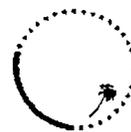


South Pacific Commission

INSHORE FISHERIES RESEARCH PROJECT

Progress Report, October 1992



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1. INTRODUCTION

The Inshore Fisheries Research Project (IFRP) was established late in 1987 in response to a growing appreciation of the need for research in support of management of inshore fishery resources in the Pacific Islands region:- a need that was expressed most authoritatively by the comprehensive review of Pacific Island fishery research capabilities compiled by Fakahau and Shepard in 1986. The IFRP's overall aim is to strengthen the capabilities of Pacific Island States in acquiring and making use of the information needed for national inshore resource management, through a wide range of activities. The project, which is funded by the British Government, became fully operational in January 1988, is an integrated part of the SPC's Coastal Fisheries Programme and works in particularly close association with the Fisheries Information Project.

Accurately defining the limits to the exploitation of inshore fisheries resources is extremely important for most of the countries of the region. The pressures arising from population growth and the decline of traditional ways of managing inshore resources favour quick exploitation and resource depletion. Lack of knowledge about the sustainability of harvest rates has often delayed the responses of national fisheries departments until they are too late. This project therefore helps to improve responses and appropriate management of inshore fisheries resources:- resources which contribute the major source of protein for most Pacific Island rural populations, and which additionally provide some of the most immediate income-earning opportunities for those same people.

The immediate beneficiaries of work undertaken by the IFRP are national fisheries departments who obtain improved knowledge of inshore resources, their exploitability, and advice on how to manage those resources for long-term biological and economic sustainability. Increasingly, as demonstrated by the ongoing project, such decentralised fishery management bodies as Island/Provincial Councils and customary fishing rights owners are also benefitting from direct contact with the project. Through Government extension activities, assisted by other SPC Fisheries Programme projects, small-scale artisanal and subsistence fishermen/women learn improved stock management or develop new nutritional and income-generating activities.

More details of the aims of the Inshore Fisheries Research Project are contained in the original project agreement (1987) and subsequent agreements (1989 & 1991).

The first substantive activity of the IFRP was the organisation of the SPC Workshop on Pacific Inshore Fishery Resources (IFRW), in March 1988. Since then, 33 specific national-level resource assessment projects have been completed or are under way using IFRP staff, consultants and trainees. In addition, IFRP staff are involved in 11 regional-level activities as well as longer-term information gathering and dissemination, and also undertake numerous smaller assignments. These are summarised individually in appendices 1 and 2.

This report provides an overview of project activities since inception, up to October 1992.

2 PROJECT ADMINISTRATION

2.1 Staff

The 1987 SPC/UK Government Memorandum of Agreement provides for three positions in the IFRP: Senior Inshore Fisheries Scientist (SIFS); Inshore Fisheries Scientist (IFS); and Project Assistant (PA).

In late 1987 Dr Rex Edwards was recruited from the UK to take up the position of IFS. Unfortunately, Dr. Edwards personal and professional attributes were not in keeping with expectations and his employment with the Commission was terminated 6 weeks later, leaving the project in serious difficulty.

In January 1988, Mr Garry Preston, at that time employed as Assistant Fisheries Officer with the

Commission, was transferred into the SIFS position, and the recruitment process for the IFS position was also resumed. Mr Preston's transfer was never envisaged as part of the original project design but took place in response to the problems caused by the dismissal of Dr Edwards. The post vacated by Mr Preston was not filled for 11 months, hence he continued to be responsible for a substantial body of duties associated with this position. Additionally, despite it being advertised in the UK national and international press, no suitable UK-national candidate was identified for the IFS position during 1988. As a result, IFRP progress was hampered for the whole of that year.

Mme Kay Legras, a UK citizen previously employed as Project Assistant to the SPC Fisheries Training Project, was appointed to the position of IFRP Project Assistant in February 1988. Project activities during 1988 were also bolstered by the recruitment, using FAO funds, of Dr. A. D. Lewis for four months as a consultant to assist in the organisation of the March 1988 Workshop on Pacific Inshore Fishery Resources, a major activity and the inaugural one for the project (see sub-project REG 1 in appendix 2).

Late in 1988, when the Commission had still not been successful in identifying a UK national suitable for the IFS position, an agreement was made with the International Center for Living Aquatic Resource Management (ICLARM) in the Philippines for the secondment of Mr Paul Dalzell to the IFRP to undertake specific project activities (sub-projects REG 2 and FSM 1). Mr Dalzell was seconded to SPC between January and September 1989, his costs being covered by unexpended funds associated with the IFS position. In October 1989 Mr Dalzell concluded his employment with ICLARM and accepted the IFS position with the IFRP.

Rationalisation of the staff structure of the Fisheries Programme resulted in the creation of a new position of Coastal Fisheries Programme Manager (CFPM), approved by CRGA in 1991, and providing a level of supervision to the Coastal Fisheries Programme similar to that enjoyed by the Tuna and Billfish Assessment Programme. Mr Preston was substantively promoted to this post in January 1992, but continued to fulfil the duties of Senior Inshore Fisheries Scientist, with the approval of BDDP until the appointment of a replacement SIFS on April 29th, 1992. Several in-country projects were completed by Mr Preston during this transitional period (see Appendices 1 and 2).

The position of SIFS was advertised late in 1991 and the appointment of Dr Tim Adams was approved by BDDP for the end of April 1992. Dr Adams is a British national and was previously employed by the Fiji Government as Principal Fisheries Officer (Resource Assessment & Development) under the UK ODA OSAS scheme. The fact that he had been working in a line position in an SPC member country since 1985, from the level of Fisheries Officer up to acting Director of Fisheries, has further refined the "user"-oriented approach of this applied project.

The present staff complement is thus as follows:

Position	Name	SPC Contract expires
SIFS	T. J. H. Adams	March 1994
IFS	P. J. Dalzell	October 1994
PA	K. Legras	February 1994

2.2 Consultants

A file of potential consultants has been compiled based on the *curricula vitae* of applicants for the SIFS and IFS position, together with a knowledge of UK nationals working in, or with experience of, the region, and on the basis of occasional contacts or information. In general, however, it is not easy to find, or cost-effective to use, short-term British consultants. Opportunities to use Pacific Island nationals as consultants have arisen only occasionally and, as a result, only three consultancies have been financed using IFRP funds:

- P. Dalzell, formerly of ICLARM, spent 9 months at SPC headquarters undertaking a preliminary analysis of SPC deep-bottom fishing data (REG 2) and establishing a ciguatera sampling protocol in FSM (FSM 1) prior to taking up the full-time position of IFRP Scientist;
- J. Munro, Director of ICLARM's Coastal Aquaculture Centre in Honiara, Solomon Islands, undertook a consultancy in November 1989 to review Tonga's Inshore Fisheries Assessment Project (TON 1). Only direct travel costs were provided by the IFRP, with ICLARM covering salary, etc;
- J. Dashwood, Secretary of Marine Resources in the Cook Islands, undertook a consultancy in November/ December to assist in the establishment of a pilot pearl oyster culture project on Namorik atoll in the Marshall Islands (MAS 1).

In other cases where consultants have assisted with Project activities, these have been financed using complementary funding provided from other SPC resources or from other donors. These are numerous, and details are provided under the relevant sections of appendices 1 and 2.

In some sub-projects Pacific Island fishery workers have acted as associate scientists, working under the supervision of the project leader but responsible for aspects of the field work, including supervision of other members of the team. Individuals who have worked as major project associates include:

- V. Vuki, Fisheries Division, Fiji, who supervised aspects of a survey of beche-de-mer resources in northern Vanua Levu, Fiji (FIJ 1). Veikila left the Fisheries Division for a lectureship in Marine Studies at the University of the South Pacific, and is presently pursuing Ph.D. studies at the University of Southampton;
- B. Yeeting, Fisheries Division, Kiribati, who planned and was responsible for executing some of the field survey work on pearl oysters in Kiritimati, Kiribati. Being is now working as a resource assessment consultant under the USAID PIMAR project in Kiribati;
- P. Lokani, Department of Fisheries and Marine Resources, Papua New Guinea, who assisted with a survey of beche-de-mer resources in Tonga (TON 2), and in the Solomon Islands (SOL 1) and has also designed and implemented resource surveys in his own country with the initial assistance of the IFRP (PNG 2);
- H. Patiale, Fisheries Division, Tuvalu, who was responsible for gathering fishery statistics and conducting an interview-based household survey as part of an assessment of the marine resources of Niue (NIU 1);
- M. Amos, Department of Fisheries, Vanuatu, who assisted with the organisation of the 1991 Trochus Workshop in Vanuatu (REG 9, where he submitted 5 background papers), and subsequently assisted with a survey of trochus in the Solomon Islands (SOL 1) and the case study of a Cook Islands trochus fishery (REG 11).
- J. Leqata, Fisheries Division, Solomon Islands, who was cruise leader, and organised most of the aspects of the fieldwork during the Solomon Islands Western Province Resource Survey (SOL 1) and assisted with the case study of a Cook Islands trochus fishery (REG 11).

All associateships have so far been free of cost, except where the project has covered the expenses of international travel. The individuals involved have been seconded to the IFRP under technical cooperation arrangements whereby the country providing the secondment stands to benefit from the experience the seconded individual will gain.

In most other sub-projects, according to the level of development, local staff have been involved on a training attachment basis, learning by experience. Only a few of the sub-projects (all in the regional category

national fisheries agency with assistance from the IFRP¹. This approach is in support of a major goal of the project: to strengthen national researcher's capabilities to perform more of their own inshore fisheries research. In many cases, this ability is already well developed, and the main need is for demonstration, guidance and supervision, (particularly with the analysis of results and the presentation of recommendations).

Since the inception of the project 79 Pacific Island fishery workers have participated in IFRP field activities, either as local counterparts, overseas technical assistants, or as attachment trainees. These are detailed under the relevant sections of Appendix 1, as follows:

COK 1	(Cook Islands)	6
COK 2	(Cook Islands)	2
FIJ 1	(Fiji)	7
FSM 1	(Federated States of Micronesia)	1
FSM 2	(Federated States of Micronesia)	1
FSM 3	(Federated States of Micronesia)	1
FSM 4	(Federated States of Micronesia)	3
KIR 1	(Kiribati)	3
KIR 2	(Kiribati)	6
MAS 1	(Marshall Islands)	2
NAU 1	(Nauru)	2
NIU 1	(Niue)	1
PAL 1	(Palau)	3
PAL 2	(Palau)	3
PAL 3	(Palau)	3
PAL 4	(Palau)	2
PNG 1	(Papua New Guinea)	4
PNG 2	(Papua New Guinea)	2
SOL 1	(Solomons)	4
TON 2	(Tonga)	5
TON 3	(Tonga)	2
TUV 1	(Tuvalu)	1
TUV 2	(Tuvalu)	2
VAN 1	(Vanuatu)	1
VAN 2	(Vanuatu)	2
REG 7	(Ciguatera)	2
REG 11	(Trochus case study)	8

This list does not include the non-Pacific Island National personnel who are employed by these countries and have participated in sub-projects.

Five national fisheries officers have undertaken formal attachments with IFRP staff at SPC headquarters:

- Albert Carlot, Vanuatu, spent three weeks analysing deep-bottom fishery data from Vanuatu (VAN 1);
- Andrew Moses Nelson, from the Federated States of Micronesia, spent one week developing a data collection system for foreign deep-bottom fishing vessels operating in FSM waters (FSM 3).
- T.Latu and S.Tulua, from Tonga, spent three weeks analysing deep-bottom fishery data from the

¹ This approach at first appeared novel to many national fisheries administrations, who are used to commissioning stand-alone external consultancies to address specific problems. However, the concept is welcomed by most fisheries research staff, who too often see themselves as mere information providers for consultants, who then take all the credit.

Tongan fishery (TON 3) and presented a seminar on their work to SPC Fisheries Programme staff, in May 1991.

- Hamidan Bibi, from the Fiji Fisheries Division, was attached to the SPC Fisheries Information Project, through the IFRP, for on-the-job training in preparing special interest group newsletters, in April 1992;

Further attachments are planned, from Papua New Guinea for the analysis and subsequent publication of accumulated fishery data, and from Fiji for a literature study and the comparative application of different stock assessment models to an in-country project on mangrove crab management, in 1993.

Also under the heading of "training" would come the 33 Pacific Island national fishery workers who attended the 1988 IFRP Inshore Resources Workshop and the 24 who attended the 1991 IFRP Trochus workshop.

3.3 Conferences and meetings

IFRP staff have attended the following conferences and meetings (excluding those organised or hosted by SPC):

- 1 Sixth International Coral Reef Congress, Townsville, Australia, August 1988 (SIFS);
- 2 Symposium on Remote Sensing of the Coastal Zone, Southport, Australia, September 1988 (SIFS);
- 3 MicroBRIAN User Group Meeting, Brisbane, Australia, September 1988 (SIFS);
- 4 Forum Fisheries Committee Technical Meeting, Majuro, Marshall Islands, April 1989 (SIFS);
- 5 USAID Atoll Research Workshop, Tarawa, Kiribati, May 1989 (SIFS);
- 6 NMFS Workshop on Tropical Fishery Stock Assessment in the South Pacific, Honolulu, Hawaii, July 1989 (IFS);
- 7 ACIAR Workshop on Baitfish Biology and Population Dynamics, Honiara, Solomon Islands, December 1989 (IFS);
- 8 IPFC Standing Committee on Resource Research and Development, and IPFC Symposium on Fish Aggregation Devices and Artificial Reefs, Colombo, Sri Lanka, May 1990 (SIFS);
- 9 Meeting of the International Society for Reef Studies, Noumea, New Caledonia, November 1990 (SIFS, IFS);
- 10 International Workshop on Remote Sensing and Insular Environments in the Pacific, Noumea, New Caledonia and Papeete, French Polynesia, November 1990 (SIFS).
- 11 Fourth International Conference on Ciguatera Fish Poisoning, Tahiti, French Polynesia, 4-8 May 1992 (IFS)

In some cases (1, 2, 3, 11) the purpose of attendance was to gather technical information relevant to the work of the project by attendance at technical presentations, participation in discussion sessions, and contact with professional colleagues. In other instances (6, 7, 8, 9) attendance was at the invitation (and cost) of the conference organisers and the staff member involved prepared and made a presentation on his area of expertise. Additionally, in some cases (4, 5, 8, 10) the individual officially represented SPC in discussions regarding policy or technical cooperation.

3.4 Reports and publications

Draft reports of all country-specific activities have been forwarded to Fisheries Departments and other relevant bodies of the countries concerned, usually within two months of the completion of the field work. (Copies of all non-confidential IFRP reports are available from the Secretariat). In most cases these will be

summarised in Appendix 2) represent activities undertaken solely by project staff.

2.3 Finances

The IFRP Memorandum of Agreement, dated 19 August 1987 and subsequently revised and extended on 25 January 1989, provides for the following schedule of expenditure:

Expenditure item	Year				Total (£ STG)
	1987/88 (£ STG)	1988/89 (£ STG)	1989/90 (£ STG)	1990/91 (£ STG)	
Scientist 1		42,800	44,200	45,600	132,600
Scientist 2		28,575	39,500	40,900	108,975
Project Asst		13,375	13,725	14,075	41,175
Capital equipment		17,340	5,000	5,000	27,340
Operational costs		50,000	45,000	45,000	140,000
6% admin costs		8,100	8,800	9,000	25,900
Total	13,390	160,190	156,225	159,575	489,380

Since the project's inception quarterly reports of expenditure have been forwarded to BDDP for reimbursement to SPC. Total expenditure to date has paralleled these allocations and at the end of the UK financial year on March 31 1991 was within 2.5% of allocation.

The renewed IFRP Memorandum of Agreement, dated May 1991, provides for the following schedule of expenditure:

Expenditure item	Year		Total (£ STG)
	1991/92 (£ STG)	1992/93 (£ STG)	
Scientist 1	50,000	50,000	100,000
Scientist 2	40,000	40,000	80,000
Project Asst	14,000	14,000	28,000
Capital equipment	0	0	0
Operational costs	46,000	46,000	92,000
6% admin costs	9,000	9,000	18,000
Total	159,000	159,000	318,000

Early in 1992, in accordance with growing SPC financial constraints, it was agreed that project funding would be disbursed quarterly in advance (instead of in arrears) of expenditure. Disbursement would be according to an advance estimate of expenditure, to be acquitted and "fine-tuned" in arrears. The changeover to the new system has not been without problems, but these are expected to ameliorate with time, particularly when the new ODA Aid Management system for the South Pacific, which replaced BDDP in 1992, becomes fully operational.

3. PROJECT ACTIVITIES

3.1 National and regional sub-projects

A list of the completed or current national-level and regional-level sub-projects is shown at the start of Appendices 1 and 2. These sub-projects encompass all substantive activities of project staff, consultants, associates and trainees. Items excluded are: small projects such as attendance at meetings and preparation

of documents for same; regional travel aimed at fact-finding or general consultation; responding to requests for information, comments on technical documents or development proposals, or contributions to external publications; and administrative work such as financial and activity reporting, both to BDDP and to other donors. These non-projectised activities account for an estimated 20% of staff time overall.

National-level activities take place in response to specific requests from SPC member countries. These requests are vetted and, if appropriate, approved by the SPC Management Committee as per all requests for SPC assistance. In many cases, project staff spend substantial amounts of time assisting national fisheries officers prepare proposals that are realistic in terms of achievable goals and relevance to national development targets prior to their formal submission to SPC through national aid-coordinating bodies and foreign affairs departments. In other cases, formal proposals are received without prior input from IFRP staff. Development and execution of national-level activities absorbs an estimated 50% of staff time overall.

Regional-level activities are those that include more than one SPC member state, or that do not have a specific national focus. These activities are usually developed in response to recommendations from SPC Regional Technical Meetings on Fisheries, once such recommendations have been approved for action by the SPC Committee of Representatives of Governments and Administrations (CRGA) and the South Pacific Conference. Alternatively, regional-level activities may be initiated in response to a clearly perceived need identified by SPC staff and verified by extensive consultation with member country representatives by correspondence, during duty travel, or via contact at regional gatherings. Regional-level activities take up about 30% of staff time overall.

Although diverse in range and scope, many project activities fall in to one of several thematic categories, reflecting prevailing interests in the region, as follows:

Pearl-oysters	KIR 1, KIR 2, MAS 1, TUV 2, REG 9
Beche-de-mer	FIJ 1, PNG 2, TON 2
Trochus	REG 9, REG 11, COK 2
Deep reef-slope fish	FSM 3, TON 3, VAN 1, REG 2
Ciguatera	FSM 1, FSM 2, REG 7
General resource surveys	COK 1, NIU 1, PAL 3, SOL 1, FSM 5
Statistics/ data gathering	TON 1, TUV 1, VAN 2, PAL 1, PAL 2
Information dissemination	PNG 1, REG 5, REG 6

There is at present a general and very welcome trend, within the national agencies responsible for fisheries development in the Pacific Islands, to consider questions of resource management more fully before promoting local development activities. Several IFRP sub-projects have been executed before local fishery development efforts in order to ensure that such efforts are likely to be sustainable. Such events are encouraging reversals of the far more prevalent trend to consider resource management issues only when a crisis occurs. Most of the regional-level sub-projects have the basic aim of promoting the concept of resource management as an integral part of the development planning process.

Full details of each national-level sub-project are given in appendix 1. Similar details of regional-level projects are shown in appendix 2.

3.2 Attachment training

One of the main aims of the IFRP is to accomplish projects collaboratively with national fisheries staff. In many cases, the sub-projects detailed in appendix 1 have been considered as projects implemented by the

published as IFRP technical documents (see sub-project REG 5) or in other forms. Project reports and publications are listed in Appendix 3.

3.5 Future work

Based on requests received so far from member countries (either individually, or collectively through regional meetings), the activities of the project next year are likely to include:

- assessment of inshore baitfish resources for offshore fisheries, Papua New Guinea (PNG 4)
- assessment of giant clam stocks in the Cook Islands, and the production of management plans for giant clam at Aitutaki and Manihiki (COK 3)
- further assistance to the Vanuatu Fisheries Department in setting up a fisheries research section, particularly data-collection procedures and priorities (VAN 2);
- assistance in designing catch-reporting systems and monitoring procedures for commercial trial fishing in Pitcairn (PIT 1)
- continued assistance with upgrading technical reports in Papua New Guinea (PNG 1), Fiji (FIJ 2) and elsewhere (REG 5);
- follow-up and monitoring of Nauru fisheries data-collection systems (NAU 1)
- assessment and management of inshore marine resources in Palau (PAL 2);
- case study of remote sensing for trochus habitat mapping in Vanuatu (VAN 3);
- continued promotion of regional collaboration on issues relating to trochus (REG 9) and pearl-oyster (REG 10) resources, and to ciguatera (REG 7, FSM 2);
- the integration of remote sensing tools and information into IFRP projects (REG 8);
- continued investigation into the potential of juvenile production and habitat modification for fishery enhancement (REG 3), including the convening of a workshop on this topic; and
- promotion of information flow in the region through technical publications (REG 5) and support to Special Interest Groups (REG 6).
- the setting up, and data analysis, of fish aggregation device-associated catch monitoring procedures in several countries of the region, in collaboration with the SPC deepsea fisheries development project;
- the setting up of an integrated regional database of national statistics relating to inshore fisheries, to be added to following each in-country project.

The IFRP will also continue to respond to other country requests as they are received.

4 CONCLUSIONS

4.1 Achievements

Administratively, the IFRP is achieving what it set out to do, in terms of channelling financial and manpower support to the efforts of Pacific Island countries in developing capabilities for research in support of rational inshore fishery management regimes. The early setbacks in terms of filling the project staff complement, and in initiating project activities at the anticipated level were overcome during 1989. Project expenditure has been at projected levels while activity, as defined in the project memorandum, has exceeded them. Country requests for assistance in both specific and general terms continue to be received by the Commission, sometimes in excess of capabilities for immediate response, indicating broad satisfaction with the services provided by the project on the part of SPC member countries. Testimonials relating to specific project activities are frequent and encourage us in our belief that the project is meeting its aims.

Quantifying the specific achievements of a project as diverse in scope and activity as the IFRP is not straightforward. Attempts to provide yardsticks by which the project's success could be measured were made in the original project document. While experience has shown that these are not entirely satisfactory, the project has in all cases met or exceeded the criteria set out.

The achievements and significance to Pacific Island countries of specific IFRP sub-projects are described under the relevant sections of appendices 1 and 2. In some cases the benefits to the country of the work undertaken are immediate and clear-cut. These may include the identification of specific, previously unrecognised development possibilities, the quantification of resource potentials, or the prevention, in response to IFRP advice, of actually or potentially deleterious activities or practices that affect the resource. In other cases, the benefits of project activities should be viewed in a longer-term perspective. The development of some activities, such as pearl-oyster culture, may take a decade or more to achieve in certain locations. In these cases project activities are exploratory and ground-breaking, building foundations for development that will mature well after the project has concluded.

An important aspect of the project's work is in human resource development. Wherever possible, major emphasis is given to training and developing the skills of local fishery workers so that the capacity of fishery development and management bodies to institute their own information-gathering activities progressively improves. As a result of project activities, there is a growing cadre of national fishery workers capable of undertaking resource assessment projects and developing fishery management options for consideration by decision makers with a minimum of outside support. The importance of developing this human resource base is paramount if national fishery management plans are ever to be effectively implemented.

Another role the IFRP has played is in the coordination and integration of research effort. The support of numerous outside organisations, including universities, academic institutions, or specialised technical agencies, has been enlisted to support IFRP activities at the national and regional levels. In most cases such support would not have been available and represents an added benefit that the IFRP has been instrumental in securing on behalf of Pacific Island countries. As the IFRP develops, there is a growing tendency for fishery research bodies with interests in the region to seek ways of cooperating with, and channelling their efforts through, the IFRP. In terms of coordination, mutual support, and avoidance of duplication, this is a highly desirable trend.

Finally, all project activities are linked to the fundamental issue of raising awareness of the need for sound resource conservation practices to ensure sustainable, long-term utilisation. The value of implementing considered fishery management practices, based on a knowledge of the nature of the resource and the way in which it is exploited, is not amenable to short-term economic measurement, but is evident in the context of long-term sustainable development of the regions important but fragile inshore fishery resources.

The project has developed according to its original aim of being a responsive, flexible body that can provide needed assistance, support and encouragement to SPC member countries in their efforts to rationally manage

their inshore marine resources.

4.2 Constraints

Whilst staffing was a problem early in the project, there are currently no significant constraints to project operation beyond those associated with day-to-day financial problems: namely the recent delays in authorisation of project payments in response to advance claims, and the general increasing difficulties of sourcing supplementary funding to support project activities. The latter problem is something that is being experienced by many South Pacific development projects and is a feature of the broader global financial climate.

It is expected that quarterly disbursements will become more timely as the re-arrangement of UK ODA administration for the South Pacific is completed. With the supplementary funding problem, the addition of the position of Coastal Fisheries Programme Manager to the SPC staff complement has enabled the Senior Inshore Fisheries Scientist to devolve some of the increasing fundraising burden to a higher level.

4.3 The future

The present cycle of project funding comes to an end on March 31st 1993 without there being any cessation to the need, or requests, for project services. Although a great deal has been accomplished:- probably far more than was envisaged in the original project document -- the demands on Pacific Island resource managers and research scientists have increased beyond expectation over the past five years, particularly with the huge increase in exploitation of inshore invertebrates for export.

However, there has also been a qualitative increase in the perception of the value of inshore fishery research and a real move towards incorporating requirements for long-term sustainability before new development, or investment, is initiated.

Future work by SPC Inshore Fisheries staff will concentrate on developing management systems, and assisting their implementation as practical day-to-day activities of national fisheries authorities. The work will still involve a great deal of basic, applied research, but the emphasis will be on direct implementation rather than on developing background information. This focus would also carry with it a more measurable definition of the rate of progress and a more definite timeframe.

It must be accepted, for the small nations of the South Pacific, that national self-sufficiency in scientific fisheries expertise is not cost-effective, and that there will always be a need for a regional component to this activity. Where so many resources are held in common, it does not make sense for every country to maintain a cadre of specialists, but to maintain a small staff of generalists and to draw on a common core of advice for specific problems.

It is envisaged that, as nations come to require principles of sustainability to be incorporated into future development, that greater national resources will be devoted towards inshore fisheries management and research, and that a proportion of these additional resources will be pooled in regional organisations to replace the resources presently provided, almost entirely, by extra-regional donors. However, that possibility is still some years away from fruition. One of the main results of future activity by SPC Inshore Fisheries staff will be to encourage the implementation of formal management systems that will require such resources to be earmarked.

REFERENCE: Fakahau S.T. & M.P. Shephard (1986). *Fisheries research needs in the South Pacific. Information requirements for the effective management and development of fisheries of Island States in the South Pacific*. Forum Fisheries Agency. Honiara. Solomon Islands.

APPENDIX 1: NATIONAL SUB-PROJECTS

COK 1	Cook Islands	Fishery resource survey of Palmerston atoll (October 1988)
COK 2	Cook Islands	Aitutaki Trochus Fishery Management Plan (August 1992)
COK 3	Cook Islands	Baseline assessment of giant clams with management plans (planned March 1993)
FSM 1	FSM	Ciguatera sampling protocol (February 1989)
FSM 2	FSM	Ciguatera mapping (June/July 1990)
FSM 3	FSM	Analysis of catch data from Chuuk outer banks (June/July 1990 & August 1991)
FSM 4	FSM	Pilot sponge culture project, Chuuk (September 1990)
FSM 5	FSM	Reef fish depletion experiment, Yap (May/June 1991)
FIJ 1	Fiji	Beche-de-mer resource survey, Vanua Levu (November 1988)
FIJ 2	Fiji	Publication of accumulated research results and analysis of data (planned June 1993)
KIR 1	Kiribati	Pearl-shell resource survey, Kiritimati (September 1989)
KIR 2	Kiribati	Pearl-shell surveys, Gilbert Islands (May 1992)
MAS 1	Marshall Is	Pilot pearl oyster culture project, Namorik, (Nov-Dec 1990)
MAS 2	Marshall Is	Beche-de-mer survey (Planned, possibly shelved)
NAU 1	Nauru	Nauru Inshore fishery data collection (July 1991)
NIU 1	Niue	Fishery resource survey (July 1990)
PAL 1	Palau	Development of inshore fishery resource assessment plan (October 1989)
PAL 2	Palau	Quantification of marine resource habitats (Planned 1993)
PAL 3	Palau	Development of inshore fishery management plan (July 1991)
PAL 4	Palau	Analysis of catch & length-frequency data from Palau's reef fisheries (August/Sep 1991)
PNG 1	PNG	Support to preparation of technical documents (July 1990, February 1991 & April 1992)
PNG 2	PNG	Beche-De-Mer and commercial mollusc research (1991/2 and ongoing)
PNG 3	PNG	Estuarine Fishery data analysis (March 1993)
PNG 4	PNG	Small pelagic stock assessment (December 1992)
PIT 1	Pitcairn	Commercial Trial Fishing monitoring (planned 1993)
SOL 1	Solomons	Invertebrate Fishery Resource Survey (Jun/July 1992)
TON 1	Tonga	Review of inshore fisheries assessment project (November 1989)
TON 2	Tonga	Survey of beche-de-mer resources, Ha'apai (June 1990)
TON 3	Tonga	Analysis of deep reef-slope fishing data (October 1990/ April 1991)
TUV 1	Tuvalu	Development of fishery statistics system (February 1989)
TUV 2	Tuvalu	Survey of pearl oyster resources, Nukulaelae (April 1990)
VAN 1	Vanuatu	Deep-bottom fishery data analysis (June 1989)
VAN 2	Vanuatu	Review of field research activities (February 1990/ October 1992)
VAN 3	Vanuatu	Application of remote sensing to trochus habitat mapping (Spetember 1993 planned)

Sub-project: COK 1
Country: Cook Islands
Title: Fishery resource survey of Palmerston atoll
Date: October 1988

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
 A. D. Lewis (FAO consultant)
 A. Wright (FFA Research Coordinator)
 N. Sims, K. Passfield, W. Marsters, N. Howard, I. Bertaram, T. Teaurii (Cook Islands Ministry of Marine Resources)
 B. Yeeting (Kiribati), F. Viala (Fiji), S. Maluofenua (Tuvalu) (IFRP trainees)

Objectives: Gather baseline information on the status of Palmerston's parrot fish stocks, and stocks of other marine resources. Apply this information in the formulation of management advice regarding the atolls fishery resources to the Palmerston Island Council and to the Cook Islands Ministry of Marine Resources.

Background: Palmerston atoll is one of the major sources of fish supply to the Cook Islands national capital, Rarotonga. Although sparsely populated (66 inhabitants at the time of the survey), the islands skilled fishermen have developed a level of "industrialisation" in the capture and processing of reef fish, especially parrot fishes, to the point where there were real grounds for concern about the future of the parrot fish resource. In response to perceptions of declines in both catch rates and the average size of the parrot fish caught, the Palmerston Island council imposed a temporary ban on parrot fish exports from the island, and sought the advice of the Cook Islands Ministry of Marine Resources (MMR) on ways in which the fishery might be restored to its former level. MMR in turn requested the assistance of the IFRP in the conduct of a field survey to gather baseline information on the status of Palmerston's parrot fish stocks, and stocks of other marine resources, and in the formulation of management advice.

Activities: A resource survey was carried out jointly by technical staff of the Cook Islands Ministry of Marine Resources (MMR), the IFRP, and the Forum Fisheries Agency, during two weeks in September 1988. Survey planning was made considerably more effective through the use of a SPOT satellite image of the atoll obtained and processed with the assistance of the New Caledonian Image Processing Laboratory at ORSTOM.

Because of its nature, every effort was made to involve field assistants from other atoll countries, to whom the survey was of considerable relevance. The final survey team consisted of the IFRP Senior Scientist, an SPC consultant, the FFA Research Coordinator, 6 Cook Islands Fisheries Officers, and Fisheries Officers from Tuvalu, Fiji and Kiribati.

Results: The survey allowed the collection of baseline information on the parrot fish fishery and on other resources, including trochus, pearl shell, giant clams, lobsters, and other finfish, as well as assessment of the status of the parrot fish fishery.

In discussion with local fishermen and island officials, management guidelines were developed, and these were formally presented to, and discussed with, the island council on the day the survey team departed Palmerston. The most important recommendations were improved collection of statistics on fish exports from Palmerston, establishment of a

permanent reserve in which fishing is prohibited, and either a continuation of the present ban for a further two years, or imposition of an annual quota of 10t/year for 5 years.

A draft report was compiled on the team's return to Rarotonga, and a second meeting with MMR officials was held prior to the team's departure. The primary "clients" of the project, the island council and MMR, were thus provided with the information they requested within a week of the survey's completion.

The draft report has been upgraded to a joint IFRP/FFA technical report documenting the status of the parrot fish fishery, and containing an inventory of Palmerston Atoll's other exploited or exploitable marine resources, and this is pending publication. The finalisation process has been slow because of the need to obtain inputs from 12 team members in 7 different countries, and to integrate what began as three distinct documents - a description of the parrot fish fishery, a parrot fish management plan, and a description of fisheries for other species.

Response: The island council concurred with the team's recommended approach and instituted new regulations governing the fishery the same day. MMR agreed to promote the development of alternative fisheries, especially those for pelagic species, at Palmerston as recommended by the team, to relieve pressure on lagoon stocks.

Follow-up: It was anticipated that a follow-up survey would need to be carried out 18 months to 2 years after this survey, to ascertain the effectiveness of recommended management measures. The IFRP indicated its willingness to provide further support if required. However, since that time, transport of fish from Palmerston to Rarotonga, and thus fishery exploitation on the atoll, has been greatly reduced as a result of interruptions to Cook Islands shipping services. It is therefore planned to postpone any further survey work until such time as commercial fishing activity resumes its former intensity on the island.

Significance: This sub-project led to the first fishery management plan to be developed for any island in Cook Islands. The plan was based on biological and fishery data and was developed through a process of consultation with resource users. This ensured that it was appropriate to the needs of the local fishing community and greatly increased its chances of being implemented. The approach taken has broader relevance not only to the Cook Islands but to other countries of the region.

Sub-project: COK 2**Country: Cook Islands****Title: Aitutaki Trochus Fishery Management Plan****Date: August/September 1992 and ongoing**

- Inputs:** T.J.H.Adams (IFRP Senior Inshore Fisheries Scientist)
P.Tuara, D.Munro (Cook Islands Ministry of Marine Resources)
- Objectives:** Making use of the opportunity provided by the case study of the Aitutaki trochus fishery (see REG 11), to produce a draft plan to formalise the stock assessment, quota settlement and other management of the Aitutaki trochus fishery, based on existing practices as far as possible.
- Background:** The Aitutaki trochus fishery is one of the most advanced model fishery management systems in the Island Pacific. Because trochus were introduced fairly recently (1957) and are not a traditionally-consumed species, it has been possible for the Island Council to introduce severe management measures, when needed. Several approaches to management of the resource have been implemented since 1981, but never formalised, and the Ministry of Marine Resources wished for the most effective of these measures to be appraised and drafted into a unified plan.
- Activities:** During the 4-week Aitutaki case study (REG 11), local Fisheries staff, Island Councillors and local fishermen were interviewed for their opinions on the effectiveness of different management measures (particularly the practicality of implementation), and any available written background information was collected. All of this was assessed in the context of the results of the case study.
- Results:** Prior to departure from the Cook Islands, a summary paper discussing the prospects and constraints of the management measures imposed on Aitutaki trochus, and identifying the most suitable options for formalisation was submitted to the Permanent Secretary for Marine Resources. A major theme was to make the plan flexible, to adaptively respond to any change in circumstance. With no negative feedback to this proposal, a draft Management Plan (in the form of a covenant between the Cook Islands Government and the Aitutaki Island Council, with suggestions for additional legal measures to be taken, if necessary) was submitted to the Ministry of Marine Resources for informal discussion with the Island Council.
- Response:** The intention of the Ministry is to submit a Plan to Cabinet, for ratification, perhaps in November. This draft has not yet had time to be discussed between the Ministry and the Council, and there is expected to be one more round of feedback and the production of a second draft before IFRP involvement finishes.
- Follow-up:** If the Plan is agreed by Cabinet, and accepted by the Island Council, it is planned for the Senior Inshore Fisheries Scientist to visit Aitutaki for the next trochus harvest, probably in early 1994, to supervise the first "round" of adaptive management.
- Significance:** This sub-project, with the production of a formal management plan for an entire, self-contained fishery, exemplifies the probable future direction of the SPC Inshore Fisheries Research Project, moving towards the integration of research results at a higher level of administration. For the Cook Islands Government, this will be the first of what is intended to be a comprehensive series of plans, covering the major inshore resources of each island in the group: plans which are now legally required for all "designated fisheries". For other Pacific Island Nations, the substance of the plan has already been requested by two of the

Federated States of Micronesia to assist in the formulation of their own management strategies for trochus (although this is only likely to be applicable, as-is, to those trochus fisheries, such as FSM, the Marshall Islands and the Cooks, where harvesting is confined to a very short period).

Sub-project: COK 3

Country: Cook Islands
Title: Giant Clam survey and production of management plans
Date: (Planned) March 1993

Inputs: T.J.H.Adams (IFRP Senior Inshore Fisheries Scientist), O.Terekia, J.Whitford (Ministry of Marine Resources)

Objectives: Perform a comparative baseline stock assessment of the *Tridacna maxima* populations at Aitutaki and Manihiki, and produce draft management plans for submission to both island councils and Government.

Background: A giant clam hatchery has been set up on Aitutaki, to test the feasibility of reef-reseeding and/or income-earning clam farming. This was set up in the last phase of an international giant clam project, and left several ends untied, particularly the baseline study of the natural giant clam population that would be necessary to assess the success of reef-reseeding experiments. Also, the Aitutaki Island Council has expressed worries about the declining status of giant clam stocks on the island and needs an opinion on whether this is due to over-harvesting or to other causes (such as pesticide run-off from banana farming, or channel-blasting).

Manihiki, being more isolated, has a comparatively untouched giant clam population and makes a useful comparator, but exploitation is likely to increase rapidly now that air links with Rarotonga are more frequent (owing to the rapid emergence of blacklip pearl culture).

The Ministry of Marine Resources has requested assistance with this assessment, and suggests March 1993 as a probable date to fit in with the hatchery work "off-season". It is likely that external funding would be available to support all costs apart from the salary and travelling of SIFS.

Activities: Spend a week at each island performing a quick baseline survey of *T.maxima* (and *T.squamosa*, where present), concentrating on familiarising Aitutaki hatchery staff with survey methodology. Meetings with Island Councils and fishermen would be held. Another week might be spent on data interpretation techniques, planning ongoing monitoring and detail work, and producing the first management plan drafts.

It is possible, through the newly-approved SPC Remote-Sensing Project (and in collaboration with EVAAM in French Polynesia), that satellite imagery of both Aitutaki and Manihiki, processed for a range of typical giant clam habitats, can be provided. The exercise of ground-truthing such images would be beneficial to both projects.

It is also possible that a related sub-project will arise during the implementation of this project, for the provision of some initial management guidelines for the Cook Islands beche-de-mer fishery. There are signs that beche-de-mer exploitation is starting to take off in previously unexploited areas (unexploited mainly due to high labour costs, such as in Australia) and it is possible that the Cooks will soon become a focus of Asian importers. Most of this advice can be provided from a distance, but this visit may also be an opportunity to finalise a Cook Islands beche-de-mer management plan.

Results: Would follow from the objectives: a baseline indicative giant clam stock assessment of Aitutaki and Manihiki; draft management plans for giant clam on both islands; an opinion to the Aitutaki Island Council on the reason for the decline of giant clam stocks; and a future research plan (for further assessing the natural population) for Aitutaki hatchery.

Response: Requests have been made by the Ministry of Marine Resources and, informally by the Aitutaki Island Council, and would be followed by an official request through Foreign Affairs later in the year. The potential external donor has indicated strong interest.

Follow-up: If the likely cause of giant clam stock decline on Aitutaki turns out not to be amenable to identification by an area-based survey, it will be necessary to have some water-samples analysed for trace contaminants. It is likely, at this point, that responsibility would be handed over to the South Pacific Regional Environment Programme (SPREP).

The IFRP would be prepared to advise on design of, and the analysis of, any giant clam surveys that the Ministry undertakes on other Cook islands.

Significance: The project would provide for an essential lack in an ongoing, capital-intensive project and formalise the management, on two islands, of a species which is archetypally vulnerable to over-exploitation. In the case of Manihiki, it may be possible to introduce pre-emptive management before over-exploitation starts.

Sub-project: FSM 1
Country: Federated States of Micronesia
Title: Ciguatera sampling protocol
Date: February 1989

Inputs: P. J. Dalzell (IFRP consultant)
M. Gawel, A. M. Nelson (FSM National Marine Resources Division)

Objectives: Advise on the use of a clinical test for ciguatera for fish quality control in FSM. Establish procedures for testing fish for ciguatoxicity so that high-risk fish can be excluded from fish export shipments. Develop a means by which outbreaks of ciguatera poisoning can be monitored within the FSM.

Background: Increasing amounts of fish (currently about 70 tonnes, worth \$200,000, per year) are being exported from the FSM to Guam, the Northern Marianas and the US mainland via Hawaii. The national and state governments of the FSM wish to expand export fisheries as revenue earners and sources of employment. One possible impediment to these plans is the occurrence in the FSM of ciguatoxic fishes.

Ciguatoxicity in fishes results from the accumulation in the marine food chain of toxins produced by ingestion of the dinoflagellate *Gambierdiscus toxicus*. The effects of ciguatera poisonings are rarely fatal but very unpleasant, and include short-term gastrointestinal trauma and long-term neurological effects. Ciguatera can occur in a wide range of species, especially in older (and therefore, usually, larger) fish, but those species that present a ciguatera risk differ from one area to another depending on local conditions.

An immediate concern of the FSM government is to prevent ciguatoxic fishes from being exported to United States territories. The incidence of ciguatera could damage the reputation of these fledgling export industries as well as leading to costly litigation and adverse publicity. In the long term, prevention of domestic cases of ciguatera is also seen as desirable given the chronic effects of this intoxication and the possible health risks presented by continued exposure to the ciguatera poisons.

A clinical test (the "Hokama" test) has been devised to identify the presence of ciguatoxins in fish flesh and preparations. Persons in the FSM have been trained in the use of this test in each of the four states. The SPC IFRP was asked to help the FSM to establish a sampling protocol for ciguatoxic fishes using the test.

Activities: Initial consultations were held with SPC health officers and epidemiologists to discuss the nature of the ciguatera problem from a public health perspective. All four FSM states were then visited and the various aspects of their fishing industries investigated from the perspective of future sampling requirements. Talks were also held with fisheries and health officials in the FSM to try to gauge the extent of the ciguatera problem and establish whether records were available on the incidence and distribution of fish poisonings.

Results: It became clear during the investigation that the use of the Hokama test for quality control purposes was inappropriate for reasons of logistics, cost, and because of the characteristics of the test itself (high frequency of false positives: occasional false negatives). The test could, however, usefully be applied in the case of a ciguatera outbreak to assist in

determining the identity and distribution of the fish responsible.

The following steps were recommended to the FSM Government as alternatives to their original plans: exports of fish from the FSM should not include the red snapper, *Lutjanus bohar*, or barracudas, since these species are commonly implicated in ciguatera poisoning throughout the country; fishes from areas where reef damage occurs should be regularly monitored to determine if they become ciguatoxic; health and fisheries authorities in each state establish an infrastructure by which ciguatera intoxications can be monitored and fishes may be collected for testing; establishment of a nationwide publicity campaign and the need to make people more aware of the need to report ciguatera intoxication, either to health or fisheries workers.

A report was presented to the FSM government giving details of the proposed sampling protocol for ciguatoxic fishes in FSM in the event of a ciguatera outbreak. The report also suggested ways to minimise the risk of ciguatoxic fish being included in export consignments by the rejection of particular species/ size grades thought to present the highest risk.

Response: The FSM Government agreed to abandon earlier plans to use the clinical test for quality control, despite a substantial previous commitment to this, once the deficiencies of this approach were made clear. Instead, priorities were placed on identifying both the areas where ciguatoxic fish were concentrated, and the species that were commonly responsible for the syndrome.

Follow-up: A follow-up project was established with the Community College of Micronesia to begin an initial compilation of case histories from college students, and thereby to compile a map of affected sites (FSM 2).

A full-scale epidemiological survey of ciguatera incidence in FSM is also planned as a direct result of this study. The survey will be carried out by the FSM government, with support from the SPC Health Programme, in 1991/92.

Significance: The sub-project identified positive action that could be taken to reduce the potential deleterious effects of ciguatera toxicity in FSM. The FSM government is now in a position to better address the ciguatera problem from both fisheries development and public health angles. SPC will take a coordinated approach to providing further support to FSM's efforts, which also have relevance to similar problems faced by other countries of the region.

Sub-project: **FSM 2**
Country: **Federated States of Micronesia**
Title: **Ciguatera mapping**
Date: **June/July 1990**

Inputs: P. J. Dalzell (IFRP Inshore Fisheries Scientist)
M. Gawel, A. M. Nelson (FSM National Marine Resources Division)
A. Edwards (Community College of Micronesia)

Objectives: Carry out a preliminary questionnaire survey of ciguatera cases in the FSM involving students and staff from the Community College of Micronesia. Based on survey responses, map the principal areas of ciguatera fish poisoning and identify causative species. Use this information to establish a stratified sampling procedure for testing of fishes in affected areas with a commercially produced chemical detector for polyether toxins, so as to further elucidate geographic and taxonomic trends affecting ciguatera distribution in the FSM.

Background: The FSM has small but developing export industries sending fresh fish to markets in Guam, Hawaii and Japan. The export of ciguatoxic fishes has the potential to lead to adverse publicity and litigation and poses a threat to the development of the FSM fish export industry.

During IFRP involvement in the development of a ciguatera sampling protocol for ciguatera in the FSM (sub-project FSM 1) it became clear that there was no recorded information about the true incidence and distribution of this type of fish poisoning in the four FSM states. The fact that individuals from throughout the FSM attend the Community College of Micronesia provided an opportunity to rapidly sample the geographical pattern of ciguatera intoxication. The IFRP was requested to assist with this activity as a follow-up to sub-project FSM 1.

Activities: Prior to travel to Pohnpei, a standard interview/data form was designed with the assistance of the SPC Health Programme. In collaboration with the Community College of Micronesia in Kolonia, Pohnpei, interviews were then held with representative numbers of people from each state in the FSM. Local medical and fisheries authorities were also consulted to obtain additional information on ciguatera cases from Pohnpei state.

Results: The data gathered were used to compile a map of the incidence of ciguatera in the country. This will serve as a precursor to a more detailed epidemiological study of this form of fish poisoning that will be carried out by FSM Government, with support from the SPC Health Programme, in 1991/92. The data was also used to ascertain as far as possible the different species of fish that are responsible for ciguatera in different parts of the FSM.

A report on the questionnaire sampling programme, a preliminary map of the islands where ciguatera fish poisoning has been recorded, and a list of fishes causing ciguatera poisoning in FSM has been forwarded to the FSM Government.

Response: FSM government has made use of the data provided in compiling an initial list of high-risk species/location combinations to be excluded from export shipments. The data will also be used by health authorities in planning the forthcoming epidemiological survey.

Follow-up: The results are being added to by an ongoing interview programme conducted opportunistically by CCM staff, with advisory inputs from the IFRP. Data are periodically forwarded to SPC for incorporation into the larger database on ciguatera poisoning that is being compiled as part of REG 7.

Once additional data has been gathered by the ongoing interview programme (see below), FSM government will institute a testing programme, using the Hokama test for polyether toxins (now produced commercially by Hawaii Chemtect), to determine ciguatoxicity levels in high-risk species from suspect areas. This will ultimately lead to greater selectivity in determining which fish from which areas should or should not be exported.

Significance: A clearer picture of ciguatera distribution and causal species is being constructed that will have significant implications for both fisheries development and public health in FSM. The avoidance of ciguatoxicity in export fish shipments will eliminate a significant business risk in this small but growing industry that the government is fostering. Greater information on the distribution of ciguatera risk to local people will enable public information programmes that will lead to a reduction in the number of poisoning incidents.

Sub-project: FSM 3

Country: Federated States of Micronesia
Title: Analysis of catch data from Chuuk outer banks
Date: June/July 1990 & August 1991

Inputs: P. J. Dalzell (IFRP Inshore Fisheries Scientist)
P. Sitan, J. Diplock, Clay Hedson (Micronesian Maritime Authority)

Objectives: Review and suggest improvements to resource assessment activities being carried out under the auspices of FSM/OFCF deep reef slope-fish resource assessment project, including fishing operations and data collection procedures. Assist with a preliminary analysis and interpretation of data.

Background: The offshore banks and seamounts of Chuuk State are currently the subject of a joint Japanese/FSM investigation to map the fishing grounds and to assess the extent and sustainability of the deep reef-slope fish resource. The fisheries potential of these seamounts and shallow plateaux between Chuuk and Yap has never been properly assessed, but there is thought to be an opportunity for Chuuk State to promote the development of a small coastal fishery based on this resource.

FSM government negotiated with the Japanese Overseas Fishery Cooperation Foundation (OFCF) for an assessment of the deep reef-slope fish resources of these areas to be carried out. Under the terms of the agreement, an OFCF chartered fishing vessel would carry out fishing in a commercial manner and provide detailed catch, effort, geographical and other data on their activities.

The IFRP was requested in 1990 to review and analyse the data collected by the OFCF vessel during its first year of operations, and advise on possible improvements to the programme. The following year, the IFRP was requested to assist in the analysis of the data collected by the OFCF vessel after the project had terminated in February 1991.

Activities: A total of 18 months of catch and length frequency data generated by the OFCF vessel were analyzed and the data summarised for location for catch rates by gear, catch composition and length frequencies of the principal species.

Results: A report to the FSM Micronesian Maritime Authority was drafted containing a summary of the and results and recommendations for future work. The principle conclusions of the report were that stocks of commercially valuable eteline snappers were present on the Chuuk outer banks. Fishing with bottom longlines selects mainly for these species but catch rates are too low to establish an economically viable fishery. Better catch rates were experienced by handlining with hand-hauled and mechanically-hauled lines. The report was presented to and discussed with FSM government representatives.

It was suggested after the first visit that, after the initial phase of exploratory fishing, more emphasis be given to fishing specific seamounts to estimate biomass and potential yield through stock reduction techniques. It was also recommended that less emphasis be given to fishing with bottom set longlines due to their poor performance and because this technique would be unlikely to be adopted by local fishermen.

- Response:** The recommendations were accepted by the FSM Government and discussed with the OFCF scientists in charge of the survey with a view to implementation in 1990/91. Plans to carry out a stock reduction study on the outer banks were also set in motion, as recommended. The data sets from fishing on specific seamounts were summarised during the second visit and were to be analysed at a later date by the MMA biologist. Unfortunately, the premature departure of the MMA biologist meant that this aspect of the project was not completed.
- Follow-up:** No further action is required for this project. During 1992, OFCF published their own summaries and analyses of the data which could be used to for stock depletion analysis of individual fishing grounds. In common with the MMA-IFRP report, the OFCF report noted the superior performance of handlines versus bottom longlines.
- Significance:** As in other small island countries, deep reef-slope fish resources are likely to be present on the Chuuk outer banks but catch rates will fall rapidly once the virgin biomass has been removed by initial fishing. This survey will ensure that information is available to allow the fishery to be developed to a sustainable level of production, and that will ensure profitable operations over the long-term for vessels involved in the fishery.

Sub-project: **FSM 4**
Country: **Federated States of Micronesia**
Title: **Pilot sponge culture project, Chuuk**
Date: **September 1990**

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
A. M. Nelson, M. Gawel (FSM National Marine Resources Division)
R. Croft (Pohnpei State Marine Resources Division)
M. Mailo, A. Sellem (Chuuk Maritime Authority)

Objectives: Carry out a seedstock survey of Chuuk lagoon to assess the potential for extending pilot sponge culture operations currently under way in Pohnpei.

Background: In the early part of the century culture of the commercial sponge *Spongia officinalis* was an established industry in some of the Japanese-occupied islands of Micronesia. During the war this cottage industry was abandoned and subsequently never re-established, despite the fact that the potential for culturing sponges still exists.

In recent years there has been a substantial increase in the value of naturally produced sponges (as opposed to synthetic ones) and these are now usually sold as an up-market, high-priced product. A strong market exists in the USA and this is coupled with a decline in production of natural sponges from other traditional producing areas, including the Mediterranean and the Caribbean.

In view of the above, the Pohnpei State Marine Resources Division in 1988 initiated a pilot sponge culture project. The aims of the project were to simultaneously re-learn the techniques of sponge culture, provide a demonstration culture operation so that potential local farmers could learn the methods involved, and establish a means of producing seedstock to support the development of commercial farms.

Sponge culture is a simple, low-technology activity. Sponge specimens are collected from the wild and cut into fist-sized pieces which are then threaded onto longlines suspended in mid-water in shallow, clear areas of the lagoon. As the sponges grow, they are either harvested and dried for commercial sale, or again cut into pieces for further on-growing. In order to establish a farm, therefore, and adequate supply of seedstock, either from the wild, or from culture operations, is needed.

After observing the success of the Pohnpei pilot farm, the FSM national Marine Resources Division wished to examine the potential of a similar operation in other areas of FSM, starting with Chuuk lagoon. The technical cooperation of the Pohnpei State Marine Resources Division was sought to provide advice on culture-related activities. The FSM government requested SPC for assistance in support of the field work.

Activities: A two-week field survey of Chuuk lagoon was carried out using SCUBA diving to identify suitable seedstock-bearing areas and potential aquaculture sites.

Results: Two seedstock areas were located, both in deep water. A site for aquaculture trials and the ultimate establishment of a pilot farm was also selected.

A draft report, containing maps and information on sponge culture techniques, was prepared. This is presently being finalised as an IFRP technical document which will provide detailed information on aspects of sponge culture for the benefit of other countries interested in similar projects.

Response: Chuuk Maritime Authority is now proceeding with the establishment of a pilot culture farm using seedstock from the populations discovered during the survey, and the recommended culture techniques.

Significance: The culture of sponges shares features with pearl-oyster and seaweed culture. Farming of these organisms can be done in remote island situations with little technological backup. Although good husbandry practices are required, start-up and operating costs are low and labour, the biggest input required, can be organised on a community or family basis. As a result, sponge culture is one of a handful of aquaculture activities that has the potential to become economically viable in outer island situations in the Pacific. This type of activity represents one of the few economic prospects for atoll dwellers throughout the Pacific Islands region.

As a result, the IFRP is committed to supporting the development of simple mariculture activities through projects such as this. In the case of the present project, the results have significance for the development of sponge culture in Chuuk, but will also provide information on which fisheries development agencies in other countries can judge the merits and relevance of this type of activity to their own needs.

Sub-project: FSM 5
Country: Federated States of Micronesia
Title: Reef Fish Depletion Experiment, Yap
Date: May/June 1991

Inputs: P. J. Dalzell (IFRP Inshore Fisheries Scientist)
A. Smith, Peter (Yap Marine Resource Management Division)

Objectives: To determine the fish standing stock at a number of reef sites by carrying out depletion experiments. Train MRMD staff in basic fish survey methods, in survey data analysis, and in assessing when reefs are overfished.

Background: Reef fish in Yap State are currently exploited principally for subsistence and limited small-scale commercial use. Yap state is one of the Pacific Island groups where traditional values and systems have been retained to a very high degree, and resource ownership and control in the is vested in local communities and their leaders. In the near future, levels of exploitation are expected to increase in response to both increasing population densities, and the active encouragement of commercial fishing activities. The Marine Resource Management Division (MRMD) of Yap State Department of Resources and Development wishes to pre-empt overfishing of these resources by ensuring that increases in harvesting pressure are limited to those that the resource can sustain. MRMD is presently compiling a coastal management plan for Yap state reef fisheries that will be completed at the end of 1991.

There are presently no available estimates of standing stocks of reef fish that can be used for fishery management purposes in the Pacific Islands. Methods for making these estimates in a reliable way have only been developed recently, and depend on the conduct of depletion experiments. In a depletion experiment, declining catch rates observed during a period of short-term intensive fishing in an unfished area are used to derive estimates of resident biomass. This information is then combined with biological information on key species in the fishery to determine levels of fishing that will optimise yields to local fishermen while still conserving adequate stocks to ensure the sustainability of fishing.

MRMD consulted with traditional resource owners in Yap's outer islands and initially secured commitments from Woleai and Elato to cooperate in the conduct of two series of depletion experiments to assess standing stocks of reef fish using the leaf-sweep method and spearfishing over a period of several days. Both methods of are commonly practised methods of traditional community fishing in the Micronesian islands

Due to logistical problems it was later decided to restrict activities to Woleai atoll only, and to carry out two depletion experiments by leaf sweep fishing and two by spearfishing. Underwater visual censuses (UVC) were also conducted at the fishing and control sites to assess densities of key species during the survey period. Routine biological data was collected from all fish captured during the fishing experiments.

Activities: The four depletion experiments (two leaf sweeps and two spearfishing) were carried out as planned. UVC counts were also conducted for three of the fishing experiments. MRMD staff and locally recruited technical assistants were given training in UVC techniques and the processing and summarisation of catch data.

Results: Standing stocks of reef fish were estimated from the four depletion experiments and this was extrapolated for the whole of the lagoon back reefs. Biological data was collected for all fishes captured by leaf sweep and spear fishing and the principal target species of each fishing method identified. UVC counts failed to show the expected correlation between population sizes at fishing sites, before and after fishing. The reasons for this were identified and can be used for planning future work of this kind based on alternative UVC methods.

A meeting was convened with the people of Woleai to discuss the findings of the project and to formulate recommendations in the framework of traditional regulation of lagoon fishing. A report was later drafted and submitted to the Yap MRMD.

Response: Management recommendations, based on the results of the project, were adopted by the people of Woleai to safeguard the stocks on the lagoon reefs. Some of the recommendations were also incorporated into the coastal management plan developed for Yap by the MRMD.

Significance: The unavailability of reliable standing stock estimates for Pacific Island coral reef fish is a major impediment in the development of rational management plans for fisheries based on these resources. This project has provided the first measures of shallow lagoon reef fish biomass which is also an important food staple for the people of Woleai and provided quantitative data on two methods of community fishing commonly practised in the Micronesian atolls.

The evolution of this project was based on the initial collection of information on traditional fishing practices in the outer islands of Yap. The successful implementation of the project demonstrated that traditional fishing techniques can be used successfully with conventional stock assessment methods to produce useful management information.

Sub-project: FIJ 1
Country: Fiji
Title: Beche-de-mer resource survey, Vanua Levu
Date: November 1988

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
V. Vuki, F. Viala, J. Navakalomana, A. Sesewa, M. Tumuri, A. Yabaki (Fiji Fisheries Division)
P. Lokani (PNG Department of Marine Resources) (IFRP trainee)

Objectives: Gather baseline information on patterns of abundance, distribution and harvesting of the sea cucumber *Actinopyga miliaris* in selected areas in Fiji. Apply this information in assessing the need for management of this fishery.

Background: Beche-de-mer is a dried seafood product derived from sea cucumbers (holothurians). Fiji has been an exporter of beche-de-mer for at least 200 years, and probably much longer. The product is non-perishable and the fishery is one of the few income-earning activities based on marine products that rural producers can participate in without the need for refrigeration and other infrastructural facilities.

Fiji's beche-de-mer fishery has undergone a recent boom because the South-East Asian import market has begun to accept traditionally low-value sea cucumbers. Fijian beche-de-mer production rose from 32 tonnes (dried weight) in 1982 to over 600 tonnes in 1987. This is equivalent to 6,000 tonnes wet weight, which exceeds the combined weight of all other Fijian seafood production, (including the catch of the industrial tuna fishing company, Ika Corporation). 95% of the 1987 harvest consisted of a single species, *Actinopyga miliaris*, which had not been previously exploited to any extent.

The growth in the fishery led to concerns on the part of the Fiji Fisheries Division as to the sustainability of harvests at this level, especially for *A. miliaris*. As a result, the IFRP was requested to provide assistance in a survey aimed at establishing basic biological and fishery information on this unstudied species.

Activities: The survey took place during 5 weeks in November/ December 1988, and involved the IFRP Senior Scientist, a counterpart from Papua New Guinea, 6 Fijian Fisheries Officers, and the 8-man crew of the Fisheries Division Research vessel Tui-ni-Wasabula. One week was spent collecting harvesting and export statistics from beche-de-mer traders in Suva and Labasa, after which two weeks field survey work was carried out in the northern lagoon of Vanua Levu, one of two main harvesting areas. The Tui-ni-Wasabula was used as a mother ship, while actual surveying was done using three smaller boats and four pairs of divers.

Results: As well as collecting baseline information on the abundance, habitat preference and population structure of *A. miliaris*, it was possible to compare several different survey methods and define the most useful combination for future, long-term monitoring work.

Based on the data collected, the team recommended appropriate means of evaluating and monitoring these resources and suggested possible management options for this fishery. The recommendations included: the establishment of an association of beche-de-mer exporters (which could ultimately be extended to cover other marine product exports); development

of a code of practice by which association members agreed to operate, and which included provision of more detailed harvesting statistics to Fisheries Division, and the provision of training in processing methods to rural collectors; compulsory membership of the association as a pre-requisite to the issue of export permits for beche-s-mer; and the institution of biological studies on beche-de-mer growth and recruitment by Fisheries Divisions Northern station.

A draft report of the survey was forwarded to the Fisheries Division, and to outside reviewers, shortly after the survey completion. Finalisation has been hampered because two batches of specimens sent overseas for taxonomic confirmation deteriorated in transit or were lost. It has now been decided to finalise the report without input from taxonomic specialists. This will be published in an IFRP Technical Document.

- Response:** The main recommendation, the establishment of a seafood exporters association in which beche-de-mer exporters are obliged to participate in order to obtain export licenses, was implemented before the end of 1988. Size limits on beche-de-mer, and improvement of the procedure for issue of export licenses, were effected early in 1989.
- Follow-up:** Follow-up work and further monitoring was recommended to be carried out by Fiji Fisheries Division. However, due to the departure of key FD personnel, and overall staffing problems within the Division, this has not so far been instituted.
- Significance:** In terms of quantities fished, and in the cash it provides to members of rural economies, beche-de-mer is by far Fiji's most important fishery. Little is known about the fishery biology of most holothurians and nothing at all about *A. miliaris*, which now makes up by far the most important component of the Fijian fishery. If exploitation of this resource is to provide sustained income-earning opportunities to rural people over the long-term, it is essential to understand the effects on the resource of the boom-and-bust production cycle that these fisheries typically undergo.

This project enabled the establishment of a mechanism to manage the level of exploitation of Fiji's beche-de-mer resources, and to gather the information needed to ensure that such management responds to the requirements of the resource and operates in the best interests of the coastal communities who depend on it. Additionally, the refinement and standardisation of field survey methods for beche-de-mer populations is of regional significance and will allow both improved resource assessment work in other countries, and comparative studies of survey data from different locations. (The methodologies developed have already been used in sub-project TON 2 and will be further extended in PNG 2)

Sub Project: FIJ 2
Country: Fiji
Title: Support to preparation of technical documents
Date: planned June 1993

Inputs: T. Adams (IFRP Senior Inshore Fisheries Scientist)
P. Dalzell (IFRP Inshore Fisheries Scientist)
S. Sharma (Fiji Fisheries Division)
A. Sesewa (Fiji Fisheries Division)

Objectives: Provide advisory and technical support to Fiji Fisheries Division fisheries officers in producing final reports of field and data collection activities.

Background: The background for this sub-project is broadly similar to the sub-project PNG 1. Fiji has, by regional standards, relatively well developed commercial artisanal fisheries. Reporting of the commercial fisheries has achieved good coverage by Fisheries Division in recent years and the production by species groups in the different districts of the country is reported each year in the annual report.

However, in common with the DFMR in PNG several research projects, carried out by Fiji Fisheries Division, remain undocumented for broadly similar reasons. The IFRP will provide assistance during 1993 in the same manner as is given to the PNG DFMR. Draft reports will be produced for eventual publication as Fiji Fisheries Division Technical Reports.

Activities: One of the IFRP scientist will visit Fiji Fisheries Division at Lami, to assess the status of outstanding data sets and project documentation and to set priorities for completion of drafts.

Results: Depending on timing, draft reports will be completed in country and finalised through correspondence.

Response: Where appropriate, technical reports will contain management advice and conclusions for government administrators.

Follow-up: Follow-up editorial, illustration and layout work will be required by a number of SPC headquarters staff.

Significance: The completion of these outstanding technical documents will significantly improve the flow of information on fishery research and development activities in Fiji from field workers to those responsible for management and decision making. Further, the availability of data on now-completed field work will reduce the likelihood of work being duplicated, and valuable development funds wasted, both in Fiji and in other regional countries.

Sub-project: **KIR 1**
Country: **Kiribati**
Title: **Pearl oyster resource survey, Kiritimati**
Date: **September 1989**

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
N. A. Sims (UNDP consultant)
B. Yeeting (Kiribati Fisheries Division, Tarawa)
M. Tekanene (Kiribati Fisheries Division, Kiritimati)
R. V. Alfred (Marshall Islands) (IFRP trainee)

Objectives: Assist in the assessment of pearl oyster resources in Kiritimati lagoon. Recommend future management approaches for this resource, including the prospects for aquaculture.

Background: Kiritimati (Christmas) Island, in the Line Islands group of Kiribati, was harvested for its pearl shell over 150 years ago by divers from the northern Cook Islands. More than 200 tons were taken from the small, shallow lagoon, and since that time it appears that stocks have remained depleted.

In 1988, the Kiribati Fisheries Division received reports that pearl shell were again being commercially exploited. It was not known whether this was an indication that stocks were becoming more abundant. Since the Kiribati Government is keen to pursue the potential of commercial pearl culture in selected lagoons, it was considered essential to survey pearl shell resources in Kiritimati and formulate a management approach that would keep open the option of pearl culture in future.

The IFRP was requested to assist in the survey and in the formulation of management options for this resource in Kiritimati.

Activities: The survey was carried out in September 1989 by a five-man team: the IFRP Senior Scientist, a consultant employed using UNDP funds allocated to SPC, and counterparts from Tarawa, Kiritimati, and the Marshall Islands. The team was supported by 4 local fishery officers and technicians.

In addition to the survey work, the team constructed and deployed 5 spat collector lines, so that levels of juvenile settlement can be assessed in future. Information on recruitment is important in assessing the aquaculture potential, especially in the Kiritimati situation with its very shallow and open lagoon, and high water exchange.

Prior to leaving Kiritimati, the team held a meeting with officials of the Fisheries Division and the Ministry of the Line and Phoenix Islands (MLPI) to discuss recommended pearl shell development approaches. A report was forwarded to the Kiribati Fisheries Division, and to MLPI, after the survey concluded.

Results: The survey revealed that pearl shell stocks were still depauperate, and that even without exploitation the stock was probably only just self-sustaining. Reports of increased harvesting were correct, and were due to an unrealistically high price being offered by the semi-government Marine Exports Division, presently being run by the Japanese Overseas Fishery

Cooperation Foundation (OFCF). Although done with good intentions to create income-earning opportunities for local fishermen, OFCF's fishery "development" initiative effectively decimated already low pearl-shell stocks. This experience underlines the need for resource survey and assessment activities in the early stages of fisheries development projects.

The team recommended management approaches to be implemented by Kiribati Government. These included a total embargo on all commercial pearl shell collection, and the maintenance of spat collectors in the lagoon. Even if aquaculture was not envisaged, it was recommended that spat collection and juvenile husbandry be used as a short-term means of bolstering the natural population

Response: The teams contention that a total embargo on pearl shell collection should be imposed was accepted by the Permanent Secretary for the MLPI. Possible supplementary work, ranging from low-level activities aimed at replenishing the natural pearl-shell population, to aquaculture at varying levels of intensity, was discussed. Much will depend on the results of the spat collector trials. The Kiribati Fisheries Division is committed to maintaining the spat collectors, and examining the spatfall thereon.

Follow-up: Reports on the status of the spat collectors have been forwarded to the IFRP by the Kiritimati Fisheries Officer from time to time. Spat taken from the collectors were forwarded to SPC by the Kiritimati Fisheries Officer in October 1990 for identification. They have proved to be *Pinctada maculata*, a non-commercial species which is commonly attracted to spat collectors in French Polynesia and other pearl oyster culture locations.

Contact is being maintained with the Fisheries Division in Kiritimati so that the success of the spat collectors can continue to be monitored. Further support to spat collector renewal will be required in 1991 and this may be sought from the IFRP. In the event of continuing problems of infestation by *P. maculata*, a further visit by IFRP staff may be requested.

If there is a major spatfall of *P. margaritifera*, it is likely that further IFRP assistance will be sought in establishing suitable juvenile husbandry procedures. Based on experience elsewhere, the team estimated that there was a reasonable chance of a good spatfall occurring within five years, although this cannot be guaranteed.

Significance: The atolls of Kiribati and other central Pacific countries have few resources on which to base income-earning opportunities. In today's economic climate pearl shell would offer such opportunities but in many atoll locations wild stocks of shell were wiped out in the last century. This sub-project represents a step towards re-establishing these stocks and then progressing towards the lucrative but nevertheless simple, low-technology culture of these organisms. The project not only contributes towards the conservation of a resources that has great cultural importance in Kiribati, but one which also has the potential to provide the basis for economic activity and thus contribute towards social stability in outer island locations. The establishment of pearl-oyster culture in Kiritimati is a long-term goal but one which is nonetheless achievable and worth pursuing.

Sub-project: KIR 2
Country: Kiribati
Title: Pearl oyster resource surveys, Gilbert Islands
Date: May 1992

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
 T. Tikai, M. Kamatie, J. Uan, T. Teema, T. Reiti (Kiribati Fisheries Division, Tarawa)
 B. Yeeting (Biosystems Ltd, Tarawa).

Objectives: Assist with the assessment of pearl-oyster resources in the Gilbert Islands group. Recommend future management approaches for this resource, including the prospects for aquaculture.

Background: Following the survey of pearl-shell resources in Kiritimati (see sub-project KIR 1), the Kiribati Fisheries Division approached the IFRP for assistance in carrying out similar surveys in the central Gilbert Islands group. Although in the early 1960's a pilot pearl oyster farm was established in Butaritari by a Japanese entrepreneur (the farm was subsequently abandoned when the individual left the island, and the degree to which the operation was successful is unknown since no documentation on it exists), natural pearl shell stocks in the group generally appear to be reduced because of exploitation pressure. The Fisheries Division wishes to manage the resource more effectively, with a view to ultimately instituting aquaculture activities.

As part of the preparation for this survey work, a staff member of the Kiribati Fisheries Division (M. Kamatie) participated in the survey of pearl oyster resources in Nukulaelae lagoon, Tuvalu (see sub-project TUV 2). This enabled him to become familiar with survey techniques and field planning requirements. A local consultant to the project, B. Yeeting, had also previously participated in the survey of Christmas Island (sub-project KIR 1) and was able to act as leader of one of the diving teams.

Activities: Preparation for the field work, which involved gathering background information to identify areas likely to have good residual pearl oyster stocks and good aquaculture potential, took place during 1991. A small atlas of Kiribati atolls, containing lagoon maps and basic environmental data extracted from available literature, was prepared by the IFRP. Kiribati Fisheries Division for their part circulated a questionnaire to outer island fisheries officers and council leaders seeking anecdotal information on past pearl-oyster abundance, use and exploitation.

Questionnaire results suggested that the pearl-oyster potential of the Gilbert Islands was as follows:

Good: Abemama, Butaritari, Abaiang
 Medium: Tarawa, Marakei, Maiana, Aranuka, Nonouti, Tabiteuea, Beru, Onotoa
 Poor: Makin, Kuria, Nikunau, Tamana, Arorae.

It was originally intended that field survey work would commence in mid- to late 1991. However, several delays occurred both with Kiribati Fisheries Division, then with SPC, due to scheduling conflicts. Field work thus did not take place until May 92, when IFRP Senior Scientist Garry Preston visited Kiribati for a 5-week period to assist with the survey.

Based on questionnaire surveys and examinations of the lagoon types, the atolls of Abaiang and Butaritari were ultimately selected as being likely to have the strongest pearl oyster stocks. Field survey work was thus directed towards these islands in the first instance, with a strong emphasis on training of the Kiribati team to ensure their ability to carry out further surveys. The Kiribati Fisheries Division stated its intention to extend the survey work to other islands as time, transport, personnel availability and financial considerations permitted.

Results: Approximately 14 days were spent in Abaiang and 10 days in Butaritari carrying out timed counts and, where possible, measured or estimated transects to assess pearl oyster densities and size distributions. Five I-Kiribati fisheries workers participated in the survey and received training in field survey practices and data analysis. The data from Abaiang were analysed and a draft report submitted to Government before Mr Preston's departure. Time in-country was insufficient for the same to be done with the Butaritari data, hence a completed draft report, covering both islands, was submitted after return to Noumea.

Pearl oyster populations in both atolls were depauperate. There was judged to be no potential for aquaculture based on adult shell at the present time, and it was recommended that steps should be taken to protect (through a harvesting bans) and, if possible, enhance the stocks.

A total of 10 spat collectors were also constructed and deployed in the lagoons (6 in Abaiang and 4 in Butaritari). These and further collectors to be deployed by Kiribati Fisheries Division will be used to monitor spatfalls and assess the potential for resource enhancement through large-scale spat collection. If this proves to be feasible, there may still ultimately be potential for aquaculture activities to be developed, but only in the long-term.

Response: The recommendations regarding management have been accepted by Kiribati Government and presented to the island councils for approval. This has reinforced a recent earlier decision of the Abaiang Island council to ban pearl shell collection indefinitely. On Butaritari, a decision regarding management has still to be made.

Follow-up: Kiribati Government, while disappointed that the results were not more encouraging, has made a commitment to completing the activities initiated during the survey. Fisheries staff have been making regular trips to the islands to check the spat collectors, and minor spatfalls have been reported, although it is not yet known what species has been collected. Further stock surveys are also planned by the Fisheries Division, in Onotoa and in Fanning Island, in the Line group, to assess development potentials and/or management needs in other areas.

Kiribati Fisheries Division is also negotiating with another technical assistance agency (Australian Centre for International Development) with a view to obtaining long-term research assistance in support of enhancing the natural pearl oyster stocks in selected Kiribati Islands. IFRP staff have been intimately involved with, and supportive of, this proposal, which if approved will enable Kiribati to effectively implement all the survey recommendations.

Significance: The atolls of the Gilberts have few resources on which to base income-earning opportunities. If pearl-oyster culture activities can be proved viable in one of the Gilbert Islands, this will serve as both a spur to development of aquaculture-based economic activity that is appropriate to the small atoll situation, as well as an encouragement to the implementation of rational pearl-oyster management systems.

Sub-project: MAS 1
Country: Marshall Is
Title: Pilot pearl oyster culture project, Namorik
Date: November - December 1990

Inputs: J. Dashwood (IFRP consultant)
R. V. Alfred (Marshall Islands Marine Resources Authority)

Objectives: Assist in the establishment of a pilot pearl culture farm on Namorik atoll. Advise Namorik Island council and Marshall Islands government on institutional arrangements needed to support the establishment of a pearl-oyster and pearl culture activities in Namorik and other atolls of the Marshalls group.

Background: The Marshall Islands Marine Resource Authority (MIMRA) have requested SPC assistance in assessing natural pearl shell stocks, and the potential for pearl culture, in the lagoon of Namorik atoll.

The request originates from the Namorik Island Council, who some years ago were approached by a Japanese company seeking an exclusive pearl-oyster farming concession on the island. The Island council rejected the Japanese offer as being inappropriate to their development needs, with inadequate opportunities for local involvement and the training of local people. Instead, the Council requested Marshall Islands Government to provide or identify a source of assistance that would enable Namorik Islanders to initiate pearl-oyster culture activities themselves.

The first phase of this assistance from SPC involved the participation of Marshall Islands Fisheries Officer Ronald Alfred in the pearl-shell survey carried out at Kiritimati, Kiribati (see report of sub-project KIR 1) in September 1989. This participation gave him first-hand survey experience and a broad conception of the issues relating to pearl-shell culture.

In December 1989 Mr Alfred spent two weeks on Namorik atoll, where pearl-oyster stocks were reported to be healthy, carrying out a survey. The survey report was forwarded to SPC and confirmed the presence of adequate wild pearl-oyster stocks to allow aquaculture activities to be envisaged.

MIMRA subsequently requested SPC assistance in furthering the development of small-scale pearl-oyster farming in Namorik. In response a consultant, Mr J. Dashwood, from the Cook Islands (where pearl oyster culture activities have been developing in recent years) was engaged to visit Majuro and Namorik for a period of six weeks in line with the above objectives. Mr Dashwood's involvement in the development of the industry in the Cook Islands made him the ideal choice for this assignment, which was undertaken in November/December 1990.

Activities: After several days of field survey work to confirm the relatively high shell abundance reported by Mr Alfred, the consultant worked with the island council in planning and establishing a pilot pearl-oyster culture operation. This included supervising local labour in the physical construction of shell-hanging longlines, and then stocking them with shell collected from the wild, as well as the construction and deployment of spat collector units.

Materials for the establishment of the pilot farm were purchased using the Marshall Islands

component of the US Tuna Treaty Fund for Regional Fisheries Development administered by the Forum Fisheries Agency. Further support is also expected to be forthcoming from this source, as well as from the Marshall Islands Government.

Additional terms of reference for the consultant were to advise both the Island council and the Marshall Islands Government on establishing a suitable institutional framework to encourage the development of a pearl oyster culture industry. This included drafting of regulations regarding management of the natural resources, and guidelines for the licensing of individuals who may ultimately wish to become involved in pearl farming.

Following the initial consultancy, Mr Dashwood joined SPC as Fisheries Coordinator in mid-1991. One of his first tasks after appointment was to undertake a follow-up visit to Namorik to monitor progress and to assess the feasibility of commencing with pearl seeding operations.

Results: During the initial visit, a small farming operation was established with a stock of about 1,000 adult shell. It was agreed that, during the next twelve months, the island council would continue expansion of the pilot farm towards a target of 5,000 adult shell under culture. This was the minimum number of shell that the consultant considered would justify the visit of a pearl seeding technician.

During the follow-up visit it was observed that the target stock level had not yet been achieved. Some problems had occurred with administration of the project, specifically with mechanisms for paying for the labour of individuals working on the farm, which is itself a community project. These issues were resolved shortly before the follow-up visit, hence the target date for achieving a stock of 5,000 adult shell has been put back to the end of 1992.

It was observed during the follow-up visit that the spat collectors were functioning well, although some had suffered from neglect. Small numbers of juvenile shell had been transferred to the pilot farm and these were under culture according to the methods recommended by the consultant.

Response: Marshall Islands Government have demonstrated considerable financial commitment to this project, and have fulfilled their obligations regarding the consultant's recommendations. Marshall Islands Government has also been instrumental in resolving the teething problems that have occurred at the community level.

Follow-up: Once the target of 5,000 adult shell under culture is achieved, a technician will be brought in to inculcate the shell, at Marshall Islands Government expense. It is expected that the IFRP will continue to provide technical advice and support to the project

Significance: As in other atoll countries, the culture of pearl-oysters represents a potentially important economic activity for the people of the Marshall Islands, which are all atolls. The preconditions for this project, however, are somewhat unique. Not only did the request for assistance originate directly from the Namorik island council, but also pearl-oyster stocks in the lagoon appear reasonably robust and in a state to support culture activities immediately. These circumstances appear to be very favourable for the success of the project within a time frame of just a few years. In this case, the project will not only yield significant economic gains to Namorik Islanders, but will serve as an important example, especially in the area of product marketing and social organisation of culture activities, from which other countries will be able to learn.

Sub-project: MAS 2
Country: Marshall Is
Title: Beche-de-mer Survey, Marshall Islands
Date: (planned)

NOTE: The request for this project was never formally confirmed by MIG, since the replacement of Steve Muller. This proposed project should perhaps therefore be regarded as defunct.

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
S. Muller, R. V. Alfred (Marshall Islands Marine Resources Authority)

Objectives: Assess the distribution and abundance of commercially important sea cucumber species in selected atolls of the Marshall Islands. Advise on approaches to development and management of a cottage industry processing beche-de-mer.

Background: The Marshall Islands government wishes to carry out a survey of beche-de-mer resources of potential commercial importance in the group. This is a precursor to the development of a small export industry for beche-de-mer, which appears to be slowly taking place at the instigation of South-East Asian businessmen who are promoting beche-de-mer processing in country. The Government favours the development of this activity and is providing additional extension and marketing support to inhabitants of the less accessible outer islands.

Experience from elsewhere, especially the atolls of Fiji, suggests that sea cucumber communities in atoll situations are not robust and are amenable to rapid depletion in the face of intense harvesting. Management and development plans need to take account of this in order to provide for a minimal level of resource conservation and to allow for the fact that harvests will not be sustained at the levels experienced when the fishery is first opened up. Novel management practices, such as rotation of harvesting, may be necessary to ensure the consistent, sustained production necessary to attract and maintain the interest of overseas buyers willing to pay good prices.

The Marshall Islands government has requested SPC to assist in the conduct of the a survey to assess the extent of beche-de-mer resources in the different islands of the group, and to provide advice on ways in which rational development of this fishery might proceed.

The University of Guam (AG), which services the Micronesian area, has offered to assist with the survey by providing professional support from Guam, and by financing the participation (as technical assistants) of present or former Marshallese AG marine biology students now resident in Marshall Islands.

Activities: Logistical details of the field work have yet to be worked out, but it is expected that the survey will take in at least the six islands closest to Majuro. Full details of vessel and counterpart staff availability are still awaited from MIMRA.

Results: The survey will enable the development of guidelines for sustainable harvest levels for each island visited, for consideration by island councils and by MIMRA.

Follow-up: Not yet determined.

Significance: The harvesting of sea cucumbers for beche-de-mer production has taken place from atolls throughout the region. The consequence has invariably been that stocks are rapidly depleted and production is unable to be sustained. This leads to inconsistent supply which in turn leads to poor prices from beche-de-mer buyers and the insufficient time for producing areas to develop top-grade products. Nothing is known of the ability of the resource to recover from this kind of overfishing but experience in Fiji suggests that periods of several years may be necessary.

The approach by the Marshall Islands of carrying out a broad resource survey before a major development push takes place is the first of its kind in an atoll environment, and is commendable. The survey will provide an estimate of beche-de-mer stocks in the islands surveyed and this will allow harvesting to be managed in a way as to ensure the long-term sustainability production, thus generating greater economic benefits to Marshall Islands from what is a very fragile resource.

Sub project: NAU 1

Country: Nauru
Title: Nauru inshore fisheries data collection
Date: July 1991/2

Inputs: P. Dalzell (IFRP Inshore Fisheries Scientist)
A. Debao, P. Jacob (Nauru Department of Island Development and Industry (DIDI))

Objectives: To establish a programme of regular data collection from inshore fishing in Nauru and to estimate the relative contributions to total landings from reef fishing, deep slope fishing and pelagic fishing, especially from around three newly deployed FADs

Background: Nauru derives most of its income from the mining of phosphate rock from the island's interior. However, the phosphate resources are nearly exhausted and the Government is looking at Nauru's other natural resources for the future. Coastal fisheries are already an important source of animal protein and fish is the preferred food of Nauruans and other islanders on Nauru employed by the phosphate mining company. The Government of Nauru is concerned at the levels of fishing effort targeted at reef fish and bottom fish from the reef slope, and may introduce legislation to conserve stocks. Prior to the drafting of legislation, however, the Government wishes to have better information on which to base management decisions

The relatively high incomes of Nauruans (due to mining revenues) means that most households possess boats, outboard motors, nets handlines and spears. Diving is popular on the island and regular dive parties go spear fishing with SCUBA gear, often beyond the safe limits of diving, to pursue fish down the reef slope. Dive fishing is often blamed for the decline in shallow reef stocks of snappers and groupers which have been depleted or have moved to deeper water beyond the reach of dive fishermen.

During 1991, three FADs were deployed around Nauru by the SPCs Fisheries Programme. There is growing interest in the region in the use of FADs to increase catches of large pelagic species, especially fishes that can be sold for high prices on overseas export markets. The inception of a catch recording project at Nauru also provided an excellent opportunity to quantitatively assess the effects of FAD deployment on small scale pelagic fishing.

Activities: The IFS (P. Dalzell) spent two weeks on Nauru making observations on the nature inshore fishing on the island and conducting trials for a preliminary sampling programme. Following experiences gained from these initial observations of landings, a sampling protocol was established for the Department of Island Development and Industry's fisheries officers.

Results: During the two week assignment, 33 sampling interviews were conducted with fishermen who were returning from fishing. Fishing activities included trolling, bottom fishing, cast netting and dive spearfishing. An inventory of boats and fishing gears was also carried out over the same period. A report on coastal fishing based on these and other observations was then drafted and included a proposal for a sampling protocol for a further 12 month period.

- Response:** The Nauru Government implemented the proposed sampling programme and undertook to continue monitoring coastal landings for a one year period.
- Follow-up:** The IFRP is currently designing a database to assist the summary and reporting of information on coastal landings. The IFRP will initially compile the database for a six month period then return to Nauru to check on data collection and instruct fisheries officers in database management and reporting.
- Significance:** The Government of Nauru has recognised that fisheries will likely play an increasing role in the economy of Nauru as the income from phosphate mining is reduced. The Government also realises that there is virtually no information available for managing the resource and has taken steps to remedy this situation by seeking the assistance of the Commission's Fisheries Programme. The results of the sampling programme will be used to estimate the total landings and the value of the catch.

Sub-project: NIU 1
Country: Niue
Title: Fishery resource survey
Date: July 1990

Inputs: P. J. Dalzell (IFRP Inshore Fisheries Scientist)
S. Lindsay (FAO consultants)
H. Patiale (IFRP Associate)

Objectives: Compile an inventory, summary and analysis of all available fisheries data concerning Niue. Carry out field observations to determine the nature and abundance of invertebrate stocks, and to estimate the productivity of selected fishing methods practised by local fishermen. Based on this information, make recommendations for future resource conservation, exploitation and management in Niue.

Background: Niue is a raised coral atoll without a lagoon, and with only a narrow fringing reef and precipitous slope surrounding the island. Most local fishing activity targets pelagic species, with one or two fishermen also fishing for deep reef-slope fish. Little factual information existed on the extent of harvests of fish and other marine organisms on Niue.

The Niue government wished to quantify the extent of marine resource harvesting activities, determine whether management attention was required for any of the species currently exploited, and assess the potential for increased exploitation, or for resource enhancement of particular species by restocking or aquaculture.

The IFRP was requested to collaborate with the FAO/UNDP Regional Aquaculture Support Programme in a survey of the marine resources of Niue in line with the above objectives.

Activities: Existing data on the marine resources of Niue were reviewed, and field observations were carried out on the island, during a 3-week period. The survey team conducted underwater transects of the reef to quantify the occurrence of trochus, pearl shell and beche-de-mer, joined fishing trips to determine catch rates of pelagic fishes and carried out a household survey to estimate the amount of fishing and harvesting by the Niue population.

A final report was produced documenting the present status of fisheries in Niue, and containing a profile of each major resource which also provides comments on potentials yields and development issues.

Results: A comprehensive assessment was made of the status of fisheries in Niue, which included contemporary catch rates of fin fishes from the pelagic, deep slope and reef environments. The densities and standing stocks of commercially important invertebrates such as clams were determined, and an assessment was made of the importance of fisheries in the Niuean economy and to local nutrition.

Recommendations were given for future monitoring activities and conservation of invertebrate stocks. Contrary to Niue Government expectations, it was felt that there was no potential for beche-de-mer production or pearl shell culture, but trochus transplantation

was thought to have potential and should be seriously considered. Stocks of the giant clam, *T.maxima*, were not depleted but those of *T.squamosa* were, and some form of conservation measure was necessary.

Response: The Niue Fisheries Division instituted conservation measures for *T.squamosa* during and immediately following the assignment. Other recommendations in the report dealing with ongoing statistical data gathering, institutional strengthening of Fisheries Division and transplantation of trochus were also accepted by the Government of Niue for progressive implementation.

Follow-up: Niue Government will implement the teams recommendations as regards fishery development and monitoring. No further follow-up action is envisaged by the IFRP at this stage.

Significance: Fishery resources in raised atolls such as Niue are extremely limited and fragile. Considerable caution needs to be exercised in managing fishery exploitation and development if the benefits of these are to be sustainable. The survey allowed the gathering of data on Niue's fisheries which will be invaluable for future development planning. The survey also permitted the identification of possible problem areas as well as development potentials which the government can now follow up on. The fact that the survey was requested demonstrates a rational and conservative approach to fisheries development that other small island countries would do well to adopt.

Sub-project: PAL 1
Country: Palau
Title: Development of inshore fishery resource assessment plan
Date: October 1989

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
N. Idechong, E. Oiterong (Palau Division of Marine Resources)
A. H. Kitalong (Micronesian Mariculture Demonstration Centre)

Objectives: In collaboration with the Palau Marine Resources Division, develop a three-year work plan and methodology which would permit assessment of the present status of the Palauan inshore fishery and monitoring of any changes that may occur as a result of development or management activities. Advise on management approaches that may be required for the fishery.

Background: Harvesting of reef fish in Palau, always traditionally important, has become more extensive and efficient in recent years with the introduction of power boats and higher-technology fishing equipment, and the development of a local and export marketing infrastructure. The Palau Government's Division of Marine Resources (DMR) was concerned at continuing reports of declining catch rates and average sizes of fish and wished to establish a research programme which would allow assessment of the status of the fishery and provide a basis for the development of a management system.

DMR requested IFRP advice on a suitable programme of fishery information gathering which would permit the development of a management regime. Ultimately, the information gathering work is to be carried out by a professional fishery biologist (the position was under recruitment at the time of this sub-project) and by three Palauan students presently completing degree courses at the University of the South Pacific in Fiji with DMR sponsorship.

Activities: The assignment was carried out in October 1990 and involved two weeks field work in Palau, mainly interviewing officials and fishery workers and carrying out literature research.

Results: A draft report containing a proposed research and management approach was compiled and discussed with DMR staff at several stages during its preparation. The report identified the information gaps that existed and possible approaches to collecting data that would rectify this situation. These included identification of key species in the catch, the establishment of a programme to gather basic biological information on these species through market outlets in Koror, the establishment of a standardised fishing programme, and the monitoring of the large volume of fish exported to Guam as passenger baggage via Palau airport. The standardised fishing programme was suggested as a means of gathering information on catch rates of key species, as first proposed by Munro for implementation in Tonga (see sub-project TON 1).

In the short term, several tasks were identified that could be achieved by the Palauan USP students during their vacation time in Palau. These included specific projects to gather biological information on key species from the Palau Federation of Fishing Authorities' fish market, and the quantification of fishery habitat types by measuring from small-scale maps using a planimeter.

The importance of extensive consultation with the state administrations, who effectively control marine resource exploitation in Palau, was emphasised. Greater extension efforts in this area would not only promote an understanding of, and positive attitude towards, management by resource users, but would also provide an excellent, low-cost data gathering opportunity.

Response: The main recommendations, regarding biological data and fishery data collection, a standardised fishing programme, and improved communications with state administrations, were accepted by MRD. Their implementation commenced in late 1990 following the recruitment of a fishery biologist. The biologist is following the proposed work plan very closely and provides periodic progress reports to IFRP for information and comment.

Follow-up: The recommended approaches to inshore fishery resource research and management have been accepted and built on by DMR. Contact is being maintained with the staff involved in the data gathering work and advisory inputs are sought from time to time.

Two further requests for IFRP assistance in this field have been received from Palau and approved by SPC management. The first is aimed at gathering additional data on the nature and extent of fishery habitats in palau, and is described in sub-project PAL 2. The second aims to gather anecdotal information on changes in the fishery as perceived by resource users over the last ten years, and to define specific management based on a programme of consultations with village leaders, and is described in sub-project PAL 3.

Significance: Palauan fishermen are efficient harvesters of marine produce and due to technological improvements in fishing are becoming more so. Fishing pressure on inshore resources, already quite substantial, is becoming greater as the harvesting of fish for commercial purposes increases alongside long-established subsistence harvesting. Although data is limited, all the signs point to a rapidly worsening overfishing situation which in some cases has already led to greatly reduced fishery production, and in other cases threatens to do so. Inshore fisheries in Palau are in urgent need of rational management but there is little information on which to decide what management measures need to be implemented, and what management approaches should be taken. This project served to identify ways in which such information can be obtained. The linked sub-projects PAL 2 and PAL 3 will support the gathering and application of this information. In the medium to long-term, this project promises to lead to a relief of the overfishing situation in Palau's inshore fishery, and consequent benefits to rural resource users.

Sub-project: PAL 2
Country: Palau
Title: Quantification of marine resource habitats
Date: 1991 & 1993 (planned)

Inputs: G. L. Preston, T. J. H. Adams (IFRP Senior Inshore Fisheries Scientists)
A. H. Kitalong, N. Idechong, E. Oiterong (Palau Division of Marine Resources)
W. Bour (Laboratoire de Traitement des Images Caledonien)

Objectives: Provide detailed estimates of the surface areas of each major fishery habitat type in Palau for all 16 states. Using this information, and estimates of production/ biomass derived from research work elsewhere, estimate standing stock and potential yields of key fishery species by state. Compare this information to estimates of current fishery landings to determine whether overfishing of key species is occurring and, if so, to what extent. Make this information available for incorporation into management decisions.

Background: One of the recommendations arising from IFRP sub-project PAL 1 was that attempts be made to quantify the extent of different types of fishery habitat in Palau. Such quantification would permit indirect estimates of standing stocks and productivity from each habitat type, as well as indicating likely habitat-determined limits to reproduction and recruitment of key species.

The purpose of generating this data is to provide information that can be used to make management decisions regarding the resource. Since such decisions are made at the state level in Palau, it is necessary for the data to be state-specific.

It was originally anticipated that this information could be extracted from existing maps, marine charts and aerial photographs as a vacation project by Palauan students studying at USP. However, examination of available material shows it to be grossly inadequate for this task. Aerial photographs of Palau to date exist only over dry land. Marine charts and maps show surface features, and provide limited information on bottom topography, but provide no detail on underwater features, or on the nature of the habitat itself.

As a result, the possibility of using digital satellite imagery for purposes of habitat quantification was investigated. After discussions between the Palau DMR, ORSTOM, LATICAL and SPC, an agreement has been reached whereby LATICAL will assist with this project by making available image processing facilities and technical support to enable a detailed marine biotope classification to be carried out on SPOT satellite images of Palau.

Activities: The images were ordered early in 1990, but it was expected that delivery could take a long time, since the satellite passes over Palau occur only once every five days, and since a 90% cloud-free image was required (a rare event in Palau). In the event, this prediction proved correct, as the images were not acquired until mid-1992.

It was planned that, once the images were delivered, they will be subjected to a preliminary classification at LATICAL. The classifications were to be forwarded for ground-truthing by DMR staff, with possible inputs from the IFRP and from SPREP, who are also interested in this project. Following ground-truthing, a more refined classification was to be completed by LATICAL.

Two events have taken place, however, in the time taken for the images to be acquired.

Firstly, ORSTOM and the New Caledonia Territorial Government have withdrawn some of LATICAL's financial and manpower support, and it is no longer certain that LATICAL support to this project can be maintained. Secondly, a major aerial photographic survey has been commissioned by the Palau Government and this is presently under way. Some reef coverage is expected, but it is not presently clear how extensive this will be, or how useful in the context of the present project.

Also relevant is the development of an in-house capability to undertake remotely sensed data analysis at SPC (see sub-project REG 8 for more details). This has now been approved by the South Pacific Conference and a proposal will be put to the EC at the end of 1992 for financing of this project, with substantial technical cooperation from New Caledonia and French Polynesia. The purchase of the SPOT images of Palau has thus been deferred pending the resolution of the various factors involved.

Results: Outputs from this project will be: a listing of major inshore habitat types in Palau, with a detailed description (in terms of community assemblage) of each; a table showing the surface planar surface (in hectares and acres) of each habitat type in each state; extrapolations from this data of standing stock and annual production for each of the key species in Palau's inshore fishery; and a report documenting the significance to the inshore fishery of each habitat type.

In parallel with this project, DMR will compile landing statistics of key species based on sampling of commercial fishermen's catches and visits to retail outlets in Koror. This work is already under way (see sub-project PAL 1 for more details). The combination of this data will permit assessment of the status of each key species and the degree, if any, to which it is overfished. Specific management options will be proposed for each species and/ or habitat type.

Response: The Palau Government has shown substantial commitment to this sub-project (and has followed up fully on its obligations regarding data collection) as well as to related projects dealing with marine conservation issues and actioned through SPREP. It is anticipated that any recommendations arising from this sub-project will be acted on.

Follow-up: IFRP Senior Scientist Dr Tim Adams will visit Palau in late 1992/ early 1993 in order to agree on future action needed on this project.

Significance: The quantification of fishery habitats in Palau is a key requirement if rational management strategies are to be developed. Even if adequate "traditional" sources of this information (i.e. aerial photographs, maps and charts) are available, extracting it is extremely laborious, time-consuming, requires specialised cartographic equipment, and is subject to a wide degree of error. In many cases, including Palau and numerous other Pacific Island locations, this type of information is not available at all.

The use of remotely sensed data combined with digital image processing technology offers a cost-effective alternative method of obtaining quantitative data on fishery habitats. Once an image has been acquired, processing can be done rapidly and the level of detail that can be achieved, especially in regard to depth and bottom topography, is far above and beyond what can be achieved manually.

This sub-project, when complete, promises to advance significantly Palau's plans for inshore fishery resource assessment and management. In addition, if the techniques used live up to expectations, they will have significant implications for resource assessment and management work in other countries of the region.

Sub-project: PAL 3
Country: Palau
Title: Development of inshore fishery management plan (planned July 1991)
Date: October 1989

Inputs: R. E. Johannes (Australian Commonwealth Scientific and Industrial Organisation)
 G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
 A. H. Kitalong, P. Siengaldab, N. Idechong, (Palau Division of Marine Resources)

Objectives: Carry out literature research, make field observations, and interview local informants in order to obtain information on: the type and extent of fishing activities for key species of inshore finfish and invertebrate resources; their present exploitation status; social and institutional mechanisms presently in place to control access to or exploitation of these resources; and sources of information that maybe used to assess or monitor changes in the status of inshore fisheries in Palau. By means of meetings and in a final written report, advise and inform the Division of Marine Resources on the overall status of Palau's inshore fishery, specific cases in which management action may be necessary at present or in the future, and suggested approaches, including legislative ones, to instituting such management action.

Background: An important recommendation that arose from sub-project PAL 1 was that DMR should improve it's extension and communication activities and consult with local and traditional authorities that control fishery exploitation. This should be done both as a means of gathering information on the fishery, and in order to ensure that the development of a management plan takes into account as far as possible the concerns and wishes of these groups.

In line with this recommendation, the Palau Government requested SPC assistance in organising a programme of field consultations with resource users in Palau. The programme aims to produce a current assessment of the status of the inshore fishery in Palau, and to provide guidance both on suitable approaches to fishery management that would be locally acceptable, and on the establishment of a long-term, ongoing consultative process.

The Palau Government specifically requested that Dr R. E. Johannes be the principal investigator in this project. In 1978 Dr Johannes published a book, "Words of the Lagoon", based on his biological and ethnological research during two years of living in a Palauan fishing community. (The book has since become a fisheries classic and is frequently cited in literature on pacific Island fisheries research and management). Dr Johannes close involvement with and knowledge of the Palauan inshore fishery 15 years ago make him the ideal person to undertake a comparative assessment of changes in the fishery since that time.

Dr Johannes services release from his employment at CSIRO in Tasmania was obtained and UNDP funding was approved to enable his services as a consultant to be retained for the 1-month duration of this assignment.

Activities: Dr Johannes visited Palau for one month in July 1991 to undertake the assignment. G. L. Preston undertook a two-week visit to Palau during the same period to assist with some of the field work, and in connection with sub-project PAL 2.

Results: Results include extensive consultations with DMR and other Palau Government staff to advise on research conclusions and management recommendations, and a report was

submitted to the Palau Government in August summarising these.

Dr Johannes also visited Noumea during the 23rd SPC Regional Technical Meeting on Fisheries in August 1991, and made a presentation describing this project as part of a one-day workshop that took place during the meeting, entitled "People, Society, and Pacific Island Fisheries Development and Management".

Response: The Palau Government showed substantial commitment to this sub-project and to related projects dealing with marine conservation and management issues. Many of the recommendations arising from this sub-project have already been acted upon, or otherwise approved for action.

Follow-up: None planned at this stage, but support may be requested from the IFRP in finalising Palau's marine resource management plan.

Significance: The successful implementation of a fishery management system in Palau will depend on the degree to which management measures developed by government are accepted by marine resources users. The fact that control over access to marine resources in Palau is exercised by state authorities and follows traditional management principles argues strongly for a management system that works with and through these customary authorities.

If a mutually acceptable approach to resource management can be agreed to between government and state authorities, implementation through the state system can be done at low cost, with a minimum of conflict between managers and users, and with a high degree of acceptance because of the strength of the customary system of community control over the activities of individuals. This sub-project promises to make a significant contribution to the development and implementation of such a system. The benefits of this, measured in terms of restored fishery productivity, will accrue to resource users throughout Palau, and will provide an example to the many other part of the Pacific where the issues relating to fishery management are comparable.

Sub Project: PAL 4
Country: Palau
Title: Analysis of catch and length frequency data from Palau's reef fisheries
Date: August/September 1991

Inputs: Paul Dalzell (IFRP Inshore Fisheries Scientist)
Anne Kitalong, Noah Idehong (Palau Division of Marine Resources)

Objectives: In collaboration with personnel from the Palau Marine Resources Division, analyse length frequency data collected over a 14 month period from reef fish landings and together with a summary and analysis of catch data provide a preliminary assessment of the exploitation of Palau's coral reef fishery resources.

Background: Following the visit of SIFS (G.Preston) in October 1989 to advise on a programme of information gathering, the PDMR began routine collection of length frequency data on the common reef fish species landed by commercial fishermen. After the first year of data collection, the PDMR requested the assistance of the IFRP in analysis of this data and to recommend future strategies for monitoring reef fish landings.

The PDMR was particularly concerned at the level of commercial landings from fixed net traps or *kesokes*, and the moves by Palauan fishermen to reduce mesh sizes from 3" to 2" in response to declining catch rates. Another area of concern was the reduction in populations of large parrotfish and wrasse through spear fishing with SCUBA diving equipment. The large species of wrasse are particularly important on Palau as customary gifts for chiefs.

Activities: The assignment was carried out between August and September 1991 and involved a two week residency in Palau working with their staff using the ELEFAN computer programme package for length frequency analysis. All existing historical catch data and length frequencies collected previously by PDMR were also summarised and analysed.

Results: A draft report containing the analysis of all the summarised length and catch data was produced on the completion of the assignment. The results suggested that Palau's reef fish stocks are, at present, only moderately exploited. A yield per recruit analysis of the length frequency data suggested that the optimum mesh size for the *kesokes* was 3" rather than 2" for most of the common species in the catch. Specific conservation methods were proposed for the large wrasse and parrotfish such as minimum size limits and banning of SCUBA assisted spear fishing.

Recommendations for future work included more length data collection, a collaborative programme of ageing selected reef fish species, monitoring exports of reef fish to other locations in Micronesia and estimation of the present subsistence fisheries production from Palau's coral reefs.

Response: Legislation governing *kesokes* mesh size and SCUBA diving was drafted by PRMD based on the recommendations in the report of this project. Possible means of collaborating on ageing of reef fish were explored with the Australian Institute of Marine Science.

Follow-up: No further action from IFRP is required for this sub-project other than the editing of the draft report for publication.

Significance: Exploitation of reef fish on Palau is not a recent phenomenon as populations were two to three times higher than at present prior to western contact, and during the Japanese administration between WW I and WW II. Current estimates of reef fish harvests suggest, however, that exploitation rates are moderate, but that these are likely to increase as the population increases. Further, the developing tourist industry in Palau and other parts of Micronesia has stimulated new markets for fresh reef from Palau's reefs but this is not accounted for in official statistics. Expansion of reef fishing is probably unavoidable but it will be to Palau's benefit to manage this increase wisely so that stocks remain productive.

Sub-project: PNG 1
Country: Papua New Guinea
Title: Support to preparation of technical documents
Date: July 1990, February 1991 and April 1992

Inputs: P. J. Dalzell (IFRP Inshore Fisheries Scientist)
A. H. Richards (PNG Department of Marine Resources, Port Moresby)
M. Chapau, P. Lokani (PNG Department of Marine Resources Kavieng),
A. Mohbia (PNG Department of Marine Resources, Daru)
W. Ulawai (PNG Department of Marine Resources, Wewak)

Objectives: Provide advisory and technical support to PNG national biologists in producing final reports of field and data collection activities. Where appropriate, assist authors to produce papers that could be considered for publication in scientific journals or IFRP Technical Documents.

Background: A common problem in Pacific Island countries is that workers responsible for the collection and recording of information on fisheries are often not highly skilled in the analysis and English-language reporting of this information. Many fishery projects that produce information, often at considerable cost, go undocumented. and reports never reach a wider audience. Over a period of time, as staff move around and institutional memory is dispersed, the information disappears. This results in fishery projects being repeated, often at great expense, in different locations in the region, or, over time, even at the same location. It also militates against critical evaluation and improvement of fishery research and development activities.

PNG is no exception from this situation and over the years a number of research and development projects have been carried out that have never been completely written up. English is often a second or third language to most Papua New Guineans, and there is no formal institutional framework to provide encouragement and support (especially editorial) to the production of reports. These two factors clearly mitigate against production of reports.

In recognition of this problem, the IFRP is committed to providing support to national fishery workers in reporting on their activities and disseminating the information more widely. A regional approach to this problem is being taken and this is described more fully in sub-project report REG 5.

In the specific case of PNG, the existence of a substantial number of incompletely documented projects led the PNG Department of Marine Resources to request a visit by an IFRP scientist to provide assistance to staff members in technical report production. The assistance requested included help in data organisation and database structure, statistical and data analytical procedures, and editorial inputs, as well as support in the production of graphics and illustrations by SPC headquarters publication department staff.

Activities: IFRP scientist P. Dalzell visited Port Moresby, Kavieng and Wewak in July 1990 to assess the status of data sets and project documentation, and to discuss the project with the staff involved. A second, month-long visit took place in 1991 where nearly four weeks were spent in Kavieng, in finalising five outstanding reports. Copies of the drafts were brought back to Noumea and finalised through a process of correspondence. A few days were spent with another fisheries scientist in Wewak, near the end of this visit, to prepare for a further

assignment the following year.

During April 1992, a third three week visit took place to Wewak and Kavieng to continue the process of clearing the backlog of reports. Three reports were completed with during ten days in Wewak, with the possibility of a fourth report to be produced during a short term attachment of Mr Ualaiwi to the IFRP in Noumea. A single large report on the sedentary invertebrate resources of Manus was edited during ten days in Kavieng. Advice was also given on the editing and production of an annual report for Research and Surveys Branch covering the years 1985 to 1991. Prior to leaving PNG two days were spent with DFMR staff in setting priorities for several outstanding reports to be edited during a future visit.

Results: The following reports have been finalised: Feasibility study of marine resource development in the Murik lakes; Development of deep-sea fishing in East Sepik; Economic appraisal of small-scale fishing vessels in East Sepik; Biology of dolphin fishes (*Coryphaenidae*) in PNG; Traditional pole-and-line fishing for mackerel tuna in Manus; Survey of bêche-de-mer resources in Manus; Survey gillnet fishing in Sissano Lagoon (West Sepik); Subsistence fisheries production in Sissano Lagoon; Biology and ecology of common carp in the Sepik river.

A further visit to PNG is likely to be requested, primarily to assist in clearing a backlog of several reports on the Western Province Barramundi fishery and artisanal fishing. A report on the bêche-de-mer resources of West New Britain will be edited in Noumea and finalised through correspondence.

Response: The response of individual staff involved in this project has been enthusiastic and it is viewed as a positive step towards completing tasks that have been in abeyance for some years. The Department of Marine Resources, from where the request originated, is equally positive about finally getting several specific projects finalised and written up in a permanent format.

Follow-up: Follow-up editorial, illustration and layout work will be required by a number of SPC headquarters staff. As indicated above, it is likely that additional in-country assistance will be sought by PNG at a later stage.

Significance: The completion of these outstanding technical documents will significantly improve the flow of information on fishery research and development activities in PNG from field workers to those responsible for management and decision making. Further, the availability of data on now-completed field work will reduce the likelihood of work being duplicated, and valuable development funds wasted, both in PNG and in other regional countries.

Sub-project: PNG 2
Country: Papua New Guinea
Title: Beche-de-mer research and resources survey
Date: 1991/2

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
P. Lokani, M.Chapau (PNG Department of Marine Resources, Kavieng)

Objectives: Provide support to PNG in its efforts to promote rational development and management of the beche-de-mer industry by assisting with surveys of beche-de-mer resources in Manus and New Ireland provinces, aiding research into growth rates of key beche-de-mer species, and assisting in the production of a beche-de-mer identification poster.

Background: As in other countries of the region, the PNG beche-de-mer fishery is expanding rapidly. PNG beche-de-mer production rose from 11 tonnes in 1983 to 195 tonnes, valued at 1.14 million Kina, in 1989. with further increases projected. The PNG Government is keen to ensure that the growth of the beche-de-mer industry results in production levels that are sustainable over the long term.

In PNG there is little information on the basic biology and exploitation of the major species on which to base rational development and management of this resource. There is a need to assess the relative abundance of beche-de-mer in different parts of the country, to undertake basic biological research on key species, and to improve public familiarity with these species as a preliminary step to implementing management measures.

The PNG National Fisheries Council (NFC) passed two resolutions relevant to this project during its 1990 meeting in Rabaul. Resolution NFC 7/90 recommended the implementation of fishery resource surveys in the provinces and the distribution of existing data on these resources to provincial administrations. Resolution NFC 12/90 calls for the Department of Fisheries and Marine Resources to consult with the provinces in implementing Sedentary Resource management Plans. These plans have been drafted based on hypothetical figures regarding marine resource abundance and sustainability which need verification.

The PNG Department of Marine Resources sought assistance and support from the IFRP in order to carry out beche-de-mer resource surveys, initially in two provinces, and to initiate a plan of research that will provide needed answers to fundamental questions on beche-de-mer biology.

Activities: Surveys of the beche-de-mer, trochus and green snail resources of two PNG provinces (Manus and New Ireland provinces) have been undertaken, using standardised assessment methodologies used in IFRP surveys elsewhere. Reports of the surveys have been produced and these provide baseline information that will be used by the Provincial Governments concerned to determine future options for development and management of these resources. Additional surveys are planned, without the need for further IFRP support.

Studies have been initiated of the growth rates of three beche-de-mer species (*Holothuria nobilis*, *Holothuria fuscogilva* and *Thelenota ananas*) kept in sea-floor cages. Some technical problems have occurred due to animals injuring themselves on the cages, and these have yet to be resolved. The experiment is continuing.

An investigation was made into the use of coded wire microtags on sea cucumbers. Retention rates so far have been reasonable (several months) but the level of tag rejection has been unacceptably high. This experiment is continuing.

An identification poster of beche-de-mer species, both before and after processing, is in preparation. A final draft has been sent to PNG DFMR for approval and once this is forthcoming the poster can be printed and distributed.

Results: Results have included the provision of advice to provincial governments regarding development and management of their beche-de-mer fisheries based on survey results. Further results expected include the elucidation of growth characteristics of the most important species that will in turn allow estimation of population turnover rates and appropriate levels of harvesting.

The poster will be used to enable provincial fisheries officers to correctly identify beche-de-mer species in export shipments, and thus will enable improvement of statistics on harvest levels in the fishery. The poster will also have other applications in marine resource education and training both in PNG and in other parts of the Pacific.

Response: The management of inshore fishery resources is becoming an issue of increasing concern to provincial administrations charged with managing these resources. In requesting the support of the national Department of Marine Resources in assessing and implementing inshore fishery management plans, provincial governments have demonstrated their commitment to the wise management of these resources. It is anticipated that the results of this sub-project will be acted upon.

Follow-up: Inputs into the beche-de-mer growth studies will be required from time to time over a two-year period. Further support to provincial survey work will be absorbed within Provincial and National Government funds.

Significance: The collection of baseline information on beche-de-mer biology, abundance and distribution is essential if these fragile and easily overfished resources are to be managed rationally and yield sustainable benefits to the coastal communities in PNG that harvest them.

This project aims to provide the information necessary to ensure that rational management is possible, and will provide encouragement to provincial administrations to implement management plans for this and other fisheries. In addition, the information gathered will be of significance to other countries with beche-de-mer fisheries based on the same species.

Sub-project PNG 3
Country: Papua New Guinea
Title: Attachment of fishery biologist to finalise study on estuarine fisheries in northern PNG
Date: March 1993

Inputs: P. Dalzell (IFRP Inshore Fisheries Scientist)
 W. Ulaiwi (PNG Dept of Fisheries & Marine Resources)

Objectives: A short term attachment of Mr Ulaiwi to Noumea to receive intensive training in a range of stock assessment techniques using data collected over a one year period from an estuarine fishery on the north coast of PNG. Drafting of a report on the results for publication in DFMR technical report series.

Background: In-country support for completion of technical reports has proved to be effective with fisheries scientists in PNG where they have analysed their data and drafted a manuscript. In some instances, however, fisheries scientists have amassed a considerable collection of data but not analysed it due to uncertainties with the techniques and approaches. In such cases the most effective approach has been to invite the scientist to the SPC for a short attachment where the data summary and analysis can be conducted without distraction and where new skills can be learned through working with the data.

The Murik Lakes region in the East Sepik Province is a series of shallow estuarine lagoons on the north coast of PNG. The PNG north coast does not have many areas of sheltered water and the Murik Lakes are important as fishing can be conducted there the year round. There is a high demand for fish in the Sepik region of PNG, particularly in the main urban centre of Wewak. A major multi-disciplinary survey of the fisheries resources of the Murik Lakes was conducted in the mid 1980s by DFMR. Based on the recommendations of this survey this was followed up by a one year in-depth investigation of gillnet fishing in the Murik Lakes during 1987 by Mr Walain Ulaiwi.

The substantial amount of data generated from the gill net study has remained unanalysed due to other commitments on Mr Ulaiwi's time and the need for advice on the treatment of the data. The expansion of fishing activities in the East Sepik region of PNG, and in particular the Murik Lakes region has prompted the need to complete this work so that advice can be given to developers and managers about expansion of fishing activities.

Activities: Mr Ulaiwi will come to Commission's headquarters in Noumea to spend a one month attachment with the Fisheries Programme working under the supervision of the IFS (P. Dalzell).

Results: The gillnet fishing data will be summarised and analysed during this attachment and a report drafted containing results, data summaries and conclusions for managing the fishery.

Follow up: Finalisation of the report will be accomplished through correspondence. Extracts of the report may be published in the IFRP Papers on Fisheries Science from the South Pacific (see REG 5).

Response: The report will form the basis of rational management and development of the Murik Lakes fisheries.

Significance: The Murik Lakes fisheries have the potential to be one of the most productive areas on the north coast of PNG. Further, these sheltered shallow waters can be fished safely throughout the year, thus ensuring supplies of fish to markets in the East Sepik region. The attachment of a fisheries scientist to the Fisheries Programme will allow increased training opportunities for imparting new skills and techniques, not usually possible during in-country visits.

Sub Project: PNG 4
Country: Papua New Guinea
Title: Study of PNG small pelagic fisheries
Date: December 1992

Objectives: Make a study of the catch composition and catch rates of small pelagic fish in the Gazelle Peninsula region of East New Britain, in relation to the possible development of a small scale locally operated fishery supplying bait to domestic longline vessels.

Background: There is increasing interest in the establishment of domestic longline fisheries in the South Pacific, particularly targeting for high quality tunas and billfish for export markets as well as increasing domestic fish supply. Part of the five year USAID funded PIMAR project is to assess the potential for a domestic small scale longline fishing operation in PNG. The project will be a collaborative effort between USAID, the SPC Fisheries Programme and the PNG Government and will be based in Rabaul, the capital of East New Britain Province. The main fishing grounds will be in the Bismark Sea and the SPC Fisheries Programme's initial involvement will be through the provision of technical expertise in longline fishing and baitfish assessment.

One of the limiting factors for longline fishing is an adequate supply of bait. Present longlining operations in the Pacific use commercially supplied bait from Japan. As well as increasing the costs of operations, this also excludes the possibilities of increased involvement of local fishermen in the longline fishery by establishing a domestic bait fishery. Certain small pelagic species in the South Pacific region may be useable as longline bait, particularly the scads and sardines. These species have been successfully exploited elsewhere for this purpose, such as in the scad fishery of the Banda Sea in Indonesia

Along the coast of East New Britain, the local Tolai people have developed a trap fishery which targets both small and medium sized pelagic fishes. These fish are sold for food, but might also be a source of bait for longline fishing. Little is known about the scale of this traditional small pelagic fishery, or whether it can be adapted to supply longline fishing vessels. The IFRP has been asked to undertake a study of the traditional small pelagic fishery, document catch composition and catch rates, and assess the potential of the fishery for supplying bait to longline vessels.

Activities: A two to three week period will be spent in New Britain interviewing owners of traditional fish traps and recording catch rates and catch composition. A sampling schedule and methodology will be formulated to be carried out by a local fisheries officer over a 12 to 18 month period.

Results: The results from the small pelagics fishery study should indicate if obtaining bait supplies locally is feasible from the traditional fishery, or if other methods of fishing should be investigated to try to increase production and the gears that might be used.

Response: If longline fishing becomes established in East New Britain, the results from the study should indicate if domestic longliners will be reliant on expensive imported live bait or whether some form of locally operated small pelagic fishery can partially or wholly replace imported bait.

Significance: PNG has probably offers the greatest potential for establishment of domestic small scale longlining and the Bismark Sea has long been known as a very productive pelagic fishing ground. Whilst longlining is likely to succeed, the direct beneficiaries from the fishing operations will be limited. There is, however, potential for village based fishermen to share in the benefits from longlining if a successful village based baitfishery can be established. An existing small pelagic fishery in the Rabaul area already targets for species thought to be suitable for bait. A study of this fishery is a sensible precursor to further development of a local baitfishery.

Although the results of this study will primarily apply to PNG, the PIMAR project is committed to the dissemination of the results to the whole of the South Pacific region. Funding has been allocated under the PIMAR project for report publication and dissemination and SPC will likely receive some of these funds for project documentation where appropriate.

Sub-project: PIT 1
Country: Pitcairn Islands
Title: Fisheries resources survey of Pitcairn Islands
Date: Planned 1993

Inputs: P. Dalzell (IFRP Inshore Fisheries Scientist)
T. Adams (IFRP Senior Fisheries Scientist)
Consultant (to be recruited if required)

Objectives: Design and implement a sampling programme for collection of catch and fishing effort data from commercial survey fishing from the waters around the Pitcairn Islands, and assist in the analysis and documentation of the the results.

Background: The land area of the Pitcairn Islands amounts to about 37 km², most of which (30 km²) is formed by the uninhabited Henderson Islands. Only Pitcairn Island itself is inhabited, though the population is very small (< 70 people). The EEZ of Pitcairn is, however, quite substantial and extends over an area of 800,000 km². Fishing is an important source of food for the Pitcairn Islanders but domestic catches offer little economic potential.

Some fishing trials have been conducted in the past in the Pitcairn EEZ by large scale fishing vessels and have shown that there commercial stocks of fish and invertebrates (lobsters) may be present. Recently, the Office of the Governor of the Pitcairn Islands has received two proposals for commercial fishing surveys in the Pitcairn EEZ. The IFRP was asked if it would be willing to assist in the design, implementation and reporting of such surveys if they eventuate.

Activities: If the fishing surveys are to go ahead, the IFRP will design a programme for sampling the catches in consultation with the fishing companies involved. If time permits one of the IFRP scientists will spend time on the survey vessels making direct observations of fishing. If this is not possible, then a consultant will be hired to carry out the necessary observations and make records.

A preliminary account of domestic fishing on Pitcairn Islands will be drafted from historical sources for comparison with the survey fishing results. If time permits the IFRP scientist or consultant will make direct observations on Pitcairn to support the historical data.

Results: The data from survey fishing will be used to produce a report on the fisheries potential of Pitcairn Islands waters. If the data is of sufficient quality it may be possible to estimate standing stocks and MSY and suggest limits to the amount of fish and shellfish to be caught annually.

Response: The Office of the Governor of Pitcairn Islands will be able to allocate fishing permits based on the recommendations of the fisheries survey results.

Follow-up: As part of the same assignment, the IFRP will design and implement a log book system to be completed by fishing vessels during each fishing season in Pitcairn waters. Further, if possible, continue to send an observer for part of the fishing season to verify data records.

Significance: Pitcairn is a remote island with poor communications with the outside world and a small population. Apart from UK funding, the present sources of income on Pitcairn are stamps, tourist souvenirs sold to passing cruise ships and remittances from islanders overseas. Licensing of commercial fishing operations in the Pitcairn EEZ may also be a further income earner for these islands.

Sub-project: SOL 1**Country: Solomon Islands****Title: Survey of Beche-de-mer and Trochus in the Western Province, with recommendations for management****Date: June/July 1992**

Inputs: T.J.H.Adams (IFRP Senior Inshore Fisheries Scientist)
 J.Leqata, P.Ramohia (Solomon Islands Fisheries Division)
 M.Amos (Vanuatu Fisheries Department)
 P.Lokani (Papua New Guinea Fisheries Department)

Objectives: To accomplish a broad-brush survey of representative parts of the Western Province of the Solomon Islands for the major exploited inshore export resources, familiarising local staff with survey techniques, and transferring skills of local staff in other countries. To provide an opinion on the state of these resources to Government, together with recommendations for ameliorating any adverse findings. To recommend measures to be included in the forthcoming Environment Management Ordinance for the Western Province.

Background: With the provincialisation of the Solomon Islands, the various provinces control the exploitation of fisheries within their own waters whilst the national government handles most fisheries research. This project arose from the need for fisheries input into a planned environment management ordinance, but turned out to require a considerable amount of practical background work before any recommendations could be made. The Solomons Government concentrates on tuna more than any other fisheries research, because tuna is by far the largest export income earner for the country. In general, very little is documented about the state of inshore resources in the Solomons, yet there has been a huge increase in the amount of beche-de-mer exported, and an unexplained slump in trochus exports.

The provision of input to the planned ordinance became secondary to the main task of broadly assessing the current state of trochus and beche-de-mer (and, adventitiously, green snail and blacklip pearl shell) stocks. The work was additionally designed to provide Solomons fisheries staff with the maximum amount of encouragement to carry out surveys in other areas, by familiarisation with non-intensive methods, by observing fisheries officers from other Pacific Islands who have become expert in their fields, and by taking more and more responsibility for running the fieldwork of this project.

Activities: Some time was spent gathering background information on the trochus, beche-de-mer, and greensnail fisheries of the Solomons. In particular analysing the 3-year old export licencing database for records of exports originating in the Western Province, and hence quantifying the very large part that the Province plays in the country's total exports.

Two weeks were spent actively on fieldwork in the Western Province, covering the southeast side of the New Georgia group from Gizo to Tetepare. Mr.Leqata organised the fieldwork as cruise leader on the Fisheries seagoing vessel "Daula", operationally funded (with its 4 crew) by the Fisheries Division with the Western Province paying all fuel costs. The "Daula" was used as a base for daily trips from a smaller outboard-powered boat supplied by the Western province. Most of the work was accomplished without needing SCUBA gear, but Fisheries Division gear was provided.

The trip also provided an opportunity for the new SIFS to meet with the new Research Coordinator at the Forum Fisheries Agency, based in Honiara, and the FFA provided considerable assistance in the form of desk space, library access, and laser-printer usage.

Results: The survey team found all of the surveyed resources to be extremely impoverished in the

areas visited. Indeed, the level of exploitation appeared to go even beyond that experienced during similar "booms" in other countries. This comparative and qualitative result was clearcut and did not need in-depth analysis at this stage. Recommendations were made both to the Western Province Government for legal measures to rationalise exploitation, for the control of companies exporting inshore marine products and for the strengthening of more informal management measures, and to the Fisheries Division for the conduct of further broad-brush and more detailed surveys.

- Response:** The first draft of the report has been received by the Government but is awaiting further discussion between the national and provincial governments before finalisation. Several of the recommendations went beyond the scope of this short survey to investigate feasibility in depth, and will require considerable local input before being adopted. However, plans have already been made for follow-up work by the national research section.
- Follow-up:** The broad-ranging recommendations will almost certainly require some follow-up, which would probably be the identification of a suitable area, and fishery, in which to implement a pilot management scheme. The Western Province Government has also requested that the IFRP assist with the production of guidelines for handling inshore marine product export investment proposals, and the collaboration of the Forum Fisheries Agency's Economics section has been sought.
- Significance:** The problems faced by the Solomon Islands in the overexploitation of inshore invertebrates for export are so huge that this one project can have little direct impact on the problem. What it has done is bring this problem to the attention of the appropriate national authorities, and of the region, and provide a grounding for future work. However, because the findings are so overwhelmingly negative, it is possible that they will not be well received, or be perceived as being too difficult to do anything about. At the very least, these findings provide an object lesson in what can happen to inshore invertebrate stocks given a rapidly-increasing level of export investment. It is a pity that the request for this project was not received two years ago, when there would have been time for pre-emptive measures (based on the "booms" that had already taken place in other countries) to be suggested, at least for the beche-de-mer fishery.

Sub-project: TON 1
Country: Tonga
Title: Review of Inshore Fisheries Assessment Project
Date: November 1989

Inputs: Dr J. L. Munro (ICLARM/IFRP consultant)

Objectives: Review the progress of the Tonga Inshore Reef Assessment and Monitoring Project. Assist in the interpretation of fishery data, including that obtained by controlled fishing with a standardised array of gear, collected by the project. Assist in the design of future data gathering activities, allowing for several different funding scenarios.

Background: In 1987 the Fisheries Division of the Kingdom of Tonga decided to embark on a three-year research programme project designed to test the feasibility of implementing the so-called "ICLARM approach" to the assessment and monitoring of small-scale, multi-species, multi-gear fisheries such as are typified by the fisheries of the island shelf of Tongatapu, the main island in Tonga. The aim was to assess the status of the inshore fishery, and in particular whether key species in the catch were overfished and in need of improved management. Previous information on the artisanal and subsistence fisheries of Tonga are exceedingly sparse.

The methodology, developed by J. L. Munro and the former Principal Fisheries Officer in Tonga, S. T. Fakahau, involves gathering data on catch rates, as well as basic biological information, on key species from a routine fishing programme. The methodology is in contrast to the normally more costly and labour intensive process of gathering statistics from local fishing activities, which is the "normal" approach that has been taken to gathering stock assessment information in the region.

The project was originally funded by USAID, who supported the costs of overseas specialists to work alongside Tongan nationals in gathering and analysing data. However, unanticipated staff turnover half-way through the project meant that Tonga was unable to maintain its commitment to the activity. Subsequently USAID reviewed its funding support in the light of this development.

The Tongan government requested the IFRP to carry out a review of the project in order to assess the results so far and the usefulness of its continuation. The Tonga Fisheries Department specifically requested that the work be carried out by Dr Munro, a British scientist working with the ICLARM Pacific Office, because of his involvement in developing the project. The review was thus carried out as a joint IFRP-ICLARM activity, with ICLARM providing salary and emoluments and the IFRP responsible for travel and associated direct costs.

Results: The review provided an up-to-date assessment of the data gathered so far and the degree to which it would serve the original project aims. It was considered that data collection activities had been extremely thoroughly executed but that analysis and interpretation had not been satisfactorily completed for several reasons, including early lack of access to computers and, later, the staff changes mentioned above. Some deviation from the original project outline occurred, in particular commencement of unscheduled work at Ha'apai before the work at Tongatapu was adequately advanced. This was attributed to lack of input from Tonga Fisheries Department, and inadequate external review of the project.

The review recommended specific options for project completion in the events of three funding scenarios. In each case it was recommended that the Tonga Government seek the inputs and support of the IFRP in ensuring that data analysis is carried out in an appropriate manner. In this context, the regional relevance of the research methodology was underlined.

A report was prepared for Tonga Government action. At Tonga government request, this is still considered confidential.

Response: The only response to the work received was a request that the report remain confidential. USAID committed further funding support to the project in Tonga but no further assistance from the IFRP has been requested. Tonga Fisheries Division still do not provide substantial staff inputs to the project, which continues to be run by overseas specialists with little direction from outside.

Follow-up: In view of the response by government so far, it is not known whether any substantive follow-up action by the IFRP will take place. It is planned to discuss the future of this project with Tonga Fisheries Department officials during March 1991.

Significance: In Tonga, this project, if successfully executed, could provide valuable data on which to base conservation and management plans for specific fisheries, including those for several invertebrates, which are widely considered to be overharvested. The degree to which this will occur, however, depends very much on the interest maintained in the project by the Tongan Government now that key staff involved in initiating and running the project have departed.

Irrespective of its success or failure in Tonga, the methodology promises to lead to reduced costs and improved success of small-scale stock assessment work in other Pacific Island locations.

Sub-project: TON 2
Country: Tonga
Title: Survey of beche-de-mer resources, Ha'apai
Date: June 1990

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
P. Lokani (IFRP associate)
N. Manu, P. Lolohea, V. Kava, T. Atana (Tonga Fisheries Division)

Objectives: Identify the potentially exploitable sea cucumber species present in the Ha'apai island group. Assess the abundance and standing stock of each of these. Using the information gathered, provide advice to the Tonga Fisheries Division on approaches to the development and management of this resource.

Background: The Tonga Government wishes to actively promote beche-de-mer processing as an economic activity for the people of Ha'apai. The Fisheries Division is considering a major extension programme to promote beche-de-mer processing in the area and has allocated funds for this activity in 1991. Prior to initiating extension work, however, the Division wished to commission an assessment of the sea cucumber resource to ensure that development efforts were in line with the capacity of the resource to sustain production.

In mid-1989, the Government of Tonga requested SPC inputs into a survey of beche-de-mer resources in the Ha'apai group, to be carried out in October 1989. Due to logistical problems, however, the survey was postponed twice and ultimately not carried out until June 1990.

Activities: A two-week field survey was conducted by SCUBA diving. 45 dives were completed in the 6 days on which diving could be carried out, and data gathered on the abundance and distribution of the sea cucumber resource. Additional information was obtained from interviews with individuals having past experience of beche-de-mer processing in Tonga, and from the unpublished records of past survey work carried out by a Japanese volunteer in Tonga.

Results: The standing stock of beche-de-mer in water less than 30m deep was estimated to be 1.01 million animals, with an additional, essentially inaccessible, reservoir of some species below this depth. A recommendation was made to the Tonga Fisheries Division to promote harvesting up to a maximum level of about 500,000 animals per year. The value of the resource to local people, if harvested at this level, would be between 0.5 and 1 million Tongan dollars per year.

No management of the resource, other than this total quota, was recommended. However, for reasons of safety and resource conservation it was recommended that all possible steps, including, if necessary, the implementation of new legislation, be taken to prevent the use of SCUBA gear for beche-de-mer collection.

A report of the survey was prepared and forwarded to the Tonga Government. This will be published in 1991 in an IFRP Technical Document.

Response: Tonga Fisheries Department accepted the recommendations regarding total quota and prohibition of SCUBA use. The extension programme is scheduled to begin in 1991.

Follow-up: During a visit by G. L. Preston to the Polynesian Remote Sensing Station (SPT) in Tahiti in November 1990, it was discovered that the station had among its archives a SPOT satellite image of Uiha island and surrounding reefs, which are inside the area surveyed. SPT agreed to undertake a preliminary bathymetric classification of the image for comparison with existing marine charts of the area. The classification was delivered to Noumea in December and will be used in the final published report to give a refined estimate of beche-de-mer abundance in that part of the survey area.

No further specific follow-up to this activity is envisaged. Assistance in establishing procedures for the collection and interpretation of statistics on beche-de-mer harvesting may be necessary once a fishery becomes established.

Significance: In many cases fisheries development activities proceed with little or no consideration given to the ability of the resource to withstand exploitation. If the development is successful, such an approach then runs the risk of causing overfishing, consequent drops in catch rate and then production, and ultimately commercial failure of the development project and disillusionment by local people in the development process.

This sub-project results from a more enlightened approach to development by the Tonga Government. The conduct of a beche-de-mer survey before fishery development work is initiated provides both guidance in the degree to which the Fisheries Division should promote this activity, and baseline data with which future information can be compared. There is now no reason why beche-de-mer harvesting in Ha'apai cannot be established and managed at levels that are sustainable. Consistent sustained production is of benefit to harvesters, processors and buyers and will serve to establish a basis for high-quality product and higher returns to Tongan fishermen.

Sub-project: TON 3
Country: Tonga
Title: Analysis of deep reef-slope fishing data
Date: October 1990/April 1991

Inputs: P. J. Dalzell (IFRP Inshore Fisheries Scientist)
T. Latu, S. Tulua (Tonga Fisheries Division)

Objectives: Provide support to the completion of a 5-year analysis of deep reef-slope fishing data from commercial fishing operations. Based on this analysis, recommend development and management approaches for the fishery to the Tongan government.

Background: The Tongan deep reef-slope fishery is the largest in the South Pacific and supplies high quality fish to domestic and export markets. The fishery is based on deep-water dropline fishing around seamounts.

In 1986, the Tonga Fisheries Division expressed concern that catches from this fishery might not be sustainable given the high rate of development of the fishery, promoted mainly by a UNCDF-subsidised boatbuilding scheme. In 1986, a programme of fishery monitoring using catch, effort and biological data gathered from the commercial fishing fleet, was instituted. The project, which was supported by funding from USAID, was planned to run for 5 years, after which adequate data would have been accumulated to permit a realistic assessment of the potential of the fishery. In the interim, periodic examination of the data gathered has made it clear that some seamount areas have demonstrated marked declines in catch per unit of effort (CPUE) since monitoring commenced.

There are still plans to expand the fishery in Tonga although such expansion might not be sustainable. As the project is due to conclude in 1991, a concise analysis of the data is necessary to clarify the extent to which the fishery should be allowed to grow, and the consequences (in terms of catch and economic return) of progressing beyond this limit.

The departure of key personnel in 1989 has made it necessary for the Tonga Fisheries Division to seek external assistance in the analysis and interpretation of this data. In 1990, the Tonga Government requested IFRP support to this project.

Activities: An initial one-week investigatory visit to Tonga was made by IFS (P. Dalzell) in October 1990 to allow a preliminary examination of data holdings, observe data collection methods, and discuss options whereby the data analysis could be completed.

The following year, two Tongan fisheries officers completed a short three week attachment with the Commission's Fisheries Programme, in Noumea, to work with IFS on the drafting of an interim report on the four years of observations on the Tongan deep reef slope fishery. Funding for the attachment was provided by Tonga Fisheries Division from USAID sources.

Results: During the attachment, all the raw data from the Tongan deep slope fishery was summarised and analysed under the direction of IFS. Estimates of the maximum sustainable yield were computed from the catch data and recommendations made about the expansion of the present fleet size. Management recommendations were made based on the nature of the fishery which primarily targets deep slope stocks on the many seamounts and banks in Tongan

waters.

An interim report was drafted containing all the summarised data and the results of the data analysis. Recommendations were made about the planned introduction of new boats to the fishing fleet, based on the results of these analyses.

Response: The recommendations were accepted for implementation by Tonga Fisheries Division. The drafting of the final report was delayed until 1992 following the implementation of the five country PIMR fisheries project, funded by USAID, which, as part of the Tonga component, assumed responsibility for bottomfish management. In November 1992, a workshop will be convened to discuss the results of the five year stock assessment project, draft the final report and devise a management plan for the Tongan deep slope fishery

Follow-up: Following the workshop, the final report of the project will be completed and, together with the management plan, will be presented to Tonga Government for consideration.

Significance: The deep-bottom fishery in Tonga has expanded from nothing to the country's most important commercial fishery in less than ten years. Experience from the Tongan fishery has shown, however, that deep slope stocks can be rapidly depleted and catch rates become uneconomic forcing fishermen to move to other fishing grounds. This is the most effective strategy for maintaining maximum economic return from the fishery as long as depleted stocks recover and there are plenty of alternative seamounts to support the fishery.

The key element for the successful management of the fishery is the fleet size and hence fishing effort, since too many boats will mean over-exploitation of the resource. If this proves to be true, there is a real danger that many of the boats now operating will go out of business in the next five years, and that the construction of new boats to enter the fishery will make matters worse. This will lead to hardship on the part of the Tongan fishermen that have invested in entry to the fishery, significant reductions in local fish supply, and disillusionment with the fisheries development process and with fishing as an income-earning activity in Tonga.

Quantification of the situation through this project will allow an estimation of the true status of the fishery and provide advice that, if implemented, will maintain fleet size and fishing effort at an optimum level and form the basis of a sustainable fishery for the future.

Sub-project: TUV 1
Country: Tuvalu
Title: Development of fishery statistics system
Date: February 1989

Inputs: P. J. Dalzell (IFRP Inshore Fisheries Scientist)
H. Patiale (Tuvalu Fisheries Division)
T. J. Lawson (SPC Fisheries Statistician)

Objectives: Review and suggest improvements to fishery statistics collection and analysis procedures in Tuvalu. Undertake analyses of existing data to elucidate economic and operational aspects of government-run and privately-run fishing vessels on Funafuti.

Background: The system for gathering statistics on fishery-related activities in Tuvalu was established in 1985 with substantial SPC inputs. Since that time the Commission has attempted to provide ongoing support and technical advice to this and related activities in Tuvalu and in other countries when possible. Since its establishment, the IFRP has become the vehicle through which such country assistance is carried out.

The Tuvalu Fisheries Department wished to extend its data gathering activities to atolls other than Funafuti, where all activity had previously been concentrated, in order to have basic information on fishing activities throughout the archipelago. Improvements to data handling procedures were also given a high priority because of the imminent initiation of several resource assessment activities, including a USAID-funded project to investigate and exploit deep-water snapper stocks.

The IFRP was requested to undertake an advisory visit to Tuvalu in connection with these aims.

Activities: Prior to the visit, background information on SPC involvement with fishery statistics in Tuvalu was sought from the SPC Fisheries Statistician, and a preliminary examination of existing SPC data holdings on Tuvalu carried out. Subsequently, an advisory visit was made by IFRP scientist P. J. Dalzell. This involved a review of Tuvalu's fisheries statistics collection activities, and collaborative work with the Tuvalu Fisheries Statistician in analysing those data already held.

Results: The review suggested specific ways in which data collection activities could be extended to outer islands. A report containing these suggestions, as well as recommendations aimed at improving existing data gathering and analytical procedures by the Tuvalu Fisheries Division was presented to the Tuvalu Government.

On request, a financial and economic analysis of the operations of the Tuvalu share-fishing fleet, which operates with substantial government support, was carried out. A confidential report was submitted detailing the operational costs and revenues of the fleet, whose commercial viability was a subject of debate between government and the Tuvalu National Fishing Corporation.

Response: Recommendations on improvements to, and extension of, data gathering procedures, were

implemented immediately after the conclusion of the review.

Findings from the analysis of economics of the government share-fishing fleet were used as a basis on which to rationalise the operations of these vessels.

Follow-up: A further report on the operating economics and fishing activities of the private fishing fleet on Funafuti is being prepared in collaboration with the Tuvalu Fisheries Statistician, mainly through correspondence.

Significance: The value and application of fishery statistics are grossly undervalued in Pacific Island countries, and statistics collection programmes, where they exist at all, are typically low-key, inconsistent in the information they gather, and suffer from lack of support and trained manpower. In spite of this, fishery statistics are invaluable in gauging the nature and extent of national fisheries, measuring the contribution of fishing to the cash and subsistence economies, assessing the status of fishery resources, and identifying and justifying development activities. The IFRP is active in attempting to raise awareness of the value of fishery statistics, and the ways in which appropriate information, consistent with country needs, can be gathered and applied in a cost-effective way within the capacity of the government to sustain.

This sub-project provided ongoing support and made improvements to statistics gathering procedures in Tuvalu, and produced valuable information on the economics of government-sponsored fishing activities which resulted in a radical improvement in operating practices of the government fleet. The latter result in itself underlines the value of basic statistical information to bodies involved in fishery administration, development and management in Pacific Island countries.

Sub-project: TUV 2
Country: Tuvalu
Title: Survey of pearl oyster resources, Nukulaelae
Date: April 1990

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
M. T. Gentle, M. Naseli (Tuvalu Fisheries Division)
M. Kamatie (Kiribati) (IFRP trainee)

Objectives: Provide support to a survey to assess the status of pearl-oyster stocks in Nukulaelae lagoon. Advise the Tuvalu government on suitable approaches to promoting the development of local pearl-oyster culture activities.

Background: Several characteristics of pearl oyster farming - relatively low set-up cost, relatively low technology, limited infrastructure requirements, and a high-value, non-perishable product - make it a potentially appropriate income earning activity for rural or outer-island people. As a result, the governments of several Pacific Island countries are becoming increasingly interested in investigating the potential of pearl oyster culture as an economic activity, especially in outer islands.

This interest is shared by the government of Tuvalu, which, in late 1989, requested SPC assistance in carrying out surveys of wild pearl oyster stocks in selected Tuvaluan atolls and, where appropriate, in promoting the development of local pearl oyster culture activities. Based on anecdotal information, the atolls thought to have potentially adequate pearl oyster stocks for pearl oyster culture were Nukulaelae, Funafuti, and Nukufetau, in that order.

The IFRP was requested to provide support to the conduct of surveys of pearl-oyster stocks in each of these three atolls. However, it ultimately proved impossible to organise inter-island transport of personnel and diving gear in such a way that would permit all three atolls to be surveyed back-to-back. It was therefore agreed that Nukulaelae would be surveyed first, with surveys of other atolls to be carried out at an agreed later time.

The participation of the Kiribati officer was arranged at the request of the Kiribati government as a hands-on training exercise, in support of further survey work planned for Kiribati (see sub-project report KIR 2).

Activities: The first survey, of Nukulaelae atoll, was carried out during two weeks in April 1990 by a four-man survey team as specified above.

Results: Pearl oyster stocks were determined to be low, especially relative to other countries where pearl oysters have been commercially exploited or cultured. Only four live specimens were found during the field work, although it was possible to examine other live and dead shell that had already been collected by island residents. Present stock levels are not adequate to support the establishment of farming activities on even a very small scale. There is no evidence that stocks were ever vastly more abundant than they are now, or that they have been greatly reduced by human collection activity.

Despite the low abundance of pearl oysters, Nukulaelae lagoon appears to present some

localised areas of suitable pearl oyster habitat. The fact that these are populated by other bivalve species suggests that physical, chemical or biological conditions in the lagoon are limiting pearl oyster population growth. It is speculated that the limitation may be acting at an early point in the pearl oyster life cycle, since the few adults taken from the lagoon during the survey, as well as shells belonging to private individuals, appeared to demonstrate good growth and to reach relatively large sizes.

Further research is required to determine whether pearl oyster population growth could be promoted by enhancing larval settlement and growth using spat collectors and juvenile husbandry methods. The constraints of initiating such a project on Nukulaelae are considerable, and an alternative approach was suggested. This involves initial deployment of spat collectors in Funafuti for research purposes, and the gradual extension of this research to Nukulaelae, and perhaps other Tuvaluan atolls, depending on results, logistics, and institutional arrangements.

A draft report, containing these recommendations, was prepared and discussed with Tuvalu Government officials prior to departure.

Response: Based on the low pearl-oyster densities observed in Nukulaelae, thought to be the most promising location for pearl-oysters in Tuvalu, the Fisheries Division has revised its work programme and will now give further pearl-oyster survey work a low priority, to be carried out opportunistically.

The recommendation regarding research into juvenile settlement in Funafuti was accepted. Division is now planning to incorporate pearl oyster stock enhancement work (through the deployment and maintenance of spat collectors) into an ongoing giant clam culture project on Funafuti.

Follow-up: No specific follow-up is anticipated at this time. Future IFRP involvement will depend on the results of spat-collector trials in Funafuti.

Significance: The atolls of Tuvalu, like those of other central Pacific countries, have few resources on which to base income-earning opportunities. In today's economic climate pearl shell culture would offer such opportunities but in many atoll locations wild stocks of shell were wiped out in the last century. This sub-project represents a step towards re-establishing these stocks and then progressing towards the lucrative but nevertheless simple, low-technology culture of these organisms. There is also a clear link with similar project in Kiribati (see report on sub-project KIR 2) and possibly Marshall Islands (see MAS 1), since the development of successful pearl-oyster culture activities in those locations will provide both a spur, and a possible source of seedstock, for parallel activities in Tuvalu.

This project thus contributes towards the conservation and development of a resource that has great cultural importance in Tuvalu and which also has the potential to provide the basis for economic activity and thus contribute towards social stability in outer island locations.

Sub-project: VAN 1
Country: Vanuatu
Title: Deep-bottom Fishery Data Analysis
Date: June 1989

Inputs: P. J. Dalzell (IFRP)
A. Carlot (Vanuatu Fisheries Department)

Objectives: Determine the effects of exploitation on Vanuatu's deep reef-slope fish stocks.

Background: The efforts of the SPC Deep Sea Fisheries Development Project in Vanuatu during the 1970's led to the establishment of a number of village-based deep reef dropline fishing enterprises, starting in 1982. During the 1980s fishing for deep slope species at the village level expanded rapidly due to Government support through easy credit schemes and subsidised boat building. From 1982 to 1988 this fishery landed between 10 to 85 tonnes of fish (average 50 tonnes) per year.

The study of these and other stocks was initially undertaken by the ORSTOM laboratory in Port Vila. As Vanuatu developed its own capacity for carrying out fisheries research, the Fisheries Department collected catch, fishing effort, catch composition and length-frequency data from the village fisheries, in association with ORSTOM. The accumulated data from 1982 to 1988 remained only partially analysed. By 1989 catches appeared to be declining and it was necessary to examine catch and ancillary data to determine effects of fishing on deep slope stocks

Activities: Mr Albert Carlot of the Vanuatu Fisheries Division in April 1989 was attached to the Inshore Fisheries Research Project for a three-week period. Mr Carlot had previously undertaken training with SPC in computer programming and the use of dBase and Lotus 1-2-3 software, as well as an FFA course on length-based stock assessment methods.

Results: Analysis of the catch data for Vanuatu showed an overall decline in catch per unit of effort (CPUE) with some very marked reductions in certain areas. There was a general decline (over time) in the mean fish size and size of the 95 percentile length of the fish in the catch samples from the village fisheries. Estimates were made of growth parameters for the four commonest species in the Vanuatu catch, based on length data, and of the exploitation rates or ratios of fishing to total mortality rates. These suggested that Vanuatu's deep reef stocks are only moderately exploited.

An estimate was made of the fleet size that would generate maximum sustainable yield (MSY) of deep reef fishes from the present fished area in Vanuatu. Optimal fleet size was found to be between 55 and 140 vessels, depending on the assumptions made about mortality.

The analysis revealed certain deficiencies in data collection which were improved on during 1990 (see report on sub-project VAN 2).

A report on the analysis was prepared and presented to the Vanuatu Government for consideration in planning and managing this fishery in the future.

- Response:** The recommended improvements to data collection procedures have been implemented. Results of the analysis, especially as regards fleet size, will be taken into account by Fisheries Division in future promotion of fishing activities based on this resource.
- Follow-up:** Further studies on Vanuatu's fisheries were undertaken at the USAID/ NMFS workshop on deepwater handline fisheries (see report on sub-project REG 2).
- Fisheries Department continues to collect catch and effort and related data to allow periodic updating of the analysis.
- Significance:** The village-based fishery for deep reef-slope fishes is Vanuatu's most important fin-fish fishery and the only fishery that has resulted exclusively from government development efforts, which are continuing today in an attempt to keep the fishery active and productive. If these efforts are to continue to be successful, the collection of data on the fishery and its application to the development and management process must continue. This sub-project has provided valuable guidance on the nature and extent of the deep reef-slope fish community and the limits to its expansion that the Vanuatu government must take into account if development is to be sustainable over the long term.

Sub-project: VAN 2
Country: Vanuatu
Title: Review of field research activities
Date: February 1990/October 1992

Inputs: P. J. Dalzell (IFRP Inshore Fisheries Scientist)
A. H. Carlot, Moses Amos, R. Lindley (Vanuatu Fisheries Department) E. Cillauren, G. David (ORSTOM)

Objectives: To provide a comprehensive review of research activities on Vanuatu's fisheries resources. If appropriate, to recommend improvements to make ongoing research work more effective.

Background: Most fisheries research activity in Vanuatu is carried out by the Fisheries Department in collaboration with, and with advice from, the French scientific research organisation ORSTOM. Research activities include the gathering of fishery statistics, biological studies on specific organisms of commercial or subsistence importance, and the collection of data on social and economic aspects of fishing activities in the country. From the governments viewpoint, the usefulness of these research activities is in their ability to provide information on which to base fishery development and management decisions.

Occasions have arisen where the differing objectives and targets of the Fisheries Division and ORSTOM have led to disagreements about research priorities and procedures. The SPC IFRP was requested by the Vanuatu Government to carry out an independent review of fishery research activities in Vanuatu and provide guidance and recommendations for future research-related work.

Activities: A two-week advisory mission to Port Vila was undertaken and the research activities of the Vanuatu Fisheries Department and ORSTOM were reviewed. Particular attention was given to research on the village-based deep reef-slope fishery, where changes in the infrastructure have necessitated changes in the fishery sampling methods employed.

Results: The most effective methods of data collection that would satisfy research and information needs on the deep reef-slope fishery were determined. The review revealed the need for changes in the monitoring programme for these fisheries to cope with changes in the infrastructure of the fishery. A number of recommendations were made to this effect.

Other important resources included in the review were trochus and other mother-of-pearl shells, bêche-de-mer and coconut crabs, about whose scale of exploitation little is known. Recommendations were made to the Fisheries Department concerning the collection and compilation of fisheries statistical information on these species.

Some analytical methods were suggested that would reduce the manpower requirements of present and future sampling and monitoring programmes. A report on the review, with recommendations as to the changes needed, was presented to the Vanuatu Government.

Response: After consultation with the Fisheries Department and ORSTOM the changes in the deep slope fishery monitoring programme were initiated during the visit.

Vanuatu Fisheries Department is examining ways to devote additional manpower resources to research-related activities, as recommended in the review.

Follow-up: Following the termination of the working agreement between ORSTOM and Vanuatu's Fisheries Division in 1992, it was decided to expand the research capability of the Division. The assistance of the IFRP was requested to review the existing data collection for the deep slope fishery, examine the research needs for monitoring trochus exploitation and suggest terms of reference for the new post of Research Advisor.

Significance: Fishery research and data gathering activities are an important component of the Vanuatu Fisheries Department's work programme, and represent a substantial financial commitment on the part of Vanuatu Government. This sub-project initially served to provide direction for fishery information gathering activities in Vanuatu whilst the follow up visit should ensure that they remain relevant to the needs of development and management decision-makers.

Sub-project: VAN 3
Country: Vanuatu
Title: Trochus stock assessment
Date: September 1993 (planned)

Inputs: T. J. H. Adams (IFRP Senior Inshore Fisheries Scientist)
Moses Amos (Vanuatu Fisheries Department)
SPC Remote Sensing Consultant

Objectives: In support of an ongoing national project to assess trochus stocks and their response to commercial exploitation in Vanuatu, to perform a case-study on the use of integrated remote sensing techniques (satellite imagery and digitised aerial photography) as a cost-effective method of accurately assessing the area of suitable trochus habitat at certain selected sites.

Background: Trochus shell is one of Vanuatu's most important marine exports, supporting 6 button factories. The Vanuatu trochus fishery has undergone considerable fluctuation in the past, but the present level of exploitation is a cause for concern by the Fisheries Department. A project to assess trochus stocks, and to actively address management problems through artificial restocking with hatchery-reared trochus, was started in 1984 and revived with FAO assistance in 1990. To date, the ongoing research project has achieved many of its aims, but has been unable to test the utility of remote-sensing as a possibly cost-effective tool for assessing trochus habitat (a problem that many other Pacific Island marine biology projects have suffered, due to the slow start-up of practical remote sensing facilities in the region). Following the 1992 CRGA decision to establish a remote sensing facility to support the SPC work-programme, initially the Fisheries Programme, a request was received from the Vanuatu Fisheries Department for assistance in completing this project.

This project, involving specialised techniques and general methodological development, is out of the scope of most national fisheries research units, and will have regional applicability.

Activities: These will depend on the scope of the remote sensing facilities eventually available to the South Pacific Commission, but will involve the acquisition of SPOT imagery, the digitisation of existing aerial photographs and subsequent image processing according to criteria defined by previous work on trochus resource mapping. The cartographic output would be compared against the previous results of conventional surveys. If favourable, the trochus resource "profile" would be extrapolated to other remotely-sensed areas and these same areas surveyed by conventional methods to judge the validity of the extrapolation.

Results: An assessment of the area of suitable trochus habitat at several sites subject to national experiments on reef-reseeding, and an appraisal of the accuracy and cost of using remote sensing methods actively in resource surveys.

Response: The Vanuatu Government has already devoted considerable effort towards trochus stock assessment, and has requested SPC assistance in filling one of the major gaps.

Significance: The project would be similar in type to PAL 2, but rather than the broad-brush focus of that study, would apply RS methods to one species only, at a few sites which have already been surveyed by conventional methods. This is likely to provide a useful and relatively quick first trial at integrating the work of the IFRP and the SPC remote sensing facility, as well as providing a baseline study to assess the success of future artificial enhancement experiments.

The project would draw together two of the newer technologies that the IFRP has been trying to develop in support of national inshore fisheries management:- remote sensing and artificial enhancement of natural stocks through hatchery production. As such, it will be a model for similar initiatives in other countries and on other species, and a first practical trial of a tool that is likely to assume greater and greater significance in future IFRP activity.

APPENDIX 2: REGIONAL SUB-PROJECTS

REG 1	Workshop on Pacific Inshore Fishery Resources (March 1988)
REG 2	Analysis of SPC bottom fishing data (January 1989 - 1992)
REG 3	IFRP/SPRADP Reef Reseeding Project (August 1988 - ongoing)
REG 4	Review of Pacific Island FAD programmes (May - August 1990)
REG 5	Technical papers on Pacific fisheries (March 1989 - ongoing)
REG 6	Special Interest Groups (SIGs) (April 1988 - ongoing)
REG 7	Cooperation in ciguatera research (ongoing)
REG 8	Development of SPC GIS/ remote sensing facility (ongoing)
REG 9	Workshop on Trochus Resource Assessment, Development and Management (May 1991)
REG 10	Study tour of pearl-oyster culture facilities (Planned 1993)
REG 11	Case study of the Aitutaki Trochus Fishery (August/September 1992 and ongoing to September 1993)

Sub-project: REG 1
Country: Regional
Title: Workshop on Pacific Inshore Fishery Resources
Date: March 1988

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
A. D. Lewis (FAO consultant)

Objectives: Summarise present management-related knowledge of the major inshore fishery resources of the South Pacific. Disseminate the practical experience of Pacific Island Fisheries Officers in research and management issues. Familiarise participants with relevant work being carried out in other countries and research institutions. Identify national and regional inshore fishery research priorities and recommend on specific areas of activity to be addressed by the SPC Inshore Fisheries Research Project. Provide opportunities for national participants to review and discuss in-country research project with specialists and other island country representatives working in similar fields.

Background: The 19th Regional Technical Meeting on Fisheries, held in August 1987, supported the organisation of this workshop as the inaugural activity of the newly established Inshore Fisheries Research Project. The workshop was to focus on the major small-scale fishery resources of actual or potential economic value to Pacific Island countries. These included various finfish resources (deep-water snappers, demersal reef and lagoon fish, pelagic species both small and large, sharks), molluscs (giant clams, pearl shell, trochus), crustaceans (deep and shallow-water shrimps, mud crabs, coconut crabs, and others), and a variety of other resources, including beche-de-mer (holothurians), marine algae, and precious and semi-precious corals. Other sessions were devoted to the various methodologies used in inshore fisheries research - survey techniques, the use of remote sensing, collection and interpretation of fishery statistics, and stock assessment approaches.

In each case, the aim was to update participants on the latest available biological and technical knowledge of the topic under discussion, review the work presently under way in countries and research organisations of the region, and identify priority areas of inshore fishery research that need to be addressed in the Pacific Islands region, especially by the IFRP.

Activities: Organisation of the workshop began in August 1987, immediately after the RTMF recommendation was formulated. Workshop-related issues continued to be a full-time activity for the two organisers until after its conclusion in March 1988, when the final task of compiling the workshop report was completed.

Results: The workshop proved to be a timely and important exchange of information, beyond the expectations of the organisers. Each session was moderated by a specialist in the topic field under discussion, who presented a review paper on the subject. Individual presentations followed, after which the floor opened for often animated discussion and question/answer sessions.

A total of over 150 papers were tabled, many of which consolidated data and information that might otherwise have remained largely unavailable to other researchers. Despite the 2-

week duration of the workshop, it was necessary to continue the sessions late into the evenings and on the mid-meeting weekend in order to accommodate the ambitious agenda.

The amount of information generated by the workshop has been substantial and is of particular value to those researchers who work in remote archipelagic areas with poor communications and limited access to relevant information from elsewhere - a common problem in the Pacific Islands region. As a communication service, the workshop provided an impetus that the Commission plans to maintain by establishing and strengthening contact groups of workers with like interests. The workshop also filled its function of providing guidance for the development of the IFRP, which now has a clear indication of those research areas considered as priorities by SPC member countries.

Outputs: As well as a synthetic workshop report, approximately 150 working, background and information papers were produced and circulated in the region after first being tabled at the workshop. Some of these will be published in IFRP Technical Documents (see sub-project REG 5)

The meeting also identified numerous specific constraints that affect the assessment and management of Pacific Island inshore fishery resources, and prioritised a number of areas for action by the Inshore Fisheries Research Project.

Follow-up: Numerous areas were identified for action by the IFRP in future, and some of these have since been formalised as sub-projects REG 3, REG 5 and REG 6.

Further occasional workshops of this nature are anticipated at 3-4 year intervals, which will provide for periodic updating of the information available to the region while remaining within the capacity of the project to organise. Specific related activities are sub-projects REG 9, REG 10, REG 11.

Significance: This workshop had a significant impact both in focusing attention on issues relating to the integration of marine resource assessment and management into fisheries development work, and in defining future IFRP work priorities. The IFRP continues to be guided by the discussions and resolutions that came out of the meeting. The value of the technical material produced is underlined by the fact that, at an ACIAR-sponsored meeting of Pacific Island fishery economists and planners in Tasmania in 1990, a senior speaker asked to address the participants referred to the workshop papers as the single most important set of documents that should be read by outsiders wanting to understand the nature of fisheries in the region.

Sub-project: REG 2
Country: Regional
Title: Analysis of SPC bottom fishing data
Date: January 1989—1992

Inputs: P. J. Dalzell (IFRP consultant)
G. L. Preston (IFRP Senior Inshore Fisheries Scientist)

Objectives: Analyse historical SPC deep-bottom fishing data to provide estimates of productivity and potential fishery yield of these resources in Pacific Island countries. Examine the data for information on regional trends in biological or other characteristics of the deep-bottom fishery. Through participation in and technical support to a USAID sponsored Workshop on Pacific Island Fish Stock Assessment, assist fishery scientists from Pacific Island countries perform assessments of national or local deep-bottom fishery resources.

Background: Survey fishing by the SPC Deep Sea Fisheries Development Project (DSFDP), targeting the snapper-grouper complex that live beyond the shallow reef, has been carried out in nearly every country and territory in the region. Each master fisherman keeps extensive records of his fishing activities and these extend from 1975 to the present. The fishermen record in detail the hourly catch rates by numbers and weight during each fishing trip and as far as possible identify each species in the catch. The SPC records therefore represents a unique body of information on fishing, often on virgin stocks, throughout the region.

Successive SPC Regional Technical Meetings on Fisheries (RTMF's) have recognised the potential value of the SPC data base, and three separate RTMF's have recommended that the Commission undertake a detailed analysis of the data. Until the establishment of the IFRP, the SPC had no mechanism through which to address these recommendations. Once the project was established this analysis was carried out through a collaborative arrangement with ICLARM, whereby a fishery scientist was made available on a consultancy basis for 9 months during late 1988/ early 1989 to undertake the work.

The sub-project was timed in such a way that the consultant could provide inputs and support to a Workshop on Tropical Fishery Stock Assessment in the South Pacific, sponsored by USAID and hosted by the Honolulu Laboratory of the US National Marine Fisheries Service, 5-26 July 1989. The purpose of the workshop was to bring together Pacific Island fisheries scientists with data on deep-bottom fisheries for analysis under specialist supervision SPC had previously been requested to assist by providing a resource assessment tutor to assist the Pacific Island scientists, and by making available SPC DSFDP data on deep reef stocks.

Activities: During February 1989 a computer database was created for the summary and analysis of the master fishermen's fishing activities. As records were entered into computer files, summaries of catch rates and catch composition, giving details of each country visit and associated activities were prepared.

The master fishermen's data were analysed on the basis of island type with respect to catch rates and catch composition. Variations in catch rate with depth and time of day were also examined.

These activities provided the basis for a preliminary analysis of the dropline data that was presented at the USAID/NMFS workshop. The bulk of the workshop, however, consisted

of aiding Pacific Island fishery scientists with the analysis of their own data. The workshop focused on the dynamics of fisheries in non-equilibrium situations and on the use of short-term and long-term depletion models. These models were used in conjunction with the participants own data sets and estimates were made of the biomass of deep reef fish at different islands and seamounts.

Most effort concentrated on data from Fiji and Tonga, which had the largest data sets from export fisheries targeting on deep reef eteline stocks (see sub-project TON 3). A large data base was brought from Vanuatu along with a report on the analyses of Vanuatu's data from a recent SPC attachment (see sub-project VAN 1). A data base from survey fishing on the outer banks of Western Samoa was also examined as were two fishing records from Papua New Guinea, one on a series of small islands and the other a depletion study of a small seamount.

Results: A synthesis of fishery-related biological information on Pacific deep reef fishes has been completed. Estimates were made of the extent of the habitat of deep reef slope fishes in the South Pacific, in as far as possible on an island-by-island basis. The total extent of the deep reef area, estimates of potential yield and the possible value of the deep reef fish resource in each country of the region were made. A comprehensive technical report providing readily accessible information on the deep-slope fish resource regionally and by country/territory, for use by fisheries officers, development planners and administrators was published in 1992.

Workshop participants were taught to compute maximum sustainable yield (MSY) using a variety of different approaches, and to understand the reasoning behind them. The workshop also gave the Pacific Islands scientists chance to interact with common problems and to share skills and ideas.

Reports from the workshop, dealing with stock assessment methodology, aspects of the resources of the region as a whole, and specific case studies in PNG, Western Samoa, Tonga, Fiji and Vanuatu, were published by NMFS in 1990.

The workshop draft of the report on the analysis of the SPC deep reef slope data base was used as the basis for an IFRP technical report written between 1990 and 1992. This report contained the analysis of the data and data summaries of each country visit by masterfishermen, showing the location of fishing, catch rates and species composition

Response: This work was initiated at the express and repeated request of Pacific Island Fisheries Departments. Constructive use has already been made in some countries of the data generated by the sub-project. This is likely to be extended further by the wider dissemination of results during 1992

Follow-up: Further assistance to countries in assessing and managing deep-slope fish resources will be provided as required.

Significance: As a result of this work, and related national projects (FSM 3, TON 3, VAN 1), there is a generally improving awareness at the decision-making level in Pacific Island countries of the need to consider deep reef-slope fish resources as finite and fragile and requiring a conservative management approach. This approach will be essential if fisheries based on these resources are to provide long-term sustainable sources of income and food for Pacific Islanders.

Sub-project: REG 3
Country: Regional
Title: IFRP/SPRADP Reef Reseeding Project
Date: August 1988 - ongoing

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
H. Tanaka (FAO Regional Aquaculture Development Project)

Objectives: Increase awareness of the potentials and limitations of projects to enhance marine resources through restocking with hatchery-produced juveniles. Identify species which might be amenable to resource enhancement in this way. For these species, support the development of appropriate aquaculture procedures that will permit enhancement of natural populations.

Background: The activities of the South Pacific Regional Aquaculture Development Project (SPRADP), as well as other organisations (ICLARM, MMDC, IFREMER, ACIAR, SPC), have aroused regional interest in the mariculture of juveniles of commercially exploited inshore marine organisms for use in programs of resource enhancement by reef restocking. Animals being considered for this type of activity include trochus, pearl shell, and beche-de-mer. However, most attention has focused on aquaculture technology and techniques and the mechanics of producing seed in large numbers. Little work has been done to assess the real effects of juvenile release on wild, exploited populations of tropical reef organisms.

Working cooperatively, the IFRP and SPRADP are undertaking a two-phase research programme to address this issue. The first phase consisted of literature research aimed at reviewing the results of relevant juvenile release programmes carried out elsewhere. Phase two was planned to consist of at least one juvenile release and population monitoring experiment, involving one or more interested national fisheries bodies. The first of these was a release of juvenile trochus (*Trochus niloticus*) on a reef in Vanuatu, that took place in May 1991 during the SPC/SPRADP Workshop on Trochus Resource Assessment, Development and Management (see sub-project REG 9). Further experiments will be planned on an opportunistic basis.

Results: Several bibliographic searches were carried out and a body of reference material, including Japanese publications and internal documents on this topic, accumulated. A working paper based on this research was submitted to and discussed at the 22nd Regional Technical Meeting on Fisheries (RTMF) (which subsequently recommended that SPC should organise a regional workshop on this topic). Additional material is still being gathered and translated and it is anticipated that the working paper will ultimately be upgraded and published as a technical document.

The release of approximately 2,000 juvenile trochus took place on a reef in Vanuatu in May 1991. These animals, which were tagged, have been monitored during the subsequent year and repeated measurements made in order to provide data for estimation of growth and survival rates. This data will be analysed jointly by SPC and the Vanuatu Government at the end of 1992. This and, when possible, other juvenile release experiments will provide quantitative information on the potential for juvenile release as a means of resource enhancement.

Response: Considerable regional awareness of and interest in the subject, as signified by the recommendation of the 22nd RTMF that SPC should organise a dedicated regional

workshop on this topic (see below).

Follow-up In response to the RTMF recommendation, a workshop on Pacific Island fishery resource enhancement was tentatively planned for late 1991/ early 1992. It was planned that the workshop would allow the presentation and exchange of recent information on various aspects of marine resource enhancement. However, lack of manpower and financial resources in both organisations at that time ultimately prevented the workshop from taking place as scheduled.

If the technical workshop is to be held as recommended by RTMF 22, it will need financial support. This was expected to come principally from SPRADP, but in August 1992 SPRADP reached the end of its present funding cycle. It is not presently known whether this project will be extended or replaced (although this seems likely). In the interim, unless other funding is located, it seems unlikely that the workshop as recommended can be organised by SPC.

Alternative mechanisms are thus being investigated to allow this interchange to take place. IFRP staff proposed a symposium on "resource enhancement through aquaculture" to be held as part of the Pacific Science Council Inter-Congress to be held in Okinawa in 1993, and the organisers are apparently investigating the feasibility of this approach.

Significance: There is a generally increasing awareness of the potentials and limitations of juvenile production and habitat modification as resource enhancement tools. As well as providing direction to national governments in considering resource enhancement activities in the context of their own fishery development programmes, this sub-project is gradually leading to a change in the perception of the contribution that aquaculture can make to fisheries development in the region. "Traditional" aquaculture projects have a very poor track record in the Pacific Islands: social, cultural and economic factors have combined to cause the failure of practically all attempts to carry out aquaculture as a food-producing activity in the region. However, "alternative" aquaculture, such as extensive farming of locally-available, sedentary marine species may have a role in outer island economies (e.g seaweed, pearl-oysters) or in improving the production of exploited wild populations.

If this sub-project achieves its long-term goals, it will enable the identification of ways in which aquaculture can make meaningful contributions to fishery development in the region and allow the institution of aquaculture activities that are more in tune with regional needs and operating constraints.

This sub-project is linked to several national-level sub-projects, including KIR 1, KIR 2, MAS 1, TUV 2, and REG 9. Follow-up work associated with these sub-projects may provide additional information-gathering opportunities on resource enhancement through the use of juvenile release.

Sub-project: REG 4
Country: Regional
Title: Review of Pacific Island FAD programmes
Date: May - August 1990

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
P. D. Gates (SPC consultant)

Objectives: Review the use of fish aggregation devices as resource enhancement tools in the Pacific Islands region. Identify means by which the SPC Fisheries Programme can support member countries efforts in this area in the future.

Background: Fish aggregation devices (FADs) are in widespread use as fishery enhancement tools throughout the Pacific Islands region. For the past 8 years the SPC has been instrumental in developing FAD technology and in supporting country efforts to establish effective FAD programmes. However, the Commission has not so far been involved in longer-term research or development programmes aimed at extending the benefits of FAD technology to Pacific Island fishermen, or at improving FAD performance in biological or economic terms, other than through engineering work to improve FAD longevity. This has long been felt to be an area in which the Commission should be more active, given its relevance to several components of the SPC Fisheries Programme.

An invitation for SPC to participate in an Indo-Pacific Fisheries Commission (IPFC) symposium on FADs and artificial reefs provided an impetus to review the problems and issues still facing Pacific Island countries in this area. The aim of the review was to assess the role of FADs in fisheries development activities in SPC member countries, examine regional experience in using FADs to support national fisheries development efforts, and identify strengths and weaknesses in these areas. Based on this, areas where SPC might support member countries efforts, and ways in which regional FAD research activities might support national efforts, were assessed.

The information gathered was also intended to form the basis of a more in-depth analysis of country experience in FAD use carried out by an SPC consultant.

Results: The review was presented as a symposium paper at the IPFC Symposium in May 1989. The symposium helped guide IPFC policy on FAD research, and will have implications regarding FAO support to FAD-related projects in the Pacific Islands region.

The review was also presented as part of the one-day workshop on FADs at the 22nd Regional Technical Meeting on Fisheries, which subsequently made recommendations as to future work by the Commission on FADs. As a result of the workshop, the Commission has renewed its commitment to FAD work, and to supporting improvements in national efforts to deploy and use FADs.

Response: The expansion of SPC's work in this area is viewed as a positive step forward by countries of the region and one which result in further benefits to those with active FAD programmes.

Follow-up: A handbook on FAD design and deployment is now in preparation, and planning of a

regional project to examine innovative FAD design modifications, as well as several experimental fishing techniques around FADs, is under way. Larger scale research on FADs will also be undertaken within the framework of two larger-scale projects aimed at industrial tuna fishery development. These activities will form part of the SPC Fisheries Programme as a whole, but will require IFRP inputs.

Significance: The use of FADs remains an important element in national fisheries development efforts in almost all countries of the region. SPC's traditional involvement in design aspects has resulted in significant improvements to the longevity and cost-effectiveness of FADs in the region. Future FAD-related work will expand on that already done to allow further operational improvements, as well as a more complete understanding of the manner in which FADs function and their effects on the resources whose capture they facilitate.

Sub-project: **REG 5**
Country: **Regional**
Title: **Technical papers on Pacific fisheries**
Date: **March 1989 - ongoing**

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
P. J. Dalzell (IFRP Inshore Fisheries Scientist)

Objectives: To improve the flow of technical information on fisheries to potential users by promoting better documentation of fishery research, development and management activities in the region.

Background: Problems in the production of permanent records of fisheries research and development activities and data in the region have been noted in numerous fisheries development reports and meetings, and were highlighted as a major cause for concern at the SPC Workshop on Pacific Inshore Fishery Resources (IFRW), held in March 1988 (see sub-project REG 1). As a result of not documenting work that has been carried out, the work itself loses its value, and information is not circulated to other potential beneficiaries. Because of this problem, there are many cases of wasteful repetition of fisheries activities in different countries, or even over time in the same country.

The writing and report production skills of scientific and technical fisheries workers in the region are generally poor. Further, there is often no infrastructure in national government departments to support the production of technical reports beyond the manuscript stage. The flow of relevant data to management and decision makers, as well as to other workers dealing with the same subject matter, is thus impeded, a situation which is clearly counter-productive.

Since the establishment of the IFRP, SPC has been examining ways of improving the degree to which the regions fisheries activities are documented and the results made more widely available. The establishment of the SPC Fisheries Information Project, and of SIGs (see sub-project REG) are two approaches to this problem: a third is to provide a greater degree of support to national workers in writing up their work, preparing it for publication, and facilitating publication in a suitable vehicle for dissemination.

A three-part approach to this problem has now been developed. The three elements are:

- provision of training in technical report writing and data presentation for national fisheries workers;
- provision of support facilities, including editorial help, and drafting, typing and layout services;
- establishment of a suitable publication vehicle.

Activities: An occasional technical paper series, in which fisheries reports can be published, has been established. The first issue, published in 1992, consists largely of selected papers from the IFRW, manuscripts that have already been submitted to the SPC Fisheries Newsletter, and solicited manuscripts.

This approach has several advantages: it allows publication of the better IFRW papers, as has been requested by several SPC member countries; it frees the SPC Fisheries Newsletter to focus on more topical issues, and to provide more detailed coverage of SPC activities, as per its mandate; and it has allowed the establishment of the technical paper series and familiarisation to potential contributors.

Subsequently, the series will rely on contributions by fisheries workers in the region. These will be encouraged by correspondence and during duty travel by project staff, who will provide in-country editorial assistance and advice when required. Activities carried out as part of related sub-project PNG 1 are expected to lead to the production of a number of technical reports for publication in this series.

- Results:** The first issues of the technical paper series, focusing on IFRW papers was published in 1992. The second issue is in preparation.
- Response:** Strong support for the concept has been received from fisheries workers and administrators in the region, both individually and institutionally.
- Follow-up:** Further activities, including continuation of the series over the long-term, and the training element, will depend on the location of additional funding support for this activity.
- Significance:** The completion and publication of outstanding technical documents will significantly improve the flow of information on fishery research and development activities from field workers to those responsible for management and decision making. Over the long term, the body of baseline information on regional resources will continue to grow and improve in availability. This increased availability will in turn reduce the likelihood of work being duplicated, and valuable development funds wasted, throughout the region.

Sub-project: REG 6
Country: Regional
Title: Special Interest Groups (SIGs)
Date: April 1988 - ongoing

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
P. J. Dalzell (IFRP Inshore Fisheries Scientist)
J-P. Gaudechoux (SPC Fisheries Information Officer)

Objectives: Promote rapid and timely exchange of information on current fishery research, development and management activities of topical interest in the region. Encourage the formation of professional contact and interchange among technical fishery workers of the region.

Background: A major concern expressed by participants at the SPC Workshop on Pacific Inshore Fishery Resources (IFRW), one of whose functions was to provide guidance to the work of the IFRP, was the low level of communication and information exchange occurring in the Pacific Islands region.

As a means of improving information flow on fisheries issues, the establishment of Special Interest Groups (SIGs) on particular issues of interest to fishery workers was proposed. The SIG concept involves establishing networks of fishery workers with similar interests, then actively maintaining an information flow between them.

The establishment and maintenance of the SIGs is the responsibility of the SPC Fisheries Information Officer. However, given the technical nature of the information being exchanged, inputs from the IFRP are extensive and involve reviewing all material before publication, preparation of articles based on SPC work or on published material, and active soliciting of contributions from professional contacts.

Activities: Support to the SIGs mainly involves circulating a periodic information bulletin on the topic in question. Additional activities include soliciting information on members current activities, and providing question-and-answer, bibliographic and library-associated services.

To initiate the SIGs, a questionnaire seeking information on the interests of regional fishery workers was circulated in 1988. About 300 responses have been received to date and these have been entered onto a computerised database so that members can be sorted according to areas of interest, and mailing lists can be automated. From the responses, a number of common areas of interest have been identified and the first SIGs to be established therefore focus on these topics. It is anticipated that further SIGs will be initiated as this activity proceeds.

Results: SIGs have been established, and six-monthly information bulletins published, as follows:

Subject	Issue 1	Issue 2	Issue 3	Issue 4	Issue 5	Issue 6
Beche-de-mer	Published	Published	Published	In Press		
Pearl Oyster	Published	Published	Published	Published	Published	In Press
Ciguatera	Published	Published	In Press			
Trochus and the shell industry	Published	In Press				
Traditional Marine resource management and knowledge	Published	In press				
Fish Aggregation Devices	In Press					
Fisheries Education & Training	In Press					

Response: The response to the SIGs from technical fishery workers both inside and outside the region has been excellent, and contributions are now being received regularly, without pressure from SPC, from regional members of the beche-de-mer and pearl oyster groups.

Follow-up: Production of Information Bulletins and the promotion of information exchange will be maintained and expanded.

Significance: The active response that the SIG sub-project has received has never previously been observed with other information exchange programmes in SPC. This positive and enthusiastic involvement by fishery workers throughout and beyond the region supports us both in our belief that the SIG concept is timely and appropriate, and in our commitment to maintain timely production schedules for the bulletins.

Sub-project: REG 7
Country: Regional
Title: Cooperation in ciguatera research
Date: ongoing

Inputs: P. J. Dalzell (IFRP Inshore Fisheries Scientist)
 G. L. Preston (IFRP Senior Inshore Fisheries Scientist)

Objectives: Promote an improved understanding of the problem of ciguatera fish poisoning at individual, community, national and international levels. Gather information on the extent, distribution and nature of ciguatera poisoning events in the region. Provide information and education to reduce the impact of ciguatera. Identify and support appropriate ciguatera research activities in the region.

Background: Ciguatera fish poisoning is of widespread occurrence in the region and has impacts on both health and economic development in Pacific Island countries. Despite its widespread occurrence, the true extent or importance of ciguatera poisoning is not fully understood. The lack of adequate reporting procedures for ciguatera cases constrains identification of locally responsible fish species or fishing areas and thus obstructs efforts to minimise the impact of ciguatera, both on population health, and in terms of its deleterious effects on fisheries development projects.

The Commission has traditionally played an important role in promoting ciguatera research and encouraging the flow of information on the topic in the region. The SPC Health Programme has attempted to incorporate reporting of ciguatera into the South Pacific Epidemiological Health Information System (SPEHIS) while the Fisheries Programme has supported several national-level projects to assess local ciguatera causes and impacts (e.g. sub-projects FSM 1 and FSM 2). In addition, the Commission has published a handbook on ciguatera poisoning (now out of print, and being revised by the SPC Fish Handling and Processing Officer), and has convened several meetings of specialists to enable dissemination of information on recent research into ciguatera testing and treatment.

There have been a number of important developments relevant to ciguatera in recent years, including the gradual improvement of a chemical test to detect ciguatoxin in fish flesh, and the discovery of a treatment that promises to promote rapid recovery for victims of severe poisoning events. A growing understanding of the ecology of toxin production also ultimately promises to enable high-risk areas or fish to be identified with improving reliability.

Activities: An inter-disciplinary committee has been formed to ensure coordinated SPC responses to problems involving ciguatera. This subject has relevance to the Fisheries, Health, and Nutrition sections, and all are represented on the committee. A Special Interest Group (see sub-project REG 6) on ciguatera has been formed and work on the first Information Bulletin for this group were published in May 1991 and July 1992

Following the approval of the 22 RTMF a seafood poisoning database (designed chiefly to report ciguatera poisonings) was established in 1990 under the supervision of the IFRP. The database was publicised through the Fisheries and Health Programme Newsletters and later through the national and international news media. To date, over 300 case histories from six countries in the region have been received and entered on the database.

The Commission assisted with the organisation of the Fifth International Conference on Ciguatera Poisoning, held in Tahiti in 1992, and the IFS (P.Dalzell) was included on the Scientific Organising Committee for the conference. The meeting was the first to be held on this topic in the region for some years and brought together up-to-date clinical, biological and economic research on ciguatera. The Commission's involvement encouraged a significant participation from Pacific Island countries and IFRP was instrumental in supporting attendance at the meeting by representatives from the Solomon Islands and the Federated States of Micronesia.

- Results** It is anticipated that this work will result in improved documentation of the true extent of ciguatera poisoning in the region, the distribution of the toxicity and of its causative agents, the environmental causes of ciguatera and ways of mitigating against them, and the identification of high-risk fish species and fishing areas that will serve as the focus of local attempts to minimise the incidence of ciguatera.
- Response:** Countries of the region expect that the Commission will remain at the forefront of regional work on ciguatera, and continue to provide strong encouragement and support to it in its efforts to do so.
- Follow-up:** The Commission will continue to maintain its commitment to this topic area with ongoing activities as noted above. The Commission has been invited to participate in a workshop on ciguatera management in the region to be held in Australia during 1993.
- Significance:** Ciguatera continues to be an important cause for concern in Pacific Island countries, mainly from the viewpoint of fisheries development, but also in terms of public health. Island governments have traditionally recognised that an international approach is needed in dealing with questions of ciguatera research and prevention, and the South Pacific Commission has traditionally been charged with the responsibility of actively promoting work in this area, a responsibility which continues today. It is anticipated that as research into ciguatera proceeds the Commission will continue in the important task of applying the results of this research to solving the specific problems caused by ciguatera to Pacific Island countries.

Sub-project: REG 8
Country: Regional
Title: Development of SPC GIS/ remote sensing facility
Date: ongoing

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
 T. J. H. Adams (IFRP Senior Inshore Fisheries Scientist)
 J. de Meijere, P. Colotte (EC consultants)
 D. van Claasen (ACIAR consultant)

Objectives: Improve the availability of geographic information data within SPC through the development of a computerised geographic information system (GIS). Establish mechanisms whereby remotely sensed data relevant to the SPC work programme be made accessible to potential users. Where appropriate, provide support to member countries in these areas.

Background: As part of a multi-disciplinary approach to improving SPC information resources and services, the Commission has been investigating the feasibility and usefulness to member countries of establishing a Geographical Information System, and associated image processing facilities for the analysis of remotely sensed (satellite and airborne platform) data.

In 1992 the CRGA approved the setting-up of a remote-sensing facility at SPC to provide support to SPC work-programmes, starting with the Fisheries Programme. EC funding to French Pacific territories has been earmarked to support this facility, and the French Pacific territories agreed that the benefits of this project should apply to the whole region at the October 1992 CRGA.

The IFRP has been instrumental in developing this initiative due to a perception of the usefulness of this data in marine resource assessment, and has maintained a high degree of interest and involvement in the evolution of this project. Several planned IFRP projects will be the first to benefit from this new facility.

Activities: IFRP scientist G. L. Preston has attended a number of technical meetings and conference on aspects of the topic. These include: Symposium on Remote Sensing of the Coastal Zone, Southport, Australia, September 1988; MicroBRIAN User Group Meeting, Brisbane, Australia, September 1988; and International Workshop on Remote Sensing and Insular Environments in the Pacific, Noumea, New Caledonia and Papeete, French Polynesia, November 1990 (SIFS).

As a result of information gathered at these conventions and from the literature, remotely sensed data has been used to good effect in several national-level projects, including COK 1, PAL 3, TON 2 and COK 2. Numerous other opportunities to use remotely sensed data in field projects have been missed in the past because SPC did not have in-house image storage, processing and retrieval facilities.

The incoming SIFS, Dr.T. Adams, has had long experience with the Fiji Government's Remote Sensing Coordinating Committee, and in researching ways of integrating remote sensing into the Fiji Fisheries Division's work programme.

Results: Once the R/S facility is in place at SPC, it will initially be fully utilised in support of IFRP

activities (particularly PAL 2 and VAN 3). An EC-funded consultant will be engaged to integrate the hardware with appropriate software, to oversee the acquisition of useful images, and to develop links with other agencies.

In future, it is expected that almost every IFRP-type activity that SPC undertakes, particularly the planned major focus on the production of management plans, will involve the use of this facility. Almost every such project requires geographically-oriented information in an area where such information is grossly inadequate, and the facility will be able to fill in a lot of cartographic blanks even where not used for more sophisticated applications like habitat classification.

Response: The use of GIS/RS in Pacific Island countries is growing rapidly, with several agencies having developed in-house facilities and becoming involved in major resource assessment and inventory projects. A number of Fisheries Departments are currently examining the ways in which GIS/RS can assist their work, and support for an SPC GIS/RS facility has been expressed informally by a number of them. The 22nd Regional Technical Meeting on Fisheries expressed its support for the continuation of the initiative taken so far in investigating the ways in which GIS/RS technology could benefit the work of the SPC Fisheries Programme.

Significance: GIS/RS technology has the potential to dramatically improve the capacity of fishery research workers to gather information from the field in an efficient and cost-effective manner. The value of survey data can be considerably enhanced by supplementary data from remote observation platforms, especially in the case of areas that are remote or difficult to access. Storage of data in a geographic format can make the application, comparison or interpretation of data more efficient and lead to increases in the likelihood of its being put to effective use.

The application of GIS/RS technology to problems of inshore fishery resource assessment and monitoring in the Pacific Islands region is only poorly developed at present. Through a combination of information gathering and the testing of specific applications in-country, the IFRP is mediating a gradual increase in awareness of the potentials and limitations of GIS/RS technology among fisheries workers in the region. This will ultimately lead to the conduct of more efficient, cost-effective and rapid assessment and information gathering activities concerning the regions inshore fishery resources.

Sub-project: REG 9
Country: Regional
Title: Workshop on Trochus Resource Assessment, Development and Management
Date: May 1991 and ongoing

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)
H. Tanaka (FAO Regional Aquaculture Development Project)

Objectives: Update participants on recent developments in trochus processing and marketing. Expose participants to current biological and aquacultural information relevant to trochus fishery resource assessment and management. Train selected participants in the conduct of field work aimed at providing assessment of the status of local trochus resources. In so doing, develop a standard trochus survey methodology for use within the region, so as to allow comparison of survey data in the future. Promote an exchange of trochus fishery management experiences in the region in order to promote effective management of this important resource.

Background: The topshell, *Trochus niloticus*, is native to countries of the Western Pacific, and has been introduced to many additional locations throughout the Pacific Islands. This shell is collected and exported for button-making and other uses, and provides an important source of income for rural and outer island dwellers in the region.

In recent years, the value of trochus shell has increased markedly. As a result, the level of exploitation has also increased in many Pacific Island countries. There are fears in some locations that present levels of harvesting will not be sustainable and that serious resource depletion will occur if management regimes are not developed and instituted. This will result in undesirable consequences for those communities to which trochus harvesting is presently economically important.

The 22nd South Pacific Commission Regional Technical Meeting on Fisheries, held in Noumea in August 1990, discussed this issue in some depth. The meeting also discussed several related topics, including: factors determining regional and global variation in trochus quality, and therefore value; the merits of regional cooperation in the marketing of marine products, including trochus, as a means of increasing economic returns to Pacific Island countries from the resource; and appropriate management approaches for trochus and other marine resources, including the use of hatchery-produced juveniles to replenish depleted natural populations.

As a result of these discussions, the meeting recommended that the South Pacific Commission take action to assist Pacific Island countries in maximising the returns they obtain from their trochus resources by promoting regional collaboration and information exchange in the development of effective exploitation, marketing and management systems.

Activities: As part of its response to these recommendations, the Commission, through the IFRP, organised a 3-week Workshop on Trochus Resource Development and Management. Given the interdisciplinary nature of the topic, the workshop was executed in collaboration with the South Pacific Regional Aquaculture Development Project, and specialist input was derived from many sources, both from the main trochus-producing countries of the region, and from some of the main trochus importing countries external to the region.

The workshop lasted for three weeks, from Monday 13 May to Saturday 1 June inclusive, and will be structured as three one-week segments. Week one covered aspects of trochus biology and life history, population dynamics, resource assessment methods, hatchery technology and juvenile propagation, resource management, shell processing and quality assessment, and marketing. Week two focused specifically on comparing field survey methods for trochus and similar species, and also included an experiment to monitor the effects of a mass release of trochus juveniles in a selected location (see sub-project REG 3 for more details). Week three provided an opportunity for participants to carry out an intensive field survey on Aneityum Island using the standardised methods developed and taught during week two. (The Aneityum survey also formed part of Vanuatu Fisheries Department's national trochus assessment project and thus provided important support for trochus resource development in Vanuatu).

Workshop sessions were coordinated by resource personnel from SPC, SPRADP and FFA, as well as by external specialists. Sessions during week one consisted of lectures, discussion sessions, and site visits to processing factories, aquaculture facilities, and other locations of interest. In addition, weeks two and three involved extensive field work that required snorkelling (free-diving) for between two and six hours per day.

- Results:** Participants who completed week 1 acquired a broad understanding of issues relating to aspects of trochus fishery development and management. Participants who also completed week two were exposed to a variety of field research and survey methods (including a multiple mark-recapture experiment) that will provide guidance in the assessment of other sedentary marine resources. Participants who attended for the full three weeks should now be in a position to carry out or supervise full-scale field surveys for trochus in their own countries. An SPC technical report, containing most of the papers presented during the workshop, together with a summary of discussion, is in preparation and is planned to be published before the end of 1992.
- Response:** The workshop was organised in direct response to a problem identified by the 22nd RTMF. There was considerable interest in the workshop and a large number of nominations were received, of which about 40 were ultimately accepted. The workshop was felt to be extremely useful and many of the returning participants have initiated new research into trochus as a result, particularly FSM and Vanuatu. The project directly stimulated further sub-projects (see SOL 1, COK 2 and REG 11), and the consistent follow-through, which will include the production of a manual of standard stock assessment methods, has received very favourable comment.
- Significance:** This fishery, which had an estimated value of about US\$26 million in 1986, provides one of the few income-earning opportunities available to coastal dwellers in many Pacific Island locations. The management of the resource to ensure sustained production in the face of increasing harvesting pressure is a challenge facing many Pacific Island governments. The workshop has had a significant impact in generating an improved understanding of the nature of the resource, and ways in which the benefits local communities draw from it can be maximised, on the part of island fisheries officers.

Sub-project: REG 10
Country: Regional
Title: Study tour of pearl-oyster culture facilities
Date: 1993 (planned)

Inputs: G. L. Preston (IFRP Senior Inshore Fisheries Scientist)

Objectives: Promote understanding of pearl-oyster culture technology and techniques by fishery scientists from countries aiming to pursue pearl-oyster culture as an economic development activity.

Background: Several characteristics of pearl oyster farming - relatively low set-up cost, relatively low technology, limited infrastructure requirements, and a high-value, non-perishable product - make it a potentially appropriate income earning activity for rural or outer-island people. As a result, the governments of several Pacific Island countries are becoming increasingly interested in investigating the potential of pearl oyster culture as an economic activity, especially in outer islands.

In August 1991, the 22nd SPC Regional Technical Meeting on Fisheries recommended that the Commission take action to address the different topics raised under an agenda item entitled "Issues relating to trochus and pearl-shell research". The specific issues raised included support to SPC member countries wishing to commence aquaculture of these species, and the possibility of a regional approach to marketing of trochus and pearl-oyster products.

Trochus-related issues have been addressed as a separate activity (see sub-project REG 9). The economics and politics of issues relating to pearl-oysters require a different approach.

Only two countries in the region (French Polynesia and Cook Islands) have successfully established village-level pearl-oyster culture activities. The industry in French Polynesia is large (spread over about 30 islands) and is supported by a strong research and marketing infrastructure, but has traditionally been closely protected from outside scrutiny by both private and public concerns. The industry in Cook Islands is small, relatively new, and undergoing the difficulties of establishment that were being experienced in French Polynesia ten years ago, but is relatively open to outsiders.

Each situation offers a different perspective on pearl-oyster culture development, both from a technical viewpoint and, equally important, from the viewpoint of social and economic development. There have been significant problems in this area in both countries, mainly arising from the conflicts that arise when some sectors of the community are suddenly able to earn very substantial incomes.

Activities: In order to allow first-hand observation of these situations by fishery scientists from Pacific Island planning to promote their own pearl-oyster culture activities, a familiarisation tour of pearl-oyster culture facilities in Polynesia for a small group of national fishery scientists is in preparation. The tour will include pearl-oyster culture centres in the Cook Islands (Manihiki) and in French Polynesia (Takapoto) and will last for 2-3 weeks, towards the end of the year. The timing will be such that participants will have an opportunity to observe pearl seeding operations, as well the annual pearl auctions in Tahiti and possibly Rarotonga.

Negotiations with the French Polynesian authorities regarding access to Takapoto are still under way. It was expected that these would be concluded earlier, but there has been considerable resistance to the study tour taking place from the private sector in French Polynesia, who perceive a threat to their own operations.

It should nevertheless be possible to resolve this difficulty by carrying out the study as part of a broader collaborative activity in which French Polynesia also perceives some benefit. Development of such a multi-country collaborative project is now under way, with SPC acting as a mediator. Until an inter-country agreement can be made, however, it is unlikely that the study will take place.

Results: It is anticipated that the tour will give selected individuals a broad perspective of the issues to be taken into account in pearl-oyster culture development, and make them aware of, and prepared for, problems experienced elsewhere.

Response: This initiative stems directly from a RTMF recommendation, and concerns an activity that is of increasing interest to the region. A further recommendation from RTMF 24 (1992), which directed the SPC Secretariat to develop additional links and collaborative mechanisms between French Polynesia and other countries of the region, added strength to the concept of the study tour. The tour has also attracted a good deal of interest at the technical level from fisheries officers of the region.

Significance: The potential of pearl-oysters culture as a potentially important income-earning activity for residents of isolated atolls has been referred to in the reports on sub-projects KIR 1, KIR 2, MAS 1 and TUV 2. The potential also exists in many other areas and as such pearl-oyster culture will probably become one of the most important areas for fishery development in the 1990's. The IFRP is committed to supporting the development of this low-cost, appropriate-technology industry which, if given adequate encouragement by national governments and regional organisations, promises to provide significant benefits to rural people in Pacific Island countries.

Sub-project: REG 11**Country: Regional****Title: Case study of the Aitutaki Trochus Fishery****Date: August/September 1992 and ongoing to September 1993**

Inputs: T.J.H.Adams (IFRP Senior Inshore Fisheries Scientist)
 W.Nash (Tasmanian Sea Fisheries Research, ACIAR-funded consultant)
 P.Tuara (Cook Islands Ministry of Marine Resources, Rarotonga)
 M.Amos (Vanuatu Fisheries Department)
 J.Leqata (Solomon Islands Fisheries Division)
 D.Munro, O.Terekia, N.Mataiti, M.Teopa, J.Whitford (Cook Islands Ministry of Marine Resources, Aitutaki)

Objectives: Following on from the 1991 IFRP-organised Regional Trochus Workshop in Vanuatu (REG 9), apply techniques discussed in a practical situation, in a model situation on a fishery (because of its very restricted harvesting season) particularly amenable to analysis. Comparatively assess the feasibility and application of three different methods of trochus stock assessment, as input into the planned handbook of trochus stock assessment. Provide SIFS and the acting Director of Research, Cook Islands Ministry of Marine Resources, with the opportunity of finalising a draft management plan for the Aitutaki Trochus fishery (COK 2).

Provide a suggested work-plan for ongoing tagging experiments to be carried out by the local collaborators over the course of the following 12 months, and assist with the ongoing analysis of generated data and the production of a final report in September 1993.

Background: The impetus for this sub-project arose from a recommendation made by the 1991 workshop, and subsequently endorsed by the 23rd SPC RTMF. The Cook Islands MMR has had a high turnover of research staff recently, and was eager to put a written management plan into place for Aitutaki, which provided the opportunity for this case-study of regional benefit.

The Aitutaki trochus fishery involves a species that was introduced fairly recently (1957) but which has since multiplied into a major income-earner for the island. Harvesting has taken place since 1981, on a limited basis under the control of the Island Council. A considerable history of transect survey data is available and the short harvesting period (usually one week or less per year) provides the opportunity of making a complete census of the catch and taking a "before and after snapshot" of the stock within a reasonable time period. It thus provides the ideal opportunity for comparatively testing some different methods of stock assessment that would be of use in assessing trochus stocks across the Pacific.

Supplementary funding (the costs of the Australian consultant, plus the travelling costs of the Pacific Island participants, and publication costs) was provided by the Australian Centre for International Agricultural Research, and the results will have considerable application to the Australian trochus fishery.

Activities: Project team members spent up to 5 weeks on Aitutaki performing pre-harvest surveys around the barrier reef, monitoring the harvest and enumerating the return of tags, and on a limited post-harvest survey. The harvesting period was extended beyond the normal by the Aitutaki Island Council because the quota was being approached so slowly, and this left little time for the planned post-harvest survey. However, this only affected one of the model assessment methods, and the work accomplished was sufficient to form a clear comparison.

Most of the fieldwork was accomplished from a small, outboard-powered boat supplied and

fuelled by the Ministry. This was a collaborative effort by all the team members, with full participation in all the fieldwork, and in the analysis of the huge amount of data generated. Several "classroom sessions" were held on the latter aspect, and on the use of standard data-manipulation packages on both IBM and Apple MacIntosh computers. There was considerable ongoing liaison with the Island Council, particularly during the harvest, where the survey results were able to provide a picture of fishing effort around the reef; to detect poaching on the reserve and, at one point, to recommend that the quota limit be reduced. This recommendation was implemented immediately.

Results: The data resulting from these 200 man-days of intensive fieldwork has not yet been analysed in full depth, but has already showed that mark-recapture methods are much more accurate than the traditionally-used transect methods, for an equivalent level of effort. There are several other significant findings, including the great heterogeneity in population structure of trochus around different faces of the reef, and observations on the "recovery potential" of trochus stocks, and these will all find application both at Aitutaki, and in other trochus fisheries around the region.

The training aspect of the project was also very successful, with Aitutaki staff picking up a great deal of practical advice from the other participants, and with everyone benefiting from the in-depth analysis of abundant data (something that has been less abundant on some other projects - see SOL 1). The final report of this phase of the project will be produced by the end of September 1992.

Response: The ongoing results of some of the work were taken under immediate advice by the the Aitutaki Island Council and used immediately in controlling the progress of the harvest (eg. noting reserve infringements, reducing the total quota, and directing fishing effort to different parts of the lagoon). The overall results will have a great influence on the final Aitutaki trochus management plan, to be implemented jointly by the Island Council and the Government (see COK 2). The preliminary results have already been utilised by Yap and Truk states in the Federated States of Micronesia in the drafting of management plans for their own trochus fisheries, and the demand for a general handbook on trochus stock assessment methodology comes from several countries.

Incidentally, the results of the comparative assessment of different methodologies has already caused the Tasmanian Sea Fisheries Research Laboratory to de-prioritise planned research into the application of change-in-ratio methods.

Follow-up: Further work will be undertaken by the Aitutaki fisheries staff, particularly marking and recapturing trochus to get a better idea of growth rates and natural mortality, over the coming 12 months, and the IFRP will assist in analysing data and producing a final, comprehensive report. A general handbook (or "recipe-book") of practical trochus stock assessment methods, with guidelines for application in different situations, will be produced in collaboration with the Australian consultant.

It is possible that enough external funds may remain (since two of the planned participants did not take part) for a short mark-recapture assessment of a similar limited-season trochus fishery in another part of the Pacific to be undertaken. This would most probably be in eastern Micronesia, where trochus was introduced just before World War II. The general idea would be to put the novel methodology developed under this project into practice in another country.

Significance: A very successful project, with very broad benefits, both methodological and training-wise. The results are likely to have a significant impact on Pacific Island trochus fisheries for some time to come.

APPENDIX 3 - PUBLICATIONS AND PROJECT REPORTSLIST OF CONTRIBUTIONS CO-AUTHORED, OR COMMISSIONED,
BY THE IFRP AS AT 23 SEPTEMBER 1992²**1. Survey of the deep water resources of the Northern Gilbert Islands, Kiribati**

Authors: B. Bruz, G.L. Preston

Work undertaken: February 1987

Notes: Draft submitted to government: June 1987

2. Report of Workshop on Pacific Inshore Fishery Resources

Authors: Anon (A.D. Lewis, G.L. Preston)

Work undertaken: March 1988

Notes: Published May 1988; SPC Meeting Report series. This workshop also generated over 100 original papers, some of which have been published, with others in preparation.

3. The marine resources of Palmerston Atoll, Cook Islands

Authors: Anon (A.D. Lewis, G.L. Preston, A. Wright, N. Sims, W. Marsters, K. Passfield, N. Howard, I. Bertram, T. Teaurii, B. Yeeting, F. Viala, S. Maluofenua)

Work undertaken: September 1988

Notes: Draft submitted to government: a) partial first draft - October 1988; b) second draft - December 1988. Publication delayed due to need for extensive revisions. Presently undergoing finalisation. Jointly carried out with the Forum Fisheries Agency and several Pacific Island Fisheries Divisions, and recommendations (including a moratorium on export of parrot-fish) acted upon by Government.

4. Exploitation of the sea cucumber *Actinopyga miliaris* (blackfish, driloli) in Northern Fiji

Authors: Anon (G.L. Preston, V. Vakamoce, P. Lokani, F. Viala)

Work undertaken: November 1988

Draft submitted to government: December 1988

Notes: Publication delayed due to problems with taxonomy of key species and departure of staff members from Fiji Fisheries Division, and then from Fiji, before completing follow-up work. Report now under revision to allow publication without this information. Jointly carried out with Fiji and Papua New Guinea Fisheries staff. After presentation of project recommendations to Government restrictions were placed on beche-de-mer exploitation in Fiji and an exporter's association set up early in 1989.

² Does not include contributions arising as a result of other project activities, but authored by others such as IFRP workshop papers, handbooks etc.

5. Deepwater dropline fishing surveys in the South Pacific in 1974-1988: A preliminary analysis of data collected by the South Pacific Commission Master Fishermen's programme.

Author: P. Dalzell

Work undertaken: July 1989

Notes: Published September 1990; in Polovina, J.J. and R.S. Shomura (eds); United States Agency for International Development and National Marine Fisheries Service Workshop on Tropical Fish Stock Assessment, 5-26 July 1989, Honolulu, Hawaii. NOAA Technical Memorandum NMFS-SWFC-148.

6. A proposed sampling protocol for ciguatoxic reef fishes in the Federated States of Micronesia.

Authors: P. Dalzell, M. J. Gawel

Work undertaken: March 1989

Notes: Draft submitted to government: May 1990

7. Pearl oysters in Christmas Island, Kiribati, and the potential for development of a pearl culture industry

Authors: N.A. Sims, G.L. Preston, B.M. Yeeting, R. Alfred

Work undertaken: September 1989

Notes: Draft submitted to government: September (Kiritimati) and October (Tarawa) 1989.

8. Inshore fishery resource management in Palau

Author: G. L. Preston

Work undertaken: September 1989

Notes: Draft submitted to government: October 1989; December 1989 (revised)

9. Evaluation of progress of the Inshore Reef Assessment and Monitoring Project, Tonga

Author: J.L. Munro

Work undertaken: November 1989

Draft submitted to government: January 1990

Notes: Confidential. Carried out jointly with ICLARM.

10. Biology and population dynamics of small schooling pelagic fishes used for tuna baitfish in Papua New Guinea

Author: P. Dalzell

Work undertaken: November 1989

Presented at ACIAR Workshop on Tuna Baitfish, Honiara, Solomon Islands, December 1989

Notes: Published September 1990; in Blaber, S.J.M., and J.W. Copeland (eds); Tuna Baitfish in the Indo Pacific region.

11. A select bibliography on the biology, ecology and culture of pearl oysters

Author: N.A. Sims

Work undertaken: January 1990

Notes: Published under the Fisheries Information Project in 1990

12. Deep reef slope fishery resources of the South Pacific

Authors: P. Dalzell, G.L. Preston

Work undertaken: June 1989 - January 1992

Notes: Published July 1992 as Inshore Fisheries Research Technical Document No. 2, South Pacific Commission.

13. A review of fisheries research activities in the Republic of Vanuatu

Author: P. Dalzell

Work undertaken: February 1990

Notes: Draft submitted to government: March 1990

14. Preliminary account and analysis of the Government small scale fishing fleet on Funafuti Atoll, Tuvalu.

Authors: H. Patiale, P. Dalzell

Work undertaken: March 1990

Notes: Draft submitted to government, May 1990

15. Issues in South Pacific fisheries development and management in the 1990s.

Authors: Anon (A. Wright, G.L. Preston)

Work undertaken: February - March 1990

Notes: Undertaken jointly with the Forum Fisheries Agency

16. Fish aggregation devices in the Pacific Islands region

Author: G.L. Preston

Work undertaken: April - May 1990

Presented at IPFC Symposium on FADs and Artificial Reefs, Colombo, Sri Lanka, May 1990

Published: August 1990; Information Paper 4, 22nd SPC Regional Technical Meeting on Fisheries, Noumea

Notes: Review prepared at FAO request. Published in IPFC Symposium proceedings.

17. Report of a survey of pearl oyster resources at Nukulaelae atoll, Tuvalu

Authors: G.L. Preston, M.T. Gentle, M. Kamatie, M. Naseli

Work undertaken: April 1990

Notes: Draft submitted to government: April 1990

18. Report of a survey of the sea cucumber resources of Ha'apai, Tonga

Authors: G.L. Preston, P. Lokani

Work undertaken: June 1990

Notes: Work undertaken jointly with Tonga and PNG Fisheries staff. Draft submitted to government: August 1990. Commercial fishery opened in 1991.

19. A review of the potential of aquaculture as a tool for inshore marine invertebrate resource enhancement in the Pacific Islands

Authors: G.L. Preston, H. Tanaka

Work undertaken: January - August 1990

Notes: Presented as Information Paper 5, 22nd SPC Regional Technical Meeting on Fisheries, August 1990.

20. Preliminary observations on the incidence of ciguatera intoxication in the Federated States of Micronesia

Authors: P. Dalzell, A. Edwards, A. Bowden-Kerby

Work undertaken: June 1990

Notes: Carried out jointly with Community College of Micronesia. Draft under finalisation among co-authors prior to submission to government.

21. Fisheries resource survey of the island of Niue

Authors: P. Dalzell, S.R. Lindsay, H. Patiale

Work undertaken: July 1990

Notes: Draft submitted to government September 1990. Carried out jointly with FAO South Pacific Aquaculture Development Project. Draft document currently being edited for publication as IFRP Technical Document

22. Small pelagic fish resources of the South Pacific

Author: P. Dalzell

Work undertaken: September - October 1990

Notes: Review prepared for FFA book 'Inshore Marine Resources of the South Pacific: Information for Fishery Development and Management.

23. The Namdrik Pearl Oyster Project

Author: Julian Dashwood

Work undertaken: November-December 1990

Notes: Draft sent to country April 1991

24. Stock assessment of snappers and groupers in the Kingdom of Tonga

Authors: T.F. Latu & S. Tulua

Work undertaken: October 1990 and April 1991

Notes: Unpublished interim report on stock assessment of Tonga's deep slope fishery resources drafted by the authors during a two week attachment to the SPC Fisheries Programme during April 1991.

25. Fisheries resources and management investigations in Woleai Atoll, Yap State, Federated States of Micronesia.

Authors: A. Smith & P. Dalzell

Work undertaken: May—June 1991.

Notes: Final draft submitted to government 25 May 1992. Draft will be edited for publication as IFRP Technical Document

26. Summary of the NFC—OFCF survey of the deep slope resources of the outer banks and seamounts in the Federated States of Micronesia, September 1989 to February 1991.

Authors: J.H. Diplock & P.Dalzell

Work undertaken: August—September 1991

Notes: Final draft submitted to government October 1991

27. A preliminary assessment of the status of inshore coral reef fish stocks in Palau

Authors: A.H. Kitalong & P.Dalzell

Work undertaken: September 1991

Notes: Final draft submitted to government 29 May 1992. Draft will be published as IFRP Technical Document

28. Ciguatera fish poisoning and fisheries development in the South Pacific

Author: P. Dalzell

Work undertaken: February to April 1992

Notes: Paper presented at 4th International Conference on Ciguatera Fish Poisoning, 4-8 May, 1992, Tahiti. Paper will be published in conference proceedings.

29. Survey of pearl shell resources of Gilbert Islands, Republic of Kiribati

Author: G.L.Preston

Work undertaken: May 1992.

Notes: Draft presented to Government.

30. A preliminary account of coastal fisheries in Nauru with an outline for a catch monitoring programme

Authors: P. Dalzell, A. Debao & P. Jacobs

Work undertaken: July 1992

Notes: Draft sent to government in July 1992, summary of findings published in SPC Fisheries Newsletter

31. Report of workshop on trochus resource, assessment, management & development, Vanuatu, 13 May—2 June 1991.

Authors: Various

Work undertaken: 13 May—2 June 1991

Notes: Proceedings of the workshop contributions; contains about 30 papers and country statements dealing with exploitation of trochus in the Pacific region. Document in press.

32. Some suggested management initiatives in Palau's nearshore fisheries, and the relevance of traditional management.

Author: R. E. Johannes

Work undertaken: July 1991

Notes: Report of consultancy submitted to Government and several measures in the process of preparing legislation.

33. Beche-de-mer

Author: G.L.Preston

Work undertaken: September - October 1990

Notes: Review prepared for FFA book 'Inshore Marine Resources of the South Pacific: Information for Fishery Development and Management'.

34. Survey of the status of trochus and beche-de-mer resources in the Western Province of the Solomon Islands

Authors: T.J.H. Adams, J. Leqata, P. Ramohia, M. Amos & P. Lokani

Work undertaken: June-July 1992

Notes: Draft with recommendations sent to government July 1992, but awaiting feedback before finalisation.

35. The Aitutaki trochus fishery: a case study

Authors: T.J.H. Adams, W. Nash, P. Tuara, D. Munro, M. Amos, J. Leqata, O. Terekia, N. Mataiti, M. Teopa, J. Whitford

Work undertaken: August-September 1992

Notes: Reports drafted under this project will be submitted to government in September-October 1992 and then circulated in the region.

36. Papers on Fisheries Science from the Pacific Islands Volume I.

Authors: Various

Work undertaken: October 1989-June 1992

Notes: Several papers from the 1988 Inshore Fisheries Research Workshop plus one other contribution were edited for publication in a new series designed to provide a publication platform for Pacific Island fisheries scientists. The document was published as Inshore Fisheries Technical document No. 1 1992.

37. Trochus Management Plan for Aitutaki

Authors: Anonymous (T.J.H. Adams and P. Tuara)

Work undertaken: August - October 1992

Notes: Draft policy instrument in the form of an agreement, or covenant between the Aitutaki Island Council and the Cook Islands Ministry of Marine Resources, with guidelines and rules for adaptively managing the Aitutaki trochus fishery. Yet to be finalised following discussion, and not yet authorised for general release.

Overleaf are listed the papers presented, or tabled, at the 1988 Inshore Fisheries Research Workshop:- the first substantive sub-project under the Inshore Fisheries Research Project. Several of these papers have been published, and others are in preparation for release as part of the Technical Report series.

The 31 papers tabled in the 1991 IFRP trochus workshop held in Vanuatu are not listed here, but will be published as a Technical Report towards the end of 1992 (see publication 31 in the previous list).

SPC Inshore Fisheries Research Workshop 1988

Papers tabled

- WP.1 The penaeid shrimp resources of the Pacific Islands, by A.D. Lewis
 WP.2 Miscellaneous mollusc resources of Pacific Islands, by A.D. Lewis
 WP.3 Synoptic study of trochus in the Pacific, by W. Bour
 WP.4 Pearl-oyster resources in the South Pacific. Research for management and development, by N.A. Sims
 WP.5 Beche-de-mer in New Caledonia: biology and fishing, by C. Conand
 WP.6 The collection and use of fishery statistics, by M.E. Molina
 WP.7 Coconut crab ecology in Vanuatu, by W.J. Fletcher
 WP.8 Trochus management and exploitation in Pohnpei State, Federated States of Micronesia, by E.F. Curren
 WP.9 Fisheries for small pelagics in the Pacific Islands and their potential yields, by P.J. Dalzell and A.D. Lewis
 WP.10 Reef resources: survey techniques and methods of study, by G.R. Russ and J.H. Choat
 WP.11 Biology of the green snail (*Turbo marmoratus*) and its resource management, by M. Yamaguchi
 WP.12 Development of phycocolloid-related industries in Oceania, by S.G. Nelson
 WP.13 Topic review: deep-water shrimps, by M. King
 WP.14 Fish aggregating devices: what next?, by R. Farman
 WP.15 A review of large coastal pelagic fishes in the South Pacific region, with special reference to *Scomberomorus commerson* in North-East Australian waters, by G.R. McPherson
 WP.16 Inshore tropical baitfish: current resource management knowledge, by A.W. Argue
 WP.17 Sharks, by G.R. McPherson
 WP.18 Tropical spiny lobster: An overview of their biology, the fisheries and the economics with particular reference to the double spined rock lobster *P. penicillatus*, by J. Prescott
 WP.19 SPREP questionnaire on destructive fishing methods: summary of results
 WP.20 Nearshore fisheries habitat assessment - remote information acquisition and analysis, by D.B. van R. Claasen
 WP.21 Habitat and fisheries enhancement strategies for Pacific Island coral reefs, by R.E. Brock
 WP.22 Status of sea turtles in the South Pacific and management needs, by J.D. Parrish
 WP.23 Semi-precious corals in the South Pacific: prospects for development and management of their fisheries, by J.D. Parrish

Background papers

- BP.1 Exploratory trawling on some sea mounts in New Caledonia, by R. Grandperrin and B. Richer de Forges
 BP.2 Semi-precious corals in the exclusive economic zone (EEZ) of New Caledonia, by B. Richer de Forges and R. Grandperrin
 BP.3 Tuna baitfishes: biology, ecology, resources in New Caledonia, by F. Conand and M. Kulbicki
 BP.4 Ageing of tropical reef fish by density of daily otolith increments, by N. Baillon
 BP.5 Status report - gillnet selectivity project (Yap, Federated States of Micronesia), by C.M. Price
 BP.6 Inshore fisheries development and management: the South Pacific experience; an overview, by P. Kunatuba
 BP.7 Summary of Information Paper 5. Biological survey of mullets in Tonga: results of the first six months, by S.A. Langi, T.F. Latu and S. Tulua
 BP.8 Fisheries research and management problems in Kiribati - Country statement, by B.M. Yeeting
 BP.9 A summary of fisheries legislation in Kiribati, by B.M. Yeeting

- BP.10 The regulation of fisheries in Kiribai, by C.C. Mees
- BP.11 Resource survey in Kiribati, by C.C. Mees
- BP.12 Country statement - Federated States of Micronesia, by M. Gawel
- BP.13 Fiji's fisheries data collection and information system, by S.P. Sharma
- BP.14 The Fijian baitfishery, by S. Sharma
- BP.15 Survey of the soft bottom carnivorous fish population using bottom longline in the South-West lagoon of New Caledonia, by M. Kulbicki and R. Grandperrin
- BP.16 Country statement - Niue, by J. Barnes
- BP.17 Fisheries for large coastal pelagics in Fiji, by A.D. Lewis
- BP.18 Pêche des vivaneaux à la palangre profonde en Nouvelle-Calédonie, by R. Grandperrin and M. Kulbicki
- BP.19 Projet d'étude du crabe de paletuviers (*Scylla serrata*) en Nouvelle-Calédonie, by S. Delathière
- BP.20 Local fisheries data collection in Kiribati, by C.C. Mees
- BP.21 Summary of Information Paper 6. Rapid identification of the sex of live trochus, with particular respect to mariculture, by C. Hoffschir
- BP.22 The importance of mangroves to the ichthyofauna of the New Caledonian lagoon, by P. Thollot
- BP.23 Stock assessment: computer programmes for use in tropical fisheries, by M. King
- BP.24 Status of the MMDC giant clam hatchery - Republic of Palau, by G.A. Heslinga, T.C. Watson and T. Isamu
- BP.25 Assessment of the biomass of corals of the Faviidae family on a commercially exploited reef in New Caledonia, by P. Joannot and W. Bour
- BP.26 Summary of Information Paper 8. A report on a collaborative research programme into baitfish populations in Solomon Islands, with some preliminary findings, by P. Nichols
- BP.27 Introduction au traitement des image SPOT, by W. Bour
- BP.28 The contribution of planktivores and herbivores to yields of fin-fishes from some coral reefs in the Pacific, by G.R. Russ
- BP.29 A direct test of the effects of protective management on a tropical marine reserve, by G.R. Russ and A.C. Alcalá
- BP.30 A report on the market survey of reef and lagoon fish catches in Western Samoa, by N. Helm
- BP.31 A coral reef fishery for aquarium fish - the Fiji experience, by A.D. Lewis
- BP.32 Security problems with resource surveys of benthic marine organisms, by R. Chesher
- BP.33 A micro-computer based resource mapping system for Pacific Islands, by R.H. Chesher
- BP.34 Progress report on a programme to assess bottom fish stocks on seamounts in Tonga, by S.A. and V.A. Langi
- BP.35 Country statement - Republic of Palau, by N. Idechong
- BP.36 A cost-benefit analysis of FADs in the artisanal tuna fishery in Rarotonga, by N. Sims
- BP.37 Trochus research in the Cook Islands and its implications for management, by N. Sims
- BP.38 Traditional management of marine resources in New Caledonia, by M.H. Teulière
- BP.39 Past and present data collection systems of the bottom fishery in Tonga: a comparison, by S. Langi
- BP.40 The status of the beche-de-mer fishery in Queensland, by C.C. Shelley
- BP.41 The collection and uses of inshore reef fisheries information to assess and monitor the shelf fisheries of the Kingdom of Tonga using the ICLARM approach. Summary of the first year's activities and results, by K. Felföldy-Ferguson
- BP.42 Country statement - Guam, by R.F. Myers
- BP.43 Guam inshore fisheries survey, by G. Davis
- BP.44 Guam offshore fisheries survey, by R.F. Myers and G. Davis
- BP.45 Guam fisheries data processing, by R.F. Myers
- BP.46 Traditional Pacific Islander management of inshore fisheries: the SOPACOAST initiative, by G.B.K. Baines
- BP.47 Black corals - post harvest aspects, by P.W. Philipson

- BP.48 Fisheries research in the South West Pacific: a summary of some of the problems, by A. Wright
- BP.49 Fish-transect surveys in Pohnpei Lagoon (Eastern Caroline Islands) to determine the influence of neighbouring habitats on fish community structure, by S. James, L. Olter and E. Endere
- BP.50 Giant clams in Fiji, by T.J.H. Adams
- BP.51 Growth and mortality rates and state of exploitation of spiny lobsters in Tonga, by J.L. Munro
- BP.52 Management of coastal fishery resources in the South Pacific region, by J.L. Munro and S.T. Fakahau
- BP.53 A cost effective approach to stock assessment and monitoring of small-scale coastal fisheries in the South Pacific region, by J.L. Munro and S.T. Fakahau
- BP.54 Status of giant clam stocks in the Central Gilbert Islands group, Republic of Kiribati, by J.L. Munro
- BP.55 Etude socio-économique du groupement des pêcheurs d'Oundjo, commune de Voh, Nouvelle-Calédonie, by Service territorial de la marine marchande et des pêches maritimes, Noumea, New Caledonia
- BP.56 Evolution of the SPC Inshore Fisheries Research Project, the Workshop on Inshore Fishery Resources, and related activities, by SPC Secretariat
- BP.57 Giant clam ocean nursery and reseeded projects, by C.M. Price
- BP.58 Country statement - Tuvalu. Development of the inshore fishery resources of Tuvalu, by E. Pita
- BP.59 The status of the Kiribati live-bait fishery, by J. Ianelli
- BP.60 Notes on Pacific Islands Decapтерus, by R. Gillett
- BP.61 Pacific Islands trochus introductions, by R. Gillett
- BP.62 Les ressources côtières en Polynésie française, by Etablissement pour la Valorisation des Activités Aquacoles et Maritimes
- BP.63 Yap Proper trochus stock assessment :1987, by J. Fagolimul
- BP.64 La pêche de Tikehau, by E. Morize
- BP.65 Summary of Information Paper 16 : Yap Proper stock assessment and prefactory market survey, by J. Fagolimul
- BP.66 Méthodes d'évaluation des stocks d'huitres nacrées et perlières en Polynésie française, by A. Intes
- BP.67 The Fiji deep-water snapper fishery - its development and management requirements, by A.D. Lewis, A. Sesewa and T. Adams
- BP.68 Progress report: American Samoa bottomfish assessment program, by D. Itano
- BP.69 Fish aggregation device (FAD) enhancement of offshore fisheries in American Samoa, by R.M. Buckley, D.G. Itano and T.W. Buckley
- BP.70 Giant clam resource investigations in Solomon Islands, by H. Govan
- BP.71 Country paper - Kingdom of Tonga. Research, management and legislation, by V. Langi
- BP.72 Country statement - Solomon Islands, by S. Diake
- BP.73 Assessment of deep-bottom fishes of Solomon Islands, by A. Wata
- BP.74 Country statement - Vanuatu
- BP.75 The Queensland trochus fishery and management-related aspects of trochus biology, by W. Nash
- BP.76 Biology and reproductive strategy of *Naso brevirostris* (Acanthuridae) and its relationship with the fishery yield, by B. Caillart
- BP.77 Summary of Information Paper 19. Deep bottom fishing in French Polynesia, by L. Wrobel
- BP.78 Research on fish aggregation devices (FADs) in Papua New Guinea during 1984 and 1985, by S.D. Frusher
- BP.79 Changes in spanner crab (*Ranina ranina*) stocks in Southern Queensland: evidence from commercial logbooks, by I.W. Brown
- BP.80 Queensland's near reef trawl fisheries, by M.C.L. Dredge
- BP.81 La pêche lagonaire dans l'archipel des Tuamotu, by A. Stein

- BP.82 A review of deep-water handline fishing in Papua New Guinea, by M.R. Chapau
 BP.83 Stock assessment of pearl-oyster resources in the Cook Islands, by N.A. Sims
 BP.84 Aquarium fish, by P. Joannot
 BP.85 SPC library and fisheries information, by K. Berg and R. Cassidy
 BP.86 Penaeid prawn research in Papua New Guinea, by S.D. Frusher
 BP.87 Reflexion sur la gestion des ressources de trocas: cas de la pêcherie de Polynésie française, by S. Yen
 BP.88 Survey of deep-water shrimps in the Northern Gilbert Islands, Kiribati, by G.L. Preston
 BP.89 La pêche à la traine autour des dispositifs de concentration de poissons mouillés à Vanuatu, by E. Cillaurren
 BP.90 Growth of the spiny lobster *Panulirus ornatus*, in the Torres Strait, by J.T. Trendall, R.S. Bell and B.F. Phillips
 BP.91 An assessment of coral exploitation in Fiji, by F. Viala
 BP.92 Recruitment in the giant clam *Tridacna gigas* and *T. derasa* at four sites on the Great Barrier Reef, by R.D. Braley
 BP.93 Spatial distribution and population parameters of *Tridacna gigas* and *T. derasa*, by R.D. Braley
 BP.94 Distribution and abundance of the giant clams *Tridacna gigas* and *T. derasa* on the Great Barrier Reef, by R.D. Braley
 BP.95 Country statement - Republic of Nauru, by P.S. Lili
 BP.96 Some aspects of the commercial prawn fishery of the Gulf of Papua, Papua New Guinea, by L.J. Opnai
 BP.97 Reseeding and introductions, by M.J. Gawel
 BP.98 *Tridacna derasa* introduction in American Samoa. Mariculture pilot project report, November 1986 to February 1988, by D. Itano and T. Buckley
 BP.99 Summary of Information Papers 17 and 18: Data acquisition and processing system for the domestic pole-and-line fishery in Solomon Islands, by P.V. Nichols and C. Maruyama
 Data acquisition and processing system for the domestic purse seine fishery in Solomon Islands, by P.V. Nichols and Y. Ota
 BP.100 Priorities and pragmatism : fisheries statistics programmes in the Cook Islands, by N.A. Sims
 BP.101 Some aspects of the resources and exploitation of the Papua New Guinea reef and lagoon associated commercial sessile invertebrates, by C. Tenakenai
 BP.102 Country statement - Tokelau
 BP.103 Country statement and research needs - American Samoa, by D. Itano
 BP.104 American Samoa - status of fishery regulations, by D. Itano
 BP.105 The CCOP/SOPAC precious coral programme in the South Pacific, by J.V. Eade
 BP.106 Table of marine species introductions to tropical Pacific Islands, by M. Gawel
 BP.107 Summary of Information Paper 24. Links between inshore fisheries resources and mangroves in tropical Australia: implications for coastal zone management in the South Pacific, by A.I. Robertson
 BP.108 The status of the beche-de-mer resource and exploitation in Papua New Guinea, by C.D. Tenakanai

Information papers

- IP.1 Recruitment overfishing in a tropical scallop fishery, by M.C.L. Dredge
 IP.2 Research studies by overseas institutions in Kiribati, by B.M. Yeeting
 IP.3 Status report - gillnet selectivity project in Yap, Federated States of Micronesia, by C.M. Price
 IP.4 The North Pacific crown-of-thorns survey, by R.H. Chesher
 IP.5 Biological survey of mullets in Tonga. Results of the first 6 months, by S.A. Langi, T.A. Latu and S. Tulua
 IP.6 Méthode d'identification rapide du sexe des trocas vivants en vue d'aquaculture, by C.

- Hoffschir
- IP.7 Biological study of exploited baitfish species *Stolephorus heterolobus* and *Stolephorus devisi* in Western Province, Solomon Islands, by G.K. Tiroba
- IP.8 A report on a collaborative research programme into baitfish populations in Solomon Islands, with some preliminary findings, by P.V. Nichols
- IP.9 Eel fishing with fyke nets: A pilot project in Solomon Islands, by M.J. Batty and P.V. Nichols
- IP.10 Recruitment in the giant clams *Tridacna gigas* and *T. derasa* at four sites on the Great Barrier Reef, by R.D. Braley
- IP.11 Distribution and abundance of the giant clams *Tridacna gigas* and *T. derasa* on the Great Barrier Reef, by R.D. Braley
- IP.12 Spatial distribution and population parameters of *Tridacna gigas* and *T. derasa*, by R.D. Braley
- IP.13 Statistiques des pêches maritimes et de l'aquaculture en Nouvelle-Calédonie (1976-1986), by Service territorial de la marine marchande et des pêches maritimes
- IP.14 Fisheries for giant clams (*Tridacnidae: Bivalvia*) and prospects for stock enhancement, by J.L. Munro
- IP.15 Yap trochus sales: 1986, by Marine Resources Division
- IP.16 Trochus: Yap Proper stock assessment and prefactory market survey, by J. Fagolimul
- IP.17 Data acquisition and processing system for the domestic pole-and-line fishery in Solomon Islands, by P.V. Nichols and C. Maruyama
- IP.18 Data acquisition and processing system for the domestic purse seine fishery in Solomon Islands, by P.V. Nichols and Y. Ota
- IP.19 La pêche profonde en Polynésie française, by L. Wrobel
- IP.20 Report on the fish aggregation device program in American Samoa, by D. Itano and T. Buckley
- IP.21 AIMS Programme description - Coastal pelagic resources, by D.M. Williams
- IP.22 Le stock naturel de nacre *Pinctada margaritifera* L. dans l'atoll de Scilly, by A. Intes, P. Laboute and M. Coeroli
- IP.23 L'huitre perlière de Polynésie française, by A. Intes and M. Coeroli
- IP.24 Links between inshore fisheries resources and mangroves in tropical Australia: implications for coastal zone management in the South Pacific, by A.I. Robertson
- IP.25 Resultats préliminaires du programme d'études des dispositifs de concentration de poissons en Polynésie française, by J. Chabanne
- IP.26 Introduction of Tridacnid clams to Yap State: 1987 status report by Marine Resources Management Division