Acoustic Survey in WA

RMPWS/05/16 was presented. The research plan of five possible surveys to monitoring age one SBT in Western Australia in 2005/06 was proposed. The acoustic survey using Taikei-maru No. 2 and the piston line survey will be conducted as last year. Two existing research programs (quick look survey conducted in the acoustic tagging program of RMP and tagging survey in the scientific research program (SRP) of CCSBT) can be utilized for monitoring. Chartering an Australian vessel that is equipped with a high performance sonar, which can be an alternative to Taikei-maru No.2 might be a low cost monitoring option for the future.

In discussion of RMPWS/05/16 it was noted that for the quick look survey, it would be better to spread the trolling effort over several days (for shorter time periods during the day) rather than on one full day. However, it was suggested that the boundary areas of the Acoustic Survey area be targeted for the quick look survey if possible, as this may be the region to pick up a low recruitment signal. Currently the quick look survey is undertaken voluntarily by the vessel skipper. It was noted that if some funds were available, the RMP could charter the vessel to conduct this work at specific locations and times through the period December to March.

It was also noted that trolling data collected during CCSBT tagging operations in WA could potentially be used to develop an additional source of information of SBT abundance. This data is currently housed at CSIRO but is not available in an electronic form. It was suggested that the data be made available as soon as possible for preliminary examination, as it may assist in planning the 2006 research activities in WA. Further discussions on the most appropriate way to access the data was held during discussions on prioritization (Section 5D). It was agreed that example data sheets be provided to the Japanese delegates.

The availability and cost of an Australian fishing vessel with a suitable high performance sonar for use during this year's Acoustic Survey was discussed, and it was noted that the charter estimate received was higher than expected. It was suggested that the Australian Maritime College be approached to determine if their research vessel "Bluefin" would be available (and suitable) for the 2006 survey season.

There was some discussion about the length of the proposed Acoustic Survey in 2006. It was noted that the maximum charter period for the Taikei-maru No. 2 was already fixed, so there was no option to extend the period of the survey. However, there was an option to reduce the total charter time and transfer some of the funds to other survey types in WA. It was also noted that if a cheaper Australian vessel was found that could replace the Taikei-maru No. 2 in future Acoustic Surveys, that the funds saved may be available to other projects within the RMP.

C. Sonic Tagging experiments in WA

RMWS/05/17 was presented. The successful use of data collected by the acoustic and archival tagging and acoustic monitoring projects in the analysis and interpretation of aerial survey abundance data has been an important achievement of the Recruitment Monitoring Program. Smart tag technology developed and/or used extensively within the RMP are now tools-of-choice in tuna research programs throughout the world to examine critical questions about habitat preferences, migration and residence patterns, and physiology.

In 2003-04 and 2004-05, the acoustic monitoring experiment provided important information about the movement pathways and residence times of age-1 SBT relative to the current Acoustic Survey Area (ASA). Estimates of SBT movement speed were variable, but in general showed that as the average movement (~60 days to move through the ASA) was slower than the time taken by the survey vessel to complete a replicate (<2 days), the sequential replicates of the AS are likely counting many of the same fish schools. This makes the timing of the AS particularly important. A key assumption is that the movement speed of individuals is the same as the movement speed of the schools.

In 2004-05, we used two tagging technologies to study age-1 SBT in the acoustic survey region of southern WA: acoustic monitoring arrays and tags (AM), and archival datalogger tags (DT). For the AM component of the project, we deployed three lines of moored listening stations to examine movements of acoustically tagged fish and obtained large numbers of tag detections and information about the residence and degree of mixing within the ASA. We propose to repeat the experiment in 2005-06.

In discussion of RMWS/05/17 it was noted that the receivers will be recovered in May (rather than March as for previous experiments) so that the movements of SBT still in the region could be monitored. There was some discussion on what new information the proposed experiments would provide, given they are the same as last years experiments. It was noted that replication of experiments was important, and that the proposed project would also investigate differences in behaviour among small and large SBT which previous work has suggested may differ (eg small fish are resident, while larger fish are more migratory). It was suggested that full analysis of all the sonic tagging work should be conducted and that this body of work could be concluded soon. It was noted that the project had some external funding for one more year.

It was asked if sonic tags could be used for biomass estimation in a similar way to the conventional tagging work. This led to some discussion on future monitoring work that used bottom mounted sonar (semi-permanent listening stations ~“ocean observing systems”) to determine the total number of SBT in schools. It was noted that the way to do this would be to using sonic tags and listening stations to (1) confirm that the schools was SBT, and (2) to determine the proportion of tagged fish in the detected school. It was noted that developing an “automatic monitoring

system” for SBT would be a 10 year plan.

RMWS/05/18 was presented. This proposal is for a small-scale acoustic monitoring experiment in the Aerial Survey Region of the Great Australian Bight to investigate juvenile Southern Bluefin Tuna (SBT) residence at topographic features and sightability from the aerial survey spotted planes. The fine-scale information and presence of acoustically tagged fish at these features will be used to understand the sightability of fish from the air. A set of five VR2 listening stations will be deployed at one of several potential hotspots in the flightpath of the commercial spotters and the scientific aerial survey line transects. A minimum of 30 fish should be tagged with acoustic tags that transmit depth information while within the detection range of the listening stations. The experiment will run from December 2005 to May 2006.

There were some discussions on the logistics of sonic tagging experiments in South Australia, given that some listening stations were lost during experiments in the 2001-02 season. It was confirmed that the technical issues that contributed to the losses had been rectified. It was also noted that conducting experiments in South Australia would be interesting because it should be possible to detect SBT that had been tagged in Western Australia in the previous year.

D. Overview and prioritization

Overall, it was recommended that maintaining multiple indices of juvenile abundance was important, especially given recent results of the Aerial and Acoustic Surveys which appear to provide different signals. Both existing survey programs have uncertainties that require further investigation through supporting studies as listed below.

Supporting studies (not prioritized)

Aerial Survey	Acoustic Survey
Commercial spotting data (SAPUE)	Sonic tagging
Calibration experiments	Piston line survey
Sonic tagging	CCSBT troll data
	Quick look survey
	Charter Australian vessel (alternate to Taikai maru No.2 in the future)

Some specific comments on the supporting projects included:

- The merits of the SAPUE survey were recognized but it was noted that it would not replace the scientific Aerial Survey.
- The Sonic Tagging was seen as a data rich element of the RMP, and the continuation of the monitoring in the present form was recognized as a priority, in light of the advantage of gaining data from the replication of the current design.
- The potential extension of the sonic tagging into the GAB was also raised with the consensus that this would provide valuable information to the RMP and industry and, that if this option was to go ahead, the substantive costs of vessel charter could be met by cooperation with Industry, with the RMP contributing to the costs of the gears, tags and expertise. It was agreed that this project should not be at the expense of the WA array, especially given that the project was into the final year of funding.
- The need for the inclusion of the side scan sonar in the Piston Survey was raised, given the potential to solely use the eyesight and trolling components of the

survey.

- There was agreement that the quick look survey would benefit from a formalized contract with the operators of the survey/tagging vessel (Quadrant).
- It was agreed that the RMP (Australia and Japan) would send the CCSBT a request for the trolling data collected during the CCSBT tagging operations in southern Australia.
- The need to reduce the overall cost of the Acoustic Survey was reiterated. The feasibility of an Australian vessel to potentially replace the Taikei-maru No. 2 in future Acoustic Surveys was considered. The need to validate the performance of such a vessel would require at least one more year of the involvement of the Taikei-maru No. 2.

6. REPORT FROM THE COOPERATIVE RESEARCH PROJECT STEERING COMMITTEE

Attached as Appendix 4

7. OTHER BUSINESS

A short presentation was given on preliminary analyses of the aerial survey school size frequency data to determine if it follows a universal scaling law, and could provide an index of abundance value. Data from all survey years was combined into a single log-log plot of frequency of school size against school size. The plot was examined to see if there was any section that appeared to be a straight line with slope of -1.5. This would be in agreement with accepted theories of school size distribution, outlined originally by Bonabeau et al. in 1999, and analyzed in papers submitted to the RMWS by Hiro-Sato Niwa of NRIFE. There was a section within the centre of the plot that had a slope of -1.65. This area was chosen to classify each log-log plot of the annual data (9 years of surveys). Of the 9 annual plots, 6 showed a close approximation to the expected slope of -1.5 in the classification area, 2 were reasonably close and the first year was not close. A line was fitted to each log-log plot in the classification area and an arbitrary point was chosen on the line to be used as an 'index'. This point was consistent for all the annual plots at a log size frequency value of 3.2. Then a graph was plotted of the slope for each year, and a graph of the index for each year. It was noted that the index values obtained from this preliminary analysis were similar to that obtained for the line transect aerial survey.

8. ADOPTION OF REPORT

It was agreed that the report will be compiled over the next month and distributed for comment before binding and distribution. Electronic copies of presentations and reports will be included.

9. CLOSE OF MEETING

The meeting was closed at 17:40.

APPENDIX 1

SEVENTEENTH WORKSHOP ON
SBT RECRUITMENT MONITORING PROGRAM
27-29 July 2005

CSIRO Marine and Atmospheric Research, Hobart, Tasmania, Australia

DRAFT AGENDA

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 - B. Acoustic Survey
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7. OTHER BUSINESS
8. ADOPTION OF REPORT

Notes on the Draft Agenda:

The venue for the meeting is in the Banquet Room at Hotel Lenna. On Wednesday and Thursday the meeting will run from 9 am to 5 pm. On Friday the Steering Committee meeting will start at 10 am. Lunch will be between noon and 1:30 pm each day.

Dinner on Wednesday night is at T42 at 7:00pm.

APPENDIX 2

LIST OF WORKSHOP PARTICIPANTS

Sachiko Tsuji	-	National Research Institute of Far Seas Fisheries, Fisheries Research Agency
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Clive Stanley	-	CSIRO
James Dell	-	CSIRO
Sophie Bestley	-	CSIRO
Thomas Kunz	-	CSIRO
Jay Willis	-	CSIRO
Rudy Kloser	-	CSIRO
Campbell Davies	-	CSIRO
Robert Harris	-	Australian Marine Science and Technology
Kumi Koike	-	Interpreter

APPENDIX 3

LIST OF WORKING DOCUMENTS

Reports of 2004/05 research

Aerial Survey

RMWS/05/01 Preliminary results of Aerial Survey and Commercial Spotting data. Marinelle Basson, Mark Bravington, Paige Eveson, and Jessica Farley.

Acoustic Survey

RMWS/05/02 Cruise report of the acoustic monitoring survey for southern bluefin tuna by Taikei-maru No.2 in 2004/2005 season. Minoru Muta, Moriaki Satani, Tomoyuki Itoh and Yoshimi Takao.

RMWS/05/03 Survey report of the Acoustic transect survey on the piston line in 2004/2005. Tomoyuki Itoh and Yoshimi Takao.

RMWS/05/04 Acoustic Index of age one southern bluefin tuna obtained from the 2004/2005 survey. Tomoyuki Itoh.

RMWS/05/05 Other indices for age one southern bluefin tuna recruitment derived from data of the acoustic transect survey. Tomoyuki Itoh and Sachiko Tsuji.

RMWS/05/06 The analyses of opportunistic data collected during the Acoustic Survey - a review and future work plan. Hans Kemps. John Totterdell and Tomoyuki Itoh.

RMWS/05/07 Spatial distribution of bait schools observed with quantitative echo sounder. Koki Abs, Atsushi Nanami, Yoshimi Takao, and Minoru Muta.

RMWS/05/08 Spatial distribution of schools of juvenile SBT and bait fishes detected with a scanning sonar. Kazutoshi Watanabe, Koki Abe, Yoshimi Takao, Koichi Sawada, and Tomoyuki Itoh.

RMWS/05/09 Universality in school-size statistics for pelagics: Introduction. Hiro-sato Niwa.

RMWS/05/10 Analyzing data from sonar-specialists' estimates based on school-size statistics: SBT. Hiro-sato Niwa.

RMWS/05/11 Analyzing data from sonar-specialists' estimates based on school-size statistics: Bait. Hiro-sato Niwa.

RMWS/05/12 Results of the muscle and abdominal temperature measurement of SBT using date logger in net cage. Yuichi Tsuda, Kazushi Miyashita, Kentaro Honda, Kou Fujioka, Koki Abe, Ryo Kawabe, and Yoshimi Takao.

Sonic Tagging Experiments

RMWS/05/13 Movements of juvenile southern bluefin tuna in southern Western Australia: lines and hotspots. Alistair Hobday, Ryo Kawabe, Yoshimi Takao, and Kazushi

Miyashita.

Archival Tagging

RMWS/05/14 Archival tagging report. Clive Stanley

Proposals for 2005/06 research

Aerial Survey Proposal

RMWS/05/15 Farley, J. Basson, M., Bravington, M., Eveson, P. Proposal for Aerial Survey 2005/06.

Acoustic Survey Proposal

RMWS/05/16 Itoh, T. Takao, T., and Tsuju, S. Proposal of RMP surveys in WA for age one southern bluefin tuna in 2004/2005.

Sonic Tagging Experiments Proposal

RMWS/05/17 Hobday A., Kawabe, R. Takao, Y., Miyashita, K. Proposal for acoustic monitoring in Acoustic survey region.

RMWS/05/18 Hobday A., Kawabe, R. Takao, Y., Miyashita, K. Farley, J., Davies, C. Proposal for acoustic monitoring in Aerial Survey region. Comparison of sighting rates.

APPENDIX 4

REPORT OF THE 2005 MEETING OF THE STEERING COMMITTEE OF THE COLLABORATIVE JAPAN/AUSTRALIA RECRUITMENT MONITORING PROGRAM FOR JUVENILE SOUTHERN BLUEFIN TUNA (SBT)

Participants

Sachiko Tsuji, Alistair Hobday, Robert Harris, Tomoyuki Itoh, Kumi Koike, Takafumi Ura, Campbell Davies.

Report of the Meeting

Final Report

The committee suggested that the final report be collated at CSIRO in Hobart and distributed to participants for approval before final printing. Copies of RMP papers and presentations will be included in the report.

Scientific Research Program

The proposed research was divided into two elements; monitoring projects to develop recruitment indices and supplemental studies to support the interpretation of the monitoring work.

Monitoring components of the RMP

The acoustic survey and the aerial line transect survey were recognized as the key elements of the RMP goal of developing an index of juvenile recruitment and gave the top priority to these monitoring components. Both Australia and Japan committed to supporting continuation of these components. With regard to the commercial spotting data collection (SAPUE), Australia has committed support to continue this for another year.

Supplemental projects

These projects were identified as the ones most contributing to the interpretation of the monitoring component, and in particular the need to develop a reduced cost survey approach for age-1 fish in Western Australia that was sustainable into the future was recognized. Sonic tagging studies that provide information on movement and residence times with the survey areas were also supported. Calibration experiments for the spotters in the aerial survey were proposed and supported. The analysis of alternative indices, such as those based on the theory presented in RMWS/05/09-11, was recognized as an area for future collaboration, and although formal funding was not allocated, all parties agreed to pursue these collaboratively. The importance of analysis of the aerial survey and acoustic survey beyond the levels covered by the available funding was noted; additional collaborative proposals will be developed in the coming financial year. The steering committee was impressed by the enthusiasm for the science collaboration shown by all participants. Each of the projects presented is discussed in the following sections.

1. Sonic tagging of 1 year old SBT in Western Australia

The proposal for continued work in Western Australia was supported, after some reduction in the budget. The project leader was asked to consider utilizing the

cooperation of the CCSBT tagging to reduce the costs. It was emphasized that with one more year, this project should have met the objectives, and continued commitment for future years was not made.

2. Sonic tagging in the aerial survey region of South Australia

The proposal for a pilot study in South Australia was supported but with a reduced budget and the project team was required to investigate alternative arrangements for minimizing deployment costs via cooperation from industry and the CCSBT for deployment and recovery.

3. Acoustic survey supplemental projects.

Several projects that were potential reduced cost survey options were discussed in detail and the workshop and considered by the steering committee. The costs for these projects will vary substantially depending on the logistical arrangements including the number of charter days and rates, suitable vessel availability, and survey design.

The projects were

1. Piston line survey – trolling and detection of surface schools at one or more cross-shelf lines
2. Troll survey as part of CCSBT conventional tagging- utilizing the vessel to undertake specific troll survey during the tagging period.
3. Quick-look survey – trolling before and after the acoustic survey period to determine if SBT were present in large numbers in the survey region.
4. Charter of Australian vessel with suitable sonar equipment – possible future replacement of the currently used acoustic survey vessel (Taikei-maru No. 2).

The available funds were not sufficient to cover all the requested proposals, and the project leader was asked to continue investigation of the design and logistics of these supplementary studies, including, hourly charter spread over a longer period of time, in collaboration with other project leaders.

4. Aerial survey - Calibration experiments

These calibration experiments would be used to determine the differences between spotters in detection rate of SBT in the aerial surveys. Australia committed to supporting these surveys at the nominated cost.

Budgets

The Steering Committee noted that the budget for the 2005-06 RMP was not sufficient to cover all the proposed research and the following allocation was agreed.

CSIRO Direct contributions	135,000
Assuming a 85 ¥ conversion rate for FRA	119,000
Total	254,000

Table 1 Funding by project

Monitoring Components	
Aerial Line Transect Survey	Australia to support
Commercial spotting survey (SAPUE)	50,000 ¹
Acoustic Survey	Japan to support
Supplementary Component	
Sonic tagging in western Australia	106,000
Sonic tagging in South Australia (GAB)	35,000
Supplemental acoustic surveys ²	43,000
Calibration experiments	5,000
Annual workshop	no costs allocated
AMSAT management cost	15,000
Total	254,000

¹ Entirely from Australian contributions.

² If changes in the exchange rate or costs of these supplementary projects can be reduced by the project leader, the additional funds will support the collaborative sonic tagging work in South Australia.

2005-06 Workshop

The next workshop will be planned for July 2006 as it allows sufficient time for preparing for field work.