CSIRO
MARINE RESEARCH

DRAFT

SOUTHERN BLUEFIN TUNA RECRUITMENT MONITORING AND TAGGING PROGRAM

REPORT OF THE FIFTEENTH WORKSHOP

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30 July – 1 August 2003

Hotel Lenna

Hobart, Tasmania

Australia

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FOURTEENTH WORKSHOP ON SBT RECRUITMENT MONITORING SURVEYS AND TAGGING PROGRAM

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APPENDICES

1. OPENING REMARKS

Ian Poiner welcomed all delegates to the workshop and wished for a productive two days of activity. He noted that this is the 15th workshop of the recruitment monitoring program which has been delivering research important to the SBT fishery. From CSIRO's perspective this collaboration is important, and we look forward to another 15 years of collaboration with Japan in this or possibly other research activities on SBT.

2. APPOINTMENT OF CHAIR AND RAPPORTEURS

John Gunn and Sachiko Tsuji were appointed as co-chairs and Tim Davis, Jessica Farley, Toby Patterson, Alistair Hobday, Sophie Bestley, Tomoyuki Itoh and Yoshimi Takao as rapporteurs.

3. ADOPTION OF AGENDA

The agenda was adopted.

4. REVIEW OF 2002/2003 CSIRO/NRIFSF COOPERATIVE RESEARCH AND RELATED RECRUITMENT MONITORING WORK

A. Aerial Survey

1. 2003 Aerial Survey

RMWS/03/01 was presented. An aerial survey was conducted in the eastern Great Australian Bight (GAB) between November 2002 and March 2003 (referred to as the 2003 season). The survey was consistent with the 2001-2 survey (2002 season) (Farley and Bestley, 2002) and comprised two parts: a reduced line transect component based on the 2000 line transect aerial survey design (Cowling, 2000) and a commercial spotting component. The same six industry spotters participated in both the 2002 and 2003 surveys.

The line transect component of the 2003 survey did not meet all of its objectives primarily due to poor weather conditions on days when aircraft and spotters were available. Of the 12 lines intended to be surveyed, only six were attempted and two were completed. Only two SBT schools were recorded during this component of the survey. Constraints on the availability of planes during suitable weather will potentially make it difficult to use commercial spotters to conduct a consistent (spatially and temporally) reduced line-transect survey each year.

The commercial spotting component of the survey was successful and data from 106 flights were collected between November 2002 and March 2003. A total of 55477 nautical miles of commercial search effort was recorded over an area of 947 x 0.1° squares, slightly higher effort and spatial range than in

2002. Spotters recorded 735 SBT sightings (comprising 1301 individual schools) totalling 38559 tonnes. The total number of sightings and number of schools recorded in 2003 was higher than recorded in 2002, but the overall biomass recorded was lower. A significant difference was found in the distributions of school sizes between seasons with proportionally more small schools recorded in 2003 than 2002. It is unclear if this was due to better sighting conditions during the season allowing for more smaller schools to be detected. The size distribution of fish recorded was similar between seasons, and the mean fish size tended to increase with increasing school size.

The commercial spotting data showed an apparent decrease in SBT relative abundance between the 2002 and 2003 fishing seasons from 1.09 to 0.85 tonnes per nautical mile searched. However, this surface abundance per unit effort (SAPUE) has not been adjusted (standardized) so that comparable indices can be developed. For example, the relative contribution of each spotter to the total search effort varied quite significantly between seasons, which biased our overall results towards the spotter with the highest effort. When data from individual spotters were analysed, an increase in unweighted SAPUE between seasons was observed for two of the five spotters compared. The reasons for both increasing and decreasing SAPUE between seasons are unclear, but may be due in part to changes in the area searched or proportion of "intensive" verses "broad scale" searching conducted by each spotter.

The data also showed that the probability of sighting SBT decreased with an increase in wind speed, swell height, and cloud cover for both the 2002 and 2003 fishing seasons, and increased with increasing air temperature in 2003. Differences in environmental conditions between seasons will therefore affect estimates of SBT surface abundance.

In 2003, a time stamp was recorded with each sighting of SBT allowing us to identify flights that overlapped both spatially and temporally, and to examine the potential differences between spotters ability to both detect SBT schools and estimate school biomass. Comparison between spotters based on total number of schools and total biomass within a 0.1º square generally showed low correlation suggesting that detection rates of schools between spotters is highly variable. However, initial results of automated and manual comparisons of school biomass (see section 4.2.6) estimates between spotters are promising, and consistent overall with those of Cowling et al. (In press), who found good correlation in school size estimates between spotters from explicit experiments conducted in 1998 and 1999. Comparisons of school biomass estimates by spotters with AFMA catch data are also encouraging, although problems with the accuracy of the school location reduce the number of direct comparisons possible.

In discussion of RMWS/03/01 it was noted that one might expect industry to have commented on fewer fish being spotted this year, especially considering

the scale of extra searching. This was not the case, the only comments being on the greater than usual days of bad weather for spotting. It was asked whether there was a difference in the age distribution of catches between years, and noted that the age composition of the 2002-03 catch was not yet available from AFMA. It was confirmed that the same six spotters were used in both years but there was some difference in the amount of flying between years due to negotiated contracts between companies. It was noted in normal years there should be sufficient good weather days to carry out the reduced line transect survey.

2. Further analysis and design of aerial surveys

RMWS/03/02 was tabled as an information paper. It was an executive summary of a larger FRDC report which was a very thorough evaluation of whether the 10 years of data could provide some index of recruitment and the report discusses the prospects for continuing the Aerial Survey. A full copy of the report could be obtained after the workshop.

RMWS/03/03 was presented which extended the re-analysis of the aerial survey data already presented at last year's RMP meeting. It is true that analysis has not been straightforward, and standard methods have had to be modified several times over the years to accommodate particular features of the data. However, the survey has been designed well and, if appropriate analyses are used, it can deliver usefully robust and precise estimates. The CV averages around 35%, of which around 6 percentage points are due to uncertainties about environmental and spotter effects. With more data, these sources of uncertainty could in principle be reduced, so a CV of under 30% is achievable using the same survey design. This precision is quite respectable in comparison with other survey-based indices of relative abundance worldwide. The remaining uncertainties about aerial survey indices seem no worse than, for example, uncertainties about the interpretation of longline CPUE data for SBT, an index which is already used in stock assessment.

For the future, there is scope for running a cheaper version of the survey that still gives good precision, by eliminating some of the transects where very few fish have ever been seen. It may also be possible to improve the analysis by making use of commercial spotting data (e.g. to provide information on patchiness and/or environmental effects on sightability), although commercial spotting data alone cannot be expected to produce a reliable abundance index. Further data on availability from archival tag studies should help in allowing for year-to-year environmental effects. And if data on age proportions can be obtained (e.g. from historical tag release statistics), then it may be possible to circumvent the current difficulty that the index is not age-specific. The cost-effectiveness of different survey designs in future needs to be evaluated in the context of utility to management (both for SBT assessment as a whole, and for the Australian domestic fishery); this needs to be studied through, for example, the Management Procedure work already undertaken for CCSBT.

Finally, there is one element that will be crucial if further surveys are to have any quantitative value. The data show that spotters can differ markedly in their ability to spot schools and to estimate biomass. It is therefore essential to somehow inter-calibrate spotters from time to time.

In discussion of RMWS/03/03 it was noted that if you used the same spotters for a number of years you would not have to calibrate between spotters every year. Trainee spotters would need more frequent calibration. Future protocols for calibration need to be designed carefully to avoid interference between spotters, just as past protocols have been. In summary we are basically happy that the statistical design of the aerial survey is of an international standard, but know there are problems in logistics, problems in not knowing the size/age distribution of the spotted fish and not knowing what proportion of the population moves into the GAB. Despite these problems, the results are robust and as good as many other studies worldwide using fishery independent surveys with a CV of ~35%. We now have reached a point where a decision needs to be made on whether this work should be continued. A decision to re-instigate the survey in the future would be made only if the fishery stock assessment and management teams say the resulting index would be useful and taken into account in their decision making processes. Some discussion occurred about how an age-aggregated index could be used, and whether other information on age-composition (e.g. from conventional tagging studies) could be incorporated. It was also noted that even given prioritization by stock assessment and management, the feasibility of re-instigating a scientific line-transect survey is not certain given the shortage of available spotters and the weather constraints of the region. Do we continue to collect data at low level knowing that we may only get a result every few years due to bad weather?

It was concluded that this marks the completion of the aerial survey reanalysis - the final FRDC report is currently being published and is available for dissemination, and the executive summary of this report has been included in the RMP proceedings as an information document.

3. Integrated Analysis

RMWS/03/05 was presented. An individual based tuna movement model (IBM) has been developed to simulate movement patterns of juvenile tuna within the Great Australia Bight (GAB) during the austral summer. This approach allows the specific spatial arrangement of habitat to be accounted for as well as temporally changing habitat parameters (such as ocean temperature). It therefore allows for the incorporation of changing seasonal or interannual habitat preferences of juvenile bluefin to the extent that data is available, for example from archival tag and aerial survey data. At the current stage of development, the IBM provides a realistic spatial distribution of bluefin within the GAB using bathymetry and temperature based preferences.

However, comparison with observation-based abundance indices from the aerial surveys 1993-1999 show the model cannot reproduce the observed interannual changes in abundance. Incorporation of wind effects on sightability of tuna schools does not improve the match to the interannual signal. A second application of the model is investigated in experiments testing the ability of the aerial survey sampling regime to detect changes in absolute abundance of schools. Under various scenarios of increasing abundance, the effect of changing survey effort with respect to number of surveys, number of transects and number of years was investigated. The results presented show that if the model correctly reproduces the tuna movements, changes in abundance can be detected with increasing probability for greater changes over a 9 year period with the existing survey design within a moderate period of time (5 years). Reducing the effort within a year in terms either of number of surveys per replicate or the number of replicates per year is found to provide a similar capacity to detect changes in abundance as reducing the frequency of years that are surveyed and allow for continuous time-series to be maintained.

Overall, the IBM approach taken in the integrated analysis project was highly commended, and the enormous progress made in the past 12 months was praised. Comments were made that this type of research was very much ahead of similar modelling work on other species, and is possibly the first IBM developed that may be useful to help improve the design of surveys such as the RMP aerial survey and acoustic survey in WA. The ability of the model to include different sampling regimes in the simulated aerial survey was considered useful. It was noted that statistical methods applied to existing data should also be considered in any redesign of an aerial survey.

However, it was noted that the IBM presented did not completely match existing data. There was some discussion about further work that could be included into the models to make them more realistic such as adjusting rules to reduce the likelihood of fish moving into the western warm pool of water in the GAB and including feeding behaviour (sea surface colour, pilchard distribution etc) as a driver of spatial distribution etc.

General Discussion of Aerial Survey

Summary of Aerial Survey Results: 1993-2003

1. Scientific Line Transect Survey

Achievements

- Developed and refined line aerial transect survey design.
- Design and survey reviewed and endorsed by a number of international peer reviews.
- Provided index of abundance for 2-4 year old SBT in the eastern GAB 1993-2000.

- CV's on 1993-2000 abundance estimates are approximately 35%. The RMP noted that these CVs compare favourably with the uncertainties in other Fishery Independent Indices of Abundance.
- The abundance estimates are for aggregates of 2-4 year old SBT, rather than cohort specific.
- Bravington (2003) suggests that CV's could be reduced to less than 30% if better information were available for calibration of inter-spotter differences, environmental effects etc.
- As the distribution of SBT schools is largely confined to the central transects within the survey area, it was agreed that a reduced number of transect lines could be run, at a reduced cost, with little cost/increase to CVs.
- Aerial survey results have been used in CCSBT stock assessments since 1996 to eliminate unrealistic assessment results. The overlap between aerial survey and assessment-derived recruitment estimates in the 1996, 1998 and 2000 assessments was very limited, and thus the agreement between the trends has not been evaluated.
- In 2004, an assessment of the SBT stock will be conducted by the CCSBT SAG. This will provide an opportunity to compare the 1993-2000 aerial survey times series with estimates and trends in recruitment derived from assessment model(s) over the same 8 year period.

Concerns

- The use of aerial survey abundance estimates and trends as an index of recruitment in the SBT stock requires the assumption that a constant proportion of the global biomass of age classes seen by the survey (principally 2-4 year olds) visits the GAB each year. This would be a very difficult assumption to test, but efforts should be made to examine it.
- The CCSBT conventional tagging program provides a viable alternative to a full aerial survey in providing estimates of abundance of juvenile SBT cohorts. However, tagging-based indices also depend on some major assumptions (e.g. mixing rates, non-reporting rates can be estimated accurately), and if these assumptions can not be validated, the CV's of estimates of cohort strength from conventional tagging could be as high or higher than those that could be achieved by the Aerial Survey.

Conclusions

- It was noted that the costs of a full scientific aerial survey were comparable, or less than those of a tagging program, but were beyond the budget of the RMP at current levels.

- The principal logistical issues that constrain the feasibility of conducting a full scientific aerial survey in the GAB are a lack of trained spotters, planes and funding.
- Nevertheless, it was agreed that some form of aerial survey could provide a very useful index for assessment and management. See the discussion of restricted line transect survey below.

2. Surface Abundance Per Unit of Effort (SAPUE) Survey

- Co-operation from industry spotters and companies, well designed logbooks, and automated position recording systems have seen the successful development of a SAPUE index from commercial spotting activities in the eastern GAB in 2002 and 2003.
- A nominal SAPUE index has been estimated from various measures of effort over the last two years, and for most of these indices the 2003 SAPUE was below those for 2002. Significant inter-company differences, apparent effects of water temperature and the influence of weather on the index were highlighted as factors for which the nominal SAPUE should be standardized.
- It was considered that a SAPUE index provided useful additional information on SBT in the GAB, for example on distribution, patchiness and school size in the commercial fishing area. These data could be very useful in design and analysis of a modified line transect survey. SAPUE was recognised as an analogue to CPUE and should be monitored in the long term.
- However, because of difficulties in standardisation and interpretation, it was noted that it was unlikely that SAPUE could be used as a "stand-alone" quantitative index.

Conclusion

- It was agreed that the costs of SAPUE index covered by the RMP should be reduced since the development phase of the project is now complete. Cost savings can be achieved if industry takes more responsibility for the co-ordination of data collection and use the equipment and logbooks according to the protocols developed over the last two years.

3. Restricted Line Transect Survey

- A restricted line transect survey has been run in the GAB since 2002. The survey uses commercial spotters during times they are not involved in commercial operations to conduct a line transect according to the protocols developed for the Scientific Line Transect (SLT) survey, and over a reduced subset of the SLT's transects.

- In 2002, six transects were run, with two replicates. In 2003 bad weather restricted the survey and allowed completion of only two lines, without replication.
- It was considered the limitations of running the Restricted Line Transect – the principal one being that the survey can only be conducted when industry spotters were not required for commercial work. This means that in years where there is limited weather suitable for spotting, there is little time available for the line transect.
- The willingness of industry to co-operate in the survey provides confidence that, given good weather, a restricted line transect could be completed.

Conclusions

- A Restricted Line Transect should be conducted in 2004, and that data from 2004 and 2002 should be fully analyzed before the 2004 RMWS to allow complete evaluation of the worth of this approach.
- It was also recommended that there be an analysis of the likelihood of completing replicated sets of 6 transects within the likely window of availability of commercial planes and weather conditions during those windows, based on data collected between 1993 and 2000 in the Scientific Line Transect Survey.

B. Acoustic/Sonar Survey

1. 2003 Acoustic/Sonar Survey

RMWS/03/06 was presented. Total of 9 transect lines were searched using a sonar that was operated by sonar specialists during the Acoustic Survey. Although total of 6 schools of juvenile SBT were detected, the sonar specialists could not estimate the weight of these school as fish were scattered.

In discussion of RMWS/03/06 the possibility that an index of CPUE might be developed from the catch by trolling was considered. It was thought that it might produce a CPUE but it would not be very reliable as an index of abundance because of gear changes and changes in fish behaviour and the environment. It was pointed out that an index based on this was used in the early surveys but subsequently discarded because of its uncertainty.

The abundance indices of age 1 SBT based on data collected in the acoustic surveys were presented in RMPWS/03/07. The indices between 1996 and 2002 were re-calculated to adjust the 2/3-sized survey area used in 2003. It was confirmed that the relative values were quite similar between indices in the 2/3-sized survey area and those in the full-sized survey area used in previous years. The indices in 2003 were zero and have been low level since 2000.

RMWS/03/10 was presented. The echo integration surveys of small pelagic fish in Survey A area of sonar survey were conducted in 2002 and 2003. The acoustic equipment was Kaijo KFC-3000 split-beam echo sounder and its frequency was 70 kHz. The echo sounder transmitting was synchronized with sonar to avoid interference. We used SonarData "Echoview" software to post-process the data. We observed fish schools on the shelf and the shelf edge with sonar signal of SBT. Average NASC were 28 m^2/ nmi^2 in 2002 survey and 35 m^2/nmi^2 in 2003.

The identification of species from sonar image was discussed. The sonar expert will usually rely on troll catch to determine species if it is available. There was some doubt of matching the catch to the sonar image taken. There was some discussion on what constituted a veteran acoustic expert. It was noted that if there are mixed schools then it is possible that the troll line catch might give you misidentification of school composition because some species are more readily caught than others. It was pointed out that the massive pilchard mortalities in 1998/1999 coincided with the start of the drastic decline of sonar survey indices and might have impacted on the results.

A verbal report on CCSBT conventional tagging in Western Australia was presented because of its value in interpreting the results of the acoustic survey. Tagging was carried out after the acoustic survey. SBT were only found inshore and also further east of but not in the survey area when the tagging was carried out. It was noted that although one year old fish were present in reasonable numbers in the west when tagging was carried out, they were not in the area of the acoustic survey.

It was also noted that a substantial number of SBT were caught by the RV Shunyo maru throughout the acoustic survey area immediately after the regular acoustic survey concluded.

Results of Evaluation of Acoustic Survey

RMWS/03/11 was presented. The sound velocity going through a muscular tissue of SBT was measured on the R/V "Shunyo maru" to calculate TS by a scattering model. The sound velocities of a piece of SBT tissue were measured by Furuno "CM-100" medical bone checker. This equipment measures the sound velocity of human foot and converts to bone density. The mode of sound velocity is 1635 m/s and the range is 1606-1687 m/s. To calculate the ratio of sound velocity, we assumed temperature difference between fish tissue and seawater is 2 degrees C. The average ratio was 1.078. The preliminary estimated results of SBT which dimensions are 50cm length, 14cm height, and 10cm width were presented.

RMWS/03/12 was presented. Target strength was measured on live juvenile southern bluefin tuna (SBT) in a cage from 1998 to 2002. The target strength

of caged SBT was measured near Cull Island, Esperance, Western Australia, using a quantitative echo sounder. The acoustic frequency of both sounders was 70kHz. Single fish echoes measured under the high signal to noise ratio were used for the analysis. We picked up the maximum value of TS (TSmax) and calculate averaged TS value (TSavg). The normalized TS (TScm) by fish length (L in cm) were calculated as following. TSmax = 20 log L – 66.3 (n=16), TSavg = 20 log L – 76.3 (n=12).

In discussion arising from RMWS/03/12 it was noted that you need to know the size of individual fish quite well to conduct the inter-calibration between sonar specialists and a quantitative echo sounder.

RMWS/03/8 was presented. A joint acoustic-survey of juvenile Southern Bluefin Tuna (SBT) was conducted by Taikei maru NO.2 and R/V Shunyo maru in Australia in 2002 summer. Basic data were collected to verify the routine survey method, faculty of the sonar specialists, and acoustic properties of Juvenile SBT. Eight archival tags and 3 sonic tags were deployed to 11 one-year-old SBT during the survey. There was also a trial of an automatic processing system from sonar images to estimate the quantity of SBT instead of sonar specialists was introduced.

In discussion of RMWS/03/8 it was noted that the neural network approach is interesting. However, the importance of obtaining data on catches to confirm the information obtained by sonar and improve the learning base for the neural network was discussed. It was noted that catch data is not available at present. There was some discussion regarding school sizes which were considered to be larger at the beginning of the surveys than now.

2. Integrated Analysis in WA

Papers RMWS/03/9, 13 and 14 were presented on behalf of the authors who were not present, thus limiting capacity for questions to be answered.

RMWS/03/14 was presented. *In situ* CTD data, collected during the annual southern bluefin tuna acoustic survey (1996-2003), interpreted with satellite sea surface temperature and topography images show that the shelfbreak and open-shelf waters between Albany and Esperance (WA) are directly within the path of the summer LC. The subtropical mixed surface layer, established by the current, is 40-80m deep at the offshore edge of the survey area, but may extend down to the seabed at the inshore boundary. When the LC is weak, however, cooler less-saline waters from the base of the LC may flow onto the continental shelf. These uplifted waters do not appear to break the surface within the boundaries of the survey area, possibly due to the typical eastward movement of high-pressure cells that rarely result in periods of consistent upwelling-favourable winds. Distinct interannual variation in the salinity of the LC indicates that high-salinity West Australian Current water is mixed with a varying proportion of less-saline waters before the current

enters the survey area. Offshore, anticyclonic and cyclonic eddies may cause substantial intra-seasonal and spatial variation in the oceanographic conditions by generating: i) strong offshoots that weaken or divert the LC; or ii) northerly flows of local sub-Antarctic water that may replace the top 20-40m of the mixed surface layer up to the shelfbreak. Through these features eddies are instrumental in the formation of surface gradients in temperature and salinity.

RMWS/03/13 was presented. The majority (ca 93 %) of southern bluefin tuna caught during the NRIFSF/JAMARC acoustic survey ranged in size from 43 to 60 cm FL. Skipjack and oriental bonito occupied similar size-groups, i.e. ca 45-65 cm FL. Albacore individuals, in contrast, were generally larger, i.e. ca 60-67 cm FL but up to 94 cm FL. Distributional differences included spatial separations between species. While southern bluefin tuna was exclusively found inshore, albacore was only encountered offshore. Skipjack did not distinguish between these environments, in contrast to oriental bonito, which mainly occurred close to the coast, where small numbers of this species appeared to co-occur with southern bluefin tuna. Whereas a relatively small proportion of skipjack was found together with southern bluefin tuna over the continental shelf, it appeared that the main distributions of these species were separated by the front of the tropical (autumn-winter) Leeuwin Current. This spatial/temporal segregation was suggested to be associated with behavioural adaptations in relation to feeding. The importance of the Leeuwin Current and associated oceanographic features (i.e. eddies, temperature gradients and offshoots) on the characteristic ecology of the region was discussed in relation to the occurrences of these species. It was concluded that southern bluefin tuna, skipjack, oriental bonito and albacore did not co-occur to a large degree off southern Western Australia during summer.

RMWS/03/9 was presented. The diet of migrating juvenile southern bluefin tuna, caught during the annual southern bluefin tuna acoustic survey (1997-2003), predominantly consisted of teleosts (*ca* 96 %vol.), but was supplemented with cephalopods (*ca* 3 %vol.) and, occasionally, crustaceans (< 1 %vol.). Pilchard (*ca* 22 %vol.), blue mackerel (*ca* 21 %vol.) and jack mackerel (*ca* 16 %vol.) were the major taxa, although other species additionally dominated the diet during particular years. Interannual variation was distinct and was caused by: i) unequal sampling of the coastal and open-shelf environments thereby introducing spatial variation in the occurrences of species; ii) variation in eastwards transport of juvenile Australian herring, skipjack trevally and beaked salmon larvae by the Leeuwin Current; and iii) the severe reduction in pilchard stocks following the viral mortalities of 1998-99. The only species that regularly measured over 100mm FL in the diet was pilchard (120-190mm FL), with most others mainly ranging between 20 and 100mm FL, which suggested that the necessary shift away from a diet dominated by pilchard resulted in a decrease in mean prey size. A possible response of southern bluefin tuna to the decrease in suitable prey on the open

shelf involved a change towards a more coastal path of migration. Several aspects of the ecology of the region, including the effect of the Leeuwin Current and the possible implications of the reduced pilchard stocks on the condition of migrating southern bluefin tuna, are discussed in regard to the above findings.

There was a general discussion of the integrated analysis papers. The information provided by these papers was commended by the meeting and it was considered that it would provide the basis for further analysis of the acoustic survey. It was noted that a lot of the information provided by these three papers would provide basic data to develop an individual based movement model.

3. Sonic/Archival Tagging Experiments in WA

RMWS/03/15 was presented. The 2002/03 Acoustic Monitoring Project was carried out in southern Western Australia to determine the speed and position of alongshore movements of juvenile southern bluefin tuna (SBT) in the region of the Recruitment Monitoring Program Acoustic Survey. The project ran for 102 days, from 10 December 2002 to 23 March 2003. A line of 20 listening stations was established running offshore from the coast near Bremer Bay to the shelf break 30 km distant. All stations were recovered at the conclusion of the experiment although one had failed due to flooding. A total of 73 SBT (44-79 cm) were tagged at four locations between 40 and 153 km to the west of the line in December and January. A total of 24 (33%) tagged SBT were detected crossing the line of listening stations; these movement occurred within 40 days of tagging. Based on the estimated coverage of the line by the listening stations from detection tests, the total movement of SBT eastwards across the line was estimated at between 78 – 100%. The majority of fish crossed the line close to the coast, with 67% of SBT first detected at the five stations closest to shore. The speed and nearshore location at which the tagged fish moved east past Bremer Bay has important implications for the timing and the location of the RMP Acoustic Survey and suggests that the timing and migration behaviour of juvenile SBT may be earlier and closer inshore compared with the late 1990's.

RMWS/03/16 presented information investigating the main causes of the decline in indices in relation to SBT migration timing, pathway and migration speed. It was considered from these results that most fish were inshore of the survey area in 2002-2003. Based on the time taken by the ship to complete a transect and the estimated time for fish to migrate from the western side to the eastern side of the survey area for lower fish speeds the ship will record the same group of fish on different replications of the survey. For higher fish speeds the replicate surveys will record different fish in each replication.

In the combined discussion of RMWS/03/15 and RMWS/03/16 it was considered that shallow water stations have longer residence times not

because they have a FAD effect, but because there is more structure there to attract them. It was noted however that there might be a possibility to follow the line of stations once a fish has reached the line of stations.

RMWS/03/04 was presented. In 2003 a total of 29 archival tags were deployed in age 1+ SBT. The fork length of these fish was 49-57cm. Four archival tags were returned to CSIRO Marine Research in 2003 from Australia (2 tags), Japan (1 tag) and Taiwan (1 tag). One of these tags (SBT 99-214) was deployed in southern Western Australian waters in 2001. It was at liberty for 700 days. Geolocation estimates were gathered for a total of 417 of the total 700 days. Longitudes were estimated using light data from the tag. Two sets of latitude estimates were generated using light sensor data and Sea-Surface Temperature (SST). SBT 99-214 spent much of the time at liberty in the waters to the south of Western Australia, venturing a significant distance away from the coastal zone. The furthest south estimated position was approximately 38oS. The SBT then made a westward excursion into the western Indian Ocean, traveling to approximately 105oE before returning east to the Western Australian coastal waters and traveling further east into the GAB. The data from the period of residence in the coastal shelf waters, showed that the fish was highly surface oriented for a period of 3 months, during which it remained above 100m. Once the SBT had moved off the shelf the depth preferences of the fish changed considerably and there were many deep dives.

It was noted that that RMWS/03/04 did not include information on the 8 ATs released from the *Shunyo Maru* and *Taikei Maru* #2 that are not included in this report. A summary of these tag releases was provided during the meeting in the form of a table which was appended to RMWS/03/04.

In discussion of RMWS/03/04 it was noted that the tagged fish presented in the talk did not feed for 15 days after the initial tagging. It was reported that the data summaries provided by CSIRO for all tags recaptured by Japanese vessels and returned to CSIRO up to 2002 was sent to fishing companies by Japanese scientists. Timely reporting on the results of archival tagging (even if the tags contain no data) was again stressed and agreed, and Japanese scientists reported that the reports sent last year got a good response from industry. Data for the Western Australian tag returned this year was provided to FRA scientists at the meeting.

It was agreed that in future, CSIRO would send all details of tag data from tags caught by Japanese fishers directly to FRA, and that FRA would then provide these to fishermen in the most appropriate form.

General Discussion of Acoustic Survey

The chair noted that following on from the Hakodate acoustic survey workshop in the year 2000, there has been much critical evaluation of the juvenile SBT acoustic survey, especially with regard to the survey design and school behaviour. Much of this evaluation is technical in nature, including suitability of sonar as a measure of tuna abundance, and the possible conditions limiting the sonar's ability. Also the appropriateness of the timing and the location of the acoustic survey has been another focus of attention. The recent evaluation suggests that we need to consider even more carefully the technical and the behaviour problems.

For the next year, Japan proposed to suspend the field monitoring because of many problems with the survey and concentrate on the analysis of the existing data. A particular focus would be to see if there are any better ways to monitor recruitment at the earliest stages. It was noted that the major change in the acoustic index happened around 1999. It will be important to consider other related changes that may have occurred in 1999, such as the decline in pilchard stocks.

A further uncertainty is the global distribution of the age-1 fish. It is not known if the apparent decline in the acoustic index is in part due to the relocation of the fish to other locations. A variety of approaches were discussed, including using fishing data from fleets elsewhere, and an IBM approach to test hypotheses about environmentally-driven changes in behaviour. Consideration of the oceanographic processes on a wider scale that might lead to a global change in the behaviour of age-1 fish was also suggested.

Even though the index shows a complete collapse, there is alternative evidence that this is not the case, e.g. there are age-2 SBT showing up in GAB the next year, while other SBT work in the same general area (e.g. acoustic monitoring work and the CCSBT tagging) indicate that fish are present. Failure to detect fish in the acoustic survey may be because of redistribution of large schools to loose surface aggregations, or into very small schools that cannot be detected by the sonar (~<0.5 tonnes). Thus, changes in behaviour are very important. Changes in behaviour that might have resulted in the SBT moving out of the survey area, for example, moving closer to the coast, should also be considered. Despite the alternative explanations for fish being present elsewhere or at different times, there is still no evidence that there are large numbers of age-1 fish in WA. Comparing the SBT to the Northern Bluefin Tuna situation where the stock size is much larger, we would expect to see the same large school structure in the WA region if the SBT stock is large.

It was noted that most of the current hotspots for age-1 SBT inshore of the acoustic survey area are in areas characterised by reefs/lumps, where the sonar signal is very corrupted, and where it is dangerous for the large survey vessel to operate. Tagging records in WA go back to 1962 and it was suggested that the current hotspot areas inshore were always high areas of abundance. Historical

information (old pole and line fishery) also suggests that over the last 3 decades, the schools size and distribution has changed.

The new archival tag data currently being collected will make a big difference to the RMP, particularly for the design and interpretation of the surveys. These data will provide unique insight for the behaviour and movement of SBT. The recently completed FRDC report included the analysis of these tags for the aerial survey region. It was noted that it seems that tag results show that individuals are very variable, and deciding how these individuals represent the school or population is an important consideration.

There is a similar need for SBT behavioural data for the acoustic survey area. The issue of the relative merit of the proposed acoustic and archival tagging projects was discussed. It was generally concluded that a combination of approaches is important, because different information is provided. For example, acoustic monitoring provides accurate data on onshore and alongshore movements, while archival tagging provides information on the vertical behaviour of juveniles and on the large-scale movements.

As the size of the survey area is relatively small (<200 n miles from east to west, 20 n mile from north to south), the accuracy of archival tag geo-location estimates limits the use of these data when examining fine scale movement in relation to the acoustic survey. Sonic tag data is useful at these finer spatial scales.

The group considered ways to assess the proportion of the age-1 fish that would pass through Western Australia. There have been several problems with archival tagging of age-1 or age-0 fish before they turn east at Cape Leeuwin and arrive in southern Western Australia. These problems were briefly summarized.

- Archival tags used to be too big for these small fish. The new generation of tags are now suitable for small SBT (~30-50 cm).
- Availability of the fish is low and they cannot be captured easily in large numbers, but it expected that with some effort (trolling) suitable numbers could be collected for archival tagging.
- Two size classes are typically encountered along the western coast of WA, the 3 month old fish (<30 cm) between Shark Bay and Cape Leeuwin seem unsuitable for tagging, and the scales fall off very easily. Ten month old fish (~45 cm) are more robust and might take the tagging stress better. These occur around Fremantle to Cape Leeuwin. However, these fish are considered to belong to the group that will likely recruit into the GAB.
- Survival of these small fish is expected to be very low, and so recovery of archival tags might also be very low. Stress associated with tagging smaller fish may also result in reduced survival.

The general conclusion was that at present it is better to focus archival tagging efforts on age-1 fish in southern Western Australia.

5. PROPOSED NRIFSF/CSIRO RECRUITMENT MONITORING COOPERATIVE RESEARCH IN 2003/2004

A. Aerial Survey

1. 2004 Aerial Survey

RMWS/03/17 was presented. The 2003 RMP aerial survey confirmed that commercial tuna spotters are capable of collecting large quantities of inexpensive information about the relative abundance of SBT in the eastern GAB. The commercial spotting component of the survey was successful and data from 102 flights were collected during the season. The data collected provided insight into school and fish sizes, the distribution and relative abundance of SBT (un-standardised) on the fishing ground, the influence of environmental conditions on the probability of sighting SBT, and "calibration" of spotters ability to detect schools and estimate biomass. Unfortunately, the reduced line-transect component of the survey failed to meet all of its objectives primarily due to poor weather during the fishing season, which significantly reduced the number of days suitable for flights. In 2003-04, we propose to collect "unit of effort" data at reduced cost, putting more responsibility for collecting commercial spotting data onto the SBT industry, and a limited line transect survey similar to that conducted in 2002 and 2003. There is a risk associated with giving responsibility for collection of commercial spotting data to industry that the quality of data collected may also be reduced as training and support given during the season will be limited. As discovered in 2003, there is also the risk that the number of transect line flown will be limited due to constraints on the availability of aircraft during the season and the possibility of poor weather when aircraft are available. These factors, will determine when and how many line-transects will be flown during the season.

B. Acoustic/Sonar Survey in WA

1. Overall Acoustic/Sonar Proposal

RMWS/03/19 was tabled, and RMWS/03/20 was presented. During the presentation of RMWS/03/20, it was explained that RMWS/03/19 should be considered as a component of the work required for the analysis of acoustic survey results.

The main points presented in RMWS/03/20 were:

- Field survey for acoustic monitoring is to be suspended for at least one year.
- A review and re-analysis focusing on the following four points will be conducted:

a) Development toward automated measurement system with sonar: The Program has accumulated a large quantity of acoustic data on SBT and other fish schools in conjunction with sonar experts judgments. Re-analyzing historical data especially focusing toward development of algorithm to be used for automated species identification and biomass measurement system. Acoustic characteristics of tunas and other species will be also reviewed and summarized.

b) Examination of reliability of indices for SBT abundance within the survey window: This is focusing to find whether the Program could provide reliable estimates of SBT abundance within the survey area during the survey period. Tasks here include detailed re-examination of historical sonar images and records, review in changes in gears, devices, personnel, etc., examination of environmental impacts on detectability, application of alternative stratifications and procedures to calculate indices, and so on.

c) Examination of reliability of indices for global age-1 SBT abundance: This tries to cover scenarios that fish proportion available to the survey varies among years, with a special focus on potential drastic changes between pre-1999 and after. Tasks include examination of SBT migration and behavior relating to oceanographic conditions including global scale variation, re-examination of tagging data, review of potential information on juvenile abundances and so on. H.A. Kemps developed an independent research proposal corresponding to this item.

d) Consideration of practical and reliable SBT recruitment procedures:

- Juvenile migration and behavior by acoustic and archival tagging (proposal prepared separately) will be continued.
- A review workshop will be held in conjunction with the next RMPWS including outside peer review.

2. Sonic and Archival Tagging Experiments in WA

RMWS/03/21 was presented. The acoustic monitoring experiment in 2003 provided important information showing that the majority of age-1 SBT moved through the acoustic survey area by mid-January and that these movements occurred inshore of the current Acoustic Survey Area (ASA). Estimates of SBT movement speed were variable, but in general showed that as the average movement (48 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, we propose to use two tagging

technologies to study age-1 SBT in the acoustic survey region of southern WA: acoustic monitoring arrays and tags (AM), and the new generation of micro-archival tags (AT) manufactured by Lotek. For the AM component of the project, we propose to deploy an array of moored listening stations to examine movements of acoustically tagged fish. The particular configurations were discussed, but depended on the funds available for the research.

In discussion, the issue of different sizes of fish to be tagged was raised, and it was considered not important to restrict the size range of fish tagged. The placement of stations was discussed but considered best to use the locations decided on last year where the shelf is narrowest. The point of abnormal behaviour after tagging might affect their movement during the experiment. Therefore, maybe the point of release should be longer from the line of stations to reduce chance of abnormal behaviour. However, it may be difficult to catch fish far enough west to do this and rate of east-west movement is known also to be highly variable. It was noted that this information on abnormal behaviour was based on one fish tagged with an AT so really need more data before changing the design. The optimal spacing of stations was discussed and it was agreed that before starting further work this issue should be addressed through evaluation of historical data. The listening stations can be in place for longer than used previously so that they might address whether fish move westwards out of the area by an inshore or offshore path. To avoid problems with time in the water it might be better to retrieve the stations and redeploy them or have stations with different periods in the water. This could be done in one cruise. The question of fouling with longer deployment and its effect on detection was raised. The importance of conducting detection experiments at the beginning and end of deployment was agreed. The question of listening stations on ships or within the core fishing region was raised to detect the fish in SA during the fishing operations, including the cages. CSIRO has been liaising with concurrent white shark sonic tagging to ensure equipment compatibility and avoid tag number duplications.

3. Integrated analysis of WA/SA Recruitment Indices

RMWS/03/18 was presented. The integrated analysis approach recently used in the GAB in association with the aerial survey was advocated for the acoustic survey region and the general Western Australian area. This would require a synthesis of recent and historical environmental and behavioural data on the distribution of SBT in southern Western Australia. The analysis of archival tags with data from this region will allow development of preferred habitat descriptions for age-1 SBT in southern WA. One outcome of this approach is an evaluation of the contribution of changes in the environment, sampling vessel, and SBT behaviour that might lead to the observed decline in the acoustic survey area. Expansion of the current juvenile SBT movement model domain to the acoustic survey area of Western Australia was also proposed. However, before the model can be realistically extended to include

younger SBT and this region, supporting data must be collected and synthesized. Existing conventional and acoustic tagging data may allow some preliminary model parameterisation for this region.

6. OVERVIEW AND PRIORITIZATION

Aerial Indices of abundance

The continuation of the SAPUE index was recommended.

The line transect component was discussed and it was noted that the current logistic problems in terms of shortage of spotters and planes will never be solved. As an alternative, a reduced survey of six lines with two replicates has been proposed. CSIRO committed to working more with the existing data this year to investigate the level of precision using the reduced design. This was recognized as a priority. It was suggested that as many "voluntary" transects as possible be completed during the line transect component of the aerial survey. In general, the time series of the full aerial survey was considered to be reliable and had CV~35%. The future challenge is to determine if the reduced survey can also provide a reliable index.

It was suggested that spotter calibration experiments should also be attempted. If the flight time is available, calibration experiments are a priority, even more important than the line transects. It was acknowledged that such calibration experiments may have to be opportunistic. Calibration might be done during the SAPUE survey where the fish are at greatest abundance. It was noted that additional data can also be used to improve the index.

Currently there is no investigation of the importance of indices of recruitment in the GAB with different CV levels for the stock assessment process. The need for improved communication between the RMP and those involved in SBT stock assessments regarding the level of precision required from such indices was emphasised.

Acoustic Listening Station project.

Acoustic tagging project was strongly supported. The need to discuss the cost of the different options presented was recognized. The priority is for two lines in the acoustic survey area, covering the inshore and adjacent acoustic survey area. The importance of an extended experimental period was emphasized.

Integrated analyses of SA and WA Indices and fish behaviour/environment

The priority and work to be undertaken in the different areas was discussed. Three areas were discussed.

Oceanography. The biological environment should be further developed to determine where the prey are distributed. The physical environment can be further developed using extra remote data that is available.

Sonar technical issues. Work examining technical aspects of sonar performance should continue. It was suggested that the acoustic survey should use ancillary data to understand the results of the sonar surveys.

SBT Behaviour. It was suggested that behavioural information obtained from AT and acoustic work should be further investigated collaboratively. IBM techniques would be applied to the west but requires extraction of data first. The data on fisheries can be sourced from the States and a person to coordinate all Australian sources of data is recommended – Alistair Hobday. T. Itoh will be the counterpart for Japan.

Plans for 2004 RMP Workshop

It was agreed that the 2004 Workshop will cover the results of all work completed in Western Australian and South Australia during the last RMP 5-year period. Subject to funding, it is planned to hold the workshop in Japan after the CCSBT meetings

7. REPORT FROM THE COOPERATIVE RESEARCH PROJECT STEERING COMMITTEE

To be added after Steering Committee

8. OTHER BUSINESS

To be added

9. ADOPTION OF REPORT

It was agreed that the report will be adopted out of session within the next month.

10. CLOSE OF MEETING

The meeting was closed at 1255.

APPENDIX 1

FIFTEENTH WORKSHOP ON SBT RECRUITMENT MONITORING PROGRAM

30 July – 1 August 2003
CSIRO Marine Research Laboratories, Hobart, Tasmania, Australia

DRAFT AGENDA[1]

1. OPENING REMARKS
2. APPOINTMENT OF CHAIRS AND RAPPORTEURS
3. ADOPTION OF AGENDA
4. REVIEW OF 2002/2003 CSIRO/NRIFSF COOPERATIVE RESEARCH AND RELATED RECRUITMENT MONITORING WORK
   - A. Aerial Survey
     - 2003 Aerial Survey
     - Further analysis and design of aerial surveys
     - Integrated Analysis
     - General Discussion of Aerial Survey
   - B. Acoustic/Sonar Survey
     - 2003 Acoustic/Sonar Survey
     - Results of Evaluation of Acoustic Survey
     - Integrated Analysis in WA
     - Sonic/Archival Tagging Experiments in WA
     - General Discussion of Acoustic Survey
5. PROPOSED CSIRO/NRIFSF RECRUITMENT MONITORING COOPERATIVE RESEARCH IN 2003/2004
   - A. Aerial Survey
     - 2004 Aerial Survey
     - Integrated Analysis in the GAB
   - B. Acoustic/Sonar Survey in WA
     - Overall Acoustic/Sonar Proposal
     - Sonic and Archival Tagging Experiments in WA
     - Integrated analysis of WA/SA Recruitment Indices
6. OVERVIEW/DISCUSSION/PRIORITISATION
   - A. Aerial Survey
     - Line Transect Survey – decisions on future
     - Collaboration on Review of Acoustic Survey
     - Integrated analyses of SA and WA Indices and fish behaviour/environment
     - Plans for 2004 RMP Workshop

7. REPORT FROM THE COOPERATIVE RESEARCH PROJECT STEERING COMMITTEE
8. OTHER BUSINESS
9. ADOPTION OF REPORT

Notes on the Draft Agenda:

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

APPENDIX 2

LIST OF WORKSHOP PARTICIPANTS

Bob Harriss	-	Australian Marine Science and Technology
Andy Bodsworth	-	Australian Fisheries Management Authority
Jay Hender	-	Agriculture, Fisheries & Forestry - Australia
Sachiko Tsuji	-	National Research Institute of Far Seas Fisheries
Tomoyuki Itoh	-	National Research Institute of Far Seas Fisheries
Yoshimi Takao	-	National Research Institute of Fisheries Engineering
Kouichi Sawada	-	National Research Institute of Fisheries Engineering
Kazushi Miyashita	-	Hokkaido University
Ryo Kawabe	-	Hokkaido University
Hajime Taguchi	-	Japan Fisheries Agency
Norihisa Baba	-	Fishery Research Agency
Masanori Takahashi	-	Japan Marine Fishery Resource Research Centre
Yukali Armstrong	-	(interpreter)
John Gunn	-	CSIRO
Alistair Hobday	-	CSIRO
Tim Davis	-	CSIRO
Jessica Farley	-	CSIRO
Sophie Bestley	-	CSIRO
Toby Patterson	-	CSIRO
Marinelle Basson	-	CSIRO
Mark Bravington	-	CSIRO
Toni Cracknell	-	CSIRO (Meeting Secretary)

APPENDIX 3

LIST OF WORKING DOCUMENTS

REPORTS

GAB Aerial Survey

2003 Aerial Survey

1. Farley, J. and S. Bestley. *Aerial survey indices of abundance: comparison of estimates from line transect and "unit of spotting effort" survey approaches.*

Further analysis and design of aerial surveys

2. Cowling et al. *Executive Summary from FRDC Report "Development of a fishery independent index of abundance for juvenile southern bluefin tuna and improvement of the index through integration of environmental, archival tag and aerial survey data – Executive Summary"*

3. Bravington, M. *Further considerations on the analysis and design of aerial surveys for juvenile SBT in the GAB.*

Archival Tagging Experiments

4. Gunn, J.S. and Patterson, T. *Archival tagging of juvenile SBT in the Great Australian Bight – Update on 2002-03 field work and analyses.*

Integrated Analysis

5. Hobday, A. and S. Bestley. *Development of an individual-based spatially-explicit movement model for juvenile SBT (3) environment-based movement rules with varying abundance and sampling regimes.*

WA and Acoustic/Sonar Survey

Acoustic/Sonar Survey

6. Ueda, K. and R. Nanami. *Summary Report of the 2003 acoustic survey for juvenile Southern Bluefin Tuna in Western Australia*.
7. Itoh, T. and T. Nishida. *Calculation of the abundance indices of age 1 southern bluefin tuna from data obtained in the acoustic surveys between 1996 and 2003.*
8. Kouichi, S., Hideyuki, T., Tsuji, S., Katsuhiko, U., Abe, K., Kawabe, R., Totterdell, J., Takao, Y. and A. Nanami. *Preliminary report of Joint Acoustic Survey of Juvenile SBT in Australia conducted by Taikei maru No. 2 and R/V Shunyo maru in 2002 summer.*

9. Kemps, H.A., Totterdell, J., Gill, H.S., Hutchins, B., and S. Tsuji. *The diet and feeding ecology of migrating one-year old southern bluefin tuna (Thunnus maccoyii) off southern Western Australia (1997-2003).*

10. Nanami, A., Abe, K., Takao, Y., Sawada, K., Miyashita, K., Kawabe, R., Yamashita, H. and K. Ueda. *Distributions of pelagic fish school observed by echo-sounder in acoustic surveys of 2002 and 2003.*

11. Abe, K., Sawada, K., Nanami, A. and Y. Takao. *Sound propagation velocity of Southern Bluefin Tuna's body.*

12. Takao, Y., Miyashita, K., Sawada, K., Nanami, A., Abe, K., Kawabe, R., Harada, S., Yamashita, H. and T. Nishida. *Summary of target strength measurements of juvenile southern bluefin tuna (Thunnus maccoyii) in cage from 1998 to 2002 (Revised).*

Integrated Analysis

13. Kemps, H.A., Cresswell, G.R. and S. Tsuji. *Distribution and ecology of migrating juvenile southern bluefin tuna (Thunnus maccoyii) and other closely related species off southern Western Australia during summer.*
14. Kemps, H.A., Chuwen, B.M., Cresswell, G.R. and S. Tsuji. *The influence of the Leeuwin Current on the oceanography of the shelfbreak and open-shelf waters off southern Western Australia during the summers of 1996-2003.*

Sonic and Archival Tagging Experiments

15. Hobday, A. *Nearshore migration of juvenile SBT in southern western Australia.*
16. Kawabe, R., Hobday, A., Takao, Y. and K. Miyashita. *Horizontal movements of juvenile SBT and implication for the design of Sonar survey in WA.*

PROPOSALS

Aerial Survey

2004 Aerial Survey

17. Farley, J. *Aerial survey indices of abundance: comparison of estimates from line transect and "unit of spotting effort" survey approaches.*

Integrated Analysis

18. Hobday, A. and S. Bestley. *Integrated analysis of SBT in southern Western Australia – implications for an acoustic survey.*
19. Kemps, H.A., Kawabe, R. and S. Tsuji. *Juvenile SBT migration in relation to the oceanography and ecology of the GAB and surrounding ecosystems.*

Acoustic/Sonar Survey

2003/2004 Acoustic/Sonar Survey

20. Tsuji, S. et al. *Overall proposal of acoustic monitoring program for 2003/2004.*

Sonic and Archival Tagging in WA

21. Hobday, A., Gunn, J., Takao, Y., Miyashita, K. and R. Kawabe. *Residence times and migration pathways of SBT in the acoustic survey region, WA* [hope to develop this proposal together on Monday pm]

APPENDIX 4

Report of the 2003 Meeting of the Steering Committee of the Collaborative Japan/Australia Recruitment Monitoring Program for Juvenile Southern Bluefin Tuna (SBT)

Participants

John Gunn, Sachiko Tsuji, Masanori Takahashi, Bob Harriss, Norihisa Baba, Hajime Taguchi, Andy Bodsworth, Jay Hender, Yukali Armstrong (Interpreter).

Report of the Meeting

Scientific Research Program

The steering committee discussed the options for research and agreed on the following projects:

1. **Acoustic survey**

   Following Japan's decision to suspend the acoustic survey field work in 2003/4, the committee agreed to support the full analysis of existing data on the abundance of fish (from the acoustic survey), behaviour of 1-2 year old fish (archival tag and acoustic listening station), oceanography (satellite based, and data collected by the acoustic program) and biology (collected by the acoustic survey – in particular the data reported by Hans Kemp). The committee encouraged collaborative efforts in these analyses and agreed to support Japan's proposal to hold the RMWS in Japan next year and also the concept of conducting a review workshop on the results of the aerial and acoustic surveys focussed on determining options for future SBT Recruitment Monitoring research.

2. **Commercial spotting survey in South Australia**

   Continuation of this component is agreed, at a reduced funding level from 2002-03. The Steering Committee noted that the project required funding from SBTMAC for it to proceed as there was no possibility of funding this project from JAMARC funds.

3. **Line transect aerial spotting**

   Noting the importance of line transect data in estimating trends in abundance, and in enhancing the utility of the commercial spotting data, the committee agreed to support the line transect project. However, with reduced funding available this year, the committee reduced the funds available to the line transect project for plane charter and requested that the project leader negotiate with industry with a view to reducing the costs of the transect work.

Despite the weather problems encountered in 2002/3, it was considered vital to continue this project for this third year. The committee asked the project leader to ensure that full analysis of the data collected is available for next year's RMWS, and that this analysis should include an evaluation of the CV's for the reduced survey.

4. **Integrated analysis**

As noted in the acoustic survey section of this report, the analysis of historical data for the Western Australian acoustic survey region will be a RMP priority for 2003/4. The integrated analysis project will play a major role in this process, and will involve collaboration between FRA and CSIRO, and to facilitate this, Sachiko Tsuji, Alistair Hobday and John Gunn will take joint leadership of project. The committee agreed to fund participation of Hans Kemp in this project, as it was considered important that his biological data and local fisheries information from WA should be included in the analyses. The committee also agreed that 25% of a CSIRO support scientist should be dedicated to support work lead by Sachiko Tsuji and her group at FRA. This work will require FRA and CSIRO collaborators to meet in Australia and Japan over the next 12 months, and funds were allocated to facilitate these exchange visits. The Integrated Analysis project is seen as a vital element of this year's RMP work program, and in the development of strong collaborative ties between FRA and CSIRO.

5. **Acoustic Listening Station and Archival tagging of 1-2 year ofl SBT in Western Australia (Joint CSIRO/FRA project)**

It was agreed that both acoustic listening stations and archival tags are required to examine the movements and behaviour of 1-2 year old SBT in Western Australia. It was also noted that the archival tagging will provide data useful for the interpretation of the CCSBT conventional tagging program.

The following details were agreed:

- 23 archival tags will be deployed (10 from RMP, 5 from CSIRO, 5 new tags and 3 left over from 2002/3 from FRA).
- 100 sonic tags will be purchased
- 23 listening stations purchased in 2001-03 will be used.
- FRA and CSIRO scientists made strong representations to the steering committee that more than 23 stations would be required to deploy two lines of stations in 2003/4.
- To allow two lines to be deployed, extra listening stations will be sought from the following options:
  - Japan – University of Hokkaido have indicated that they may be able to lease 6 stations to the RMP for 2003/4.
  - CSIRO – will make 6 extra listening stations (currently used for shark research) available for RMP use in 2003/4.

The costs of making moorings for the 12 extra listening stations will need to be found from the existing budget as the Steering Committee was not able to provide extra funds for this project activity.

It was suggested that Japan's FRA Fisheries Engineering group may be able to provide acoustic tags for use in the project, and that if so, the saving could be used to fabricate the moorings for the listening stations.

Budgets

The Steering Committee noted that the budget for the 2003-04 RMP represented a significant reduction over the previous year's budget, which had significant implications for the work that could be funded by the RMP.

AFMA noted that the voluntary Industry Research Fund, administered by AFMA with advice from SBTMAC and one of the major supporters of the RMP over the last decade, had been significantly reduced in 2003-04. The cuts in funding available for research result from increases in industry contributions to SBT observers, and to the stock assessments. Industry have chosen to reduce their voluntary contributions to research to pay for these costs, and as a result the funds available in 2003-04 is expected to be about half of previous levels – ie approximately $100,000.

Japan also noted that as a result of the decision to suspend the acoustic survey pending analysis and review of the data collected over the term of the project, that JAMARC had reduced funds available for the 2003-04 RMP. Their contribution this year will be in the order of $187500 (assuming an exchange rate of 80 ¥).

Expected level of funding is listed below.

Assumed contribution for SBTMAC	100,000
Assumed carry over from SBTMAC/CSIRO from 2002/3 project	60,000
CSIRO Direct contributions	50,000
Assuming a 80 ¥ conversion rate for JAMARC	187,500
Total	**397,500**

The Steering Committee agreed that any positive change in exchanging rate will be used for archival and acoustic tags.

Table 1. Funding by project	
1a. Commercial spotting survey	51,949
1b. Line transect component	91,165
2. Sonic and archival tagging in WA	162,386
3. Integrated analysis	65,000
Annual workshop	7,000
AMSAT management cost	20,000
Total	**397,500**

2003-04 Workshop

The next workshop (timing and duration) is to be discussed between the RMWS Chairs but a preference would be early July and should be before October. The committee noted that the busy schedule for CCSBT SAG and SC in 2004 will be a problem for scheduling of the RMWS, but that it was essential to hold the workshop in the middle of the year to allow arrangements to be made for field work in 2004/5.