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**TUNA AND BILLFISH ASSESSMENT PROGRAMME: WORK
PROGRAMME REVIEW 1992-93 AND WORK PLAN 1994**
(Paper prepared by the Secretariat)

TUNA AND BILLFISH ASSESSMENT PROGRAMME

1. The Tuna and Billfish Assessment Programme (TBAP) was established by the 1980 South Pacific Conference to continue the work initiated by its predecessor project, the Skipjack Survey and Assessment Programme (SSAP). The Programme is funded by extra-budgetary contributions from Australia, France, New Zealand and the United States of America. Funding for specific projects during the past three years has also been received from the European Community (EC), the International Centre for Ocean Development (ICOD) of Canada, the Australian International Development Assistance Bureau (AIDAB) and the Food and Agriculture Organisation of the United Nations (FAO).

2. The TBAP mission, as drafted by the Fourth Standing Committee on Tuna and Billfish (SCTB) and endorsed by the Twenty-third Regional Technical Meeting on Fisheries, is "to provide member countries with the scientific information and advice necessary to rationally manage fisheries exploiting the region's resources of tuna, billfish and related species". The structure of the TBAP recommended at the Fourth SCTB, i.e. Statistics and Monitoring, Biological Research, Stock Assessment and Modelling, Reporting and Liaison, continues to be used to review work programme activities and to frame work plans. Note that this Programme structure has now received the official approval of the 17th CRGA and 32nd South Pacific Conference. The Albacore Research Project, which draws on each of these areas, is described separately, as is the TBAP involvement, on a consultancy basis, in the Philippines Tuna Research Project. Finally, a status report on the TBAP computer system and plans for its enhancement are described.

3. This year, the review of the 1992-93 work programme and the presentation of the work plan for 1994 have been consolidated into the one document. It is hoped that this will more clearly demonstrate the links between this year's and next year's activities and therefore give participants a more concise picture of the status and direction of the Programme.

1. STATISTICS AND MONITORING

1.1 Regional Tuna Fisheries Databases

1.1.1 Catch and Effort Logbook Data

Background:

4. Since its inception in 1981, the TBAP has maintained a database on industrial tuna fisheries in the region. The main sources of data have been catch and effort logsheets provided to SPC by member countries; the logsheets have been obtained either from distant-water fishing nations (DWFNs) under access agreements or from vessels of domestic fleets. The database is used for research and monitoring purposes; in particular, to assess the state of exploitation of the stocks and to study interactions between the different fleets operating in the region. Monitoring of the fisheries is facilitated through quarterly publication of the SPC Regional Tuna Bulletin. Data summaries are also provided to member countries on a quarterly basis. For several member countries, the processed data are returned on diskettes for incorporation into databases which are maintained on computers within each country.

1992-93 activities:

5. During 1992-93, logsheet data for tuna vessels fishing in the region were received from Australia, the Cook Islands, the Federated States of Micronesia, Fiji, French Polynesia, Kiribati, the Marshall Islands, New Caledonia, New Zealand, Palau, Papua New Guinea, Solomon Islands, Tonga, Tuvalu and the United States. Coverage of domestic fleets by the Regional Tuna Fisheries Database has remained high. Delays with logsheet data from Solomon Islands have however continued. Improvements on the quality of ROC small longline and purse seine data are becoming apparent.

1994 work plan:

6. Maintenance of the catch and effort logsheet database and efforts to improve its coverage will continue.

1.1.2 Standing Committee Database

Background:

7. At the meeting of the Standing Committee on Tuna and Billfish held in Suva on 19-21 June 1989, the Committee considered the problem of inadequate statistical coverage of the fishing activities of DWFNs in the region, including Indonesia, Korea, Japan, Philippines, Taiwan and the USSR. The Standing Committee discussed the establishment of a common database consisting of aggregated data provided by all fishing nations (including DWFNs), which would be separate from the data currently assembled by SPC in the Regional Tuna Fisheries Database (which are contributed only by SPC member countries).

1992-93 activities:

8. At present, data have been provided to the Standing Committee Database by Australia, Fiji, Japan, Kiribati, Korea, New Caledonia, New Zealand, Papua New Guinea, Solomon Islands, Taiwan, Tonga and the United States. During 1992, additional data were received covering American purse seiners active during 1981-1985. Data covering Japanese longline and pole-and-line fleets during 1981-1990 and purse seine fleets during 1981-1991 were received at SPC from the Fisheries Agency of Japan in December 1992. Data covering Korean longliners since 1988, and Korean purse seiners since 1985, are still forthcoming.

1.1.3 SPAR Database**Background:**

9. At the Second South Pacific Albacore Research (SPAR) Workshop, held in June 1989, the participants agreed to the offer made by SPC to act as a clearinghouse for the receipt and distribution of albacore data.

1992-93 activities:

10. At present, catch and effort data have been provided by Australia, Japan, Korea, New Caledonia, New Zealand, Taiwan, Tonga and the United States. Size frequency data have been provided by the Australia, Fiji, French Polynesia, Japan and the United States. Data for the SPAR database were updated in preparation for the fifth meeting of the SPAR group, held in Papeete, French Polynesia, from 29 March to 2 April 1993.

1994 work plan:

11. Maintenance of the SPAR database will continue, even though the three year research program on South Pacific Albacore essentially concluded at the end of 1993.

1.2 Port Sampling**Background:**

12. Sampling of size and species composition of landed catches in port often provides a convenient means of monitoring these characteristics of the commercial catch. These data are fundamental for stock assessment and fishery interaction research. The amounts unloaded are also useful information that can be compiled during port sampling.

1992-93 activities:

13. During 1992, port sampling programmes to collect biological data and amounts unloaded from landings were supervised by the TBAP in the Federated States of Micronesia, Fiji, French Polynesia, Marshall Islands, New Caledonia and Palau. The sampling data are forwarded on a quarterly basis to SPC, where they are then processed. The sampling programmes in the Marshall Islands and Palau suffered from lack of personnel during late 1992, but these problems were resolved during early 1993. A further interruption in port sampling in the Marshall Islands occurred in mid-1993; the problem was resolved in October 1993 with funding assistance from SPC.

14. It is noteworthy that new minimum terms and conditions of access to SPC members' EEZs have limited high seas transshipment since from 15 June 1993. As a result, more transshipment has occurred in regional ports, with a corresponding increase in port sampling.

1994 work plan:

15. Existing sampling programmes will continue to be supported during 1994, and expanded where necessary to cover increased transshipment activity. A new sampling programme has been planned for Guam, but logistic problems have delayed implementation of the programme.

16. The TBAP will hold a port sampling workshop from 17 to 21 January 1994 on Chuuk, Federated States of Micronesia. Port samplers from American Samoa, FSM, Fiji, Kiribati, Marshall Islands, Palau and Papua New Guinea will meet to review current port sampling programmes, to examine and standardise port sampling procedures, to consider the development of a regional port sampling manual, and to provide a forum for port samplers, and SPC staff, to meet each other and share experiences.

17. On a wider scale, port sampling as envisaged under the Lomé IV-funded South Pacific Regional Tuna Resource Assessment and Monitoring Project (SPR TRAMP) will be extended where possible to cover a representative proportion of unloadings of western Pacific fish at a maximum number of locations. The sampling design may need to include south-east Asian ports, transshipment operations (high seas and in ports of member countries), and cooperative programmes with DWFNs. Under SPR TRAMP, a Port Sampling and Observer Manager, based in Noumea, and five or more local samplers, will be recruited.

1.3 Observers

Background:

18. To date, the TBAP has played mainly an advisory role with respect to observer programmes in the western tropical Pacific. Since the inception of the observer programme on American purse seiners under the US treaty, which is administered by FFA, the TBAP has played a key support role in observer training, design of data collection forms, processing of observer data and data quality assessment.

1992-93 activities:

19. During 1992-93, this advisory role to the American purse seine observer programme continued. One TBAP scientist acted as lecturer in the observer training course held in Apia and Pago Pago in February 1993. Further, financial and technical assistance was provided by SPC to the Micronesian Maritime Authority (MMA) to initiate placement of observers aboard Taiwanese purse seiners and to monitor transshipment. A longline observer form was developed and tested in collaboration with MMA staff. The implementation of observer programmes in the Marshall Islands and Palau was proposed and discussed with national counterparts.

1994 work plan:

20. The TBAP will continue to support the US treaty and national observer programmes. Under the SPR TRAMP, the TBAP will have substantial funding available for the placement of scientific observers aboard commercial tuna fishing vessels over the next five years. It is intended to recruit five scientific observers, who will be expected to spend up to 75 percent of their time at sea, involving vessels of all fleets. The main role of these observers will be the collection of biological and fishing effort data, however the TBAP will attempt to accommodate requests from other agencies and member countries for the collection of other data.

21. During 1994, the TBAP will initiate discussions with member countries, FFA and other relevant agencies regarding their plans for observer placement in coming years. Taking this information into account, the TBAP will prepare a develop procedures for onboard sampling and a sampling design for the placement of SPC observers. Ideally, the SPC observer programme will form part of a regionally-coordinated observer effort that includes other agencies and national programmes.

1.4 SPC Regional Tuna Bulletin**Background:**

22. The quarterly SPC Regional Tuna Bulletin provides summaries of catch and effort by month, gear type and fishing nation, for all commercial tuna fleets in the SPC area. It has been distributed since the first quarter of 1988 to fisheries officers within the region and to research institutions and industry within the region and beyond.

1992-93 activities:

23. During 1992, the mailing list was updated and, for the first time, payment was requested from subscribers from the private sector in order to partly offset the cost of publication. Currently, 13 out of 151 subscribers pay US\$ 50 per annum for the Tuna Bulletin.

1994 work plan:

24. The Tuna Bulletin will continue to be published on a quarterly basis.

1.5 SPC Tuna Fishery Yearbook**Background:**

25. At the third meeting of the Standing Committee on Tuna and Billfish (SCTB), held in June 1990, the members of the committee called for the TBAP to compile fishery status reports, in order to facilitate the review by the SCTB of the TBAP work programme and to place the work of the TBAP in perspective. The status reports, which contain historical and current estimates of annual catches, by species, for each of the fleets that have operated in the SPC area, have since been produced each year and presented at meetings of the SCTB.

1992-93 activities:

26. The report on annual catches up to 1992 was presented to the sixth meeting of the SCTB, held on Pohnpei in June 1993. In previous years, the status report has been published in the TBAP Technical Report series. The 1992 report will be the first published in a new SPC series, the SPC Tuna Fishery Yearbook.

1994 work plan:

27. Another edition of the SPC Tuna Fishery Yearbook will be produced, with estimates of annual catches up to 1993 and revisions of historical estimates.

1.6 National Fishery Statistics Systems

Background:

28. Commencing in 1988, tuna fishery databases have been developed and installed on computers in fisheries departments of thirteen SPC member countries. The systems are customised according to the needs of the member country, but typically allow the production of data summaries and maps of fishing activity within their EEZ. Some systems also include a logsheet data entry component that allows in-house data processing. In cases where data entry is carried out at SPC, regular data updates are sent via Peacesat or on diskette by mail.

1992-93 activities:

29. During 1992-93, several countries (Federated States of Micronesia, Marshall Islands, Palau and Papua New Guinea) were visited by TBAP staff to provide programming support for their in-country fisheries databases.

1994 work plan:

30. During 1994, TBAP staff plan to visit several countries to provide programming support and database development, including extensive upgrading of their existing systems. A request for the development of a fisheries database system in French Polynesia will be met during 1994.

1.7 Statistical Support for Other SPC Fisheries Projects

Background:

31. Statistical support is provided to other SPC fisheries projects, in addition to the research and assessment work of the TBAP, in particular the Deep Sea Fisheries Development Project, the Inshore Fisheries Research Project and the Regional Fisheries Training Programme. Data management for the tagging projects conducted by the TBAP has been carried out since 1989.

1992-93 activities:

32. Most of the support provided during 1992-93 concerned continuing maintenance of database systems for the Regional Tuna Tagging Project (RTTP) and associated projects. With the completion of tagging activities during 1992-93, programming assistance continued with tag recovery data processing and data summaries.

1994 work plan:

33. During 1994, support will continue to be provided on request to other SPC programmes, as resources allow.

2. BIOLOGICAL RESEARCH

34. The focus of the TBAP's biological research during 1992 continued to be the RTTP, which concluded its operational phase on 19 December 1992. Several new activities foreshadowed at SCTB 5 (mainly analysis of biological material collected during the RTTP) have been postponed due to the delayed implementation of the SPR TRAMP and high TBAP staff turnover during 1993.

2.1 Regional Tuna Tagging Project

Background:

35. The RTTP was a three-year project undertaken by the TBAP, with 3.5 million ECU in funding from the European Community Sixth European Development Fund (Lomé III). The project was expressly designed to provide practical answers to questions raised by tuna fisheries interaction and tuna exploitation generally within the region. The project will provide information on the population characteristics of yellowfin, skipjack and, to a lesser extent, bigeye, so that these questions can be addressed using various modelling approaches. Tagging was carried out predominantly from the chartered Tuvaluan pole-and-line vessel, *Te Tautai*, although various locally-based vessels have been used on an opportunistic basis for specific in-country components in Solomon Islands, Kiribati and Fiji (which also contribute to the overall objectives of the project). The operations of the *Te Tautai* began in December 1989, following initial work in Solomon Islands during the second half of 1989 on Solomon Taiyo Ltd pole-and-line vessels.

1992-93 activities and final results:

36. With tagging activities extended to two of the French territories with additional EC funding (Wallis and Futuna: 6-9/3/92; 16/6-3/7/92; New Caledonia: 23/11-5/12/91; 22/11-19/12/92), *Te Tautai* charter did not conclude until 19 December 1992. This included 20 months of EC charter (plus 8 weeks extension) and 8 weeks of Australian-funded charter in the Coral Sea (1991 and 1992). The RTTP was suspended for three months (August-October 1992) while the *Te Tautai* was involved in the Philippines Tuna Research Project (See section 6).

37. Including the various in-country tagging projects (Fiji, Kiribati, Solomon Islands) and some experimental releases, a total of 133,129 tunas were tagged and released. At the end of November 1993, 14,482 of these (11%) had been returned, as summarised in Table 1, below. The attached Tagging Summary, October-December 1993 (Annex 1) gives more recent details of the current status of these data.

38. The release numbers are substantially in excess of the targets quoted in the original Project Proposal - 80,000 tuna over the two-year charter period, to be released widely throughout the area of the existing fishery. Both in terms of release numbers and their geographical distribution (Figure 1), it can be reasonably concluded that the RTTP has either met or exceeded its operational objectives.

Table 1. RTTP tag releases (including experimental purse seine releases) and returns as at 30 November 1993.

	<u>Yellowfin</u>	<u>Skipjack</u>	<u>Bigeye</u>	<u>Oth./Unkn.</u>	<u>Total</u>
Releases	33,525	92,377	6,795	423	133,129
Returns	3,391	10,669	418	4	14,482
Return rate	10.1%	11.5%	6.2%	0.9%	10.9%

39. Similarly, the collection of a large amount of biological data from tuna caught during fishing operations, but not tagged because of hook or other injury, has been pleasing (Table 2). These data will provide the basis for several important investigations, including age and growth, stock structure, feeding behaviour and reproductive biology. Various analyses of this large amount of data have now either begun in earnest or are planned to begin in the coming year.

Table 2. Biological data collected during the RTTP.

Species	Length	Weight	Sex and gonad stage	Otolith sample	Stomach contents	Morphometrics
Yellowfin	3,374	1,954	1,518	704	1,517	996
Skipjack	6,788	3,216	1,867	0	1,861	0
Bigeye	278	229	183	61	181	83

40. During the course of the RTTP, tagged tuna have been released both in country EEZs and in high-seas areas. The in-country releases, and associated recoveries, will be extremely valuable for the analysis of country-specific interaction and exploitation questions. In-country releases and associated recoveries are shown in Table 3.

Table 3. In-country tag releases and recoveries, as at 30 November 1993.

Country	Releases			Recoveries			Rate (%)		
	SKJ	YFT	BET	SKJ	YFT	BET	SKJ	YFT	BET
Australia	4,535	2,908	4,274	51	57	105	1.1	1.9	2.4
Fiji	3,995	1,000	4	495	38	1	12.3	3.8	25.0
FSM	8,713	2,572	268	1,025	214	59	11.7	8.3	22.0
Howland-Baker	19	23	1	4	8	0	21.0	34.7	0.0
Indonesia ¹	5,721	2,717	46	875	502	8	15.2	18.4	17.3
Kiribati	10,012	3,032	1,018	760	224	93	7.5	7.3	9.1
Marshall Is.	2,148	17	--	63	1	--	2.9	5.8	--
New Caledonia	4,806	695	1	36	--	--	0.7	0.0	0.0
Nauru	1,439	21	--	367	1	--	25.5	4.7	--
PNG	27,326	13,789	894	3,819	1,593	119	13.9	11.5	13.3
Philippines ¹	5,073	1,017	19	703	153	3	13.8	15.0	15.7
Palau	4,582	2,625	67	531	317	7	11.5	12.0	10.4
Solomon Is.	11,892	2,725	52	1,848	264	8	15.5	9.6	15.3
Tuvalu	790	123	11	54	2	--	6.8	1.6	0.0
Vanuatu	72	--	--	0	--	--	0.0	--	--
International	345	164	140	29	16	15	8.4	9.7	10.7

¹ Does not include releases and recaptures associated with the Philippines Tuna Research Project.

41. In three cases, Solomon Islands, Kiribati and Fiji, locally-based commercial tuna fisheries operate. In these countries, *Te Tautai* releases have been bolstered by substantial numbers of releases from local vessels (with financial assistance from AIDAB in the case of the Solomon Islands). The analyses of these country-specific tagging data are now being incorporated into National Fisheries Assessments (Country Reports). The recent Solomon Islands and Papua New Guinea Country Reports include extensive analyses of both the in-country tagging data and the RTTP data as a whole.

42. An important aspect of the RTTP has been the estimation of tag loss due to tag shedding and non-reporting. Double-tagging experiments were carried out at various times during tagging operations, and the returns of these tags have allowed the estimation of tag shedding rates. With the assistance of MMA staff in Pohnpei and NMFS staff in Pago Pago, tag seeding experiments have been carried out since 1990. Observers on purse seiners were asked to discretely tag five dead fish before they were placed in wells. With various assumptions, the return rate of these seeded tags provides an estimate of the rate of reporting of genuine tags. To date, 91 such experiments have been carried out (443 tags seeded), with a preliminary overall return rate of about 66%.

1994 work plan:

43. No further tagging will be undertaken in 1994, although tag seeding will continue while significant numbers of genuine returns are still being received. Work in 1994 will focus on the continued processing of tag returns and screening the data base for errors/missing data and taking appropriate action.

2.2 By-catch and Discards in Western Pacific Tuna Fisheries

Background:

44. A review of by-catch and discards in western Pacific tuna fisheries commenced during 1991-92 following a recommendation of SCTB 4. The objective of the study is to review by-catch and discard practices of the industrial tuna fisheries operating in the western Pacific, using logsheet data provided to SPC member countries, observer data, and published and unpublished reports. The review is intended to provide authoritative background information on this topic and to point the way towards any further studies or data collection programmes that may be required.

1992-93 activities:

45. A preliminary draft of the review has been completed and was presented to SCTB 6.

1994 work plan:

46. The report will be finalised, circulated for comment to Standing Committee members and modified as required. A final review prior to publication will be undertaken at SCTB 7. Collection of further data on by-catch and discards will be considered when planning the SPR TRAMP observer programme.

2.3 Age and Growth of Tropical Tunas

Background:

47. The age and growth of tropical tunas are important aspects of their population dynamics. Tag returns are now providing a large amount of new information on growth, particularly of the longer-lived species, yellowfin and bigeye. Also, during the RTTP, 704 yellowfin and 61 bigeye tuna otolith samples were collected. In combination, these data, along with a growing database of size composition data, should provide much new information on age and growth of tropical tunas.

1992-93 activities:

48. In late 1991, a small number of yellowfin were injected with oxytetracycline (OTC) prior to tagging to hopefully confirm the periodicity of ring formation. Eleven of these fish have been recaptured and the otoliths recovered. This material was sent to Dr Alex Wild of the Inter-American Tropical Tuna Commission, who analysed the samples. He concluded that yellowfin otoliths from the western Pacific were much more difficult to interpret and showed greater variability in increment spacing than those from the eastern Pacific. This has also been previously noted for skipjack otoliths. The results of the experiment to date are shown in Table 4. Unfortunately, 8 of the 11 returns did not have recapture dates precise enough to enable a reliable assessment. Of the remainder, 2 returns showed a close correspondence between the number of rings and the number of days at liberty. However, a third return, at liberty 175 days, had substantially fewer rings (mean 136.05) than days. Although these tests are far from conclusive, they suggest that the reading of otoliths from western Pacific yellowfin and their interpretation in terms of age, would be far from straight forward.

Table 4. Results of the yellowfin oxytetracycline experiment.

Tag number	Mean no. rings	95% confidence interval	Days at liberty
T00034	29.45	28.23 - 30.67	29-60
T00041	37.57	34.28 - 38.86	29-60
T00055	25.79	24.45 - 27.13	29-60
T00105	45.85	44.65 - 47.05	49
T00117	51.35	49.30 - 53.40	0-124
T00138	21.67	20.73 - 22.61	21
T00148	44.62	43.26 - 45.98	29-60
T00156	27.28	26.14 - 28.42	29-60
T00159	136.05	133.13 - 138.97	175
T00162	35.53	34.57 - 36.49	29-60
T00164	53.08	51.24 - 53.93	29-60

1994 work plan:

49. During 1994, the tagging data will be screened to provide a data subset with reliable length increments and times at large. The subset will be analysed to provide estimates of growth rates and their variability in time and space. The available length-frequency data will be assessed for their utility in providing estimates of growth using the MULTIFAN method. This work will be undertaken by TBAP staff in collaboration with Mr Sylvester Diake, Solomon Islands Ministry of Natural Resources, as part of the requirements of his MSc degree at the Australian Maritime College.

2.4 Assessment of Western Pacific Yellowfin Stock Structure by Analysis of Morphometric and Meristic Characters

Background:

50. During the RTTP, morphometric (13 measurements) and meristic (gill raker count) data for 996 yellowfin and 83 bigeye were collected. These data are potentially useful for detecting possible geographical structure in the western Pacific yellowfin stock.

1992-93 activities:

51. Analysis of this data set is being undertaken on a part-time basis due to shortage of manpower.

1994 work plan:

52. The data will be analysed using well-known statistical techniques (multivariate regression, discriminant analysis, etc). The objectives of the analysis will be (i) to assess and describe the geographic variation in the characters and (ii) based on the findings of (i), to test various hypotheses regarding spatially-distinguishable geographical groupings that may indicate some degree of spatial structuring of the stock. The possibility and desirability of combining these data with those from a similar study in the eastern Pacific will be investigated.

2.5 Analysis of Yellowfin Reproductive Condition

Background:

53. A substantial amount of data on yellowfin gonad stage, weight and other variables was collected during the course of the RTTP (see Table 2). The analysis of these data would be a valuable pre-cursor to a more comprehensive study of yellowfin reproductive biology in the western Pacific.

1992-93 activities:

54. The yellowfin reproductive data have not yet been analysed due to lack of manpower. During 1992-93, a project proposal for a more comprehensive study was developed in collaboration with the University of Hawaii, NRIFS (Japan) and MMA (FSM).

1994 work plan:

55. The yellowfin reproductive data will be analysed with the objective of characterising variability in yellowfin condition (as indicated by gonad stage and GSI) by fish size, season and location. The large-scale yellowfin reproductive biology study has been funded by the University of Hawaii and work will commence in early 1994. The TBAP will participate in this study by collecting gonad samples during observer trips.

2.6 Food and Feeding of Yellowfin

Background:

56. A substantial amount of data on yellowfin stomach contents was collected during the RTTP. There is substantial interest in this data set and its possible value in clarifying certain aspects of yellowfin feeding ecology, particularly from scientists working in the eastern Pacific fishery.

1992-93 activities:

57. No analysis of these data have yet been carried out due to shortage of manpower and other priorities.

1994 work plan:

58. Expressions of interest will be sought from other scientists in undertaking a collaborative analysis of these data. The analysis might include characterisation of feeding and diet of yellowfin in relation to school association, area, time of day and other factors.

2.7 Billfish Research

Background:

59. The TBAP is mandated to conduct research on billfish (marlins, broadbill swordfish and sailfish), although this has received little attention in the past due to the emphasis of the programme on commercially important tunas. The TBAP's work in this area has concentrated on the collection of fishery statistics, providing information on billfish on an *ad hoc* basis to member countries on request and collaborating with outside researchers where appropriate.

1992-93 activities:

60. Apart from *ad hoc* requests for information, work on billfish was restricted to the incorporation of billfish data into the by-catch and discards report (section 2.2) and collaboration with Australian Institute of Marine Science (AIMS) researchers in compilation of a billfish atlas for the Coral Sea basin. Summary data from the Regional Tuna Fisheries Database were provided to AIMS for this purpose.

1994 work plan:

61. The 1992-93 activities, including collaboration with AIMS, will be continued, as appropriate. It is anticipated that the new SPR TRAMP observer and port sampling activities will result in much improved billfish databases, allowing more in-depth analyses to be undertaken in the future.

3. ASSESSMENT AND MODELLING

62. Work is in progress on the detailed analysis of RTTP results, and TBAP research will continue to focus on this in 1994. Brief descriptions of assessment and modelling work undertaken in 1992-93 and plans for 1994 are as follows:

3.1 Skipjack and Yellowfin Assessment Using Tagging Data

Background:

63. Two of the principal objectives of the RTTP were to provide a first overall assessment of the status of the western Pacific yellowfin stock and to provide a reassessment of the status of the skipjack stock. To this end, a preliminary analysis of aggregate RTTP results, for the purpose of evaluating the status of the stocks and their exploitation potential, was presented at SCTB 5.

1992-93 activities:

64. The analysis has been updated to include new data and some refinements to the method. These refinements include the use of a non-parametric bootstrapping procedure in the estimation of confidence intervals, and the incorporation of uncertainties in tagging mortality and tag shedding rates into the confidence intervals. A summary of this and other assessment work was presented to SCTB 6. The results of these assessments continue to suggest that both the skipjack and yellowfin stocks in the western Pacific are only moderately exploited and could withstand increased exploitation.

1994 work plan:

65. This work will be finalised early in 1994 and a manuscript submitted for publication. The remaining major refinements considered necessary is the estimation of tag reporting variability from the tag seeding and other data and the incorporation of spatial and size structure. The testing of alternative models (e.g. time-variant M models) will also be carried out.

3.2 Development of Indices of Yellowfin Abundance

Background:

66. During 1991-92, work was initiated to develop indices of yellowfin abundance utilising daily catch and effort logbook data for the American and Japanese purse seine fleets, as well as on oceanographic parameters and other data. A paper describing the variation in yellowfin catch rates in relation to some of these factors was presented to WPYR 2.

1992-93 activities:

67. A generalised linear model has been fitted to the available data and significant independent variables identified. Preliminary results indicate that yellowfin stocks have not declined in response to increased purse seine effort. This work has been refined during 1993 and the results were reported in detail to WPYR 3.

1994 work plan:

68. Following review, a final document will be prepared and published in the SPC Technical Report series.

3.3 Development of Skipjack Movement Model

Background:

69. This work is being undertaken in collaboration with Otter Research Ltd. of Canada. A working version of a prototype model was presented at the FAO Expert Consultation on Interactions of Pacific Tuna Fisheries, held in Noumea in December 1991; a detailed report of this work is available as document TIC/91R#4 of that meeting.

1992-93 activities:

70. During 1992-93, the model was tested using simulated data and shown to be robust under a variety of experimental conditions. Preliminary fits of the model to subsets of the SSAP tag return data have yielded parameter estimates consistent with expectation. A verbal presentation of the results to date were made at SCTB 6.

1994 work plan:

71. Fitting of the model to SSAP and RTTP skipjack tag return data will be carried out during 1994. A report of the work will be prepared for the second Expert Consultation on Interactions of Pacific Tuna Fisheries, to be held in late 1994.

3.4 Case Study of Fishery Interaction in a Pacific Island Country: Kiribati

Background:

72. This project received strong support from Pacific Island countries at the 1991 Expert Consultation on Interactions of Pacific Tuna Fisheries. Kiribati was nominated as the subject for the case study because of the presence of a number of different scales of fishing activity in the EEZ artisanal/subsistence, small-scale commercial and large-scale industrial. A proposal or funding the study was prepared and submitted to FAO. After lengthy review, FAO agreed to fund the study in early 1993.

1992-93 activities:

73. Delays in final project approval and commitment of funding resulted in little work being undertaken in 1992-93. Liaison with Kiribati Fisheries Division staff regarding the compilation of artisanal fishing statistics has commenced and preliminary evaluations of tagging data to be used in the study have been undertaken.

1994 work plan:

74. Funding for the study has recently been confirmed, and the work proper about is to commence. During 1994, we will attempt to (i) quantify the overall levels of exploitation of skipjack and yellowfin tuna in the Kiribati EEZ (primarily the Gilbert Group); (ii) quantify the interaction between artisanal, domestic commercial and DWFN purse seine fleets operating within the Kiribati EEZ; and (iii) quantify the interaction between fisheries operating in the Kiribati EEZ and large-scale industrial tuna fisheries operating throughout the greater western tropical Pacific. The analyses to be undertaken include the construction of abundance indices using catch and effort data and analyses of tagging data for both releases in the Kiribati EEZ and in the greater western tropical Pacific.

3.5 National Fisheries Assessments (Country Reports)

Background:

75. National Fisheries Assessments (NFAs) are produced by the TBAP to inform member countries of the status of their tuna fisheries and the stocks that support them. The reports are based primarily on logsheet data obtained through access agreements with DWFNs and submitted to SPC by the member country concerned. Recent reports have been upgraded, and now include sections on the biology of the major tuna species, oceanographic influences in the EEZ, reviews of the fisheries and analyses of data, assessment of stocks and management recommendations. In some cases, the reports have included analyses of RTTP and/or in-country tagging project data, enabling more quantitative assessments and management advice.

1992-93 activities:

76. During 1992-93, one NFA was completed (Solomon Islands) and the results presented to government and industry officials. This report incorporated an analysis of data from the Solomon Islands In-Country Tagging Project and the RTTP, thus enabling some specific questions regarding fishery interaction to be answered. An Australian scientist, Mr Albert Caton, was seconded to the TBAP, with financial assistance from AIDAB, to complete a report for PNG. A draft report has been prepared and presented to the PNG Government. This work follows a more specific report, requested directly by the PNG Government, on their tuna resources with particular reference to the Morgado Square.

1994 work plan:

77. A Fisheries Research Scientist position within the TBAP has recently been filled. This position will focus on the production of NFAs, and it is anticipated that 3-4 reports can be produced during 1993-94. These reports are likely to be for Fiji, Palau, Marshall Islands and possibly Tuvalu. If there is a demand and additional funding becomes available, it is possible that the preparation of additional NFAs might be possible on a consultancy basis.

3.6 Effects of FADs and Islands on Movement of Skipjack

Background:

78. The Solomon Islands In-Country Tagging Project was undertaken during 1989-90. One of the objectives of the project was to quantify the aggregating effect of FADs and if possible to make some comments on optimum FAD spacing. During 1991-92, Dr Pierre Kleiber of NMFS was seconded to the TBAP to develop a spatial model of skipjack movement that incorporated the effects of FADs. A preliminary report of this work was presented to SCTB 5 by Dr Kleiber.

1992-93 activities:

79. Further testing of the model has taken place and various fits of the model to different subsets of the tagging data compared. The model appears to produce fairly consistent results in terms of the attractive effects of FADs and islands, although there is substantial parameter variation among the different data subsets. The study has now been finalised and the results reported to SCTB 6. Parameters estimated from the fits to the tagging data were used in a simulation model to assess the level of interaction between the purse seine and pole-and-line fleets in the Solomon Islands, and to estimate the average effects on the local skipjack population of increases in effort by the purse seine fleet. These results were incorporated into the recent Solomon Islands Country Report (December 1992).

1994 work plan:

80. As the project has been completed, no further work is planned for 1994, apart from that described in section 3.8.

3.7 Investigation of Interaction Between Surface and Longline Fisheries for Yellowfin

Background:

81. This issue has for some years been a concern for SPC member countries and its resolution was one of the major objectives of the RTTP. It is planned to carry out an analysis of tagging, size composition, catch and effort data in order to evaluate the effects of the various surface fisheries on the longline fishery.

1992-93 activities:

82. Commencement of this work has been delayed to allow a clearer picture of tagged yellowfin recoveries by longliners to emerge.

1994 work plan:

83. It is intended that this work will be undertaken as part of Phase II of the SPC-NRIFSF collaborative study. A proposal for funding is currently before the Japanese Government, and we await their advice on the outcome.

3.8 Bioeconomic Modelling of Western Pacific Tuna Fisheries

Background:

84. The Australian Centre for International Agricultural Research (ACIAR) has recently funded research on various aspects of the PNG tuna fishery. This work has been carried out by economists from the Universities of Tasmania, New South Wales and Queensland. A new three-year project has been proposed, also funded by ACIAR, in which this work would be extended in a more region-wide approach. The work would focus on determining the optimal (from a bioeconomic point of view) level and distribution of purse seine effort under different circumstances. It is envisaged that the new project would involve collaboration between the TBAP, FFA and the University of Queensland and would have three main objectives requiring TBAP input:

- (i) To determine the optimal level and distribution of purse seine effort within an EEZ, taking account of interaction with the pole-and-line fishery, tuna movement and the used of fish aggregating devices. (This would build on work undertaken in Solomon Islands and described in section 3.6.)
- (ii) To determine the optimal level of purse seine effort in each EEZ, taking account of spatial interactions.
- (iii) To determine the optimal level of purse seine effort for the region as a whole, taking account of the interaction between purse seine and longline fisheries.

1994 work plan:

85. The project will be further refined through consultation between the TBAP, FFA and University of Queensland. If the proposal is successful, TBAP staff will begin to develop and/or adapt tuna population models to provide the biological basis for the work.

4. REPORTING AND LIAISON

Background:

86. The reporting and liaison function of the TBAP ensures that (i) member country requirements are adequately catered for by the work of the Programme; (ii) the results of TBAP research are communicated in appropriate form to member countries; and (iii) member countries receive the best available scientific advice regarding the management of their tuna fisheries. Much of this is achieved through informal contact between TBAP staff and Fisheries Officers during country visits, regional meetings, etc, and through formal presentation of work at meetings such as this.

1992-93 activities:

87. Results of TBAP work were reported back to member countries at several levels - in broad outline to regional meetings (RTMF, August 1992; CRGA, May, October 1992 and 1993; and FFC, May 1992 and 1993), in greater detail to the Standing Committee on Tuna and Billfish (June 1992 and 1993), and as a contribution to the work of specialist research groups (SPAR group, March-April 1993 and WPYR group, June 1992 and 1993).

88. Reporting was provided to specific countries in the form of national assessments (see above), and responses to specific queries on current status of stocks, likely effects of different harvest strategies, etc. Technical input to regional review processes, e.g. the US Multilateral Treaty on Fisheries (December 1992, April 1993), and sub-regional bodies, e.g. Parties to the Nauru Agreement (May 1993) also occurred. Statistical reporting occurred at formal publication level (*SPC Regional Tuna Bulletin*) and directly to countries on receipt of data (see section 1).

89. Reporting to countries involved in RTTP activities continued through a series of timely Activity Reports (there have now been 23 of these), and informal customised reports on interim tagging results. Detailed reports in the TBAP Technical Report series continued to be published.

90. Regular liaison was maintained with other regional and international organisations, particularly the FFA, but also the US National Marine Fisheries Service, the Western Pacific Regional Fishery Management Council, the Inter-American Tropical Tuna Commission, the Indo-Pacific Tuna Management and Development Programme, the Japan National Research Institute of Far Seas Fisheries, the Tohoku National Fisheries Research Institute, the National Taiwan University, the Western Pacific Fisheries Consultative Committee and organisations in Australia and New Zealand, to promote collaborative research and exchange of information. Participation in consultations held by several of these organisations occurred.

1994 work plan:

91. The informal contact and formal reporting activities undertaken in 1992-93 will continue in 1994. In addition, work will continue in 1994 on the publication of the results of the RTTP in the form of a monograph. This is an ambitious task, but it is hoped that, with staff levels soon to return to establishment levels, a major portion of the work will be completed during 1994. It is anticipated that the completion of this work should approximately coincide with the culmination of the activities of the WPYR group, and would contribute substantially to a scientific workshop on yellowfin stock assessment and interaction.

5. ALBACORE RESEARCH PROJECT

92. SPC's expanded work programme on South Pacific albacore began in 1990, with the creation of the three-year ICOD-funded Albacore Research Project. Additional funding for tagging, observers and port sampling was obtained from the EC. Funding for the project ceased at the end of 1993, at which time its major objectives were largely completed. It is intended that the albacore fishery monitoring and assessment work will continue within the general framework of the TBAP. Brief descriptions of the work undertaken in 1992-93 and plans for 1994 are as follows:

5.1 SPAR Meetings

Background:

93. This informal working group promotes co-operative research on South Pacific albacore. The fourth SPAR meeting was held in November 1991 at the National Taiwan University, Taipei, but various delays resulted in no meeting being held during 1992.

1992-93 activities:

94. The fifth SPAR meeting was held in Papeete, French Polynesia from 29 March to 1 April 1993. The meeting noted that both troll and longline catches of albacore have continued at moderate levels (a total catch of approximately 31,000 t in 1991) since the virtual cessation of driftnetting in the South Pacific in mid-1991. For the first time, a comprehensive population model for South Pacific albacore was presented to SPAR. The model, being developed by SPC and Otter Research Ltd (Canada) with ICOD funding is based on catch, effort and size composition data, and will be used to develop a first assessment of the stock by the end of 1993 (see section 5.5).

1994 work plan:

95. On the recommendation of the fifth SPAR meeting, future meetings may be reduced in frequency to one every two years, unless fishery or research developments demand otherwise. It is likely that a SPAR meeting will be held in late 1994. To ensure continued communication and flow of information, an annual newsletter devoted to albacore matters has been instituted.

5.2 Tagging and Observer Work

Background:

96. SPC has coordinated observer work on albacore troll vessels for the past three years. In addition, SPC undertook, with EC funding, a dedicated albacore tagging programme in 1990-91 using a chartered Fijian pole-and-line vessel, suitably modified for trolling. In anticipation of continued EC funding, albacore tagging was carried out during a second season (1991-92) in the central South Pacific, the coastal waters of New Zealand and the Tasman Sea. Over 6,500 albacore were tagged by six observers placed on troll fishing vessels for the duration of the fishing season. These observers tagged a portion (~10-20%) of the albacore caught each day, assisted with fishing activities, sampled the catch, and collected fishing statistics as done by observers during the previous two seasons. Approximately 10,000 albacore were tagged during the two seasons. To date, there have been 75 tag returns from albacore tagged in the troll fishery since 1986, 50 of which are from SPC's releases in 1990-91 and 1991-92. Observers also continued the collection of length-frequency data and information on the incidence of albacore bearing driftnet scars.

1992-93 activities:

97. No tagging or observer work was carried out during the 1992-93 troll fishing season.

1994 work plan:

98. At this stage, there are no plans for further tagging or observer work for 1994. The need for further work of this nature will be reassessed in the light of the albacore stock assessment results (see below). Albacore tag returns will continue to be monitored and analyses carried out as appropriate.

5.3 Albacore Port Sampling

Background:

99. Port sampling of albacore catches began in 1990 to complement the data being collected by observers, and to collect some specific information in support of albacore biological studies.

1992-93 activities:

100. In 1992-93, port sampling continued in Noumea (New Caledonia) and at the PAFCO cannery in Levuka (Fiji) to cover longline catches, and expanded in Papeete (French Polynesia) to cover both troll and longline catches. During 1992-93, additional port sampling was set up in Westport (New Zealand) to cover troll landings during peak periods, and in Suva (Fiji) to cover domestic longline catches.

1994 work plan:

101. The sampling of albacore catches in the various locations carried out in 1992-93 will be continued in 1994. Size composition sampling will be restricted to sampling in port, and consideration may be given to expanding sampling effort if that is considered necessary to maintain an appropriate level of coverage. A sampling design for albacore size composition will be considered as part of the TBAP's expanded port sampling programme under the SPR TRAMP.

5.4 Biological Studies

Background:

102. Various biological studies have been initiated since 1990 as part of SPC's Albacore Research Project. The studies include age and growth, reproductive biology and stock structure.

1992-93 activities:

103. The study of albacore age and growth, using length frequency data, tagging data and vertebral ring counts has been completed and has recently been accepted for publication. The three methods provided consistent estimates of growth, about 0.5 cm per month for an 80 cm fish. The results also suggested that the length frequency modes represent year classes and that the vertebral rings are annual structures.

104. The SPC-NMFS collaborative study on albacore reproductive biology has been completed and a joint paper is currently being prepared for publication. The study concluded that South Pacific albacore have a single, clearly-defined spawning season in the austral summer.

105. During 1992-93, the TBAP initiated a pilot study of albacore population structure in the Pacific by means of an electrophoretic analysis of blood proteins. Blood samples were collected from freshly caught albacore in seven locations: Tasmania, New Zealand, New Caledonia, Fiji, French Polynesia, the north-eastern Pacific and the north-western Pacific. In general, gene frequencies from the five South Pacific locations and the north-eastern Pacific location did not show significant heterogeneity. However, on at least two of the screened loci (Pgm-2 and Ada), there was significant heterogeneity among the samples, which seems to be due mainly to differences between the above locations and a small ($n=19$) sample from the north-western Pacific. These results suggest unrestricted gene flow within the South Pacific, but are inconclusive regarding gene flow between the South and North Pacific. Further samples from the North Pacific would assist in clarifying this question.

1994 work plan:

106. No new biological studies on South Pacific albacore will be initiated in 1994.

5.5 South Pacific Albacore Assessment**Background:**

107. The principal objective of SPC's three-year Albacore Research Project was to produce a first assessment of the stock by the end of 1993. The data collection activities and biological investigations described above have been firmly aligned with this objective.

1992-93 activities:

108. The development of a length-based assessment model for South Pacific albacore continued during 1992-93 in collaboration with Otter Research Ltd. This work extends the existing MULTIFAN model to undertake a full age-structured analysis based on size structure, i.e. to provide estimates of mortality rates, population sizes, catchability and gear selectivity parameters. Much of the model development work has now been completed and some preliminary fits of the model to South Pacific albacore data have been undertaken.

1994 work plan:

109. Work has continued on model development, extensive testing using simulated data and further application to real data. In addition, a simpler age-structured model based on vertebral ring aging has been developed and applied to the data. These models now form the primary research tools for evaluation of albacore stock status and fishery interaction. The analyses are currently being written up for publication.

6. PHILIPPINES TUNA RESEARCH PROJECT

Background:

110. The TBAP, with the approval of SPC management and under the auspices of the WPFCC, has been contracted as consultant to the Philippines Tuna Research Project (PTRP), which has as its goal an assessment of the offshore (skipjack, yellowfin and bigeye) tuna resources of Philippines waters. The work, to span a two year period from December 1991, is based on tagging experiments using the *Te Tautai*, under an extension of the RTTP arrangement. It involves existing TBAP staff, as well as additional short term recruitment as necessary.

1992-93 activities:

111. Work began in April 1992 with trial tagging of ringnet-caught tuna. While the trial was considered successful from the point of view of releases, none of the 157 tuna tagged and released have been recaptured to date, suggesting that there may be survival problems with tuna captured and tagged in this manner. The major tagging effort was therefore concentrated on the *Te Tautai*, which was chartered for a three month period from August to October 1992 for this purpose. During this period, 13,715 tuna were tagged. Recoveries have been high, with 3,560 tag returns (26%) so far documented (Table 5). It is thought that this is due both to high fishing intensity and very high project awareness among the diverse Philippine fishing community.

Table 5. PTRP tag releases (excluding experimental ringnet releases) and returns as at 30 November 1993.

	<u>Yellowfin</u>	<u>Skipjack</u>	<u>Bigeye</u>	<u>Unknown</u>	<u>Total</u>
Releases	6,510	5,921	1,269	15	13,715
Returns	1,478	1,725	357	0	3,560
Return rate	22.7%	29.1%	28.1%	0%	26.0%

1994 work plan:

112. The project has now entered its analytical phase. Preliminary analyses have been carried out and estimates of exploitation rates for each of the major tuna species in the Philippines obtained for the first time. A preliminary report was presented in October 1993 and this will be finalised in early 1994.

113. The TBAP will continue to provide assistance to the PTRP in the development of a Landed Catch and Effort Monitoring (LCEM) system. This system will eventually allow the systematic collection, processing and analysis of catch and effort data from the Philippines domestic tuna fisheries, with emphasis on skipjack, yellowfin and bigeye (as opposed to the "small" tunas - kawakawa, bullet and frigate tunas).

7. THE TBAP COMPUTER SYSTEM

Background:

114. The TBAP computer system has always been an integral component of the work of the programme. It is required to process and store the large volume of statistical data that is generated by the fisheries in the region and to undertake analyses of those data in support of programme objectives.

1992-1993 status:

115. As of December 1993, TBAP staff had at their disposal 23 computers, including an HP-9000 845S minicomputer, a Sun IPC Sparcstation, an HP 9000 715/33 workstation, 17 IBM PC compatible desktop and notebook computers, and 3 Apple Macintoshes. It was the Year of the LAN for the TBAP. The HP-9000 845S minicomputer, Sun IPC and HP 9000 715/33 workstations, all 386 and 486-based IBM PC compatible computers and 2 of the Apple Macintoshes were connected by TCP/IP ethernet using 10BaseT wiring and 2 HP Ether-Plus hubs, to allow rapid and easy exchange of data amongst these platforms. In addition, a Netware 3.1 server was set up and made accessible to the PCs in order to provide expanded user access to the tagging database over ethernet, and to explore various network performance issues. Various software packages were tested in their ability to provide for data transfer between machines over the net, including Sun's ARPA services, NFS and PC-NFS, HP ARPA services for Netware and for the HP-9000, HP NFS for the HP-9000, Netware for the HP-9000, and ARPA services for the Macintosh. Results of these experiments indicated that an integrated Netware approach for the PC side would provide needed connectivity while minimising user confusion and support difficulties. The HP and Sun computers will utilise ARPA services and/or NFS, as need dictates. The needed hardware and software to complete the network integration process for the HP-9000, and Sun, Macintosh, and PC workstations were purchased, eventually delivered, and are in the process of being installed and integrated.

116. LAN experimentation led TBAP computer staff to discover a serious hardware fault in the HP-9000 845S, which would prevent our being able to keep this important machine on the network. As the machine was past its 90 day hardware warranty period when the fault was discovered, we were duly advised by HP Australia that it would cost TBAP approximately A\$22,000.00 to repair the fault. Given the rapidly falling prices for hardware in the current computer market along with the vast increases in performance provided by current machines over the old 845S, it was thought more desirable to contribute such a large sum of money towards replacing the 845S with a more efficient, up-to-date unit, rather than towards repairing the older machine. Research into the matter revealed that TBAP would be able to purchase a new HP-9000 F30 (roughly twice as fast as the old 845S, and also cheaper to maintain, smaller, more power efficient and robust), along with twice the memory and roughly the same disk capacity, for US\$24,000. Another HP minicomputer was preferred since this would allow TBAP to continue to utilise many of the HP storage devices from the old system, and to maintain maximum compatibility with applications currently in use on the older 845S, and with FFA and their stable of UNIX based HP minicomputers. TBAP purchased the F30 in November of 1993, with delivery scheduled for late December.

1994 work plan:

117. Top priorities for this period include complete migration of all minicomputer-based databases and analytical tools from the HP-9000 845S to the new HP-9000 F30; integration of all data entry and verification processes onto the TBAP Novell server; and upgrade of older TBAP workstations with more capable components to allow increased productivity through the use of up-to-date user interfaces and analysis and modelling tools. The Netware server will be upgraded as well, in order to provide improved speed, reliability and capacity, to better support rapidly growing data entry, storage, and retrieval activities for a wide variety of microcomputer-based data sets. System enhancements and upgrades to be performed on PC workstations are mostly aimed towards providing increased capacity needed to support Microsoft Windows and associated applications. This is necessary to keep the TBAP up to date with the main stream of computer industry software developments, and to maintain compatibility with FFA and the various computer systems in the region supported by them, all of whom are stampeding towards Windows and Windows-based applications (at FFA behest). Various DOS-based applications in use by the TBAP will be phased out and replaced with their Windows counterparts, as required, and investigations into the benefits of peer-to-peer networking as provided by Workgroups for Windows will be undertaken. Better ways of accessing and presenting information held by TBAP databases will be investigated, including exploration of client-server SQL models utilising new types of easy-to-use database query front ends, and new data mapping and analysis packages. FFA is recommending Microsoft's Access product as a Windows/PC database standard, so TBAP is actively investigating this package, along with Foxpro for Windows, and PC ORACLE as candidates for the Server / PC workstation database system.
