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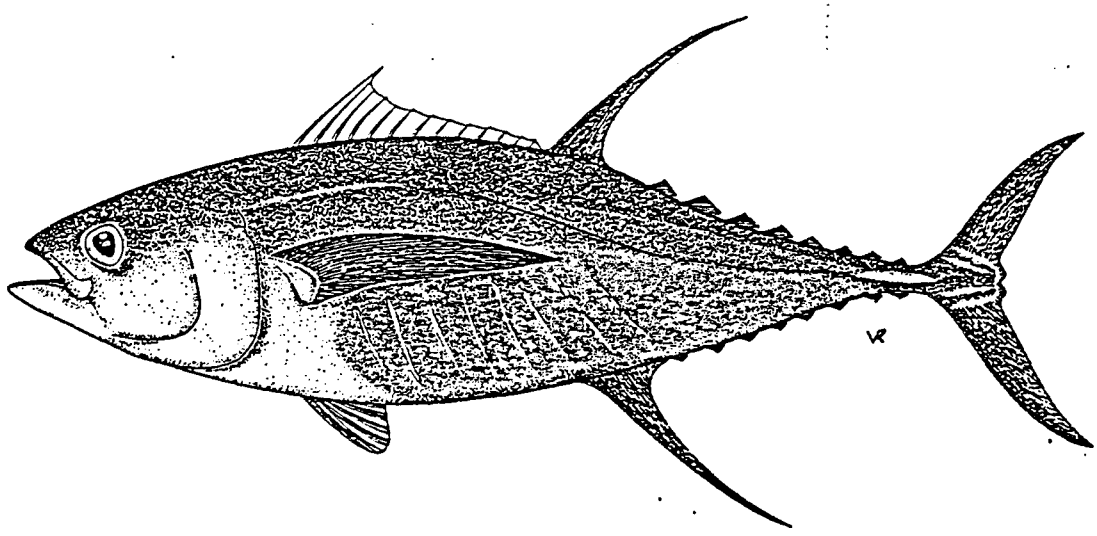
REGIONAL TUNA TAGGING PROJECT OVERVIEW AND PROJECT EVALUATION BY THE EUROPEAN COMMUNITY



Tuna and Billfish Assessment Programme
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1. INTRODUCTION

This paper is intended to provide a brief overview of the Regional Tuna Tagging Project (RTTP), which was completed in operational terms in December 1992, with respect to its development, implementation, achievements to date, and plans for ongoing activity. As the preliminary assessment of yellowfin and skipjack stocks in the western tropical Pacific, based on the RTTP results, was presented to SCTB5, and is updated in WP3, this treatment looks primarily at the planning and delivery of the RTTP, and the TBAP view on the extent to which project objectives were achieved.

The RTTP was funded to the extent of 3.5M ECU from the 6th EDF (Lome III) Pacific Regional Marine Resources Development Programme. Under the terms of this funding, a mid-term evaluation of the project was required. In the event, a mid-term review was not possible, but a final evaluation of the RTTP was carried during February/March 1993 by a team of independent EC consultants. The findings of this review are presented for the information of SCTB, and TBAP reaction to these discussed.

2. HISTORY OF THE RTTP

The Regional Tuna Tagging Project has its origins in a proposal presented to the 17th Regional Technical Meeting on Fisheries (RTMF) (1985) to provide, through the conduct of a three year tagging programme (two 10 month periods of field work), "practical answers to the questions raised by fisheries interaction in the region". The total tuna catch in the SPC area had doubled between 1979 and 1984, with growing purse seine catches outstripping previously dominant longline catches during this period. The 23rd South Pacific Conference (October 1983) had previously assigned highest priority to the "assessment of interaction between fisheries", and a Meeting of Coastal States and DWFNs in June 1984, Noumea, had expressed similar concerns.

Following a recommendation by 17th RTMF that "the Secretariat seek funding in order to allow implementation of the proposed tuna tagging project which will enable the analysis of interactions between surface and longline fisheries in the western Pacific", the project in outline, was subsequently approved as part of the SPC Work Programme by the 25th South Pacific Conference in Honiara,October 1985.

After several years' unsuccessful search for funding, the project's future was finally assured with the Pacific ACP states agreeing to allocate priority to it with in the Lome III Pacific Regional Marine Resources Development Programme (PRMRDP). A draft Project Proposal was reviewed in March 1988 by Fisheries Officers and technical experts, during the Inshore Fisheries Research Workshop. The final dossier was submitted to the EC Pacific Delegation and approved by the ACP-EC Ministerial Meeting in April 1988. The proposal was approved for EC funding in late 1988, and a financing agreement for the PMRDP, between the EC and South Pacific ACP states, signed into effect on May 3rd 1989, with the Solomon Islands Government as Regional Authorizing Officer, and the EC Delegation in Honiara the responsible EC Delegation.

Recruitment procedures commenced soon after this, as did the calling of open international tender to secure the services of a suitable pole-and-line vessel. Field operations commenced in December 1989.

3. OBJECTIVES

The objectives of the project, as initially proposed, were defined as follows:

(a) to estimate interactions between tuna fisheries in areas where several different fisheries operate concurrently;

(b) to further use the description of tuna movements to predict interactions for projected fishery developments;

(c) to provide estimates of yellowfin tuna population parameters for selected areas of currently intense fisheries;

(d) to provide updated estimates of skipjack tuna population parameters for selected areas where fishing has increased since 1980;

(e) to provide assessments of the potential for further expansion of tuna fishing in the region.

With tuna catches from the western Pacific continuing to increase rapidly during the late 1980s, and increasing concern being expressed regarding the possible impact on yellowfin stocks, the Third SCTB agreed to modify the objectives, which were restated as follows:-

- to provide estimates of yellowfin population parameters for selected areas of currently intense fisheries.
- to estimate interactions between tuna fisheries in areas where several different fisheries operate concurrently.
- to further use the description of tuna movements to predict interactions for projected fishery developments.
- to provide updated estimates of skipjack tuna population parameters for s
elected areas where fishing has increased since 1980.
- to provide assessments of the potential for further expansion of tuna fishing in the region.

Expected outputs from the RTTP, in the general sense, were identified as below:

(a) Island states will be provided with an additional tool for planning optimum development and management of tuna fisheries.

(b) Island states will be able to determine the extent to which distant-water fishing fleets may operate within their EEZs without significantly impeding operations of their national fleets or threatening the livelihood of artisanal fishermen.

(c) It will be possible to gauge the impact on tuna fisheries of the major changes in fishing practices that have occurred since 1980.

(d) Estimates of yellowfin tuna population dynamics will be revised in relation to changes in the fishery.

In addition to the above primary outputs,

(f) Participation in the field operations by fisheries staff of the countries in which the project operates will afford the opportunity for technology transfer in various aspects of fishing, novel bait fishing techniques, and fisheries research.

(g) Improve the prospects for conservation and optimal utilisation of South Pacific tuna resources.

(h) Improve the Commission's ability to undertake economic evaluation of fishery projects as requested by member governments.

(i) Enhancing regional co-operation between the regional organisations involved in the development and management of fisheries resources of the region.

4. PROJECT DESIGN

The basic design of the project envisaged two ten-month periods of charter of a pole-and-line vessel suitable for long range activity, enabling tunas to be tagged and released throughout the main operational area of the western Pacific purse seine and longline fishery, primarily a large oceanic area of the western tropical Pacific bounded by 10°N - 10°S, 120°E - 170°W.

This activity was to be supplemented by tagging activity on a national scale, using domestic vessels, to address interaction and exploitation issues of local concern.

Yellowfin, if possible of a representative size range, were to be tagged and released as priority, recognizing that skipjack, which normally comprise 90% or more of pole-and-line catches in the WTP, would be readily available in the normal course of events. Bigeye were to be tagged and released when available.

A nominal target of 40,000 releases (all species) was established, based on general consideration of numbers needed to address most objectives, with expected 10% return rates. In practice, it was hoped to release 40,000 of each of the target species - yellowfin and skipjack. Double tagging, to enable estimation of slippage rates, was to be carried out.

Considerable effort was to be devoted to international publicity, and establishment of tag recovery mechanisms and reward systems, to cover the large number of gear types, vessel flags and unloading/processing points which would be expected to provide tag recoveries. Estimates of levels of non-reporting were to be provided by tag seeding experiments.

Operational details of project design have been described in various technical reports and are not repeated here.

5. IMPLEMENTATION

Field staff for the RTTP were recruited during October/November 1989, and charter arrangements finalized at this time, after open international tender. Field operations utilizing the vessel selected,

the *F.V. Te Tautai* from NAFICOT, Tuvalu, commenced following modifications and minor refit on December 21st 1989, in the Solomon Islands.

The 20 months of charter were officially concluded in July 1992; a one month delay due to mechanical problems at the start of 1991 charter period, and a 5 weeks period of supplementary charter in the Coral Sea during October/November 1991, resulted in six weeks of charter being carried over into 1992. With additional funding from 6th EDF Regional OCT sources, RTTP activity was extended to French territories adjacent to the primary operational area, with 8 weeks of additional charter (Wallis and Futuna - 6-9/3/1992; 16/6-3/7/1992; New Caledonia 23/11-5/12/1991; 22/11-19/12/1992). A second period of Coral Sea charter (3 weeks) was also carried out in November 1992, and the *Te Tautai* was chartered for the related Philippines Tuna Research Project for a three month period (25/07-25/101992) prior to this.

In-country tagging projects, utilizing local pole-and-line vessels, were also carried out in Solomon Islands (July 1989 - June 1990), Kiribati (August - September 1992) and Fiji (January - March 1992). Some experimental tagging was also carried out on a Japanese group in April 1990.

A total of 132,777 tunas - 33,520 yellowfin, 92,381 skipjack, 6,794 bigeye and 82 longtail tuna - were released during the RTTP proper, in-country tagging projects and Coral Sea tagging (but excluding PTRP tagging in July - October 1992). These releases were widely distributed throughout the operational area, including high seas areas and the adjacent waters of Indonesia and the Philippines. A representative size composition of skipjack was released, but less so in the case of yellowfin, despite some success in tagging and releasing quantities of fish $\geq$ 100 cm LCF. The number of bigeye tagged and released must be considered a bonus for this poorly understood species.

At the 7th of June 1993, 14,194 recoveries had been reported (10.7%), with recoveries still being received at a rate of approx. 150 per month. This total exceeds the anticipated 10% return rate which formed the basis of RTTP planning, and will continue to increase. Nearly 5,600 of the recoveries (42%) were made in canneries or at transhipment/unloading points, with the remainder onboard fishing vessels. In view of the predominance of purse seine activity, this was expected, and reflected in publicity/tag recovery strategy. Table 3, in WP3, provides a summary of releases and recaptures by country (EEZ) of release.

Whilst analyses of these tagging data, plus the large amount of biological data collected during the RTTP, will continue for some time, it is considered that the basic operational objectives of the project have been met.

6. EUROPEAN COMMUNITY EVALUATION OF THE RTTP.

An evaluation of the SPC and FFA components of the Pacific Regional Marine Resources Development Programme was carried out by an independent team from the Marine Resources Assessment Group (MRAG), London, during the period January - March 1993. The review considered the RTTP, the associated Albacore Tagging Project, funded primarily from 5th EDF/OCT sources, the RTTP Extension, funded from 6th EDF/OCT, and the background to the TBAP Technical Assistance, to enable the RTTP analytical work to continue.

The review team comprised a fisheries scientist, a resource economist/team leader, and accountant, and examined programme management, financial management, programme context, regional institutional relationships and proposed Lome IV projects, as well as the scientific review of the RTTP. The draft final report was presented to the EC in early June 1993.

Annex 1 presents the Conclusions and Recommendations of the review of the RTTP and the Albacore Tagging Project, and Annex 2 the Executive Summary of the overall review.

These are presented for SCTB information and comment where appropriate. The conclusions and recommendations relate to methodological appraisal, research integration, activity coordination, political impact, training and recommendations for future work.

7. TBAP REACTION TO THE REVIEW

The RTTP review is perceived as fair, constructive where it is critical, and generally very favourable. Suggestions for improvements to current analytical approaches have already been implemented in several cases, and the rigorous scrutiny provided by the review has been welcomed.

EC consideration of the Lome IV proposal for the SPR TRAMP was, to a considerable extent, contingent on a favourable review of the RTTP, which has now allowed implementation of this to proceed in principle.

REGIONAL TUNA TAGGING PROJECT

Conclusions and Recommendations

The conclusions, findings and recommendations of the RTTP are divided up into 6 major areas; methodological appraisal, research integration, activity coordination, political impact, training and recommendations for future work.

Methodological appraisal

1 Considerable methodological development has been carried out in order to analyse the tagging data. However, to gain full advantage from the tagging programme, further development is required (see below), and the data collection programme to monitor the status of the tropical tuna stocks annually must be extended, to allow more reliable ongoing assessment of stock status. (This is already proposed for funding under Lomé IV.)

Recommendation: *Every effort should be made to appoint an additional modeller to the TBAP team, to aid the development of tag attrition and fish movement models, to investigate the potential roles of spatial models (for example to utilise satellite data), and to implement modelling methods for analysing annual commercial, observer and port sampling data. If a modeller with substantial relevant experience cannot be recruited, the current policy of contracting in required expertise should be continued.*

2 Estimation of stock abundance from tagging data requires reliable catch data. While considerable progress has been made in securing data from all fleets, the quality and completeness of data from different fleets is highly variable.

Recommendation: *SPC should continually review their links with DWFNs, and make strenuous efforts to bring the standard of data from all fleets up to the level of those from the US purse seine fleet. (See also under 'Integration of the research programme with other relevant research programmes'.)*

3 Even with full cooperation from DWFNs, sources of uncertainty in the catch data will persist, especially with regard to discards and bycatches.

Recommendation: *Port sampling and observer programmes should be extended to fleets of every type and nationality that take a significant harvest of tropical tuna. (See also under 'Recommendations for future work'.)*

4 The database of catch data contains information from many different sources. Sophisticated database management and validation methods have been implemented by SPC, yet many inconsistencies, omissions and errors inevitably remain in the data. For example, whole cruises are often missing; reported catches are frequently only a small proportion of the vessel's hold capacity; information on trans-shipment is often missing; logbook data supplied through different routes often conflict.

Recommendation: *Validation and follow-up procedures should be fully documented and reviewed. Additional checks, both to locate correctable errors and to provide indications of data reliability, should be incorporated. For example, effort should be checked to ensure that it is not inland; independent information on location and current catch notified by vessels when they cross an EEZ boundary might be incorporated for validation purposes (currently proposed under Lomé IV); cross checks of each vessel with the regional register and with the dates of the previous cruise of the same vessel should be carried out to assess consistency and reliability.*

5 The weakest component of the tag attrition models for assessing stock abundance is estimation of the tag reporting rate. This rate almost certainly varies by date, by fleet, and

by landing location. Current analyses assume the rate is constant, and do not take account of observed variation in the data from seeding experiments to estimate the variance of the estimated reporting rate. Bias in the reporting rate estimate generates substantial bias in the stock size and recruitment estimates.

Recommendation: *Existing data from seeding experiments should be reanalysed, to model reporting rate as a function of date, fleet and landing location. For some fleets and locations, data are sparse or non-existent; in these cases, comparisons of the tags-returned-to-catch ratio across fleets and locations should be made in an attempt to estimate reporting rates by fleet and location. Variances should be estimated, and should reflect as far as possible the true uncertainty in the observed reporting rates. A suitable model for the variance should be developed, to allow estimation in cases where no seeding was carried out.*

6 For yellowfin tuna, two age classes (less than two years old and three plus years old) dominate the purse seine catch. Fish of age three plus were not accessible to the tagging operation.

Recommendation: *Further model development should be carried out to incorporate age structure, and vulnerability to fishing by age, into the tag attrition models. If this proves problematic, the effect of variable vulnerability to fishing by age on the model estimates should be investigated by simulation.*

7 Most of the catch and most tag returns arise from the purse seine fisheries. There is some indication that tag returns from at least some components of other fisheries are lower than would be anticipated, given the rate of return from purse seining. Seeding experiments, from which reporting rates are estimated, were carried out almost exclusively on purse seiners.

Recommendation: *Given the heterogeneous nature of the fisheries, and that reporting rate was estimated only for purse seiners, a reanalysis should be attempted based solely on catches and tag returns from the purse seine fisheries. If the resulting estimates are inconsistent with those from analysing all data, reasons for the discrepancies should be investigated. An analysis of tag return rates by fishing mode should be carried out.*

8 Recent methodological developments in mark-recapture allow the effects of covariates to be modelled using logistic regression (Huggins, 1989, 1991; Alho, 1990). Covariates might include geographic location, fishing mode, fleet nationality, landing location, fish size at tagging, time between tagging and recovery, date, and any other available factors or variates that might affect the probability of tag recovery.

Recommendation: *The value of logistic regression for tag attrition analysis should be assessed, for incorporating covariate information both in the general analysis (possibly as an alternative to stratification for some factors and variates) and in the analysis of the double tagging data set (used to estimate the short and long term rates of tag shedding).*

9 Catch discard may have a significant impact on estimates of stock size. Discarded fish do not feature in the catch statistics, yet some tags from such fish might be recovered by fishermen. Two extreme scenarios are that either all tags or no tags are recovered from fish subsequently discarded.

Recommendation: *A reanalysis should be carried out excluding all data for fish that were tagged when smaller than the maximum size that fishing vessels typically discard. If stock estimates change appreciably, the effects of discards should be considered in greater detail.*

10 Bootstrap methods provide a powerful tool for quantifying precision of parameter estimates obtained from tagging data, by resampling from the data, or from models fitted to the data. They are currently being used reasonably effectively, but further development may prove

valuable.

Recommendation: *The bootstrap approach should be extended and strengthened to provide more effective quantification of the precision of stock assessment parameter estimates. The relative merits of parametric and nonparametric methods should be explored, and the percentile (or related) method should be used to provide more robust confidence intervals. If computer power is sufficient, the number of bootstrap replicates (currently 100) should be increased. Estimation of variation in the tag reporting rate should be more effectively incorporated in the bootstrap procedure.*

11 Useful preliminary work has been carried out to assess the effects of fishery interactions and the extent of fish movement through the development of a Solomon Islands fish aggregation device (FAD) model.

Recommendation: *Further model development along the lines investigated should be carried out, to devise realistic fish movement models, and hence to provide as comprehensive an assessment as possible of fishery interactions in the region.*

Integration of the research programme with other relevant research programmes

1 The project almost exclusively comprised tagging experiments, and issues directly related to them. Because the Inter-American Tropical Tuna Commission (IATTC) currently has no fish tagging programme, integration is not relevant, although links with IATTC appear good. Independent island states have given excellent support for and a high level of collaboration with the tagging exercises.

Recommendation: *The policy of preparing Country Reports should be supported as a means of making the complex findings of the tag attrition modelling readily accessible to fisheries managers in the various island states.*

2 SPC cannot require that DWFNs supply data, and Japan in particular does not recognise the authority of FFA, although it does have a formal arrangement with SPC to provide data. In the light of these difficulties, it is encouraging that so much progress has been made in recent years in securing data from all large fleets, achieved in part through the workings of the Western Pacific Yellowfin Research Group (WPYRG) and the Standing Committee on Tuna and Billfish (SCTB).

Recommendation: *SPC and FFA should jointly seek greater cooperation with DWFNs as well as with island states, through bilateral and multilateral treaties, data access agreements, or any other approach, to improve data reliability. The links with DWFN research programmes through the WPYRG, SCTB and other routes should be continued and, where appropriate, expanded.*

3 Several countries supply logbook data in electronic form, thereby increasing their commitment to the research programme, improving their ability to access data, and reducing cost overheads to SPC.

Recommendation: *SPC should continue the policy of encouraging countries to supply data in electronic form. They should prepare documentation of their validation procedures, and send copies to those countries that supply data in electronic form. The offer of software to validate data should be made, and if accepted, training in the use of the software given.*

4 Increasingly, individual countries are likely to want on-line access to the parts of the scientific database relevant to their own interests. Currently, the Federated States of Micronesia have such access via PeaceSat.

Recommendation: *The use of PEACESAT to provide on-line access should be extended to all relevant states that request this service.*

Coordination of activities between FFA and SPC

For effective management of stocks, reliable data on catch, effort and related variables are essential. Both FFA and SPC have done much to improve data quality, and their continued efforts in this area are critical. The implementation of a joint database for fisheries data has been a major step forward in the management of stocks. Greater collaboration might lead to more effective management at lower cost.

Recommendation: *Formal links between FFA and SPC should be strengthened, building on the successful 1992 SPC/FFA colloquium. The feasibility of joint observer programmes, to ensure the data quality required by SPC together with adequate surveillance required by FFA, should be investigated (see also recommendation 6, Section 8.6). Other uses of shared resources should be considered to avoid duplication of effort, and greater communication between staff with similar interests or responsibilities should be encouraged, to ensure that the requirements of each organisation are well understood and accepted by the other.*

Evaluation of the political impact of the project

The project has played a key role in providing fisheries information to island states and in demonstrating the benefits of regional cooperation in managing the marine resources of the region.

Recommendation: *The policy of funding a strong group of research scientists to provide information to managers throughout the region should be strongly encouraged and supported.*

Training programmes

There is no specific training component in the project proposal, although the Financing Agreement does provide for this. Most operational staff were Pacific islanders, and during tagging operations within EEZs, observers from the country concerned were always on board, receiving training in various aspects of the programme. In several instances, local commercial fishermen spent periods on board the vessel, to gain experience with techniques of particular interest. Counterpart officers were identified for in-country tagging programmes and worked for short periods at SPC, receiving training and participating in the reporting process; other interested scientists worked at SPC for short periods. Links are being established with the University of the South Pacific, to enable postgraduate students to work at SPC under supervision. This will have the dual benefits of widening the research expertise at SPC and of generating professionally qualified Pacific islanders who will be strongly placed to compete for fishery scientist and management posts throughout the region. FFA also have a policy of attachments, by which fishery personnel and students receive training at FFA.

Recommendation: *The move to place postgraduate students at SPC should be pursued vigorously. The attachment scheme of FFA should be extended to allow research students to carry out the bulk of their studies at FFA. Country fishery groups should also be encouraged to seek placements for postgraduate students.*

Recommendations for future work

1 Large-scale tagging programmes are useful for accumulating information on a stock quickly, but they are not suited to long term management of a stock. Although preliminary work has been done in implementing alternative methods for ongoing stock assessment, considerable development is still required.

Recommendation: *Alternative methods of stock assessment, including catch per unit effort (CPUE), catch-at-age and catch-at-length, should be investigated and, if appropriate, implemented as a matter of priority.*

2 CPUE methods are sensitive to changes in fishery operation and efficiency, to trends in environmental conditions or fish behaviour, to changes in species composition, and to many other factors.

Recommendation: *Generalised linear models (McCullagh and Nelder, 1989; Medley, 1991) should be implemented to determine whether such factors can be adequately quantified for the different fishing modes and fleets. The regional register should be extended to include information on whether the vessel uses high resolution radar, a helicopter, or other aids to detection, and specifications for fishing gear, to allow more comprehensive modelling of CPUE series.*

3 Catch-at-age methods require that samples are collected and analysed in an ageing laboratory. They are the primary tool used by IATTC to assess stock abundance in the eastern tropical Pacific.

Recommendation: *A facility should be established to allow implementation of catch-at-age methods.*

4 Catch-at-length methods are cheaper to implement, but are of limited value for stock assessment when fish are recruited to the population on a continuous basis.

Recommendation: *Catch-at-length methods should not be used for stock assessment unless clear evidence emerges that they are of value for tropical tuna stocks. However, lengths of catches should continue to be monitored, so that trends in the size of fish caught may be used as one indicator of the status of stocks.*

5 Purse seiners of the US fleet operate with observers on board. These observers can potentially record much useful information to aid stock assessment. Efforts are currently being made to improve the standard of scientific data recorded by these observers.

Recommendation: *The existing observer programme should be extended, or supplemented, to allow sampling of vessels of all fishing modes and fleets. Agreements should be sought so that scientists in charge of the observer programme can select the vessels on which observers are to be placed. Observer recruitment and training should be of sufficiently high standard to ensure collection of reliable data. This is likely to be achieved by recruiting a small number of permanent observers, some of whom may subsequently be recruited into the scientific staff complement of FFA, SPC or island nations.*

6 FFA requires observers for surveillance purposes. Thus they require more observers than SPC, but do not have the same requirement for training them.

Recommendation: *A formal workshop or similar meeting, possibly as a follow-up to the successful 1992 SPC/FFA colloquium, should be convened to establish the exact role of observers, and to determine whether a joint observer programme can be established between FFA and SPC.*

7 Purse seiners frequently operate by actively searching out tuna schools, using binoculars, helicopters or high resolution radar. In principle, it is possible for observers to record all schools detected by the vessel, and their position relative to the vessel trackline. For schools subsequently set upon, an estimate of school size is available.

Recommendation: *The feasibility of implementing line transect type methods using observer data should be investigated, to monitor trends over time in school encounter rate, school size, and the effective width of the search of purse seiners, and hence to estimate trends in relative abundance of the surface component of tuna stocks, and to provide potentiallyuseful covariates for CPUE analysis.*

8 If it is feasible to develop a dynamic spatial model, for example using oceanographic, satellite and recent logbook data, to predict stock abundance by geographic location, it may be possible to achieve more effective management of the stocks through positive feedback to the fleets, advising them of areas that are likely to provide productive fishing. This may help avoid severe local depletions of resources while gaining the confidence and goodwill of the commercial fleets.

Recommendation: *The feasibility of developing spatial models that predict tuna abundance by geographic location, and changes in abundance over time, be investigated.*

9 Genetic evidence has indicated that skipjack tuna in the western Pacific do not comprise genetically isolated stocks. However there is a cline in allele frequencies throughout the region with the exception of the eastern Pacific. Yellowfin tuna also exhibit no evidence of genetically isolated stocks, although they exhibit a cline in allele frequencies right across the Pacific.

Recommendation: *Management of tropical tuna in the western Pacific should continue to be on the basis of a single stock of each species, but should recognise that there is only incomplete mixing through the region, and that movements may be age dependent, with different components of the population possibly favouring different geographic locations. Thus efforts should be made to avoid severe local depletions of the stocks.*

10 It has been suggested that all parties involved in the fisheries might agree to cap takes at current levels, or at least to restrict licenses to vessels currently operating in the region.

Recommendation: *If such an agreement is reached, the current arrangements for managing stocks should suffice for the foreseeable future. In that case, ongoing monitoring of the stocks through CPUE, catch-at-age or other methods should be continued, possibly at a reduced level, to ensure that the fishery is sustainable indefinitely.*

ALBACORE TAGGING PROJECT

Conclusions and Recommendations

The conclusions, findings and recommendations of the RTTP are divided up into 6 major areas; methodological appraisal, research integration, activity coordination, political impact, training and recommendations for future work.

Methodological appraisal

1 The albacore tagging project will not deliver all the results that had been anticipated at the outset, and has not proved a cost effective option.

Recommendation: *Further tagging of albacore should not be considered in current circumstances. If circumstances change appreciably, a further tagging programme should*

only be contemplated if a realistic assessment of what can be achieved is made, in the light of experience from this project. The costs and benefits should then be weighed against those of other assessment methods before a decision is taken.

2 The reporting rate from the tagging project is unknown, and there is speculation that it might be low. There are also uncertainties about the tag shedding and tagging mortality rates. These uncertainties rule out useful stock abundance estimation from tagging data.

Recommendation: *No attempt should be made to estimate stock abundance using the tagging data as the primary source of information.*

3 Releases of tagged albacore and albacore catches from surface fisheries are concentrated in a few areas comprising a very small proportion of the albacore's range in the south Pacific. Preliminary genetic data show no evidence of more than one stock in the south Pacific region. Apparent movements from the relatively few tag returns might be misleading.

Recommendation: *Observed albacore movements should not be quantitatively interpreted until a model that takes full account of the locations of releases and of catches, and of age-related movement, has been developed and tested. If such modelling indicates that data are inadequate to reach firm conclusions on general patterns of movement within the stock, this should be clearly stated in any scientific documents on the subject.*

4 The collation of port sampling, logbook and observer data is an essential prerequisite to monitoring the status of the stock.

Recommendation: *Data validation methods should be continually reviewed, implementing parallel methods wherever possible to those adopted for the tropical tuna database.*

5 The MULTIFAN analysis models the data on length composition of the catch. The approach was given greater prominence when it became apparent that the tagging project would not yield the detailed stock assessment required. In the case of albacore, clear cohorts are generally evident from the catch length data, at least for sub-adults. MULTIFAN yields estimated growth rates from these data, and potentially allows stock assessments to be made.

Recommendation: *Full sensitivity trials and/or simulation studies should be carried out before stock assessments from catch-at-length data are used to provide management advice.*

6 The von Bertalanffy growth curve assumed by MULTIFAN constrains growth to be fastest for the smallest fish. Real data indicate that growth rates increase initially, before declining. Although the Gompertz curve has also been used, as yet, the sensitivity of growth rate estimates and of consequent stock assessments to the choice of growth curve has not been addressed.

Recommendation: *Detailed comparisons between estimates obtained from different growth curves should be carried out. These should include curves that allow growth rates to increase initially, such as the Gompertz and logistic growth curves.*

Integration of the research programme with other relevant research programmes

1 The widespread concern about the effects of driftnetting, combined with the need to learn more about a common resource available to several SPC states, led to collaborative research programmes between SPC, Australia, France, New Zealand, the USA and several Pacific island states.

Recommendation: *Every effort should be made to retain the excellent degree of*

collaboration achieved to date through the SPAR group, now that political interest in the albacore fishery has declined, following the demise of driftnetting.

2 Free access to logbook data, the ability to place observers on board vessels of the scientists' choosing, and the use of common databases is the ideal required for effective management.

Recommendation: *SPC and FFA should jointly seek greater collaboration with DWFNs and other interested parties, to attempt to attain this ideal.*

Coordination of activities between FFA and SPC

1 SPC have the scientific base to build an effective programme for monitoring the status of albacore stocks. FFA has an important management role, as was demonstrated during the period of greatest concern about the effects of driftnetting. The 1992 SPC/FFA colloquium to review the roles of the two organisations was a welcome step towards greater cooperation, and hence more effective management.

Recommendation: *Formal links between FFA and SPC should be strengthened through regular meetings to review the status of the albacore stocks, and to assess the need for management action.*

Evaluation of the political impact of the project

The cessation of driftnetting shortly after the start of the project largely removed the motivating issue behind it. SPC were able to quantify to some degree the likely magnitude of the albacore take in the driftnet fishery, and thus to interject some objectivity to the political debate over driftnetting.

Recommendation: *The region should seek to retain a strong fisheries research capability, able to respond at short notice to any new perceived threat to the albacore resource.*

Recommendations for future work

1 The development of catch-at-length assessment methods shows some promise. While preliminary work has been done in implementing this and other methods for ongoing stock assessment, considerable development is still required.

Recommendation: *Other methods of stock assessment, including catch per unit effort (CPUE) and catch-at-age, should be investigated in addition to catch-at-length. This investigation should include a simulation study, with parameters chosen to reasonably represent the albacore stock, to compare catch-at-age and catch-at-length methods.*

2 CPUE methods are sensitive to changes in fishery operation and efficiency and to many other factors. The vessels operating in the albacore fisheries are highly variable.

Recommendation: *Generalised linear models (McCullagh and Nelder, 1989; Medley, 1991) should be implemented to determine whether vessel variability and other factors can be adequately quantified to provide useful assessments of the status of the stock.*

3 Catch-at-age methods require that samples are collected and analysed in an ageing laboratory.

Recommendation: *The facility recommended for ageing tropical tuna should also gather data to allow implementation of catch-at-age methods for albacore.*

4 There has been speculation that the driftnetting in the late 1980s may have caused a

'signal' in the fisheries data that would allow an assessment of stock size.

Recommendation: *The effects of driftnetting takes on the CPUE series and catch-at-length data should be examined, and the feasibility of estimating minimum stock size by this method assessed.*

5 The observer and port sampling programmes provide invaluable data for monitoring the status of the stock.

Recommendation: *Funding should be sought so that the policy of placing observers on troll vessels and of port sampling continues indefinitely. The feasibility of observers recording oceanographic data such as thermocline depth and the location of thermal fronts should be assessed.*

6 The observer programme does not extend to the longline fleet. Although port sampling is an adequate substitute for most purposes, little information is available on bycatches and discards.

Recommendation: *Recognising the difficulties and dangers of placing observers on board Taiwanese and Korean longliners, the feasibility of implementing a small observer programme for the fishery should nevertheless be reconsidered.*

EXECUTIVE SUMMARY

General

This report is presented as a final report of the evaluation of European Community contributions to regional fisheries management and development in the South Pacific, through a programme of assistance to the South Pacific Forum Fisheries Agency (FFA) and the South Pacific Commission (SPC). Those contributions are defined within the Financing Agreement between the European Commission and the Pacific ACP States (Fiji, Kiribati, Papua New Guinea, Solomon Islands, Tonga, Tuvalu, Vanuatu, Western Samoa), entitled the *Pacific Regional Marine Resources Development Programme* (PRMRDP) - Agreement No: 4225/REG, signed on 3rd May 1989, by the South Pacific Forum Secretariat.

Total budgetary contributions to that programme which consisted of 5 major projects were ECU 10.7 million, of which the fisheries components initially received ECU 5.7 million. The balance of ECU 5 million was for the South Pacific Applied Geosciences Commission (SOPAC). These funds came from the 6th EDF Regional ACP funds, Lomé III. In addition, the EC has made available ECU 273,000 for extension of one of the projects to two OCT countries, New Caledonia and Wallis and Futuna, sourced from 6th EDF OCT Regional funds.

The Albacore Tagging Project (ATP) was initiated after the inception of the four fisheries components of the PRMRDP. ECU 500,000 was initially allocated for this additional research. There was some confusion over the source of these funds. In the event, ECU 400,000 was allocated from 5th EDF/OCT funds; ECU 100,000 was financed from within the Regional Tuna Tagging Programme (RTTP). There is still uncertainty by some parties on the source and management of these funds. Since inception of the ATP, SPC management have been under the impression that the ECU 100,000 drawn down from the RTTP allocation (in order to get the project underway early) would be later reimbursed. Although there were early indications that there would be a separate Financing Agreement for the ATP it is clear that these funds were augmentations of the original Financing Agreement, and that the start-up funds of ECU 100,000 would be funded from within the RTTP.

A further ECU 527,000 has been sought, from 6th EDF OCT Regional funds. These funds, requested in December 1992, had received agreement in principle during the conduct of the evaluation and have since received final agreement by the European Commission. A summary of funding is described in Table 1 below. A total of ECU 7.055 million has thus been contributed to regional fisheries programmes under Lomé III and OCT funds.

Fisheries Programme Evaluation Stages

The two SPC tagging projects (the RTTP and its extension, and the ATP) are substantially complete and this report presents a final evaluation of them. The Tuna and Billfish Assessment Programme Technical Assistance project (TBAPTA) has yet to begin but has been designed primarily to carry on the work of both tagging projects into an extended analytical phase. We attempt no evaluation of this latter component other than comments in later sections on its value and relevance. The three projects based at FFA - the Maritime Boundaries Delimitation project (MBD), the Regional Tuna Fisheries Management Information System (RTFMIS) and the Conference Centre (CC) - are to be completed by the end of 1994; therefore, a mid term evaluation of these components is presented.

At some point in late 1994 or early 1995 when the ongoing projects are completed there will be a need to conduct final evaluations of them. It is recommended that approximately ECU 30,000 be committed for these evaluations, sourced from available or augmentation funds.

Table 1 SUMMARY OF EC FUNDING FOR FISHERIES UNDER THE PACIFIC REGIONAL MARINE RESOURCES DEVELOPMENT PROGRAMME

	ECU	SOURCE
FORUM FISHERIES AGENCY		
Maritime Boundary Delimitation Project (MBD)	450,000	6th EDF/ACP
Regional Tuna Fisheries Management Information Service (RTFMIS)	900,000	6th EDF/ACP
Regional Conference Centre (CC)	850,000	6th EDF/ACP
Technical Assistance *1	155,000	6th EDF/ACP
FFA subtotal:	**2,355,000**	
SOUTH PACIFIC COMMISSION		
Regional Tuna Tagging Project (RTTP)	3,400,000	6th EDF/ACP
Regional Tuna Tagging Project Extension *2	273,000	6th EDF/OCT
Albacore Tagging Project (ATP) *2	400,000	5th EDF/OCT
Albacore Tagging Project (ATP)	100,000	6th EDF/ACP
Tuna and Billfish Programme Technical Assistance Project (TBAPTA) *1	527,000	6th EDF/OCT
SPC subtotal :	**4,700,000**	
PRMRDP (FISHERIES) TOTAL:	**7,055,000**	

Note *1. Addition funding under separate agreement via an accelerated PAC
Note *2. Augmentations of the original Financing Agreement

In addition to the above project funding distribution there was an original requirement in the Financing Agreement for evaluations; these to be funded from within the overall programme. We have estimated approximately ECU 30,000 for the final evaluations of the three FFA projects and the TBAPTA. Together with the cost of the current evaluation, the overall evaluation process will require funding as follows:

Final SPC and Mid Term FFA Evaluations - 1993	109,000	6th EDF/ACP
Final SPC and FFA Evaluations - 1994	30,000	6th EDF/ACP(?)
TOTAL	**139,000**	

It is unclear how these amounts will be accounted for within each project.

Structure of the Report

All of the projects, including the two scientific projects at SPC, are so different from each other that collective use of the 'Logical Framework' of the integrated approach was precluded. This report is, therefore, divided into 6 separate parts so that each may be reviewed within the Logical Framework as an entirely separate exercise. This is a natural division that allows the evaluation to proceed in a structured way.

This first part, the Overall Programme Evaluation, traces the origins of the programme; their context, both within the regional fisheries and within the work programmes of FFA and SPC, are presented. This is done in order to address a number of aspects of the terms of reference (see Annex 1: Conduct of the Evaluation), that do not lend themselves to direct analysis according to the integrated approach for project/programme cycle management that the evaluation was required to follow. Nevertheless, the overall PRMRDP is also included in this part and is evaluated in terms of major headlines of the logical framework in order to place the programme within the wider developmental objectives of EC/ACP development assistance.

One reason why it is difficult to impose an evaluation structure such as the Logical Framework, with its formal and integrated structure, is that, although the requirement to evaluate the Lomé III project in those terms is now non-conditional, the projects were never defined in that format. The Logical Framework defines "Objectively Variable Indicators" that are explicit. At present the Integrated Approach to Programme Project Cycle Management uses the Logical Framework to approach feasibility, project definition, monitoring reports, etc all in the same manner. None of the documentation reviewed for this evaluation were presented or available in this format.

Context of the Programme

The PRMRDP has its origins within the Lomé III Agreement between the EC and ACP States. That Agreement was the first time that a separate fisheries chapter had been included. The context of overall fisheries support in which PRMRDP is set within the region is extensive, with multi-donor support, both multilateral and bilateral. In addition to the EC, multilateral agencies providing grants and loans in fisheries include UNDP/FAO, Asian Development Bank, Commonwealth Fund for Technical Cooperation and the World Bank. Bilateral funding for fisheries work comes principally from the development agencies of UK, Australia, New Zealand, France, Canada, USA, and Japan. A description of the proportions of funding from these sources that is available to the regional agencies - FFA and SPC is described in later sections of this Overall Programme Evaluation part. In general, this support of contributions in kind and technical assistance is addressed to some of the poorest nations in the world, a number of whom are classified by the UN as 'least less developed countries'.

Programme in the Context of the Fishery

The fisheries context informs the importance of the work carried out under the PRMRDP. During 1991, approximately 1,070,000 metric tonnes of tuna was caught within the region. Of this only about 64,000 metric tonnes was caught by island states; about 6% of the catch. The majority of catch of the Island States was taken by one country, Solomon Islands. In financial terms, the total value of the overall catch for 1992 is expected to exceed US$ 2 billion. Of this, island states are expected to earn, from access licence fees and domestic catch export income, less than US$100 million; about 5% of the value.

Regional capital investment in fishing vessels is tiny compared to the fleets of Distant Water Fishing Nations (DWFNs): e.g there are three purse seiners based in Solomon Islands, compared to 208 purse seiners (mostly of larger size) operating in the region during 1991. Catch levels, especially by the DWFN purse seine fleets, are growing so rapidly, that there are serious concerns that the fishery will need increased levels of management in the near future.

Evaluation

Following this Executive Summary, this Overall Programme Evaluation continues with an evaluation of the ways in which the fisheries projects of the PRMRDP have been managed, from the standpoint of programme implementation, and from a financial management perspective. Programme management revolves around the ways in which the implementation schedule has been undertaken and the personnel have been managed. The quality and relevance of the documentation produced are described and analysed. The Financial Management section analyses for each of the participants - FFA, SPC, EC Delegation and EC Brussels - the ways in which authorisation and control, reporting, monitoring and feedback have been managed. That section concludes with a summary of financial management and general recommendations on procedures.

This section of the report then provides a narrative on summary findings and recommendations. This extracts general recommendations, as appropriate, from the individual project parts of this evaluation, and also puts them in the context of the general objectives and methods of the

programme - particularly with regard to the ways in which the participants have and should function in the achievement of the programme goals.

In general, the evaluation finds that the programme has achieved the aims and objectives as set out in the following documents: the Financing Agreement, additions thereto, the project dossiers, the workplans, and at their current stage of project completion in terms of the SPC projects, and at mid term in the case of the FFA projects. There have, of course, been errors of omission, commission and misunderstandings, and some time delays caused by a number of factors. This evaluation attempts to trace the source of these problems. While some of these stem from administrative failures by all participants, others are found to be principally external to the projects. This is not surprising, nor should the EC or Pacific ACP States be unduly worried about this, since the overall regional programming and these fisheries projects are relatively new to the South Pacific region. The ways in which the various participants have acted, particularly in the latter stages, when rules and procedures became clear or were developed, is to be commended. As with all such new relationships, the functional capacities of participants to coordinate with one another have been tested. In some circumstances, this has caused strained relationships and some degree of financial uncertainty and cost. Nevertheless, as these were overcome by discussion and formalisation of procedures, the projects have proceeded, or are proceeding, on target.

It should be emphasised here that, apart from the Conference Centre, the projects undertaken are largely unique. They are employing methods and implementing systems that generally have no equivalent elsewhere in the world. Nowhere has such a large number of yellowfin tuna ever been tagged (the RTTP); and this for the benefit of critical scientific research on the most important tuna fishery in the world. Nowhere have regional developing country organisations adopted methods of harmonised legal/technical programmes (the MBD) or systems of information management, transmission and dissemination (the RTFMIS) that can compare with the systems now in place and being developed. The regional standardisation of communications hardware, computer hardware, software, information management procedures and training is testimony to the unity of purpose of the region in managing their living marine resources for their benefit.

It also has to be said that the world benefits from that concern:

- from access being granted to the Distant Water Fishing Nations;
- from the stable relationships that are developing between fishing fleets and the region;
- from increasing supplies of food now reaching international markets;
- from the gradual extraction of resource benefits that stem from ownership of the tuna stocks now proceeding, thereby improving the welfare of the region and limiting dependence on international aid, and
- from the concern of the region that *'conservation and promotion of the objective of optimum utilisation'* is the modern view of sustainable natural resources exploitation.

It has been said that this is the 'Information Age'. The regional organisations and the governments that control them have taken this concept and applied it in a meaningful manner. It is also the era in which inappropriate resource use and over exploitation of natural renewable resources are of global concern. The region and national governments clearly take all the above issues seriously. The fisheries projects of the PRMRDP, in coordination with the other fisheries programmes, will assist the region in both the short term and the long term in addressing these issues.

The results of the programme will be sustainable. It is certain that use of the scientific data and analyses generated by the RTTP will continue in the years to come; the RTFMIS will develop and grow in scope and use; the MBD will set in train international legal processes that will define the extent of national sovereignties; and the regional conference centre will provide a facility where fisheries authorities and others may meet to discuss and plan the future of the region's fisheries.

In accordance with the Terms of Reference, all available Financial Reports of the Pacific Regional Marine Resources Development Programme projects from commencement of projects to 31st December 1992, have been examined. In performing this examination, an omission of ECU 60,000 has been discovered in the Financial Report of the Regional Tuna Tagging Project at SPC for the year to 30th September 1991. This was an isolated omission with regard to a transfer of funds to cover the salary of a scientist that moved from the Tuna and Billfish Assessment Programme (TBAP) to the RTTP. Except for this omission, it is confirmed that the recorded expenditure is in accordance with the accounting records of the projects and presents fairly, in all material respects, the expenditure committed in accordance with the Work Programmes and Technical Assistance contracts for the above projects in conformity with generally accepted accounting principles. Although no financial reports have been prepared for the FFA Regional Conference Centre, all documents on material costs were reviewed, and their authenticity confirmed.

The Future

The terms of reference require the evaluation to look to the future and to formulate recommendations for follow-up. This is done in the section on the Lomé IV Fisheries Programme. Two project dossiers that form part of the indicative planning for the EC regional fisheries programme were made available to the evaluation:

- Integrated Regional Fisheries Surveillance and Management Programme
  [IRFSMP - FFA initiated - ECU 4.7 million]

- South Pacific Regional Tuna Resources Assessment and Monitoring Project
  [SPRTRAMP - SPC initiated - ECU 5.5 million]

In addition, the evaluation was made aware of the other priority ranked regional fisheries projects that have been compiled by the South Pacific Forum Secretariat. Of particular note were two further projects that have received second priority from the regional ACP Council of Ministers, but which may well be placed high on the list for funding under the second financial protocol of Lomé IV:

- Forum Fisheries Agency Training Centre
  [FFA initiated - ECU 500,000]

- Regional Post-harvest Fisheries Centre
  [SPC initiated - ECU 1.3 million]

These latter two projects appear at first sight to have little relationship to, nor follow up on the projects under the current PRMRDP. Although these latter two projects address an important need, particularly with regard to national fishery developments in the region, this evaluation does not assess their value. However, it should be clear that, if domestic fishery production is to be promoted and value-added fish products are to be generated for export from the region, then both the above projects are very important indeed.

It is highly recommended that serious consideration be given to funding these latter two projects within the first financial protocol, if other regional programmes are unable to meet the time schedules for their implementation.

The first two projects - the IRFSMP and the SPRTRAMP - are, in general, well prepared dossiers that directly build on the results of the current EC-funded programmes. The IRFSMP, based at FFA, would build on the communication systems in place following the RTFMIS; and on the legal/technical information that will allow maritime boundary delimitation and subsequent mapping. It will afford the FFA and member countries with the capability to undertake active fisheries management and the provision of sound real-time advice to member states on the disposition and activities of the DWFN fleets operating in the region.

The SPRTRAMP would enhance the capability of the Tuna and Billfish Programme at SPC to undertake fishery monitoring, statistical preparation and biological research that will be essential for the further elucidation of the characteristics and progress of the tuna fisheries in the regions.

There are a number of issues that need careful consideration in these projects, and these are addressed in the section dealing with the Lomé IV Regional Fisheries Programme. However, in general, these projects are recommended for continuity and expansion of the extent of regional capabilities on behalf of member states.

Regional Institutional Relationships

This summary document culminates with an assessment of the nature of the relationship between the main regional fisheries institutions of FFA and SPC. This is done in order to satisfy the Terms of Reference requirement to *'evaluate the political impact of the current projects with regard to their contribution to improved regional cooperation in the field of joint sound management of the living marine resources.'*

This evaluation concludes that the projects have, indeed, had a political impact and have strengthened relationships between the two organisations. The impact has also been felt on the wider political scale, particularly with regard to the DWFNs. However, there have been concerns in the past about the nature of the organisations and the ways in which they may best serve the interests of the island states. Those concerns have included some member states raising the issue of a single regional organisation, perhaps to replace the wide range of technical specialist agencies that are present in the region. Other concerns include the future of fisheries management; whether it would be wise to vest fisheries management in a single body - controlled by members - that would take management action, rather than having that body limited to management advice, as is the current case.

Recent moves by the SPOCC (South Pacific Organisations Coordinating Committee) to readdress this latter issue have met with few positive responses from the relevant organisations. However, it is understood that the issue has been raised again, and possibly resolved. It is not in the scope of this evaluation to suggest ways and means to arrive at that resolution. However, the incidental results of the PRMRDP in strengthening relationships and enhancing institutional roles may well assist the political moves towards that goal.

Acknowledgements

The evaluation team would like to thank all those who participated openly and willingly in the evaluation, and in particular the heads of the regional organisations who offered their time and that of their staff to assist the team in their investigations and deliberations. A list of all persons consulted may be found in Annex 1 of this summary document.

A special tribute is also made to Kevin Bailey who died so tragically during the conduct of this evaluation. Kevin was a key participant during the entire Regional Tuna Tagging Programme at SPC; he was Cruise Director and resident scientist on board the *Te Tautai* for more than half the time it spent at sea; he produced numerous reports and scientific work of outstanding value to the region; he travelled widely and was well respected. He also participated in this critical evaluation with candour and knowledge, and his views are reflected here. In large measure the success of the RTTP was due to his participation; he was a regional asset that can not be replaced.

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